Foods and diets of communities involved in inland aquaculture in Malaita Province, Solomon Islands

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FOODS AND DIETS OF COMMUNITIES INVOLVED IN INLAND AQUACULTURE IN MALAITA PROVINCE, SOLOMON ISLANDS

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EXECUTIVE SUMMARY

Solomon Islands has a population of just over half a million people, most of whom are rural-based subsistence farmers and fishers who rely heavily on fish as their main animal-source food and for income. The nation is one of the Pacific Island Counties and Territories; future shortfalls in fish production are projected to be serious, and government policy identifies inland aquaculture development as one of the options to meet future demand for fish. In Solomon Islands, inland aquaculture has also been identified as a way to improve food and nutrition security for people with poor access to marine fish.

A WorldFish study under the CGIAR Research Program on Aquatic Agricultural Systems has been exploring the potential role of land-based aquaculture of Mozambique tilapia in Solomon Islands as it relates to household food and nutrition security. This nutrition survey aimed to benchmark the foods and diets of households newly involved in small homestead tilapia ponds and their neighboring households in the central region of Malaita, the most populous island of all the provinces in Solomon Islands. Focus group discussions and semistructured interviews were employed in 10 communities (five inland and five coastal), four clinics, and five schools.

The diet of the participants was characterized by large amounts of carbohydrate-rich staples and a limited supply of animal-source foods. Fresh marine fish and canned tuna were the most common animal-source foods. The results show that imported foods are regularly consumed, particularly rice and noodles. People stated that their choice of imported foods over local foods was spurred on by three factors: climate change, which was the reason respondents gave for lower agricultural crop production; changing traditional family roles; and migration to urban areas. Despite a majority of participants perceiving imported foods as "bad kaikai" (bad food), these foods are consumed on almost a daily basis and are often mixed with everyday local ingredients, which are perceived as "good kaikai."

Tilapia has yet to become a common food item in the study households, although many see its potential. Tilapia was consumed by households that produced it from their ponds, although a few also caught it from neighboring streams or occasionally bought it from urban produce markets. Less than two years into the interventions initiated by the Australian Centre for International Agricultural Research project, at the time of this study, farmers were tending to focus on digging new ponds or producing larger-sized tilapia rather than on harvesting.

Although tilapia is not a preferred fish over reef fish, and with its small size requires different cooking techniques compared to some larger fish that can be bought at the market, a great interest was expressed in its production. Both men and women felt that farming tilapia was both cost-effective and time-efficient compared to the available options for accessing fresh fish, which are — depending on the distance of the village from the sea — going fishing at sea or purchasing fresh marine fish from local markets or directly from marine fishers.

INTRODUCTION

The archipelago of Solomon Islands is situated in Oceania, lying east of Papua New Guinea and northwest of Vanuatu (Figure 1). Of a total population of 515,000, 19 percent live in urban areas and 75 percent are subsistence-oriented, smallholder farmers and fishers.[1] Like other Pacific Island Countries and Territories, Solomon Islands has a great reliance on fish for food and income, and fish accounts for 73 percent of total expenditure on animal-source foods.[2]

Figure 1. Map of Solomon Islands highlighting Malaita Province.[3]

Agricultural production throughout the country is diverse due to variations in climate, soil and topography; however, increased availability of imported foods that are high in carbohydrates and fat is changing the dietary pattern toward a less nutritious diet. At the same time, lack of cash income limits access to nutrient-rich foods. Fresh marine fish and canned tuna are the most common animal-source foods, but fresh marine fish is not equally available to all, due to high cost or poor access to coastal areas.[4]

The consequence of variable access to nutritious foods means that in the general populace, Solomon Islanders suffer from both under- and overnutrition, placing a burden on the health system.[5] The latest Demographic and Health Survey, conducted in 2006–2007, obtained anthropometric measures from a representative sample of 3,247 women and 1,693 men above 15 years of age in three provinces: Guadalcanal, Malaita and Western. Of these, 29.9 percent of women and 25.0 percent of men were overweight, with 14.5 percent of women and 5.8 percent of men being classed as obese.[6] Only 1.9 percent of women and 2.2 percent of men were underweight.[7] However, stunting[8] is prevalent in children: In 2,029 children less than five years of age, 32.8 percent showed signs of stunting,[9] suggesting that they are affected by "hidden hunger" — deficiencies of essential vitamins and minerals, leading to reduced growth, impaired development and decreased ability to fight infection.[10]

As the primary animal-source food, fish plays an important role in the nutrition of rural families. Fish are nutritionally rich and are a good source of protein, fats, and micronutrients such as vitamin B12, calcium and potassium.[11] It is of concern, therefore, that in some Pacific Island Countries and Territories, including Solomon Islands, an increasing gap between fish supply and demand is projected[12] due to growing populations, combined with the impacts of climate change and overfishing on the health of inshore reefs and fisheries. With future shortfalls in food fish production in Solomon Islands projected to be between 6,000 and 20,000 metric tons per year by 2030,[13] inland aquaculture development has been identified as one way to contribute to meeting future demand for fish.

Aquaculture of finfish in Solomon Islands is limited to Mozambique tilapia (*Oreochromis mossambicus*), which was introduced during the 1950s and is well-established in many fresh and brackish waters around the country. It is harvested for food and income by some households, particularly by the poor in urban and peri-urban areas and those without ready access to near-shore marine resources.[14] In response to self-initiated demand from prospective pond farmers in Malaita and Guadalcanal provinces, a scoping study[15] showed that, although yields from roughly constructed backyard ponds were low, households were enthusiastic about culturing fish and farmers were experimenting on their own in the relative absence of access to technical knowledge. Although there are commercial limitations on Mozambique tilapia farming in Solomon Islands, it is currently the only fish accessible to farmers. Working with what they have at hand, farmers have continued to look for an opportunity to expand their livelihood base and their experience with aquaculture through farming Mozambique tilapia.

In 2011, the Australian Centre for International Agricultural Research-funded project FIS/2010/057 "Developing Inland Aquaculture in the Solomon Islands" was implemented by WorldFish, the Ministry of Fisheries and Marine Resources, and the Secretariat of the Pacific Community. One component of the project focused on opportunities for improvements in yields to the current systems of farming Mozambique tilapia through improved management. The study aimed to contribute to the research question "How can aquaculture be developed to optimize food and nutritional benefits for those most in need?"

This component of ACIAR project FIS/2010/057 is focused on Malaita Province (Figure 1). Malaita has the highest population density of all Solomon Islands' provinces and a total population of 137,596.[16] This report presents the findings from a nutrition survey carried out by WorldFish in central Malaita in 2013. At the time of this study, there were 20 farmers with ponds who were undertaking participatory action research with WorldFish. The aim of this study was to benchmark the current food and diets of pond farmers and neighboring households.

During the design phase of this research, a qualitative framework was selected as being appropriate for the cultural context. It was recognized, based on researchers' experience and the literature, that the use of methods required to obtain robust quantitative data in rural communities can be inappropriate in certain cultural contexts. We chose not to implement quantitative methods such as 24-hour recall because the necessary rigor would have required time and resources that were beyond the scope of this study. Furthermore, using a rigid framework to push for quantitative answers, particularly about a sensitive topic such as household practices, can confine participants' answers and stunt the fluidity of conversation. Sharing stories, however, is a common means of sharing information in Solomon Islands.[17] Using qualitative methods draws on this existing communication system and creates a flexible and familiar space for participants to converse within. In this context, focus group discussions and semistructured interviews were the two main techniques employed in this research, as they both draw on story-sharing characteristics.

In addition, using qualitative methods was logistically efficient. Obtaining accurate estimates of food quantities proved to be a difficult task. Villagers have limited means of measuring or weighing what they eat. Food was usually measured in "parcels," "sacks" or "heaps," but the weight of each of these portions varied according to the number of people living in a household and according to personal perception. For example, one participant described a heap of eggplant as "the same as at Auki market"; conversely, another participant described her heap as being "twice the size as at Auki market." We acknowledge that without quantitative data to support our qualitative data, we are limited in the options we have for analysis. However, the data collected through dialogue provide valuable insight into emerging trends and issues regarding nutrition in central Malaita.

Village selection

Villages were selected from those that had a relationship with WorldFish, and then based on their geographical location. At the time of the nutrition survey, the ACIAR FIS/2010/057 project had been active in Malaita for two years. During this time, relationships with various farmers and households have been established. The selection of villages was based on local researchers' knowledge of where ponds were relatively well established and where researchers' relationships suggested that villages would be willing to participate in such a study. Villages were further selected to get a relatively even spread between coastal and inland locations. The decision to include both locations was made in order to reflect known differences in access to land and sea resources across the Malaitan landscape; coastal livelihoods are relatively more based on fisheries and produce from mangrove forests. In many places, the historic practice of trading fish, shellfish and other marine foods for garden produce between inland and coastal dwellers continues.[18] Initially, 11 villages were selected — six inland and five coastal. However, due to prior commitments, one inland village chose not to participate, leaving five inland and five coastal villages (Figure 2). Note that the furthest inland community in this study was Aisikisiki, which is 1 kilometer from the sea and is located directly beside the road that provides market access. Those that live further inland have no road access to the coast, are located on the mountain ranges or in remote valleys, and rely primarily on subsistence farming,[19] and therefore were not part of this study.

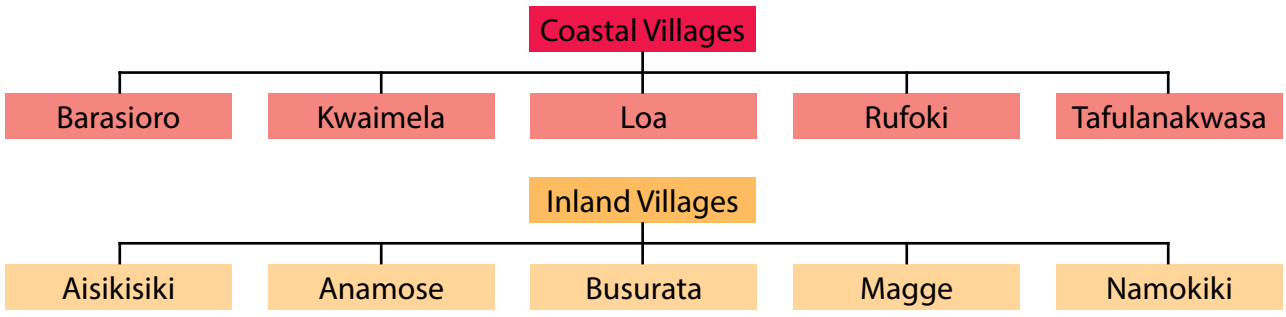


Figure 2. Selected villages by geographical location.

