The contribution of kumala to traditional food systems in two districts of Tanna Island, and its potential for increasing food security

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Please note the first year of this thesis was undertaken during the period of COVID19 lockdown in both New Zealand and Vanuatu and thus impacted by the inability to interact directly with the study participants or academic support, in particular for undertaking study in a culturally acceptable method at that time.

Abstract

Sweetpotato (*Ipomea batatas*) is considered a versatile food crop owing to its robust adaptability to diverse soil conditions and environmental conditions. In Vanuatu sweetpotato is a significant food security crop that smallholder farmers cultivated within traditional cropping system. Within the national and local context, sweetpotato has played a significant role as recovery crop that supports the farmers and increasing urban population buffer against food scarcity during the aftermath of natural disasters. The research reported in this thesis examined and explored how kumala (sweetpotato) contributed to smallholder farmers livelihood and enhanced food and nutrition security. The aim of the study was to understand the significant role of kumala within the traditional food system and draws on smallholder farmers perspectives. Storian is the overarching cultural approach that underpinned the research process in this study, supported with the use of qualitative methods of collecting data these included, semi structure interviews, secondary data, and field observation. Subsequently the data collected through the interviews and storian were analysed using qualitative data analysis. The research study was carried out in Tanna Island, a society with stronghold of traditions and cultural activities that are interwoven in the livelihood of smallholder farmers influencing the farmers perception on the production of kumala. This research highlights kumala is a favoured food security and recovery crop featured as response to recovery program. Kumala has a role in the traditional food system which is enhanced by existing social and cultural ties. The study put forward a critical perspective on leveraging on short term resilient crops that emerge through strengthening and revitalize the role of kumala within the local food system can strengthen household resilience and enhance food security for smallholder farmers.

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Tanak asori (Southeast Tanna language) Thank you

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Abbreviations

Abbreviations	Full Phrases
AAO	Assistant Agriculture officer
ADB	Asian Development Bank
DARD	Department of Agriculture and Rural Development
DOI	Department of Industry
DSPAC	Department of Strategic Planning, Policy, and Aid Coordination
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
MALFFB	Ministry of Agriculture, Livestock, Fisheries, Forestry and Biosecurity
NSDP	National Sustainable Development Plan
PAO	Provincial Agriculture Officer
SDGs	Sustainable Development Goal
VARTC	Vanuatu Agricultural Research and Technical Centre
VNSO	Vanuatu National Statistics Office

CHAPTER ONE

1.1 Introduction

Smallholder farmers are at the forefront of contributing to sustainable food supply in urban and rural settings in Vanuatu. The challenges of climate change impose negative impacts on the production of traditional crops that are part of the local food supply; this causes urban and rural communities to rely on resilient crops such as kumala (Sweetpotato). This thesis focuses on smallholder farmers on Tanna Island, Vanuatu. Tanna Island is known to be a stronghold of traditional and culture, which is embedded in the livelihood and influences the traditional farming practices of smallholder farmers. This research was completed using a qualitative case study research design based on data collected through incorporating an indigenous method (storian) and semi structure interviews. Theoretically the research is framed by the sustainable livelihood framework (SLF), to understand the rural livelihood of smallholder farmers, and the status of sweetpotato within the traditional food system. This case study provides valuable insights into smallholder farmers' perceptions on the status of kumala within the traditional food system and explores the significant contribution of kumala in addressing food security within local communities and at the national level. This chapter introduces the thesis by describing the research background and context, it also introduces the research aim, and research questions are then presented, and finally the outline of the thesis structure.

1.2 Background

Agriculture is the backbone of Vanuatu's economy, with 80% of the total population relying on local agricultural produce for food (VNSO, 2021). Most farmers are smallholder subsistence farmers, involved in farming of food crops, cash crops and rearing of small livestock (Welegtabit, 2001). Agriculture provides local consumption for urban and rural areas and exports that collectively contribute to the nations GDP (VNSO, 2021). The Vanuatu agriculture sector like other Pacific Island countries, is vulnerable due to the continuous impacts of climate change (DSPPAC, 2023; Gwenzi et al., 2016). The majority of smallholder farmers in Vanuatu rely on traditional food systems that maintain a diversity of crops and produces food all year around (Lebot & Bedford, 2023; Sardos et al., 2016). These systems play a significant role in rural food security and supporting rural livelihoods during environmental shock and uncertainty (McGuigan et al., 2022). Scholars Iese et al. (2020) and Allen (2015) have identified that natural disasters exacerbate vulnerabilities across traditional food systems within Pacific Island countries. This has reported to be the case in Vanuatu, where smallholder farmers on most islands have transitioned to cash crops, due to favourable prices (Lebot & Bedford, 2023). According to VNSO (2021), the recent food security baseline survey shows that farmers in Vanuatu have been abandoning traditional food crops and using earnings from the sale of kava cultivation to purchase imported food. In addition, there is ample evidence that changes in seasonal weather patterns have disturbed the growing seasons of many traditional food crops, thus reducing agricultural production (Cvitanovic et al., 2016; Le Dé et al., 2018). Another challenge is that the establishment of perennial cash crops (coffee, coconut, cocoa, Kava) or permanent pastures for cattle has reduced fallow periods across traditional food systems (Sardos et al., 2016). Furthermore, compounding pressures on the agriculture sector, such as population growth, present major challenges regarding arable land-use, leading to intensification declines in soil fertility (Komugabe-Dixson et al., 2019).

The COVID-19 pandemic presented (and continues to do so) unprecedented challenges to the global food systems. Despite the vulnerabilities already highlighted in the

traditional food system across Pacific Island countries (Steenbergen et al., 2020), the national Vanuatu COVID-19 food security response plan highlighted a significant reliance on the local food production (Farrell et al., 2020). According to ADB (2023) the Vanuatu government implemented programs such as food baskets to support urban dwellers access fresh local produce. Iese et al. (2021) highlighted that most Pacific Island countries experienced shifts in the traditional food system and increased food garden production during the COVID-19 pandemic. Tendall et al. (2015) and Béné (2020) argued that understanding factors that contribute to resilient local food system plays an important role in developing strategies. Such strategies could be aligned to increasing local food production and improving food security status in Vanuatu. Lebot and Bedford (2023), emphasised that redevelopment of traditional food systems is important in improving diets, health, and food access issues. Other studies in Pacific Island countries including Vanuatu, encouraged the cultivation of early maturing crops such as sweetpotato (*Ipomea batatas*) as an approach to address food security (McGuigan et al., 2022; Mertz et al., 2012).

According to Iese et al. (2018), the rise of sweetpotato production within traditional food systems has been reported in many Pacific Island countries as a means of improving food security, boosting sustainable local food supply and enhancing smallholder agricultural productivity (Sakai et al., 2020). Sweetpotato is an important crop in the staple diet for many Pacific Island countries (Roullier, Kambouo, et al., 2013); the crop can grow year-round in the tropics, with relatively low inputs, can be grown in both rich and poor soil, and produce high yields per hectare (Georgeou et al., 2022). Most sweetpotato varieties are fairly drought tolerant, they are resilient to drought and therefore are an important crop during times of droughts (Iese et al., 2018). Over the years sweetpotato has featured as recovery crop in post-cyclone in Pacific Island countries including, Vanuatu, Fiji and Tonga, cementing the importance of sweetpotato as a food security crop (Iese et al., 2018; McGuigan et al., 2022). Furthermore, the national government of Vanuatu and other Pacific Island countries encouraged the cultivation of sweetpotato through distribution of planting materials. The distribution of planting materials before and during the aftermath of disasters improve food security and increase the availability and accessibility of food (McGuigan et al., 2022). However,

several factors influence the production of sweetpotato in Vanuatu, including market access opportunities, policy research and ongoing environmental shocks. This research focusses on the status of sweetpotato within the traditional food systems in Vanuatu, drawing on smallholder farmer perspectives. This study also explores the broader dynamics of social and cultural values and activities embedded in the livelihood of smallholder farmers that influence the production of sweetpotato.

1.2.1 Smallholder farmers in Vanuatu

Smallholder farms in developing countries contribute to 80% of the daily food supply, and play a pivotal role in promoting sustainable food systems and feeding increasing local populations (Fan & Rue, 2020). In addition, smallholder famers play a key role worldwide in contributing to global food security. Lowder et al. (2016), explained that size of small farms is determined by the agro-ecological zone and socio-economic conditions, and farmers owing less than 2 hectares of land can be considered as smallholders. Despite the significant contribution of smallholder farmers, they are among the most vulnerable in the agricultural sector. According to (Fan & Rue, 2020, p. 14)

> Smallholder farmers are increasingly faced with mixed challenges, including those that are natural occurring and those that are caused by humans, these cumulatively influence capacity to increase food production.

Within Pacific Island countries smallholder farmers have been identified as key contributors to local food production (Shah et al., 2018). Other studies in Oceania have reported the significance of small farms in maintaining rich agrobiodiversity and their role as buffers against food and nutrition insecurity (Burlingame et al., 2019; Vogliano et al., 2020)

Agriculture is the primary source of food, livelihood, and income for many smallholder farmers in Pacific Island countries (Iese et al., 2020). In Vanuatu, most smallholder farmers are subsistence farmers who contribute to agricultural production in rural and urban areas. According World Bank (2022) smallholder farmers produce 90% of Vanuatu's agricultural produce, of which 75% is grown through subsistence production

and 15% is semi-commercial. Like other Pacific Island countries, smallholder farmers in Vanuatu depend on customary land (Addinsall et al., 2017) to access food, resources, shelter and support their livelihood (Anderson, 2011). Often, smallholders cultivate less than two hectares of land, managing the land through different cropping systems to sustain and support their livelihood. Smallholder farmers in Vanuatu, grow different species of crops such as cassava, yam, taro, sweet potato, and others like bananas, foods that are part of the main diet, and their production is heavily dependent on rainfall (Sardos et al., 2016). In addition, local food production and farming is complemented by small herds of poultry and piggery.

Smallholder farmers in Vanuatu and other Pacific Island countries are faced with multiple challenges (Lebot & Siméoni, 2015) which affect their livelihoods, including population growth, market access, transition of farming systems, scarcity of land, changes in consumption patterns and environmental shocks (Langford, 2022). Many smallholder farmers have transitioned from growing traditional foods to monoculture of cash crops; that provide incomes which is often used to purchase imported foods (Addinsall et al., 2017). As explained by Campbell (2009), the decline in local production increases the risk of food insecurity, thus affecting the household resilience in the face of natural disasters. In addition, with increasing local population, traditional cropping systems are faced with a reduction in the fallow period due to increased pressure on the cultivation of perennial cash crops (coffee, cocoa, coconut) (Lebot & Siméoni, 2015; Sardos et al., 2016). Buckwell et al. (2020) reported that local communities in Tanna Island in Vanuatu observed a declined in taro production due to reductions in soil fertility and farmers being faced with the choice between growing food for cash rather than subsistence.

Despite these challenges, in most rural communities' traditional food system continue to provide food for the growing population. For instance, during COVID-19 pandemic the rural population relied on the traditional food system (Ferguson et al., 2022; Iese et al., 2021). A recent study in Vanuatu has shown that during COVID-19, farmers in the rural areas relied heavily on the production of local food crops (Steenbergen et al.,

2020). Similarly reports were evident in the Solomon Islands and Fiji, were the rural population relied on the traditional food system during COVID-19, (Iese et al., 2021).

Vanuatu's national agriculture sector policy 2015-2030 also highlighted the importance in improving production and market access for smallholder farmers (Department of Agriculture and Rural Development, 2015). Market access is a challenge for smallholder farmers throughout the Pacific Islands, including Vanuatu (Langford, 2022). According to ADB (2023), smallholder farmers in Vanuatu are faced with inadequate infrastructure, high transport costs and irregular transport services, pressures that will only increase with growing population. Smallholder farmers in Vanuatu are faced with compounding costs associated with shipping, and poor-quality transport infrastructure that affects their ability to get their produce to the main market in Port Vila (World Bank, 2022).

Root crops have been exported to countries like Australia and New Zealand from some Pacific Island countries, including Fiji, Tonga, Samoa, and Vanuatu (VNSO, 2021). Studies conducted by Langford (2022) and Martyn et al. (2014) in Vanuatu highlighted that there is potential for smallholder farmers to diversify their income through local agricultural production, however market access in rural communities continues to be a challenge. FAO (2013), reported that promoting smallholder productivity is prominent in the agriculture sector in Vanuatu, however attempts to raise productivity have limited success due to market access issues. World Bank (2021) reported that remoteness also inhibits the flow of market information, farmers often have limited awareness of how to access market opportunities. Similarly, a report by FAO (2016) mentioned that market access is a limiting factor that slows the transition to commercial agricultural production by smallholder farmers in Vanuatu; as a result Vanuatu has become increasingly dependent on imported food from Australia, New Zealand, and Fiji. In addition, increasing uncertainty from the impacts of climate change continuously place the livelihood of smallholder farmers at risk. The following section explores climate change and agriculture in Vanuatu, followed by the impacts of tropical cyclones on Vanuatu's agriculture sector.

1.2.2 Climate change & agriculture in Vanuatu

Climate is an important determining factor in the cultivation of crops and overall agricultural production (Mendelsohn, 2009), yet the intensity of climate change can have positive and negative impacts on vulnerable sectors, including agriculture (Stevanović et al., 2016). Agriculture is directly affected by climate change (Malhi et al., 2021). According to FAO (2016) , climate change has direct and indirect impacts on the agricultural food systems due to changing and inconsistent rainfalls , temperatures, and high incidence of extreme weather events. Studies in developing countries have highlighted that yield reductions due to impacts of climate change can lead to increased food price and influence food supply (Powell & Reinhard, 2016; Stevanović et al., 2016). In Vanuatu and other Pacific Island countries, the impact of climate change on the agriculture sector has raised food insecurity concerns for rural and urban dwellers (Barnett, 2001; Barnett, 2011; Iese et al., 2020).

The Vanuatu climate varies considerably from year to year due to the EL Nino-Southern Oscillation (ENSO) that is experienced across Pacific Island countries (Weir et al., 2021). ENSO is a natural climate phenomenon that occurs across the tropical Pacific and affects weather globally (Goddard & Gershunov, 2020). There are two extreme phases of ENSO, El Nino, and La Nina. The impacts of environmental shocks include long dry spells and prolonged wet conditions associated with El Nino (warm phase) and La Nina (cool phase). The occurrence of El Nino and La Nina often triggers droughts and floods (Kuleshov et al., 2014), these natural phenomena are reported to cause damage to agriculture sector in Vanuatu and across other Pacific islands simultaneously (Goddard & Gershunov, 2020). For instance in 2014, the Solomon Islands experienced devasting flash floods which caused damage to over 9000 households and badly damaged food gardens (OCHA, 2014). According to OCHA (1998) Fiji was affected by severe drought this continued for eleven months causing drastic loss in the sugar cane plantations, and economically significant crop in Fiji. It is reported by World Bank (2022), that Vanuatu has experienced more hydrometeorological hazards such as cyclones, floods and droughts and geophysical disasters such as volcanic eruptions, earthquakes and tsunamis.

1.2.3 Impact of tropical cyclone on Vanuatu agriculture sector

In Pacific Island countries, agricultural systems are rain-fed making them vulnerable to both high and low rainfall (Iese et al., 2020). Challenges caused irregular rainfall continue to challenge Pacific Island agriculture, including Vanuatu, these have increased in recent years due to climate change, particularly tropical cyclones (ADB, 2023). Studies from other countries in the Pacific regularly affected by tropical cyclones such as Fiji, Tonga, among others have highlighted that smallholder farmers are vulnerable to cyclones (Iese et al., 2020).

The impact of tropical cyclones in Vanuatu have brought loss and damages that negatively impacted the local and national economy (DSPPAC, 2023). Tropical cyclones have threatened the livelihoods of most people and placed risk on smallholder farmers who are the key contributors to the food supply in Vanuatu (Steenbergen et al., 2020). According to ADB (2023), in 2021 Vanuatu was ranked the world's most vulnerable country to disasters caused by natural hazards. Recently, in March of 2023 two category four tropical cyclones hit Vanuatu, both cyclones caused significant damage to over 60% of the population due to high winds, heavy rain, and flooding (DSPPAC, 2023). In 2020 tropical cyclone Harold hit Vanuatu, causing damage to infrastructure and consequently economic output. Financial losses across the agricultural sector was estimated at US$ 167 million (Widlansky et al., 2023). A category five tropical cyclone hit Vanuatu in 2015, cyclone Pam, where over 70% of the local population was affected along with their livelihood (Le Dé et al., 2018). According to World Bank (2021), a recent report has found that natural disasters have the potential to increase Vanuatu's public debt which already sits at roughly US$230 million.

A post disaster needs assessment by the Government, reported that the national agriculture sector was severely affected by tropical cyclones Harold and Judy (DSPPAC, 2023). These impacts to the agricultural sector continues to increase food insecurity risk, and resulting damage to local food production systems influences reliance on imported food amongst rural and urban population increases (Savage et al., 2020; Wentworth, 2020) . According to the national agriculture sector policy the impacts of natural disasters increase notable risk in the subsistence sector, regarding the size of

potential yield of the crops at a given time, thus giving risk to food insecurity. The following section explores other aspects of smallholder farmer's livelihood within the rural communities.

1.2.4 Livelihood of smallholder farmers

At the core of smallholder farmers' livelihood in rural communities are the social and cultural activities that are supported by crops cultivated within the traditional food system (Barnett, 2011). Most root crops are seasonal and have periods when they are available to contribute to cultural exchange practices, and contribute to household food supplies (Campbell, 2015). For instance, the cultivation of yam and taro has high cultural value in Vanuatu and other Pacific Island countries. Blanco et al. (2013), reported that in Vanuatu traditional crops are used based on the features and varieties of the crops; for instance, yam used in cultural ceremonies is usually long in size, which is reflective of its value.

Over the years, smallholder farmers in Vanuatu and other Pacific Island nations have adopted strategies based on traditional agriculture knowledge that have shown to be significant when adapting to climate change (Addinsall et al., 2015; Radcliffe et al., 2021). Scholars Kuhnlein et al. (2009) explained that traditional food systems are linked intrinsically to traditional knowledge that contributes to the entire well-being of indigenous people. In most Pacific Islands, rural populations often rely on local knowledge to manage natural resources (Hosen et al., 2020). Traditional knowledge related to farming systems are embedded within the livelihoods of smallholder farmers in most rural populations (Janif et al., 2016) and is intertwined with the social and cultural values that build resilience among vulnerable communities during and after the aftermath of natural disasters (Malsale et al., 2018).

Scholars Race et al. (2016), and Hosen et al. (2020) agreed that understanding the environment with traditional knowledge offers a buffer when faced with climate change uncertainty. Traditional knowledge is local and site specific and it includes component of environmental management and farming. For instance, smallholder farmers in Pacific Island countries rely on traditional knowledge by using environmental indicators (Balick

et al., 2023), to cultivate and harvest different crops through their understanding of natural ecosystems that are accumulated through experience and knowledge sharing (Radcliffe et al., 2021). Furthermore, smallholder farmers have been integrating coping and livelihood strategies to mitigate natural disasters, promote food security and sustain their livelihood across many generations (Weir et al., 2017). These include diversifying livelihood activities (Georgeou et al., 2019), maintaining soil fertility, growing early maturing crop varieties, and planting resilient crops, are strategies that farmers adopted to mitigate the challenges of climate variability (McNamara & Prasad, 2014).

Sweetpotato is an example of a resilient root crop selected by farmers in Vanuatu and other Pacific Island countries for cultivation and integration into traditional food systems (Iese et al., 2018). A recent study highlighted the benefits of sweetpotato in addressing sustainable food production in developing countries and meeting the food supply and demand (Afzal et al., 2021). Blanco et al. (2013) reported that adopting new crop species including cassava and sweetpotato can potentially increase resilience in Vanuatu's food system. A recent study have highlighted the significance of cultivating kumala as a recovery crop in Oceania before and during the aftermath of natural disasters (Iese et al., 2018). Janif et al. (2016), explained that in Taveuni in Fiji, villagers' plant sweetpotato before December to have available food during the cyclone period. The production of sweetpotato has been supported by policy and researchers in Vanuatu and in other Pacific Island countries and is increasingly cultivated for its favourable growing characteristics, including a short growing period, suitability for non-season production, and different altitudes (Iese et al., 2018). In addition, sweetpotato is promoted as a resilient root crop and contributes to food security for local subsistence farmers during drought and tropical cyclones (McGregor et al., 2016). The following section explores the production of kumala in the Pacific and in Vanuatu.

1.2.5 Kumala (Sweetpotato, *Ipomoea batatas*)

Sweetpotato (*Ipomea batatas*) is the seventh most important food crop in the world after rice, wheat, potato, maize, cassava and barley (FAO, 2022). Kumala belongs to the Convolvulaceae plant family and is consumed worldwide (Sapakhova et al., 2023). China is the largest global producer of sweetpotato, followed by Africa and other Asian

countries (FAO, 2022). Smallholder farmers in developing countries adopted sweetpotato due to its robustness, ability to be grown on marginal soils, with relatively low labour inputs, short harvesting period (Echodu et al., 2019) and tolerance to a wide range of climatic conditions (Lebot, 2019). Sweetpotato is cultivated worldwide and is increasingly being considered as a superfood due to the health benefits associated with the crop and high nutritional value (Cartabiano-Leite et al., 2020; Johnson et al., 2022), including high levels of carotene, fibre, and several vitamins found in different varieties of sweetpotato (Hagenimana & Low, 2000; van Jaarsveld et al., 2005).

Sweetpotato is a fairly drought tolerant crop with potential to mitigate challenges of drought and increase food security in developing countries (Kwak, 2019). Sweetpotato remains an important crop in overcoming food security and reduce poverty for the fast population in developing countries (Alam et al., 2016), high yielding, versatile crop with a relatively short growing season (Kassali, 2011). In addition, diversification of sweetpotato into value added products with potential to supplement incomes and improve livelihoods (Mudege et al., 2017). For instance, purple flesh sweetpotato is often used in food processing industries as a food colorant for snacks (Mmasa & Msuya, 2012). Furthermore, a significant review on the benefits and trade-offs of sweetpotato, has shown that sweetpotato has the potential to enable smallholder farmers to make progress towards achieving the SDGs (Afzal et al., 2021).

1.2.6 Kumala in the Pacific

Kumala is an important versatile food crop across Pacific Island countries. According to Iese et al. (2018) kumala was and continues to be an important food security crop for Pacific communities. Across the Pacific Island countries sweetpotato has been known by many different names (see Table 1). Throughout this thesis sweetpotato and kumala refer to the same species both terms will be used interchangeably to refer to (*Ipomoea batatas*). Several scholars have documented the spatial distribution of kumala across Pacific Island countries (Ladefoged et al., 2005; Leach, 2005; Roullier, Benoit, et al., 2013). These studies highlighted the historical role of kumala in promoting food security and its role as a recovery crop in the face of natural disasters (Allen, 2005; Iese et al.,

2017). The prehistoric and historic pattern of kumala (sweetpotato) distribution in Oceania has been widely researched (Ladefoged et al., 2005; Leach, 2005; Roullier, Benoit, et al., 2013; Yen, 1963). These scholars have established that sweetpotato originated in Central America and make way to Oceania through early Polynesians and early European explorers. Other scholars have claimed that kumala was already present in Polynesia around the start of second millennium (Green, 2005; Hather & Kirch, 1991). Despite the debate on its spread across the Pacific, kumala has historically played important role in supporting food insecurity and recovery. According to Allen (2005), in the 1940s to 1950s, sweetpotato was vastly adopted in the Papua New Guinea and the Solomon Islands as a staple food crop, after a decline in taro production due to spread of taro leaf blight. Sweetpotato is also centred in Maori, Easter Island and Hawaii traditions, as a significant cultural crop (Leach, 2005; Roullier, Benoit, et al., 2013). Wallin et al. (2005) acknowledged that in Rapa Nui (Easter Island) sweetpotato became a staple food due to its drought tolerance compared to other traditional staples. In Papua New Guinea, sweetpotato is a staple food crop, contributing to its high production among the smallholder farmers in the highlands of Papua New Guinea (Fujinuma et al., 2018). Sweetpotato distinct characteristics mentioned in the previous section, has contributed to its intensification within the local food system and increasing production across the Pacific Island countries. According to recent FAO statistics it shows that more than 950 million tons of sweetpotato were produced in Oceania in 2022 (see Figure1

Table 1 Other names of sweetpotato in Oceania

Traditional names	Countries
kumala	Vanuatu, Fiji, Tonga, New Caledonia
Umala	Samoa
umara, umaa	Tahiti
‘Uala, ‘uwala	Hawai’i
kumaa	Marqueses
Ku’a’ra	Mangaia
kumara	Rarotonga, Tuamotu, Mangeareva, Easter Islands

Adapted (Roskruge, 2014)

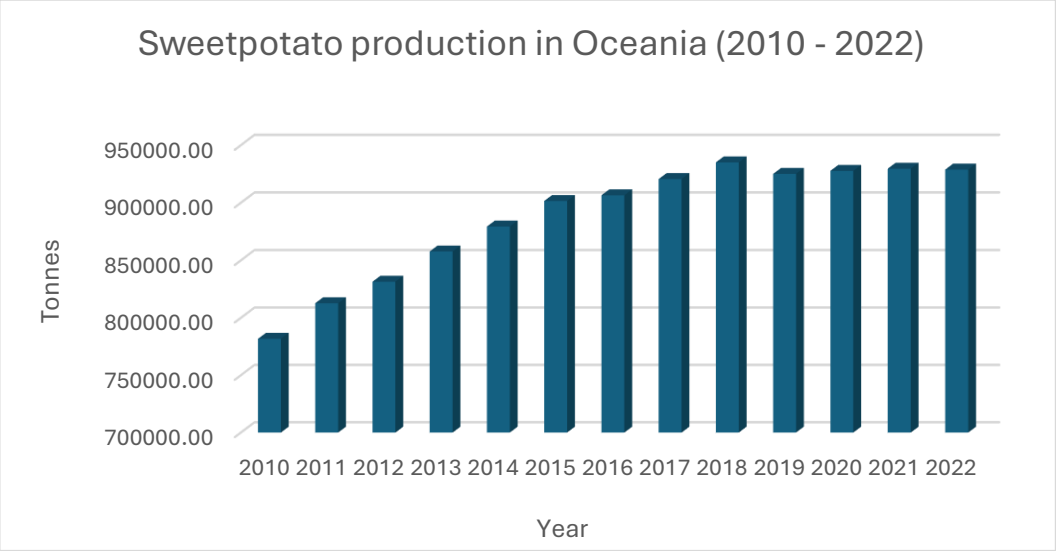

Figure 1 Production of sweetpotato in Oceania

(FAO, 2022)

1.2.2 Kumala in Vanuatu

Kumala is cultivated amongst smallholder farmers in Vanuatu, and regraded as an introduced species within Vanuatu’s traditional food system (Blanco et al., 2013; Lebot & Bedford, 2023). Over the years kumala (sweetpotato) production has not been

recorded in Vanuatu despite its increasing cultivation promoted by the Department of Agriculture and Rural development (DARD). However, the recent agriculture census taken in 2022 has provided information on different root crops including sweetpotato. Figure 2, shows the value and volume of sweetpotato production in 2022. Gibson (2023) emphasised that a barrier to agriculture development in Vanuatu and other Pacific Island countries, is the result of inadequate and unreliable data. Statistical information on agricultural production is often provided by VNSO which was first launched in 2007 and subsequently the second national agriculture census that was carried out 15 years later (VNSO, 2022). In addition, the 2022 national agriculture census was supported by FAO and EDF11 (European Development Fund). FAO (2022) reported that the census data will be used to strengthen the agriculture sector to promote effective planning and policy planning in Vanuatu.

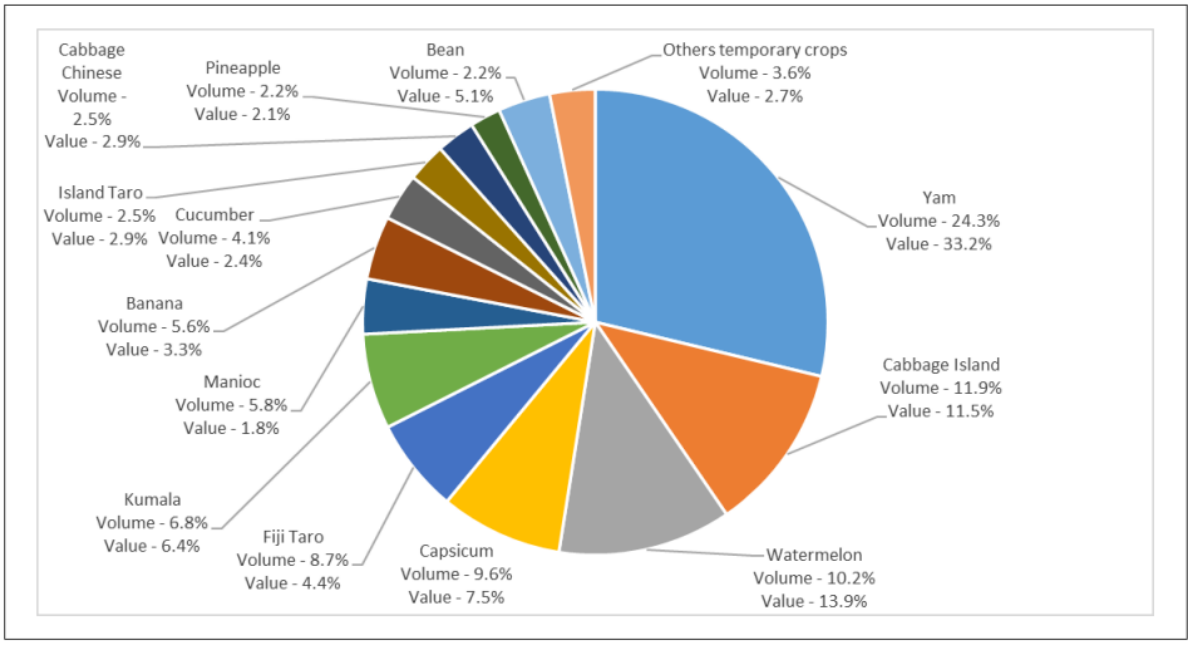

Figure 2 Production of agricultural produce in 2022

(VNSO, 2022)

The Department of Agriculture in Vanuatu has continued to support the production of kumala through several programs and projects. DARD emphasised the production of resilient crops such as kumala through research and development across national agriculture policy (Department of Agriculture and Rural Development, 2015).

These enabled smallholder farmers throughout Vanuatu to access different varieties of kumala. According to Tensly Sumbe (2019), the Scientist working with the ministry of Agriculture in Vanuatu Dr Lebot, emphasised that a lot of research has been done to improve the potential of kumala, that aimed at finding high yielding varieties of kumala and distribute these to farmers. DARD, under the Ministry of Agriculture in Vanuatu continued to encourage and promote the production of kumala through field trials and demonstration plots (MALFFB, 2022). Thus, the majority of the kumala field trials managed by DARD have been successful, allowing smallholder farmers to have access to the kumala planting materials enabling farmers to viably grow different varieties of kumala (see Figure 3). In 2015, the Vanuatu Agriculture Research Technical Centre (VARTC) introduced 50 improved varieties of kumala, enabling farmers to produce 20 to 30 tonnes of kumala within 3 to 4 months (RNZ News, 2015). Vanuatu has a small niche of value-added root crop products including those made from kumala; several countries have shown that diversifying into value added products has the potential to increase crop utilisation and generate income for smallholder farmers in developing countries (Oumer & de Neergaard, 2011).

Production of kumala has supported the livelihood of smallholder farmers in urban and rural areas in Vanuatu. The recent food response program has also influenced the production of kumala amongst the smallholder farmers. For instances, an agriculture officer interviewed explained that:

> During Covid-19 food responses, planting materials were sourced from DARD and leading farmers to support the shortage of local produce. Kumala roots, planting materials and other crops were distributed. Among the crops distributed during the covid pandemic, kumala vines recorded the highest number of planting material distributed at DARD (K5).

Figure 3 Some varieties of kumala (sweetpotato) obtained from cross breeding trials

(Pakoa Leo, 2020)

1.3 Research Aim

This doctoral study aims to explore the role of kumala (sweetpotato) in supporting the livelihoods of smallholder farmers in Vanuatu with a particular focus on food and household resilience, by drawing on farmers' perspectives on the status of kumala within the traditional food system and understanding the dynamics of social and cultural values that are interwoven and embedded in the livelihood of farmers in rural communities in Vanuatu.

1.4 Problem statement

The risk of food insecurity in Vanuatu is exacerbated by the impacts of continuous natural disaster events on the agriculture sector, these directly threaten the livelihoods of smallholder farmers. These farmers play a pivotal role in strengthening and maintaining traditional food systems, employing their local knowledge and external knowledge to cultivate root crops which serve as staple foods for most Ni-Vanuatu[1]. Kumala (sweetpotato) is one of several root crops supporting the livelihood of smallholder farmers and its production is promoted collectively by extension services. However, the traditional knowledge and practices of farmers is not documented. Understanding the role of this crop within local production systems will support its future role in achieving food security and resilience for local communities.

1.5 Research Question

The questions that guide this doctoral study are:

1. What is the traditional system of growing and utilising kumala?

2. How does the traditional system of growing kumala contribute to sustainable livelihood and food security in Vanuatu?

[1] Term referring to Vanuatu citizens.

1.6 Objectives

1. Drawing on small holder farmers (both male and female) traditional knowledge, describe the traditional practices of growing and utilizing kumala in two different climatic zones in Vanuatu.
2. Describe how the traditional growing and cultivation of kumala supports, and has supported, small holder livelihoods and food security.

1.7 Thesis structure

The doctoral thesis follows a standard monograph format and consists of eight chapters. This subsequent section summaries the thesis structure.

I. Chapter one provides a general introduction to the context of this thesis. This chapter explains the research background, followed by aim of the study, research questions and objectives, and outlining the structure of the thesis.

II. Chapter two presents an overview of contextual information to the research. It includes information about Vanuatu, the agriculture sector in Vanuatu. Followed by a reflection on the national polices and strategies that framed and support the agriculture sector in Vanuatu.

III. Chapter three reviews the literature and framework used to underpin the study. Initially reviewing the role of traditional knowledge in rural communities and traditional cropping systems. This is followed by the impacts of climate change on agriculture, reviewing the status of food security and the role/s that kumala plays across this landscape. This chapter also reviews the role of kumala in achieving SDG2, followed by the concept of food sovereignty and ethnobotanical framework. Finally, this chapter reviews researcher conducted using sustainable livelihood frameworks and the components, followed by a summary of the chapter.

IV. Chapter four discusses the research design used, underlining the research paradigms relevant to the context of this study. The choice of research approach is initially explained and the research strategy that is adopted. This is followed by the case selection. Next, the research process is described in detail, and this is followed by a detailed description of the field work completed. Subsequently, the data collection method and data analysis are explained followed by a brief description of the ethical approach used to conduct the research.

V. Chapter five the case description provides detailed information to understand the context of study by initially reviewing background information specific to Tanna Island. This is then followed by a description of the local land tenure system and the services provided to smallholder farmers. Next, a detailed description of the smallholder agriculture sector in Tanna Island is provided, including farming practices and information on kumala production in Tanna Island. Finally, cultural, and social activities that are embedded in the livelihood of farmers are discussed.

VI. Chapter six details the main findings and addresses the research questions. Firstly, the production of kumala is discussed and the various components of farming calendars. Followed by the results on cropping system and the detailed components. Next, results highlighting cultural and social roles and obligations are discussed including the status of kumala in Tanna community. Subsequently food security and climate change are discussed in the context of kumala production. Finally, a summary of the chapter is provided.

VII. Chapter seven discusses the main findings of this study supported by relevant literature. Initially the status of kumala within traditional food systems is discussed. Followed by the role of kumala in promoting food security and reliance on kumala as a recovery crop. Next, a discussion of farmers copping, and livelihood strategy and livelihood diversification is provided. Subsequently, a discussion of farmers resources, and the means through which these are shared

to enhance household resilience, farmers knowledge, and natural capital and the impacts of this on local kumala production. Finally, a summary of the chapter.

VIII. Chapter eight offers a conclusive reflection of this thesis. Followed by theoretical contributions to literature and the implications of this study. This chapter then provides a reflection on research design and finally a suite of suggestions and recommendations for future research.

The following section provides contextual information of the research, that are useful to explain the major findings of this study. It is divided into four sections: 2.1 provides an overview of Vanuatu where this research was carried out, 2.2 presents a description of the agricultural sector in Vanuatu, 2.3 gives a brief context of the sustainable development goals (SDGs) in a Vanuatu context, 2.4 provides a description of the Department of Agriculture and Rural Development (DARD) and other support services available to smallholder farmers in Vanuatu

CHAPTER TWO

RESEARCH CONTEXT

2.1 Vanuatu

Vanuatu is a small island state nation located in the South Pacific Ocean (Figure 5,) it is a volcanic archipelago made up of 83 islands, of which 63 are inhabited (VNSO, 2021). Vanuatu has a total land area of 12,281 km^2, spread over an exclusive economic zone of about 663,300 km^2. Vanuatu is divided into six provinces, Torba, Sanma, Penama, Malampa, Shefa and Tafea (Ralph Hakkert & Scott, 2022). Port Vila, the capital city, is located on the island of Efate in Shefa province. Port Vila is 1,288km to southeast of Honiara, Solomon Islands; 1071 km west of Suva, Fiji; and 2,394km east of Carins, Australia. Efate is a densely populated island, although Santo in Sanma province is the largest island in Vanuatu (VNSO, 2020). Vanuatu has three official languages, Bislama, French and English, that were introduced during European colonisation, the nation is culturally diverse with 138 distinct vernacular languages.

2.1.1 Demography

The current population of Vanuatu is 300,019, with the rural population sitting at 233,266 and the urban population at 66,753 (VNSO, 2020); the total population saw an increase of 65,966 people since the 2009 population census. According to the national population and housing census in 2020, the average population density was 24.4 people /km^2 an increase from 19.1 people/$km^{2.}$ (Ralph Hakkert & Scott, 2022). Port Vila has a growing population with a rapid 4.1% increase annually, associated with rural migrations from other islands seeking better opportunities in the city (VNSO, 2022). Population densities vary throughout the six provinces in Vanuatu due to urbanisation, and

migration to urban centres as educational, health services, and infrastructure are often limited to certain areas (VNSO, 2020). Shefa province is mostly populated due to it being a significant centre of services, trades, health, education, and urbanisation. The population pyramid showed that the largest percentage of people living in Vanuatu are in younger age groups, with increasingly narrow bars towards the top of the pyramid which represents the decreasing representation in the older age groups (see Figure 4).

