

The role of sweetpotato (*Ipomoea batatas*) as a food security crop in Vanuatu: A Tanna Island case study

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Abstract. *Kumala* (sweet potato, *Ipomoea batatas*) is a food crop in the traditional food system of Vanuatu. It contributes to sustainable livelihoods and food security for many smallholder farmers. How *kumala* is grown and how it enhances livelihoods on Tanna Island is the case study reported in this paper. This study was completed using a qualitative case study research design based on data collected through incorporating an indigenous method (*storian*) and semi-structured interviews. *Kumala* is regarded as a food security crop because it is drought tolerant, has a short growing cycle, will grow in a variety of situations, is preferred as a food crop, and its use is not influenced by cultural obligations like the traditional crops of taro and yams. *Kumala*'s uptake as a food crop is informed by traditional knowledge of crop growing and uses, along with contemporary knowledge embedded in plant material that is collectively supported by agriculture extension services. Traditional social networks facilitate the exchange of *kumala* and its role in contributing to food security.

Keywords: *Kumala*, food security, traditional food system, traditional knowledge, livelihoods

Introduction

Vanuatu's agriculture sector consists of three distinct sub-sectors: the subsistence sector (75%); the semi-commercial sector (15%); and the commercial sector (10%). The agriculture sector in Vanuatu is dominated by smallholder farmers farming one-hectares or less. The available crop statistics indicate the long-standing cash crops (kava, coffee, cocoa, and coconut), along with traditional root crops (taro and yam) and other root crops such as *kumala* (sweet potato, *Ipomoea batatas*) and cassava are the common produce farmers grow (Department of Agriculture and Rural Development 2015). The Vanuatu Government has developed policies and strategies to provide the agricultural services to support smallholder farmers throughout Vanuatu. Support services from the government are vital to increasing agricultural production. The Department of Agriculture and Rural Development plays a significant role in supporting smallholder farmers through extension services and implementing the policy directives that are relevant to agriculture production. The National Agriculture Sector Policy aligns with the national sustainable development plan to ensure food security, through growing resilient crops and encouraging farming practices that provide sufficient food (Department of Strategic Policy 2016). The Vanuatu agriculture sector policy is made up of thirteen thematic areas. Food security is one of the thematic areas. The following policy directives are relevant to the four pillars of food security (food availability, accessibility, utilisation and stability) (FAO 2008).

1. Increase production of sufficient and nutritional adequate food at a national level.
2. Improve access to and availability of sufficient, safe, and nutritionally adequate food.
3. Encourage the utilisation of sufficient and nutritionally balanced diets.
4. Enhance the sustainability of food at the national level (Department of Agriculture and Rural Development 2015).

Smallholder farmers are the backbone of food production in Vanuatu. They are subsistence oriented and grow a range of root crops and vegetables for household consumption with surplus sold to local markets to generate income (Addinsall et al. 2015). However, the effects of extreme weather events on this sector are critical. For instance, severe droughts, intense floods, and tropical cyclones have regularly (at least annually) reduced both crop yields and total production, increasing the risks of food insecurity in communities (Iese et al. 2018). Another constraint is land scarcity due to a growing population, and there is a need for crops that are resilient and can produce high yields (Barnett 2011). As food security throughout Pacific Island countries is at risk, smallholder farmers are encouraged to adapt to more resilient crops, like sweetpotato, to provide sustenance before and after natural disasters and enhance the livelihood of smallholder farmers in rural communities (Iese et al. 2018). Throughout this paper sweetpotato and *kumala* refer to the same species so both terms will be used interchangeably to refer to *Ipomoea batatas*. The aim of this paper is to acknowledge *kumala* as an important food source within the traditional food system and describe how *kumala* supports the livelihood and food security for small holder farmers in rural communities. It is guided by the following question: What makes *kumala* a useful food security crop in Vanuatu?

Literature review

The literature explores the interwoven concepts of food security, traditional food system, livelihood and social relationships that contribute to understanding the role of *kumala* as a food security crop.