Data collection

The survey was carried out over nine days between October 9, 2013, and October 17, 2013, by seven researchers — five women and two men. All but one researcher were native speakers, with one other fluent in the local Kwa'rae dialect. Reflection meetings were held every evening among the research team. The day's progress was reviewed with a particular focus on emerging trends. Two reflection days were also scheduled. This gave the team time to digest information and start with analysis and transcribing. At the end of the survey an after-action review was held. An integral part of the monitoring and evaluation for learning in the CGIAR Research Program on Aquatic Agricultural Systems involves the whole team taking time to reflect on the processes used, what worked well, what did not work so well and what could be changed for similar future activities.

In total, 18 focus group discussions — nine with women and nine with men — and one semi-structured interview with one individual were carried out with a total of 176 participants — 57 women and 119 men. Participants were given the choice whether to be voice recorded or not, and out of the 18 focus groups and one interview, only four groups declined (Table 1). The survey was written in English, then tested and modified by local researchers fluent in English and pidgin to clarify any ambiguities. Group discussions and interviews were conducted in pidgin. If necessary, translation into a local language was assisted by a researcher fluent in the local dialect.

Questions were developed by the lead researcher with guidance from WorldFish technical staff. Discussions were focused around four concepts: (i) local knowledge and attitudes about nutrition; (ii) general dietary practices and how these have changed over time; (iii) the practice of aquaculture for consumption and sale; and (iv) how pond farming can contribute to household nutrition (Appendix 1).

Two weeks prior to the scheduled visit, we contacted each village in writing, proposing a date and time for each focus group discussion. Focus group discussions aimed to target tilapia-farming families and families in the vicinity who may become tilapia farmers or would benefit from ponds being in the village. Noting that "when women and young people participate in discussions, culture dictates what they say and limits their comments to what is appropriate and not offensive to leaders and elders,"[20] groups were separated by sex. Attempts to separate adults and youths were not successful, however, with female and male youth preferring to join the women and men. Initially, we requested six to eight participants in each group; however, we remained flexible regarding how many people could join, as we wanted the villages to have power over the research process. Being flexible meant that in practice, participant numbers ranged from two to 30 (Table 1). In one instance, when only one participant showed up, a semistructured interview was conducted instead.

Village	Inland or Coastal	No. of Female Participants	No. of Male Participants	Voice Recorded
Rufoki	Coastal	12	27	Yes/Yes
Anamose	Inland	1	11	No/Yes
Loa	Coastal	8	6	Yes/Yes
Namokiki/Maoro	Inland	3	7	Yes/Yes
Tafulanakwasa	Coastal	5	8	Yes/Yes
Magge	Inland	2	0	No/No
Kwaimela	Coastal	4	13	No/Yes
Barasioro/Zion	Coastal	6	6	Yes/Yes
Busurata	Inland	8	11	Yes/Yes
Aisikisiki	Inland	8	30	Yes/Yes

Table 1. Overview of focus group discussions.

Data analysis

Analysis of data occurred during the field work process and after field work was concluded. A week after focus group discussions and interviews were completed, two research assistants transcribed audio recordings into Microsoft Word for analysis. Quotes were then thematically sorted using mind maps. This method allowed us to visually outline information and make links between themes. Data collected from charts were categorized and entered into Microsoft Excel for graphing. The data were separated by gender and geographical location to gain a more comprehensive understanding of emerging trends. Once themes were established through these processes, they were discussed with the project team and the initial write-up phase began. From the records, a list of common foods was also collated and sent to Pitakia Tikai from The World Vegetable Center to provide nutritional information. No further quantitative analysis of nutritional content was attempted at this stage.

Collection of data with school groups and health clinics

Semistructured interviews were held with key informants in four health clinics and five schools, including two primary and three secondary schools, near the villages. Commonly, in health clinics one or two nurses were available to talk; however, in schools, many interviews turned into focus group discussions, one with 10 teachers. The questions were essentially an expansion of the issues presented in the focus group discussions, only differing slightly depending on the participant's occupation (see Appendix 1). The purpose of these interviews was to (i) confirm local norms, (ii) understand what education is available about nutrition, and (iii) understand how diets have changed over the past five to 10 years.

Referencing

In this study, opinions from participants remain anonymous. In each focus group discussion and semistructured interview, it was explained to participants that their opinions could not be traced back to them. In this report, the geographical location and characteristics of the participants are not given.

After-action review of data collection

The outcomes from the after-action review are presented here as context for the interpretation of results.

What worked well?

- Focus group discussions were scheduled to take one to two hours; this time frame worked well for the men but not the women (see below).
- Having two researchers concurrently transcribing audio recordings and writing up charts allowed the team to understand trends as they were emerging. This method also allowed us to understand which issues gave us more data than others and pointed to areas we should concentrate more on.
- Before the survey, a majority of the team had already worked together on similar projects. We were confident in a team environment, as we had previous experience conducting similar activities.
- Three researchers on the team were from Malaita, including one from one of the study communities. Having this grounding, we felt we had a good understanding of the cultural dynamics of the people we were working with. We were able to be flexible and make appropriate decisions when changes in approach were required.
- Conducting focus group discussions created a collaborative environment for both participants and researchers to share ideas comfortably and in a secure fashion.

What did not work so well?

- The women's focus group discussions sometimes extended to three hours. This led to fatigue for participants and researchers and resulted in a constant stream of participants walking in and out of the focus group discussions, with some even leaving before the discussion was completed.
- Throughout this study, there were twice as many men as women. Letters were passed to male farmers in person by the aquaculture team to inform other households about the focus group discussions. However, these letters were predominately passed on to other men. Upon arrival in the villages, female researchers had to walk around to find women available and confident enough to participate in the focus group discussion. Through this approach, the team did manage to encourage women to participate in each village.

- Confusion over the purpose of our visit emerged; although the letter and explanation given by the aquaculture team clearly stated that this exercise was purely for data collection, many thought it was a space to receive aquaculture training or nutritional information. One village in particular thought it was an all-day training exercise, and researchers had to approach the community again — due to lack of reliable telecommunication, the most effective communication is face-to-face — to reiterate the purpose for the trip.
- Once the women's focus groups were convened, there remained a learning curve for the research team to be able to explain and discuss the concepts being probed, as many of the women struggled with the concept of nutrition.
- In rural Solomon Islands, women are generally less educated than men; 38.9 percent of females over six have received no education, compared to 28.8 percent of men.[21] When discussing nutrition concepts, confusion about what was "good" (healthy) or "bad" (unhealthy) food emerged. The root of this problem was caused by people's lack of understanding of what the term "nutrition" means and the inexperience of the team in being able to successfully communicate the concept. In pidgin, there is no word for nutrition, and instead of explaining its complex meaning, we used the question: "Wat kaen kaikai hem gud/nogud fo bodi blo iufala?" ("Which food is good or bad for your body?"). With this as our base, we aimed to tease out ideas about how people think food affects their bodies. Despite these efforts, people would frequently base their opinions on taste (as one participant stated, "taste is important for the body and is a key element for happiness") and accessibility.
- Some of the descriptions given for how certain foods impacted participants' bodies needed to be interpreted for the researchers by local clinical staff. For example, terms such as "dries out blood" or "bad or good for blood" were commonly used to describe how some foods impacted their bodies. Despite these various barriers, the information gathered clearly provides insight into how the respondents value different foods.

What to change for next time?

- Guiding questions to stimulate discussion should be condensed and fewer in number, in order to allow women's groups more time for discussion. The gender difference in time needed for discussion may be due to men having previous experience discussing themes on inland aquaculture; they thus had a greater understanding and more confidence to navigate the discussion.
- Use additional avenues to engage with the community, such as asking the pastor to announce the purpose of the work in church.
- Combine the data collection with the provision of nutritional information. We could link with health organizations such as the World Health Organization and the Ministry of Health to distribute information to rural communities, and by doing so, create a more participatory, rather than extractive, relationship.
- In the future, a stronger partnership with Ministry of Health or local staff may help researchers understand local discourses on this subject matter more easily.
- Take examples of measurements to the communities to have a consistent understanding of the amounts of food they are consuming. This could mean bringing an average-size bundle of cabbage from the market or bowls to provide a conceptual and mutual understanding of size.

Theme one: Common foods

What does the central Malaitan diet look like?
The everyday diet of the central Malaitans in this study, both for inland and coastal villages, was characterized by large amounts of carbohydrate-rich staples such as kumara or sweet potato, cassava, rice, taro, and noodles; leafy green vegetables such as amau, slippery cabbage, ofenga and chinese cabbage; and all-season vegetables and fruit crops such as banana, eggplant, pawpaw and beans. The local and scientific names are given in Table 2, and nutrient composition in Appendix 2.