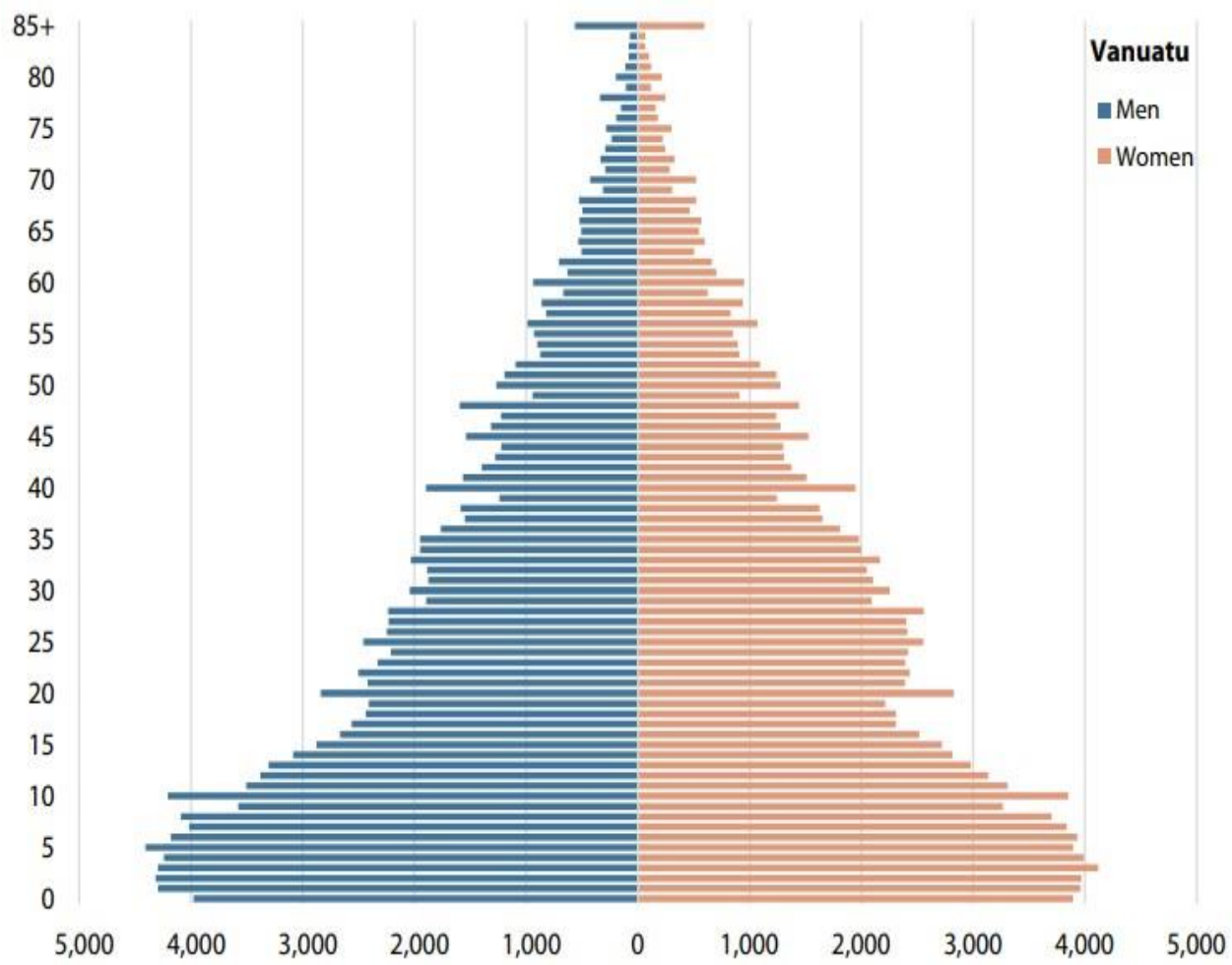

Figure 4 Population pyramid of Vanuatu

(VNSO, 2020, p. 7)

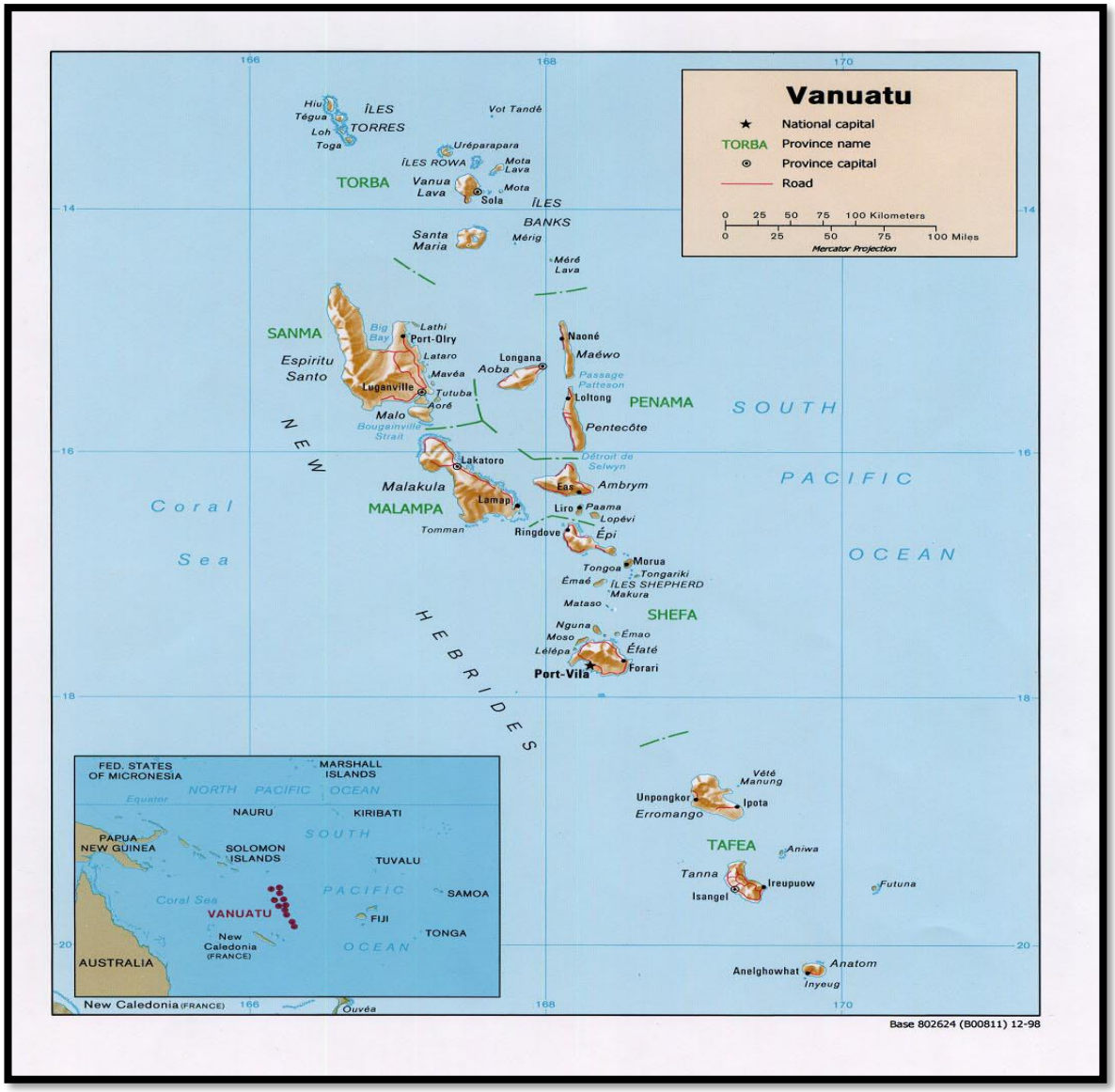

Figure 5 Map of Vanuatu

(Nations Online Project, 2021, p. 1)

2.1.2 Socio economic status of Vanuatu

On 4th December 2020 Vanuatu graduated from the category of less developed countries (LDCs). Tourism and agriculture sectors are large contributors to the domestic economy in Vanuatu. The wider economy of Vanuatu is based on the service sector that contributes to 66% GDP, followed by agriculture (22%) and industry 11% (Ralph Hakkert & Scott, 2022). Vanuatu's economy remains strongly oriented towards agriculture,

especially in the rural areas, however only one third of this production is commercial, resulting in the sector's relatively low share of GDP (FAO, 2020). Vanuatu's social geographical characteristics influence the economics of scale, as trade is limited to certain areas with high production cost (World Bank, 2022). However, in 2021 Vanuatu experienced an economic decline of 1.6%, this was driven by industry and weak growth services and the exposure to and the impacts of natural disasters.

Vanuatu's export goods are focused on a few value-added products of cash crops (cocoa, coffee, coconut, and kava), while almost all consumer goods are imported (World Bank, 2022). In the past few years, Vanuatu's environmental and economic vulnerability remained high in the face of natural disasters such as tropical cyclones exacerbated by the impacts of climate change (ADB, 2023). According to World Bank (2021) analysis on climate risk profile, Vanuatu is expected to incur $USD48 million from losses imposed by the impacts of tropical cyclones and earthquakes. In addition, to date ADB has committed 98 public loans, grants and technical assistance totalling $210.3 million to Vanuatu (ADB, 2023). FAO (2020), reported that economic growth in Vanuatu is constrained by access to market, related to the remoteness of the rural communities and high transport cost. As a result, Vanuatu is dependent on aid and external supports from international and regional organisations that continue to support and rebuild the livelihood of most vulnerable communities over the past years (ADB, 2023; FAO, 2020).

2.2.3 Climate in Vanuatu

Vanuatu has two distinct seasons, a warm wet season from November to April and a cooler dry season from May to October (World Bank, 2021).The average annual temperature across Vanuatu is between 23.5-27.5^{o}C, the change in temperature is often influenced by ocean temperatures. Annual average rainfall measures at 1,500mm. Tropical Cyclones are common during the warmer months of November to April, however recent cyclones occurred outside the traditional cyclone seasons. In Vanuatu like other Pacific Island countries climate varies considerably due the association of EL Nino Southern Oscillation (ENSO). El Nino is a natural climate phenomenon

characterized by unusually warm ocean temperatures, these events usually occur every 3-7 years during the month of December and January and often persist for one year (Widlansky et al., 2023). According to Widlansky et al. (2023), Vanuatu is likely to continue experiencing occasional droughts triggered by ongoing events of El Nino events. According to Vanuatu's climate risk profile completed by World Bank (2021), it is predicted and expected that drought periods will increase into the future throughout the Islands.

2.2 Agriculture sector

Agriculture remains as the backbone of the Vanuatu's economy, the total area of farmland comprises 87,775 hectares representing 7.3 % of Vanuatu's total land area (VNSO, 2022). Department of Agriculture and Rural Development (DARD) aims to build an agriculture sector that is robust and competitive, in addition to a sector that improves economic growth, food security and equally improve livelihoods within rural and urban population (MALFFB, 2022). According to the recent agriculture census, approximately 87.3% of households in Vanuatu are involved in agricultural related activities (DSPPAC, 2023) and which collectively contributes to the nation's overall GDP. VNSO (2022), reported that 50% of agriculturally based households grow and sell their crops as the main source of income, and a further 23% work in non-agricultural occupations that serve as the main income source for their households.

In Vanuatu the agriculture sector is comprised of three subsectors, including the; subsistence sector which makes up 75% of the overall sector a growing semi-commercial sector occupying 15%, and the commercial agriculture subsector which is based on cash crops contributes to around 10% of total production in the sector (Department of Agriculture and Rural Development, 2015). According to VNSO (2022), 62% of the agriculture households do not use machinery to grow crops, 32.2 % reported used small machinery and 1.8% households used heavy machinery for farming activities. According to, the Department of Agriculture and Rural Development (2015) the subsistence sector is centred on the cultivation of root crops (yam, taro, kumala (sweetpotato), banana and

leafy vegetables. The range of crops are utilised for home consumption and often to support cultural obligations.

Subsistence farming is dominant in rural areas, where farmers grow different crops, and farmers raise small livestock to support their livelihood. The semi-commercial sector is based on farmers who raise crops for both home consumption and for sale at local markets, in this sector farmers cultivate a wide range of vegetables. Favoured crops include cabbages, tomatoes, capsicums, different herbs, and other introduced species that are becoming popular. The semi-commercial sector is mostly centred around the urban centres where human population are high and where industries such as tourism have created growing markets for food crops (McCormick, 2016). Perennial cash crops (cocoa, coffee, coconut, and kava) are the main crops contributing to the commercial sector. Exports are mostly made up of agriculture products, the commercial sector plays a significant role in the livelihoods of smallholder farmers. VNSO (2022) reported that the agriculture census showed that kava has the highest volume of production, followed by coconut, cocoa, coffee (see Table 2). Despite making up 10% of the of the agriculture sector, the commercial sector makes a large contribution to overall GDP. Perennial cash crops (coconut, cocoa, kava, coffee) are favoured by the agricultural policies which contributes to their production across this part of the sector in Vanuatu.

Table 2 Different cash crops cultivated by smallholder farmers in Vanuatu

Cash crops	**Kava**	**Coconut**	**Cocoa**	**Coffee**
Number of households	29,802	27,977	5,822	676
Total Volume of Production (in metrics tonnes)	153,446.7	680,445.2	3,847.5	14.5
Total gross value of crop production (in billon Vatu)	240.175	81.994	0.226	0.008

Adapted (VNSO, 2022)

The following section discusses the Sustainable Development Goals (SDGs) of Vanuatu. Global initiatives are introduced in this chapter to highlight the link between wider global goals and the national sustainable development plan (NSDP) to promote

sustainable food production and smallholder farmers' contribution towards achieving the SDGs for Vanuatu.

2.3 Sustainable development goals – Vanuatu context

The 2030 Agenda for SDG's, adopted by all United Nations member states in 2015 including Vanuatu, provided an international development agenda that centres around 17 SDGs. Agriculture plays an important role towards achieving SDG2, aimed at ending hunger, achieving food security, and promoting sustainable agriculture. The Zero hunger goal calls for 100% increase in smallholder production and income, 100% access to adequate food supply and food system are sustainable (United Nations, 2015) . According to the global commitment by UN, the SDG2 aims to:

> ensure sustainable food production systems and implement agricultural practices that increase productivity and production, help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters and that progressively improve land and soil quality (United Nations, 2015, p. 1)

Studies in developing countries have highlighted the role of smallholder farmers towards contributing to global food production and achieving SDGs (Bizikova et al., 2020; Khanal et al., 2021; Ricciardi et al., 2018) . According to Fan and Rue (2020, p. 14)

> Enhancing the viability of smallholder farming could reduce rural poverty and improve food security and nutrition and contribute to the achievement of multiple SDG's.

Linked to the global commitment of SDGs, the Vanuatu government has developed the National Sustainable Development Plan 2016-2030 (NSDP). The NSDP constitutes three pillars including social inclusiveness, environmental protection, and economic growth (DSPAC, 2016). Within the context of sustainable food systems, the NSDP is structured to guide Vanuatu in achieving SDGs set by the United Nations on sustainable food production. The environmental NSPD pillar (objective one) calls "to ensure food and nutrition security needs are adequately met for all people through increasing sustainable food production and household production" (DSPAC, 2016).

The NSDP is a roadmap that guides the Vanuatu government departments such as DARD, to develop and implement policies that directly support food security and promote sustainable food production. A study of Pacific Island countries has shown that smallholder farmers have the potential to achieve SDG 2 (Zero Hunger) (Abraham & Pingali, 2020). A recent study by Vogliano et al. (2021), has shown that farmers in the Pacific Islands can progress towards achieving this goal through leveraging on traditional knowledge of farming practices to cope with ongoing impacts of climate change and overcome food insecurity risk.

2.4 Department of Agriculture & Rural Development

The Department of Agriculture and Rural Development (DARD) under the Ministry of Agriculture, Livestock, Fisheries, Forestry & Biosecurity (MALFFB) is localised in the six provinces in Vanuatu with respect to extension services, further to Agriculture Assistant officers (AAO) are stationed on each island of Vanuatu. An administrative centre station is set up in the six provinces, supporting smallholder farmers on all islands of the six provinces, providing extension activities that included inf dissemination of information , workshops, and training. In addition, it is mandated that DARD carry out research and training on the different root and cash crop species. The vision and goal of DARD is to guide the agricultural sector in Vanuatu.

Vision: Agriculture food and cash crops of Vanuatu are sustainable and profitably managed, contributing to sustainable development for the wellbeing of all people in Vanuatu by 2030 (Department of Agriculture and Rural Development, 2015).

Goal: The nation's agriculture resources are managed in an integrated and sustainable manner to provide food and improve income as well as contribute to environmental and social services to enhance the wellbeing of all people in Vanuatu (Department of Agriculture and Rural Development, 2015).

The national agriculture sector policy (2015-2030) is underpinned by economic, social, cultural, and ecological principles and sustainable development pillars, is organized around 13 thematic areas. DARD developed policies and strategies to promote

agricultural services and increase the production of agricultural crops in Vanuatu (Department of Agriculture and Rural Development, 2015; Reeve et al., 2022). In addition, DARD promotes food security at the national level, through policies mandated by the agriculture extension officers. Food security is a thematic pillar in national agricultural sector policy. The policy directives for food security include,

I. Increased production of sufficient and nutritionally adequate foods at a national level

II. Improve access to and availability of sufficient, safe, and nutritionally adequate food.

III. Encourage the utilization of sufficient and nutritionally balanced diets.

IV. Enhance the sustainability of food at national level.

These policy directives align with the work of FAO in the Pacific Island countries including Vanuatu.

> FAO work plays a role in linking agriculture and health, strengthens inter-agency linkages and develops partnerships to foster a sustainable increase in production, trade and marketing of domestic agriculture products and heathy consumption of diverse and nutritious food (FAO, 2021, p. 3).

2.4.1 Strategies and Policies in the agriculture sector

Despite the establishment of significant cash crops in Vanuatu under colonial governments (Sharp & Busse, 2019), the local government through the Ministry of Agriculture over the past six years has developed strategies to promote and increase the production of these crops (MALFFB, 2022). These strategies highlighted the responsibilities of different government departments, private sectors, and non-government organisations and linked their functions in supporting the agriculture sector (Department of Agriculture and Rural Development, 2015). The strategies are developed to promote sustainability of each crop and contribute to the overall production of individual crops, these strategies have been launched and are available to the relevant stakeholders and smallholder farmers.

- Vanuatu national coconut strategy- 2016-2025
- Vanuatu national coffee strategy -2021- 2026

- Vanuatu national kava strategy -2016-2025
- Vanuatu national cocoa strategy- 2020-2025
- Vanuatu national fruits and vegetable strategy -2017-2027
- Vanuatu national root crop strategy -2024-2030

(Department of Agriculture and Rural Development, 2015; MALFFB, 2019)

Recently the Ministry of Agriculture in Vanuatu launched the agriculture subsidy policy. According to Adorina Massing (2020) the subsidy allows the smallholder farmers access to agriculture equipment and small machinery to promote increased crop production. However, it is argued that agriculture policies and foreign agencies favour perennial cash crops in Vanuatu (Siméoni & Lebot, 2012). It is reported by FAO (2021) that despite the involvement of the rural population in subsistence agriculture, most investments in agriculture are made towards cash crops. Khanal et al. (2021) emphasised that it is significant for policies to encourage farmers to adapt practices that have the potential to enhance farmers productivity. According to Reeve et al. (2022) a study in Vanuatu and Solomon Islands in understanding the national food system policies, emphasised that in both countries there is opportunity for policy makers to centre more on production, distribution, and marketing of healthy local produce. Furthermore, the government of Vanuatu, though DARD, has initiated programs such as food baskets and is working together with farmers and other departments to support the local supply of food during natural disasters.

2.4.2 National food basket

The food basket is an incentive that addresses food security during and in the aftermath of natural disasters, for the urban and rural population in Vanuatu. The initiative is supported by DARD provincial officers and assistant agriculture officers, aims to restore food security, provide planting materials, and support communities to increase production and improve livelihoods (Agriculture News, 2021). In 2017 DARD established the first food basket in Penama province on the island of Maewo after the evacuation of the people of Ambae during the volcanic ashfall. It was reported that 1000 yam tubers, 2300 kumala vines and 3100 taro suckers were planted as part of the food basket

program, after planting the crops these plantings were maintained by local communities (DARD, 2022). According to Provincial Agriculture Officer (PAO), located in Penama province, the establishment of food baskets in the six provinces in Vanuatu is an effective way to address food security at the community level (DARD, 2023). In 2021, DARD launched the 'Think big' food basket initiative in Sanma Province on the island of Malo as part of the recovery program to support local people. According to DARD's deputy director, this initiative creates an avenue where sufficient food is produced to support and restore food security (Agriculture News, 2021). Food basket was set up in provinces in Vanuatu, to support the local communities with the supply of local produce and planting materials, in preparedness for natural disasters in Vanuatu (see Figure 6). In addition, COVID 19 food security response plans included the food basket incentive. DARD worked with smallholder farmers and collected local produce and sold them at the DARD warehouse. The incentive allowed urban households to access local produce at affordable prices.

Figure 6 local community benefiting from kumala harvested from food basket program in Efate (Pakoa Leo, 2023)

2.4.3 Research and technical support

Enhancing agricultural research and development is significant to boost agricultural productivity and promote food security in rural and urban Vanuatu. Vanuatu agriculture research & technical centre (VARTC) is the national agriculture research centre in Vanuatu mandated by the MALFFB (MALFFB, 2022). In addition, a FAO report in Vanuatu also acknowledged that VARTC also carries out applied and development-oriented research in the fields of agriculture and livestock, and has worked with MALFFB to facilitate the application of the research results (FAO, 2020). Some of the main activities carried out at VARTC since its establishment, include maintaining the national germplasm bank of different root crops, cash crops and vegetables, and identifying sustainable cropping systems that can maximise return for farmers and to continuously provide technical support to farmers. The conservation and breeding program at VARTC includes the crossbreeding and selection of different varieties of sweet potato and other root crops. DARD encourages the cultivation of different varieties of sweet potato through the dissemination of planting materials at field days and workshops. In addition, DARD has established centres for planting materials to be readily available and accessible for people, which is a specific objective under theme 7 of the national agriculture sector policy. Anita (2023), reported on the launch of first VARTC strategic plan, the plan draws from different policies and strategies, and provides a pathway for collaboration with regional and international research partners. These include South Pacific Community (SPC), the National Agriculture Research Institute in Papua New Guinea (NARI), the Australian Centre for International Agriculture Research (ACAIR) and the French Agriculture Centre for International Development (CIRAD) in France.

Furthermore, research that combines traditional knowledge and formal research can contribute to sustainable productivity. The Department of Agriculture acknowledged the incorporation of traditional knowledge in agriculture research in the national agriculture sector policy. In 2023, Vanuatu traditional knowledge indicator booklet was produced under the department of Vanuatu Meteorological and Geo-hazards (VMGD) with support from SPREP and relevant stakeholders (Ministry of Climate Change, 2015).

2.4.3 Other government services

Apart from the departments within the Ministry of Agriculture in Vanuatu, other government departments also play a pivotal role in supporting the agriculture sector in Vanuatu. These government agencies include the Department of Industry (DOI) under the Ministry of Trades, Industry, Commerce and Ni Vanuatu Business and the Department of Vanuatu Meteorological and Geo-hazards (VMGD), National Disasters Management office (NDMO), Department of Climate Change (DOCC) all under the Ministry of Climate Change and Natural Disasters (MOCC) in Vanuatu.

NDMO, VMGD and DOCC

NDMO is mandated under the National Disaster ACT No.1 of 2000: to develop strategies for the prevention of and preparation for responses to recover from natural disasters and to ensure that strategies are implemented to counter the effects of disasters. NDMO works with local and international NGO, in helping communities to be disaster resilient. NDMO is responsible for coordinating emergencies and natural disaster responses across Vanuatu. NDMO recommends that farmers prepare for natural disasters through warning systems, that allows farmers to prepare for drought, heavy rainfall, and tropical cyclones. In addition, food security and agriculture clusters (FSAC) led by the Ministry of Agriculture and National Disasters Management office (NDMO), work together with FAO and other governmental agencies to ensure coherent assessment of food security and the needs of affected population (Ministry of Climate Change, 2015).

VGMD collaborate with DARD to produce the agromet bulletin that is supported by other regional and international organisations. Vanuatu's agromet bulletin is a climate smart approach to support farmers with relevant and detailed information on when to plant different types of crops and the farm management practices (VGMD, 2022)

Department of Industry (DOI)

The Department of Industry in Vanuatu is mandated to promote, facilitate, and support the growth of sustainable and value-added industries in Vanuatu and to provide for related matters (Department of Industry, 2022). DARD has strong partnership with these

government departments, they often collaborate to implement projects that support the agriculture sector in Vanuatu. DOI has invested in value added projects over the last five years that have contributed to generate income for smallholder farmers. According to national industry development strategy, the department of industry has invested in value-add products of several key cash crops in Vanuatu, however there are capabilities to diversifying into value added products of other local produce in the future (Department of Industry, 2022).

Non-government organizations (NGO) have been a long-standing support to the agricultural sector in Vanuatu. International, regional, and local NGOs have been working in partnership with DARD or independently, involved in projects that support and rebuild the livelihood of smallholder farmers in local communities throughout Vanuatu. Working in partnership enables organisations and stakeholders to share knowledge, skills, and expertise, producing tangible benefits for the community. Some NGO projects also provide extension services to the rural communities, often on specialist crops such as vanilla, other crop species and livestock, addressing production, processing, and export. These NGOs include World vision, CARE Vanuatu, Live and learn, Oxfam, Save the Children, ACTIV. In addition to international and regional organizations (FAO, SPREP, SPC) , these organisations work closely with DARD and independently to support the work of agriculture extension throughout the islands in Vanuatu (FAO, 2020).

- **Care International Vanuatu**

  Care international Vanuatu was established in Vanuatu since 2008. The organisation works with local communities to build resilience to disasters and climate shocks, increase women and girls' involvement in community and national leadership. Care international has partnered with DARD to assist local communities in Tafea province in recovering during the aftermath of tropical cyclone Judy and Kevin. The benefits for smallholder farmers include access to seedlings, gardening tools and planting materials of resilient crops (Care International, 2015).

- **World vision Vanuatu**

  This organisation has been present in Vanuatu since the early 1980s, initially focusing on education, training and income generating projects. Over the last two decades, projects have expanded involving agriculture, rural development. In 2018, world vision collaborated with DARD and distributed 55000 coffee seedlings to over 650 farmers in 14 communities across Tanna, the initiative was part of a project that also trains smallholder farmers to improved farming practices for marketable produce (World Vison, 2020).

2.5 Summary

Vanuatu's economy remains strongly oriented towards agriculture especially in the rural communities where smallholder subsistence farmers are key contributors to food supplies in Vanuatu. However, the social and economic challenges continue to be a barrier for food trade and links to urban market. The Department of Agriculture and Rural Development under the Ministry of Agriculture, through collective extension services continue to support smallholder farmers through decentralisation of agricultural services, and research or technical assistance that addresses issues related to crop production. Subsequently, collaboration between government departments and partnerships with non-government organisation also play a significant role in supporting the livelihood of smallholder farmers, through projects that promote food security and rebuild their livelihood.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter provides a review of the literature relevant to the research questions. As mentioned in Chapter 1, this study aims to acknowledge kumala (*Ipomoea batatas*) as an important food source in the traditional food system of smallholder farmers in Vanuatu. This research was set in the context of smallholder farmers in rural communities that rely on subsistence farming and growing kumala to support their livelihood. The research questions of this study are.

1. What is the traditional system of growing and utilising kumala in Vanuatu?
2. How does the traditional system of growing kumala contribute to sustainable livelihood and food security in Vanuatu?

This chapter's structure is organised as follows: first, an introduction to the chapter is provided. Section 3.2 outlines the importance of traditional knowledge in rural communities, exemplified through the traditional calendar, cropping system and practices. Following this section 3.3 explores the traditional cropping system in Vanuatu. Next section (3.4) reflects on the impacts of climate change on agriculture and the status of food security in the Pacific and Vanuatu (3.5). This is followed by a review of the traditional food system (3.6); then section 3.7, which explores the role of kumala as a potential food security crop in developing countries; and section 3.8, explores kumala contribution towards achieving SDGs, followed by section 3.9 which draws on kumala cropping systems and utilisation. Section 3.10 reviews the food sovereignty and 3.11 explores the ethnobotanical framework/s adopted in this study and section 3.12 explores the literature review on sustainable livelihood framework (SLF) and its components. Finally, a summary of this chapter is provided in section 3.14.

3.2 The role of traditional knowledge in rural communities

In many developing countries, traditional knowledge remains the driving force in their communities. It is a body of knowledge, beliefs, and practices handed down from generation to generation (Berkes, 2009). Literature varies in defining traditional knowledge from the relationship and association with the land, decision-making, and sociocultural context (Antweiler, 1998). Other terms that describe the same knowledge include local and indigenous knowledge. Agrawal (1995) views traditional knowledge as holistic and interconnected with social culture, where it represents understanding and interpretation of cultures that is intertwined with languages, resources, and practices (Stilwell, 2010). Scholars Verlinden et al. (2006) and Briggs (2005) claim that traditional knowledge is often unique to a specific geographical location, such as local communities that rely on sources of knowledge to support and shape their livelihood. For instance, it builds on linkage with indigenous people of a particular place over time (Grenier, 1998). These studies highlighted that traditional knowledge tends to result from cumulative experience and observation subjected to the everyday life of people living in local communities.

Traditional knowledge is increasingly adapted to support people's well-being, such as customary governance, use of resources, management practices, and weather observation through environmental indicators and cultural values (Granderson, 2017). Traditional knowledge and practices have been increasingly recognised by disaster risk reduction projects and scholars (Chanza & De Wit, 2016; Rautela & Karki, 2015). These scholars emphasise the significance of blending traditional knowledge into disaster risk reduction in building resilience in rural communities. Granderson (2017) explains that indigenous knowledge is deeply embedded within local communities and is passed orally from generation to generation. The interaction and understanding of ways to use natural resources are informed through traditional knowledge (Averweg & Greyling, 2010), which forms the basis of decision-making in addressing rural communities' agricultural and other social issues (Agrawal, 1995). Historically, people in the local communities used livelihood strategies to manage the ongoing natural hazards. Often,

these methods are based on their skills, local knowledge, values, social relationships, and other resources acquired by indigenous communities (Granderson, 2017).

This study uses the terms traditional, local, and indigenous knowledge synonymously. The following section will discuss the difference between local knowledge and external knowledge and how both types of knowledge support the livelihood of smallholder farmers.

3.2.1 Local knowledge and external knowledge

Local knowledge is holistic, considering social, environmental, and cultural dimensions. Studies in local communities in Africa highlight the impact of local knowledge in contributing to sustainable and resilient agriculture (Munyua & Stilwell, 2013) (Hart & Mouton, 2005), their findings illustrate that local knowledge exists within the local communities. A study in Uganda shows that farmers utilise local knowledge to cultivate vegetables (Hart & Mouton, 2005). External knowledge, often referred to as western knowledge which is accumulated through years of research, evolves by building on previous accomplishments and is recorded in publications (Warren, 1991). A few differences between traditional knowledge and external knowledge includes; (a) they are embedded in different epistemology backgrounds are derived from different histories and (c) are varied in context (Agrawal, 1995).

Several scholars have argued that traditional knowledge is neither static nor isolated from other knowledge systems. Berkes (2007) explains that combining scientific and traditional knowledge enhances the understanding of the social-ecological system's resilience and supports the development of new learnings and practices. Scholars like Speranza et al. (2010) and Beckford and Barker (2007) agree that integrating local knowledge and other sources of external knowledge contributes to enhanced farmer agricultural production and livelihood. For instance, Briggs and Moyo (2012) reported that in Malawi, farmers still use their local knowledge and farming practices and that external knowledge is adopted to increase productivity, generate income, address food security, and support sociocultural activities.

Furthermore, smallholder farmers often integrate local and external knowledge to adapt and mitigate the challenges and impacts of climate change. According to Johnston (2015) a study in the remote islands of Fiji and Tonga, shows that integrating traditional knowledge and western knowledge reduces vulnerability to natural disasters, enabling them to adapt during natural disasters and to grow food to support their livelihood. Scholars Šūmane et al. (2018) and Clark and Murdoch (1997) , explained that farmer's knowledge is a subset of local knowledge that allows them to farm within local locations. Curry and Kirwan (2014) argued that local knowledge in most cases, is orally transmitted from one generation to another. In addition, Girard (2015) emphasised that local farmer knowledge is connected to environmental and social values that often reflected in farming practices. Radcliffe et al. (2021) reported that in Vanuatu and Papua New Guinea local indigenous knowledge is embedded in all aspects of daily life and is shared through song and stories. In addition, indigenous knowledge is widely shared amongst members of the same community.

Smallholder farmers often come from a generation of farming families that obtained their agricultural knowledge from the elders in their communities. Scholars Yang et al. (2019) and Trudinger et al. (2023) explained that local knowledge stems from culturally appropriate use of local resources, and is used to promote agricultural sustainability and improve food security. According to Radcliffe et al. (2021) a study in Vanuatu and Papua New Guinea explained that local knowledge is also based on agroforestry techniques, use of environmental indicators and organic inputs of soil improvement and pest management. The farmer's knowledge contribute to sustainable agriculture and household resilience and supports their livelihood (Mavhura et al., 2013).

Studies have shown that local knowledge is relevant for smallholder farmers in rural communities, as it is already present at the community level (Leal Filho et al., 2021; Nyong et al., 2007). Scholars Beckford and Barker (2007) and Kothari (2002) view farmer's knowledge as a subset of local knowledge belonging to a particular geographical location. Farmer's knowledge is relevant and vital as it constitutes an understanding of cultural and natural resources. In addition, it embraces every aspect of farmers 'well-being, from farming, food preparation, eating habits, and

environmental conservation (Agrawal, 1995; Thomas et al., 2020). This research explores the local and external knowledge that informs the cultivation of kumala by smallholder farmers in rural communities in Vanuatu.

3.2.3 Losing local knowledge in the Pacific Island countries.

According to Lebel (2013) indigenous people are those who are attached to their geographical distinct cultural habitats or ancestorial territories. Globally, indigenous communities possess oral histories that include adaptions to local environmental conditions (Lilomaiava-Doktor, 2020; Mahuika, 2019) . In most rural villages in Vanuatu, elders in the community hold the greatest amount of traditional knowledge and they influence how traditional knowledge can be assessed (Walshe & Nunn, 2012). There has been an increasing number of studies illustrating the value of traditional knowledge and its complementarity with external knowledge (King et al., 2008; Nalau et al., 2018), in disaster risk management projects (Berkes, 2009) and use of local knowledge to understand climate change (Riedlinger & Berkes, 2001). However, most Pacific Island countries have raised the concern over the loss of traditional knowledge among the local communities, triggered through rapid urbanization, greater emphasis on external knowledge and the rapid changing weather patterns impacting the behaviour of traditional environmental indicators (Brahy, 2006; Turner et al., 2000). Iticha and Husen (2019) argued that despite the reliability of traditional knowledge with understanding the weather, the impact of climate change will cause this local knowledge to disappear. For instance Breuning-Madsen et al. (2010), reported that local knowledge of soil in Bellona, Solomon Islands needs to be recorded before its completely lost due to cultural and social changes in communities. Balick et al. (2023) reported that on Tanna Island in Vanuatu, local people expressed concern about recent changes in the weather pattern reducing abundance of certain plants and how these changes will affect them in the future. Several studies from other countries such as India and Africa have also reported loss of traditional knowledge (Patel et al., 2020; Tripathi & Singh, 2013).

Multidisciplinary projects have engaged with local communities to safeguard the traditional knowledge and protecting biodiversity in the Pacific Island countries (Hossain & Ballardini, 2021; Kariyawasam, 2008; Nemogá et al., 2022). Granderson

(2017), emphasised that documentation of traditional knowledge is a significant approach to preserve the traditional knowledge. For instance according to Balick et al. (2023) and their study on environmental indicators in Vanuatu, acknowledged that it is important to record and revitalise traditional knowledge before it is completely lost within local knowledge systems. Furthermore, in Vanuatu and other Pacific Island countries there are strategies and policies implemented by the government departments to document and share traditional knowledge (Kitolelei et al., 2021; Malsale et al., 2018). For instance, the Ministry of Climate Change has implemented Vanuatu Change and Disaster Risk Reduction policy 2016-2030 which emphasised the documentation and sharing of traditional knowledge in Vanuatu (Ministry of Climate Change, 2015). For this reason, the following section explores the traditional cropping system that forms the smallholder farmers' farming system in the rural communities of Vanuatu.

3.3 Traditional Cropping System in Vanuatu

Traditional cropping system practices stem from primitive farming methods and are prevalent in rural communities; they involve managing and using natural resources informed through traditional knowledge and practices (Lebel, 2013). Traditional cropping systems are often sustainable and environmentally friendly and have continuously provided food throughout the years (Singh & Singh, 2017). Studies in Pacific Island countries have shown that traditional farming systems can be classified into agroforestry, arboriculture, and horticulture (Kennedy, 2012; Lebot & Siméoni, 2015). Lebot and Siméoni (2015), explain that agroforestry includes growing crops among fruit trees; the practice is common in the Pacific islands and worldwide particularly where people rely on the natural forest for food. Throughout Pacific Island countries, agroforestry systems serve as a source of food and shelter for farmers living in rural communities whom depend on natural resources for their livelihood (Shin et al., 2020). Shifting cultivation is the primary cropping system practised in Vanuatu and Pacific Island countries (Sardos et al., 2016). It is described as slash and burn, known as swidden cultivation, is one of the oldest cultivation system known to man and was or is regarded as environmentally friendly, and has long fallow periods (Gupta, 2000).

Traditionally, crops are grown on land covered with ashes from burning bush; a practice that is often carried out before the rainy season. Shifting cultivation is no longer suitable for the environment, and farmers are moving to alternative cropping systems (Mertz et al., 2012). Studies have shown this transition is due to increasing populations in rural communities, land scarcity, and the choice of cropping systems suitable to support their family's needs (Addinsall et al., 2015; Buckwell et al., 2020). For instances scholars Nielsen et al. (2006) and Padoch and Pinedo-Vasquez (2010) explained that shifting cultivation is in competition with intensive monoculture due to high incomes it generates for smallholder farmers in the rural communities.

Blanco et al. (2013), explained that cultural and agro-environmental conditions often influence farming system practise by smallholder farmers in Vanuatu. These studies show that the cultivation of Taro (*Colocasia esculenta*) and Yam (*Dioscorea alata*) is influenced by agro-environmental conditions (soil fertility, water availability, and wind exposition) and determine the cropping system (Blanco et al., 2013; Lebot & Siméoni, 2015). For instance, taro is often cultivated in wet zones and the yam in the drier areas often on slopes (Blanco et al., 2013). According to these studies on cropping systems in Vanuatu (Lebot, 2013; Lebot & Siméoni, 2015), the cultivation includes three phases. The first phase is the cultivation of the two traditional crops, yam, and taro; often, these crops are not planted with other species if the garden is reserved to support the traditional ceremonies (Blanco et al., 2013). However, if the garden is intended to provide food, crops such as cassava can be grown around the garden, and kumala can be grown between the crops. In the second phase, after harvesting the primary crops in the garden, kumala (*Ipomea batatas)* and cassava (*Manihot esculenta) c*an be planted into the vacant spots, and island cabbage (*Abelmoschus manihot* (L.) between the crops. Finally, in the third phase, cassava continues to grow as a food preserved in the ground (Lebot & Siméoni, 2015).

Scholars Blanco et al. (2013) and Sardos et al. (2016) have established that sweetpotato (kumala) is an introduced species within Vanuatu's farming systems. However, Blanco et al. (2016) argued that the manner by which the new species are integrated into the

existing farming system is important, and the farmers are encouraged to cultivate new species in their traditional gardens. In this study, the term traditional farming system refers to cultivation methods specific to a particular geographical region, influenced by agro-environmental conditions and social and cultural values. The following section explores the traditional calendar's environmental indicators and significance.