Food security

The agriculture sector in Pacific Island countries plays an important role in contributing to food security, and sustainable livelihoods (Iese et al. 2020). Tropical root crops including taro, yam, cassava and sweet potato are the main staple food in Pacific Island countries (Thaman 2008). Among the food crops, *kumala* is a food security crop within the local food system in several Pacific Island countries. According to McGuigan et al. (2022) and Mertz et al. (2012) leveraging on short-term resilient crops within the local food system in Pacific Island nations is an approach to address food security and adapt to the challenges of food shortage due to natural disasters.

Iese et al. (2018) argued that *kumala* was, is and will continue to be a significant food security crop across Pacific Island countries. Many countries in Africa, Asia and the Pacific Islands have been growing *kumala* as a significant food crop that contributes to food security (Mabhaudhi et al. 2015; Iese et al. 2018; Gatto et al. 2021). The distinct characteristics of *kumala* are consistent with the four pillars of food security (Iese et al. 2018). It features prominently in smallholder cropping systems and plays a pivotal role in food security. Studies across the Pacific Islands have shown that *kumala* is a food crop that supports household food security (Mertz et al. 2012; Iese et al. 2018; Leweniqila & Roskrige 2023). This study explores the status of *kumala* across local communities, contextualizing the four pillars of food security in Tanna Island and through the support of government.

Traditional food system

In Vanuatu, as with other Pacific Island countries, agriculture systems are rain-fed making them highly dependent on rainfall for planting some of the traditional root crops (Kaoh et al. 2016; Iese et al. 2020). Scholars Thaman (2008) and Allen (2014) argued that traditional food systems are dynamic and structured to provide food all year around in Pacific Island countries. However, it is claimed that cultural and agro-environmental conditions often influence farming system practised by smallholder farmers in Vanuatu (Mael 2013; Lebot & Siméoni 2015). These studies show that traditional farming systems in Vanuatu often begin with planting of yam and taro in the first phase, where taro is cultivated in wet zones and yam in the drier areas often on slopes (Blanco et al. 2013). Blanco et al. (2013) and Sardos et al. (2016) highlight that *kumala* is an introduced species within Vanuatu's farming systems. However, Blanco et al. (2016) argued that how new species are integrated into the existing farming system is important, and the farmers are encouraged to cultivate new species in their traditional gardens. According to Iese et al. (2018) the rise of sweet potato 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). This study explores how *kumala* fits into the traditional food systems in local communities that are interwoven with social and cultural activities embedded in the livelihood of smallholder farmers.

Livelihood strategy

Smallholder farmers have been integrating livelihood strategies to adapt and improve food security that sustain their livelihood across many generations (Weir et al. 2017). According to Habib et al. (2023), livelihood strategies are not static, with change often influenced by social, environmental, and economic factors, which often vary in different contexts, reflecting on how individuals, households and communities pursue their livelihoods. Scoones (1998) classified livelihood strategies into three clusters, agriculture intensification or extensification, and livelihood diversification. Scholars Danso-Abbeam et al. (2020) and Haggblade et al. (2010) categorised livelihood activities into non-farm and on-farm activities; with non-farm activities being activities that are not related to the agricultural sectors. These activities help to diversify rural livelihood activities and generate income from other sources, for instance value addition of products as a non-farm activity (Haggblade et al. 2010).

The on-farm activities are where farmers engage in various farm activities to reduce risk (Ellis 1998; Alemayehu et al. 2018), for instance, crop diversification, rearing of livestock and farming crops to generate income. Crop diversification is an approach used to build a resilient agricultural system, primarily where communities depend on agricultural products (food and fodder) for their livelihoods (Govereh & Jayne 2003). Smallholder farmers in most rural communities in the Pacific Islands practice crop diversification (Koczburski et al. 2012; Lebot & Siméoni 2015; Georgeou et al. 2022). These studies tended to focus on high levels of production, with diversified crop

production on small plots of land. However, it is argued by Iese et al. (2020) that adopting resilient crops in the face of unchanging weather patterns in the region is a strategy to increase food security. This study contributed to understand the role of *kumala* in supporting the livelihood of smallholder farmers in rural communities.