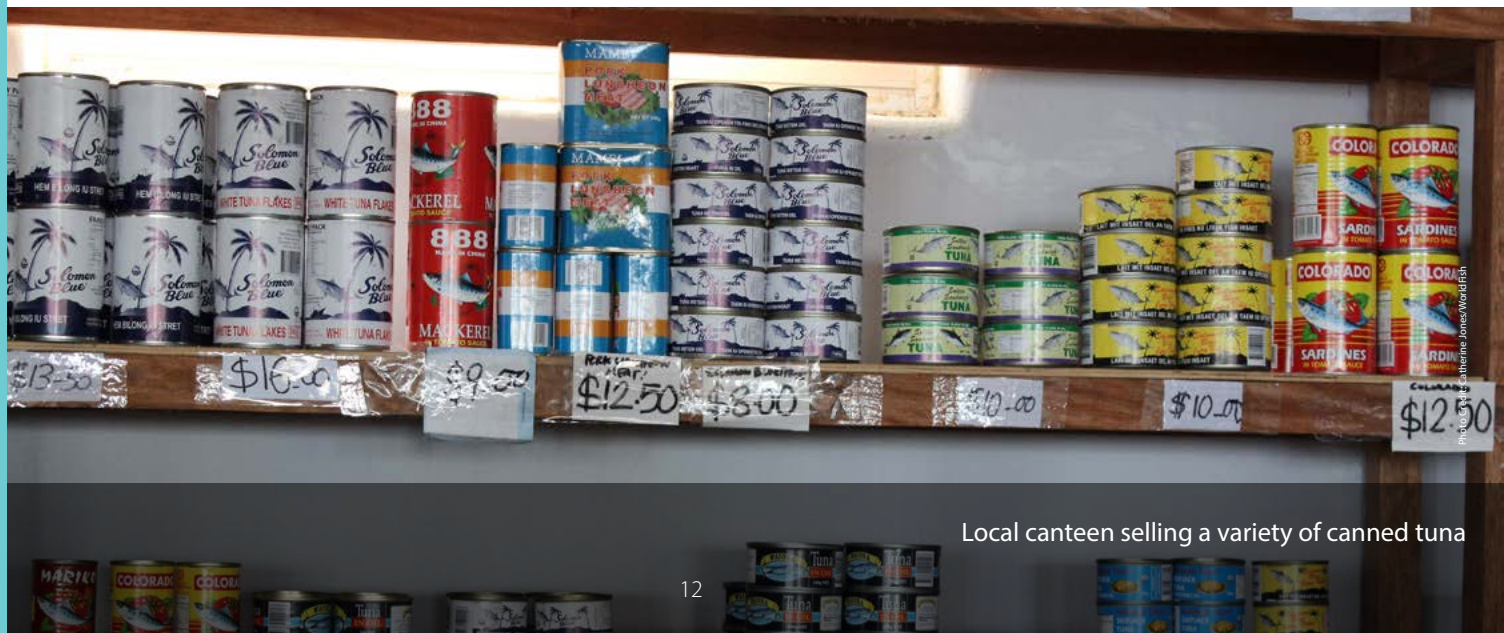
Crop (Local and common name)	Scientific name	Edible part	Cooking technique
FRUITS, NUTS and SEEDS			
Breadfruit (Afio)	*Artocarpus altilis*	Fruit	boiled
Alite	*Terminalia catappa*	Nut/kernel	raw
Avocado	*Persea americana*	Fruit	
Betel Nut	*Areca catechu*	Fruit (kernel)	raw
Breadfruit (Afio)	*Artocarpus altilis*	Fruit	baked
Cocoa	*Theobroma cacao*		
Coconut (Dry)	*Cocos nucifera*	Flesh/mature	
Coconut (Green)	*Cocos nucifera*	Flesh/immature	immature
Cut Nut	*Barringtonia edulis*	Kernel	
Durian	*Durio zibethinus*	Fruit	
Enkori, Ainakori, Piraka, Golden Apple	*Spondias cytherea*	Fruit	
Guava	*Psidium guajava*	Fruit	
Malay Apple, Wild Apple, Kabarai, Kapika	*Syzygium malaccense*	Fruit	
Mango	*Indica america*	Fruit	
Mangrove Fruit (Koa)	*Bruguiera gymnorhiza*	Fruit	
Ngali Nut	*Canarium indicum L.*	Kernel	
Orange	*Citrus sinansis*	Fruit	
Rambutan	*Nephelium lappaceum*	Fruit	
STARCHY STAPLES (ROOT CROPS)			
Cassava (Kaipia, Tapioca)	*Monihot esculenta*	Tuber	boiled
Common Taro (White)	*Colocasia esculenta*	Corm	boiled
Giant Taro	*Alocasia macrorrhiza*	Corm	boiled
Kongkong Taro	*Xanthosoma sagittifolium*	Corm	boiled
Pana (Lesser Yam)	*Dioecoreae esculenta*	Tuber	raw
Potato (Kumara Orange)	*Ipomoea batatas*	Tuber	peeled, boiled
Potato (Kumara White)	*Ipomoea batatas*	Tuber	peeled, boiled
Taro (Swamp Taro)	*Cyrtosperma merkusii*	Corm	boiled
Yam (Greater Yam)	*Dioecoreae alata*	Tuber	
Yam (Go'e, Efiabe)	*Dioecoreae nummularia*	Tuber	
GREEN LEAVES			
Amau (Sandpaper Kabis)	*Ficus copiosa*	Leaf	
Chinese Cabbage	*Brassica chinensis*	Leaf	cooked
Fern (Kasume)	*Athyrium esculentum?*	Leaf	boiled
Ofenga	*Pseuderanthemum whartonianum*		
Pumpkin Leaves	*Cucurbita maxima*	Leaf	boiled
Slippery Cabbage	*Abelmoschus manihot*	Leaf	boiled
Taro Leaves	*Colocasia esculenta*	Leaf	boiled
Watercress	*Rorippa nasturtium - aquaticum*	Leaf	cooked

Crop (Local and common name)	Scientific name	Edible part	Cooking technique
LEGUMES			
Bean (Yard-Long Bean, Snake Bean)	*Vigna unguiculata*	Fruit	boiled
FRUITS and VEGETABLES			
Banana	*Musa sp (A or B) cv*	Fruit	
Cucumber	*Cucumis sativus*	Fruit	raw
Eggplant	*Solanum melongena L.*	Fruit	boiled
Pawpaw	*Carica papaya*	Fruit	
Pineapple	*Ananas comosus*	Fruit	
Pumpkin	*Cucurbita maxima*	Fruit	boiled
Tomato	*Solanum lycopersicum L.*	Fruit	ripe
Watermelon	*Citrullus lanatus*	Fruit	
OTHER VEGETABLES			
Corn (Losi)	*Zea mays L.*	Cob/seeds	boiled
Mushroom	*Flammulina velutipes*	Full mushroom	cooked
Shallot	*Allium cepa*	Leaf	boiled
Sugarcane	*Saccharum officinarum*	Juice	

Table 2. Common and scientific names of all locally grown foods mentioned by the participants.

Animal-source foods were commonly consumed on a daily basis and were dominated by tinned fish (locally known as "taiyo"). Participants suggested the high consumption rate for tinned fish was related to cost-effectiveness, accessibility and product shelf life. Rural canteens, which are small stores, stock taiyo along the main road or within the villages themselves. Prices range from around 6.00 Solomon Islands dollars for a 100-gram tin — or 60 Solomon Islands dollars per kilogram — to 13.50 Solomon Islands dollars for a 380-gram tin — or 35.50 Solomon Islands dollars per kilogram. After taiyo, fresh bonito (whole fish; approximately 16 Solomon Islands dollars per kilogram in Auki market) or reef fish (whole fish; approximately 125 Solomon Islands dollars per kilogram in Auki market) are the most frequently consumed animal-source foods, usually eaten one to three times per week. However, participants stated that as "fish is less abundant nowadays, it affects the diet of most families and changes them from high animal protein content diets to low protein" unless taiyo is used to fill this void.

The least commonly consumed foods overall were other animal-source foods and products such as chicken, tinned meat such as luncheon meat or corned beef, duck, pig, opossum, and beef. These animal protein foods are regarded as "special kaikai" and are only eaten on special occasions such as weddings, birthdays or religious celebrations. Such foods are special because



Local canteen selling a variety of canned tuna

Photo: Catherine Jones/WorldFish

eating "those tin meat and luncheon meat, chicken and corn beef depends on whether people have money." Other special foods included a range of "puddings" (a gelatinous cake made from pounded starch), extracted from root vegetables, including cassava, taro[22] and kumara.[23]

In Solomon Islands, there are two main seasons: relatively wet during the cyclone season of November to March, and relatively dry during the southeasterly "trade wind" season of April to October, with an average air temperature of 27 degrees C throughout the year. Most foods can be grown all year round; however, the availability of some fruits and vegetables is influenced by specific seasons (these foods are highlighted in the Seasonal Calendar in Figure 3). However, in some villages, participants stated that they did not recognize or understand the seasons and reported that "we do not know what season to plant, we just plant any time, so do not know the exact seasons." While crops or particular marine species are in season, they are consumed regularly — on a daily or weekly basis — to maximize the harvest "for all the seasonal food, when it reaches the season we eat it every day until its season is over. For example, mamamu [bait fish] lasts for one week, so throughout the week we eat and also comes once a year." Only a few meat sources were stated to be seasonal, such as crab, sea worm (*Eunice viridis*) and turtle, whereas fish is eaten all year round.