3.3.1 Environmental indicators and Traditional calendar

Environmental indicators have played an essential role in predicting weather patterns for farmers over the years, and for people living in rural villages whom rely on these environmental indicators (Granderson, 2017; Petzold, 2016). Kassam et al. (2021), argued that traditional calendars are based on context specific knowledge generated by communities that have inhabited landscapes for multiple generations. Janif et al. (2016) mentioned that most local communities have accumulated traditional knowledge through their long history of managing their natural surroundings. The traditional calendar is essential to understanding environmental changes, including climate variability. Yang et al. (2019) and Nakashima and Roué (2002) argue that traditional calendars are often based on context-specific relationships involving communities and the environment; the calendar features often relate to crop production, fishing, hunting, and gardening associated with changes in weather patterns, temperatures, and wind directions. Local communities in Africa utilise environmental indicators and approaches based on local knowledge to predict weather conditions for farming activities (Gwenzi et al., 2016). A study in Zimbabwe showed that people living in rural communities still rely on environmental indicators to make daily predictions on rainfall forecasts (Soropa et al., 2015). Veitayaki (2002), reported that the traditional calendar in Fiji is based on the food source available at various times of the year. Shah et al. (2018) further explains that the traditional calendar of Fiji guides natural resource use, exemplifying the intricate relationship between indigenous Fijians and the land. The Indigenous Aboriginal people of Australia use traditional seasonal calendars to predict and adapt to changes in weather patterns for their farming activities (McKemey et al., 2020). In addition, Lefale (2010) reported that the Samoan culture observes changes in plants and animal behaviour to forecast weather. Leonard et al. (2013) argue that the traditional calendar and meaningful information about ecosystem dynamics at the local

level can contribute to science and the understanding of ecosystems. For instance, traditional knowledge within livelihood practices can provide insights into how different aspects of the local environment can provide understanding of when to plant and harvest specific crops (Turner et al., 2000). In Vanuatu, local peoples are knowledgeable about the environment and its dynamic nature, which is commonly exemplified by a traditional calendar associated with the environmental indicator based on farming activities and food availability at different times of the year (Chambers et al., 2021). Environmental indicators based on plant and animal behaviours were common in most Islands in Vanuatu. For instance, the onset of the flowering of the Malay apple *(Syzgium malaccense)* indicates when to start clearing gardens for the planting seasons (Chand et al., 2014). According to Setak (2018), local farmers identified environmental indicators associated with cultivating kumala in rural villages in Santo. Furthermore, these examples of indigenous people using traditional calendars indicates their understanding and relationship with the environment that surrounds them. The following section explores the effects of climate change on agriculture in developing countries.

3.4 Impacts of Climate Change on Agriculture

Today's agriculture sector in most developing countries is experiencing a profound change due to contemporary issues such as climate change and food insecurity (Berkes, 2009). According to (Barnett, 2011, p. 4)

> "Climate change will adversely affect food systems in the region, including the supply of food from agriculture and fisheries, the ability of countries to import food, systems for the distribution of food, and the ability of households to purchase and utilise food".

McGregor et al. (2016), explained that climate is vital in determining crop production, as plants require optimum temperature, rainfall, humidity, and other environmental factors that contribute to growth and development. However, the continuous impacts of climate change on global agricultural production have risked the livelihood of smallholder farmers, increasing the risk of food insecurity amongst the growing population (FAO, 2013). These have been assessed in numerous studies (Dun et al., 2023; Lobell et al., 2011). Conditions such as droughts, intense floods and tropical cyclones directly impact the production of crops and the livelihood of smallholder farmers (Downing et al., 1996; Kiley, 2024). According to Arora (2019) communities

involved in agricultural production are most vulnerable to climate change, mainly when their livelihoods depend on the natural surroundings. For instance, smallholder farmers in Madagascar suffered from damages caused by cyclone, almost 90% of the farmers indicated that their rice fields were damaged by the cyclone (Rakotobe et al., 2016).

The damages and loss in agriculture due to the impacts of climate change have been intensely reported worldwide. Studies in Africa have reported an increased frequency of droughts and dry spells that have resulted in crop failure and livestock death, affecting the livelihood of smallholder farmers (Mabhaudhi et al., 2015; Masih et al., 2014; Rakotobe et al., 2016). Similarly, smallholder farmers in Asia face the devasting impacts of climate change (Aryal et al., 2020). A study on crop production in India indicated that climate change has reduced wheat yields across time (Gupta et al., 2017). Studies in South Pacific Island countries have shown that rural communities are vulnerable to climate change due to flooding from heavy rainfall and droughts that directly affect food production (Iese et al., 2020; Nunn, 2009; Smucker & Wisner, 2008). A study showed that prolonged drought periods significantly impacts crop yields in Fiji and Vanuatu, as water shortages have become challenging (McNamara & Prasad, 2014). In Papua New Guinea, drought and frost are expected impacts of climate change on agricultural produce (Ramakrishna & Bang, 2015). The Pacific Islands will continue to face the impacts of climate change as rural populations rely heavily on farming, which forms the basis of their livelihood.

Tropical cyclones are among the most devasting natural disasters often faced by Pacific Island countries (Steenbergen et al., 2020; Thomas et al., 2019). Rabuku and Cagivinaka (2023) reported in Fiji, cyclones cause significant agricultural production losses. For example, cyclone Ami caused over US $35 million in lost crops in 2003. In 2015, category five tropical cyclone Pam affected the livelihood of half the population of Vanuatu, raising the issue of food security at local and national levels (Magee et al., 2016; Nalau et al., 2018). Farrell et al. (2020), reported on the impact of cyclone Harold, in Vanuatu, Fiji and Solomon Islands caused intense damage to food crops that affect the livelihoods and wellbeing of the people (Steenbergen et al., 2020). However, it is reported that foods consumed in urban areas across the region are imported food, and traditional

foods are declining over time (Bovell-Benjamin, 2007). There is potential risk for conventional foods to be wholly substituted by imported foods or urban diets.

The following section explores the use of traditional knowledge to cope with the impact of climate change.

3.4.1 Traditional knowledge and coping with climate change

> "The traditional knowledge and networks of communities and households can be mobilised to prepare for, mitigate and manage disasters related to climate change before, while and after they occur" (FAO, 2009, p. 9)

According to the above statement, the Food and Agriculture Organization of the United Nations describes traditional knowledge as a significant approach to mitigating the challenges of climate change, ensuring household resilience and food security before and during the aftermath of natural disasters. The role of traditional knowledge in climate change adaptation is widely acknowledged in studies within the context of climate change adaptation in local communities (Granderson, 2017; Janif et al., 2016). For instance, these studies have shown that many rural communities in developed and developing countries have relied on traditional knowledge through experiences of managing their natural resources over the years. Furthermore, the impacts of climate change continue to be a challenge for smallholder farmers who live on marginal lands with high dependence on natural resources to support their livelihood (Morton, 2007; Mutekwa, 2009).

In the context of natural disasters, researchers have increasingly acknowledged the importance of traditional knowledge as a strategy to respond and prepare for natural disasters in rural communities (Nyong et al., 2007; Son et al., 2019). Historically, smallholder farmers have applied their traditional knowledge to respond to the impacts of environmental challenges; these traditional knowledge, skills and practices are increasingly recognised as essential resources for adaptation (Mafongoya & Ajayi, 2017; Mavhura et al., 2013; Mercer et al., 2007). Aligning to this, Mafongoya and Ajayi (2017) argued that harmonising indigenous knowledge with mainstream scientific knowledge through research is necessary as it produces new co-produced knowledge to respond to

climate change at a small scale. Similarly, Robinson and Herbert (2001), stressed that integrating indigenous knowledge into climate change policies leads to developing cost-effective strategies to cope with climate change. In addition, Shawoo and Thornton (2019) explore the possibilities of integrating traditional knowledge into climate policy, within aboriginal communities. Nyong et al. (2007) reported that in the region of Sahel in Africa, local farmer knowledge on the impacts of droughts is incorporated into climate adaptation approaches to enhance sustainable development and reduce vulnerability in the local communities. A study in sub–Saharan Africa, urges smallholder farmers to organise their planting calendar to include information from warning systems and traditional knowledge (Ayanlade & Radeny, 2020).

Past studies in Pacific societies have highlighted the significance of blending traditional knowledge and other knowledge systems to deal with climate change challenges (Janif et al., 2016; Mercer et al., 2007). For instance, a case study in Vanuatu brings together representatives from six provinces with an NGO (Non-Government Organization) organised by the Vanuatu Meteorology and Geo Hazards Department (VGMD) and relevant stakeholders, illustrating that incorporating local knowledge into existing seasonal forecasts is essential to reduce vulnerability and improve farming related discussions for farmers (Chand et al., 2014). Several scholars argued that there is a need to integrate traditional knowledge into environmental decision making (King et al., 2008; Sillitoe, 2009). These studies have shown that integrating traditional knowledge and other knowledge systems is advantageous for rural communities as their livelihood revolves around the use of land. Systematically, local communities' traditional knowledge interwoven into climate change adaptation has increasingly become the baseline assessment for preparedness towards the impacts of climate change within rural communities.

The following section explores food security status, emphasising the subsistence sector for smallholder farmers.

3.5 The status of food security: In the Pacific and Vanuatu

The food security definition by the World Food Summit in 1996 states that, food security exists when all people, always have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences to lead a healthy and active life (FAO, 2016) . This definition reinforces the multidimensional nature of food security that includes the four pillars; availability, accessibility, utilisation, and stability. Food availability refers to physical availability of food, focussing on the level of production and supply. Food accessibility alludes to physical and economic access such as household income, expenditure, and food prices. Food utilisation includes the contribution of food consumption to health and nutritional status of individuals. Food stability refers to the sustainability of the three-pillars food availability, accessibility, and utilisation, in addition the four pillars are documented essential pathway to advance towards achieving food security (FAO, 2017).

Food security is central to achieving sustainable development goal (SDGs) for Pacific Island countries and the worldwide population(United Nations, 2015). Across Pacific Island countries, the agricultural sector has traditionally played a central role in food security (Iese et al., 2020; Thaman, 1995). These studies reported that agriculture contributes 80% of income and food security for Pacific Island households. It is reported that subsistence food production is practised by over 90% of Pacific Island people (Singh-Peterson & Iranacolaivalu, 2018), with the remaining 10% comprising commercial farmers that supports the export market (Iese et al., 2021). Studies shown that smallholder subsistence farmers played a pivotal role in continuous supply of food within rural and urban centres throughout the Pacific Island countries (Georgeou et al., 2019; Georgeou et al., 2022). Food insecurity is prevalent in rural communities in Vanuatu and other Pacific Island countries, due to the lack of an efficient sustainable food system (Iese et al., 2021). As reported by FAO (2017) it is important for food systems to deliver food security and nutrition for all in such a way that economic, social, and ensures that the environmental bases to generate food security and nutrition for future generations are not compromised. According van Berkum (2021) smallholder farmers often struggle with the food supply chain as a result lack of capacity to scale

up or implement new practices. Other factors challenging food security in Vanuatu and other Pacific Island countries include the transition from subsistence farming to cash-oriented farming, resulting in use of earnings to purchase imported food (Welegtabit, 2001). According to Langford (2022), a recent study in Vanuatu reported on increasing dependency on imported foods which raised food insecurity concerns, as imported foods are substantially cheaper than the local produces sold at the local market.

Even though farming is the primary occupation of people in rural settings across Pacific societies (Iese et al., 2020), it is reported that another challenge to food security is urbanisation; as people move to town, they do not have sufficient space to grow their food (Georgeou et al., 2022). In Vanuatu increasing foreign assistance through food aid has also contributed to the increase in food imports, affecting the local food consumption pattern and food and nutrition security (Steenbergen et al., 2020). Furthermore, a prevalent factor that has been a continuous threat to food security across Pacific Island countries is ongoing natural disasters, that increase the risk of food insecurity in the vulnerable communities (Reti, 2008; Trudinger et al., 2023).

According to Iese et al. (2020), the agriculture sector throughout the Pacific Island countries must transform to more resilient approaches in the face of the ongoing challenges of climate change. In the recent past scholars have explored from a deeper and context-based point of view the strategies that supports smallholder farmers contribution to enhance food security status within local and national contexts (Buckwell et al., 2020; Georgeou et al., 2022; Kaoh et al., 2016). Georgeou et al. (2022), emphasised the dynamic contribution of crop diversification as a strategy practiced among the smallholder farmers throughout Pacific Island countries and its contribution to food security. For instance, a study in Papua New Guinea reported that intercropping of oil palm and food crops has contributed to enhancing food security and cash income for smallholder farmers (Koczberski et al., 2012). In addition, scholars have acknowledged the economically viability of crop diversification compared to mono cropping as it maximises economic returns and minimise the risk of crop failure (Baba & Abdulai, 2021; Mango et al., 2018) and the contribution of diversification of crops practised within subsistence farming enhances food and nutrition security (Yadav et al., 2015). Studies have highlighted that smallholder farmers who diversify through

intercropping and crop rotation have enough food supplies (Ebert, 2014; Waha et al., 2020). Ebert (2014) explained that growing two or more crop species on the same land leads to disease control, mitigates climate change impacts and increases production. For instance, it is a coping strategy to increase household income and adaptation to environmental challenges that often result in food shortages (De Haen & Hemrich, 2007).

Furthermore, FAO (2009) acknowledged that local communities can reduce food insecurity risk by "complementing their traditional knowledge and practices with information and supports from governments and others including capacity building for disaster preparedness, mitigation and management"(FAO, 2009, p. 5). For instance, a study with the people of Yao in northern Vietnam highlighted that integrating traditional knowledge with policies centred on conservation enhance household resilience (Son et al., 2019). In addition, studies across Pacific Island communities, including Vanuatu have highlighted the contribution of traditional knowledge in mitigation and adaptation studies that promotes household resilience and enhance food security (Granderson, 2017; Nakamura & Kanemasu, 2020). The following section explore the traditional food system in the Pacific Island countries and its contribution to promote food security.

3.6 Traditional food systems in the Pacific Islands

Traditional food systems of indigenous people is defined as all food within specific culture that are readily available from local natural resources and culturally accepted, including sociocultural meanings, processing techniques, use and nutritional consequences for the people using the food (Kennedy et al., 2021; Kuhnlein et al., 2009). Scholars Thaman (1990) and Allen (2015) argued that traditional food systems are dynamic and structured to provide food all year around in the Pacific Island countries. Hence the reliance on traditional food systems for sustenance, that includes seasonal fruiting trees, traditional food crops, and wild plants (Van der Merwe et al., 2016). Traditional knowledge is embedded through experience which form the basis of understanding traditional food systems in most Pacific Island countries. According to Chris et al. (2020), a recent study in Solomon Islands, highlighted the significance of including traditional knowledge in strategies centred on improving food and nutrition

within the traditional food system. FAO (2009), highlights the significant role of traditional knowledge and the process to enhance food security can alleviates poverty in local communities. Similarly Andrew et al. (2022) emphasised that across the Pacific Islands focusing on local food system can preserve and promote the sustainability of cultures and ecosystems.

However, the contemporary issues of urbanisation, population growth, land scarcity and challenges imposed by the environmental shocks have increase the pressure on traditional food systems throughout the Pacific Island countries (Addinsall et al., 2015; Iese et al., 2017; Komugabe-Dixson et al., 2019) . In Vanuatu, as with other Pacific Island countries, agriculture systems are rain-fed making them highly dependent on the rainfall for planting some of the traditional crops (Iese et al., 2020; Kaoh et al., 2016). These studies highlight the impacts of climate change including the tropical cyclones that increase the intensity of inconsistent seasonal weather patterns, that are causing vulnerabilities within traditional food systems (Allen, 2015) For instance, the reliance on rainfall to cultivate traditional crops has altered crops patterns, and damage from tropical cyclones on the seasonal fruiting trees increase food insecurity (Iese et al., 2018; Wairiu et al., 2012). According to Iese et al. (2018) these challenges can create a "gap" within the traditional Pacific food supply systems as availability and accessibility is reduced.

As the vulnerabilities within the traditional food system increases among the rural communities, smallholder farmers are encouraged to adapt to risk reduction measures across different levels (McGregor et al., 2016). Furthermore, regionally there are projects supported by the government and NGOs that assisted farmers build their adaptation strategies (Iese et al., 2017; Morgan Wairiu et al., 2011). FAO (2009) reported on adaptation measures, that involved local communities changing their agriculture practices to mitigate the impacts of droughts. Pacific societies are shifting to resilient crop varieties such as sweetpotato (*Ipomoea batatas*) to provide sustenance and support their livelihood (Iese et al., 2018). Kumala (sweetpotato), is a robust and adaptable crop that plays a significant role in reducing gap in local food systems in many Pacific Island countries (Iese et al., 2018; Shah et al., 2018).

This doctoral study shifts the emphasis to exploring the status of kumala as a potential food security crop within traditional food systems, understanding the perspective of smallholder farmers in the rural communities, that are interwoven with traditional and cultural values centred on traditional food crops.

3.6.1 Reclaiming traditional food systems; promoting food security.

The COVID-19 pandemic had a significant impact on the global food system, that influenced the importance of resilience in ensuring household food security (Kubatko et al., 2023). Several studies across developing countries highlighted the unfolding impacts of COVID-19 within the agriculture sector (Aday & Aday, 2020; Andam et al., 2020). For instance, in Nepal the commercial sector was more impacted compared to subsistence sector as families relied on the local produce for sustenance (Adhikari et al., 2021).

Across Pacific Island nations, the impact of COVID-19 has led to rural population to revitalise their traditional food systems to support their food demands (Iese et al., 2021). Marrero and Mattei (2022), argued that reclaiming local food production can promote food security and improve climate resilience. For instance a case study in rural Fiji, has shown that strengthening traditional food systems has great benefits for local communities (Vunibola & Leweniqila, 2021). Several studies in the Pacific Islands highlighted resilience within traditional food system, that enabled subsistence-oriented farmers to supply local produce during COVID-19 pandemic (Farrell et al., 2020; Ferguson et al., 2022; Iese et al., 2021). These studies show that people in rural communities throughout Pacific Island countries have increased local food production since COVID-19. According to Iese et al. (2021), the impacts of COVID-19 in Fiji and Solomon Islands show that households increased food production through home gardening, cultivating root crops, vegetables, and fruits.

In addition, Kubatko et al. (2023) assessment on the impacts of COVID 19 on global food systems, showed that promoting and strengthening local food production had positive impacts on mitigating the challenge of household food security. A study in Vanuatu, reported that during COVID-19 local produce from home gardens was noted as primary

food sources (Steenbergen et al., 2020). As suggested by Ferguson et al. (2022) strengthening local food practices has significant and potential roles in sustaining rural Pacific communities in the face of unprecedented events like the COVID-19. Furthermore, improving local food distribution can support smallholder farmers to meet increasing food demands during and post natural disasters and disruptions such as COVID-19. In a national context, governments throughout the Pacific Islands encourage and enhance local food production through programs that boost household food resilience. It is reported that in Vanuatu, the Department of Agriculture and Rural Development (DARD) encourages backyard gardening for urban dwellers, prioritising the distribution of planting materials (Steenbergen et al., 2020). The following section explores the significance of kumala as a food security crop in developing countries.

3.7 Kumala (sweetpotato), an important food security crop in developing countries.

Kumala or sweetpotato has been cultivated in most developing countries and is considered as a staple food crop (Mmasa & Msuya, 2012). In recent years kumala has gained status as a food security crop (Mukhopadhyay et al., 2011). Many countries have been growing kumala as a significant food security crop that contributes to livelihoods and household resilience in Africa, Asia, and many Pacific Island countries (Iese et al., 2018; Mabhaudhi et al., 2015; Mukhopadhyay et al., 2011). Kumala is among the most important global food crops, it is mainly cultivated in developing countries to solve hunger problem and improve food security in rural and urban areas (J. Low et al., 2017). Studies in African countries has shown that kumala has positively contributed to reducing hunger, generating income for smallholder farmers and allowed them to afford other necessities to support their families (J. Low et al., 2017; Okonya & Kroschel, 2014).

Furthermore, kumala plays a significant role in mitigating the impacts of environmental shocks on local food supply, including droughts and flooding, through its adaptability (Low et al., 2020) and drought tolerance. According to Motsa et al. (2015), kumala is grown as a cover crop, and can grow in different altitudes (Mukhopadhyay et al., 2011)

some varieties of kumala are rich in micronutrients (J. W. Low et al., 2017). Studies have highlighted the economic value of kumala in addressing the global food security crisis in developing countries, due to the attributes that increase and enable the production of kumala among smallholder farmers (Kulembeka et al., 2004; Sapakhova et al., 2023).

Cultivation of tropical root crops such as kumala continue to contribute to the staple diet of most Pacific Islanders (Roullier, Benoit, et al., 2013). Kumala features prominently in smallholder cropping systems and plays a positive role in food security (Bovell-Benjamin, 2007). Its contribution to promoting food security and sustaining livelihood has gained significance in South Pacific nations such as Papua New Guinea, the Solomon Islands, Fiji, New Caledonia, and Vanuatu (Iese et al., 2018). Bourke and Vlassak (2004) reported that kumala makes up two-thirds of the staple food in rural villages in Papua New Guinea and the Solomon Islands. Kumala is a recovery crop post-cyclone in most Pacific Island countries (Iese et al., 2018). A recent study in Fiji showed that farmers grow different cultivars of kumala post cyclone, and it is the most common emergency root crop mentioned by farmers in the village's damaged by tropical cyclones (McGuigan et al., 2022). According to Allen (2005), kumala mitigates food shortages during drought events in Papua New Guinea. Gatto et al. (2021), reported that in Philippines during post typhoon, two provinces grew kumala as a recovery crop contributing to food security and household resilience. In addition, kumala requires little labour input compared to other root crops, and it is not severely damaged by pest and diseases contributing to its availability and accessibility as a food crop (Jackson et al., 2012). Furthermore, in most Pacific Island countries, kumala varieties are vegetatively propagated, ensuring desirable genetic traits are maintained and are easily accessible and available among smallholder farmers therefore supporting SDG Target 2.5 (Hagenimana & Low, 2000).

This study expands on the status of kumala across local and national contexts, relating to the four pillars of food security in Tanna Island and through the support of government. Similarly, Iese et al. (2018) has extensively reviewed the status of kumala in the Pacific Island countries, highlighting the role of kumala in disaster recovery and within the traditional food system. Iese et al. (2018) also explored the features of kumala

and how they complement the four pillars of food security (availability, accessibility, utilisation, stability)

Availability

Availability refers to food availability and the production of kumala as a root crop (FAO, 2016). Wallin et al. (2005) states that the characteristics of kumala contribute to producing large quantities of surplus food in the unpredictable environment of Rapanui / Easter Island. The crop can be grown on moderate or low fertility soil, and be stored for long periods (Bourke & Ramakrishna, 2009). It has shorter growing seasons, and can grow in different altitudes (Lebot, 2010). The features of kumala that contribute to its availability include the ability to grow on fertile and infertile soil and non-seasonally in the Pacific Island countries (Iese et al., 2018).

Accessibility

Refers to adequate food supplies at the national level determined by economic factors such as income, expenditure, markets, and prices in achieving food security (FAO, 2016). According to Iese et al. (2018), the review on kumala in Pacific Island countries highlights the following features: short growing cycles, drought tolerance, and adaptability to different elevations, promoting accessibility. In the Vanuatu context, kumala is a non-seasonally grown root crop like other Pacific Island countries; it can be grown in home gardens close to home and throughout the year.

Utilisation

Utilisation refers to the ability of the body to utilise the nutrients in food (FAO, 2016) . For instance, orange-fleshed kumala varieties are a good source of β carotene (pro vitamin A (Alam et al., 2016), and purple kumala varieties have high levels of anthocyanins (Herawati et al., 2020). In countries where the production of kumala is in high demand, people utilise millions of tons of kumala in large and small-scale enterprises (Girard et al., 2021; Tedesco et al., 2023). A recent review on the nutritional value of kumala highlighted that every part of kumala (stem, leaf, and roots) can be edible and varies in nutritional composition (Alam et al., 2016). A study conducted on

kumala in Vanuatu (Setak, 2018) shows that different varieties of kumala are preferred and planted in villages due to their versatility.

Stability

Stability refers to the sustainability of food availability, access, and utilisation (FAO, 2016).The consistent availability of food and being able to access and utilise often is being disturbed seasonally through changing weather patterns. Kumala has increasingly been the focus of food policy (Afzal et al., 2021), as it presents in the national food security clusters with opportunities to support the growing population with food before and during the aftermath of natural disasters (Iese et al., 2018).

In summary, kumala has been extensively cultivated across Pacific Island countries as a food security crop, and it is an important staple food crop in several countries in the South Pacific and adopted in the food program as a recovery crop to mitigate the challenges of food shortage before and during the aftermath of natural disasters. Within the context of Vanuatu, this doctoral study sets out to understand how kumala (sweetpotato) as a food security crop that supports farmers, driven by the cultural and social obligations embedded in smallholder farmers' livelihood.

The following section explores kumala production in supporting smallholder farmers advance towards achieving SDG2 in the Pacific Island countries including Vanuatu.

3.8 Kumala contribution towards achieving Sustainable Development Goal for Pacific Island countries -Vanuatu.

In 2015, UN member states adopted Sustainable Development Goals (SDGs) which comprise 17 goals with 169 targets (United & Nations, 2015). The global goals of SDGs call for United Nation member states to develop policies and strategies, that can advance towards achieving the SDGs. These goals must be achieved by 2030 reflecting the name, Agenda 2030, from the 17 goals this study focusses on SDG2 (zero hunger) to “End hunger, achieve food security and improve nutrition and promote sustainable agriculture” (United & Nations, 2015). SDG 2 is underpinned by the issues of food security and significant sustainable production of food (FAO, 2021). In addition, SDG2

recognizes the connections in supporting sustainable agriculture, empowering smallholder farmers, promoting gender quality, ending rural poverty, ensuring healthy lifestyle and addressing the issues of climate change (Arora & Mishra, 2022)

A current report on the global state of food security estimated that between 691 and 783 million people in the world faced hunger in 2022 (FAO, 2022). Despite global efforts towards reducing hunger, the unprecedent event of global COVID-19 pandemic exacerbated food security situations at the time with about 150 million more people facing hunger in 2021 (Gartaula et al., 2020). Studies in developing countries reported on the drastic impacts of COVID-19 on local food systems (Kubatko et al., 2023; Workie et al., 2020). In Pacific Island countries including Vanuatu, increased pressure on rural and urban incomes associated with COVID 19 restrictions saw increased the prices and limited access to local produce (Steenbergen et al., 2020). However, a recent study show that, revitalization of local food systems is a significant strategy that supported smallholder farmers to contribute to the local supply of food during the pandemic (Davila et al., 2021).

Food insecurity across Oceania is prevalent and continues to be a challenging issue, affecting smallholder farmers that farm on marginal land. Several studies across Pacific Island countries have emphasized the significance of leveraging short-term resilient crops within the food system (McGuigan et al., 2022; Mertz et al., 2012), particularly to address food security and mitigate the challenges of food shortage due to natural disasters (Wairiu et al., 2012). Sweetpotato is the seventh most important food crop in the world and has gained recognition as a crop that enhances food security (Mabhaudhi et al., 2015; Mukhopadhyay et al., 2011). Studies across developing countries including the Africa region and Asia have explored the importance of sweetpotato in reducing hunger, poverty (Kassali, 2011) and improving the livelihood of the increasing population (Gatto et al., 2021).

Sweetpotato (kumala) has the potential to advance towards achieving SDG2 for Pacific Island countries including Vanuatu. According to Vogliano et al. (2021), a study across Melanesia on the progress towards achieving SDG2, it emphasised cultivation of kumala as a significant food crop that can support Melanesian countries achieve SDG2. Iese et

al. (2018) argued that kumala has in the past, is currently and in the future will continue to be a significant food security crop across Pacific Island countries. The distinct characteristics of sweetpotato has been documented to fulfil the four pillars of food security (Iese et al., 2018). The features included, robust adaptability, short production period, high yield capacity in marginal land, fairly drought tolerant, grows well in different elevations, and its high nutritional value (Lebot, 2010). In addition, these attributes, make kumala a potential food crop that can support the smallholder farmers and national government advance towards UN SDG2.

Aligning to target 2.1, kumala production can help reduce hunger considerably since kumala is a non-seasonal crop and can be planted at any time and it is a staple crop in most local communities in the Pacific communities (Lebot, 2010; Sapakhova et al., 2023). Due to its robust adaptability, farmers grow kumala on marginal land, with low production cost due to low labour inputs and produce high yields. As previously discussed, kumala plays an important role in household resilience, in mitigating natural disasters impacts following droughts, floods, and tropical cyclones. For instance, orange flesh sweetpotato in Uganda is a drought tolerant variety, contributing to mitigating disasters (Kapinga et al., 2005). Past studies across the Pacific Islands have highlighted the role of kumala as a recovery crop (Allen, 2005; McGuigan et al., 2022). A recent study has shown that during a post-cyclone in Fiji sweetpotato was an emergency's food crop that farmers relied on (McGuigan et al., 2022), and due to its short period of growth compared to the other traditional staple crops kumala temporarily replaced taro during post cyclone recovery. With regards to target 2.2 (end all malnutrition), kumala is considered as a superfood owing to its nutritional content (Johnson et al., 2022), making it a crop that has the potential to attain that target.

Aligning to target 2.3, the diversification of kumala into value added products has the potential to increase income for smallholder farmers. According to Omoare et al. (2015) show that sweetpotato can be processed into various healthy value-added products. In addition, processing into value added products can improve the livelihoods of smallholder farmers. Studies showed that investing in diversification of sweetpotato can increase income and solve unemployment issues and improve livelihoods in developing

countries (Laurie et al., 2018; Omoare et al., 2015). In terms of target 2.4 (ensuring sustainable food production systems and implementing resilient agricultural practices) kumala can be grown in different cropping systems (Mertz et al., 2012), it requires low fertilizer input , it has the capacity to produce under marginal land, drought and low soil fertility (Bourke & Ramakrishna, 2009).

Pertaining to target 2.5. kumala is vegetatively propagated through stem cuttings, ensuring the availability and accessibility of the planting materials among the smallholder famers across the Pacific Island countries (Lebot, 2010). Sweetpotato germplasm is maintained at the international, regional, and national level (Iese et al., 2018). The gene bank at the International Potato Centre maintains over 5,500 accessions of sweetpotato (kumala) originating or donated from 62 different countries. Acknowledging the significant distribution mechanism that allowed smallholder farmers across the Pacific to have access to different varieties of kumala. The distribution of kumala varieties from CePaCT (Centre for Pacific Crops and Trees) to the national level is mainly through research centres and respective agricultural ministries. Projects through CePaCT have enabled Pacific Island countries to have access to kumala planting materials and gradual increases the kumala production over the years. For instance the Vanuatu government have conducted trials for new varieties before distributing them to farmers (Tensly Sumbe, 2019). Kumala is vegetatively propagated, this allows kumala to be easily accessible among farmers, thus farmers also contribute to the maintaining different varieties of kumala through on farm conservation. According to Vernooy et al. (2014), community seedbanks have three important functions; the conversation of genetic resources, improve access and availability of planting materials.

The attributes of kumala contributed to its role as a significant food security crop outlined in the previous section, these sections emerge with contributions of kumala as a crop that can advance towards achieving the sustainable development goals outlined in Table 3.

Table 3 Sweetpotato production can advance towards achieving the Sustainable Development goal (SDG2) in Pacific Island countries (United Nations, 2015)

TARGET	Sweetpotato characteristics to enable target achievement	Sources
2.1 By 2030, end hunger and ensure access by all people in particular the poor and people in vulnerable situations, including infants, to safe, nutritious, and sufficient food all year around.	- Produce high yield/ per hectare - Grows well in infertile soil - Low labour input, can be easily cultivated - Produced all year around - enhanced food security and reduced by reducing hunger and poverty - drought food (disaster recovery)	(Sapakhova et al., 2023)
2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women, and older persons.	- Sweetpotato is a superfood with high nutritional content including-B-carotene, Vitamin C, Dietary fibre.	(Johnson et al., 2022; Kurabachew, 2015)
2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists, and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and	- Sweet potato can be cultivated by both genders. - Diversification into value added products has the potential to increase income for smallholder farmers	(Mudege et al., 2017; Mwanga & Ssemakula, 2012)

opportunities for value addition and non-farm employment.		
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters and that progressively improve land and soil quality	- Can be grown in contemporary and traditional food system- (mixed cropping, intercropping and monocropping) - Grown as cover crop that retains moisture - its capacity to produce under marginal land conditions (drought and low soil fertility)	(Kassali, 2011)
2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants, and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional, and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed	-Vegetatively propagated through stem cuttings -Different varieties are cultivated and distributed to smallholder farmers across Pacific Islands -Collection of different varieties are international, regional, and national promoted and distributed - On farm conversation by smallholder farmers	(Iese et al., 2018; Mok & Schmiediche, 1999)

The following section explores the different kumala cropping systems that farmers utilised to cultivate kumala.

3.9 Cropping system of kumala (Ipomea batatas)

Smallholder farmers grow kumala in different farming systems across developing countries. Most farmers maintain a high diversity of crops grown in other production systems through crop rotation, mixed cropping, intercropping (Shah et al., 2021) . Globally kumala is cultivated under different cropping systems or regimes. In Nigeria, kumala is intercropped with plants such as millet and maize; due to high production and demand for the crop, whilst some commercial farmers grow kumala as a mono-crop in some parts of Africa (Nedunchezhiyan et al., 2012). Vegetables such as tomatoes, string beans and red beans are usually intercropped with kumala across different countries (Weerarathne et al., 2017). This is also mirrored across the Pacific Islands; in Papua New Guinea, the crop is grown among other staple crops such as taro, cassava, yams, banana, corn, and peanuts (Van Wijmeersch, 2001). Growing kumala in raised beds is a common practice in several Pacific Island countries. For instances in the highland province of Papua New Guinea, kumala is often grown in raised mounds (Bourke, 2001). In addition, kumala is cultivated as a cover crop, usually intercropped with other root crops, such as taro and yam (Kaoh et al., 2016) as is reported by Iese et al. (2017) in the Solomon Islands where farmers intercrop kumala with taro. In Vanuatu, kumala is cultivated after the dominant crop of yam and taro are harvested, and intercropping of kumala is usually done in rotation (Lebot & Siméoni, 2015).

However, kumala can also be grown in mixed cropping and mono cropping practices. Furthermore, kumala produces high yields in mono cropping system resulting from no competition between crops (Mbayaki & Karuku, 2021). The following section explores the utilisation of kumala in developing countries.

3.9.1 Uses of kumala

The utilisation of kumala varies between developed and developing countries (Bovell-Benjamin, 2007). The uses of kumala are underexplored in Pacific Island countries, compared to countries such as Africa and Asia. Despite their distribution and production across Pacific Island countries, adding value to kumala tubers to generate income has yet to be fully realised by the national agency. Neela and Fanta (2019), argued that in

developing countries sweetpotato are underutilised and that this potentially could improve livelihoods and poverty statistics.

According to Bovell-Benjamin (2007), sweetpotato roots made up 80-90% of the carbohydrate, mainly starch that is utilised in the starch industry in African countries. A recent study on product development suggested that utilising kumala starch and flour processing can add value to the crop (Dereje et al., 2020), and provide further employment activities for farmers and rural households whilst simultaneously adding nutritional value to their daily diet. According to Mukhopadhyay et al. (2011), purple flesh kumala is used in food industries as a food colorant for making snacks, noodles, and bread. A study in Sub Saharan African region have engaged in value-add activities of sweetpotato such as OFSP (orange flesh sweet potato) bread with improved nutrition (Owade et al., 2018). Other studies showed that kumala can be utilised as animal feed or processed into other nutritional products (Murugan et al., 2012; Pandi et al., 2016). For instance, sweetpotato vines and foliage is a common feed for small livestock such as pigs in many countries including, China, India, Indonesia, Philippines, and Papua New Guinea (Pandi et al., 2016). In most Pacific Island countries, the decision to adopt new kumala varieties lies in its utility, yield performance, taste, and nutritional value. Generally, the kumala roots are consumed fresh, cooked by boiling, frying, and processed into various traditional snacks. In addition J. W. Low et al. (2017), emphasised that kumala is mainly grown for homestead food and is sold to local markets for fresh consumption in developing countries.

The following section explores the right to produce food (food sovereignty) in the context of local communities.

3.10 Food Sovereignty

Food sovereignty challenges current global food systems and promotes and protects the rights of small-scale producers, food providers and consumers (Walsh-Dilley et al., 2016). It focuses on a human rights-based approach to respect and protect people who produce food and the right of individuals to have access to healthy and affordable food

(De Schutter, 2009). The concept of food sovereignty was described in 2007 at the Nyeleni International Forum as:

> The right of people to access healthy and culturally appropriate food produced through ecologically sound and culturally appropriate methods, and their right to define their own food and agricultural systems (De Schutter, 2009, p. 5)

This concept puts the aspirations and needs of those who produce, distribute, and consume food at the heart of food systems and policies, rather than the demands of markets and corporations. This is emphasised in the six pillars of food sovereignty developed at Nyeleni in 2007 by the international food sovereignty movement.

1. **Focuses on food for the people**, placing people's need for food at the centre of Policies, and insisting that food is more than just a commodity
2. **Values food providers** by, supporting sustainable livelihoods and respecting the work of all food providers
3. **Localises food systems** by, reducing the distance between suppliers and consumers, rejecting dumping inappropriate food aid, and resisting dependence on remote and uncountable corporations.
4. **Places control at a local level** by, placing control in the hands of local food suppliers, recognising the need to inhabit and share territories and rejecting privatization of natural resources.
5. **Promotes knowledge and skills** by, building on traditional knowledge, using research to support and pass on this knowledge to future generations and rejecting technologies that undermine local food system
6. **Work with nature by**, maximizing the contribution of ecosystems, improving resilience, rejecting energy intensive, monocultural, industrialised and destructive production methods.

Food sovereignty is the right of each nation to maintain and develop its capacity to produce its essential foods, respecting cultural and productive diversity (Wittman, 2011). In addition, Levkoe et al. (2019) emphasised that food sovereignty aims to secure the right of local communities to make independent decisions about their food systems. Several developing countries have acknowledged the concept of food sovereignty and integrated this into their policies, constitutions, and research programs. These countries

include, Ecuador, Venezuela, Boliva, Nepal, Senegal, Mali, and Egypt (Siwior, 2021). As suggested by Wittman (2011) national governments play a significant role in the implementation of food sovereignty through the development of policies that urge to meet food security at the national level. Scholars Levkoe et al. (2019) and Wittman (2011) emphasised that food sovereignty aims to protect rights of people and countries to construct independent decisions regarding their food systems without any external influences.

The multidimensional nature of food sovereignty aligns with the conceptualisation of local or traditional food systems for Pacific communities (Connell et al., 2020). That is local food systems embedded in culture and traditions and primarily provides for the daily sustenance including food, medicine and sustainably supports the livelihood (Sampson et al., 2021). Within Pacific Island countries, studies have emphasised that introducing food sovereignty policies and concepts can reduce the risk of vulnerabilities of food insecurity (Connell et al., 2020; Patay et al., 2024), that is aligned to the significant role of smallholder farmers across the Pacific Island countries that produce 80% of the food and rely on agriculture for sustenance. Within the context of Vanuatu, the concept of food sovereignty is interwoven into the Vanuatu's gudfala kaikai (good food) policy 2020-2030 that was launched in 2020 (Adorina Massing, 2020). The main objectives of the policy are to:

1. Improve access to affordable, nutritious diet through a sustained increase in the production of aelan kakae[2] (local food)
2. Promote aelan kakae as a key part of a sustainable and nutritionally balanced diet
3. Improve access to nutritious, convenient aelan kakae through increased access to appropriate technology, knowledge and skills in food production, preservation, and storage
4. Facilitate a reduction in the consumption of food imports contributing to poor health outcomes
5. Improve resilience of agricultural production systems through the adoption of sustainable and climate smart agricultural practices.

[2] Alen kaekae, (local food) including local grown root crops, and vegetables.

6. Improved multi-sector co-ordination, implementation, and monitoring of actions to address food and nutrition security, and food safety

The following section explores the ethnobotanical framework.

3.11 Ethnobotanical knowledge

This study was classified as ethnobotanical research as it explores traditional knowledge, beliefs and practices that relate to people and their natural surroundings. Ethnobotany is the relationship between people and their environment (Fuller, 2013). According to Balick and Cox (1996), people have a long history of using plants for different purposes such as food, medicine, shelter, decoration, and clothing. Across developing countries many indigenous communities hold holistic views, that unfolds intrinsic relationships between the people and their environment (Brondízio et al., 2021; Gillani et al., 2024) . Scholas Kumar et al. (2021), and (Kaltoft, 1999) describe ethnobotany, as knowledge that covers both wild and domesticated plants species, and it is embedded in cultural relationships and traditional knowledge.

