



In a nutshell

- Consumers in Pacific Island Countries (PICs) have become increasingly reliant on non-traditional and imported processed foods to meet food and nutritional needs.
- Traditional knowledge on edible plants (fruits, root crops and vegetables) and marine resources (seaweeds, sea cucumbers) is diminishing, and with it the loss of indigenous varieties.
- The rich biodiversity of terrestrial and marine organisms has yet to be fully studied to identify the bioactive compounds that have health and nutritional benefits; however, 75 crops and marine resources commonly consumed in PICs have been profiled for their health and nutritional benefits.
- There is need to invest in scientific research and product development of traditional local food crops and seafood to contribute to improving the food, health and nutrition situation in PICs, as well as provide new income-generating opportunities that specially benefit local communities.

Key recommendations

- Fund scientific research to provide evidence to validate the health and nutritional benefits of traditional crops and marine resources and support more informed policy decisions.
- Harness and integrate traditional knowledge with modern scientific knowledge on the nutritional, health and economic benefits of local foods to better address food and nutrition security (FNS) challenges.
- Foster greater collaboration between academic and research institutes, government ministries, non-governmental organisations, and local communities to increase awareness of the potential benefits of highly nutritious local crops and seafood.
- Identify species with known benefits that have agribusiness potential to meet growing demand for healthy and nutritious foods in local and international markets.
- Mobilise public and private investment to increase production, processing, consumption and marketing of nutritious local foods and marine resources to address FNS challenges in the region.

The seven Pacific Island Countries that are the focus of this brief cover a total land mass of 63,454.8 km² with hundreds of small islands and archipelagos. Although total land area is small, these islands are large ocean states, rich in biodiversity (terrestrial and marine), and with diverse cultures and traditions.

Traditionally, Pacific Islanders depended on crop production and fishing to sustain their daily diets and livelihoods. However, in recent years, they have become increasingly reliant on non-traditional and imported processed foods, which are often high in fat, salt and sugar. As a result, many of the PICs have very high rates

(average of 60%) of overweight and obesity and non-communicable diseases (NCDs), such as cancer, diabetes (ranging from 14% to 44%), heart disease and high-blood pressure (average 25%).

The decline in the FNS situation of Pacific Islanders is further exacerbated by a reduction and/or stagnation in agricultural productivity, overexploitation of marine resources and climate change, which make it challenging for many low-income households to afford nutritionally balanced, diversified diets. There is a rich biodiversity of terrestrial and marine organisms in the PICs, many of which have been used for generations for food and medicine but are yet to be fully studied for their health or nutritional value. It is imperative that Pacific people consume a more diverse diet that incorporates more locally available nutrient-dense foods, including fruits, root crops, vegetables and seafoods, to reduce the high NCD rates across the region.

Box 1. **What are bioactive compounds?**

Bioactive compounds are defined as “substances that are ‘extra-nutritional’ or ‘extra-non-nutritional’ components of living organisms including plants and marine organisms that have a beneficial effect on health”. They include secondary metabolites which help an organism to survive and adapt to local conditions, improving growth and development or reducing risk factors to diseases.

The presence of bioactive compounds such as alkaloids, carotenoids, flavonoids, lactones, phenols, and sterols etc. in foods have been shown to have various properties, for example anti-cancer, anti-diabetic, anti-inflammatory, anti-obesity, anti-microbial, cardio-protective and hepato-(liver) protective. Foods containing bioactive compounds, which have been scientifically validated to protect against major diseases when consumed in sufficient amounts on a regular basis, offer potential for further development.

This brief provides insights into the current status of knowledge on key nutrients and bioactive compounds, known or associated with traditional crops and seafood available in seven Pacific Island Countries: Fiji, Kiribati, Marshall Islands, Samoa, Solomon Islands, Tonga, and Vanuatu. The results can be used to advocate for the greater incorporation of traditional crops and marine resources as part of diversified diets for a healthier Pacific population to improve the FNS situation and enhance income-generating opportunities for local communities.

Combining traditional and scientific knowledge

An integrated approach combining traditional and scientific knowledge was used to gather information on traditional crops and seafood consumed in the seven PICs. Information was initially gathered through guided interviews with traditional knowledge experts. In the Pacific, much of the traditional knowledge on foods with nutritional and/or medicinal value is passed on orally and there are few published reports on such traditional knowledge. Although traditional knowledge experts/leaders may not know the active ingredients or the bioactive compounds present in traditional foods, the nutritional benefits or medicinal values are well known, and such information has been gathered over a long period of time spanning several generations.