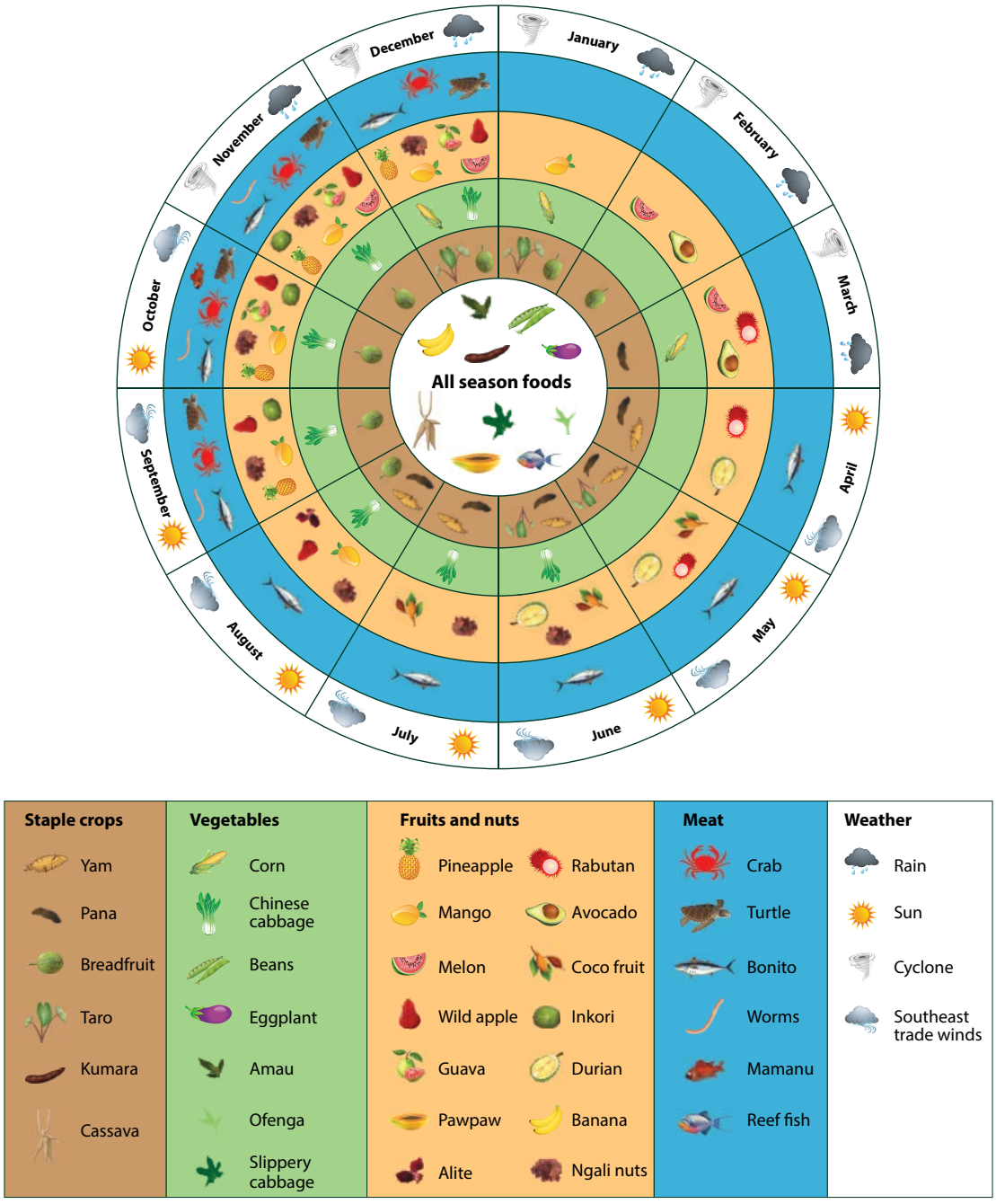


Figure 3. Seasonal food calendar for foods listed in Table 1 that are not available all year round.

Photo Credit: Catherine Jones/WorldFish

Bundles of cabbage at Auki market

How much of each food group is consumed?
It was not possible to obtain data on the quantity of food consumed by household using focus group discussions. Because households varied in size and used different ways to describe the amount of food they consumed, measurements were not consistent. For instance "rice, if a bigger family, will finish in a week compared to a smaller family." This was the same for kumara, cassava and taro; the amount eaten in a week was dependent on the size of the family and how many times family members — and also how many people — go to the garden in a week. Household size within the focus groups varied considerably. Some households, such as newly married couples, only had two people, while in others families could reach up to 10 or more.

Despite this variation, the focus group discussions did reveal some commonalities. Both men's and women's focus groups agreed that apart from tinned fish for some, animal-source foods such as fresh fish, crustaceans or other meat were commonly consumed on less than a daily basis, and with the exception of marine shells, which were consumed more frequently in one village, less than three times a week. The majority of groups agreed that tinned fish, was commonly consumed on a daily basis; however, seven groups agreed that tinned fish was consumed twice a week or less. There were no striking differences in the frequency of consumption as elicited from the focus group discussions by inland and coastal communities for fresh animal-source foods. Tinned fish appeared to be eaten slightly more frequently by the coastal communities.

Carbohydrate-rich foods such as kumara, cassava and taro were generally measured in recycled 20-kilogram rice bags.[24] Depending on the size of the household, between 20 and 40 kilograms of root vegetables would be consumed in a week; that is, the household would require one or two bags to supply them for the week. Taro and cassava were commonly collected in three-day intervals, as they "cannot stay longer than three to four days, [they] will taste stale," unlike kumara that can be harvested weekly and used throughout the week. Leafy greens were commonly measured in "parcels" or "bundles" and described as being "twice the size of those at Auki market." Leafy greens such as taro and pumpkin leaves, ofenga, and slippery cabbage were collected every three days, as they "cannot stay more than three to four days." On average, one parcel was cooked once a day. Fruits, including pineapple, pawpaw and mango, were eaten at least once a day when in season.

The frequency of consumption of store-bought foods such as taiyo (both imported and locally produced brands of tuna are available), rice and noodles was determined by communities' geographical location and an individual's purchasing power. Villages that were geographically remote or had poor transport routes commonly consumed fewer imported products. For example, in the remote inland village of Busurata, participants stated that "we don't eat [taiyo] too much, only on Sundays or Sabbath or special day. Only when we cook Chinese cabbage then we buy taiyo to mix with it. For those people who don't work they eat taiyo once a month; one medium tin a month." In comparison, participants from villages closer to Auki market or that had accessible transport routes, such as Barasioro and Loa, would mix at least one can of taiyo into their evening meal. This trend was also described for rice and noodles, both consumed on a daily basis in areas with easier access to imported products.

How are foods prepared?

Food was largely prepared by the women and "young ladies" of the household, and "men will sometimes help but mothers take the lead." Depending on the person and the household's proximity to its garden, the number of meals ranged from two to three a day. Children usually have three meals, while adults who work in the gardens or go fishing tend to have two meals (breakfast and dinner), chewing betel nut in between.[25] Because of this, breakfast and dinner have supplementary carbohydrate-rich foods that are high in energy, including kumara, cassava, taro and rice, as "it makes our body strong to work." Breakfast and dinner rarely differ in the common diet except in that more carbohydrate-rich food is eaten at dinner.

There are numerous ways food is prepared in the communities, and this also varies between villages. The staple meal for most communities, however, is "supsup,"[26] a soupy mixture of vegetables, coconut milk and fish served with root vegetables — taro, cassava or kumara — and rice, or "lulugna," a vegetarian version of supsup using taro instead of fish. Yet as imported foods such as rice, noodles and taiyo play an increasing role, they are quickly becoming a staple ingredient in these recipes, as "every supsup cabbage must have noodle added into it to make it tasty, sometimes taiyo." On the weekends, commonly after attending church in the morning, a traditional "motu" is often prepared. This involves cooking vegetables and meat covered in banana leaves over hot stones. This form of cooking can take three to four hours, so is only undertaken once or twice a week.

Photo Credit: Catherine Jones/WorldFish

Chinese cabbage and slippery cabbage at Auki market

Who eats what?
Respondents stated that the diet is usually the same for everyone in the household, regardless of age or sex. However, there are a few foods that are reserved for particular groups of people due to "kastom" (a derivative term for custom). In particular, leafy greens such as ofenga, taro leaf or pumpkin leaf and fruits such as banana, "koa,"[27] mango and pawpaw are "good for pregnant women, help with milk production" and "usually for babies, as they are soft and sweet." Clinical staff highlighted that pregnant and lactating women were warned by others in the village about eating too much fish, particularly bonito, as "for women who have just given birth to a child, they are not allowed to eat fish because there is a sickness that usually happens to the baby and the sickness is called 'fish.'" "Fish" in this context is a type of illness in babies, which is locally believed to be contracted through mothers if they have eaten too much bonito. As a result of this illness, "baby's body will become hot with sores and boils" and cheilitis will occur. To cure such illnesses, women suggested that mothers should "give the baby coconut water, makes it strong, same with banana, they are both sweet, so they like to eat it too."

Women suggested that children tend to eat more melon, cocoa fruit, apple, cucumber and guava, as various women in the communities suggested "adults [are] not interested in eating these fruits." Gathering fruit and nuts is mainly a children's activity; they "eat lots of ngali nuts when it's in season, they come back every day after school, climb and eat it." Only adults have the right to consume kastom foods, which include opossum, pig blood (only men), sea worms (*Eunice viridis*) and betel nut. Participants argued that these foods are "part of the culture" in Malaita and are commonly consumed in traditional ceremonies such as weddings and funerals, but not religious ceremonies.

Diets are also influenced by religious practices. Christianity is the main religion in Solomon Islands, and Seventh Day Adventists make up 10 percent of the practicing Christian population.[28] Part of the Seventh Day Adventist lifestyle is to maintain a healthy, low-fat vegetarian diet; therefore, "for [Seventh Day Adventist] people, they don't eat pig or meat." In relation to "special foods" as opposed to everyday diets, in some parts of Malaita traditional beliefs continue regarding the influence of spirits on illness as the result of violation of rigid taboos, especially by women.[29] To expiate such offenses against the spirits, "pig and coconuts are used for sacrifice, usually heathen people from Kwaio, and only men are allowed to consume [the offering] due to their belief."

Theme two: Knowledge and attitudes

Which foods are considered good (healthy) or bad (unhealthy) by communities?
Locally produced foods were predominately viewed as "good because they are all natural foods that help provide a healthy and strong body." The ways that participants described "good" or "healthy" local foods were categorized by the researchers into three categories: energizing, body building and protective. The main energizing foods included carbohydrate-rich staples such as kumara, cassava and taro, described as being able to "last long in the stomach and give more energy to do work," while animal-source foods (not including canned meat) were described as being "good sometimes, because the body needs meat for body building" and "for people who work hard in the garden it gives them good strength." Vegetables and fruits were considered to not only provide energy and to help build a "strong body" but also to possess a "protective function," being described as good for "blood circulation" and "cancer fighting." Some specific fruits, such as pineapple and mango, were considered to be both protective and energizing foods, but were recognized as "not good for people with ulcers because they contain acids."

Packaged and store-bought products, on the other hand, were perceived to be unhealthy foods or foods that were "not good." As one participant stated, compared to local foods "all foods in the store are no good, I think they stay in the store for too long, so it has expired and that's not good for it, it smells good but we don't know how long it has been sitting there for." Because rural canteens sometimes have a low turnover rate, cans of food can be shelved for long periods of time and there are "no fridges so we can't store food." So "easy cooked foods from the store are not healthy for our bodies, our bodies get weak, ulcers and we have vision problems." Despite the negative

perception of imported foods, participants stated that "particularly children don't want cassava or kumara, taste has turned toward rice and imported foods, people are becoming addicted to junk food." Through discussions with participants, we established that a range of imported — mainly processed — foods are purchased; however, rice, noodles, and locally produced or imported tinned tuna were deemed to be the three main staples.

Rice has become a staple food in central Malaita and was perceived by participants as both unhealthy and healthy. While rice was liked for its taste and relatively short preparation time, the participants felt that rice did not provide sufficient nutritional value to carry out daily activities: "for people working in the garden, rice is not that good to eat; people get tired, weak and hungry easily." In comparison to kumara or cassava that "is good for the body and makes the body strong and healthy," rice " doesn't give energy to work in the garden" and "doesn't last a long time in the stomach." Despite this, communities "now eat rice all the time, morning, lunch and dinner; before we eat potato and taro, now we eat rice and noodle a lot."