In Vanuatu, like many other Pacific Island nations, the relationship between people and the natural surroundings is embedded in the culture and way of life. For instance, Balick et al. (2023) emphasised that traditional calendars are unique as they speak to and are embedded in the relationship of people to their ecosystem. In most Pacific Island countries like Vanuatu, traditional gardens are grown with distinct crops in rural villages, these systems have strict harvest protocols and limited access at certain points of the growing cycle (Atkinson, 2018), that acknowledges the relationship between gardener or farmers and their garden (Mitchell, 2021). Reyes-García et al. (2007)explained that the ethnobotany discipline collects and analyses local and traditional plant knowledge systems and their uses. According to Hunter et al. (2021) and Ulluwishewa et al. (2008) the relationship between people and plants is often found within specific geographical locations. The relationship between plants and people are well documented in Melanesia (Balick et al., 2023; Bonnemaison, 1994; Leach, 2005; Simon Apang Semese, 2018). These studies highlight plant uses that provide sustenance in some cultures such as in Papua New Guinea. In Vanuatu these uses are informed by traditional knowledge

and practices, as is true for the Māori people of (New Zealand) (Ulluwishewa et al., 2008) enabling them to sustain and manage the use of the natural resources. Ethnobotany is important to preserving the diversity of plants and understanding traditional knowledge, contributing to the sustainable use of resources worldwide (Brondízio et al., 2021) . Culture beliefs aligned to individual crops have played vital roles in nutrition, medicine and food sustenance during the pre-historic era and continue to be applied today. For instance, in Fiji there are a range of plants still used for food, medicines and cultural purposes, foods that continue to be grown for household consumption and to support cultural obligations (Shah et al., 2018).

Given and Harris (1994) explain that researchers in ethnobotany identify their role as targeting at least one of three ideas:

I. Rescue missions- aligned to a culture near extinction; this includes systematically recording ethnobotany knowledge.
II. Industry investigations into the relationship between plants and commerce, and
III. Culture enhancement- aligning science and culture where possible in the interest of study; culture enhancement applies to this doctoral study.

Within the context of this doctoral study, culture plays an important role in understanding the relationship and interaction embedded within the way local food systems are promoted and maintained through traditional knowledge accumulated across time. The following section explores the sustainable livelihood framework (SLF) and the components of the framework. The current study incorporates SLF to understand how kumala has supported smallholder farmers' livelihood and contributes to enhancing food security and household resilience.

3.12 Sustainable Livelihood Framework

The Sustainable Livelihood Framework (SLF) has been extensively utilised by development non-government organisations (Oxfam, UNDP, Care) and DFID (UK Department for International Development) as a strategy to evaluate and monitor

livelihood transformation (Knutsson & Ostwald, 2006; Scoones, 1998). According to the work of Chambers and Conway (1992, p. 5), a livelihood is

> "The capabilities, assets and activities required as a means of living. A livelihood is sustainable when it can cope with recovery from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future while not undermining the natural resource base".

The sustainable livelihood framework (see Figure 7) is a holistic and dynamic approach involving individuals, communities, and institutions, building on a people-centred system, and exploring different initiatives contributing to sustainable livelihoods (DfID, 1999). Scoones (1998) describes SLF as an analytical tool that helps to identify the connection between people and their environment, shaped through livelihood strategies and outcomes. The SLF recognises the multiple inputs and assets individuals, households, and communities use and require to build their livelihoods (Tabares et al., 2022) . Tambe (2022) explains that SLF is a tool that provides a baseline for livelihood analysis by identifying key factors affecting livelihoods and the relationships between these factors. In addition, Scoones (2009), emphasises that while the SLF may not accurately represent any community, it can help to analyse the complexity of livelihood in a particular community. According to Cahn (2008) the SLF can be used to identify gaps and challenges and boost development of local initiatives. Studies and projects across countries in Asia and Africa have used the framework in the context of rural development (Alemayehu et al., 2018; Harohau et al., 2020). In addition, this framework is often integrated into agricultural contexts to understand smallholder farmers perception and support systems through a holistic approach (Li et al., 2020).

However, in the Pacific Island countries there are only a few studies that incorporate the SLF. These studies in Pacific territories have used the framework to understand the complexity of rural livelihoods and how individuals and communities, adopt certain livelihood strategies to manage the use of their resources, mitigate the impacts of environmental shocks and build their livelihood (Addinsall et al., 2015; Park et al., 2012). For instance, Addinsall et al. (2015) integrated the SLF and agroecology concept in Vanuatu and Fiji and developed ASRLF (Agroecology Sustainable Rural Livelihood

Framework) emphasising its holistic approach in understanding the complex interaction of smallholders' rural livelihood. As highlighted in the work of Cahn (2008) , within the Pacific context, culture and traditions are significant aspects of sustainability that maintain and enhance all resources from livelihood activities in remote communities. In the context of Pacific Island countries, Cahn (2006) view of the definition of Pacific sustainable livelihood comprises:

> ...the capabilities, assets and activities that provide a means of living; and a sustainable livelihood that works within a traditional and cultural context, adapting to and coping with vulnerability while maintaining and enhancing assets (Cahn, 2006, p. 286)

Scholars Tao et al. (2010) and Addinsall et al. (2015) agree that culture is a significant component of a Sustainable Livelihood Framework (SLF), it influences individuals, household, and communities choices to attain livelihood outcomes within a specific context.

The vulnerability context within the SLF includes shocks (environmental factors), seasonality (the price of goods and employment opportunities) and critical trends (demographic, economic and governance) (Addinsall et al., 2015; Reenberg et al., 2008). Smallholder farmers in rural communities often operate in a vulnerable context, usually related to environmental shocks, such as the impacts of climate change on the production of crops. It is noted by Alinovi et al. (2010) that most of Pacific Island nations depend on subsistence and small-scale agriculture for their livelihood while earning cash through the sale of crops and marine resources. In Vanuatu's rural communities, like Tanna and other islands, community activities are vital to people's way of life. The impacts of climate change continue to add risk to smallholder farmers in Tanna; therefore, farmers rely on activities that allow them to cope with uncertainty and risk (Mitchell et al., 2020)

In this research, the interest is to explore how smallholder farmers grow and utilise kumala, not in isolation, but as part of their integrated farming and food system. Further, the research aims to make clear why farmers grow and use kumala as they do and how

knowledge (traditional and otherwise) informs their growing practices. This desire for a holistic understanding of kumala within farmers' broader livelihood systems is why the sustainable livelihood framework was used to frame the research. The following section will continue to review the components of the sustainable livelihood framework and the significance of each.

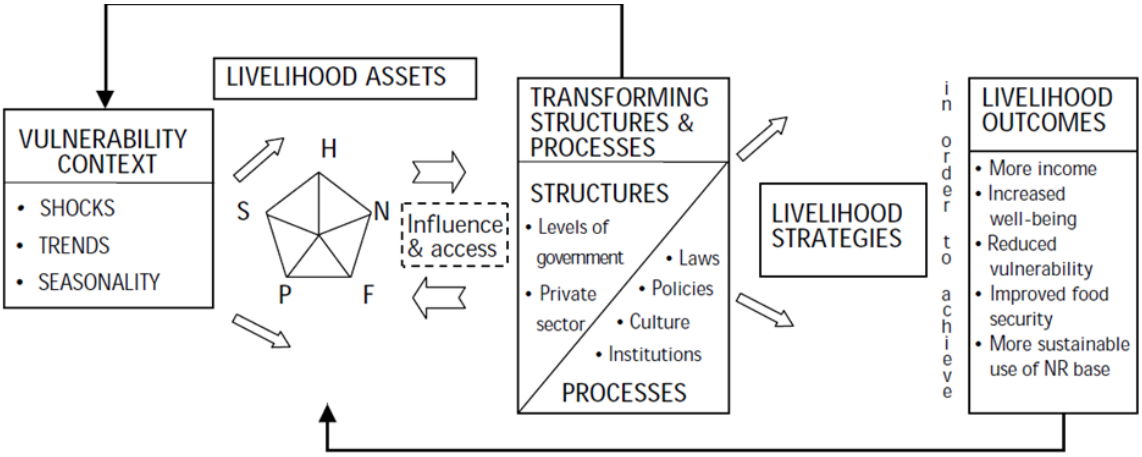

Figure 7 The Sustainable Livelihood Framework

(DfID, 1999)

3.12.1 Assets/ Capitals

At the centre of the SLF is the capital or assets that people rely on to support and build their livelihood (Bebbington, 1999). In this thesis, the words assets and capitals are used interchangeably. According to Chambers and Conway (1992), the SLF includes five kinds of livelihood capital: (1) Social capital, (2) Human capital, (3) Natural capital, (4) Physical capital, and (5) Financial capital. Capital can be accumulated, exchanged, and used for activities that generate income and support livelihoods. Social capital includes social networks, associations, and networks that build trust within individuals and communities (Partelow, 2021). Human capital refers to skills, availability of labour, and knowledge. Physical capital refers to infrastructure (buildings, facilities) including roads, and transportation needed to support their livelihood (Scoones, 2009). Financial capital

comprises financial resources, including cash flow, savings, and earnings (Campbell et al., 2002).

Assets can provide a living for people and offer people an opportunity to barter and negotiate for further capital, which is influenced by different contexts and structures. Possessing one form of capital can enable farmers to access other capitals, and access to land (natural capital) enables farmers to gain financial capital through selling crops. These capitals would allow farmers to mitigate challenges and boost the production of kumala, a significant food crop in traditional food systems that support the livelihood of smallholder farmers. This study identifies the types of capital that support the growing of kumala and its use as a food security crop on Tanna.

3.12.2 Social Capital

Social capital is based on solid social relationships, a network reflected through community cohesion (Putnam, 2001). Other studies highlight the characteristics of social capital in the communities, including social networks, norms, and trust that strengthens coordination and cooperation among community members enabling them to collaborate for mutual benefits (Easterling, 2008; Potapchuk et al., 1997; Wallis et al., 1998). Pretty (2003) argued that social capital includes three aspects, (a) bonding, (b) bridging and (c) linking. Bonding is described as a strong tie between people of similar backgrounds (friends, families, kin) which is maintained through trust and reciprocity (Gonzales & Nowell, 2017). Bridging refers to the collaboration and coordination of small groups and communities that enable them to share information. Linking refers to formalised institutions (government agencies, research centres and banks). In addition, Rudd (2000) explains that social capital is a significant feature of rural communities and that diverse livelihood activities can influence access to assets. According to Putnam (2015), social connections enhance social capital; these relationships build trust and emphasise reciprocity, which is crucial to the inner workings of social capital. Fountain (1998) also highlights norms, trust, and relationships as significant aspects of social capital. Sandefur and Laumann (1998) argue that social capital is embedded in society rather than individuals, but individuals and communities value it. In this research, social

capital is evident in the actions of individuals and communities that reflect social relations and networks that individuals and communities possess through the existing cultural ties.

Several studies in the Pacific Island countries have acknowledged the importance of social capital centred on sustainable livelihoods in rural communities (Nakamura & Kanemasu, 2020; Warrick et al., 2017). Over the years, it has been argued that social relationships form the backbone of resilience in Pacific Island communities (Aldrich, 2017; McMillen et al., 2014). Studies in Fiji have reported on the contribution of social relationships embedded in iTaukei people, that enables them to support each other (Leweniqila & Roskruge, 2023; Nakamura & Kanemasu, 2020; Neef et al., 2018). In Vanuatu, social capital is embedded in daily livelihood activities and plays a significant role in household recovery after natural disasters (Jackson et al., 2017). For instance, within rural communities' food sharing is exemplified through relationships of reciprocity and kinship that enhance food accessibility. Social networking is highly important in facilitating food security strategies and contributes to individual and community resilience (Vachette et al., 2017).

3.12.3 Cultural Capital within the SLF

The literature associated with SLF often underestimate cultural capital, however several scholars have acknowledged the significance of cultural capital in community development and integrating this into development policy (Bebbington, 1999; Throsby, 1999). Scholars Azril Mohamed Shaffril et al. (2013) argued that cultural capital is more present in rural communities in most developing countries. As highlighted in the work of Bebbington (1999) it is relevant to include cultural capital in the SLF. Similarly, Daskon and Binns (2010) argued that intangible cultural capital, including cultural values and norms, is significant and is the central to understanding how people draw from the different livelihood strategies in rural communities. In addition, this may enhance human adaptability in vulnerable situations and help them pursue new livelihood strategies to sustain their livelihood. For instance Leonard et al. (2013), reported that the Mirriwong people in Australia abide by cultural protocols that restrict their harvest,

hunting and water collection practices at certain times of the year. Similar cultural norms are observed and practiced in most Pacific Island countries (Neef et al., 2018). According to McMillen et al. (2014) customary management of resources is an adaptive strategy employed by many Pacific Island countries. Hipwell (2009) emphasises that cultural capital is exemplified through beliefs, hunting skills, and inherited traditions that often vary across gender, ethnic groups, and social status. Scholars Duncan (2008) and Cahn (2008) , emphasised that within Pacific communities daily life is embedded with cultural perspectives and practices through intangible outcomes described by Cahn (2008) including trust, sharing and caring, social interconnectedness, community cohesion and services to others. For instance food exchange is a cultural feature in small local communities, which is commonplace when the relationships held are based on reciprocity and kinship (Gonçalves et al., 2022). This study reflects on social and cultural perspective of smallholder farmers; this study acknowledges cultural practices and values that shapes the livelihood of smallholder farmers in Tanna Island and the way it influences the growing of kumala. This study recognizes the livelihood perspective as a holistic approach in which cultural capital can be explicitly regarded as assets or resources to understand the sustainable livelihood of smallholder farmers in rural communities.

3.12.4 Human Capital

Human capital includes the capacity of people's knowledge, skills, and experience to overcome challenges. Habib et al. (2023) explains that human capital refers to an individual's skills, experiences and characteristics that are utilised to increase productivity. Studies have shown that access to human capital, such as knowledge, work, and training, can increase agricultural production (Futemma et al., 2020; Wallace, 2007). Agricultural extension services and integration of local farming knowledge sit amongst the knowledge smallholder farmers throughout the Pacific Islands relied on to adapt to climate change (Lasco et al., 2016).

Agricultural knowledge provided through training and support from extension services are vital to farmers' livelihoods. According Nalau et al. (2018), well-structured

demonstration plot through agricultural extension program can lead to co-produced knowledge, and learning. Hainzer et al. (2022), a study in Papua New Guinea, has shown that agriculture extension officers worked with lead farmers to gain positive impacts from the community on the adoption of a clean seed system for sweetpotato. A recent study on Tanna Island, Vanuatu reported that demonstration plots and agriculture extension workers improved the productivity of subsistence garden(Buckwell et al., 2020) . This emphasis on a culture of learning that motivated and encouraged farmers to adopt new practices through observing good results (Radcliffe et al., 2021).

Meng (1995) emphasised that human capital is a significant capital to acquire to be able to use other assets. A study in Fiji has shown that family labour is accumulated through solid family ties and plays a vital role during the recovery from environmental shocks (Currenti et al., 2019). Furthermore, family members sharing labour reduces labour and production costs. Tamura (2002) and Retnowati et al. (2014), explained that knowledge related to agriculture production is an essential human capital that most farmers rely on to plant and grow their crops. Retnowati et al. (2014) states that integrating indigenous knowledge with scientific knowledge through research is essential as it can generate new co-produced knowledge relevant to effective adaptation strategies and actions at local levels. Ohmagari and Berkes (1997) argued that local knowledge, social networks, and skills are essential for a community to recover and maintain its livelihood after a shock. In addition, human capital can enable planning and development activities that could potentially contribute to sustainable livelihoods.

3.12.5 Natural capital

Natural capital is the term used to describe the availability of natural resources that contribute to livelihood outcomes (Scoones, 2009). Natural capital is essential for smallholder farmers in rural communities where most activities (farming, fishing, and hunting) are based on natural resources (Barbier, 2019; Tibesigwa et al., 2016). Nguyen-Anh et al. (2021), explained that cultivated land is a component of natural capital for smallholder farmers that supported their livelihood. According to Cao et al.

(2016), farmers in developing countries access to farmland is a requirement for many livelihood activities. The management of natural resources and conservation of ecosystems in most islands in Vanuatu is based on traditional practices and Vanuatu legislation (Regenvanu et al., 1997). In Vanuatu, access to land is through customary rights, often passed on from generation to generation. This is discussed in detail in Chapter 4 (Case study description).

3.12.6 Physical capital

Physical capital includes basic infrastructure, such as roads, buildings, and transport, that enable people to meet their basic needs (Bebbington, 1999). In the context of smallholder farmers in developing countries, physical capital plays a significant role in increasing the production of small farms (Gibson & Olivia, 2010). For instance, with limited transport access, farmers cannot get their products to market, which may affect their livelihood (Bhandari, 2013). A study in South Ethiopia showed that market access and infrastructure is a problem that disturbs agricultural production (Mengistu, 2016). Feeny (2007), emphasised that it is significant for roads in rural communities to connect smallholder farmers in the local communities to markets. Fafchamps (1992) and Radchenko and Corral (2018), described that market access and poor infrastructure as important contextual factors that influence the choice and outcomes of crop production. As suggested by Singh-Peterson and Iranacolaivalu (2018) the lack of affordable transport in remote communities in the Pacific Island Countries result in difficulties in the development of small agribusiness. For instance, constraints on transport links often limits the ability of highlanders in Papua New Guinea to supply their local produce to the main markets (McGregor et al., 2009). A recent study in Vanuatu, highlighted that increases in local food consumption among the urban population can be successful through better accessibility and availability of local produce in Port Vila Market (Langford, 2022).

3.12.7 Financial capital

Financial capital refers to the financial resources that people use to achieve their livelihood(Israr et al., 2014). Scholars characterised financial capital as formal, informal credit and savings (Biggs et al., 2015; Williges et al., 2017). Financial assets are linked to other assets, allowing individuals to pursue various livelihood strategies. Kohansal et al. (2008) emphasises that agricultural credits significantly improve farm production and increases incomes of smallholder farmers. Kumar et al. (2019) posited that financial capital positively impacts food security; through the provision of food for households which requires economic activity to generate income. Hosseini et al. (2017) explained that direct subsidies from the government support the agricultural sector and contribute to the smallholder farmers' livelihoods. This enables them to acquire the required assistance to boost their agricultural production. Ankrah et al. (2023) showed that smallholder farmers in South Ghana require financial capital to be able to respond to and recover from the effects of climate variability. Several studies have shown that smallholder farmers generate income from selling their produce; the cash is often for household expenses and saving towards bad seasons (Danai Manyumwa et al., 2018; Ruiz Meza, 2015). Furthermore, these capitals complement each other; one capital pursued by individuals or households enables the use and access of others. Studies have shown that the accumulation of certain assets can transform and generate income and resources to mitigate the impacts of natural disasters (Liu et al., 2020; Manlosa et al., 2019; Syafriala et al., 2022). For instance, a study in Indonesia highlighted the significance of the livelihood capital in improving household food security among smallholder farmers (Syafriala et al., 2022). Individuals and households engaged in various livelihood strategies using the five available assets to achieve livelihood outcomes. Thus, livelihood strategies are different activities and choices people build to earn their livelihood goals (Ellis, 1998). In addition, livelihood strategies can be described as coping with stress and shocks (Chambers & Conway, 1992; DfID, 1999).

3.12.8 Livelihood strategy

The livelihood strategy refers to how individuals and households utilise diverse opportunities to make a living to meet their essential needs for food and shelter. According to Scoones (1998), livelihood strategies can be classified into three clusters:

(1) Agricultural intensification/extensification, which involves agricultural activities such as farming, forestry, and livestock ownership that enables anyone to gain more from these activities or invest more in outputs such as labour and finance to cultivate more land and diversify to other activities to generate income.

(2) livelihood diversification may involve expanding livelihood activities to cope with stress and shocks or relying on a particular resource as a coping mechanism, and

(3) migration, which is described as people's temporary or permanent movement to seek livelihood opportunities. Wouterse and Taylor (2008) emphasises the positive impact of temporary migration on an individual to pursue livelihood activity and earn income, often providing income security for the household. Livelihood strategies are not static and change is often influenced by social, environmental, and economic factors (Chen et al., 2016; Reardon, 1997), which often vary in different contexts, reflecting how individuals, households and communities pursue their livelihoods. Several scholars have highlighted that traditional norms and customs within rural communities are often influenced by social factors that in-turn influence livelihood strategies (Alary et al., 2014; Bebbington, 1999). According to, Barrett et al. (2001), economic aspects such as market-orientated strategies have a significant impact on generating income for smallholder farmers. Environmental factors such as land, soil and water often influence the livelihood strategies of smallholder farmers in rural communities that dwell on the natural surroundings to provide for their sustenance.

3.12.9 Agriculture intensification/ extensification

Agriculture intensification refers to the increased average input use of labour or capital on smallholdings, either for cultivation or grazing, to increase output per hectare. According to Vanlauwe et al. (2014) increasing agricultural production in the face of climate change calls for smallholder farmers to intensify their agricultural production

systems. Thus, agricultural intensification is often pursued as a livelihood strategy for gaining more from agriculture by investing more capital or labour per unit area (Mariano et al., 2012). A study in Nepal has shown the impact of agriculture intensification on smallholder farmers. It improves socioeconomic conditions for farmers, and access to inputs such as irrigation enable farmers to cultivate more than two crops, providing extra income (Adhikari et al., 2021). Helfenstein et al. (2020) suggested that agriculture intensification can be through increased frequency of cultivation, adopting new technology such as improved crop varieties, high level of input use to increase production.

3.13 Livelihood diversification

Livelihood diversification is defined as the process that rural communities construct various livelihood activities and social support to improve their standard of living (Ellis (2000). Several authors describe livelihood diversification as a form of self-insurance that people construct with the assets and activities to support their livelihood (Ebert, 2014; Habib et al., 2023; Hänke & Barkmann, 2017). Iese et al. (2020) note that diversification reduces livelihood failure by spreading risk across multiple activities. As explained by Danso-Abbeam et al. (2020), livelihood activities are distinguish between non-farm and on-farm activities

Non-farm activities include small businesses such as retail shops, grocery stores, and handicrafts, including engaging in services such as transportation, education, and health services. These are a significant approach to diversifying livelihood activities and generating income from other sources (Haggblade et al., 2010). Scholars Otsuka and Yamano (2006) and Tuyen (2015) argued that in developing countries rural non-farm income activities offer another path out of poverty and can be key to achieving food security. For instance, in India, a study showed that non-farm work reduced the likelihood of farming household having insufficient food (D'Souza et al., 2020).

On-farm activities are based on the agricultural sector, where farmers engage in varied farm activities to reduce risk (Alemayehu et al., 2018; Ellis, 1998). For instance, crop diversification, rearing livestock, and farming crops to generate income, and engaging in

value add activities that increase profitability are among the on-farm activities smallholder farmers engage in to sustain their livelihood (Alary et al., 2014).

Crop diversification is an on-farm practice employed by smallholder farmers to mitigate the risk of crop failure (Manlosa et al., 2019), it is based on cultivating more than one variety of crops belonging to the same or different species in each area. Sunderland (2011), explained that crop diversification involves integrating diversity of crops and varieties into smallholder systems. Crop diversification is an approach towards a resilient agricultural system, primarily where communities depend mainly on agricultural products (food and fodder) for their livelihoods (Govereh & Jayne, 2003; Jones, 2015) . These studies identified that crop diversification may benefit household food and nutrition security through having direct access to several varieties of staples and other types of food.

According to Vernooy (2022), it is an approach to increase diversity of crops through different farming practices that is centred on improved and sustainable production of food crops. Jones et al. (2014) and Ricciardi et al. (2021), explained that crop diversification has a positive impact in generating more income and promoting food security. As suggested by Feliciano (2019) crop diversification also contributes to diversifies household diets. Similarly, the practice of intercropping also plays a significant role in achieving food security and earning income. It is reported by Koczberski et al. (2012), that smallholder farmers benefited from intercropping cash crops and crop rotation, these include coffee, coconut, and cocoa with root crops, and wide range vegetables that generate income (Thaman, 1995). Past studies have shown that it is significant for smallholder farmers to engage in non-farm and on-farm activities to mitigate risk and respond to opportunities that promote the welfare of smallholder farmers (Asmah, 2011; Danso-Abbeam et al., 2020).

In the present study rural communities such as Tanna Island, smallholder farmers engaged in livelihood activities as a strategy to enhance their food availability and to provide income, to support cultural and social activities and to adapt and rebuild their

livelihoods from the aftermath of natural disasters such as tropical cyclones and prolonged droughts.

3.13.1 Migration

According to Wouterse and Taylor (2008) people move to facilitate investments in new activities and income security. Climate change often stresses smallholder farmers' livelihoods in vulnerable communities, causing people to move due to less income from sales of agricultural produce (Bardsley & Hugo, 2010) and impacts of climate change on agricultural produce, such as drought and tropical cyclones that caused people to migrate temporarily (McLeman & Smit, 2006). Past studies have argued that migration may generate income through remittance, which can also give vulnerable communities access to basic needs and financial capital(Birk & Rasmussen, 2014; Connell & Conway, 2000). In Pacific Island countries remittance is identified as a significant component of livelihood diversification, constituting a substantial source of income to maintain the household (Ash & Campbell, 2016; Craven, 2015).These studies have shown that the opportunities provided by remittance enables Pacific islanders to access basic needs including food, clothing and income to support their families (Ash & Campbell, 2016; Yamamoto & Esteban, 2017). Studies in Vanuatu and Fiji have shown that during extreme events such as recovery from cyclones and droughts, people have migrated in the short-term to support their families (Bailey, 2020; Connell & Conway, 2000). Farming families regularly make choices to support their families through temporary or permanent moves to seek employment and support their families financially. The livelihood strategies pursued by individuals and families aim to achieve livelihood outcomes.

3.13.2 Livelihood outcome

Livelihood outcomes are the results of successful livelihood strategies. Most livelihood strategies aim for positive outcomes often relevant to a particular context (Amekawa, 2011). The significant livelihood outcome for people usually involves activities that

reduce vulnerability, improve well-being, increase income, improve food security and promote the sustainable use of natural resources (DfID, 1999). Past studies have shown the relationship between the impacts of effective livelihood strategies and positive outcomes for smallholder farmers in rural communities (Makate et al., 2016; McCord et al., 2015). In addition, determining livelihood outcomes associated with different livelihood strategies is particularly important for smallholder farmers in rural communities.

In summary, the sustainable livelihood framework has contributed to valuable insights into the various ways individuals, households, and communities in different contexts use resources or capital to produce outcomes that can enhance their livelihood. Referring to the research question, how does the traditional system of growing kumala support the livelihood and food security of smallholder farmers. In this study, livelihood outcomes of smallholder farmers are determined by how farmers utilise the resources or assets that are available within their communities and through developing livelihood and coping strategies.

3.13.3 Coping strategies

Coping is a term that refers to the approach or ways in which people handle and interact with challenging situations. According to Mosberg and Eriksen (2015), coping strategies are short-term measures for managing shock exposure when faced with unexpected livelihood failures. Scholars Yohe and Tol (2002) and Eriksen et al. (2005) describe coping strategy as short-term actions taken to counteract the immediate negative impacts of climate change. Several authors describe the features of coping strategy as short-term, immediate, oriented towards survival, and motivated by crisis (Amekawa, 2011; Tao & Wall, 2009).

Karki (2021) states that in order to understand sustainable livelihoods it is relevant to understand the coping strategy pursued by individuals and communities, Habibov and Afandi (2017) explained that often the coping strategies vary from household to

community. Studies in developing countries have shown that smallholder farmers often adopt similar coping strategies to support their livelihood; this includes diversifying their income (Hussain et al., 2020) and building on social networks in the community that support them (Bhatta & Aggarwal, 2016; Rozaki et al., 2021). For instance Antwi-Agyei et al. (2014), reported that sharing of traditional knowledge through social relationships to mitigate impacts of climate change in Ghana was a significant coping strategy. Aligning to this Osbahr et al. (2008) emphasised that coping strategies are natural reactions to extreme events that emerge from local survival strategy. For instance, a study in Bellona in the Solomon Islands has shown that when banana plants are blown to the ground during cyclone and extreme events, the stems are cut to initiate regrowth (Iese et al., 2017). A study in Western Cape town, South Africa highlighted the significance of social networking as a coping strategy amongst smallholder farmers during drought (Fanadzo et al., 2021). According to Brockhaus et al. (2013) smallholder farmers copping strategies to climatic shocks are place-specific and are adapted to local circumstances. Rakotobe et al. (2016) reported that in Madagascar, smallholder farmers coping strategies during the aftermath of cyclone, include the replanting of trees, replanting crops, shifts in the types of crops grown, and reliance on foods received from relatives and neighbours. Similarly, in sub-Saharan Africa, farming communities coping strategies employed in response to the impacts of climate change included growing early maturing crops varieties, intercropping, migration of farmers to more productive areas and land conservation measures (Ayanlade & Radeny, 2020).

3.14 Summary

The literature explores traditional knowledge and illustrates the significance of traditional calendars and traditional cropping systems, and their contributions in providing valuable insights into understanding the significance of kumala across traditional and conventional food systems and as a food security and recovery crop in Pacific Island countries. This chapter has also reviewed empirical literature on the sustainable livelihood framework (SLF). Furthermore, an important gap identified from reviewing SLF literature, the holistic approach of the framework to understand rural development. However, none of the literature discusses the use of SLF framework to frame the contribution of a significant food crop in supporting the livelihood of smallholder farmers within Pacific Island. As such this present study used this framework to understand the role of kumala and how the crop supports the livelihoods of smallholder farmers through social, cultural, and economic values and how farmers use their resources to enhance household resilience and food security. This contributes to the existing literature on the livelihood of smallholder farmers in the rural communities in Vanuatu.

CHAPTER FOUR

RESEARCH DESIGN

4.1 Introduction

This chapter outlines the research design used in this study. There are two research questions that guided the research design of the study: 1. What is the traditional system for growing and utilising kumala in Vanuatu? and 2. How does the traditional system of growing kumala contribute to sustainable livelihood and food security in Vanuatu? A qualitative case-study methodology was used that incorporated an indigenous data collection method. Two case study sites on Tanna Island in Vanuatu were selected for data collection and the rationale for this and the process of field work and data collection are described in detail in this chapter. Data collected was analysed using a thematic analysis and followed by the final part of this chapter describes the ethical approach used to carry out the research.

4.2 Research paradigms

Paradigms are defined as a world view, a general perspective and a way to break down the complexity of the "real world" (Das & Devi, 2023; Khatri, 2020) Omodan (2022), explain a paradigm as a way of "seeing the world and making sense of it". In different fields of research, the researcher understands what knowledge is and what is the truth, this shapes the researcher's view of the world. Epistemology deals with kinds of knowledge and how we know what we know (Bloomfield & Fisher, 2019). The types of epistemologies include positivism and constructivism the foundation of positivism based on a rigorous scientific approach to understand the world (Bogna et al., 2020). In contrast, according to Kalpana (2014),constructivism centres on building subjective meanings and understanding of an individual's experience within their social and cultural background . A constructivist paradigm has framed this research as the aim was to capture smallholders' experiences of kumala and ascertain how and why they grow kumala. This research accepts that the practice of growing and using kumala on Tanna Island by smallholder farmers occurs within a specific cultural, social, and geographical context that shapes smallholder farmers practices and knowledge. According to Wilson et al. (2022), knowledge is produced in both social and cultural contexts, and learning is obtained through interaction and connecting with social activities. This view of learning and knowledge is fundamental to the approach taken in this research. The following section describes the research approach applied in this study. The study adopted a qualitative study to explore and understand the context of the study to answer the research questions that guide this research study.

4.3 Research Approach

The research used a qualitative case study design, integrated with an indigenous method that is used to enhance the cultural context of the study. Qualitative case studies have been recognised as suitable for exploring the complex world of lived experiences from the perspective of those who live within their natural context (Creswell & Poth, 2016). As proposed by Tashakkori and Teddlie (2008), the use of multiple methods is an ideal way to provide better opportunities to answer research questions and interpret research findings.

Several studies in Pacific Island countries often use Pasifika methodologies as the overarching research method that guides the studies carried out in Pacific. For instance, scholars of Tongan, Samoan, and Fijian ethnicity, used indigenous frameworks such as the kakala framework (Thaman, 1990), Vanua framework (Nabobo-Baba, 2008) kaupapa and talanoa research methods (Vaioleti, 2006) to capture interwoven perspectives within the cultural context. The frameworks and methodologies are culturally appropriate to understand and capture indigenous worldviews. Several studies undertaken in Fiji have incorporated the use of Vanua framework (Leweniqila & Roskruge, 2023; Vunibola, 2020). Vunibola (2020), stated that the use of Vanua framework to understand the perspective of indigenous people and conceptualised economic development within the cultural context is important. Pacific research methodology shared the same themes, these include

I. They uphold Pasifika values and beliefs.
II. They recognize the participants as equal partners in the research process.
III. Reciprocity is the core requirement that includes the sharing of findings with participants.

The indigenous methodology acknowledged and respected the knowledge and the values that uphold the culture and traditions of Pacific Island societies (Nabobo-Baba, 2008). The Melanesian region of the Pacific also have a contextual approach to inform, gather, and share knowledge. For instance, in Vanuatu the term storian is a bislama term for everyday conversation meaning to chat, yarn, and swap stories (Crowley, 2000).This form of conversation is widely practised in informal and formal contexts in Vanuatu.

(Walker, 2013). Similarly, according to Sanga et al. (2018), Tok Stori in Papua New Guinea or Pidgin in the Solomon Islands, both refers to everyday conversation. Sanga and Reynolds (2021), have utilised Tok Stori as a research method to explore communal cultural knowledge, and discourse on leadership development (Sanga et al., 2018) and social research, particularly in the Solomon Islands (Sanga et al., 2020).

Similarly, according to (Vaioleti, 2006) in using Talanoa there is no formal structure to the conversation, and participants are free to discuss openly. As suggested by Prescott (2008), indigenous research methods can significantly impact the validity and depth of information attained through research as it tends to be embedded in trust, solid relationships, and research environments that encourage open engagement. In most Pacific Island countries knowledge is traditionally disseminated orally (Kovach, 2010), thus indigenous methods such as storian, tok stori and talanoa, are culturally appropriate to study, social, and cultural perceptions of people in the rural settings across Pacific Island countries. According to Kovach (2010, p. 42)

> Conversation is significant to indigenous methodologies because it gathers knowledge based on oral storytelling traditions congruent with an indigenous paradigm. It involves dialogic participation with a deep purpose of sharing stories to assist others.

Aligned to this research, storian is the overarching cultural approach that foster relationships which underpinned the research process. As explained by Fonua (2021) Pacific indigenous methods acknowledge the cultural protocols, values, knowledge and beliefs. In addition, it allows the researcher to gain access to the local communities, and established connection which is a significant aspect of data collection. Simons (2009) posited that trust is important for good field relations and is natured by adhering to protocols. Similarly Ponton (2018) and Bennett et al. (2013) acknowledged that Pacific values like respect, reciprocity, service and humility are important to establish relationship with participants in the Pacific context. Subsequently, the use of storian was supported by the use qualitative methods including, semi structure interviews, unstructured field observations and secondary data to collect valuable data from the local participant.

Blending complementary and indigenous method of collecting data allows the researcher to collect valuable information cent, while respecting the information

provided by the respondents (Bennett et al., 2013). Qualitative research was used in this study to gain in-depth information on the complex realities of smallholder farmers' livelihood in rural communities as proposed by Tomaszewski et al. (2020). Busetto et al. (2020) and Nassaji (2020), have argued that the qualitative case study approach, allows the researcher to implement suitable data collection methods based on the research context for capturing valuable insights and detailed information from participants.

According to chapter Three, this research employs the use of sustainable livelihood framework (SLF). Aligning to the research process, the framework was used to guide the data analysis. Subsequently, this framework is a people centred approach implemented to understand, how farmers growing kumala used their available resources to support their livelihood and the holistic contribution of kumala within the traditional food system. The following section explores the case study used to understand the context of study.

4.4 Case study research

A case study is the study of the particularity and complexity of a case, understanding its activity within critical circumstances (Stake, 1995; Yin, 1992). This research accepts Creswell and Poth (2016) definition of a case study as, "a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple bounded systems (points) through multiple sources of data collection" (Rashid et al., 2021). In this research the case explored is centred on the growing and use of kumala to support the livelihood of smallholders on Tanna Island. The nature of the study on how and why smallholder farmers grow kumala to support their livelihood is embedded on social and cultural perspectives. A case study approach allows the researcher to investigate and understand the different interactions. As emphasised by Baxter & Jack (2008), a case study provides an opportunity for the researcher to gain in depth holistic view of the research problem. According to Stake (1995), there are different case studies; these include instinct, instrumental and collective case studies. An intrinsic case

study involves studying a unique situation (Creswell & Poth, 2016) and an instrumental case study provides insight into a phenomenon (Johnson & Jones, 2018); collective cases are like multiple cases in nature; it involves more than two case studies and relate to understanding the similarities and differences within and across the cases (Simons, 2014). This study was a multiple case study by design; it provides insight into how kumala has supported smallholder farmers' livelihood in two distinct study sites. The researcher applied multiple data collection methods, semi-structured interviews mixed with storian, physical observations, and documentation to understand the livelihood of smallholder farmers within the rural context.

4.4.1 Case Study Boundaries

The research is centred on smallholder farmers in different locations, who are engaged in growing kumala, drawing from resources that are available and accessible within their respective locations. This aligns with what Baxter and Jack (2008), states that having a case study boundary helps the researcher to be time cautious, select appropriate study locations, execute targeted activities, and profoundly identify the sole definition and context of the research. In addition, Flyvbjerg (2011) explains that case study boundaries must be related to the researcher's interest area, thus accomplishing the purpose, and answering the research question. Moreover, Flick et al. (2004) mentions that having criteria is essential for establishing boundaries, setting the boundaries standards will be determined on rural communities, people, and access to information. Baxter and Jack (2008), also highlighted that having boundaries indicate the scope of the research study and guide the research question.

4.5 Case selection

The phenomena under study were the smallholder farmers growing kumala (sweetpotato), in the two rural communities on Tanna Island, Vanuatu, focusing on how it promotes food security and sustains their livelihood. According to Hyett et al. (2014), the selection of a case is firstly guided by the research questions of the study. In this case, what is the traditional system for growing and utilising kumala in Vanuatu? and how does the traditional system of growing kumala contribute to sustainable livelihood and food security in Vanuatu?

4.5.1 Site selection

The research was carried out in Tanna Island, located in the Southern part of Vanuatu (see Figure 9). Agriculture is central to the livelihood of smallholder farmers in Tanna, with farmers cultivating a wide range of vegetables, crops, animal husbandry, and fishing for sustenance. It is Rainfed agriculture system, like other islands in Vanuatu, thus the agriculture production is dependent on rainfall in most part of the islands. Tanna Island is often faced with natural disasters, including flooding, drought, and Volcanic ashfall; these place risk on the livelihood of smallholder farmers; thus, smallholder farmers are encouraged to grow and utilise resilient crops such as kumala to support the daily supply of food.

Tanna Island is administered by six area councils: North Tanna, Middle Bush Tanna, West Tanna, Whitesands, Southwest Tanna and South Tanna Area Councils. The study was conducted within the Middle Bush Tanna and West Tanna Area Council locations. The criteria for selection of the case study sites were based on the following.

- Agriculture is the primary source of income for smallholder farmers
- The farmers are engaged in different farming system.
- Distinct weather pattern at the sites that influences the production of different crops including kumala. Middle Bush Tanna is 300m above sea level, so it tends to have a subtropical climate where coffee, sandalwood, citrus species, and vegetables are grown. West Tanna lies towards the coastline, experiencing drier weather and sometimes drought throughout the year.
- The existence of agriculture extension services operated in the case study sites.

Apart from these criteria's, accessibility to the sites was also important, it enables the researcher to settle in the sites. Based on these four criteria, Middle Bush Tanna, and West Tanna area in Tanna Island was selected as the case study sites. The participants in this case study sites are smallholder farmers who have been growing kumala either for home consumption or for income to support their families. The researcher is from Tanna Island in Southeast Tanna, however the language spoken there differs from the sites selected for this study, and the researcher has not lived or worked at the case study sites therefore, this reduced the bias in how the participants were interviewed Bislama was the main language used for interviews in both sites (locations) of study.