A definition for traditional foods was applied and includes indigenous or locally grown or introduced crops and seafood, which form part of the traditional diet. Additionally, a systematic literature review was carried out to determine scientific knowledge on the nutritional value and bioactive compounds from the identified crops and seafood.

From the interviews with traditional leaders, a total of 75 crops and marine resources were identified as commonly consumed and/or having health benefits or foods which could be better used in daily diets. Further information gleaned from 433 scientific articles on the bioactive compounds and health benefits in these 75 crops and marine resources was also compiled under the categories: root crops, fruits and vegetables, seaweed, fish and shellfish (see Table 1).

Table 1: Bioactive compounds and associated health benefits of a selection of Pacific crops and seafood traditionally consumed and used

No.	Scientific name	Common names	Uses	Bioactive compounds including associated health benefits
Root crops				
1.	<i>Alocasia macrorrhiza</i>	Giant taro	Corm consumed boiled or baked in most PICs.	Antihyperglycemic, antioxidant anti-inflammation, antimicrobial, anticancer, analgesic, hepatoprotective, antioxidant and antifungal and cytotoxic properties.
2.	<i>Colocasia esculenta</i>	Taro	Taro leaves and stalk widely consumed. Corm is a staple in Pacific diets. Cultural significance.	Contains flavonoids, steroids, alkaloids, saponins, tannins, anthocyanins. Used as laxative, diuretic, anti-inflammatory, anti-cancer, anti-diabetic, anti-hepatotoxic, anti-helminthic.
3.	<i>Manihot esculenta</i>	Cassava	Widely consumed in Fiji, Kiribati, Tonga, Solomon Islands, and Vanuatu. Less popular in Marshall Islands and Samoa. Flour is also used. Leaves are nutritious but seldom used.	Antioxidant, anti-carcinogenic, antibacterial, anti-helminthic and antidiarrheal activity. Contains carotenoids, nitrate, polyphenols, oxalate, and saponins.
Fruits and vegetables				
4.	<i>Artocarpus altilis</i>	Breadfruit	Widely consumed in all PICs. Leaves and bark used as medicine.	Contains phenols, β -sitosterol and flavonoids, carotenoids. Has antioxidant, antidiabetic, antihypertensive, anticancer properties.
5.	<i>Cocos nucifera</i>	Coconut	Widely consumed in all PICs. Coconut cream and oil widely used. All parts have some use.	Contains polyphenols, flavonols, carotenoids, terpenoids, alkaloids, resins, glycosides and steroids, triglycerides, lauric acid, myristic acid, ketones, lecithin, phytosterin, and globulin. Anti-helminthic, anti-tumour, antimicrobial, and wound healing properties.
6.	<i>Moringa oleifera</i>	Drumstick	Leaves consumed. Fruits and seeds less commonly used.	Antioxidant, anticancer, anti-inflammatory, antidiabetic and antimicrobial, anti-obesity properties. Contains tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids, glucosinolates, isothiocyanates, and glycoside.
7.	<i>Pandanus tectorius</i>	Pandanus	Fruits, juice and flour consumed in Kiribati, Marshall Islands, Samoa and Tonga. Roots and leaves used for making traditional herbal medicine.	Contains phenolics, flavonoids, terpenoid, steroids, saponins aldehydes and glycosides. Antioxidant and antibacterial properties. Isopentenyl and dimethylallyl acetates and cinnamate isolated from fruit essential oil. Caffeoylquinic acids – may protect against diabetes.
Seaweed (Algae)				
8.	<i>Acanthophora</i>	Kirokiro (Vanuatu) lumi karokaro or lumi karo (Fiji)	Edible fresh as salad or cooked with soups or pudding.	Contains flavonoids. Lowers blood cholesterol and prevent blood clots. Potential anticancer activity.
9.	<i>Caulerpa</i>	Sea grapes and green sea feathers	Edible raw; or cooked.	Contains phenolics, triacylglycerols, and polyunsaturated fatty acids. Has antioxidant, anti-tumour activities. Reduces high blood pressure, and rheumatism.
10.	<i>Cladosiphon</i>	Tangau (Tonga)	Edible raw or in salads.	Contains fucoidan, triacylglycerols, and polyunsaturated fatty acids. Has antioxidant, anti-inflammatory, anti-allergic, anti-tumor, anti-obesity, anti-coagulant, anti-viral, anti-hepatopathy, anti-uropathy, and anti-renalpathy properties. Protects against heart disease.
11.	<i>Gracilaria</i>	Sea moss, lumi wawa, lumi yara (Fiji), limu aau (Samoa)	Edible raw in salads or blanched, added to soups; referred to as sea noodles.	Contains phenolic compounds. Has antioxidant, anticancer, antimicrobial, antifungal, laxative properties.
Fish and shellfish				
12.	<i>Holothuriidae</i>	Bêche-de-mer (French) or Sea cucumber (English)	Edible raw or smoked, cooked or boiled.	Contains triterpene, glycosides, phenolics, sponins, polysaccharides, sterols, cerberosides, lectins, peptides, glycoprotein, carotenoids and essential fatty acids. Has anticancer, antioxidant, anti-inflammatory, hepatoprotective properties.