Noodles, like rice, were generally perceived to be both unhealthy and healthy; yet conversations about the product were primarily negative. Within the communities, noodles are eaten daily, either in "supsup," mixed with rice or uncooked. Women in particular thought noodles were good, but, like rice, this was because of their taste, accessibility and relatively minimal preparation time: "lots of people include noodle in their diets; people like it because of how it tastes and it smells nice inside supsup" and "it's good because it's cheap and sweet." Noodles have become a common lunch meal for many children in local schools, costing 2 Solomon Islands dollars a packet, and are often eaten raw. While noodles play a fundamental role in the diet of participants, when questioned about the effect of noodles on their bodies, an overwhelming negative response emerged: "noodles are not good because it's not fresh and dries our blood [unhealthy for the body]" and "noodles cause lots of boils on our body and makes the body swell." Particularly eating them dry was deemed harmful as "it dries out the water in our bodies" and encourages illnesses "such as heart problems, kidney problems and constipation." When participants were asked what they thought the relationship was between the food and illness, they said that they were concerned about the "wax content in the noodle, which is not nutritious to be eaten every day, and we don't know whether the environment where it has been manufactured is clean."

Taiyo was the biggest concern for communities in regard to nutritional value, and was perceived as bad food by both men and women. Taiyo was often referred to as a "dead food," and participants felt the "freshness" of the product had a significant impact on its nutritional benefit. People's perception of taiyo was sometimes quite negative; people told us that "taiyo is not good; it is really oily, and sometimes when we open the tin we find flies inside it, and once the can is open it's not safe to leave it" and "taiyo is not good; it contains oil from factories, flies in it if not kept clean, and also it is risky; you need to look for the expiry date before you eat it." There were clear concerns over how it is impacting their bodies, as one participant further stated: "before no taiyo was mixed in the food, only shallots and tomatoes and that's why before people are very strong and healthy compared to us now." Nevertheless, taiyo was eaten daily in most of the study communities.

Overall, unhealthy foods in comparison to healthy foods were judged more on taste, accessibility and how people's bodies reacted than on nutritional value. While a majority of respondents were aware that bad food provided less energy and caused numerous health-related problems, "the taste of food from the store makes us addicted; the taste of it adds flavor." Conversely, "good kaikai" was discussed in a different fashion, with vegetables, fruits and fresh meats perceived as ways to obtain energy or protect against diseases. With these foods, taste was not cited as a deciding factor; however, access was important: "All fruits and vegetables come free from the garden."

What information about nutrition is available? There are currently five avenues through which the study communities can access information on nutrition:

1. Teachers from local high schools highlighted that they provide "very basic nutritional education" in Home Economics in Forms 1–3 and "try to encourage students to plant and grow vegetables, so they know how to grow food and its importance." There is no specific nutrition course in the school curriculum, however, and only students who choose to take Home Economics benefit from this basic training. Some high schools hold speech competitions; the topic at Maoro Community High School this year was "junk food and local/health food." High schools also celebrate events such as World Consumer Day, endorsed by the Solomon Islands Planned Parenthood Association and Ministry of Commerce.

2. Nurses from rural health centers "talk about [nutrition] in front of the clinics and inside schools; they do talks about how to have a balanced diet, saying food like this is good, this is not good." In addition, nurses from Kilu'ufi Hospital, the main hospital in Malaita, also "give pamphlets and posters to the community to read it and gain information about nutrition." Although these clinics provide some awareness on the nutritional value of foods, they mainly "focus on children and mothers on how to prepare food for babies, frequency of feeding and breastfeeding."

3. Government-based organizations such as the Solomon Islands Broadcasting Corporation give "nutritional awareness [talks] on the radio, from 7 p.m. most nights, about how to have a balanced diet."

4. Nongovernmental organizations, including Save the Children and Kastom Garden Association, have been active in rural areas of central Malaita. For example, in the Kastom Garden Association's project "Women and Nutrition," women drawn from selected partners are trained as local resource people; they learn about nutritional information to then spread to neighboring communities. There are currently six women in the program, with two residing in central Malaita. Save the Children's primary project in central Malaita is "Youth Partnership Outreach," which uses sports to encourage youths to live a healthy lifestyle, and includes a module on "Healthy Kaikai."

5. Church groups and elders such as the South Seas Evangelical Church Health Division provide information about sanitation and cleanliness. Furthermore, "village elders talk about nutrition to us, saying we must eat local food."

While these services exist, they do not necessarily reach everyone. In our survey, all respondents in 42 percent of the focal groups said they currently have no access to information on the nutritional value of foods. This was voiced more commonly by women than men, as described by various women: "we go ahead and eat, not knowing what it does in our bodies"; "no awareness done, no people come and talk to us about nutrition yet"; "there is no group doing awareness or workshops in the area"; and "nobody has come to talk about anything; they forget about grassroots; there are things in the towns but not in rural areas where they should be working."

The reasons for this divide are complex. Women in Malaita tend to lean on existing knowledge structures or information passed down through family members — "my husband goes to Honiara and comes and shares information" — rather than ask advice from others. Secondly, regular trips to health clinics are not common. Women in particular rarely visit local clinics, and when they do, it is usually to give birth or treat illnesses. Without seeing people at regular checkups, nurses' ability to pass on nutritional information is further limited. Another factor can be pinpointed to geographical limitations. While there are various clinics scattered along the main roads in Malaita, reaching such amenities can be a struggle for many women. Transportation in central Malaita is limited and further restricted due to its high cost — return from Aisikisiki to Auki is 60 Solomon Islands dollars — so for women whose main method of transport is walking, attending clinics regularly can be a struggle. This is further exacerbated by the daily duties of many women. Local clinical staff highlighted that between going to the garden, household duties and caring for children, finding time to attend workshops or obtain information themselves can be a challenge.

How are diets changing?

Over the past 10 years, "there has been a change in food and diet; this is in terms of people favoring processed food more over locally grown crops; this is because of sugar, salt, taste and flavor content, also due to transport accessibility to town." While issues of nutrition and health that are related to imported and processed foods are primarily seen as an urban issue, in Solomon Islands,[30] this trend also flows into the rural context. Almost all rural communities have "wantoks"[31] or family members in urban areas who provide supplies of imported foods, which are commonly high in carbohydrates and fat. These two characteristics of the foods "lead to the combination of malnutrition and overweight being not just an urban phenomenon, but also a problem in rural areas." [32]

Participants provided a variety of reasons as to why imported goods were increasingly incorporated into their everyday diets; these discussions can be subcategorized under three main headings: climate change, changing of traditional family roles and migration to urban areas.

Communities believe that climate change is having an impact on their land and marine resources. Such changes "contribute to changes in our diet, plenty rain and little sunshine," making it harder to nurture crops and predict seasonal trends. In regard to staple root crops such as taro, kumara and cassava, the expected times for planting and harvesting and the yield were stated to have been constantly changing over the past 10 years, due to unexpected weather patterns and degradation of soils: "Before people used to plant their crops and expect a good harvest, but as time goes on and climate changes today, when people plant kumara instead of harvesting that plot for 20 kilograms, we get 10 kilograms; many families today experience this; even the size of the fruit has changed and become smaller."

Photo Credit: Catherine Jones/World Fish

Bulk rice at a local canteen in Auki, Malaita

In addition, it has been predicted that fish consumption will continue to decrease in the future due to increasing population pressure, poorly managed coastal resources and environmental degradation.[33] These predictions and related fears were echoed in the communities: "Changes in terms of food 10 years ago, is that back then fishermen would catch big fish at the edge of the reef, while nowadays, catches are done in deeper waters and only smaller fish can be found on the reef's edge. The reason for this is that 10 years back only the older people would do the fishing, while today everyone fishes, including youth, women, men. Also population increase has created a high demand in surplus. Second reason is that reef fish feed mainly on corals and the lack of coral due to logging, which is smothering them; the fish population has decreased, and also harvesting wild coral for consumption and export. There was also the practice of tambu [taboo] areas in the local community, but today poaching in these areas is a big problem."

Over the past 10 years, traditional family roles have shifted, impacting food cultivation and preparation. Before, men and women used to share the task of going to the garden, which can be located over an hour away by walking — due to kastom land ownership, garden plots can be some distance from the village. Today, this relationship has changed, as one woman voiced: "Now we lean so much on rice and noodles; this is because men and women don't work together anymore. Before, men and women were very committed to working in the garden. Now, the women have taken on the burden of looking after the family. Men have the privilege to roam around. The men fish a lot, they don't help out the wife with the garden, and the young boys are not committed to family work; they just hang around with other boys and stay in the house and do what they want to do. People don't work hard like before; when the men come home they just roam around in village."

Because of this extra burden on women, the ability to cultivate "staka" or numerous crops on their own is difficult in addition to carrying out their household duties, especially when the gardens are being located further and further away due to the degradation of the soil. Therefore, "[they rely] more on store foods because it's easy and quick to prepare" and "parents want their children to eat fast and go to school." Because of this trend and pressure on women's time and workload, people are planting less as imported goods become more accessible: "before the main food was taro; now we don't plant like before, so there isn't much in the gardens; this is because of rice."

Urbanization in Solomon Islands is a relatively recent phenomenon.[34] Malaita has experienced rapid urban growth in the last 50 years, with Auki, Malaita's provincial center, estimated to be growing at 11.6 percent annually. [35] This rapid population growth has impacted the way food is traded among communities. Rather than the traditional barter system that was used between land and sea villages, the relationship is now more focused on exchange between rural and urban centers, such as Auki and Honiara, where "local foods are planted mainly to sell at the market to pay for processed foods such as rice, taiyo, noodles and sugar." Rural communities therefore forfeit their good produce for the sake of money or imported goods and are commonly left with the offcut crops for personal consumption, which are sometimes not enough to feed the extended family. The old barter system allowed communities that were restricted by geographical location to access foods necessary to maintaining a healthy diet; for instance, "taro would be exchanged for fish." Instead, this new system relies on monetary value. Compounding this issue is the movement of people away from the villages to urban areas for employment, as "people who work in town work less in the garden, so we depend more on store foods." Overall, the evidence suggests that urbanization has transformed trading systems in Malaita, which has directly impacted the types of foods eaten in remote communities.