4.6 Research process

The research process involves two phases. The first phase began in Port Vila where the Head office of the Vanuatu Department of Agriculture and Rural Development (DARD) is located. The second phase of the research took place in Tanna Island, involving smallholder farmers. Initially before the research was carried out the researcher consulted Vanuatu cultural centre to ensure all cultural protocols are adhered to before any actual research. Researchers must sign a research agreement at the Vanuatu Cultural Centre (refer to Appendix 4). However, a research agreement was not required for this study because Ni Vanuatu undertook the research.

I. In June 2021, the first phase began, the researcher met with Senior Agriculture officers at the Department of Agriculture and Rural Development (DARD) and introduced her proposed research work. An information sheet containing research information was presented to each participant to read before the interview was carried out (See Appendix 2). The researcher discusses her research with the principal officer who managed the extension officers in Tanna Island. The principal officer organized the logistics for the researchers' travelling arrangements with extension officers on Tanna Island for the second phase of the research process. The researcher met with the DARD communication officer and collected some reports and documents relevant to the research study. Few key informants stationed at DARD were interviewed on the production of kumala, different varieties of kumala, how DARD support the kumala farmers and the challenges.

II. On the 22nd of June 2021, the researcher travelled to Tanna to carry out the second phase, data collection, at the case study sites. This study has two case study sites (described in the next section). In the context of the study, the researcher acknowledged traditional Vanuatu cultural approach. Gaining approval from the local chief in the community is fundamental for the study, acknowledging and respecting the community and individuals. Respect in the local context entails acknowledging the existing traditional governance in the research area. The researcher began the data collection in West Tanna. The cultural approach or protocols to enter a local community in most islands in

Vanuatu is still practised as it contributes to maintain the social structure, traditional values, and beliefs within a specific context.

Throughout Tanna Island, the culture and traditional way of living contribute to the vibrant rural community's way of living. Women's voices and ideas are rarely spoken out in organised village matters held in the nakamal by the important leaders, such as chiefs in each village. Women are prohibited from being a part of any decision organised by the elders in the nakamal, where only men can be part of it. The nakamal is traditionally used by men to consume kava[3] and discuss village matters. According to the nature of the study, the primary researcher was a female, and she was not allowed to enter the nakamal to inform the chiefs of the purpose of the study. A male assistant agriculture officer represented the researcher and presented fresh kava root to the chiefs in the nakamal, relating to them the nature of the visit and how long the researcher will be living with them in their community. The traditional way of presenting gifts to chiefs allowed the researcher to be part of the community and assured the researcher that she could carry out her research.

The researcher moved to the second case study site (Middle Bush Tanna) the same approach described earlier was carried out before the field work began at the end of August 2021. In both case study sites, the researcher stayed with host families organised by the extension officers, allowing her to participate in community activities. The researcher was in the field for five months, from June-October 2021; during that period, she arranged to engage in the progress of her work with her supervisors through Zoom meetings.

4.6.1 Sampling

The researcher liaised with the agriculture extension officer from the respective case study sites to develop a list a few smallholder farmers that were growing kumala. The extension officers contributed to list of smallholder farmers growing kumala in both case study sites. According to the list provided, farmers were sometimes unavailable as they

[3] Kava (*Piper methysticum*) is an intoxicated root drink traditionally shared among men, and often used in traditional ceremonies.

had to attend to other activities. In both case study sites, after the first two weeks, the researcher became familiar with the community, connected and interviewed farmers on the list and some who were not on the list were interviewed. The description of sampling aligns to what Naderifar et al. (2017), would classified as snowball sampling, it is a gradual process that provides the researcher with opportunity to communicate better with the farmers and as the researcher builds the network and connection that leads to the next farmers (Etikan et al., 2016).

Pseudonym names were used instead of participants' real names throughout the research to ensure confidentiality. In this research, the pseudonyms used are MBTF (Middle Bush Tanna farmers), WTF (West Tanna farmers) and K representing the different (key informants) who were interviewed as part of this study.

4.7 Data Collection Method

Primary and secondary data are part of the data collected for this research study. There were several methods used to obtain primary data from smallholder farmers and key informants, the secondary data included the documents and reports that were relevant to gain insight on the study context. Stake (1995) and Yin (1992) have acknowledged at least six sources of evidence that can be presented in case studies. These include documentation, archival, records, interviews, direct observations, participant observation and physical artefacts (Bloomfield & Fisher, 2019). As argued by Hamel et al. (1993), case study employed a variety of ways to gather data, including interviews, participant observation and field studies from which general conclusions can be drawn and discussed. In this research data collection method involved, storian (indigenous method), semi-structured interviews that weave ideas and perspectives that merged from the participants in the case study. The data collection enables the researcher to gather valuable insights, drawing on smallholder farmers perspective on kumala production and its significant role within the traditional food system. Other sources of data from this study are documents, unstructured field observation and photographs that captured significant features from the case study sites.

4.7.1 Storian

In Vanuatu context, storian is described as informal storytelling that involves everyday conversations. Storian has always existed in Vanuatu's culture, as people engaged in conversation in a cultural context (Crowley, 2000). Storian was culturally appropriate as a method in this research. This approach allowed participant's perspectives to be shared as they exchange conversation with the researcher on a given topic. Warrick et al. (2017), explained that the central feature of storian is to build rapport with the participants, it is a flexible approach to collecting data. Similarly, Sanga et al. (2018), argued that Tok Stori involves interaction, relationships, and inclusiveness. Within the Melanesia context, Storian and Tok Stori have similarities with Talanoa. All these indigenous methods foster a relationship between the researcher and the participants (Prescott, 2008). This creates a space where stories can be exchanged with other people, a process of speaking and listening begins an interaction that provides deep understanding (Sanga et al., 2018). Storian and Tok Stori have been described as ways Melanesia people share what they know and a problem-solving strategy involving traditional parameters centred on oral activity (Sanga & Reynolds, 2021; Warrick, 2009). A few studies in the field of anthropology and ethnography in Vanuatu have used Storian as a method to collect data (Addinsall et al., 2015; Warrick, 2009). Addinsall et al. (2015) study with smallholder farmers in Vanuatu, combined storian and participatory approach to understand how agroecology and tourism contribute to sustainable livelihood in Pentecost Island. Similarly, in Papua New Guinea and Solomon Islands, Tok Stori has been used to conduct research in different research disciplines, including ethnography and anthropology (Evans et al., 2010; Sanga & Reynolds, 2021; Vella & Maebuta, 2017). In this study, storian was not an absolute replacement for the interview but rather a complementary addition to collecting in-depth data to connect the information and provide the research findings.

4.7.2 Semi structure interview

Semi-structured interviews are described as an organized conversation obtained from interactions that unfold through the conversation between a researcher and the interviewee. Kallio et al. (2016), describes a semi-structured interview as a monologue on the research topic; often, the interviewee expresses their thoughts and allows the

conversation to carry on to the next topic. Scholars like Rowley (2012) and Naz et al. (2022) suggested that the researcher can control the direction of an interview by using a semi-structured interview. According to Cousins and Giraldez Hayes (2022), the researcher can modify and add questions in semi-structured interviews to facilitate participant responses.

The semi-structured interviews were conducted in Bislama, a Neo-Melanesian Pidgin which is the national language in Vanuatu. In field practice, the researcher considered the interview as an interaction instead of a formal two-way question-and-answer process, which may create a friendly space for participants to converse. This aligns with what Daymon and Holloway (2010), attributes to semi structure interview, as it provides flexibility and enables the researcher to better understand the perspectives of the research participants.

Several studies in the Pacific Island countries have used semi-structured interviews in community-based research centred on smallholder farmers' livelihoods (Addinsall et al., 2015; Currenti et al., 2019). Apart from smallholder farmers, the researcher interviewed key informants and other participants using the structured interview to appraise how kumala has supported the livelihood of smallholder farmers. By adhering to indigenous methodologies such as kaupapa, talanoa, vanua and storian in the Vanuatu context, the semi-structured interview respects participants as it does not overcontrol the interview process. The following section describes the interview guide used to structure the interview with the smallholder farmers and the key informants.

The design of the interview guide

Using the interview guide, ensure consistency of the relevant information captured from the Storian. The interview guide was pertinent to guide the context of the Storian between the researcher and the participants, and it included the information and topics needed from the participants. Scholars like Ruslin et al. (2022) and Krauss et al. (2009), describe an interview guide as a list of questions that directs the conversation towards the research topic during the interview. Chenail (2011), suggested the guide aims to obtain in-depth answers from the participants. Two interview guides were outlined

based on the different types of interviewees. These include interview guidelines for smallholder farmers and interview guidelines for key informants. The examples of the interview guides used to guide the storian are included in Appendix 1. Simultaneously, the researcher asked probing questions based on the participant's responses to obtain more information. The set of probing questions reflects the research questions and the objectives. It allowed the participants to provide detailed information. The use of probe questions allowed the smallholder farmers to describe the role of kumala within the traditional food system and how it supported their livelihood.

Procedure

The interview began with the researcher introducing herself and the aim of the research to the participant. Then, she assured the confidentiality of the information they were to provide by asking them to sign the consent form if they agreed to begin interviewing. All interviews were carried out between June and November 2022. Each interview was conducted within 40 to 60 minutes, depending on the availability of the participants. The consent form was translated from English to Bislama. The consent form (See Appendix 3) confirmed that the research participants agreed to participate in the research and whether they agreed or not to be interviewed for this research study. The consent form was explained to the participants before the interviews. In some interviews, the researcher had a translator who explained the consent form to participants who preferred to be interviewed in their dialect.

A total of forty-six participants were interviewed as part of the research. These include forty interviews with smallholder farmers, twenty farmers on each case study site and six interviews with the key informants. All the interviews were conducted in Bislama; a translator assisted when farmers preferred to be interviewed in their dialect. All participants provided their consent for the researcher to record the interviews using a digital recorder. In addition, the researcher took notes on the participant's responses and observations relevant to the study context.

4.7.1 Secondary data

Secondary data are used to support the narratives presented in the case studies (Miles & Huberman, 1994). Document collection is valuable to gain insight and relevant information to build an understanding on the study. The documents include government reports, project documents, statistics reports, strategic and policy reports, and relevant website reports. The secondary data was collected through the assistance of Agriculture officers at the Vanuatu Department of Agriculture and Rural Development (DARD). The researcher collected documents such as the Vanuatu National Agriculture sector policy, a monthly report compiled by the communication officer and a report from the project officer. The researcher also accessed government documents such as the National Development Plan of Vanuatu, statistics, and strategic reports from their website repositories. The information gathered from these documents was used to understand the study context and support the information collected from the interviews and observations.

1. Vanuatu Agriculture sector policy 2015-2030
2. Vanuatu National Sustainable Development Plan 2026-2030
3. 2022 Vanuatu National Agriculture census preliminary report
4. Port Vila Central Market Survey Report
5. Vanuatu Rural extension strategy 2019-2029
6. Climate risk profile: Vanuatu
7. 2020 Vanuatu national population and housing census analytical
8. Food security in Vanuatu 2019-2020 NSDP baseline survey
9. Vanuatu climate change and disaster risk reduction policy 2016-2030

4.7.2 Unstructured field observation

Observation is one of the significant methods often integrated into qualitative research designs. It is often used in ethnography studies where the researcher participates in the community's life, it usually involves long term immersion in the culture or community being observed (Brannan & Oultram, 2012). Observation is usually essential to gain insights into a case study by observing the reality within the study context. The

researcher blends into the case study environment to understand the livelihood of smallholder farmers through the activities in that they are involved in their communities. Smit and Onwuegbuzie (2018) suggested that observation provides a direct idea of the case study features. The researcher lived in the two case study sites over several months and engaged in a several village activities, such as traditional marriage ceremonies. Living with the farmers and attending the cultural and social activities in the communities allowed the researcher to comprehend well what the participants talked about in their interviews. For instance, many respondents mentioned the status of kumala in the cultural ceremonies was less significant compared to other traditional crops; being able to present at the traditional marriage ceremony in the case study sites, the researcher was able to observe this difference and how kumala was given the status "food belonging to the kitchen" instead being placed in the nakamal where the cultural ceremonies usually occurred in the rural villages (see Figure 8).

The researcher visited the Napil Rural Training centre in Middle Bush Tanna. The training centre was a focal point for smallholder farmers' development in the rural communities around Tanna. The centre provides training that enhances farmers' ability to maximize land use and increase their income by cultivating various vegetables and root crops. The partnership with the extension officers and training centre enables access to information and knowledge on activities that can assist farmers in increasing production. Villagers who attended the Napil Training Centre often are farmers with a hectare of land or two garden plots that sustain their livelihood. In August 2021, the researcher participated in the National Agriculture Festival in Tanna and interacted with extension officers and local farmers from the six provinces in Vanuatu to showcase their local produce. During the one-week festival, the researcher observed farmers promoting their local produce (both crops and livestock) and value-added products from local produce.

Figure 8 Traditional bride price ceremony attended by the researcher in West Tanna

(Amanda Nasse,2021)

4.8 Data analysis

Qualitative data require aggregation and sorting for the meaning to be precise. Dey (2003), suggested three data analysis phases in qualitative research. These include describing data, classifying data, and connecting data. According to Coffey and Atkinson (1996), "a basic principle of qualitative research is that data analysis should be conducted simultaneously with data collection". Vaismoradi et al. (2013) and Sjah et al. (2006), agreed that data analysis begins as soon as data collection starts and continues until the data is thoroughly analysed. This research adopted thematic analysis, to analysis and identify the emerging themes within the context of the study. According to Fereday and Muir-Cochrane (2006), thematic analysis is a method of identify, analysing and reporting patterns with a data. Clarke and Braun (2017), explained that thematic analysis allows the researchers to perceive and make sense of collective or shared meanings and experiences. Castleberry and Nolen (2018), posited that thematic analysis is appropriate method for any study that has large amount of qualitative data. This process of analysing the data was carried out through six steps. The initial phase includes the researcher transcribing the interviews. All the interviews were transcribed manually by the researcher. All forty-six interviews were transcribed in bislama (Vanuatu national

language) to maintain the voices of the participants. Transcribing was done manually to produce handwritten transcripts. The transcripts were grouped according to similar characteristics (farmers in Middle Bush Tanna and West Tanna, and key informants. The second step of data analysis, the researcher produced a summary description of the set of transcripts to gain an overview of the raw data. The description provides the researcher an understanding of smallholder farmers and key informants perceptions respectively, confining to the research study. After completing the description, the researcher manually coded the data from the different groupings. By carefully reading the transcript line by line, themes and concepts relevant to the research questions were identified. The relevant quotes from the transcripts were also identified and noted during the coding step.

In this phase the researcher immerses in the data drawn from transcriptions of interviews manually. The researcher rereads the transcripts to identify codes to further organised the data. For example, during the Storian with individual farmers the researcher noted that kumala planting materials were source from farmers on farm conservation, families & friends, and extension officers. Aligning to Coffey and Atkinson (1996), describing coding as derived from the participant's responses, such as statements and reports, it is a process that breaks down the data into segments and assigns a name to each. The third step involves connecting the themes, the researcher systematically sorting the different codes into potential themes, it also involves a broader recognition of the themes, combining different codes to form the overreaching themes. Step four is related to step three; the process involves reviewing the identified themes and checking the themes in relation to the codes. In step five, it involves naming the themes that will be further used in results. Finally, the last step the researcher wrote a report that reflects the identified themes. These six steps are aligned with what Clarke and Braun (2017) developed in the context of thematic analysis, which includes:

1. Familiarising yourself with the data
2. Systematic coding of the data
3. Developed potential themes.
4. Revision of the themes
5. Defining and naming themes

6. Producing the report

The following section describes the ethical issues that were considered for this research.

4.9 Research Ethics

Research ethics process ensures integrity of the research and that the research is conducted in an ethical manner. As proposed by O'Leary (2005), research integrity also includes ethical consideration of research participants . This study acknowledged both formal and cultural ethics simultaneously. Formal ethics is obtained through the respective institutions, and cultural ethics centred on the cultural context of Vanuatu. Subsequent section covers the ethical conduct of this research.

Formal ethics

The research was assessed and approved as a low risk by the Massey University Human Ethics Committee (Appendix 5). This study was recognised as a low-risk study as the researcher ensured integrity. The researcher obtained a permit from the Vanuatu National Cultural Council to undertake a study in Vanuatu. The researcher signed an agreement at the Vanuatu Cultural Centre when she arrived in Vanuatu. However, an agreement was not required for this study because Ni Vanuatu primarily did the research. The confidentiality and privacy of the participants were primary ethical concerns, and the researcher ensured that the information collected through the interviews was confidential. The research participants were informed of the purpose of the study, were also advised that the level of participation in this study is their choice, and that participation is voluntary, and they may refuse to participate anytime.

Cultural ethics

It is important that research process is ethical within the cultural context of the research setting (Tunufa'i, 2016). As an indigenous researcher is important to understand the cultural protocols within the research settings, involving the people, chiefs, and their territory. Acknowledging the cultural protocols enhance the value of the research within the cultural context has been proposed by (Meo-Sewabu, 2014). After the cultural

protocol has been made, the researcher began her storian within the farmers in the local communities. All the participants gave their consent to be recorded and interviewed and to protect the participants' confidentiality, the names were replaced by using pseudonyms. Few participants had the consent form explained to them in their dialect by the assistant to ensure they understood the purpose of the consent form and what they were involved in. When the participants cannot sign their names on the consent form, the researcher records their verbal consent. The participants also consented to take photos of the garden and cultural ceremonies that constitute the farmer's livelihood. The field observation was carried out with consent from the elders in the community, enabling the researcher to openly explore the case study sites to maintain the confidentiality of participants, the actual names of the farmers and key informants were not used in this thesis.

4.10 Summary

The doctoral study took a qualitative approach, incorporating storian, an indigenous method that was culturally appropriate to significant to understand the perspectives of smallholder farmers' livelihood in rural communities.; about how a root crop, such as kumala, has contributed to their livelihood. This chapter enables the reader to gain in-depth account of how the research study was conducted. To answer the research questions, a multiple case study was adopted to collect detailed information from smallholder farmers in two respective sites in the island of Tanna. Several data collection methods were described, and they have been used to obtain detailed information on how kumala has supported the livelihood of smallholder farmers and the status of kumala within the traditional food system. This study employed thematic analysis to generate meaning from the data. The process of the thematic analysis was described, with the relevant steps applied to understand the data. Massey University's Human Ethics Committee approved the research and obtained approval from the Vanuatu Cultural Centre.

CHAPTER FIVE

CASE STUDY DESCRIPTION

5.1 Introduction

This chapter highlights the context of the study. The study focuses on kumala as a traditional food source, drawing on smallholders' traditional knowledge. The two case studies of kumala farmers are undertaken in the Middle Bush and West Tanna. Introduce the agricultural support service, which includes government and non-government organizations, to smallholder farmers in Tanna. In addition, the chapter outlines details of the farming systems and a description of smallholder farmers in Tanna. Subsequently, a brief background to livelihood activities and food security, cultural and social obligations in Tanna. A summary of the chapter is then given.

5.2 About Tanna Island

Tanna Island is in the Southern Province of Tafea in Vanuatu. The Island is densely populated with a population of 32,280 people, covering a land area of 58,783km^2 (VNSO, 2016). Tafea Province is made up of six islands including, Erromango, Aniwa, Futuna, Anityum and Tanna. Tafea Province (see Figure 9), has a total of land area of 1632km^2, with a population density of 28.0 people km^2, off all the islands, Tanna is the most populous in the province. Tanna Island is home to the accessible Volcano Mt Yasur, throughout the year it attracts tourists, with fertile volcanic soil rich in nutrients such as nitrates and phosphate.

Most households are involved in food production and raising livestock especially poultry and pigs. Lenakel Town[4] is the main town and administrative centre for the people in Tanna Island, and the outer islands in Tafea province. Paid employment is limited and centred in the main town. Lenakel town is located in West Tanna, provide the significant government services to the people of Tanna and the outer islands, including health (main hospital), airports, and wharfs which are significant to the population of Tafea province. Tanna Island comprises of six area council, Middle Bush Tanna, West Tanna, South Tanna, Southwest Tanna, Whitesands, and North Tanna. The area council are set up by the government to ensure that government services are decentralized to the rural areas. Tanna has a young growing population. Over the past years, people have travelled abroad to work in seasonal jobs to support their families. Throughout Tanna, both men and women engage in agricultural activities mainly for subsistence living. Surplus produce is sold to the few tourism businesses in and around Tanna and at the main market in Lenakel. For this study, the case study is carried out in villages in West Tanna (Lokatai, Lenamer, Letus) and Middle Bush Tanna (Lamlu, Lamnatu, Lowehao)

[4] Main town in Tanna Island

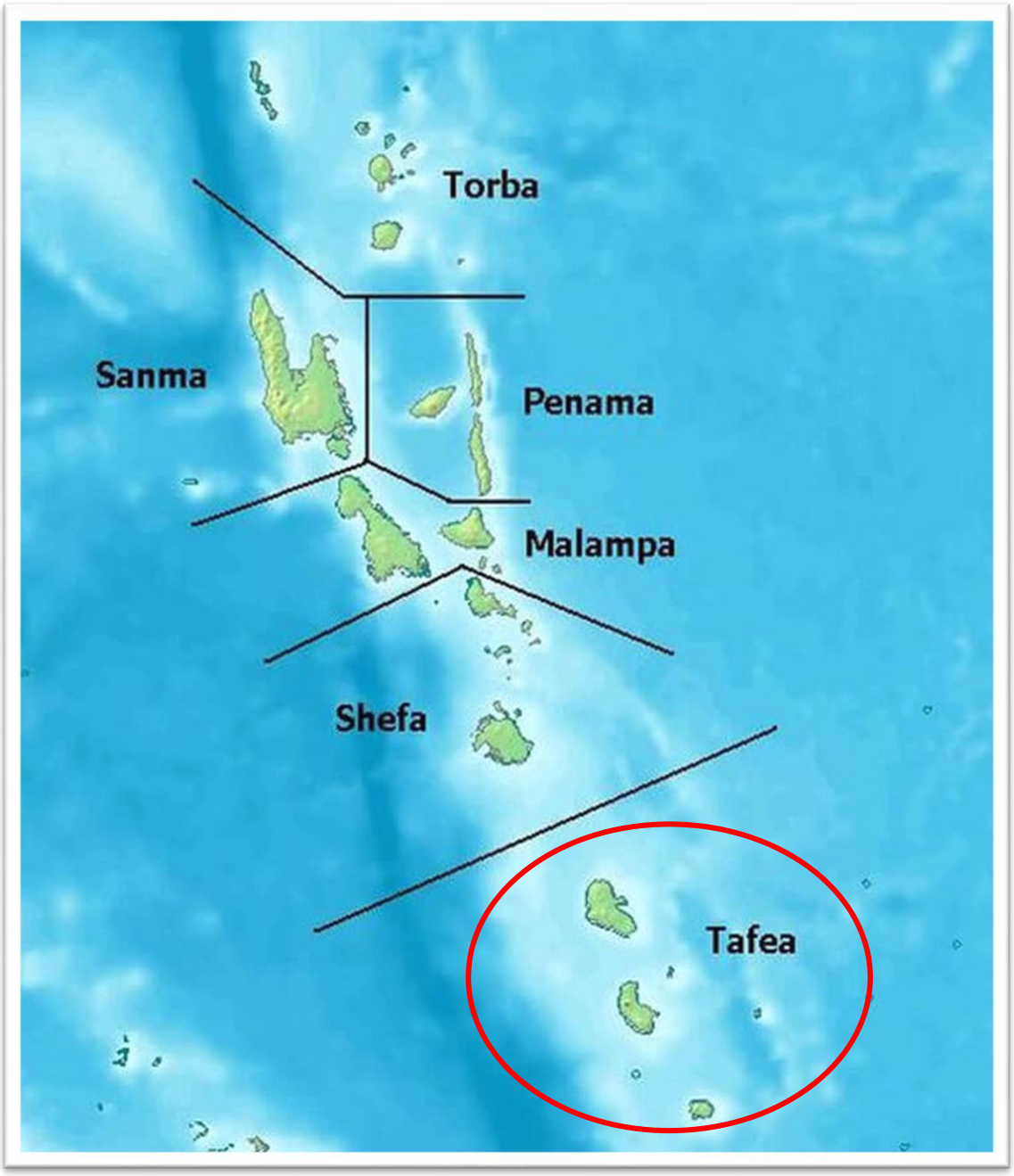

Figure 9 Map of Vanuatu divided into six provinces, showing the location of Tafea Province

(Wikimedia, 2023, p. 2)

5.3 Climate in Tanna

There are two distinct seasons that influence the Vanuatu archipelago: a hot and wet season from November to April, known as the cyclone season, and a cold and dry season from May to October (Reti, 2008). Rainfall often peaks during the earlier season and its mostly associated with cyclones or depressions in that period annually. Average temperatures range between 21°C and 27°C and average humidity ranges between 75% and 80% declines from over 4000mm in the north to less than 1500mm in the south (Mourgues, 2005). Vanuatu is prone to natural disasters, mainly the tropical cyclones that often occur during the warmer months from November to April, although cyclones have recently shown signs of development outside this season. Vanuatu is also vulnerable to long dry spells and prolonged wet conditions associated with the El Nino (warm phase) and La Nina (cool phase) of the El Nino-Southern Oscillation (ENSO) phenomenon (World Bank, 2021). Climate in Tanna varies throughout the island, with parts of the island in the wet and dry area. In 2015, Vanuatu experienced category 5 tropical cyclone Pam, 80% of household members in Tanna were affected by the damage caused by high-speed winds affecting crops, livestock, and homes (shelter) (VNSO, 2016). The recent cyclone Judy, caused severe damage to the islands in the south of Vanuatu including Tanna (DSPPAC, 2023; VNSO, 2016).

5.4 Location of case study sites

The two case study sites selected for this research are Middle Bush Tanna and West Tanna area council. Both sites are within different agroecological zone, with West Tanna located along the coast experiencing more drier weather and Middle Bush Tanna located in the interior forest exposed to monthly cooler seasons (see Figure 10).

Figure 10 Map showing case study sites Middle Bush Tanna and West Tanna

(VNSO, 2016, p. 9).

5.4.1 Middle Bush Tanna

The data was collected in Lamlu, Lamnatu and Lowehao villages in the Middle Bush area. The total area of Middle Bush is 76.3 km2. The Middle Bush area has an estimated total population of 5,994 in 2016 which 3000 are females and 2,994 are males (VNSO, 2016). There are more than 30 villages in the Middle Bush area, each with an estimated population of 150-200 people. The villages spoke the same language, and they have access to the same health, education, and other government services. At a latitude of 19°30'S and altitude of 400-600 metres above sea level. Middle Bush can be best described as located on the central plateau of Tanna Island at an elevation of 400- 600

meters. The Middle Bush area experiences average monthly cool season minimum of 11-12°C. The climate means subtropical and temperate crops can be grown. Middle Bush area is known to be the home to traditional and temperate vegetables that gives a vibrant colour to the main market in Tanna. Smallholder farmers access to the main market in this area, is often disturb by poor road works due to bad weather. Middle Bush area is in the wet part of Tanna Island, it experiences more rain than other parts of Tanna. The soil in Middle Bush Tanna is rich, due to the volcanic activity of Mt Yasur, it can be viewed as the "Vegetable bowl of Vanuatu." Fresh produce is the primary source of cash income, kava sales are significant, and other smallholder farmers receive income from sales of arabica coffee(VNSO, 2016)

5.4.2 West Tanna

In West Tanna, data was collected in Lokatai, Lenamer, Letus villages. The total area of 98.10km2 area. West Tanna has the highest population of 8545 of all area councils on Tanna area council on Tanna. In this population 4,301 are males and 4244 are females. There are more than 50 villages in West Tanna each with an estimate population of 200-300 people. The three villages spoke the same language and had access to the same government services, like Middle Bush Tanna area. The villages are approximately 14km from each other. Lenakel Market is the main market where farmers throughout Tanna come to sell the local produce. It is located in West Tanna. Adjacent to the main market is the Lenakel wharf. Small trading and passenger ships facilitate the inter-island trade and transportation, with a weekly schedule allowing the islanders to travel occasionally. Smallholder farmers in West Tanna have good and more access to better roads and facilities compared to farmers living in other area councils in Tanna. West Tanna experienced periods of drought compared to other parts of Tanna. The area has faced prolonged drought periods over the years. The impacts of El Nino and the dry season slow the onset of the wet season, often resulting in water shortages. The dry weather conditions in West Tanna make it suitable to grow few crops like yam and fruit trees, including coconut and mango, compared to Middle Bush Tanna. Higher temperatures are usually recorded between January and March, while lowest temperatures are

recorded between July and September (VNSO, 2016). Lenakel is the centre for trade and hosts most of the basic and government services throughout the island. Unlike other parts of Tanna, there are more primary and secondary schools in this area, it has a high youth population.

5.5 Land tenure system

Customary land use rights are recognized in the Laws of the Republic of Vanuatu. “All land in the Republic of Vanuatu belongs to the indigenous customary owners and their descendants” (FAO, 2020). Approximately 90% of all land in Vanuatu is managed under the customary tenure arrangements (Jolly, 1992) . All agricultural lands (arable lands) are considered private based on customary land use rights. The use of customary land is inherited through patrilineal or matrilineal system, in which the land is passed on through the father or mother’s lineage. Land use management and access to marine resources in some rural areas in Vanuatu are governed by the customary land laws (Hickey, 2008). In rural settings, such as in Tanna, the land is owned by the indigenous communities and administered in line with the customs and norms of that island. Inheritance of land in Tanna follows a patrilineal lineage. Traditional chiefly authority and inheritance systems still hold power across Tanna, but, particularly in the larger Christian settlements on the coast, they have had to accommodate the influence of the church, tourism, trade, and centrally administered systems of ownership and commerce. Under the customary tenure, every male on Tanna has a custom name, which gives lifelong entitlement to a specific land area. The customary traditions throughout Vanuatu determine the customary tenure, land use rights and inheritance rights. In Tanna, women have very limited rights to control and manage land and only have rights to use land through their husbands, fathers, and brothers. Throughout Tanna male chiefs allocate land for community use and to ensure that people have land to live on and garden. In addition, allocated family land within the village cannot be bought or sold, only allocated by the grandfather. Customary land plays a significant role in the livelihood of smallholder farmers, from cultivating crops to meet market demands, it is essential for them to remain on their customary land while meeting their social needs (Anderson, 2011). Throughout history, customary land has been a very

important part of smallholder farmers' cultural identity and the basis of shelter, natural medicine, and food security (Simo, 2010). In most villages in Tanna smallholder farmers continue to rely heavily on access to customary land to grow food crops and support their livelihood.

5.6 Decentralization of services to smallholder farmers

The Department of Agriculture and Rural Development (DARD) plays a significant role in supporting the farmers in Tanna and other islands in Vanuatu. The dissemination of information and decentralization of services is crucial to support smallholder farmers throughout Vanuatu. The agricultural extension services are a vital support for farmers to strengthen and improve their livelihood, build community resilience and food security (MALFFB, 2019). DARD and VARTC often provide agricultural extension officers stationed in the different islands in Vanuatu including Tanna with technical advice, and training to support the farmers in the rural areas (Department of Agriculture and Rural Development, 2015).

The recent rural extension strategy aims to strengthen the role of agricultural extension throughout Vanuatu, supporting farmers to build their livelihood through the agricultural related projects (MALFFB, 2019). VARTC plays a significant role in providing research through improved varieties of crops that can withstand certain climatic conditions, meeting the needs of smallholder farmers throughout Vanuatu, including Tanna. In addition, with the assistance from the agriculture assistant officers, the improved crop varieties are trialled out for farmers to select according to their preferences. The use of demonstration farming plots has been significant and proven to be effective in encouraging farmers to adopt different varieties of crops. In the six provinces, the demonstration farming plots are set by the agricultural assistant officers stationed in the respective islands, within the plot different varieties of crops are grown and during field day farmers are encouraged to visit the plot and select the different varieties of crops.

In the case study sites, agriculture extension officers provide support to the local farmers and introduce relevant strategies that the Department of Agriculture launched to support the farmers. DARD also focuses on import substitution; and encourages farmers to cultivate crops that are suitable in the different islands in Vanuatu. There are a few crops that can be grown locally by smallholder farmers, these include English potatoes, carrots, and onions. Introducing these crops into the farming system has made a great impact on the livelihoods of smallholder farmers. Smallholder farmers in Tanna have been growing these crops in their gardens, supplying them to the retail shops, and selling them at the local market and Port Vila. The National agriculture sector policy aligned with the national sustainable development plan aims to promote food and nutrition security (DSPAC, 2016). The agricultural extension officers in the rural communities ensure that policy is implemented through the activities carried out to assist the smallholder farmers in their communities. The climate variability causing inconsistent weather conditions experienced by smallholder farmers throughout Vanuatu including Tanna, has raised food security concern and farmers are encouraged to cultivate resilient crops such as kumala.

The Department of Agriculture and Rural Development (DARD) is mandated to promote food security to ensure food supply is available and accessible for the people at the local level. “Food basket” is an initiative from DARD and is supported by the relevant stakeholders as part of the recovery program before and during the aftermath of unexpected natural disasters in rural areas. The food basket program has been successfully implemented in some islands in Vanuatu, including Tanna Island. The program supports farmers’ livelihood through increased agricultural production, provides planting materials and restores food security, as shown in (see Figure 11). Root crops such as kumala are highly recommended by the Department of Agriculture. It is a short-cycle crop that can be harvested within 3 months and has the ability to withstand adverse climatic conditions. Therefore, it is a potential food crop to enhance food and nutritional security.

Figure 11 Farmers in Middle Bush harvesting kumala for food basket

(AAO Central Tanna, 2022)

5.6.1 Extension services

Vanuatu Agriculture research station located in Santo in the Sanma province, is the hub of Vanuatu's national germplasm. The collection of different varieties of different species, citrus, fruit trees and root crops are kept in the research station. The research stations mandated to carry out, train and disseminate technical information to local farmers throughout Vanuatu. VARTC[5] is an important agricultural research facility in the country. Throughout the past years the research station has partnership with DARD and scientists based in Vanuatu to collect, maintain, and disseminate the improved kumala varieties to the local farmers throughout Vanuatu (see Figure 12)

[5] Vanuatu Agriculture Research Technical Centre (VARTC)

Figure 12 Some of the different varieties of kumala obtained through the breeding program at the Department of Agriculture and Rural Development, Port Vila

(Pakoa Leo,2022)

According to RNZ News (2015), Mr Lebot a crop scientist working with MAFFLB acknowledge that , "one priority is to cross pollinate the types of sweetpotato that already exist to produce improved varieties and also to upgrade the potential of sweetpotato" (RNZ News, 2015, p. 1). The Department of Agriculture and Rural Development (DARD)[6], through the extension services have significantly supported

[6] Department of Agriculture and Rural Development (DARD)

smallholder farmers throughout Tanna Island. Smallholder farmers in Tanna access the planting materials from the agriculture assistant officers that are sourced from VARTC, and DARD see (see Figure 13)

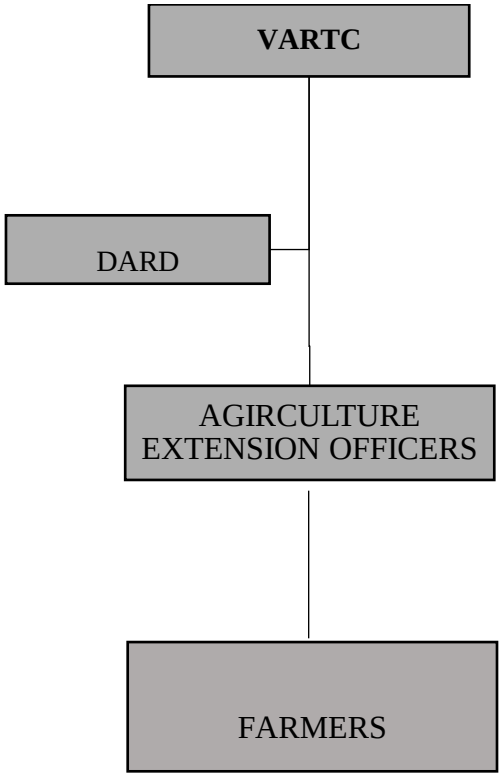

Figure 13 Flow of sourcing planting materials to the local farmers

As previously acknowledged in chapter one DARD collaborated with NGOs that are in Tanna Island to implement programs for food security and climate change adaptation throughout the island. The programs focus on supporting livelihood through farming activities in the communities, helping farmers to increase production and provide awareness of adaptation to the communities. Different non-government organization usually distribute planting materials during the aftermath of cyclones to the farmers who are most affected by the natural disasters. Supporting livelihood of farmers through rehabilitation programs is one of the many objectives of the non-government organisation. According to an NGO based in Tanna the officer explained the support the organization has given to the farmers in Tanna.

> We partnered with rural training centre in Middle Bush Tanna (Napil training centre) and provided the planting materials and involved the trainees to grow food to support the food basket that was distributed during damages caused by the volcanic ash fall (K5)

Despite farmers from case study sites being able to grow kumala in their own gardens and having access to the planting material through the agriculture extension services, the extension services has had challenges with monitoring and evaluating farmers progress after disseminating information and distributing planting material. According to a senior agriculture officer

> A challenge for the extension officers is to follow up on their farmers, a lot of experience have shown that the extension officers provide workshops with the farmers, but we do not follow up, we do not check whether the crop is grown for home consumption or to be sold at the market (K1).

5.7 The smallholder agriculture sector in Tanna Island

Small holder farmers in Tanna are subsistence orientated, engaged in various farming practices, and cultivating different crops to support their livelihood. According VNSO (2016) to the census in 2016, 90 % of household in Tanna are involved in food production, mostly root crops and vegetables from household garden, animal husbandry (pigs and chickens) and fishing for villages along the coastline. Agriculture is the dominant occupation in Tanna Island, most farmers are small holder farmers growing crops in less than 2ha of land as defined by (Lowder et al., 2016). Root crops represent an important part of the rural smallholder farmer's diet in the villages. Taro and yam are traditionally important in the cultural ceremonies as well as part of the cash income. Other root crops such as kumala, cassava, and banana are also socially important in supporting the livelihood of smallholder farmers. In addition, smallholder farmers throughout Tanna grow cash crops, such as coffee, kava, coconut, and coconut (see Table 4). Several households cultivated kava, and it is also reported that Tanna alone produced 98% of the coffee in Vanuatu.

Table 4 Number of households growing different cash crops in Tanna area councils

Tanna Area Council	Kava	Coconut	Coffee	Cocoa
North Tanna	558	641	207	11
West Tanna	790	574	340	21
Middle Bush Tanna	889	217	534	24
Southwest Tanna	892	374	382	25
Whitesands	632	552	30	32
South Tanna	200	131	79	6
Total	**3961**	**2489**	**1572**	**119**

Adapted (VNSO, 2016, p. 15)

However, traditional cropping system is commonly practiced by farmers throughout the island, small holder farmers rely on this system to grow food for the growing population and for their families. Based on the growing population and the pressure on land, a recent study has highlighted that farmer in Tanna increased the number of crops their cultivated compared to leaving to fallow period, thus resulting in reduced soil fertility (Mitchell et al., 2020). Furthermore, land is an important natural resource for the smallholder farmers, it determines the choice and type of cropping system used among the farmers. Mixed cropping of different root crops such as kumala and vegetables are commonly found in the traditional cropping system. They believe if one crop fails due bad weather or attack by pest and disease, another crop would save them. Apart from gardening to support their families and lifestyle, farmers raised livestock as it is an important way to support their livelihood. Subsistence food production integrated with cash crops are approach smallholder farmers are currently involved in to utilise the farm area.