Social relationship

Social relationships facilitate food security strategies and contribute to individual and community resilience (McDaniel et al. 2021). Over the years, it has been argued that social relationships have been the backbone of resilience in Pacific Island communities (McMillen et al. 2014; Thaman 2014; Aldrich 2017). Several studies in Pacific Island countries have highlighted the importance of social relationships centred on sustainable livelihoods in rural communities (Le Dé et al. 2018; Nakamura & Kanemasu 2020). In Fiji, social relationships were a mechanism in the iTaukei villages, and people supported each other during Tropical Cyclone Winston while waiting for assistance from the government (Nakamura & Kanemasu 2020). In Vanuatu, as in other communities, social relationships are embedded in daily livelihood activities and play a significant role in household recovery after a cyclone (Jackson et al. 2017).

Research Methodology

The study was carried out in two council areas in Tanna Island, Middle Bush Tanna, and West Tanna area councils (see Figure 1). Tanna Island is in one of the six provinces in Vanuatu. It hosts the provincial headquarters of the province. Tanna Island is relatively densely populated, with a population of 32,000 people (VNSO 2016). The two areas were selected because agriculture is the primary source of income for smallholders and they have distinctly different weather patterns throughout the year that influence crop production and have different topography. Middle Bush area is in the wet part of Tanna Island, it experiences more rain than other parts of Tanna. West Tanna experiences periods of drought compared to other parts of Tanna. The area has faced prolonged drought periods. These differences determine how farmers' farm the land and the type of crops they grow at a particular time of the year.

Figure 1: Map of Tanna Island showing the two case study sites



Source: (VNSO 2016)

Data was gathered on how *kumala* is grown within the traditional growing system, and its significance to food security and other social obligations in Tanna Island. Participants included *kumala* farmers and key informants. Twenty farmers were selected using a snowball sampling technique in each site and six key informants were selected from Government and NGO staff that were in Tanna Island. The key informants were selected based on their involvement with smallholder farmers in the local communities, supporting and building their livelihood.

The study was undertaken incorporating '*storian*', an indigenous research method (Warrick 2009), supported by semi structured interviews undertaken with farmers and key informants on Tanna Island. Indigenous research methodologies within the Pacific Island countries such as *talanoa*, *storian* and *tok stori* affect the depth of information attained through research (Sanga & Reynolds

2021). It is embedded in trust, solid relationships, and research environments that encourage open engagement (Prescott 2008). In the Melanesia context, *storian* is described as informal storytelling incorporating conversations and interactions in everyday settings (Crowley 2003). *Storian* has always existed in Vanuatu's culture, as people engaged in conversation in a cultural context. *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 (2009) explained that a central feature of *storian* is to build rapport with the participants. Before beginning interviews, a traditional protocol was followed to seek permission from the chiefs and elders of each community. It is important to acknowledge the traditional norms and protocol within the rural communities, as it allows the researcher to connect well and create a bond of relationship with the people.

The study received a Low-risk Ethics Approval from the Massey University Human Ethics committee. This study acknowledged formal and cultural protocols, seeking approval of individuals and local communities before carrying out the research. All interviews were recorded and were transcribed verbatim. The interviews were primarily conducted in Bislama, a neo-Melanesian pidgin and national language. The data was analysed manually based on thematic analysis, that constituted: describing the phenomena, classifying data, and connecting to the relevant themes (Dey 2003). Finally, results of analysis were translated into English to further connect and link the themes.

Results

This section outlines the findings from both sites. Quotes are used to include the voices of smallholder farmers and key informants.

Kumala is a favoured food security and recovery crop.

Food security is a challenge faced by smallholder farmers in Tanna. Within the farmer's garden, they cultivated *kumala* along with other crops due to it being resilient to changing climate and different weather patterns.

According to farmers interviewed at both case studies sites, *kumala* is a recovery crop that contributes to the daily diet and improves food security for rural communities in the aftermath of natural disasters:

Kumala is a crop that has helped a lot during the aftermath of cyclones in the past until today, and during cyclone season, *kumala* is a crop that is available in our kitchen (MB11).

A farmer explained 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, and Cassava, but *Kumala* provides food within three months (MBF10).