Theme three: Tilapia and aquaculture

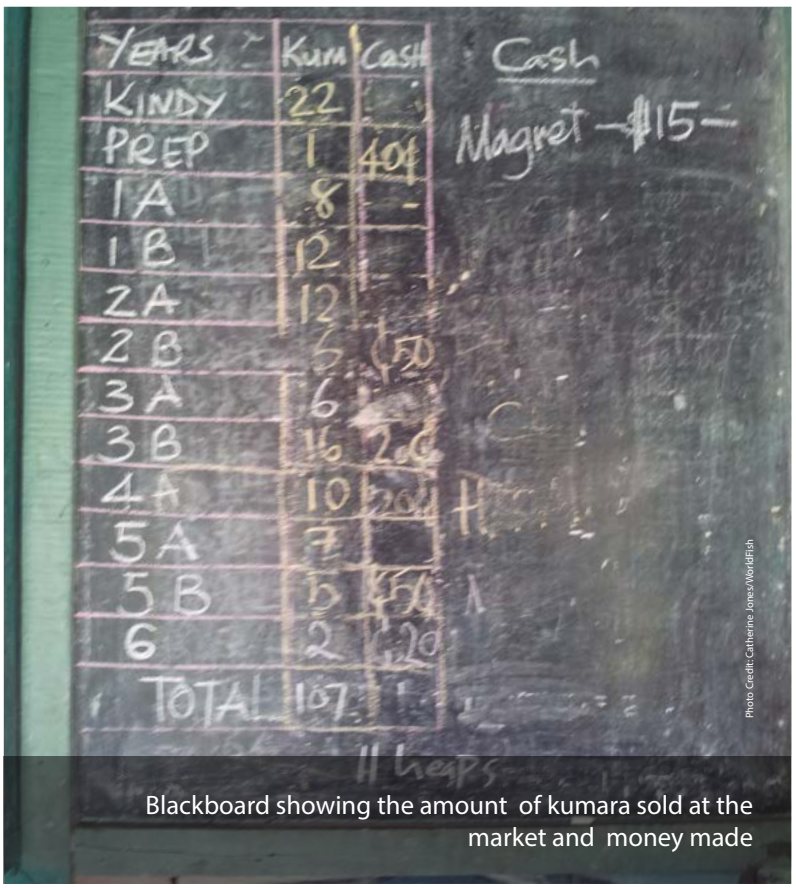
Who is currently consuming tilapia?

Cleasby et al. reported that households that were directly engaged in tilapia fishing from the wild "consumed, on average, 84 percent of the fish they caught. Sixteen percent of fishers reported that they also sold some of their catch in local markets (formal and informal) at 5–20 Solomon Islands dollars for approximately 5–10 fishes."[36] The households in the study have not historically fished tilapia from the wild, and tilapia is not a common food in their diets; only fish-farming households generally have tilapia in their diets. The perception of nonfarming participants was that these households have a tendency to "feed [the tilapia] and leave them, don't eat or share them." Probably because the fish farming concept is relatively new, rather than harvesting, farmers have tended to focus their efforts on digging new ponds or increasing fish size. So far, this drive to perfect their technique has resulted in irregular yields. Individual households are beginning to harvest what they need, but focus group participants said that farmers rarely sell or gift tilapia to neighbors.

What do people think of tilapia?

Within each focus group, people were asked to come to a consensus about a ranking for tilapia, starting from a rank of 1 as their least preferred to 5 as their most preferred fish to eat. Reef fish and bonito were commonly preferred fish over tilapia, particularly in coastal areas, where tilapia ranked 3.4 on average: "[tilapia] not salty enough, like other fish in the sea." Inland communities ranked tilapia higher than coastal communities at 4.5 on average. Unlike coastal villages, the ranking of inland communities was not solely based on taste, but included its functionality, accessible nature and low cost in contrast to sea fish. In general, tilapia was described as the "best fish to eat" with a majority saying this was because of its "tasty greasy texture."

Nevertheless, a common issue mentioned in all communities by both men and women was the small size of tilapia. Mozambique tilapia can grow to 20 centimeters in the wild,[37] but to date in central Malaita, pond fish tend to reach no more than 12 centimeters and 17 grams.[38] In comparison, bonito and reef fish are much larger. At the Auki market in November 2014, for example, the average length of bonito was 57.95 centimeters and the average weight was 3.05 kilograms; the average length of reef fish was 27.9 centimeters and the average weight was 35 grams.



Blackboard showing the amount of kumara sold at the market and money made

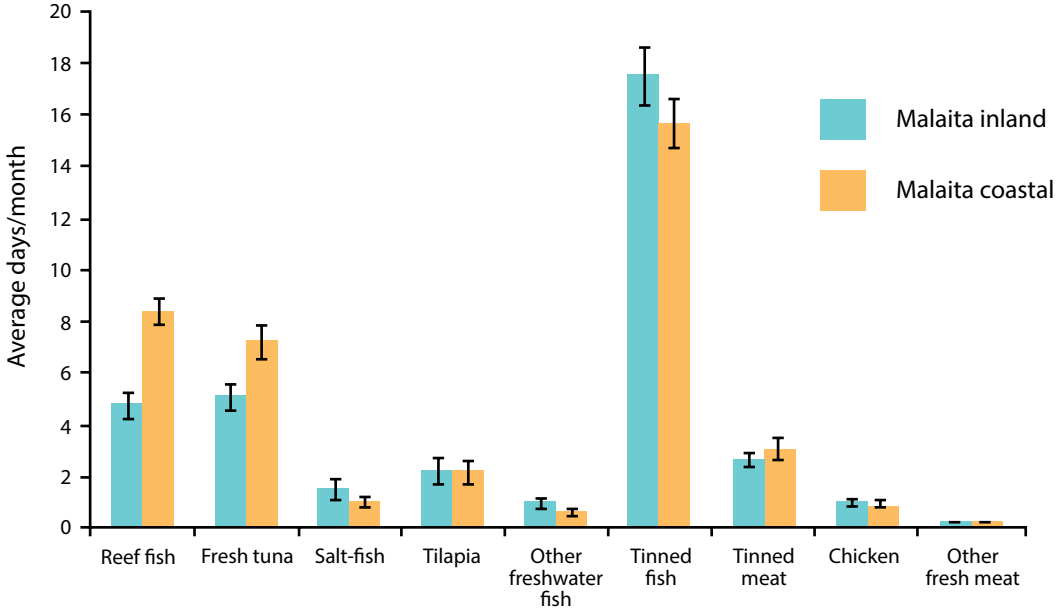


Figure 4. Average days per month each major source of fish or meat was consumed for inland and coastal communities in Malaita. Error bars represent standard error of the mean.[40]

Who is interested in tilapia farming?

Respondents expressed a great interest in tilapia cultivation, whether they owned ponds or not. Both men and women agreed that farming tilapia was both cost-effective, as the fish is free from the pond or perceived to be potentially cheaper than purchasing other fish from markets, and time-efficient: "it's a good fish, as you don't need to spend money to get it, just need to go to the garden and take it." Inland communities in particular struggle to obtain a regular supply of fish, often relying on catches from coastal villages, which can be inconsistent and varied in quality: "sometimes we are unsure about the fish at the market and uncertain if they are good or healthy meat free from poison [from dynamiting] and not sure how long flies sit on it." Furthermore, fish is more expensive for inland communities. On average, a medium-sized fish at Auki market costs between 20 and 60 Solomon Islands dollars when fish stocks are plentiful, in comparison to inland markets where "fish is very expensive, we have to share fish across houses because it can cost 50–100 Solomon Islands dollars." Farming tilapia was therefore perceived to be a remedy to these issues, allowing inland communities to have ownership and "control over fish intakes" as they "don't have to rely on coastal communities to go fishing." This pattern is further supported by Cleasby et al., who used quantitative data from a household survey to show that "when comparing coastal and inland settlements, in Malaita (study conducted in the same central region) the people on the coast ate significantly more reef fish than inland people" (Figure 4).[39]

Photo Credit: Catherine Jones/WorldFish

A heap of kumara sold by students at the market

Photo Credit: Catherine Jones/WorldFish

Fried tilapia served with rice

Aquaculture has been postulated as an avenue to teach young people about agricultural systems. As more communities rely on store-bought foods, traditional farming and fishing methods are practiced less and not necessarily passed down to the younger generations. One method to help rejuvenate this situation is through tilapia farming. One woman from an inland community suggested, "I would like to have tilapia pond for me and my children, so we can start doing it and not just see other people doing it. Would be good to have the experience of how to feed and care for [tilapia]." Various schools in central Malaita have agricultural programs, in which root crops are commonly grown and sold at local markets to raise money for school supplies or given freely to neighboring households. Yet, there is limited education on marine or freshwater resources. Various teachers stated that there is a "need for students to understand and not eat small fish; one day we will run out, if we don't understand how they breed or protect them." Tilapia farming in schools was suggested as one solution to this issue. Growing tilapia will not only demonstrate to young people about the life cycles of fish but also provide a talking point for teachers to explain the importance of sustainable food sources and protecting their environment.

How are people eating tilapia?

Due to its relatively small size, tilapia is commonly cooked whole. To catch the fish, farmers use fishing or mosquito nets or a traditional line and hook. Once caught, the fish is cleaned, scaled and gutted in preparation for cooking. Commonly, tilapia is cooked in one of four ways: (1) boiled with coconut milk and local vegetables; (2) fried in vegetable or coconut oil, in a batter made of corn or wheat flour; (3) baked in a traditional motu; or (4) cooked over an open fire. Tilapia is a white fish, described as tending to absorb flavors,[41] so common spices such as garlic, salt, ginger and chili are added for flavor.

