Tackling NCDs from the ground up: Nutritious leafy vegetables to improve nutrition security on Pacific atolls

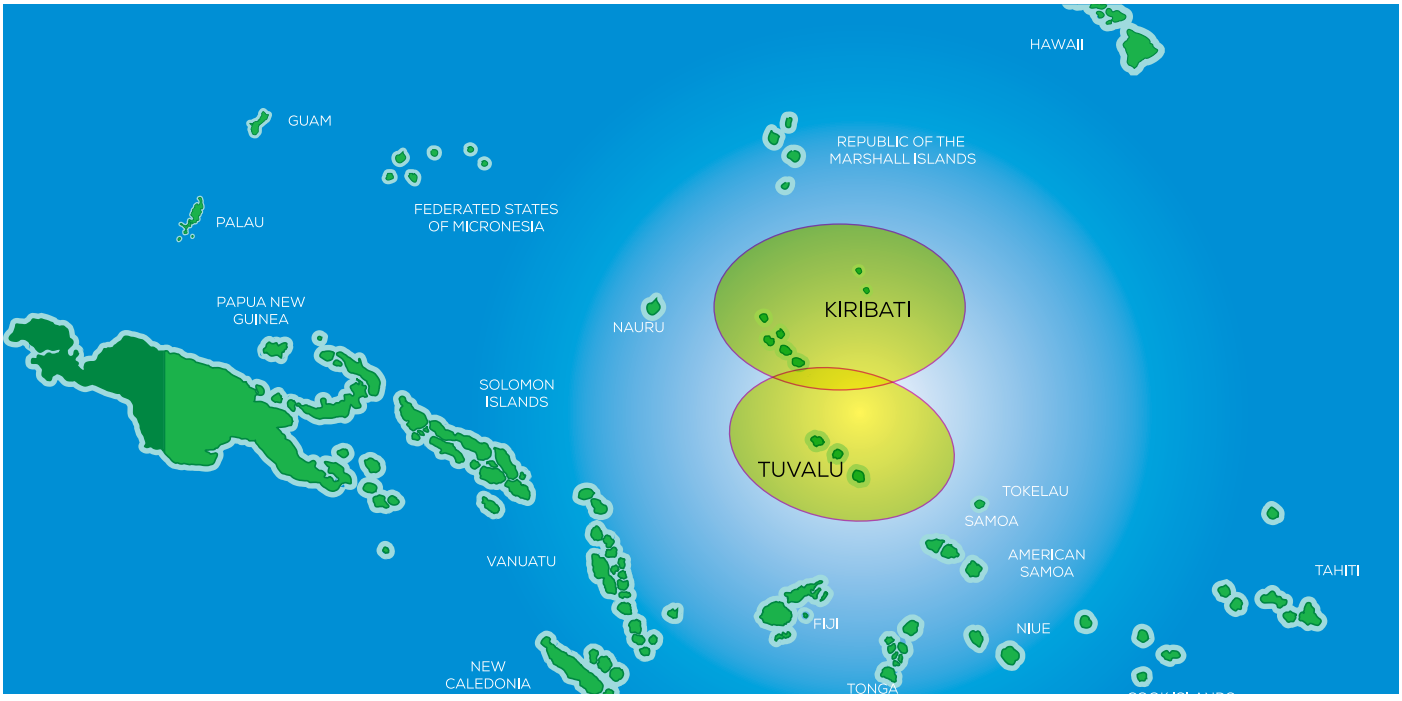
Introduction

Epidemic of non-communicable diseases (NCDs)

Since the 1940s the consumption of high-energy, low-nutrient foods, including white flour, sugar, polished rice, turkey tails and mutton rib flaps by Pacific Islanders and indigenous Australians, combined with reduced exercise, has resulted in alarming rates of obesity, heart disease, diabetes and certain cancers. Indeed, **around 70% of deaths in Pacific Island countries (PICs) are due to NCDs.** Apart from the tragic personal cost, premature death and disability undermines national economic productivity. These conditions were not present when traditional diets and lifestyles predominated. In addition, many PICs are affected by the "double burden" of NCDs and undernutrition; for example, high rates of iron deficiency anaemia in PNG, Fiji, Solomon Islands and Tuvalu.