Most farmers in both sites grew *kumala* for food. However, the availability of *kumala* before and during the aftermath of cyclones is another reason farmers grew *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*, ready to harvest after three months, which we can plant before and after the cyclone season. The main reason is that *kumala* provides food when needed (MBF9).

Kumala planting material was available and accessible at both sites, and growing *kumala* had contributed to farmers' staple diet. In the 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).

The concept of food basket

The Department of Agriculture and Rural Development in Vanuatu partners with non-government organizations to provide services to smallholder farmers in the rural communities. These services encourage farmers to grow more local produce. The food basket program from the Department of Agriculture and Rural Development ensures that food is available and supports the recovery during the aftermath of natural disasters.

According to a Vanuatu Skills and Partnership officer:

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 mainly 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 damage in any part of the island, food crops are sourced from farmers in villages that are not affected by the disasters. For instance, the volcanic ash fall that affected the Eastern part of Tanna in 2021, the farmers from Middle Bush provided food crops to the 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 distributed to the boarding school and communities that are affected by the ash fall in Eastern Tanna (K3).

Kumala within the traditional food system

Traditionally, *kumala* is grown within the dominant crop system in the respective case study sites; yam-based cropping system in West Tanna and taro-based cropping system in Middle Bush. However, the choice of growing *kumala* in other systems such as intercropping and mixed cropping, are determined by farmers needs and priorities.

An elderly farmer 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 won't grow well and, we don't waste the soil from our labour, instead of leaving it there we must plant *kumala* (WTF1).

Another farmer in West Tanna shared his response on growing *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 don't usually get good yield (WTF8).

From both sites farmers indicated that growing *kumala* with other crops and vegetables in a mixed farming practice has been an 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 I don't usually experience shortage of food (MB15).

Some farmers mentioned that they occasionally practice sole cropping or mono-cropping of *kumala*, which happens when they purposely grow *kumala* for a specific need, like paying their children's school fee.

Sourcing of planting material is achieved through social relationships

Social relationships are the basis for 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 these relationships to get their *kumala* plant material. It was evident from the interviews in West Tanna 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 relationships 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 impact on the planting material. During such events, farmers around West Tanna collect plant material from friends and relatives in Middle Bush. Two farmers commented on sourcing planting material from Middle Bush area:

Sometimes there is a long 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).

Status of kumala in Tanna community

In the local community in Tanna, some farmers acknowledged the role of *kumala* in the traditional food system. According to a farmer in West Tanna:

Kumala has assisted us a lot in providing food, there is no sacred farming practices involved; therefore, we can plant and harvest *kumala* and eat like we want with no cultural restrictions (WTF5).

Another farmer shared the same view on *kumala*:

We rely on *kumala* for food; unlike Yam, *Kumala* immensely helped us. It provided food when needed, and there is no traditional taboo associated with cultivating *kumala* like Yam; it is a root crop that anyone can plant and harvest (WTF 6).

Culturally, *kumala* is given the status of *kaikai blong kitchen*, meaning food belonging to the kitchen rather than the *nakamal* (a cleared open space under a banyan tree, where important gatherings and ceremonial activities take place) by most respondents in both sites. *Kumala*'s status as an important crop in the traditional food system was commonly expressed by farmers.

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

Kumala as an income source

The market options for *kumala* farmers at both sites were limited to the domestic market. The primary market in Tanna is at Lenakel, located on West Tanna, where all farmers go and sell their local produce, including *kumala*. Some farmers sell their *kumala* in the market outlets in Port Vila depending on the amount of crop and the logistics of getting the crop to the market. Other farmers use roadside markets 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 ship the *kumala* to Vila and sell them at the market to pay for my children's school fee (WTF20).

Farmers in the Middle Bush area live far from the main local market in Tanna. Therefore, it is more convenient for them to use the roadside market to sell their local produce. For example, a farmer 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 don't have to spend money on transport to go to the Lenakel market (MBF20).

Some interviewees from both 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 and grow it to feed my family. When I have a good harvest, I sell them to the market (MBF8).

Farmers also explore different value-added products of each crop they grow in their garden, such as *kumala*. Adding value to *kumala* is an opportunity for the livelihood of farmers, especially for income generation and longer storage. *Kumala* chips were identified by most farmers as a value-added product, that supported them to earn extra income to pay for their children's school fees. While they acknowledged the traditional way of cooking, farmers interviewed in both communities indicated they were eager to learn more about *kumala* value-added products.