Source: Adapted from Singh, S. (2018) 'Profiling Bioactive Compounds and Key Nutrients in Pacific Island Crops and Marine Resources', Wageningen: CTA

Why the need to profile bioactive compounds?

Few Pacific food crops and seafood have been scientifically evaluated for bioactive properties and data are generally lacking on locally available sources. Some remain underutilised in diets across the Pacific Islands (see Table 2). From surveys with traditional leaders, a number of reasons were given:

1. There is increased preference for easily available foods (biscuits, bread, canned foods, frozen meats, noodles and rice), which are generally cheaper, take less time to prepare and are more appealing. Decisions on what to eat are not necessarily based on nutritional value or health benefits.
2. Some foods have become/are becoming scarce and less frequently accessible (either expensive or unavailable), e.g. selected species of fish, giant clam and sea cucumber and traditional varieties of banana, breadfruit and yam.
3. Traditional knowledge is diminishing as the younger generation lack knowledge of edible wild plants or seaweeds.
4. More people are reliant on markets/supermarkets for supply of fruits, root crops, seafood and vegetables due to urbanisation.
5. Cultural preferences for food: certain foods are not consumed unless there is famine. For example, cassava and sweet potato are not widely eaten in Samoa as they are considered as famine food.
6. People have not developed taste preferences for certain fruits, vegetables and seafood because of lack of awareness on their nutritional value and cooking recipes. This includes amaranth, bitter melon, drumstick, sea cucumber and seaweeds, which are all highly nutritious but only selectively used by people from certain cultural backgrounds.
7. Certain fruit/plant parts are not utilised or rarely used although they are of high nutritional value (See Box 4).

Further research is needed to confirm the presence and quantify the bioactive compounds in locally available foods in Pacific Island Countries and validate the health and nutritional benefits.

Table 2: Food commodities categorised based on their consumption, nutritive and bioactive properties

Category	Commodity
Regularly consumed commodities – high in nutritive value and containing bioactive compounds with known health and other benefits.	<p>Root crops: Taro, yam, sweet potato, cassava</p> <p>Fruits & Vegetables: Island cabbage, pineapple, breadfruit, pawpaw, watermelon, lemon, coconut, pumpkin, mango, banana, kava, guava, tomato, eggplant, ginger</p> <p>Seafood: Fish</p>
Commodities less regularly consumed but also of high nutritive value and containing bioactive compounds.	<p>Root crops: Giant taro, giant swamp taro</p> <p>Fruits & Vegetables: Okra, slender amaranth, soursop, jackfruit, starfruit, vegetable fern, legumes, polynesian chestnut, water spinach, bitter melon, noni, drumstick, rambutan, pandanus, avocado, lychee, golden apple (vi), cocoa</p> <p>Seaweed (Algae): Limu karo, supreme limu, large wire weed, sea grapes, curly fishing line, tangau, totoya sagati, papery sea bubble, lumi boso, sea moss, red sea lettuce, brown liquorice algae, sea fan, sargassum, sea lettuce</p> <p>Seafood: Eel, freshwater mussel (kai), sea urchin, crab</p>
Commodities that are of high nutritive value which contain bioactive compounds but for which little scientific information exists or are under threat of extinction.	<p>Seaweed (Algae): Brown ribbon weed, little wire weed, south sea colander, lumi vakalolo, flower limu, lumu mie'ta, slippery cushion, glassweed, tender golden weed, spiny leaf</p> <p>Seafood: Sea cucumber</p>