This project, funded by the **Australian Centre for International Agricultural Research (ACIAR)** and titled *Improving soil health, agricultural productivity and food security on atolls* (ACIAR SMCN2014/089) builds on the project Feasibility study on increasing the consumption of nutritionally-rich leafy vegetables by indigenous communities in Samoa, Solomon Islands and Northern Australia (ACIAR PC/2010/063): *www.aciar.gov.au/publication/fr2014-15* The project included a GxE study in which single leafy vegetable species were sampled across different sites/different soils and multiple species growing at the same site were sampled, then analysed for mineral nutrients and carotenoids, including beta-carotene (pro-vitamin A). This approach enabled partitioning of the effects of environment (mostly soil type) and genetics (plant species). The data were used to identify the most nutritious species and these are featured in a factsheet series: *www.aciar.gov.au/News2013July*

Can the high rates of NCDs in Pacific Island countries, and atolls in particular, be reduced while improving nutrition security and income on atolls? To address this question, this project, which commenced in 2016, aims to diversify food crop production, including nutritious leafy vegetables, on outer island atolls of Kiribati and Tuvalu. It is linked to the **International Fund for Agricultural Development (IFAD)'s *Outer Islands Food and Water Project.***



Project location: atolls of Kiribati and Tuvalu. The project is implemented by SPC, Suva, Fiji, in conjunction with The University of Tasmania and The University of Adelaide, and funded by ACIAR, Canberra, Australia

The special case of atolls

Although the project focuses on Kiribati and Tuvalu, it is also relevant to other Pacific and Indian Ocean atolls. Atoll soils are formed almost entirely from coral (calcium carbonate with some magnesium). They are coarse-textured with no clay, so water flows straight through them. Moreover, droughts are common in this part of the world. The soil is often salty, highly alkaline (high pH) and low in nutrients such as potassium, iron and anganese. Iron deficiency is usually shown by yellow young leaves and stunted growth. Furthermore, inorganic fertilisers and chemical pesticides are prohibited on the atolls as they could pollute valuable underground fresh water.

Our criteria for ***atoll suitable*** **leafy vegetables** are: 1) Highly nutritious, 2) Taste good, 3) Tolerant of alkalinity (high soil pH), 4) Tolerant of salt and drought, 5) Easy to grow, prepare and cook.

In a scoping study for the current project, we collected leaf, soil and compost samples in Kiribati and Tuvalu. Surprisingly, we found 11 of the 12 leafy vegetables featured in the earlier factsheets growing on South Tarawa and Funafuti, in gardens and hedges; however, they were usually used for animal feed or as ornamentals. Clearly, raising awareness is an important program component, which includes school food gardens and curriculum development, farmer field schools, village workshops and media promotion.

Improving soil health through targeted composting, along with growing and eating nutritious crops on atolls will lead to improved diet, nutrition and health. This also makes economic sense by reducing trade deficits associated with the high consumption of imported foods in countries like Kiribati and Tuvalu, where imported food comprises about 65 % of food eaten. Moreover, increased food crop diversity enhances the resilience of food systems to climate change, and thus strengthens food and nutrition security.

Giant swamp taro food garden

How better to grow these crops than with traditional Giant swamp taro pits? (*Cyrtosperma merkusii*, called *babai* in Kiribati and *pulaka* in Tuvalu). These have been historically dug by hand down to the water table. Many of these pits are now neglected but they provide a strong connection to both culture and underground water.



Babai food garden under development on Abemama Island, Kiribati in February 2017

In an adaptation of this pit system, kangkong can be grown in the water with the swamp taro. Hence the drought tolerance requirement is waived for this species. The other crops are grown on terraces forming the pit walls, and drumstick, ofenga, hedge panax and yellow beach pea are planted around the pit at ground level. Other crops, such as bananas, pawpaw, sweet potato and annual vegetables can be included. This mini food system can, once established, provide virtually complete nutrition for a family. The size can be as small as 100 square metres or as large as 0.3 hectares. In crowded places, such as Betio on South Tarawa, there is usually room to at least plant a drumstick tree or two, which would soon provide a sustainable daily supply of leaves for a family.