However, there are only a small number of farmers who have been able to sell value-added *kumala* products. A farmer shared 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).

Discussion

The current study explored the role of *kumala* (sweetpotato) as a food security crop supported by the following aspects: *kumala* is integrated well into the traditional food system, promoted through social and cultural ties, and provides income and food for smallholder farmers.

Kumala, a food security crop in Vanuatu

On Tanna Island, as in other Pacific Island countries, *kumala* is cultivated due to key features; high yields, drought tolerance, able to be grown in all altitudes, relatively low labour input, and can be grown as part of the traditional food system. This study concurs with previous studies highlighting *kumala* as a prominent crop for food security in Pacific Island countries. Iese et al. (2018) reported that in most Pacific Island countries *kumala* cultivation has increased because of its ability to grow at different elevations, drought tolerance, resistance to pest and diseases, and it is a non-seasonal crop. Mertz et al. (2012) noted in Bellon (Solomon Islands) that farmers are growing more *kumala* because of high yield, and the less weeding once the crop is planted.

According to 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 (cyclone), due to its shorter growing cycles than other Asian staples. Mabhaudhi et al. (2015) reported that 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.

This research explores the resilient features of *kumala* relevant to food security pillars in the context of smallholder farmers in Tanna Island. The pillars of food security include food availability, food accessibility, utilisation, and stability (FAO 2016). Table 1 highlights the features of *kumala* and its relevance to the four pillars of food security identified by smallholder farmers across the study sites. *Kumala* is both available and accessible for farmers in both case study sites. It is a non-seasonal crop grown throughout the year in tropical locations, reflecting the availability of the crop. The planting material is accessible between the farmers and across the villages through the bond of existing social relationships. *Kumala* is widely cultivated, due to the taste preferences for a few varieties that farmers grow, that is relevant to utilisation of the crop. This study highlights the role of *kumala* as an essential food security and recovery crop grown by farmers but also its contribution to the food basket program. This initiative ensures the availability and accessibility of food crops and planting materials is achieved, especially before and during the aftermath of natural disasters, thereby promoting food stability (fourth pillar of food security). Similarly, this concurs with Iese et al. (2018) study which reviewed the role of *kumala* as a food security and recovery crop and explored the significant features of *kumala* that complement the four pillars of food security across the South Pacific territories.

Table 1. Features of *kumala* and four pillars of food security

Food security pillars	Tanna Community level
Availability	<ul style="list-style-type: none"> Seasonal crop: farmers in both case study sites grow <i>kumala</i>. Farmers grow drought-tolerant varieties, ensuring food availability during drought periods.
Accessibility	<ul style="list-style-type: none"> Staple food crop: therefore, it is accessible for both men and women to cultivate <i>kumala</i> in both case study sites. <i>Kumala</i> tuber and planting materials are accessible between farmers and across different villages. <i>Kumala</i> is not associated with cultural obligations such as Yam and Taro; therefore, it is accessible throughout the year as a food source.
Utilisation	<ul style="list-style-type: none"> <i>Kumala</i> is grown for food and sold at the market to generate income. <i>Kumala</i> is widely cultivated due to its preferred taste.
Stability	<ul style="list-style-type: none"> The short growth duration enables farmers to access <i>kumala</i> tubers and planting materials yearly. The continuous cultivation of <i>kumala</i> due to its accessibility and availability as plant material and food crop reflects its sustainability in the traditional food system

Kumala is a root crop that can be grown within the traditional system.