Smallholder farmers in Tanna have access to training centres that are available throughout the island. The training centre provides training to youth who have dropped out of high school. Through the training schools' farmers in the village are introduced to the importance of producing high yielding crops and land use sustainability. This

provides an important demonstration for farmers in other locations facing similar problems. Napil training centre located in Middle Bush Tanna, is one of the training centres currently providing training to the youths, who have been around the villages and are dropped out of school. The youths learn how to manage their farm and grow their own vegetable seeds. A profound goal of Napil training centre is, "To train and establish young Ni-Vanuatu farmers on their own land in their villages to have viable livelihoods, sustainable management over their own land, with the ability to plan and respond to climate and economic changes for productive and environmentally sustainable agricultural sector in Vanuatu" (McGregor & Matairatu, 2014, p. 4). Farmers in Tanna Island like other islands in Vanuatu have also faced challenges, that had a great impact on the production of agricultural produce, the most prevalent are the impacts of natural disasters on the crops. According to World Vison (2020), 80% of the people in Tanna were affected by the volcanic ashfall especially from east to south Tanna. Another challenge is the location of the villages determines the access to infrastructure and services available to the villages. According to FAO (2020, p. 13) throughout Vanuatu:

> Transportation constraints negatively impact the productive sector including agriculture and fisheries. The high cost in air, marine and land transportation of products coupled with extremely poor road, marine and market infrastructure constrain rural people's ability to sell their products.

The main town in Tanna is Lenakel, established along the coast of West Tanna where trade and government services are available for the people. Moving further inland there is minimal infrastructure development with most villagers living in a traditional setting. The transport system has changed and slowly developed over the years. In Tanna Island the transport system is based on trucks, these are private trucks owned by people in Tanna. In the case villages in West Tanna, farmers have access to better roads and more trucks are available for the farmers to transport their produce. As mentioned earlier farmers. This makes it difficult to move the farmer's local produce from the garden to the main road. Overall, the poor roads, inconsistent air flights and sea routes between islands in Vanuatu determines the access of planting materials from DARD headquarters in Port Vila and VARTC in Santo.

5.7.1 Farming practices

Smallholder farmers in rural Vanuatu, including Tanna, are mainly involved in subsistence agriculture based on shifting cultivation, practised on less than 2ha of customary land. The primary cropping systems within shifting cultivation are yam-based and rain-fed taro cropping systems. Subsequently, mixed cropping of other crops, including kumala, peanuts, and vegetables, is also grown. The practice of monocropping different root crops and vegetables is often based on the farmers' household needs. The two case study sites are geographically located in different agroecological zones, which determine the dominant cropping system within the sites. West Tanna situated along the coast, experiencing humid trade winds is favourable to cultivate yam. The wet ecosystem mostly apparent in the interior forest such as in Middle Bush Tanna, is suitable to grow taro. This dominant cropping system have been reported by Sardos et al. (2016), a case study understanding the root crop diversity in the traditional agroforestry system in Vanuatu. In addition, the distinct cropping system based on taro and yam in Vanuatu have been acknowledge by Blanco et al. (2013).

Culturally, yam-based farming system is a common practice for the smallholder farmers in West Tanna. It is a crop with high value status among the food crops, and it requires a lot of labour from the farmers. Due to the cultural significance of yam, it is a dominant crop in the farming system, farmers can rotate kumala with yam, after harvesting yam in the month of April and May. Traditionally, rain fed taro-based farming systems are a common practice throughout the villages in Middles Bush area. In such cropping system taro is the dominant crop, and it is rotated with other root crops like kumala. Taro and yam-based cropping system practiced respectively in each site are not exclusive of other crops. Common in both locations, the practice of intercropping, mixed cropping, crop rotation and mono cropping practices. Smallholder farmers practice, intercropping in both case study sites a practice also identified by Flexner et al. (2024) in Tanna. Once the main crop is grown, farmers intercrop with corn (*Zea mays*) and island cabbage (*Abelmoschus manihot*). Kumala is sometimes intercropped with crops like corn, it is a way to optimize land use and maximize the labour inputs (see Figure 14).

Figure 14 Kumala intercropped with corn in Middle Bush Tanna

(Amanda Nasse, 2021)

Mixed cropping and mono cropping practices are both common among the smallholder farmers in both case study sites. Crops such as corn, cassava, peanuts are grown in mixed farming systems, and kumala is also grown as a cover crop. Mixed farming, involves cultivating a variety of crops, is a common practice aimed at mitigating the risk of crop failure and ensuring sufficient food production. In contrast, monocropping, a practice observed in both case study sites, is primarily driven by market demands and household needs. For instance, root crops like kumala are often cultivated in a monocropping system due to their short growing cycle. Traditionally smallholder farmers in Tanna and most rural communities in Vanuatu, owned several small gardens among the household, to provide food, earn income, meet their cultural obligations and most importantly to combat risk of natural disasters (Kaoh et al., 2016). The high population density and shortage of arable land, increased farmers interest in home gardening throughout the islands in Vanuatu (Steenbergen et al., 2020). Home garden refers to the cultivation of a small portion of land which may be near the house or within walking distance from the family home (Saediman et al., 2021). Farmers in both case study sites set up home gardens where they grow and maintain a variety of vegetables, which contribute significantly to their household food supply. Maintaining diversity in gardening systems is essential for agricultural systems against climate variability. The different crops in

traditional farming are suited to various environmental conditions; when conditions are not optimal for one crop, other varieties must remain unaffected to ensure food security.

5.7.2 Types of crops grown

Smallholder farmers in the case study sites grow various crops to support their livelihood. Traditionally, root crops are staple carbohydrates in both case study sites, among other vegetables. The types of crops grown by farmers are broadly similar across the sites. However, weather patterns determine the yield of different crop and types of crops grown in the case study sites. For instances a number of vegetables are produced by smallholder farmers in Middle Bush Tanna compared to other parts of the island due to the favourable weather conditions. In addition, mango tree, breadfruit tree and coconut are more abundant in West Tanna along the coast, compared to Middle Bush Tanna. Cash crops are a significant component of farmers livelihood in both case studies as mentioned in the previous section. Coffee has been grown in Tanna since the late 19th century, however only in the last 10 years have farmers in Tanna produced exportable quantities. Due to good agronomic conditions to grow coffee, farmers in the Middle Bush Tanna can grow Arabica coffee intercropped with either kava or taro to utilise their farming area; they have been growing coffee to earn money and support their family (see Figure 15).

Figure 15 Coffee intercropped with kava in Middle Bush

(Amanda Nasse, 2021)

Farmers in both case study sites cultivate kava, an important traditional drink that most farmers grow. Growing kava for smallholder farmers in rural communities is traditionally, economically, and socially important to the villagers in Tanna Island and across the different Islands in Vanuatu. In addition, the Ministry of Agriculture aims to promote import substitution, encouraging smallholder farmers to grow crops that are suitable to grow locally in Vanuatu. This include crops such as English potato, onion, and carrot, the seeds were distributed to farmers by the agriculture assistant officers (AAO). Smallholder farmers in Middle Bush Tanna are reported to be successful in growing potato and it has been the highest producing area for potato in Vanuatu (see Figure 16). The emphasis on import substitution, through the cultivation of these crops was to reduce the imports of crops that can be grown locally and increase farmers introduced to different crops.

Figure 16 Potato grown at Lamnatu village Middle Bush Tanna

(Amanda Nasse, 2021)

Smallholder farmers conserve planting materials of different crop species within their garden. Asrat et al. (2010), explained that on farm conservation is a dynamic process in which local farmers managed different varieties of crops. Within the national context it is reported by Camus and Lebot (2010) that on farm conservation in Vanuatu was an appropriate strategy for the conservation of root crop germplasm, that has been successfully carried and maintained by the DARD and VARTC. In Vanuatu, the local system for acquiring planting materials is embedded in the social network of reciprocity, mutual support, and social obligations. Local farmers in all parts of Tanna Island have access to planting materials for different species of crops, including kumala, through social connections, family ties and relationships between the farmers and local communities. Throughout Vanuatu, farmers know about the different species of crops grown in their gardens, and planting materials are exchanged among farmers and between villages.

Furthermore, farmers in both case study sites managed small livestock, including pigs, chickens, and cattle. Figure 17, shows Lenakel market, were farmers come to sell their local produce. Cash incomes are higher for people living near the main town, West Tanna. Smallholder farmers in the West have extra income through families working in the tourism industry. In the case study villages, women are involved in various traditional activities to earn money. Another everyday activity on the West Tanna was women selling cooked food at roadside markets in the evening. In addition, other activities, such as weaving traditional mats and baskets, are among the activities women are engaged in to sell and buy food items or support different needs.

Figure 17 Lenakel Market, West Tanna

(Amanda Nasse, 2021)

5.8 Kumala production

The Department of Agriculture influences the kumala production in rural villages through the distribution of different hybrid of kumala. Kumala is a non-seasonal crop, and it is cultivated all year around in both case study sites. However, the yield is determined by the different weather conditions. Despite not having the annual production of kumala over the years, a mini census has reported the number of farmers that grow different crops in the different area council in Tanna. Table 5, show the number of farmers involved in growing kumala in both sites that was studied. The farmers in the villages cultivate different varieties of kumala, such as baby kumala and a few other local varieties that were mentioned by the farmers. In West Tanna, farmers grow a local variety of kumala, known as Uma. The name Uma is from a devastating cyclone that hit Vanuatu in 1980, the variety was introduced by DARD after the cyclone. The smallholder farmers also grow different improved varieties of kumala that were distributed by DARD officers such as Baby Kumala.

Table 5 Different crops grown by household by six area council in Tanna Island

Tanna area Council	Cassava/ Manioc	Banana	Island Cabbage	Fijian Taro	Yam	Kumala	Island /water Taro	Corn
North Tanna	759	740	718	733	737	533	725	712
West Tanna	1471	1449	1357	971	1423	1134	682	1273
Middle Bush Tanna	1046	951	1008	1022	741	1050	1017	848
Southwest Tanna	981	958	982	977	972	955	963	914
Whitesands	1367	1144	895	1260	790	1118	1188	685
South Tanna	266	263	266	257	250	226	266	254
Total	**5890**	**5505**	**5226**	**5220**	**4913**	**5016**	**4841**	**4686**

Adapted (VNSO, 2016, p. 15)

5.8.1 Challenges of Kumala production

The prevalent challenge to the production of kumala in Tanna Island and other Islands in Vanuatu is the changes in the weather pattern. The impacts of climate change and volcanic ash falls from Mt Yasur continuously pose threats on the production of kumala in both case study sites. The periods of drought and flooding from heavy rainfall are significant threats that farmers faced in both case study sites. Pests, such as rodents, are sometimes found in the garden, attacking kumala tubers. The DARD officers also commented on the influenced of environmental factors also have great influence on the yield of kumala:

> "Environmental factors such as the climate change and soil type often have a great influence on the growth of different kumala hybrid, sometimes a hybrid can produce good yield in the demonstration plot set up in Port Vila, however while introducing it to some Islands it can relatively produce low yield" (K2).

The islands' geographical location in Vanuatu from the capital city (Port Villa) gives smallholder farmers a considerable challenge in getting their produce to the capital, where there is high demand due to a high population and more trade opportunities. Despite having the land to grow abundant food crops such as kumala, smallholder farmers are faced with the logistic cost of cargo freight either by ship or plane; therefore, sometimes, farmers request help from DARD to assist in selling their local produce.

5.9 Cultural and social activities

Tanna Island is referred to as a stronghold of traditions, where the people still trace their lineage through traditional songs and participate in ceremonial activities (Sahin et al., 2021). Tanna Island represents a society, where traditional knowledge is interwoven with decision making, and land use management. In addition, traditional governance plays a prominent role in maintaining and promoting cultural and social values (Clarke et al., 2019). Smallholder farmers living in the rural villages are part of a community that foster social relationships and build interactions that supports their livelihood. In Tanna, social relationships have long been part of the livelihood of smallholder farmers enabling household resilience in the face of calamities. In many villages, traditional houses are organized into small clusters that link to a nakamal[7] where the men in the village assemble in the evening to drink kava (See Figure 18). Kava roots, alongside other traditional crops and practices played a significant role in traditional ceremonies. These ceremonies are similar across the island; these include bride price (marriage), circumcision, traditional exchange ceremonies, funerals and other ceremonies associated with transition in tribal rank in Vanuatu (Bonnemaison, 1994).

[7] Refers to a cleared open space under a banyan tree, where important gatherings and ceremonial activities took place.

Figure 18 Nakamal in Middle Bush Tanna

(Amanda Nasse 2021)

At the heart of cultural and social activities in most rural communities in Vanuatu are the traditional root crops of yam and taro (Blanco et al., 2016). Within the context of this study, understanding the status of traditional root crops is relevant to understanding the holistic nature of the traditions and culture involved with food crops. Cultivation of traditional root crops are embedded with traditional calendars, which play a significant role in the cropping systems on Tanna Island. In Tanna, the traditional root crops of yam and taro have high cultural value, like in other Pacific Island countries. Yam and taro are the two prominent crops in the traditional ceremonies organized around the harvest cycle. These crops are often cultivated in traditional gardens, with strict protocols to harvest and access at certain phases in the growing cycle (Lindstrom, 2011). The traditional food system is interwoven socially and culturally with village life in the remote islands of Vanuatu, including Tanna. Traditionally, the intricate association between people and land has been embedded in smallholder farmers' livelihood in Tanna's rural villages. The traditional calendar in Tanna is centred on the cultivation of yam. Traditional knowledge is embedded in customary gardens. Several older farmers in this study shared their views on the strict cultivation of yam in the traditional garden.

> Growing yam requires care and respect it has traditionally been ruled that yam growing is practiced throughout the different stages of its growth, once yam is planted prohibitions are placed on fishing, and collecting shellfish.

The work of cultivating yam in traditional Tanna communities is rooted in traditional knowledge. “Yam thrives in new gardens and in a soil which must be finely sifted again through the hands of the farmer and their family members. Before the mounds are made for planting the yam, all rough material is removed. In the past the yam mound was a site of creative and aesthetic effort. After planting care is very important, traditional for yam to grow properly a trellis of wild cane fastened with pandanus to protect the vines from the hot ground “(Mitchell, 2021, p. 9). According to Mitchell (2021), these restrictions and work imposed during the growing season of yam protects and allows other species to regenerate. In addition, the work of planting yam elicits the social and moral relationship embedded in in traditional garden preparation in Tanna communities. Despite the stronghold of traditions within the smallholder farmers, modernisation and other contemporary pressure today do influence the livelihood activities. This is prevalent among the types of goods used for the exchange in the cultural ceremonies. For instance, goods sold in small retail shops are often part of the traditional crops offered for bride price ceremonies. In addition, contemporary issues increase the demand for cultivating short term crops, and vegetables to earn income to support the cultural activities. In a study of history of traditions on Tanna Island, Lindstrom (1980), explained that traditional kastom[8] roads are pathways to exchange of food crops across Tanna Island. According to(Atkinson, 2018, p. 10) , kastom “is a whole way of life that dictates almost all of one’s action and provides its own particular interpretation of almost everything that happens”. An elderly farmer in West Tanna articulates the significance of kastom road in Tanna.

> There are four significant kastom roads (pathways) on Tanna Island; the main road, Kotarhen (by sea), follows the shoreline around the entire Island. A second road, Nimhiarap, parallels half up the slope. The third road, Nimatakeiu, lies further inland. Then, there is only one road from the top of the Island to the coastal areas, normally called Nuan-Nipiken (Head and Tail). The roads pass through different nakamals around the Island, acting as a gateway for the passage of information. The kastom roads or pathways. Till today the kastom roads continue to play a vital role in maintaining the cultural rituals, includes, traditional exchange of food crops, arranged marriage, and solving disputes. These kastom roads strengthens family, tribes, and the communal way of life in Tanna Island (WT17)

[8] “Kastom “involves the beliefs, and attitudes embedded in the traditional way of living for a Ni Vanuatu.

5.10 Summary

Vanuatu remains predominantly an agricultural country. Two of the area councils in Tanna Island chosen for this research study are Middle Bush Tanna and West Tanna case study sites. The location of the sites influences the cropping system farmers' practices. Extension services provided through training and dissemination of planting materials support the production of kumala on Tanna Island. The section describes different types of crops farmers grow to support their livelihood and other livelihood activities. Finally, the chapter also unfolds the cultural and social activities embedded in the smallholder farmer's livelihood in the rural communities in Tanna. Understanding these elements of the intrinsic value of root crops such as Yam is essential to view the holistic nature of the farming system in Tanna.

CHAPTER SIX

RESULTS

6.1 Introduction

The research questions for this study are (1) What is the traditional system of growing and utilizing kumala in Vanuatu? and (2) How does the traditional kumala contribute to sustainable livelihood and food security in Vanuatu? In summary, this chapter begins with an understanding of the traditional system of growing kumala. The second section describes the dynamics of the sustainable livelihood of smallholder farmers in Tanna. Then the extension services, and the other supports to the farmers in Tanna Island. Following on, is the section on food security and the impacts of climate change on the production of kumala in Tanna. The chapter concludes with a summary of the key findings from this research. All through the chapter, quotes are used to illustrate the voices of the farmers and key informants and they are indicated using indented quote.

6.2 Kumala Production

The production of kumala is a dynamic process involving planting and harvesting kumala. The production of kumala at both case study sites is small-scale, where most farmers grow the crop to provide food for their families, earn money, and contribute to social obligations. Sustainable production of crops such as kumala, contributes significantly to the livelihood of farm households. Even though production records over the years are limited, small holder farmers at both case study sites have continuously grown kumala for many decades. The changes in weather patterns have impacted kumala production at the two areas. The crop is produced in large food gardens, among other crops and in backyard gardens. Kumala is still cultivated in the traditional farming system within the two sites. Most traditional root crops are cultivated within the traditional food system that is interrelated. In remote villages throughout Vanuatu, such as in Tanna, the traditional system of growing root crops is associated with the farming calendar and the type of cropping system practiced by the farmers living in different parts of the island. The farming calendar, and cropping system contributes to the traditional system of cropping kumala in the case study sites.

6.2.1 Farming calendar

Smallholder farmers in the case study villages use both traditional and seasonal calendars from the Department of Agriculture and Rural Development (DARD). Local farmers throughout the Islands in Vanuatu still practice and hold the use of traditional calendar within their local communities. In Tanna the traditional calendar is associated with the environment, mostly based on the behaviour of local plants and animals. In addition, their farming activities especially time of planting and harvesting aligns to cultural festivals and other ceremonies of significant importance. The traditional calendar is a calendar used by farmers from a specific place, and it is passed on from one generation to another orally. The seasonal calendar consists of detailed information of over 50 crops, it features information such as periods of sowing, space between plants and rows, harvesting period, and production density. Smallholder farmers in both case study sites still practice the use of traditional calendar, and others have adopted the use of a seasonal calendar from DARD.

6.2.1.1 Traditional calendar

Traditional calendars have a strong relationship with the environment. In Tanna Island, the traditional calendar centres on the traditional growth of Yam. According to the observation done in the villages studied, the elders in the community are the guardians of the traditional calendar. Tanna Island has its own traditional calendar that begins when the land is cleared to plant Yam (see Table 6). The traditional calendar comprises of 12 months, with May divided into 2 separate months. May is a significant month, divided into important phases of growing Yam: harvesting and offering. However, traditionally crops in the garden are planted after planting Yam. Yam is the most valuable crop within the traditional gardening system; therefore, the cultivation of Yam is treated with respect from land preparation, planting and harvesting by the people of Tanna. Traditionally, farmers mention that planting kumala after harvesting yam is a common practice that farmers have been using for more than 3 decades. As described by a farmer:

> The practice of planting kumala after harvesting Yam, is the traditional practice we have been practicing in the past until today (WTF1)[9]

Yam is at the centre of traditional and cultural activities it is the beginning of the traditional gardening system. Even though kumala does not have the cultural importance of Yam, it is grown within the traditional growing system. According to the respondents, the planting and harvesting time of kumala in both case study sites were included in the traditional calendar. The traditional calendar is still used by farmers in both case study sites. A farmer from Middle Bush describes the significance of the traditional calendar:

> The traditional calendar is in our blood, we know just by observing from the past, it is in our knowledge that we harvest this crop today we can plant another crop, unless a cyclone happens to hit us very badly and we must change the cropping pattern of the crops (MBF9[10]

A senior agriculture officer shared his view on traditional knowledge that farmers still practice:

[9] West Tanna Farmer 1
[10] Middle Bush Farmer 9

> Traditional knowledge is part of the farmer's daily life, most farmers still use their traditional knowledge today. It is important knowledge passed down from the elders in the community. The external knowledge we share with farmers is there to support the farmers and build on the knowledge they have accumulated over the years (K1).

Traditional calendar is unique because it is embedded in the relationship of people and environment. The traditional calendar in Tanna centres on the different phases of growing Yam, a culturally significant crop that is embedded in the cultural activities. Table 6 shows the traditional calendar used by farmers in Tanna Island.

Table 6 Tanna Island traditional calendar

Tanna Traditional calendar	~Gregorian calendar	Significance occurrence
Nahwa Asuas	January	Rain and cyclone season
Nahwa Matua	February	Fruits ready for picking. The Yam vines are spread
Varitam	March	Vegetative growth of most food crops and vegetable in the garden.
Iatnus	April	-Harvest of first Yam -Harvest citrus fruits such as orange, mandarin. -Flying fish abundance in the Sea. - Plant Kumala (Baby kumala)
Silmos	May	-Selection of the best Yam and fruits for offering. offering of first harvest is a main activity in May. -Plant Kumala.
Iapakalpakal	June	Last harvest of Yam. Occurrence of traditional ceremonies such as traditional wedding and circumcision
Mauk Mai	July	Clearing and burning bushes to establish new garden sites. Tree leaves like Chinese Banyan and Tropical Sea almond start to fall off from the branches. Cold and dry season. Harvest kumala (Baby Kumala)
Mauk Tou	August	-Plough the soil getting ready to plant Yam

Mauk-Wia	September	Yam shoots are growing. staking of the yam vines
Mauk-Kilo	October	Yam tuber formation at this month.
Tamtam	November	Start of cyclone season.
Katik Makos	December	-Fruit trees start flowering, mango, Nakavika (Bell fruit) - Population visits the old garden - Harvest Kumala (Uma)

6.2.1.2 Seasonal calendar

The seasonal calendar is produced and published by technical staff at the Department of Agriculture and Rural development. The seasonal calendar is a tool that provides timely information on different crop species. The calendar provides detailed information on more than 50 edible crops. Unlike the traditional calendar, it includes detailed information on the sowing, planting time, plant density and harvesting time of different crops including yam and kumala.

However, some farmers in both case study sites still use traditional calendars. Other farmers in both case study sites mentioned that they only use the seasonal crop calendar from the Department of Agriculture and Rural Development. Some farmers acknowledged that they use both calendars, due to the changes observed in the weather pattern. Other farmers mentioned that impacts of climate change influence the harvesting and planting seasons. Therefore, they are now using the seasonal calendar from the Department of Agriculture and Rural Development to cater for the changes that comes with climate change. As an example, a farmer in the Middle Bush area explained the changes in the cropping pattern of kumala due to climate change:

> We normally plant kumala in May, June, and July after we harvest Taro, but the weather we experience now changes the growing cycle of kumala; now we can plant kumala in any months and harvest it (MBF10)

Another farmer in Middle Bush also mentioned that:

> …traditional knowledge is the foundation of knowledge that helped build my understanding on ways to grow food in my garden, but now we are living with the impacts of climate change in our environment; therefore, I started practicing using the cropping calendar to plant vegetables that are off-season and use proper spacing for each root crops to increase the yield (MBF4).

Despite the use of both traditional calendar and seasonal calendar, the weather patterns at both case study sites have led to changes in the cropping pattern of kumala. A farmer at Middle Bush describes the changes in the cropping pattern of kumala as follows:

> In the past kumala is usually harvested in specific months, however that has changed a lot. Now we can grow kumala and harvest it throughout the year unless there is heavy rainfall or a long period of drought which can affect the growth of kumala (MBF17).

The onset of changes in the weather pattern have made farmers blend the traditional calendar with contemporary knowledge of different crop types and varieties: One of the farmers stated that:

> I appreciate the knowledge I learned from my forefathers, to grow and plant our own food. But a lot has changed over the past years, I am now planting a variety of kumala given by DARD that I can harvest within 3 months after planting (WTF3).

Another farmer interviewed said:

> We use our knowledge to plant and grow kumala and other vegetables, we also get support from the extension officers when they come around to educate us about the different pest and diseases of plants, and we consult together to find market opportunities for our crops, I think that traditional knowledge and external knowledge are fundamental for us farmers to know (MBF4).

Farmers in both case study sites choose between traditional and seasonal calendars. To most of the farmers, having both calendars is significant, despite the elders in both communities stressing the importance the traditional calendar has being part of their culture and traditions.

6.3 Cropping system

Traditionally, Taro and Yam are the two main dominant crops grown in Tanna, and now kumala has become a common crop in the traditional growing system. Kumala cultivation in both case study sites is determined by cultivating the dominant crop in each area. Due to different weather patterns at each location, West Tanna is dry and favourable to grow Yam and Middle Bush area is often wet, that is suitable to grow taro. Yam is the most significant crop in the traditional system, followed by taro, and the cultivation of both crops drives the traditional growing system of kumala.

The taro cropping system is common in Middle Bush area. Taro is the dominant crop, it takes 6 to 9 months to harvest taro, once harvested other crops like kumala are planted. Taro and kumala are staple crops commonly cultivated in Middle Bush. The respondents in Middle Bush still acknowledge taro cropping system as the main cropping system that farmers this practice. Despite cultivating kumala on a taro-based cropping system, some farmers practice mono-cropping of kumala in their gardens, according to these farmers the soil in Middle Bush is ideal to grow kumala, they can plough a new garden and grow kumala. As mentioned by one of the farmers here:

> We plant kumala after we harvest Taro, traditionally that is a common practice for us, sometimes I plant kumala in new plot among other vegetables (MBF18).

Other farmers explained that planting kumala is sometimes determined by their family needs. This usually happens when families rely on gardening for income to pay for school fees. A farmer shares his experience:

> I often plant kumala in my garden in a monocropping system because I rely on the income to pay my children's school fees. Sometimes I cultivate another plot and grow kumala with other crops, which would be to support our daily diet (MBF14)

Middle Bush practiced several cropping systems that farmers practice in their garden, apart from taro-based cropping systems, mono cropping and mixed cropping are also practiced by farmers to cultivate kumala in Middle Bush.

In West Tanna, a yam-based cropping system is the common system practiced by farmers. Traditionally, yam is the first crop to be planted in the garden. When yam is ready to harvest, farmers dig up the yam and plant kumala on the yam mound. Most of the farmers in West Tanna still practice planting kumala based on a yam cropping system. Once kumala is planted, sometimes it is intercropped among other vegetables. Some of the West Tanna farmers commented on the growing system as one that tolerates the humidity and the distinctly dry weather and means kumala can be grown successfully. A respondent stated:

> We experienced long periods of drought; sometimes, the soil is too dry to plant kumala, using the soil from the yam mound, it is much cooler to grow kumala rather than digging up new mounds again to plant kumala (WTF7).

Farmers described this as a traditional system that being a practice used by forefathers and mothers. Several farmers commented on the significance of this traditional system.

> Traditionally, Yam has a significant status in our culture. It is vital to plant Yam first, as told us by our forefathers. After we harvest Yam, we can plant kumala to ensure a good yield of kumala.

An elderly farmer also expressed his view on the traditional cropping practice:

> In the past I have been planting kumala after harvesting Yam, because if I cleared a new garden to plant kumala, it would not grow well and we do not waste the soil from our labour, instead of leaving it there we must plant kumala (WTF1).

Farmers in both case study sites practice traditional cropping systems. Mixed cropping is the main practice farmers use to plant and grow kumala. With a mixed cropping system, kumala is grown among other crops such as, taro and vegetables. For example, a farmer in West Tanna expressed her view on the best time to grow kumala:

> The best time to plant kumala is after we harvest Yam that is what I learnt from my grandparents, I have tried to grow kumala on a separate garden, but I do not usually get good yield (WTF8).

As for Middle Bush farmers, several farmers mentioned that once kumala is planted other crops are intercropped with kumala. Other farmers mentioned that sole cropping of kumala is a choice they make according to their family needs, especially farmers who plant kumala for specific needs such as to pay for their children's school fee. The cropping system of kumala in both case study sites reflects the livelihood activities that supports the smallholder farmers.

In both case studies the location of gardens is sometimes far from home; therefore, most farmers grow kumala in mixed cropping system with other crops. A few of the farmers at both case study sites have gardens located far from their home. They mentioned that because of this it is important for them to plant a mixed cropping system as they usually walk to their garden, and it is convenient to have a full selection of food crops grown in the same garden. In addition, the growing of a range of crops was identified by them as an advantage as if there is a natural disaster, they have multiple crops to rely on for food. Furthermore, in both case study sites farmers indicated that growing kumala with other crops and vegetables in a mixed farming practice has been a

significant approach to food security. Some farmers in Middle Bush Tanna share similar views on diversifying crops:

> After I harvest the Taro in my garden, I plant kumala and in between the kumala mound I plant corn, sometimes peanut, and island cabbage, in doing it this way I don't usually experience a shortage of food (MB14).

Crop diversification through intercropping and crop rotation have impacts for the farmers in this study. Another farmer explained:

> It is significant to plant kumala among other crops, to provide variety of food crops in our diet (WTF17).

An extension officer mentioned that he continuously encourages farmers to intercrop kumala with other vegetables:

> Most farmers have less than a hectare of land, with the increasing population I encourage farmers to intercrop their kumala with other vegetables and root crops (K4).

In addition, throughout Vanuatu kumala is disseminated through vegetative propagation. Farmers in both case study sites in Tanna source the planting material from different sources.

6.3.1 Site selection

Most farmers from both sites grow food on their forefather's land, maintaining the garden throughout the year is important for each farmer as after the first cultivation phase the land is left for a short period, before it is ready to grow food crops again. Maintaining an old garden[11] is an important task for smallholder farmers in the case study sites. According to most farmers interviewed in Middle bush:

> To have healthy kumala vines to plant in the new year we must take good care of the old garden, once the food is harvested, we still manage to weed around the garden to keep it free from pest and disease, as the new year approaches and we are ready to plant kumala in our new garden we can take vines from our old garden.

Similarly in both case studies, farmers identify old gardens, and fallow land as the best sites to grow kumala. A common reason farmers select fallow land is due to its high soil

[11] Old garden, first garden a farmer cultivated to grow his or her crops.

fertility. According to the farmers, fallowing period takes 2 to 3 years. However, in West Tanna most farmers identified old yam gardens as the best site to grow kumala, traditionally this has been the practice as is explained by a West Tanna farmer:

> The best site I select to grow kumala is my old yam garden, in the past I have watched my parents rotate among our yam gardens to plant kumala, I still carry out the practice today (WTF1).

In both sites, modern tools are used instead of traditional tools for clearing new land to grow kumala. Most farmers in both locations reported using modern tools such as, bush knives, hoes, and other tools for clearing land for their kumala gardens (see Figure 19)

Figure 19 A farmer in Middle Bush harvesting kumala using knife

(AAO Middle Bush, 2021)

6.3.2 Source of Planting Material

Kumala is grown and sourced from vegetative propagation throughout the islands in Vanuatu. The planting materials are source from the DARD. In Tanna planting materials are sourced from the agriculture station, through the extension service provided by the extension officers. Social relationships play a significant role with dissemination of planting materials within the rural communities. In addition, throughout the past

smallholder farmers in Tanna have proven to be self-reliant, relying on their own garden for planting material.

The extension officers from the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (MALFFB) grow different varieties of kumala in demonstration plots within their local agriculture station. When the kumala are ready to harvest, the field officer organized a field day where farmers can come and select the variety of kumala they prefer to grow. At the agriculture field day, organised by the extension officer, often held at main agriculture office in Tanna, officers explain the characteristics of the variety of kumala in demonstration plots. Farmers attend the field day to select for themselves the variety of kumala they prefer to grow in their farm. In addition, nutritional value, good taste, and adaptation to different weather conditions are other characteristics of kumala that field officers ensures that farmers understand. Often the different varieties of kumala grown in their demonstration plots before distributing them to local farmers as these are important characteristics that local farmers preferred to plant. An extension officer based in Tanna explains the characteristics of kumala distributed to the farmers:

> Farmers prefer kumala that has a good taste, therefore as an agriculture field officer it is important that I carry out the trial before distributing kumala to the farmers. Another important factor is that kumala varieties distributed to the farmers can be grown and adapt to the weather in Tanna (K2).

According to another extension officer:

> The main reasons we breed different varieties of kumala and distribute them is to find varieties that are free from pest and diseases, drought tolerant, and promote food nutrition and security (K3).

Non-government organisation (NGO) partnerships with the Department of Agriculture also support farmers with the supply of planting material. Different non-government organisations usually distribute planting materials during the aftermath of cyclones to the farmers who are most affected by natural disasters. Supporting livelihood of farmers through rehabilitation programs are one of the many objectives of the non-government organizations. However, among the farmers interviewed, few farmers mentioned they had received kumala vines from non-government organization. According to an extension officer, the majority of the smallholder farmers in West Tanna, collect their

planting material from the extension services provided to the farmers. The planting material is either distributed to the farmers by the agriculture field officers or the farmers attend the kumala field day to collect the vines for themselves as is illustrated in the following two quotes from two farmers:

> The kumala vines I planted in my garden were collected from a field day that was held at the agriculture station (WTF3).
>
> I plant the kumala varieties that were distributed by the extension officer (WTF2).

According to the above quote, smallholder farmers are benefiting from the extension services provided by the assistant agriculture officers stationed at the respective sites. The extension services include information on different varieties of kumala, and organized field days that allowed the farmers to observe and collect preferred varieties. In addition to sourcing of planting materials from DARD, sharing of planting material including kumala is common among farmers. Farmers in the two sites experience different weather patterns throughout the year, therefore farmers in the West Tanna rely on kumala farmers in Middle Bush to supply them with planting material, especially during drought.

Social relationships are the basis of sourcing plant material in both case study sites. In most villages throughout the island one family may have an extended relative married into a family on another part of the island. Several farmers indicated that they used this pathway to get their kumala plant material. It was evident from the interviews in West Tanna that those social relationships through families and friends contributed to the availability of planting material for the farmers. From the interviews, some kumala farmers gave examples of the importance of social relations in accessing plant material:

> I get the vines from friends and families in the village, I usually ask them to prepare some vines for me especially the ones that I like to grow (WTF1)
>
> In my family we all have a garden, and we all grow kumala. So, when I want to plant kumala I ask within my family members to supply me with some vine (WTF4)

In West Tanna farmers indicated that they experience periods of drought that have significant impact on the planting material. During such events, farmers around West Tanna collect plant material from friends and relatives in Middle Bush. Two farmers comment on sourcing planting material from Middle Bush area:

> Sometimes there is extended period of droughts, to get healthy kumala vines I have travelled to Middle Bush and collect vines from my family (WTF10).
>
> When the kumala vines in my garden are damaged from the long dry periods I faced here, I travelled to Middle Bush and collect the kumala vines from my mum (WTF15).

Furthermore, farmers on-farm conservation has been a source of different planting materials including kumala. Smallholder farmers often maintained and managed their own planting materials. The farmer's on-farm conservation is a source of planting material that smallholder farmers rely on; it has also contributed to food security. The smallholder farmers in this study have traditionally practiced keeping planting material from their farms for the next planting season. The farmers grow kumala from vegetative propagation, therefore, it is very important that viable plant material is available for the farmers during planting seasons. The practice of collecting kumala planting material from old gardens is a common practice for some farmers in both case study sites. However, the case study sites experience different weather patterns. In West Tanna, sometimes farmers faced prolong periods of drought that affects the growth of kumala. Therefore, they sometimes source the planting material from Middle Bush area. A kumala farmer in West Tanna mentioned:

> At the beginning of new year when I am ready to plant Kumala I collect the vines from my old garden and plant them in my new garden, however sometimes the vines are not healthy to replant again because of the dry weather conditions faced here, when this happens, I travelled to Middle Bush area and collect my kumala vines (WTF18).

In Middle Bush area most farmers mentioned that they rely on their own garden collection for kumala planting material, with few farmers identifying the agriculture extension service as the supplier of planting material. Unlike in West Tanna the majority of the Kumala farmers get the kumala vines from the agriculture extension officers and a few get their vine from their families and friends. Majority of the farmers interviewed

in Middle Bush area, commented on the favourable weather that is suitable to grow kumala. Most of the farmers in Middle Bush mentioned that:

> When we are ready to plant kumala in our garden, we collect the vines from our old garden. We usually have a surplus of vines in our old garden for us to replant

Due to the favourable weather experience in Middle Bush area, farmers can have more healthy planting materials in their old garden. Having an abundance of good planting materials results in continuous all year around in Middle Bush area. The farmers have enough for themselves and to share with friends and families, especially to the farmers in West Tanna that are growing kumala. There are different varieties of kumala that farmers source to plant in their garden. Farmers still plant and grow a few local varieties and varieties introduced by the DARD. Chapter 4 of this thesis highlights the different varieties of kumala grown by the farmers through VARTC extension officer distributions.

6.3.3 Kumala varieties grown by farmers

There are over 50 varieties of kumala collected and maintained at VARTC[12]. The different varieties of kumala are disseminated to the DARD, then later shared to the smallholder farmers. There are few local varieties that farmers in the respective case study sites have been growing. In the context of this study, local variety is defined as a variety that has been grown locally by the farmers in a geographical location over a period of time. Local varieties are either of original descent or are being introduced from other places and are accepted and are grown continuously in the local area. Within the two case study sites farmers have also few local varieties that farmers still grow in their garden.
A description of a few of these varieties are outlined below:

I. Baby Kumala

Farmers from both sites describe Baby kumala as a variety with a short growth cycle (see Figure 20) The variety is planted by farmers in both sites. It can be harvested 3-4 months

[12] Vanuatu Agriculture Research Technical Centre located at Santo Island, Sanma Province

after planting. Baby kumala can be planted in both wet and dry conditions and is in high demand in the local market. It is described as soft once cooked and very sweet tasting, both skin and the flesh of this variety are orange. Baby kumala was also recommended to farmers by Department of Agriculture and Rural Development. According to key informants some old varieties have been lost due to pressure on farmers to grow the new introduced varieties.

(A)

(B)

(C)

Figure 20 (A)Cross section of Baby Kumala (B) Cooked Baby Kumala (C) Baby Kumala tuber

(Pakoa Leo, 2022)

II. Uma

The Uma variety was only mentioned by farmers in West Tanna and gained its name from cyclone Uma that hit Vanuatu in 1980. It was also referred to as a local variety by the farmers in that area. It was originally brought to the island by the extension officers after cyclone Uma in 1980. The farmers have a lot of knowledge about this variety (see

Figure 21). For example, many mentioned it has high yield, it can be harvested 6 months after planting, and it stores well both after harvesting and in field storage. The variety has a white skin and white flesh and is in high demand in the market.

Figure 21 Tuber of Uma

(AAO West Tanna, 2023)

III. Yahlume

This variety was only mentioned by farmers in Middle Bush area, where it is commonly grown (see Figure 22). It takes 3 to 4 months to reach harvest, is high yielding and produces lot of tubers. It is usually planted in May. Yahlume, once cooked, is described as soft and sweet. It is suitable for both dry and wet conditions and it grows easily. It is described by farmers as having star shape green leaves with the tubers having white skin, white flesh and it is sold at the local market.

(A) (B)

Figure 22 (A) tuber of Yahlume, (B) cross section of Yahlume

(Amanda Nasse, 2021)

IV Yotil

Yotil was a local variety of kumala identified by farmers in Middle Bush. It takes 5 to 6 months to reach harvest (see Figure 23). It is high yielding and produce a lot of tubers. It is suitable to grow in Middle Bush area. It has a yellow skin and yellow flesh, when grown in surplus farmers sold it at the local market.

