



# School food and nutrition environments in the Pacific Islands: opportunities to support healthier diets

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## Review Article

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### Abstract

The Pacific Islands region is home to a diversity of countries and territories, who are at the forefront of climate change and the triple burden of malnutrition. In recent years there has been increasing interest in schools as a setting for transforming food systems, improving nutrition and health outcomes, increasing educational outcomes, and enhancing livelihoods in the Pacific Islands. This review examines and describes current school food and nutrition initiatives within the literature that aim to promote healthier, sustainable diets within the Pacific Islands region. As there is a paucity of literature in this area of interest in the Pacific Islands, the review focuses on the policy landscape, the provision of food near, and in schools, nutrition education, and future opportunities. The available literature demonstrates that there is broad regional interest and momentum from numerous stakeholders to enhance SFNE in the Pacific Islands, with several opportunities for future activities. While there are frameworks to explore food environments available there is a need for a Pacific Islands school food environment conceptual framework that captures aspects, both within and around schools, that can guide research and assessment for robust comparable data collection. This may in turn support healthier SFNE and ultimately nutritious food choices for children and adolescents.

School food and nutrition environments (SFNE) in the Pacific Islands have the potential to play a significant role in the transformation of food systems, improve nutrition and health outcomes, increase educational outcomes, and enhance livelihoods. The Pacific Islands region is home to a diversity of countries and territories spread across the vast South Pacific ocean. While subsistence food production still plays an important role across the region, a nutrition transition (a large shift in human activity and dietary patterns resulting in nutritional outcomes)<sup>(1)</sup> is underway<sup>(2)</sup>, with significant health impacts already observed in communities and individuals. Rates of diet-related non-communicable disease (DR-NCD) in the Pacific Islands region are some of the highest globally<sup>(3)</sup>. At the same time, the region is at the forefront of the impact of climate change, including sea level rise and inundation, and devastating climatic events such as tropical cyclones<sup>(4,5)</sup>. The changing climate is having serious impacts on Pacific agriculture, further amplifying existing food system vulnerabilities<sup>(5–7)</sup>.

The nutrition transition has led to substantial changes in food environments in both urban and rural areas of the Pacific Islands region<sup>(4,7)</sup>. More imported, and often ultra-processed foods are becoming available<sup>(2,8)</sup>, changing traditional diets. Traditional diets across the region were typically based on starchy root crops (for example, taro, cassava), fish, seafood, and local fruits (for example, fe'i bananas), however, refined, imported foods like rice, instant noodles and biscuits are now widely available and consumed<sup>(2,9–11)</sup>. The triple burden of malnutrition, that being the coexistence of overnutrition (overweight and obesity), undernutrition (stunting and wasting) and micronutrient deficiency, exists in the region<sup>(3,12)</sup>. An important concern in the Pacific Islands has been the rising prevalence of overweight, obesity and DR-NCD among children and adolescents<sup>(13)</sup>.

Nutritional status during childhood affects health in adulthood<sup>(14)</sup>. Good nutrition is essential for achieving educational outcomes<sup>(15,16)</sup> and is linked to adult cognitive and employment prospects<sup>(17)</sup>. Establishing healthy behaviours during childhood and adolescence sets the scene for healthier habits and behaviours in adulthood<sup>(18,19)</sup>. An imbalance between calorie (energy) intake and expenditure is linked to overweight and obesity for children and adolescents. While limited data exists in the Pacific Islands, it is plausible that, like in many parts of the world, epidemiological, nutritional, and technological changes are linked to altered eating habits, including an increase in energy consumption. Studies have shown that 40% to 70 % of

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obese children become obese adults<sup>(20)</sup>, underscoring the need to consider opportunities to support healthy, sustainable food behaviours. While overnutrition is often highlighted across the region, undernutrition is also a significant issue. Stunting and wasting are reported across the region, with rates varying by country<sup>(21)</sup>, but some of the highest rates globally. Undernutrition can present significant challenges to a child engaging with learning at school and cognitive development<sup>(15,16,22)</sup>.

Schools are an ideal setting to provide opportunities to support healthy food behaviours<sup>(3,23–25)</sup>. While the education systems vary across the region, children tend to start their education in primary school (generally ages 5–11) and continue in secondary school (generally 12–18 years). Children spend a large portion of their day in school, generally eat at least one of their main meals there, and the types of foods accessed within school food environments often make up a significant proportion of a child's intake<sup>(26)</sup>. Children are receptive to education<sup>(27)</sup> and can create a ripple effect by positively influencing other family and community members. Schools and churches have long had an important role in Pacific society, influencing societal behaviours and attitudes<sup>(28,29)</sup>. Schools are also therefore an important setting for focusing on Indigenous Peoples' food and knowledge systems, with significant potential for these to be embedded in school food activities and programmes to ensure future generations learn and can continue to share this knowledge.