Kumala is adding to the resilience of Vanuatu farmers, and it is grown within the conventional food system, building on traditional farming practices associated with traditional crops yam and taro. This concurs with a previous study in Vanuatu that showed adopting root crops such as *kumala* enhances the cropping system's resilience. For instance when the cyclone damaged taro farms in Tanna, the farmers responded by planting *kumala* due to its short growth duration (Blanco et al. 2013). This is because *kumala* is a similar crop to yam and taro, and can be grown in conjunction with traditional crops, either intercropped or following yam and taro. This complementarity would not exist if it were a non-root crop or did not have the characteristics that *kumala* has, such as drought tolerance, or the short growing season; therefore, it is an ideal food security crop. Several studies have shown that cultivating *kumala*, among other crops, is often informed through the different farming practices and local knowledge of smallholder farmers, accumulated through experiences by farmers who rely on farming to support their livelihood (Bourke & Ramakrishna 2009; Leweniqila & Roskrug 2023). Beckford & Barker (2007) study in Jamaica similarly shows that smallholder farmers have practiced yam-based cropping systems informed through traditional or local knowledge, and the ability to grow yam is shared among the smallholder farmers in the different regions.

Kumala exchanged among networks to support food security and social connections.

Kumala is exchanged to support individuals, families, and communities facing prolonged drought and damage from volcanic ashfall. The exchange of food crops has been a long-standing tradition

to cope with environmental damage in developing countries (Scott 2021). This study aligns with scholars such as Adam et al. (2018) and Gatto et al. (2021), who acknowledge that the exchange of food crops enables farming families to access the food that is unavailable during the aftermath of natural disasters through their social relationships. For instance, in this study farmers during drought periods in West Tanna exchanged coconut for *kumala* vines with farmers in Middle Bush. Similarly, McGuigan et al. (2022) reported that strong social connections across Fiji facilitated the exchange of *kumala* planting materials post cyclone. 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 improves access to resources such as food crops, labour and livestock. Exchange occurs within the communities, and the agroecological conditions often challenge the farmers to grow the crops and conserve their planting material (Spencer et al. 2020).

Status of *kumala* in the cultural context

This 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, thus enhancing the value of *kumala* as a potential food security crop that is 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. Leach (2005) explains that in Fiji while taro has high cultural significance compared to *kumala*, increased *kumala* cultivation temporarily replaced taro during post cyclone periods. The finding in this study reflects Ba et al. (2023) who 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. Therefore, it is evident in this study that *kumala* is a food security crop that fits within the traditional food system and is available and accessible for smallholder farmers.

Diversification of *kumala* for food and income

In this study, smallholder farmers grew *kumala* with other vegetables, root crops and a few cash crops to diversify the source of food and earn extra income. 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). According to Mabhaudhi et al. (2015) in South Africa, *kumala* is tolerant to mild drought and can be harvested progressively. Its diversification with other crops has proven to be a good approach to food security.

In the current study, diversifying *kumala* into non-farm activities through the development of processed products and value addition also has the potential to increase crop utilisation and generate income. The value-added products of *kumala* are currently at a small scale; however, a few farmers already benefit from the income through the sale of *kumala* chips to support them financially. These studies have also stressed the contribution of value-added products of *kumala* in financially supporting the livelihood of smallholder farmers in the developing countries (Sebatta et al. 2014; Orinda et al. 2017; Alalade et al. 2019). Adeyonu et al. (2016), highlighted that for Nigerian smallholder farmers to be fully engaged in value-add products of *kumala*, such as flour, and *kumala* fries, training and extension services are necessary to assist the farmers. This concurs with this study, smallholder farmers emphasised that training is a practical approach to help farmers engage in value-add products of *kumala*.

Conclusion

This study explores how *kumala* is grown and its contributions to enhancing the livelihood of smallholder farmers in Tanna Island, Vanuatu. *Kumala* is integrated into Tanna Island food systems as a livelihood strategy that supports farmers' household resilience and contributes to food security. Smallholder knowledge of growing root crops, along with the support of agriculture extension services, has enabled them to grow *kumala* successfully. *Kumala* is a food security crop for communities on Tanna Island because, it can be shared and exchanged through social exchange that is embedded in social values, promoting food security between farmers 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. This study highlights the importance of revitalising the role of *kumala* within Vanuatu's food system, to enhance food security and promote household resilience in the face of adverse impacts of climate change. This study recommends documentation of traditional knowledge within the local communities, for the government to incorporate traditional knowledge into adaptation strategies and policies that supports farmer livelihoods. Further research and support from the government could support value addition of *kumala* for smallholder farmers and create and strengthen market opportunities.

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