Why leafy vegetables?

Many different types of leafy vegetables are grown and eaten in the Pacific region. When available, local vegetables are usually inexpensive and thus affordable to most people in both urban and rural areas; despite this, they are often overlooked, being sometimes regarded as "low status foods". However, research has shown they are valuable foods, being nutritious and rich in protein, minerals, vitamins (e.g. A, B, C, K), beneficial phyto (plant) compounds and fibre. Moreover, leaves are an ideal weight loss food.

Iron is an important mineral nutrient found in leafy vegetables. Lack of iron can cause iron-deficiency anaemia, common in women, inducing fatigue and weakness, and in children, affecting growth, energy levels and learning ability. Chaya, yellow beach pea, purslane, pumpkin/choko tips and kangkong are good sources of iron.

Phytocompounds such as flavonoids, anthocyanins, polyphenols and carotenoids are beneficial to humans as antioxidants and anti-inflammatory agents in reducing the risk of diabetes, heart disease and cancers; for example, glucosinolates in drumstick leaves and anthocyanins in purple sweetpotato leaves. Certain carotenoids, notably beta- and alpha-carotene, are converted to vitamin A when eaten, especially if consumed with some oil (e.g. coconut cream). Others, notably lutein (which is often abundant in leafy vegetables) and zeaxanthin are important for eye health, including reducing the risk of cataracts.

Although this project focuses on the food/nutritional value of leafy green vegetables, traditionally in many countries they are used for specific medical applications; for example, chaya (from Mexico) protects the heart, liver and kidneys from toxin damage; drumstick (India and Pakistan) has anti-bacterial effects; bele (Papua New Guinea and Solomon Islands) is used for bone repair and treating osteoporosis, and hedge panax, drumstick, chaya and bele can stimulate lactation. Especially important, given the high NCD (particularly diabetes) rates in the Pacific and Northern Australia, are the anti-diabetes effects of chaya, drumstick, ofenga, amaranth and purslane, demonstrated in scientific studies. We believe that NCDs need to be tackled using this *food system* approach, starting with the soil.

How to eat these nutritious vegetables

It is recommended to eat around one and a half cupfuls or three handfuls (around 150 ml or grams) of leafy vegetables each day. Some green leaves can be eaten uncooked, for example kangkong, drumstick and chilli, which preserves most vitamins. Optimum cooking methods are steaming, simmering in a little water, baking or stir frying in a little oil (ideally virgin coconut oil or coconut cream) for minimal time to limit nutrient loss. The cooking water can be used for soup. **A simple method which suits all of these vegetables is: chop them into small pieces (except drumstick, in which case strip the leaflets from the wiry petioles), simmer in water for 10-15 minutes, add coconut cream and simmer for a further 10-15 minutes.** Other ingredients can be added if further flavour is desired.

The factsheets

In addition to this introductory factsheet, 12 factsheets have been produced, which feature the most *atoll suitable* nutritious leafy vegetables identified during the project. Numerous other leafy plants in the Pacific are suitable for eating and nearly as nutritious as those featured here, for example the Lettuce Tree (*Pisonia grandis;* te buka, puka vai) though some may not be as suitable for atolls that are subject to drought; for example, sweet potato, cassava and edible ferns. The Bird's Nest Fern (*Asplenium nidus*; katafa, laukatafa, laulu) is popular, especially in Tuvalu, in particular the youngest leaves cooked in coconut cream. We found it to be relatively high in potassium and boron. Leaf mineral and carotenoid (if analysed) data are presented in each factsheet in the form of a table which includes the featured leafy vegetable sampled at a particular representative site, compared with other leafy vegetables growing at the same site. English cabbage is also included, as a moderately nutritious yardstick, using average values of samples purchased at markets in the South Pacific. The final factsheet #13 discusses nutritional aspects of composting materials suitable for atolls.

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