(A) (B)

Figure 23 (A) tuber of Yotil (B) Cross section of Yotil

(Amanda Nasse, 2021)

In West Tanna, most farmers interviewed grow the local variety Uma and other varieties that are recently introduced by DARD. Uma is a kumala variety popular among the farmers in West Tanna. Farmers in West Tanna claimed Uma to be a local kumala variety that has been continuously cultivated since 1980, Uma was the only variety of kumala in West Tanna that the farmers referred to as the local variety. Following is an account from a farmer on the variety of kumala:

> In 1980 there was a cyclone called Uma. It hit Vanuatu very badly that year, damaging most of the crops in the garden. After the cyclone, the Department of Agriculture officers came around and distributed a kumala vine that we named after the cyclone Uma (WTF2).

Another farmer in West Tanna mentioned:

> in my garden, I grow our local kumala variety, Uma, I have been growing this variety since 1980 when it was brought here. When I did not have enough, I asked my friends who grew the same variety (WTF14).

According to the farmers interviewed, there are few local varieties of kumala that farmers are still growing in their gardens. In Middle Bush, the farmers indicated that two local varieties of kumala are grown among the community's villagers. Among many types

of kumala, Yahlume and Yotil are local varieties of kumala that farmers in Middle Bush grow in their gardens. In addition, Baby kumala is introduced and distributed by the Department of Agriculture and Rural development to the local farmers throughout Vanuatu. Most farmers in both case study sites prefer to plant and grow Baby kumala. As two farmers share about the variety of kumala that they grow.

> In my garden I grow baby kumala that was distributed to us by the agriculture officer located that resides here in Middle Bush, I have been growing this variety for quite some time now. Apart from Baby kumala I also grow the Yahlume (MBF4)
>
> Baby kumala is one of the varieties we grow a lot in our garden (MBF2)[13]

The agriculture extension officer expressed his view on the introduced variety of kumala:

> Farmers often come to us and collect the different introduced varieties of kumala, returning to their gardens and planting them. When they harvest them, they forget to plant them again, so we must try to get more from Santo, which is quite far (K3).

He continued to explain the advice he usually gives to farmers is to be mindful of the different varieties of kumala they continually plant, that it would not outgrow the few local variety they are still growing:

> I encourage farmers to grow Uma (local variety) in a separate garden to be able to keep our local variety because we have a lot of improved variety from the Department of Agriculture (K4).

The farmers in both case study sites grow both local and introduced variety from the DARD. Individually, some farmers mentioned that they choose to grow any variety they prefer. Some make the choices based on the taste, demand in market, and most importantly, ability to withstand the weather changes.

6.3.4 The work of growing kumala

Gardening is a daily activity for most farmer participants undertaken by men and women in the two case study sites. It is often the responsibility of the men to do the hard labour in the garden, such as clearing of bush and cutting down trees, whereas the women plant kumala. Despite men and women sharing labour to cultivate kumala, some women

[13] MBF2 (Middle Bush farmer 2)

in the case study sites had taken the responsibility of clearing land to plant kumala. For instance, a women shared her experience:

> I am a widow, it is normal for me to do my garden by myself, I plough and plant kumala, I treat my garden like a child, and I take good care of it and often visit my garden, when I do this, it makes me happy (WTF17).

Another man explained.

> My wife and I work together, we plant the kumala and harvest it together, my sons are married, and they now have their own garden, and my family enjoy working together in the garden (WTF5).

In both cases some interviewees commented on the challenges they experienced in finding enough time to spend in their gardens in both case study sites. Women farmers in both case study sites commented on the influences of social activities on their ability to work in their gardens. Several women in the case study sites mentioned:

> The way we do our daily activities have changed a lot. In the past, we only had one main activity: going to the garden. We would go in the morning and work until noon. However, now things have changed a lot; we have so many commitments with the community, it reduces the hours we spend in our kumala gardens (MBF8).

In the villages where everyone is related, things are often shared. Working together as a group is naturally expected in traditional villages. Some farmers in both case study sites commented on village group work that happens in the villages:

> Sometimes, when we need extra help, we reach out to our families and people in the village for help. We helped each other establish our garden and plant big crops such as kumala and Taro.

However, for some farmers, labour is a household decision that they share with their families; as social activities are increasingly becoming part of their lives, farmers ensure sufficient labour is also given to their kumala gardens

6.3.5 Kumala Harvesting

Kumala is usually harvested at different months in the two case study sites. The harvesting duration of kumala depends on the variety that farmers grow. Farmers that grow baby kumala harvest the kumala after three months of planting. In West Tanna, most farmers mentioned that they usually harvest kumala in October and December, as

illustrated in Table 7. In Middle Bush, most farmers mentioned that due to the ideal weather for kumala, it can be harvested all year round. Respondents in both case study sites that grow kumala, such as Baby kumala, harvested the kumala three months after planting; other farmers in West Tanna mentioned that local varieties, such as Uma, can be harvested six months after planting.

Table 7 Planting and Harvesting period for Kumala

Case study sites	**Planting season**	**Harvest season**	**Remarks**
Middle bush	July to August	All year around	Most interviewed mentioned farmers harvest Kumala all year around.
West Tanna	- April – May	- August -6-month variety around December	Most farmers harvest Baby kumala 3 months after planting Uma takes 6 months to harvest, some farmers mentioned they usually plant so they can harvest around Christmas

It was observed that kumala is stored longer in the traditional kitchen[14] compared to other root crops. This is another reason farmers prefer to cultivate kumala for household consumption. In West Tanna, most farmers commented on Uma (Kumala variety) as a variety that can be stored in the traditional kitchen for more than seven days compared to some of the other variety. Most farmers commented in a similar way on the storage of root crops, an example is:

> We don't usually store food in the garden or in the house, when the cyclone damages the crops in the garden, we would go to the garden and replant the crops again, it is convenient to rely on kumala to rebuild or contribute to food after natural disasters (WTF 15)

[14] Traditional Kitchen is a kitchen made of traditional material and is usually bult adjacent to the family home.

6.4 Kumala as Part of Farmers Sustainable Livelihood

Sustainable livelihoods in rural communities reflect farmers' daily activities to sustain their daily needs. In Tanna, livelihoods centre around gardening activities as claimed by most farmers interviewed *Mifala I laef long Karen nmo*, a translation ("The garden is our life). This is a common statement in Bislama for a farmer or anyone who relies on gardening to support their livelihood. Sharing and exchanging are fundamental to how the small holder farmers sustain their livelihoods in rural communities. Within the two case study sites, smallholder farm households' livelihoods rely on the daily gardening of crops and rearing of livestock. Most farmers rely on the earnings from selling the produce they grow (traditional roots crops, vegetables, or cash crops) to provide other necessities. In the case study sites smallholder farmers grew different vegetables, root crops and cash crops that suit the different weather patterns in the different sites. In both case study sites smallholder farmers grow kumala to support their daily supply of food source and earn income from the sale of kumala at the local market. Some farmers also add value to kumala to expand the market options and contribute to sustaining their livelihood.

6.4.1 Kumala an important source of food

Kumala was identified as a staple food by some farmers in both case study sites. Kumala is grown to support the livelihood of smallholder farmers, farmers grow kumala as a food source for their family and for social activities. In Middle Bush area most farmers claimed that taro and kumala are their main staples. Whereas in West Tanna kumala was only identified by a few farmers as a staple food in their diet, and their staple root crop is cassava and yam. Women were identified as being responsible for preparing and cooking kumala for families at both sites (see Figure 24) There are many local well-known dishes on Tanna Island that incorporate kumala; however, they are given different names according to the different languages spoken by the farmers in the case study sites.

Figure 24 A mother preparing kumala for dinner

(Amanda Nasse, 2021)

Bounia is a dish prepared from kumala in West Tanna that is referred to as *katikan* in Middle Bush. The dish is prepared with root crops such as kumala, a choice of meat, and vegetables such as island cabbage, wrapped in banana leaves and baked in an earth oven. The introduction of pots by Europeans contributed to the emergence of a mixture of dishes throughout Vanuatu. Tanna soup is a common dish on the island of Tanna. It is cooked in pots; the dish is eaten daily around the island of Tanna. It is a soup that is cooked with a mixture of root crops such as kumala and vegetables, sometimes coconut milk is added to the soup. In addition to this, *kasul asul or karuaiaruai* is a kumala dish, the dish is composed of sliced kumala steamed with coconut milk, cooked, and enjoyed in both case study sites (see Figure 25). Most women from the study sites shared the same views on the meals incorporated with kumala:

> Kumala is a staple in our kitchen, we cook kumala for our family. A kumala dish I cook would be steamed kumala in the pot with coconut cream that is a very nice way to cook kumala for my family, sometimes I prepare this kumala dish called karuaiaruai for my family it is simple, and my family enjoys it.

Figure 25 Kumala dish

(Amanda Nasse,2021)

Several interviewees from both case study sites indicated they share their kumala harvest with extended family who visit. A large amount of kumala is eaten within households in Middle Bush, and it is cultivated by most households. Some farmers identified kumala as a staple crop that they grew in their gardens and supported them

by providing food for their extended family, other farmers grow kumala as a substitute for crops like cassava.

> … I have been growing kumala in my garden for some time now, but I grow it for my family and extended family and other friends that visit from other villages (MBF5).

6.4.2 Kumala as an income source

The market options for kumala farmers in both case study sites are limited to the domestic market. In Middle Bush area, smallholder farmers access to the market is often determine by the access to better roads. Unlike farmers in Middle Bush, farmers in West Tanna have better access to the main market and more opportunities. Some farmers were able to sell their kumala in the market outlets in Port Vila. Other farmers use roadside market that are available in their villages. One farmer explained his marketing of kumala:

> I have been growing kumala for a while now, I usually sell kumala here at Lenakel market, when I have a good harvest, I shipped the kumala to Vila and sold them at the market to pay for my children's school fee (WTF20).

Farmers in Middle Bush area live far from the main local market in Tanna. Therefore, it is sometimes convenient for them to use the roadside market to sell their local produce. For example, a farmer who was selling her local produce at the roadside market shares her view:

> I have been selling vegetables and other crops such as kumala in this roadside market for quite some time now. The roadside market is much cheaper for us because the market is closer to where we live, we do not have to spend money on transport to go to Lenakel market (MBF20).

Some interviewees from both case study sites indicated that they sell kumala that is excess to what is needed for food by their family:

> Every year I plant kumala in my garden, I grow it to feed my family, when I have a good harvest then usually, I go to the market and sell them (MBF8).

6.4.3 Other source of income

Most farmers in both case study sites diversified in what they grew in the garden. Some farmers in Middle Bush mentioned that they were earning a significant income from the sale of coffee, which has been around their family for more than four generations. Rearing livestock (pigs and chicken) for sale was among the sources of income a few farmers in both case study sites relied on. Farmers who raised livestock for sale also do it for other villagers to purchase for special occasions such as weddings, funeral feasts, bride prices and exchange ceremonies.

Value addition

Farmers are also able to explore the different value add products of each crop that they grow in their garden, such as kumala. A few farmers have responded positively to the impact of promoting value add of kumala. While they acknowledged the traditional way of cooking, farmers interviewed in both communities indicated they were eager to learn more about kumala value add product. According to some participant farmers, they would attend a training if it were provided in their community. A farmer expressed her view:

> We grow a lot of kumala here, we can make other things like kumala chips and flour, but we don't have access to the training and market, If I attended a training and learn how to do chips and other products, I will make it and sell it on the roadside market to earn some money (MBF20).

However, there are only a small number of farmers who have been able to sell value added Kumala products and it has had a significant impact for them and their families. A farmer shares her experience of selling kumala chips:

> I have been making kumala chips for a very long time now, my eldest son is now a teacher, and my two younger children are studying at the nursing school, they are all able to go to school because of the money I earn from selling kumala chips at the roadside market (WTF10).

Another farmer explained the benefits to him, and his family gained from the sale of kumala chips:

> I have been making chips from our local crops in the past years and kumala chips is one of them, the money I get from selling kumala chips, have helped me to buy other things that I need (WTF11).

Furthermore, one government office the Vanuatu Bureau of Standards (VBS) provided training to the local farmers on the value add of local produce. The researcher observed some farmers receiving training on Value add of Kumala, apart from Kumala chips farmers learned to make kumala jam (see Figure 26), flour and prepare frozen kumala chips (see Figure 26). Despite the contribution of kumala in the smallholder farmers livelihood, the market opportunities are often limited. Marketing is a challenge for farmers growing kumala in both case study sites. Some participants commented that the market access was not enough for every kumala farmers. Despite having access to the main local market in Tanna some farmers also sold through roadside markets available to them. As identified by some farmers in the case studies, roadside markets have recently become convenient markets. A few farmers mentioned the benefits of selling their vegetables and crops at the roadside market. A farmer shares his experience on the challenge of marketing his Kumala:

> We have land to plant kumala and access to planting material, but we are still struggling to sell our kumala. Last year I planted one hectare of kumala I sold some at Lenakel market, but still have kumala left that are not sold. So, I had to give them away to my extended families, the market we have is not enough for everyone. I had a good harvest last year, but I could not make good money out of it. If only the government can help to pay and supply local food like kumala to the school (WTF7).

Figure 26 Kumala Jam

(Amanda Nasse, 2021)

Figure 27 Frozen Kumala Chips

(Amanda Nasse,2021)

6.5 Cultural and Social Obligations

Culture and traditions play a significant role for the people of Tanna. Culturally, food crops contribute to traditional ceremonies and rituals. It was observed that the cultural exchange of food crops still exists and plays a significant role in both case study sites. Traditionally, the exchange of food crops, fruits, and vegetables is a way of life that farmers have engaged in throughout the years. Most food farmers exchange is abundantly grown in their natural surroundings due to the environmental conditions providing suitable growing conditions. The Western part of Tanna is ideal for fruit trees such as coconut, breadfruit, and mango. Middle Bush area, taro and kumala are highly cultivated. From the case study sites, kumala is not recognized as an important cultural crop, yet it is highly cultivated for food. Culturally, the exchange of crops throughout the island has continuously supported social relationships:

One of the farmers stated his positive views on the status of kumala in the rural community:

> Kumala is part of the food crop that we exchange in the past and still happening today, because crops such as Yam and Taro are not yet ready to harvest, and when we want to visit any family and friends, we take kumala and we exchange kumala with families in the West for coconut (MBF9).

Another farmer explains:

> Exchange enables us to have access to food, which we don't have such as coconut (MBF1).

Most farmers in West Tanna made the same comment on the exchange of food crops when they want to eat kumala and taro they exchange mangoes and breadfruit with families and friends in Middle Bush Tanna.

Both case study sites are rural communities, where farmers are involved in community activities and kastom ceremonies. Some farmers from both case study sites emphasized the importance of planning out their garden activities to ensure food security. A farmer described why planning was important to manage their gardens:

> We are part of a big community and our kastom rituals are very important part of our people's life, everyone always felt obligated to contribute food crops to these activities, thus it is important to plan according to the activities in our community, doing this we can have enough food for ourselves and gather for our custom ceremonies (WTF17).

In addition, most elders in both communities shared a view on the importance of culture and kastom rituals as a pathway to ensure that they always have food in their community. Exchanging of food crops between people in the island, is a pathway that our forefathers have used to enable them to have access to food that they don't have. Root crops including kumala forms the huge portion of goods in the exchange and so a lot of farmers grow them for these activities.

6.5.1 Status of kumala in Tanna Community

In the local community in Tanna, some farmers have acknowledged the significant role of kumala with the traditional food system:

> Kumala is a root crop that is recently introduced in our communities compared to Yam, however unlike Yam, kumala has assisted us a lot in providing food, there is no sacred farming practices, therefore we can plant and harvest kumala and eat like we want with no restriction (WTF5).

Socially, kumala is given the status of kaikai blong kitchen, meaning food belonging to the kitchen rather than the nakamal[15] by most respondents in both case study sites.

[15] Refers to a cleared open space under a banyan tree, were important gatherings and ceremonial activities took place.

However, some farmers expressed the views on the social status of kumala as it being a very important crop in the traditional food system:

> Local root crops such as yam and taro are grown in season, and it contributes to the kastom ceremonies, kumala is usually left in the kitchen and provide food for the family, when all the crops are taken to the traditional ceremonies, we would come home to have kumala (MBF5).

An extension officer shared the same view on the status of kumala in his community:

> Kumala belongs to our home kitchen, we take yam and taro to the nakamal for kastom ceremonies, it provides food at home (K4).

For some farmers in both communities, kumala is a feasting food, that is cooked in large gatherings such as weddings and Christmas holidays where family gather to share big meals. Traditionally, people have strong relationships with the food they grow, it promotes culture and supports the livelihood of people in Tanna. Sharing of resources, interdependence, collected community efforts are important values in both sites. However, some farmers in both sites shared their feelings on the change that has influenced cultural rituals:

> We can see our kastom rituals becoming a competition, in traditional wedding ceremonies the exchange gifts have drastically increased over the years, when our children get married, we must grow more food to prepare for their wedding, yet the space is becoming limited for a family.

One farmer expressed his view on the status of kumala in the local community:

> our forefathers lived differently from the way we are living now. Today, food has become a competition for farmers in relation to yield and gaining social status. Culturally, kumala has no value compared to Yam, but things may change in the future and kumala can have a value like Yam and Taro in our cultural ceremonies because it has become a staple crop for us and helps our living (MBF9).

6.6 Food security

Food security is a substantial issue that smallholder farmers are facing in rural communities. Within the traditional cropping system, farmers have engaged in cultivating crops such as Kumala that is resilient to the changing weather patterns. Kumala is recommended by DARD, as an important resilient crop that it is implemented by the extension officers to the smallholder farmers.

An extension officer in Tanna shared their view on what the purposes of household gardens need to be:

> In Tanna a farmer grows food for three main purposes, to support traditional ceremonies, for food, and cash. Sometimes farmers focus more on traditional ceremonies and cash, and they forget about food or have little to support them with, thus we extension officers continue to encourage farmers to have separate gardens for these three main activities, traditional rituals, food, and cash. So that they can sustainably provide food for their family, earn money to support other needs and continue to support the cultural rituals (K4).

Both case study sites participants identified kumala as a recovery crop that not only contributes to the daily diet but also improves food security for rural communities during the aftermath of natural disasters. According to farmers interviewed.

> Kumala is a crop that has helped us a lot during the aftermath of cyclones in the past up to today and during cyclone season kumala is a crop that is available in our kitchen.

A farmer expressed the importance of kumala as a source of food.

> Kumala helped us a lot, when you plant another local root crop, it takes a while. We must wait to harvest crops such as Yam, Taro, Cassava but Kumala provides food within three months (MBF10).

In addition, the agriculture office expressed the importance of kumala production:

> The kumala production is very important throughout the years, it has increased, and more people are interested in planting kumala, it is a resilient crop, it is a source of food that is available during the aftermath of disasters (K1).

The extension officer's advice to farmers was to grow resilient crops such as kumala in their garden. An extension officer recounts what he tells farmers:

> During the field day I advise farmers on the different varieties of kumala and explain the importance of kumala that is a crop with a short grow cycle and high nutritional value, we recommend farmers to continue growing it in their gardens (K2).

Kumala was regarded as an important food security crop by farmers at both case study sites. Farmers in West Tanna commented on the traditional status of Yam, as it can only be harvested once in a year, therefore kumala has been a constant support for their household food supplies. A farmer comments on the reliance on kumala as a staple food for his family:

> We rely a lot on kumala for food, unlike Yam Kumala helped us a lot it provided food when we needed it, and there is no traditional taboo associated with the cultivation of kumala like Yam, it is a root crop that anyone can plant and harvest (WTF 6).

Kumala is available and accessible in both case study sites, for farmers growing kumala has contributed to their staple diet. In Middle Bush area, farmers claimed that kumala is a crop that can grow well in their area, and it has become a non-seasonal crop that they can grow in any month of the year. According to a farmer in Middle Bush:

> Kumala is a good food crop, it is not labour intensive to plant kumala, the planting material is available around us, and we can now grow and harvest it throughout the year (MBF4).

Most farmers in both case study sites grow kumala for food. However, the availability of kumala before and during the aftermath of cyclones, is another reason farmers grow kumala in their gardens. A farmer who relied on his garden for food explains the value of kumala:

> We are so grateful for kumala, there are varieties of kumala such as baby kumala that are ready to harvest after 3 months which we can plant before the cyclone and after the cyclone season. The main reason is kumala provides food when we need it (MBF9).

From both case study sites farmers indicated that growing kumala with other crops and vegetables in a mixed farming practice has been a significant approach to food security. Some farmers in Middle Bush shared similar views on diversifying of crops:

> After I harvest the Taro in my garden, I plant kumala and in between the kumala mound I plant corn, sometimes peanut, and island cabbage, in doing this way I don't usually experience shortage of food.

Despite the traditional growing of kumala through the different farming systems in the case study sites, the impacts of climate change on the farming system have shifted the farmers approach to growing their crops. Farmers in both case study sites are relying more on the home gardens that constantly provide food for their family.

Home gardens are a garden commonly located around the house or within the walking distance from their home. Home garden is an approach farmers rely on for food security and their support the livelihood. Some farmers in the case study sites have home gardens where they grow food that is part of their daily diet. A farmer in Middle Bush explains the significance of her home garden:

> I grow most of the food crops and vegetables that we often eat at our home garden, such as island cabbage, kumala, corn and other vegetables. My garden is across the road to my house, it is convenient for me to get kumala with my other vegetables, so when I am busy, I still can get food (MBF14).

Kumala is regarded as a potential food security crop, the short growth cycle promotes its availability as a food crop, and a recovery crop during the aftermath of natural disasters. These attributes have enabled kumala to be significant food crop in the food basket ensuring that local and healthy food is available, during and after a natural disaster.

6.6.1 The Concept of Food Basket

The Department of Agriculture and Rural Development in Vanuatu usually partner with non-government organisations to provide services to the smallholder farmers in the rural communities. These services encourage farmers to grow more local produce. The concept of a food basket from the Department of Agriculture and Rural Development, ensures that food is available and supports the recovery during aftermath of natural disasters. The concept of a food basket was explained in more detail in the case description.

According to a Vanuatu Skills and Partnership officer an NGO located in Tanna Island:

> We have been in partnership with the Department of Agriculture and Rural Development in the Food Basket program working together with the extension officer in Tanna and Napil training center. We grow a lot of the local root crop such as kumala and cassava, we distribute the food crop to the communities in East Tanna that are affected by the volcanic ash fall (K5).

As well as growing kumala as a staple food for the household, farmers in Middle Bush usually contribute to the food baskets that are distributed to communities that are affected by natural disasters. When there is a natural disaster that caused severe damage in any part of the island, food crops are sourced from farmers in villages that are not affected by the disasters. For example, the volcanic ash fall that occurred in parts of Eastern Tanna in 2021, the farmers from Middle Bush provided food crops to their families in East Tanna.

According to the extension officer:

> We sometimes buy kumala at a reasonable price from the farmers in Middle Bush area and distribute it to the boarding school and communities that are affected by the ash fall in Eastern Tanna (K3).

Traditionally, culture and social obligations support food security within the local communities. Social obligations such as exchange of food crops, have been pathways for the people living in the rural communities to have access to food.

6.7 Kumala and Climate Change

The impacts of climate change have farmers in both case study sites describing the changes in the weather pattern, and the impacts of the aftermath of tropical cyclone, that led to prolonged drought in West Tanna and flooding in Middle Bush. The changes in the weather pattern that farming families are experiencing have increased their reliance on resilient crops that can withstand the changes in the weather pattern. Farmers in West Tanna explained that the dry season leads to prolong period of droughts that affect the growth of crops in their garden. According to a farmer in West Tanna:

> When there is long period of drought, the kumala vines are dried up, when this happens it affects the tuber. Sometimes the drought period makes the soil too dry to be able to plant our kumala (WTF8).

Another farmer continued to explain that in West Tanna:

> When the heat from the sun is too strong, it affects most of the crop, sometimes we had to plant our crops close to big trees where there is less heat from the sun heating the soil (WTF12)

During the hot and wet season which falls between November and February, tropical cyclones are likely to occur with heavy rainfall that causes flooding of gardens. According to some farmers in Middle Bush area:

> When we experienced flooding in our garden, it damages the kumala (MBF17).

Another natural disaster is volcanic ash fall from Mt Yasur a volcano located southeast of Tanna. The volcanic ash falls damage most of the crops in the garden:

> Ash falls from the Volcano on the kumala leaves and other crops, leads to damage and poor-quality crops (WT10).

Despite the impacts of climate change such as tropical cyclones, farmers at both case study sites commented on kumala as a crop that can adapt to different weather conditions and therefore it is widely grown by the farmers in both case study sites. Some farmers in West Tanna comment on the traditional practice of planting kumala after harvesting Yam, as a practice adopted as an adaptation to the dry seasons that they usually experience in Western Tanna:

> In August when we harvest the last Yams in our garden, we are now ready to plant kumala that is also the dry season, using the soil from the Yam mound is much cooler and soft to plant kumala and kumala grows well when planted this way during the dry season (WTF13)

Other than these environmental impacts, farmers in both case study sites mentioned that sometimes the kumala tubers are damaged by rats which is a common pest that damages the kumala tubers in on the field.

6.7.1 Preparation for natural Disasters

In both case study sites, most farmers shared the same approach to prepare for the cyclone. A common practice farmer used to prepare for natural disasters such as cyclones is cutting down branches of cassava and adding mounds to the kumala before the rainy season. Interviewees from both sites commented on the ability of kumala to survive during cyclones. Most farmers describe kumala as an underground tuber, where sometimes it can survive the devasting weather conditions:

> As the strong wind blows the tuber remains healthy and strong and underground, and it only takes 3 months to harvest. In wet seasons, farmers grow the kumala on raised mount to prevent the soil from washing away during events of heavy flood.

6.7. 2 Use of Traditional Knowledge

Extension officers lived within the rural communities and continued to put strong emphasis on the uses of traditional knowledge. With the influence of climate change observed in both communities, the extension officers have promoted both traditional

knowledge and external knowledge. An extension officer expressed his view on the advice he gives the farmers about traditional knowledge:

> I encourage farmers to hold onto the traditional knowledge it has a strong relationship with our environment. I also encourage farmers to balance both knowledge, because both knowledge is important, for example when we give farmers introduced variety of kumala, we must explain the best growing conditions for this new variety (K3).

It emerged from the study sites that most of the farmers acknowledge traditional knowledge and commented on its influence in their livelihood such as cultivating land to plant and grow crops.

> We plant and grow food using the knowledge we learnt from our elders in the community, finding the best fishing grounds building traditional houses.

Maintaining traditional knowledge among the younger generation is a challenge shared by most farmers in the two study sites. A farmer explained in the past they learnt the knowledge from their parents:

> In the past when our mother and father goes to the garden, we would also follow them, that is how we are taught and learn the traditional farming practices, it is different now the children go their own way and do activities while parents would go gardening (WTF2).

Some participants lamented the loss of traditional knowledge in the younger generation, one participant explains. Most elderly farmers in both case studies, emphasised the loss of traditional knowledge among the new generation, as more youths are moving to the urban centre to find more opportunities.

> Our children now do not even spend time to learn or listen to old people, when they are doing something, working in the garden, or cooking traditional dishes (WTF17).

6.7.3 Environmental indicator

Environmental indicators were commonly used by some farmers to guide them with their different cropping activities. They are a component of traditional knowledge that farmers hold in their communities. The knowledge on behaviour of trees is widely used, in the traditional societies such as in Tanna. The use of Tropical almond tree and Chinese Banyan have been extensively used as an indicator for farmers to clear and burn bush

to start planting (see Table 8). In addition, traditional knowledge is still used to clear land to cultivate kumala, it is a knowledge shared by farmers at the two case study sites. Most farmers in both case study sites make the same comments on the use of environmental indicators:

> When the leaves of the Natapoa (Tropical Almond) and Nabanga (Chinese Banyan) tree start to dry up on the branches and fall, we know it is time to clear and burn the bush.

The knowledge on flowering and fruiting of trees are commonly used in the rural communities to identify when to undertake the different cropping activities. An environmental indicator used to determine the planting time for kumala is the peach tree (see Figure 28). When the peach tree flowers, it indicates the time to plant kumala. According to the modern calendar, the main flowering season for peach tree is from April to May. Most interviewees referred to this as an indicator that they used in both case study sites to plant kumala. According to an agriculture field officer with the changes in the weather, the animal's behaviour and plant growing patterns are changing:

> Therefore, farmers need to balance the use of both traditional and external knowledge in their cropping management (K2).

Figure 28 Peach Tree (Prunus persica)

(Amanda Nasse 2021)

The impacts of climate change have altered the behaviour of plants over the past years. Some farmers in both case study sites shared the same experience on the changes they have observed throughout the years:

> We still rely on the traditional knowledge, such as observing the changes on the tree to know when the right time is to clear the land to plant, however the changing weather pattern has changed the growth behaviour of some of the trees.

The researcher observed that the elders in the case study sites are the custodian of knowledge on the environmental indicators. In addition, most elderly farmers stress their views on the disappearance of the tree that relates to planting of kumala. A farmer shares his experience:

> The peach tree is slowly disappearing, we have been using it in the past however the changes in the weather pattern have slowed the onset of flowering and nowadays it is difficult to find the tree. It used to be seen growing everywhere but not anymore, I am not sure if we can still find them around in next five years (MBF12).

Smallholder farmers knowledge on planting kumala and other crops includes the environmental indicators, indicating the best time to grow kumala as illustrated in Table 8

Table 8 Trees and their relationship with planting Kumala across both study sites

Common Name	**Botanical Name**	**Local name**	**Relationship to farming**
Tropical sea almond Chinese Banyan Tree	*Terminalia catappa* *Ficus microcarpra*	Natapoa Nepuk, Nabanga	When the leaves become dry and falls off, it indicates the best time to clearing land and burning of bush to establish new garden
Peach	*Prunus persica*		The Peach Tree indicates planting time for kumala when it is at the flowering stage.

6.8 Summary

This chapter describes the main results of the study. The findings from the interviews regarding the status of kumala as a significant food crop within the traditional food system are initially provided. The study shows that kumala fits into the traditional cropping system. It highlights the different sources of planting materials that contribute to the availability and accessibility of kumala as a food crop for smallholder farmers in both communities. The study highlights the role of kumala as a crop for recovery during the aftermath of natural disasters, a food security crop for farmers, and its contribution to the food basket. Both case studies provide details on how and why kumala supports the livelihood of smallholder farmers. It further highlights the smallholder farmers' perspective on the status of kumala within communities embedded in cultural and social values. The results from the study highlight that the cultivation of kumala is informed through the traditional knowledge of other traditional crops, acknowledging the traditional calendar and environmental indicators still used by smallholder farmers.

CHAPTER SEVEN

DISCUSSION

7.1 Introduction

This chapter compares the findings from the study with the literature and uses information about the research context (chapter four) to explain the differences and similarities. This chapter discusses the research findings related to this study's research questions: (1) what is the traditional system of growing and utilising kumala in Vanuatu? and (2) how does the traditional method of growing kumala contribute to sustainable livelihood and food security in Vanuatu? The study applied a qualitative case study approach, and the data was collected through a mixed methodology of the traditional method (storian), semi-structured interviews and secondary documents. Kumala has supported the livelihood of Vanuatu farmers and gained the status of recovery crops in the food basket and a food security. Therefore, relevant stakeholders in the government must provide and support market access and acknowledge the role of kumala in the traditional food system.

7.2 Kumala grown in the traditional food system.

This study and research found that kumala contributes to local resilience, and is grown within traditional food systems, building on traditional farming methods, knowledge and calendars associated with traditional crops. It was evident in this study that the cultivation of kumala within the traditional food system, underpins the greater adherence to traditional food system that is supported by smallholder farmers' traditional knowledge of maintaining diversity of food crops. Kumala is a similar crop to yam, and taro and can be grown in conjunction with these traditional crops, either intercropped or following yam and taro production. This complementarity is in large part due to kumala's drought tolerance, short growing season, ability to be grown at different

altitudes, and long storage life. Therefore, it is an ideal food security crop. Similarly, a study in Vanuatu by Lebot et al. (2015), reported that cassava fits into Vanuatu cropping system due to ease cultivation and its well incorporated within the cropping cycles. As reported by Blanco et al. (2013), a study in Vanuatu shows that adopting root crops such as kumala promote resilience in traditional cropping system. For instance, when cyclone damaged taro farms in Tanna, farmers responded by planting kumala due to its short growth duration. Beckford and Barker (2007) conducted a study in Jamaica which similarly showed that smallholder farmers have practiced yam-based cropping is informed by traditional or local knowledge, and the ability to grow yam is shared among the smallholder farmers in the different regions It was evident in this study that despite growing kumala within traditional cropping systems, smallholder farmers extended the cultivation of kumala to other systems to enhance wider production and to provide extra income for households. Root crops such as yam and taro are deeply rooted in the traditional rituals, knowledge, and practices of rural communities in Vanuatu. Similarly, Van der Merwe et al. (2016) highlighted that in South Africa, the cultivation of indigenous crops is associated with traditional knowledge, methods, and experiences that farmers share. This current study found that unlike other root crops such as yam and taro, kumala is a root crop with no traditional norms associated with planting and harvesting enabling the farmers to grow it throughout the year, thus promoting kumala as a potential food security crop that is readily available and accessible. For instance, kumala is unlikely to be present in traditional ceremonies as a food crop to be exchanged in bride price ceremonies, however, farmers claim it is a crop that provides food in their households. Therefore, it is evident in this study that kumala is a food security crop that is fitted into the traditional food system. Yet, it can be available and accessible for smallholder farmers in both case studies. The findings in this research reflect those of Ba et al. (2023) and likewise emphasise the lack of cultural value attributed to kumala and yet acknowledge that kumala is a staple food crop, grown to support household food demand among the local farmers in Rakai, Taiwan. Leach (2005), explains that in Fiji, taro is of high cultural significance compared to kumala, and commented on the increased kumala cultivation temporarily replaced taro during post cyclone periods.

7.3 Kumala, a food security crop in Vanuatu

Empirical reviews have explored the role of kumala (sweet potato) in developing countries, a significant food source to mitigate hunger and as a sustainable crop to address the issue of food security (Mabhaudhi et al., 2015; Mukhopadhyay et al., 2011). The current study, like the work of Iese et al. (2018) in Pacific Island countries, highlights that kumala is a prominent crop for food security due to its ability to grow at different elevations, tolerance to drought, resistance to pest and diseases, and it is a non-seasonal crop in some parts of Tanna Island. These characteristics contribute to sustainable production and build household resilience of rural communities before and during the aftermath of natural disasters. Furthermore in the context of the Pacific, kumala is cultivated due to its features, high yielding, a staple food, and its contribution to food security for farming families in rural communities (Gouveia et al., 2019; McGregor et al., 2016; Thaman, 1990). Gatto et al. (2021), a recent study in Philippines showed cultivation of kumala contributes to household resilience and reduced exposure to food insecurity post-typhoon, due to shorter growing cycles than other Asian staples. Motsa et al. (2015) reported that in South African farmers producing under drought conditions benefit from the cultivation of kumala, it is less susceptible to drought stress and produces higher yields, greater than their popular staple such as maize.

In this study, kumala is available and accessible for farmers in both case study sites. It is a non-seasonal crop grown throughout the year in one part of Tanna reflecting the availability of the crop. The planting material is accessible between the farmers and in both study sites through the bond of existing social relationships and the practice of food and plant material exchange. Similarly past studies have acknowledged the significant role of kumala as a food source and the features that complement the four pillars of food security (Iese et al., 2018). The pillars of food security include availability, accessibility, utilisation, and stability (Nanbol & Namo, 2019; Vogliano et al., 2021). Table 9 highlights the features of kumala and its relevance to the four pillars of food security identified by smallholder farmers across the study sites.

Table 9 Features of kumala and four pillars of food security

Food security pillars	Tanna community level
Availability	• Seasonal crop: farmers in both case study sites grow kumala. • Farmers grow drought-tolerant varieties, ensuring food availability during drought periods.
Accessibility	• Staple food crop: therefore, it is accessible for both men and women to cultivate kumala in both case study sites. • Kumala tuber and planting materials are accessible between farmers and across different villages. • Kumala is not associated with cultural obligations such as yam and taro; therefore, it is accessible throughout the year.
Utilisation	• Kumala is grown for food and sold at the market to generate income. • Farmers incorporated value add products, such as kumala chips, to support their financial income.
Stability	• Short growth duration enables farmers to access kumala tubers and planting materials throughout the year. The continuous cultivation of kumala due to its accessibility and availability as plant material and food crop reflects its sustainability among other root crops to support the livelihood of smallholder farmers

The utilization of crops as primary inputs for value-added products, contributes to the livelihood of smallholder farmers, providing income to support their families (Codjoe & Owusu, 2011). In this study, value-added kumala products were small in scale; however, a few farmers rely on the generated income from the sale of kumala chips to support them financially. This corroborates with studies in Nigeria emphasising the value-added products of kumala that financially support the livelihood of smallholder farmers (Adeyonu et al., 2016; Parmar et al., 2017), also farmers to be fully engaged in value-add products of kumala, such as flour, kumala chips, the support from training and extension services are necessary to assist farmers. This is consistent with this study where smallholder farmers emphasised that training is a practical approach to help farmers engaged in value-add products of kumala.

This study not only highlights the role of kumala as an essential food security and recovery crop grown by farmers but supports the role of kumala in the food basket an initiative from the Government. This initiative provides kumala tubers and planting materials to ensure the availability and accessibility of food crops before and during the

aftermath of natural disasters promoting stability, the fourth pillar, which refers to sustainability of the other three food security pillars. Furthermore, policy makers and researchers are increasingly supporting the production of kumala as a food security and recovery crop (Afzal et al., 2021). Studies in Africa have reported on support from the government regarding the production of kumala as demand increases to support smallholder farmers to have access to food during famine periods (J. Low et al., 2017). In Tonga, the Ministry of Agriculture promotes the production of kumala through distribution of planting materials as an important disaster recovery crop (Iese et al., 2018). Similarly in Fiji (McGuigan et al., 2022), local Government promotes kumala as an important disaster recovery crop, increasing its distribution among the farmers.

Furthermore, referring to Table 3 in chapter three, the literature has highlighted the significant role of kumala in supporting smallholder farmers in rural communities to advance towards achieving SDG2 focusing on the five targets. Pertaining to the above section, kumala is a food security crop in Vanuatu, this study also acknowledges the role of kumala in progressing towards achieving Vanuatu's global goal of SDG2. It was evident in this study respective of the SDG2, that smallholder farmers cultivation of kumala, promoted and supported through the extension services and polices in Vanuatu has the potential to advance towards achieving SDG2 targets. This is consistent with the recognition of kumala (sweetpotato) in developing countries, as an important food security crop with potential to reduce hunger, and as a resilient crop that grows on marginal soils, incurs low production cost, serves as a cover crop to prevents soil erosion, has high nutritional content and value (Johnson et al., 2022), and played a critical role to buffer against food shortage during natural disasters (Gatto et al., 2021; Sapakhova et al., 2023). Similarly a recent study by Afzal et al. (2021), emphasised that sweetpotato has important untapped potential to advance progress towards the SDGs linked to versatility of the crop and the multiple benefits.

7.3.1 Reliance on kumala as recovery crop

It is evident in this study that kumala is a resilient crop that plays a significant role in buffering from natural disasters ensuring accessibility and availability of food crops. Similar findings were reported in Bellona Atoll in the Solomon Islands, highlighting that during environmental disasters the habitants were reliant on kumala as opposed to taro as a food source (Iese et al., 2017). Kumala has played a significant role in mitigating impacts of natural disasters (van Jaarsveld et al., 2005). The use of drought-tolerant varieties of kumala has been reported by other studies in Africa, highlighted the role of kumala an important crop that smallholder farmers have increasingly cultivated to mitigate the environmental shocks such as droughts, flooding and famine, to provide food and contribute to livelihood and wellbeing of smallholder farmers (Heider et al., 2021; Manners et al., 2021; Schwarz et al., 2011). Similarly, studies in Pacific Island countries showed that in times of drought, growers tended to adopt the drought-tolerant varieties of kumala (Gwatirisa et al., 2017; McGuigan et al., 2022). For instance, a study in Fiji, based on post-cyclone resilience in local food system, showed that sweetpotato was commonly listed as an emergency food by smallholder farmers. The following section describes the impacts of climate change on growing kumala, and the approaches farmers adopt into their farming system to mitigate these challenges.