Source: Adapted from Singh, S. (2018) 'Profiling Bioactive Compounds and Key Nutrients in Pacific Island Crops and Marine Resources', Wageningen: CTA

Realising the potential of Pacific food crops and marine resources

Increasingly, nationally and internationally, there is a focus on consuming foods which have health benefits in addition to meeting nutritional requirements.

Value addition

Seaweeds are a relatively inexpensive source of protein, vitamins and minerals and are a promising source of bioactive compounds. There is increased interest in using them for enriching other food products, as well as in the cosmetic industry. For example, seaweeds used instead of salt in brown bread has been reported to have resulted in a longer shelf-life. However, research is needed on the associated health and other commercial benefits of Pacific seaweed varieties, and protocols should be developed for value-added products destined for local consumption and for export markets (see Box 2).

Breadfruit is high in complex carbohydrate (fibre), low in fat and cholesterol and is gluten free. It is also rich in carotenoids (Vitamin A). In order to increase availability, breadfruit can be processed (e.g. flour, slices – dried/baked/frozen) to provide new income-generating opportunities for local communities. The most suitable PIC varieties for processing also need to be determined as well as their nutrient composition and health benefits.



Box 2. Mozuku farming (seaweed aquaculture) in Tonga

Seaweed (mozuku) is high in nutrient value and an important resource for coastal communities. A decrease in wild seaweed in Tonga had been observed due to overharvesting and climate change. In 2017, South Pacific Mozuku (SPM), a Tongan owned SME with the assistance of researchers, examined the possibility of farming mozuku (Limu Tanga'u). This was followed by a trial that proved its potential despite farming the seaweed outside the optimal season and following Cyclone Gita.

The government has established Special Management Areas (SMAs) to preserve, protect and, where possible, to restore the natural resources of the coastal zone owned by local communities. SPM has been developing sustainable seaweed cultivation techniques. Through trial and error, SPM has identified key factors for success through working in partnership with coastal communities in SMAs.



Box 3. Adding value to farmed bêche-de-mer in Kiribati

Bêche-de-mer (English: Sea cucumber) are eaten raw or smoked, cooked or boiled. The Kiribati social enterprise Atoll Beauties has successfully developed a sustainable and commercial bêche-de-mer farming technique, which can be easily implemented by local communities. A process to preserve bêche-de-mer shelf life for more than 2 years in a 'ready to cook' state has also been identified.

Sustainable management of resources

Sea cucumber/bêche-de-mer (*Holothuroidea*) contains several macro and micro-nutrients and can be further processed to expand market opportunities (see Box 3). However, there is scope for better management as several species are slow growing and populations are dwindling due to overexploitation. Sea cucumbers could be better targeted for development through aquaculture; thereby ensuring consistent supplies.



Tilapia fish is regarded as a sustainable source of protein in PICs. Tilapia is mostly farmed, and aquaculture projects have been successful in a number of PICs including Fiji, Solomon Islands and Vanuatu.

Similarly, crabs, eels, prawns and shellfish also have potential health benefits and nutritional value and could be targeted for aquaculture farming to meet FNS, as well as provide income-generating opportunities for Pacific Islanders.

Increasing consumption of underutilised crops and their leafy parts

A lack of knowledge of the properties, as well as taste preferences or cultural beliefs, means that various parts of several crops (leaves, stems, seeds etc.) remain underutilised (see Box 4). For example, cassava, sweet potato and pumpkin leaves (and seeds in the case of pumpkin) – although nutritious – are not exploited for their potential. Further research documenting their uses and bioactive properties is needed.

In addition, some of the traditional varieties of commonly consumed crops, like breadfruit, banana and taro, are declining. Many nutrient-dense vegetables that are available in most PICs could be sustainably grown and used to develop new market opportunities and increase consumption.

Increasing awareness on health benefits of green leafy vegetables and plants

Plants in the PICs continue to offer prospects of new medicinal compounds. Some of the crops are not widely utilised by all cultural groups. For example, bitter melon is commonly found (cultivated or wild) in Fiji, Samoa, Solomon Islands, Tonga, and Vanuatu, but is not widely used possibly due to people's taste preferences (see Box 4).