The positive effects of nutritious school food and nutrition environments go beyond just health<sup>(30)</sup>. At specific times and in certain Pacific Islands locations, agricultural production or access to locally produced foods may be limited. The Pacific Islands often have complex agrifood systems, given the vast geographical distance between domestic islands, countries or even cities/towns within the same island that lack sufficient road infrastructure. This translates into long distances to transport food which is often heavily dependant on shipping, and hence vulnerable to rising fuel costs and increasing shipping rates. Processing and packing infrastructure is also often lacking, with cold chains often difficult to maintain, if at all, resulting in variability in the availability and quality of food and high-end costs to the consumer<sup>(31)</sup>. Compounding this, climate change is leading to an increase in drought, tropical cyclones or unexpected heavy rains which is negatively affecting agriculture productivity<sup>(32)</sup>.

Schools can help drive markets and boost local value chains by offering a sustainable demand for local production. Utilising local and traditional foods in schools presents a significant opportunity within the region, and more broadly to not only ensure food and nutrition security, but to support local livelihoods through driving markets and employment opportunities, to increase food literacy, and help students to understand the role of, and develop a preference for these foods<sup>(12)</sup>.

In recent years there has been increasing interest in schools as a setting for transforming food system and health change in the Pacific Islands region<sup>(12)</sup>. Therefore, the aim of this review is to examine and describe current school food and nutrition initiatives within the literature that aim to promote healthier, sustainable diets within the Pacific Islands region. Given the diverse ways in which to categorise Pacific Islands, within this review, we focus on the countries and territories within the remit of the Pacific Community (SPC), that being; American Samoa, Commonwealth of the Northern Mariana Islands, the Cook Islands, the Federated States of Micronesia, French Polynesia, Guam, the Independent State of Papua New Guinea, the Independent State of Samoa, the Kingdom of Tonga, New Caledonia, Niue, Pitcairn Islands, the

Republic of Fiji, the Republic of Kiribati, the Republic of the Marshall Islands, the Republic of Nauru, the Republic of Palau, the Republic of Vanuatu, Solomon Islands, Tokelau, Tuvalu, and Wallis and Futuna.

### The school food and nutrition environment

SFNE across the region are not well understood. Defining the SFNE is a significant challenge due to the ongoing debate about whether it encompasses solely the school premises or also extends to the surrounding environment<sup>(33)</sup>. Leading on from this, there is little consensus on how to assess and evaluate school food environments. Some literature investigates food availability near school grounds<sup>(8,34)</sup>, focusing on what students have access to while travelling to and from school when a broad approach is used. Other literature focuses only on the internal school food environment or activities that occur within school grounds<sup>(35)</sup>. Additionally, much of the focus on SFNE has been in high-income countries. As there is a paucity of literature in this area of interest in the Pacific Islands, this review focuses on the policy landscape, the provision of food near, and in schools, nutrition education, and future opportunities.

### The policy landscape

The wider policy landscape of SFNE within the Pacific Islands region is somewhat unclear. One study by Reeve *et al.* (2021) reports on an activity including key stakeholder interviews and document analysis to understand policy implementation processes in Samoa<sup>(36)</sup>. The authors identified that there was strong commitment to healthy school food environments demonstrated by leaders and policymakers, however, there were still improvements that could be considered<sup>(36)</sup>. These included compliance with school nutrition standards and that strong incentives were likely to support compliance and enforcement<sup>(36)</sup>. Community leaders were identified as critical to the success of policy implementation and continued use of these<sup>(36)</sup>. Many of the challenges that exist for effective policy identified for example, prioritisation by non-Health stakeholders, and the availability of less nutritious food choices in the areas around schools<sup>(36)</sup>, are also reflected in a study undertaken in 2018 across 14 Pacific Island countries (including Samoa). This 2018 study identified varying capacity for development and implementation of policy and legislation across the region, as well as responsibility for policy monitoring and evaluation, and this likely impacts the success of school food nutrition programmes<sup>(36)</sup>.

### The provision of food near, and in schools

School students are often exposed to food items and marketing on their way to, and from school, presenting opportunities to source food. As the nutrition transition continues in the Pacific Islands region, students are increasingly exposed to imported, ultra-processed foods, in both urban and rural settings. Ultra-processed foods are often seen as a convenient and cost-effective option but offer little nutritional value<sup>(37,38)</sup>. As food preferences and behaviours are shaped in childhood and adolescence, consumption of these ultra-processed foods can lead to children and adolescents developing a preference for these, often displacing local, traditional foods. The concern around these ultra-processed foods is the increasing global evidence that their consumption is related to numerous serious chronic health diseases especially cardiometabolic, common mental disorders, and mortality outcomes<sup>(39)</sup>.

In 2020 a mapping exercise showed that primary school-aged children in Fiji are exposed to, and have access to significant amounts of ultra-processed foods (NOVA category 4 foods)<sup>(8)</sup>. When considering the foods available to students within a 400 m radius of 88 schools in Fiji, sugar-sweetened beverages were available in 80 %, and lollies/confectionary in just over 60 % of outlets. Just over 20 % of outlets had fresh fruit available, while fresh vegetables were available in less than 20 % of outlets<sup>(8)</sup>.