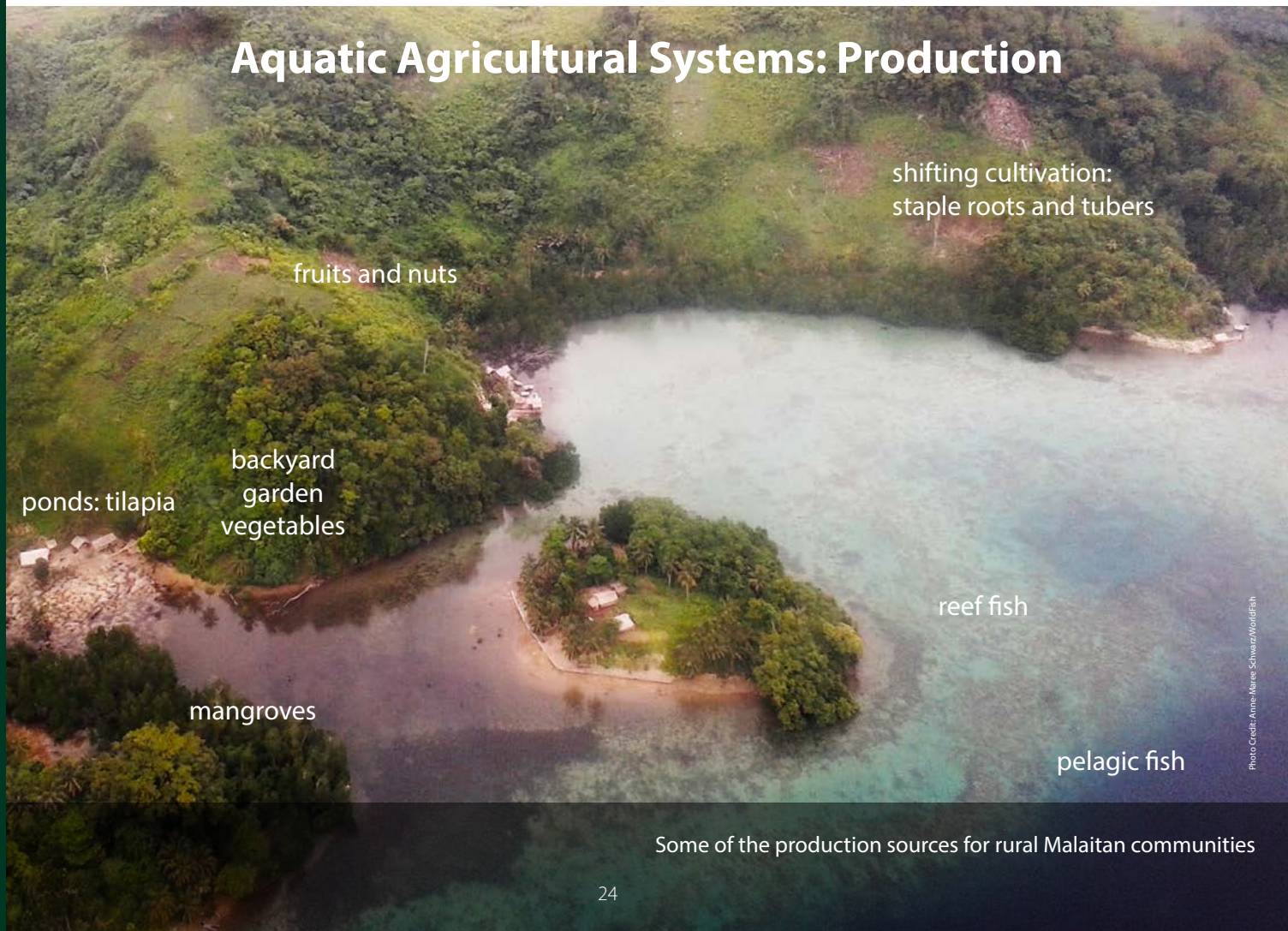
SUMMARY

In summary, the diet of the target communities was characterized by large amounts of carbohydrate-rich staples and a limited supply of animal-source foods. Locally produced staples, vegetables, fruits and nuts, and wild-caught fish were supplemented by store-bought foods, and there were early indications that for some, a tilapia pond will contribute to this suite of available foods.

Fresh marine fish and canned tuna were the most common animal-source foods. Imported foods, particularly rice and noodles, are regularly consumed. People said that the choice of imported foods over local foods was a result of climate change (an interpretation of poorer agricultural crop production), changing of traditional family roles and an increasing urban influence.

Tilapia has yet to become a common food in the study households, although many see its potential as a household food source. Both men and women felt that farming tilapia was a cost-effective and time-efficient way of accessing fish for daily needs. Inland communities in particular struggle to obtain a constant source of fish, relying on catches from coastal villages.

Aquaculture has been suggested as a vehicle to bridge a projected fish supply shortage and as a possible contributor to improving nutrition in Solomon Islands.[42] Although there is an increasing reliance on processed foods throughout the country,[43] the reality is that income levels in most rural communities in Solomon Islands, including central Malaita, tend to be low and irregular; hence diets cannot be sustained by store-bought foods. A fish pond near the house therefore offers the advantage of increased intake of animal-source food and added diversity to supplement the predominantly carbohydrate-rich diet.



Some of the production sources for rural Malaitan communities

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APPENDIX 1. GUIDING QUESTIONS FOR DISCUSSIONS AND INTERVIEWS

Questions for Village Discussions:

First Prompter Question: Hu nao kuki lo haus? (Who cooks in the house?)

1. Can you draw on here what kind of foods you eat and at what times of the year? [In regard to fish, make sure you get what type; i.e., reef fish, benito, tuna.]
2. Are there foods not on here that you also eat? [E.g., store-bought foods?] Do you eat these more at a certain time of year?
3. How often do you usually eat this? Every day/weekly/monthly?
4. Which food is good — why? [E.g., is it good for certain people; does it have good things in it for your body; e.g., nutrients/energy/vitamins/protective foods?]
5. Are there some common foods that you think are not so good? Why do you think that? [E.g., sugar — diabetes?]
6. For the foods you have listed, who in the household eats each one? Why? [E.g., only kids, lactating women, only men?]
7. What time do you normally eat — morning, afternoon, evening? [Indirectly try and get how many meals they have a day.]
8. If you think back over the last two weeks, how much of these foods have you eaten? [Apart from everything else they commonly eat, have an estimate for the amount of fish and other animal-source foods. Obtain units; e.g., five bundles of slippery cabbage.]
9. Have the foods that you eat changed over time; say, compared to five to 10 years ago? How and why have they changed? [I.e., is it harder to get fish; is the quality of fish and other foods still the same?]
10. [If there has been informed feedback on nutritional value of food] — where do you get this information? Has someone come and talked to you about this? Who? Maybe learned it at school? [Talk this out with key informants. What do people learn about nutrition?]

Questions for Health Clinics and Local Schools:

1. Do you have any nutrition programs? If so, can you explain them to us?
2. Are you aware of any other nutritional programs in the area? If so, could you tell us about them?
3. What are some common foods people are eating in the area? Do you know the different seasons (if they have them) of these common foods?
4. Have diets changed over time; say, compared to five to 10 years ago? How and why have they changed?

APPENDIX 2. NUTRIENT CONTENT OF ALL LOCALLY GROWN FOODS AND THREE TYPES OF FISH RECORDED DURING THIS STUDY

			Measure	Water	Energy
Common and local name	**Scientific name**	**Edible part**	g	g	kcal
FRUITS, NUTS and SEEDS					
Breadfruit (Afio)	*Artocarpus altilis*	Fruit, boiled	100	81	75
Breadfruit (Afio)	*Artocarpus altilis*	Fruit, baked	100	74	103
Mango	*Indica america*	Fruit	100	82	68
Rambutan	*Nephelium lappaceum*	Fruit	100	85	59
Golden Apple (Enkori, Ainakori, Piraka)	*Spondias cytherea*	Fruit	100	70	
Malay Apple, Wild Apple, (Kabarai, Kapika)	*Syzygium malaccense*	Fruit	100	90	26
Durian	*Durio zibethinus*	Fruit	100	67	140
Guava	*Psidium guajava*	Fruit	100	87	31
Avocado	*Persea americana*	Fruit	100	73	212
Orange	*Citrus sinansis*	Fruit	100	89	46
Ngali Nut	*Canarium indicum L.*	Kernel	100	35	461
Cut Nut	*Barringtonia edulis*	Kernel	100	33	433
Betel Nut	*Areca catechu*	Kernel, raw	100	12	352
Alite	*Terminalia catappa*	Nut/kernel, raw	100	52	272
Coconut (Dry)	*Cocos nucifera*	Flesh, mature	100	86	81
Coconut (Green)	*Cocos nucifera*	Flesh, immature	100	54	283
Cocoa	*Theobroma cacao*		--	--	--
Mangrove Fruit (Koa)		Flesh	--	--	--
STARCHY STAPLES (ROOT CROPS)					
Cassava (Kaipia, Tapioca)	*Monihot esculenta*	Tuber, boiled	100	68	117
Potato (Kumara Orange)	*Ipomoea batatas*	Tuber, peeled, boiled		79	69
Potato (Kumara White)	*Ipomoea batatas*	Tuber, peeled, boiled	100	77	79
Pana (Lesser Yam)	*Dioecoreae esculenta*	Tuber, raw	100	74	
Yam (Go'e, Efiabe)	*Dioecoreae nummularia*	Tuber	100	72	
Yam (Greater Yam)	*Dioecoreae alata*		--	--	--
Giant Taro	*Alocasia macrorrhiza*	Corm, boiled	100	73	92
Taro (Swamp Taro)	*Cyrtosperma merkusii*	Corm, boiled	100	78	72
Common Taro (White)	*Colocasia esculenta*	Corm, boiled	100	73	212
Kongkong Taro	*Xanthosoma sagittifolium*	Corm, boiled	100	89	46