7.4 Smallholder farmers in Tanna; Impact of climate change on growing kumala.

This current study concurs with previous studies, highlighting challenges smallholder farmers face regarding climate change on the production of kumala, such as drought and high rainfall. In this study, the farmers in West Tanna faced prolonged periods of droughts that impacted the growth of kumala, resulting in vine death, and poor yields. Respectively, most farmers in Middle Bush mentioned that heavy rainfall often damages the kumala tuber. Studies in South Pacific Island countries have shown that rural communities are vulnerable to climate change due to flooding from heavy rainfall and droughts that directly affect food production (Nunn, 2009; Smucker & Wisner, 2008). In developing countries smallholder farmers face continuous challenges in the face of climate change that negatively impact the production of agricultural produce that

constitutes farmers' well-being in rural communities as reported by (Chandra et al., 2016; Fanadzo et al., 2021). Rural smallholder farmers in the South Pacific are left vulnerable in the face of risks and challenges presented by climate change (McGregor et al., 2016). For instance, prolonged periods of drought, heavy rainfall, and tropical cyclones affect agricultural crop production directly impacting smallholder farmers' livelihoods in Fiji (Magee et al., 2016; McNamara & Prasad, 2014; Sharma, 2007). These studies showed that drought after a cyclone in rural villages in Vanuatu and Fiji damaged most garden crops. Eriksson et al. (2017) highlights the impacts of tropical storm Pam in 2015, which induced a prolonged drought period that impacted garden crops (manioc, banana), cash crops (coconut and cocoa) and fruit trees. Another important natural disaster affecting crops in Tanna and the livelihoods of smallholder farmers in Tanna, was the ash fall from the Volcano (Mt Yasur). According to studies these (Clarke et al., 2019; Cronin & Sharp, 2002) the ashfall on Tanna Island contaminated garden crops and affected the livelihood of farmers. Smallholder farmers engage in various livelihood activities to support their families, to provide food and necessities to cope with natural disasters and rebuild their livelihoods. In addition, agricultural producers in vulnerable communities such as smallholder farmers adopt coping strategies to mitigate challenges and improve their livelihood.

7.5 Farmer's coping and livelihood strategy

Coping strategies are often short-term responses to crisis when livelihood of smallholder farmers is compromised, responses are adopted to mitigate the challenges. This study reflects the findings of several similar studies in documenting the adoption of drought tolerant varieties of kumala (Mabhaudhi et al., 2015). This study explores that the traditional practice of planting kumala after harvesting yam is a practice that farmers maintain to cope with the dry seasons in West Tanna; farmers mentioned that in dry season using soil from yam mounds was cooler and easy to plant kumala.

The coping strategies farmers adopt in response to climate change challenges are often short-term and location specific (Ashraf & Routray, 2013). Several studies in African regions highlight the different strategies to mitigate the impacts of climatic shocks on

agricultural production, such as storing food, planting early maturing varieties, and drought-tolerant varieties (Okonya et al., 2013; Quandt, 2021; Ubisi et al., 2017). Similar coping strategies have been noted for smallholder farmers in Ethiopia and South Africa (Hassan & Nhemachena, 2008; Kom et al., 2022). Similarly, studies in Pacific Island countries have shown that smallholder farmers coping strategies include planting drought-tolerant varieties of crops and diversifying their livelihood activities (Iese et al., 2017; Sulu et al., 2015).

The current study shows that the practice of growing kumala among other root crops is a livelihood strategy to response to natural disasters in Vanuatu. Sakdapolrak (2014), emphasised that environmental factors can influence livelihood strategies, often vary in different contexts, reflecting how individuals, households and communities pursue their livelihoods. Farmers mentioned that unlike cassava, kumala tubers are less prone to damage from cyclone, therefore smallholder farmers grow the crop before and after natural disasters. A study based on rural villages of Vanuatu and Fiji highlighted that local villagers grow drought-resilient crops, including kumala, before the dry season to ensure food supplies are sufficient when coping with extreme weather conditions in both countries (McNamara & Prasad, 2014). Other studies in Asia show that despite consuming rice as the main staple, in the face of natural disasters such as typhoons, people grow and consume kumala in the aftermath of typhoons, and the households that cultivate kumala before typhoons have more food available compared to those that do not follow this practice (Bertuso, 2018; Gatto et al., 2021).

7.6 Smallholder farmers' livelihood diversification

Livelihood diversification is extensively studied in the context of rural poverty and development studies (Scoones, 2009). In the context of this study, livelihood diversification centred on smallholder farmers daily activities was linked to on-farm and non-farm activities that contribute to their household needs and sustenance. In this study farmers engaged in varied farming practices on-farm through incorporating kumala to support their livelihood. Most farmers that cultivate kumala in a mono cropping system, prioritise selling at the local market to earn income, this money is then

used to pay for children's school fees and other household needs. Mertz et al. (2012), reported that in Bellona Island in Solomon Islands farmers have increasingly cultivated kumala due to the crops high yields and have subsequently practiced mono cropping kumala solely for local market. According to Bourke and Ramakrishna (2009), a study in the highlands of Papua New Guinea, highlighted that kumala is the dominant crops in most garden plots and is often intercropped with maize, highland pitpit (*Setaria palmifolia*), and *Amaranthus, Rungia klosii* and other food crops. This study showed that across both case study sites kumala is intercropped with other crops, and cash crops for instance; kumala is intercropped with maize and other leaf vegetables. In Middle Bush Tanna, some smallholder farmers diversified their livelihood activities to rely on cash crops (coffee) as a source of income and grow kumala as a food source to provide for their families. As reported by Georgeou et al. (2022) other Pacific Island countries, including Tonga, Kiribati and Papua New Guinea farmers intercrop supplementary crops including a variety of vegetables to diversify food supplies and incomes (Bourke & Ramakrishna, 2009). A study in West New Britain (Papua New Guinea) reported that farmers who engaged in mono-cropping of kumala also diversified into cash crops such as vanilla (Koczberski et al., 2018).

This study found that smallholder farmers have diversified crop systems to include kumala due to its high yielding, short growing duration making it suitable to cultivated among other vegetables and root crops. Kumala is tolerant to mild drought and can be harvested progressively, and this practice has proven to be a sound approach to food security (Mabhaudhi et al., 2015). Crop diversification helps farmer and households mitigate the risk of food insecurity due to increased risk from crop failure due to natural disasters, as reported by several studies (Mango et al., 2018; Njeru, 2013). As explained in a study in Africa, small-scale farmers who practise crop diversification improved household resilience, and it was a potential strategy to improve crop production (Makate et al., 2016). In addition, in the aftermath of natural disasters, smallholder farmers have engaged in crop diversification to ensure access to food in Ompong, Philippines (Gatto et al., 2021).

Smallholder farmers on Tanna have diversified their incomes by engaging in non-farm activities. Non-farm activities in this study refer to activities that are outside of farming, including the production of handicrafts, weaving of traditional mats, baskets, and owning small retail shops. Smallholder farmers in communities studied engaged in these livelihood activities and incorporated them into their daily lives to support their household needs. A similar finding was highlighted by Okonya et al. (2013); understanding the farmer's perception of coping strategies in Uganda has shown that farmers engaged in various non-farm activities to mitigate the impacts of climatic shocks and support their livelihood. Other studies in Pacific territories have shown that farmers engaged in small market vendors contribute to income generation that supports their livelihood and wellbeing (Georgeou et al., 2022; Koczberski et al., 2018; Savage et al., 2020).

7.7 Understanding livelihood of smallholder farmers in Tanna

Past studies have used sustainable livelihood frameworks and asset components to evaluate social, economic, cultural, and financial situations (Amekawa et al., 2010; Biggs et al., 2015). The framework is adopted in development studies to understand and assess the situation and develop solutions. Drawing on the sustainable livelihood framework, the results of this study identify three capitals that significantly contributed to support the place of kumala in the livelihood of smallholder farmers in Tanna. These include social, human, and natural capital and influence how farmers utilise these capitals in coping strategies to shape and support the livelihood of smallholder farmers in Tanna and how this shapes the growing of kumala. In this study, the sustainable livelihood framework is used to describe how kumala supports the livelihood of smallholder farmers and relevant assets that farmers utilise to ensure access to food during and in aftermath of natural disasters. Diversifying livelihood activities by smallholder farmers often enhances the resilience and capacity of smallholder farmers to mitigate the challenges faced in their gardens. The following section reflects on other livelihood activities farmers engaged in to support their livelihood.

In this doctoral study, the growing of kumala is a livelihood and coping strategy in the for-smallholder farmers, in the cultivation and provision of food, to explore market opportunities, and to support social obligations. The distinct features of kumala have increased focus on the crop as a drought-tolerant crop that enhances food security. The following section describes the status of kumala within traditional food systems and how it contributes to household resilience during the aftermath of natural disasters.

7.8 Sharing of resources builds household resilience.

On Tanna Island individuals and households are part of strong social networks within their community, village, and extended families. In this study, community refers to a cluster of people living together and sharing resources to support their daily activities. Scholars Barnes-Mauthe et al. (2015) and Putnam (2001) explained that social capital encompasses a broad spectrum of elements that refer to the extent and complexity of bonds and interactions among individuals within their community. The current study shows that farming families have solid bonds and relationships that facilitate the sharing of resources and knowledge amongst smallholder farmers, as is also reported by other scholars (Partelow, 2021; Yila & Weber, 2013). Kumala planting materials are shared among farmers in the same village and these are often shared with other farmers across different villages. In Tanna, sharing resources, interconnectedness, reciprocity and collected community efforts are important values in rural communities, has also been reported by Le Dé et al. (2018). Within Tanna Island the social relationship that builds on strong cultural values and community cohesion, promote the exchange of food crops within communities contributes to food security. Kumala has a significant role in social exchanges that still exist and are practiced in rural communities, it is considered a significant food crop that is highly present in the smallholder farmers households.

The exchange of kumala is prominent in social contexts, enabling individuals and communities to access food as a gift or exchange to support a community and individuals on both case study sites This is consistent with McGuigan et al. (2022), who reported that social relationship across local communities in Fiji facilitate the exchange of kumala and other food crops post cyclone. In addition Leweniqila and Roskruge (2023), reported

on the significance of social relationships among indigenous Fiji communities has contributed to the production of kumala. Other studies have likewise emphasised the significant role of social networks in rural communities and their contribution to resilient communities during and after natural disasters (Adger et al., 2005; Partelow, 2021).

7.8.1 Social exchange to cope with environmental issues.

In this study, it was found that kumala is exchanged to support individuals, families, and communities facing prolonged drought and volcanic ashfall from the volcano. A study in Mozambique by Osbahr et al. (2008) highlighted that a significant way to cope with environmental stresses is through the reciprocal exchange of resources that ultimately improves access to resources such as food crops, labour and livestock, and other resources. Exchange occurs within the communities but is has been found that the agroecological conditions often challenge farmers to grow the crops and conserve the planting material (Spencer et al., 2020). This study aligns with scholars such as Adam et al. (2018) and Gatto et al. (2021), who acknowledge that exchanging food crops enables farming families to access unavailable food during the aftermath of natural disasters through social relationships. For instance, in this study, in the case of West Tanna, farmers exchange coconut for kumala with farmers in Middle Bush during drought.

In rural communities, exchanging food crops has been a long-standing tradition that continues today and in a modern context aid in mitigating the impacts of climate changes. As highlighted in this research and previous scholarly work, the social networks play a significant role in supporting smallholder farmers and building resilience in vulnerable communities in the Pacific islands (Currenti et al., 2019; Faulkner et al., 2018; Taylor et al., 2012). The findings of a study by Hagedoorn et al. (2019) indicates the significance of social networks in coping with the impacts of climate change in rural communities. Overall, this research explores and confirms the crucial role of social networks in enabling smallholder farmers to access resources such as kumala planting material and tubers for consumption, in the face of climate change which continues to threaten smallholder farmers in Tanna Island. Evident in this study is the vital link between smallholder farmers and extension officers that provides access to information regarding the production of kumala in both case study sites. Scholars Pretty (2003) and

Partelow (2021), explain that linking with formal institutions such as researchers, policy makers and advisors is significant to gain access to resources that are beyond the communities' networks as is the case in this research.

7.9 Human capital

In the current study human capital includes skills, knowledge, and availability of labour that allows individuals and households to pursue different livelihood activities (Bohle, 2009). In this research, the traditional knowledge of farmers on Tanna enabled them to grow kumala and integrate it into existing food systems because it is similar to other traditionally crops. Tanna farmers hold and use traditional knowledge of growing root crops such as yam and taro, and this knowledge informed their adoption of kumala. According to Ankrah et al. (2023) traditional knowledge is embedded in smallholder farmers livelihood and is used to deal with challenges in the production of agricultural root crops in the Pacific Islands countries and has been widely recognised (Fletcher et al., 2013; Iese et al., 2017). Leweniqila and Roskruge (2023) showed that smallholder farmers in local communities in Ra, Fiji rely on their traditional knowledge to grow and cultivate kumala.

Environmental indicators among smallholder farmers, often in rural communities, are based on local knowledge (Gwenzi et al., 2016; Yang et al., 2019). In the current study, farmers acknowledged the use of environmental indicators in their decision making of growing kumala in their own gardens. These indicators are linked to the growing of traditional root crops. For instance, the peach tree, at its flowering stage, indicates the best time to grow kumala. Similarly, a study on kumala in Vanuatu by Setak (2018) acknowledged the significance of environmental indicators smallholder farmers in East Santo use to grow kumala in their gardens. However, farmers in this study emphasised that trees and plants related to the cultivation of kumala are disappearing within their local communities. Balick et al. (2023), showed that in a study on environmental indicators on Tanna Island, that changing weather patterns threaten the existence of plants used in the agricultural activities.

In this study, the growing of kumala was based on local knowledge of crop production associated with growing of yam and taro. This local knowledge was complemented by new knowledge about kumala gained from the extension services and other farmers who had experience growing kumala. This knowledge on different varieties of kumala is shared between farmers, across villages and agriculture extension officers, enabling them to grow drought tolerant varieties. Foley (2010) argued that the collective action of sharing knowledge and skills provides a pathway to promote agricultural knowledge that sustains farm production. Thamaga-Chitja and Tamako (2017) reported that in South Africa, smallholder farmers shared knowledge on the crops they grow that contributes to build resilience among families and in their communities. A study in Tanna by Buckwell et al. (2020) reported on the significance of knowledge exchange between farmers and agriculture extension officers, emphasising demonstration plots as a crucial approach to improve production of agricultural crops. Iese et al. (2018) highlighted the importance of exchanging information and knowledge between farmers and extension officers on planting materials, helping farmers to understand the distinct characteristics of kumala.

Human capital in the form of labour invested in crop cultivation and farming contributes to smallholder farmers' sustainable livelihood (Dorward, 2013). It was evident in this study that most farmers rely on agriculture, which is what they do to support themselves with food, earn income, and address their cultural obligations. In the current study, work put into cultivating kumala in both case study sites was shared by both men and women in the communities where men tended to undertake more of the physical work than women. Similarly, a study in Vanuatu Setak (2018) showed the cultivation of kumala was shared by both men and women in the rural villages in East Santo. However, this study found that increased social activities and other commitments, such as church activities in rural villages, impacted the hours female farmers spent in the garden compared to the past, where more time was spent there. Past studies (Liu & Yamauchi, 2014; Yemoh & Yemoh, 2022) have shown that access to human capital, such as knowledge, labour, and training, has the potential to influence agricultural production and support smallholder farmers. This research highlights the relationship between human and social capital. In this study, reciprocity of labour and working together to support each other

is common, as most households rely on farming, and kumala is commonly cultivated by most families. Aligning to this relationship, farmers work together as a group to establish gardens as it requires more labour; the ties that coexist in the cultural context support the livelihood of smallholder farmers in rural communities. In Fiji, a similar relationship between society and people has been the foundation of recovery during the aftermath of tropical cyclones; people rely on the availability of labour and connection as the first response to recover (Currenti et al., 2019; Yila & Weber, 2013).

7.10 Natural capital

The ability to utilise land and natural resources is a livelihood strategy for smallholder farmers (Tibesigwa et al., 2016). In the current study farmers relied heavily on the natural resources around them, either for food or traditional medicines. Martin et al. (2018) agreed that people living in rural communities rely on the land as a source of generating income and producing food to support their daily livelihood. Customary land is a significant source of natural capital for smallholder farmers in Tanna and other Pacific Island countries (Addinsall et al., 2015) . In this research, farmers from both case study sites grow kumala along with other crops and vegetables in their customary land. Access to land, a natural capital asset, contributes to their daily livelihood activities, and this is evident with smallholder farmers in most Pacific Island countries (Shah et al., 2018; Versteeg et al., 2017). Natural capital is important in buffering households from food and income shortages. For instance, a study by Twine et al. (2003) found that homes in rural districts of Limpopo province in South Africa rely heavily on natural resources for food, such as species of local wild vegetables, fruits, and their staple food.

Physical and Financial capital is often challenging for smallholder farmers to access. Previous studies in the rural communities in the South Pacific islands have emphasised that the lack of transport is a constraint for agricultural development in rural communities (Duncan, 2008; McGregor et al., 2009). A study in Fiji showed that transport was an issue for farmers in the remote community of Balevuto, farmers spend more on transport costs, and the roads are often treacherous (Singh-Peterson & Iranacolaivalu, 2018). This study concurs with these and highlights that transport links

to the market were a constraint for smallholder farmers in marketing kumala, increased market demand for kumala relies on the farmers' accessibility of transport to the local market.

7.11 Summary

This study takes a holistic view of the traditional cropping system, where smallholder farmers' traditional knowledge of growing root crops such as yam and taro enable them to cultivate kumala within this system. The results of this study provide a clear picture of the smallholder farmers' perspective on the status of kumala in the Tanna community. Here, cultural, and social values play a significant role in the livelihoods of farmers in rural communities. The presence of traditional root crops such as yam and taro are a cultural obligation, and kumala is unlikely to be present on such occasions. However, since there are no traditional norms associated with the planting and harvesting of kumala, it is considered a reliable food crop within the traditional growing system.
The current study acknowledges kumala as a food security and recovery crop that farmers grow in both case study sites due to its resilient characteristics, which were also highlighted by several studies in Pacific Island countries.

Farmers engage in coping strategies, such as planting drought-tolerant varieties of kumala, to prepare for and recover from the aftermath of natural disasters. This study evidently shows that kumala farmers integrate a wide range of livelihood activities to support their household needs for food and other necessities.

The current study reveals that kumala is a root crop that can significantly support the livelihood of smallholder farmers in Tanna. It was evident in this study that social values of reciprocity and relationships that coexisted among the smallholder farmers promoted the production of kumala, ensured food was available and accessible, and enabled them to mitigate the impacts of climate change and vulnerable crises such as volcanic ash falls to promote food security and household resilience in the rural communities.

CHAPTER EIGHT

RESEARCH CONCLUSIONS

8.1 Introduction

This study explores kumala as an essential food source in the traditional food system in Vanuatu and its contribution to supporting the livelihood of smallholder farmers. This doctoral study answers the two research questions: (1) what is the traditional system of growing and utilising kumala in Vanuatu? and (2) how the traditional system of growing kumala contributes to sustainable livelihood and food security in Vanuatu. To answer the research question, the researcher selected a case study of smallholder farmers on Tanna Island in Vanuatu who grow kumala in traditional farming practices informed by local farmers' knowledge and existing knowledge from extension officers. This chapter presents the conclusions drawn from this research. Subsequently, the practical implications of the study are outlined followed by reflections on the research design and some final suggestions and recommendations.

8.2 Key conclusions

The Vanuatu agriculture sector is dominated by subsistence smallholder farming. Farmers grow crops for multi-purposes, these include subsistence household use, sold at market and customary purpose. The significance of kumala cultivation to smallholder farmers livelihood is well acknowledged in the literature and further confirmed by the findings of this research. This research explores the dynamics of kumala cultivation, within local communities in Tanna Island that has a stronghold of traditions and culture which influences the farming system and smallholder farmers' perceptions. The research addresses the contribution of kumala to promote food security, framed with the sustainable livelihood framework and understanding

the livelihood assets that contributed to the production of kumala. The key conclusions derived from the study are:

- Kumala is a valuable food security crop that is now integrated into the food system of smallholder farmers in Vanuatu and other Pacific Islands and developing countries.
    - Kumala has been integrated within the Tanna Island food system, not only as a coping strategy to ensure food security following adverse events, but it is now a livelihood strategy of many smallholders and the local communities.
    - Its integration into the traditional food system on Tanna Island reflects the similarity of kumala with the existing traditional staple foods of taro and yam.
    - Smallholder knowledge of growing root crops, along with the support of agriculture extension services, has enabled them to grow kumala successfully. Furthermore, kumala can be grown as part of the traditional cropping system without impacting on the production of traditional crops.
    - Kumala has characteristics that enhances its integration by smallholder farmers into the traditional food system; these are importantly highlighted by this research study.
- Kumala is a food security crop for communities on Tanna Island because kumala planting materials and kumala tubers can be shared and exchanged between villages depending on the need. This highlights the need in developing policy around food security in rural Vanuatu to account for not only household but also community level dynamics and coordination.
    - It can be shared and exchanged through social exchange that is embedded in cultural and social values, promoting food security between farmers and across the villages.

    - Furthermore, kumala buffers against any food shortage during the aftermath of natural disasters (for example cyclones or volcanic activity) that is supported by the networks and social relationships, promoting household

resilience for individual farmers, local communities, and importantly featured in the national food programs.

- Cultural norms can both limit and enable food security. In this study the cultural norms specifically linked to yam and taro but not applied to the cultivation of kumala, enhanced kumala as a food security crop and also opened opportunities for income generation.
    - Kumala not being a traditional crop embedded in cultural ceremonies and norms means there is flexibility as to when and how it its grown and it can be used solely for food consumption between farming families and across the villages. The cultivation of kumala as a non-seasonal crop has introduced flexibility into the local food system, enabling farmers to maintain the cultivation of taro and yam to honour the traditional ceremonies embedded in their livelihood and culture.

    - The traditional root crops of yam and taro are significant to smallholder farmers as their part of the local culture; however, the production of these crops is highly seasonal and kumala is therefore valued as a staple food crop and food security crop among the local communities throughout the year.

- Smallholder farmers are drawing on both traditional and external knowledge to adapt to change brought by environmental factors such as climate change. The value of extension and research to provide access to new improved varieties is confirmed by this research.
- This study concludes that food crops are likely to be integrated into smallholder food systems when the crop is complementary with the existing production system and draws from the existing farming knowledge of smallholder farmers. Furthermore, kumala is root crop that not only produces a better yield in the face of adverse events but also adds value to the livelihood of farm household that are also grown by smallholder.

8. 3 Implications of study

This study highlights the importance of revitalising the role of kumala within Vanuatu's food system by increasing food production, enhanced food security and promote household resilience in the face of adverse impacts of climate change on crop production. In the perspective of resilient and recovery root crops, encouraging the cultivation of kumala within the local food system, will promote food security and household resilience in the Pacific Island countries. This study notes the existence of traditional knowledge, interwoven in the farming practices of smallholder farmers in Tanna Island, upheld by the elders in the communities, thus reiterating the importance of capturing the existing knowledge.

Furthermore, this study shows that holistically the integration of traditional knowledge and value of extension is important in understanding the perspective of smallholder holder farmers within different context and communities, to understand why and how farmers cultivate kumala on Tanna Island.

8.4 Reflections on research design

Blending qualitative and indigenous methodologies when carrying out research within rural communities enabled the researcher to view the traditional system of growing kumala holistically. Storian was the culturally appropriate method to obtain data in this study; it created a space for interactions that allowed respondents to converse openly. Storian builds relationships, in this case between the researcher and the respondents, and helped establish trust which is important to sharing knowledge. Storian is often used in both informal and formal discourse. This research highlights the importance within the Vanuatu context as a method to collect information. The advantage provided to me as the primary researcher, is that I am from Tanna Island, Vanuatu. Most storian were undertaken in Bislama the local language, which enabled me to interact with the smallholder farmers in a conducive manner that allowed the farmers to share their valuable information.

Subsequently the semi-structured interviews proved to be of value in obtaining data for this research. these interview processes guided the flow of storian as both methods merged to provide valuable information from the participants. Probing questions periodically arose guiding the researcher to gather information not initially anticipated but adding considerable value to the research.

The choice of the researcher to focus primarily on the status of kumala within the traditional food system, provided the opportunity to explore the complexity of the farmers' livelihood, and identify how kumala supported livelihood and built household resilience of smallholder farmers. This study further demonstrates the value of field observations. Residing in the rural communities selected for the case study, provided insights into the status of kumala through smallholder farmers cultural perspectives. Involving the daily activities farmers engaged in within their communities gives a better understanding on the complex livelihood of smallholder farmers in the rural communities.

8.5 Future research – suggestions and recommendations

At the national context, Vanuatu government has developed and implemented polices and strategies to increase the production of key crops and to improve the dynamics of the agriculture sector in Vanuatu. However, the initial emphasis on the production of root crops which constitute the main diet for most Vanuatu people, needs to be strengthened to address the issues of food insecurity. This study shows that kumala or sweetpotato has the potential to improve the livelihood of smallholder farmers in Vanuatu and can significantly contribute to the national goal of achieving the target SDG2. The Vanuatu Government through the Department of Agriculture and Rural Development has recently launched the root crop strategy 2024-2030. This strategy puts forward the significance of root crops within the food system and their contribution to food security in Vanuatu. The strategy also unfolds the role of relevant stakeholders, who contribute and promote the root crops sector production in Vanuatu. There is a need to look strategically at enhancing the value chain to support the domestic

distribution of local produce – including kumala - to promote a sustainable food system that can support the livelihood and food security of all smallholder farmers in Vanuatu.

- This study recommends further research and support from the government that are driven towards investing in value addition of kumala for smallholder farmers and creating and strengthening the market opportunities.

  - a systematic approach to understanding the opportunities and barriers within the market dynamics of smallholder farmers in rural communities is relevant to boost and alleviate the production of local root crops.

- This study recommends documentation of traditional knowledge within the local communities and the government to incorporate traditional knowledge into adaptation strategies and policies that supports farmer livelihoods.
- This study also recommends further studies to understand and identify similarities between the different crops cultivated by smallholder farmers and their contribution to enhancing and supporting household food security. Furthermore, to expand and understanding of interventions that enhance food security, a study on exploring a crop that requires new practices and draws on farmers existing knowledge.
- Owing to over 30 varieties of kumala collected by DARD in Vanuatu, and the different characteristics favoured by smallholder farmers, this study recommends further studies to evaluate and develop a market pathway for specific varieties of kumala, to support and promote the transition from subsistence to commercial production. This includes collaboration between the following Vanuatu Government Departments: Biosecurity, Department of Agriculture and Rural Development, and Department of Industry

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Appendix 1 Interview guide

Following is a set of questions used during the case study. The questions were used interchangeably in the case study locations as a guide to collecting data for the research from targeted informants (farmers/agriculturalists).

Interview topic/ information on: General farming system.

1. What the farming system you practice (Subsistence or Semi commercial)
2. How long have you been using this farming practice?
3. What are the different crops grown in your garden?

Interview topic/ information on: Cultivation of kumala (sweetpotato)

1. What varieties of kumala do you grow in your garden
2. Are they any varieties of kumala you preferred?
3. Describe the characteristics the preferred kumala variety.
4. Where do you source the planting materials from?
5. What type of cropping system do you use to cultivate kumala?
6. Are they any traditional practice you use to cultivate kumala, how long have you been using this practice?
7. What tools do you use for planting kumala?
8. What type of calendar do you use to plan kumala? (Traditional or Seasonal calendar from DARD)
9. What are the environmental indicators relating to kumala planting?
10. What is the best month of planting the different varieties of kumala?
11. Do you use traditional knowledge to cultivate kumala?

Interview topic information on livelihood and cultural activities.

1. Is kumala a staple food crop for your household.
2. What is the purpose of growing this crop (home consumption, market, or other purposes?
3. What is the status of kumala within the traditional ceremonies? Compared to other root crops
4. In your experience what are the challenge of kumala production.
5. What other activities you involved in to support your livelihood
6. What is your view on kumala as a food security crop?

Interview topic /information on: Climate change and cultivation of kumala.

1. What are the challenges you faced in your garden?
2. What are some activities you do to prepare for cyclones?
3. Are they any practices you do to manage your kumala crop during cyclones?
4. Do you grow any drought tolerant varieties of kumala?
5. From your experience do you think kumala is a best recovery crop after the aftermath of cyclones

Interview topic/ information for key informants.

1. How does the DARD conserve the planting materials of different varieties of kumala?
2. How do farmers have accessed to the planting materials of kumala
3. What are the challenges of kumala production?
4. What is your view on kumala as a food security crop?
5. Are they any food security programs that? That contributes to the production of kumala.

Appendix 2 Information sheet

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

This information sheet introduces the researcher and provide an overview of her research, titled *"Kumala (Ipomoea batatas); the contribution of traditional knowledge to food security in Vanuatu."* The purpose of this, is to give clarity and understanding to the research participants and why the research is important. Not only for the researcher but for the community and Vanuatu in general.

Researcher(s) Introduction

My name is Amanda Nasse the primary researcher for this research. I am Currently a PhD candidate in the school of Agriculture and Environment, I am conducting this research for my PhD in the field of Horticulture and Enthnobotany. This research is a qualitative study, and the primary approach is a case study. The project will be carried out on the island of Tanna in Vanuatu. The Case study aims to investigate the level of traditional knowledge around kumala production, the importance of traditional agriculture knowledge in the community, the role of kumala in the livelihood of small holder farmer's and their sustainability and resilience through traditional knowledge. The involvement of agriculture extension to acknowledge traditional knowledge used by farmers throughout the past will generate ways for the government to support and boost the kumala production. The data collection will be collected through culturally appropriate method (storian), semi structured interview and observation. The supervisors for my PhD are Associate Professor Nick Roskruge, Dr Janet Reid and Mr Simon Semese from the School of Agriculture and Environment, all at Massey University. Our contact details as follow

Amanda Nasse -Principle Researcher Massey University.
Email: [redacted] / A.Nasse@massey.ac.nz.

Professor Nikorima (Nick) Rahiri Roskruge- Primary Supervisor.
Email: N.Roskruge@massey.ac.nz

Dr Janet Reid- Co supervisor. Email: J.I.Reid@massey.ac.nz

Mr Simon Semese- Co supervisor. Email: S.Semese@massey.ac.nz

An invitation

Being invited to participate in this research project, it is important that you understand what the research is and why you are chosen to participate. Please read this information sheet carefully and seek for assistance if it may need or if you are comfortable to discuss with others feel free to do so. Thank you

Participant Recruitment

I am seeking your involvement in this research because you have been identified by the agriculture extension officer or by me as someone with knowledge and information that will help me to complete my research. You are selected because you are involved in agricultural activities in your community, and you have experience and knowledge that will contribute to agriculture sector in Vanuatu. There will be 10 participants from each village who will be involved in this study; this number may be increased to 20 maximum depending on the diversity of information.

Project Procedures

With your consent the interview will be recorded. That is to ensure an accuracy in data collection to do the data analysis. The taped interview will be transcribed and analysis using Thematic analysis. I will be the transcriber of all the interviews. Your name and identity will be kept in confidentiality.

Participant involvement

The interview will be arranged based on your schedule. The time and location will be agreed by you, and it will be maximum of 60 minutes.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- *decline to answer any particular question;*
- *withdraw from the study (specify timeframe);*
- *ask any questions about the study at any time during participation.*
- *provide information on the understanding that your name will not be used unless you give permission to the researcher;*
- *be given access to a summary of the project findings when it is concluded.*
- *ask for the recorder to be turned off at any time during the interview.*

Research Ethics

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Prof Craig Johnson, Director, Research Ethics, telephone 06 356 9099 x 85271, email humanethics@massey.ac.nz".

Appendix 3 Participant consent form

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

Project Title: "Kumala (*Ipomoea batatas*); the contribution of traditional knowledge to food security in Vanuatu."

PARTICIPANT CONSENT FORM - INDIVIDUAL

I have read, or have had read to me in my first language, and I understand the Information Sheet attached as Appendix I. I have had the details of the study explained to me, any questions I had have been answered to my satisfaction, and I understand that I may ask further questions at any time. I have been given sufficient time to consider whether to participate in this study and I understand participation is voluntary and that I may withdraw from the study at any time.

- I agree/do not agree to the interview being sound recorded. (if applicable include this statement)
- I agree to participate in this study under the conditions set out in the Information Sheet.
- I agree to / do not agree for photographs to be taken

Declaration by Participant:

I _____ [print full name] _____ hereby consent to take part in this study.

Signature: _____ Date: _____

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

Project Title; Kumala a traditional food source; drawing on Vanuatu small holder's traditional knowledge

Patisipaisen Kosen -

Mi ridim long fes langwis blong mi, mo mi andastan infomesen long pepa ia. Mi andastan popse blong stadi mo eni kwestin we mi askm ol I ansarem I strt long tingting blong me, mo sipos mi gat eni kwestin bae mi save askm eni taem. Mi bin gat I naf taem blong tingting sipos mi wantem tekpat long stadi, mo mi andastan se patisipaisen blong mi long stadi ia I wan voluntri , mi save kamout long stadi ia eni taem

- Mi agri / or no agri blong intaviw ia bae oil sound recodem
- Mi agri blong patisipet long stadi ia folem ol kondisen long infomesen Pepa
- Mi agri/ or no agri blong oli tekem photo

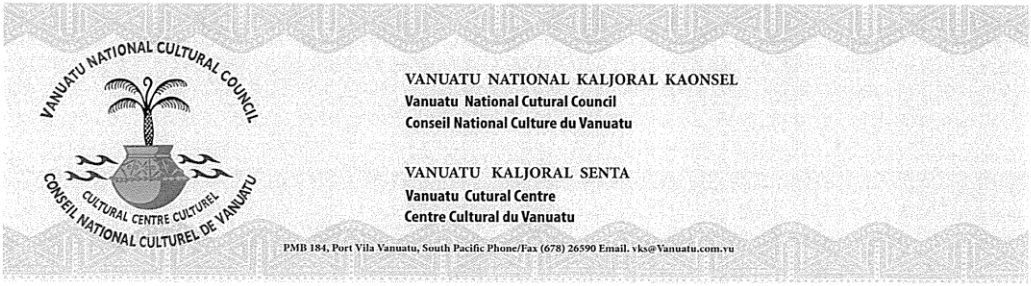
Dekleresen blong Patisipen

MI _____ [ful nem] _____ agri blong tekpat long stadi ia.

Sign _____ Diet: _____

Appendix 4 Vanuatu research form

In order to do research in Vanuatu, you must meet all the criteria as required by the government. Here is the completed Vanuatu government research form, the researcher did and was given the permission to do her research.



APPLICATION FORM FOR RESEARCH IN VANUATU

All research in Vanuatu falls under the jurisdiction of the Vanuatu Cultural Centre and the Vanuatu National Cultural Council which must be notified of any research activity in the country. Please, answer to the following questions before to send your query to: **shingr@vanuatu.gov.vu**

1- Name: Amanda
2- Surname : Nasse
3- Name of your institution: Massey University
4- Address of the institution: Massey University, Manawatu campus, Palmerston North
5- Phone: +64[redacted] or +67[redacted]
6- Email: anasse@massey.ac.nz / [redacted]
7- Subject of your research (please, attach 1 or 2 pages giving details about your subject and about partners and funds engaged) **see attached page**

8- Location in Vanuatu: Tanna island (West Tanna and Middle Bush)
9- How many persons are included in the staff coming for this research? None
10- How long time will you stay in Vanuatu? From June 2021 To December 2021
11- Is it the first time you come as researcher in Vanuatu? Yes - No (If not, please indicated the title, the subject and the location in Vanuatu of your last researches)

It is my first time to carry out an academic research as student

12- How your research will be used after your fieldwork in Vanuatu (publication, seminar, documentary, etc.)
The research will be seen in any publication relevant to the area of work, such as horticulture and enthnobotany in Vanuatu. It will be assist future students in Vanuatu who want to pursue a study under the discipline of horticulture

I declare on my word of honor that the information provided above is true and complete and that I am aware that any incorrect statements may invalidate my expression of interest.

Date : 9/06/2022
Location: Massey University, Manawatu Campus, Palmerston North, New Zealand
Signature (s): AAnasse

Subject of your research (please, attach 1 or 2 pages giving details about your subject and about partners and funds engaged) Please see attached Researcher(s) Introduction

My name is Amanda Nasse the primary researcher for this research. I am currently a PhD candidate in the school of Agriculture and Environment, I am conducting this research for my PhD study in the field of Horticulture and Enthnobotany. This research is a qualitative study and the primary approach is a case study. The project will be carried out on the island of Tanna in Vanuatu. The two case study sites are middle bush and west Tanna. The Case study aims to investigate the level of traditional knowledge around kumala production, the importance of traditional agriculture knowledge in the community ,the role of kumala in the livelihood of small holder farmer's and their sustainability and resilience through traditional knowledge. The involvement of agriculture extension to acknowledge traditional knowledge used by farmers throughout the past will generate ways for the government to support and boost the kumala production. The data collection, within a duration of 6 months will be collected through Talanoa method (storian), interview and observation. The Thesis Topic: ***Kumala a traditional food source; drawing on Vanuatu small holder's traditional knowledge.*** The Aim of this research: The aim of the research to acknowledge Kumala as an important food source in the traditional food system. It is of importance that small holder farmers and consumers know that status of kumala in the traditional food system. The policy makers, should acknowledge the role of kumala in the local food system and maintain and promote the crop. The budget of this research will be covered by Vanuatu Government who also provide the PhD scholarship for my study.

The supervisors for my PhD are Associate Professor Nick Roskruge, Dr Janet Reid and Mr Simon Semese from the School of Agriculture and Environment, all at Massey University, Manawatu Campus, New Zealand. Contact details as follow

- Amanda Nasse -Principle Researcher Massey University. Email: [redacted] / A.Nasse@massey.ac.nz
- Professor Nikorima (Nick) Rahiri Roskruge- Primary Supervisor. Email: N.Roskruge@massey.ac.nz
- Dr Janet Reid- Co supervisor. Email: J.I.Reid@massey.ac.nz
- Mr Simon Semese- Co supervisor. Email: s.semese@massey.ac.nz

Appendix 5 Research Ethics

As part of the research, Massey University requires all students to do ethics. Here is the approved Human Low Risks Ethics given by the university.

Nick Roskruge

From: Nasse Amanda <[redacted]>
Sent: Thursday, 30 May 2024 12:22 pm
To: Nick Roskruge
Subject: Fwd: Human Ethics Notification - 4000023871

---------- Forwarded message ---------
From: <humanethics@massey.ac.nz>
Date: Fri, 12 Feb 2021, 14:39
Subject: Human Ethics Notification - 4000023871
To: <Amanda.Nasse.1@uni.massey.ac.nz>, <J.I.Reid@massey.ac.nz>, <N.Roskruge@massey.ac.nz>, <S.Semese@massey.ac.nz>
Cc: <humanethics@massey.ac.nz>

HoU Review Group

Ethics Notification Number: 4000023871
Title: Achieving Sustainable livelihood for Vanuatu Kumala farmers; the role of traditional inputs

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the Massey University Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research.
If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Professor Craig Johnson, Director (Research Ethics), email humanethics@massey.ac.nz. "

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish require evidence of committee approval (with an approval number), you will have to complete the application form again answering yes to the publication question to provide more information to go before one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

You are reminded that staff researchers and supervisors are fully responsible for ensuring that the

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information in the low risk notification has met the requirements and guidelines for submission of a low risk notification.

If you wish to print an official copy of this letter, please login to the RIMS system, and under the Reporting section, View Reports you will find a link to run the LR Report.

Yours sincerely

Professor Craig Johnson
Chair, Human Ethics Chairs' Committee and
Director (Research Ethics)