Box 4. Underutilised nutritious crops

Amaranth: Used in Fiji, less popular in other PICs. Has antiviral, anti-inflammatory, and antioxidant properties.

Bitter melon: Has antidiabetic, antioxidant, antirheumatic, antihelminthic, antimicrobial, anti-inflammatory, antifungal, anti-gout properties.

Cassava and sweet potato leaves: Tubers are widely consumed but leaves contain several bioactive compounds and are hardly utilised.

Drumstick: Underutilised as communities have not developed taste preferences, antioxidant, anticancer, anti-inflammatory, antidiabetic, antimicrobial, and antiobesity properties.

Golden apple (vi): Contains phenols and flavonoids; has antioxidant, anti-inflammatory, cytotoxic and thrombolytic activity.

Noni: Immune stimulant, useful against gastritis, skin diseases, osteoarthritis, respiratory infections, menstrual and urinary tract disorders, fever, diabetes and venereal diseases.

Pumpkin (leaves & seeds): Fleshy part widely used while leaves and seeds are hardly utilised, although nutritious.

Starfruit: Consumed raw when ripe, made into pickles or used in salads. Plant parts such as leaves and roots are known for traditional medicine uses.

Rambutan: Has antioxidant, antibacterial, antidiabetic, antihyperlipidemic, anti-inflammatory, hepatoprotective properties.

Vegetable fern: Antioxidant, antimicrobial, antifungal, antihelminthic, and antidiabetic effects.

Soursop: Protects against high blood pressure and heart disease.

Water spinach: Can be used in salads, soups or consumed steamed. Has antidiabetic, antioxidant, and antimicrobial properties.

Conclusion

Traditional knowledge from PICs needs to be harnessed and integrated with modern scientific knowledge to address nutritional and health problems. Research on nutritious local foods must be given greater emphasis, given their potential role in addressing the health, economic and FNS challenges in the PICs.

To further develop local nutrient-dense food crops and marine resources in PICs, which also have health-promoting benefits, there is a need for greater collaborative research between academic and research institutions and government ministries (Agriculture, Development and Economy, Health, Industry and Trade), non-governmental organisations, and communities. Public-private partnerships are needed to mobilise investments in support of small and medium enterprise development.

“Development of value addition of traditional foods is very slow due to inadequate knowledge of appropriate technologies, poor infrastructure, inadequate facilities and lack of incentives, investments and policies to support such activities. Strengthening public-private-producer partnerships, capacity building and prioritising and mainstreaming the development of food value chains in policies and programmes is the way forward.”

Dr. Viliami Toalei Manu, CEO for Agriculture, Forestry and Food, Ministry of Agriculture, Food, Forests & Fisheries, Kingdom of Tonga

About the project



The project “Leveraging the Development of Local Food Crops and Fisheries Value Chains for Improved Nutrition and Sustainable Food Systems in the Pacific Islands with a focus on Fiji, Kiribati, Marshall Islands, Samoa, Solomon Islands, Tonga, and Vanuatu” is co-funded by the International Fund for Agricultural Development (IFAD) and the Technical Centre for Agricultural and Rural Cooperation (CTA) and is implemented in partnership with the Pacific Islands Private Sector Organisation (PIPSO). The goal is to strengthen the capacity of the Pacific Island governments, farmer and private sector organisations, and sub-regional institutions to develop strategies and programmes – as well as mobilise financing – that can increase poor rural people’s access to nutritious and healthy food. CTA has overall responsibility for the implementation of the project.

About the project partners

IFAD

The International Fund for Agricultural Development (IFAD), a specialised agency of the United Nations, was established as an international financial institution in 1977 as one of the major outcomes of the 1974 World Food Conference.



PIPSO

The Pacific Islands Private Sector Organization (PIPSO) is the premier private sector representative body in the Pacific Islands region. It was set up through the mandate of the Forum Economic Ministers in 2005, and legally established in 2007, to be the representative body of the Pacific region’s private sector.



Further reading

Singh, S. (2018) ‘Profiling Bioactive Compounds and Key Nutrients in Pacific Island Crops and Marine Resources’, Wageningen: CTA.

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