	Energy	Protein	Total fat	CHO	TDF	Na	Mg	K	Ca	Fe	Zn	Retinol	β-carotene	Tot. Vit A	Thiamin	Riboflavin	Niacin	Vitamin B12	Vitamin C	Vit. E	Cholesterol
	kJ	g	g	g	g	mg	mg	mg	mg	mg	mg	µg	µg	µg	mg	mg	mg	µg	mg	mg	mg
	313	1.3	0.9	14	2.5	1	23	350	13	0.2	0.1	0	30	3	0.1	0.1	0.7	0.00	22	0.7	0
	429	1.3	0.6	22	2.5	1	23	436	18	0.3	0.1	0	23	2	0.1	0	0.6	0.00	22	1	0
	285	0.7	0.2	15	2.1	3	9	225			T	0	1,590	133	0.1	0.1	0.9	0.00	41	1.1	0
	247	0.7	0.1	14	0.9	5	5	29	22	2.5	0.1	0	0	0	0	0	0.1	0.00	39	0.1	0
	657	0.6	--	--	--	--	--	--	--	0.4	0.1	--	--	1	--	--	--	--	34	--	--
	109	0.7	0.2	4.5	1.9	1	5	38	13	0.8	0.1	0	0	0	0	0	0.5	0.00	8	0.2	0
	587	2.5	1.6	28	2.3	1	28	600	20	0.9	0.3	0	11	1	0.3	0.3	1.2	0.00	37		0
	131	0.7	0.5	3.5	5.4	4	12	150	10	0.2	0.1	0	430	36	0	0	1	0.00	240	1.2	0
	887	1.9	23	0.4	1.5	2	23	470	20	0.7	0.5	0	290	24	0.1	0.1	1.7	0.00	9	2.1	0
	192	0.6	0.3	10	0.7	2	9	145	21	0.3	0.2	0	130	11	0.1	0.1	0.8	0.00	30	0.2	0
	1,931	8.2	46	0.5	11	18	284	627	44	3.5	2.4	0	165	14	0.1	0.1	1.7	0.00	8		0
	1,811	12	38	7.1	10	4	182	376	48	2.7	3	0	200	17	0.1	0	2.9	0.00	6		0
	1,474	5.2	10	53	17	77		450	400	4.9	3.1	0	0	0	0.2	0.5	1.1	0.00	T	6.4	0
	1,138	9.6	24	2.4	5.9	8	257	567	83	0.2	0.4	0	9	1	0.1	T	0.8	0.00	11	12	0
	338	1.8	5.9	3.8	3.2	33	30	377	2	1.3	0.6	0	0	0	0	0	0.6	0.00	2	0.6	0
	1,185	3	27	3.6	7.6	16	48	340	10	1.1	0.4	0	0	0	0.1	0	3.6	0.00	3.8	0.2	0
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	490	0.6	0.4	28	1.4	22	22	217	10	0.2	0.3	0	T	T	0	T	0.3	0.00	15	0.2	0
	287	1.9	0.1	14	2.3	10	13	225	26	0.5	--	--	--	--	--	--	--	--	--	--	--
	329	1.4	0.1	17	2	12	8	182	13	0.5	0.4	0	17	1	0	0	1.1	0.00	19	3.8	0
	374	2.1	--	--	--	--	--	--	--	0.3	0.6	--	--	9	--	--	--	--	20	--	--
	443	2	--	--	--	--	--	--	--	0.4	0.5	--	--	17	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	386	2	0.1	20	1.7	27	47	243	35	0.8	1.5	0	0	0	0	0	0.3	0.00	8.5	2.2	0
	302	0.5	0.2	16	2.5	65	19	61	165	0.6	1.9	0	27	2	0	0	0.3	0.00	7.9	1.8	0
	887	1.9	23	0.4	1.5	2	23	470	20	0.7	0.5	0	290	24	0.1	0.1	1.7	0.00	9	2.1	0
	192	0.6	0.3	10	0.7	2	9	145	21	0.3	0.2	0	130	11	0.1	0.1	0.8	0.00	30	0.2	0

Common and local name	Scientific name	Edible part	Measure	Water	Energy
			g	g	kcal
GREEN LEAVES					
Amau (Sandpaper Kabis)	*Barringtonia edulis*	Leaf	100	--	--
Fern (Kasume)	*Areca catechu*	Leaf, boiled	100	89	31
Chinese Cabbage	*Terminalia catappa*	Leaf, boiled	100	96	15
Ofenga	*Pseuderanthemum whartonianum*		--	--	--
Pumpkin Leaves	*Cucurbita maxima*	Leaf, boiled	100	91	26
Taro Leaves	*Colocasia esculenta*	Leaf, boiled	100	91	28
Slippery Cabbage	*Abelmoschus manihot*	Leaf, boiled	100	89	31
Watercress	*Rorippa nasturtium-aquaticum*	Leaf, boiled	100	92	18
LEGUMES					
Bean (Yard-Long Bean, Snake Bean)	*Vigna unguiculata*	Fruit, boiled	100	90	30
FRUITS and VEGETABLES					
Cucumber	*Cucumis sativus*	Fruit, raw	100	96	12
Pumpkin	*Cucurbita maxima*	Fruit, boiled	100	82	44
Pawpaw	*Carica papaya*	Fruit	100	92	26
Pineapple	*Ananas comosus*	Fruit	100	87	53
Watermelon	*Citrullus lanatus*	Fruit	100	93	24
Tomato	*Solanum lycopersicum L.*	Fruit, ripe	100	94	26
Eggplant	*Solanum melongena L.*	Fruit, boiled	100	92	24
Banana	*Musa sp (A and/or B) cv*	Fruit	100	73	103
OTHER VEGETABLES					
Mushroom	*Flammulina velutipes*	Whole, cooked	100	89	39
Shallot	*Allium cepa*	Leaf, boiled	100	92	24
Corn (Losi)	*Zea mays L.*	Cob/seeds, boiled	100	70	116
Sugarcane	*Saccharum officinarum*	Juice	100	83	68
FISH[2]					
Nile Tilapia	*Oreochromis niloticus*		100	76	110
Tuna	*Thunnus alabacare*	Edible flesh, raw	100	68	150
Snapper	*Pagrus auratus*	Edible flesh, steamed	100	73	122

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T = trace (less than the limit of detection)
-- = missing data

	Energy	Protein	Total fat	CHO	TDF	Na	Mg	K	Ca	Fe	Zn	Retinol	β-carotene	Tot. Vit A	Thiamin	Riboflavin	Niacin	Vitamin B12	Vitamin C	Vit. E	Cholesterol
	kJ	g	g	g	g	mg	mg	mg	mg	mg	mg	µg	µg	µg	mg	mg	mg	µg	mg	mg	mg
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	132	3.6	0.9	0.4	3.8	18	118	484	268	1.9	1.8	0	2,530	211	T	0.2	0.6	0.00	2	0.3	0
	65	1.7	0.4	0.7	1.2	30	15	249	66	0	0.3	0	2,549	212	0	0.1	0.6	0.00	7	0.2	0
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	108	2.7	0.2	1.5	3.7	5	38	114	335	1.5	0.4	0	2,972	248	0.1	0.3	1.1	0.00	4	1	0
	118	3.8	0.6	0.7	2.5	5	24	305	214	1.7	0.3	0	4,973	414	0.1	0.1	1	0.00	20	2.2	0
	132	3.6	0.9	0.4	3.8	18	118	484	268	1.9	1.2	0	8,770	731	0.1	0.3	1.3	0.00	7	1	0
	77	2	0.2	T	4.4	4	15	391	117	2.9	0.2	0	2,940	245	0.1	0.1	0.9	0.00	29	0.5	0
	124	3.3	0.3	1.6	3.8	1	25	135	22	0.5	0.4	0	430	36	0	0.1	0.6	0.00	22	0.5	0
	48	0.4	0.1	2.1	0.4	21	9	97	13	0.3	0.4	0	35	3	0	0	0.2	0.00	8	0.1	0
	182	2.3	0.4	7.1	1.4	1	13	310	27	0.5	0.3	0	2,680	223	0.1	0.1	0.7	0.00	11	2	0
	110	1	0.1	4.7	1.5	7	20	215	38	0.3	0.2	0	15	1	0	0	0.3	0.00	40	0.8	0
	221	0.7	0.3	12	0.8	2	10	180	17	0.5	0.2	0	35	3	0.1	0	0.3	0.00	22	0.1	0
	101	0.6	0.2	4.9	0.3	4	8	92	8	0.2	0.1	0	160	13	0	0	0.2	0.00	6	T	0
	110	1.2	0.3	4.2	1.2	6	10	200	7	0.6	0.1	0	350	29	0.1	0	0.6	0.00	23	0.8	0
	99	1.2	0.3	2.9	2.5	5	8	153	22	0.2	0.1	0	19	2	0	0	0.6	0.00	2	0.3	0
	433	1.3	0.4	24	0.8	29	33	241	11	0.6	0.2	0	46	4	0.1	0.1	0.7	0.00	17	0.4	0
	162	1.9	0.2	7.1	0.7	5	11	346	2	1.2	1.1	0	13	1	0.4	0.5	8.1	0.00	3	T	0
	99	1.2	0.3	2.9	2.5	5	8	153	22	0.2	0.1	0	19	2	0	0	0.6	0.00	2	0.3	0
	487	3.3	1.3	21	3.7	17	32	249	2	0.6	0.5	0	300	25	0.2	0.1	1.6	0.00	6.2	0.9	0
	284	0.3	0.2	17	0	2	--	--	10	13	0	0.0	T	T	0	0	0.1	0.00	T	0.0	0
	466	21	3	0	0	55	36	341	19	0.5	1.4	2	T	2	1	0.1	8	0.7	T	0.7	
	628	26	4.7	0.3	0	35	41	431	9	1	0.5	20	T	20	0.1	0	2.1	0.7	0.3	0.5	53
	511	24	2.7	0	0	102	33	403	30	0.3	0.6	8	0	8	0.1	0.1	5.2	3.2	T	0.7	89

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[8] "Stunting is a result of long-term deficiency of energy and nutrients, as a consequence of repeated exposure to illness and/or inadequate food intake over a long period" (Andersen, A.B., Thilsted, S.H., and Schwarz, A.M. (2013). Food and nutrition security in Solomon Islands, p. 8. Penang, Malaysia: WorldFish).

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[22] Taro pudding is known locally as "tadili," "lakeno," "kata" or "gata."

[23] Kumara pudding is known locally as "ara."

[24] When packed with kumara, taro or cassava, the 20-kilogram bag made for rice weighs the same.

[25] Betel nut is a sedative that suppresses hunger.

[26] "Supsup" can also be a vegetarian dish using just kumara and taro. Making a non vegetarian suspsup depends on the communities' access to fish or tinned meat; as one participant stated, "if taiyo is not added in the cabbage soup, then vegetables can be added instead, tomatoes, pepper."

[27] "Koa" is the local name commonly used for both mangrove trees and *Bruguiera gymnorhiza* fruit.

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About the CGIAR Research Program on Aquatic Agricultural Systems

Nearly 500 million people in the developing world depend on aquatic agricultural systems for their livelihoods, with 140 million living in poverty. Occurring along freshwater floodplains and coastal deltas, aquatic agricultural systems are highly productive farming and fishing systems that provide multiple opportunities for growing or harvesting food and generating income.

The CGIAR Research Program on Aquatic Agricultural Systems (AAS) seeks to better harness the agricultural potential of these systems, while helping to build adaptive capacity and resilience in the face of social, economic and environmental change.

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