These findings are similar to those from the Kingdom of Tonga, where more evidence exists. During 2017/18, Pauvule *et al.*<sup>(34)</sup>, used Google Earth Pro supported by Google Maps, a government map and in-person observations to identify zones (250 m, 500 m, 80 m and 1000 m) around a public Secondary School in Nukualofa, Tonga to physically and virtually observe the food outlets available, and the foods within these (health-promoting foods, risk promoting foods and sugar-sweetened beverages). As seen in Fiji, the project found that food outlets around schools had predominately unhealthy foods available. The authors report on the lack of food outlets selling healthy foods near the school, and the closest option classified as 'very healthy' was nearly 900 m from the school. One hundred and fifty outlets were identified within the 1000 m radius of the school, with majority of these (98 %) categorised as 'very unhealthy', with one of these being the school canteen. These studies appear to be the only research available that utilises mapping of food outlets in and around schools in the region.

In 2011, Cacavas and colleagues also conducted a study on the eating behaviours of Tongan adolescents aged 12–19 years. The study examined sources of food (including from schools) and dietary patterns within a cohort of Secondary school students<sup>(35)</sup>. Overall students generally sourced breakfast from home, but got morning tea/recess and lunch from the school canteen or tuckshop (morning tea: 66.1 % of males and 74 % of females; lunch 65.3 % males, 71.6 % females)<sup>(35)</sup>. Female participants reported more frequent consumption of sweet foods, soft drinks and packaged sweet foods, but male participants reported more frequent consumption of fruit<sup>(35)</sup>. The majority of participants (83.9 % of females and 80.1 % of males) perceived positive encouragement from schools for healthy eating<sup>(35)</sup>. This included the use of policies, however, some students also spoke about the range of 'unhealthy' foods available in school canteens<sup>(35)</sup>. Students also reported purchasing 'unhealthy' foods from sources near schools<sup>(35)</sup>. Cacavas *et al.*, note the potential for environmental interventions within school settings, especially those embedded in policy<sup>(35)</sup>. While important, there is no other current literature available to assess if similar findings would be seen in other islands within Tonga or other Pacific Islands countries.

More recently Veatupu *et al.*, utilised wearable cameras to investigate Tongan childrens' food choices<sup>(40)</sup>. While not specifically focusing on school food environments, 36 children, aged 10–12 years wore a body camera for three consecutive days to record the nature and context of food consumption<sup>(40)</sup>. The children were found to eat more non-core foods (for example, unhealthy snack foods, cookies, cakes, confectionery, processed meat, fast food) than core foods (for example, fruits, meats and alternatives, breads and cereals, vegetables)<sup>(40)</sup>. This was particularly evident within the school setting, where children consumed non-core foods 'at a mean rate 3.5 times that of core foods, per day'<sup>(40)</sup>. These authors also call for more information on and action to limit the presence of high-energy, nutrient-poor foods in schools, through implementation of the School Food Policy in Tonga, and amongst other actions, increased food taxes<sup>(40)</sup>.

In New Caledonia, the food environment has been described as 'obesogenic', with many takeaway stores available, even in remote areas, and fast-food restaurants in close proximity to schools<sup>(41)</sup>. Students 11–16 years of age in both rural and urban locations have been reported to acquire knowledge of food through school nutrition programmes and from the school canteen<sup>(41)</sup>, however further details of these programmes are not available in the literature. In this study, students brought sugar sweetened beverages and candy to school, often as a gift or to exchange with fellow students<sup>(41)</sup>. Lunch was often eaten in the school canteen and was the structured meal of the day for some children<sup>(41)</sup>. In Guam, an initial exploration of food stores within 1 mile of schools, resulted in a finding that linked reduced risk of obesity to availability of fruit and vegetables in food stores; however, the authors note that more information is needed on school food environments in Guam, including longitudinal studies<sup>(42)</sup>.

There are several ways to provide access to food within the school food environment, including school meals programmes (SMP), canteens/tuck-shops, food vendors, school gardens, ad-hoc activities and bringing one's own lunch/food. While providing food to students can support their nutritional needs, there is a critical need to consider the types of food included. Locally grown and procured food is a nutritious, healthy, and efficient way to provide students with access to food, at the same time, improving opportunities for smallholder farmers<sup>(43,44)</sup> and creating awareness of nutrition and healthy food practices in the community<sup>(45)</sup>. This is often referred to as 'home-grown' school feeding. Recently, the novel concept of 'planet-friendly school meals' was presented at COP28, demonstrating the potential for school meals to contribute to climate resilient food systems<sup>(46)</sup>.

SMP are increasingly touted as a strategy for food system transformation<sup>(47)</sup>. Globally they are estimated to feed over 400 million children<sup>(43)</sup>, providing not only access to nutritious food, but also supporting local communities, smallholder farmers and livelihoods, and enhancing school attendance and educational outcomes<sup>(47)</sup>. Currently, SMP are not widely used in the Pacific Islands<sup>(3)</sup>, yet there is increasing interest and momentum towards understanding how they can be used in this region, especially with models that support and promote the integration of local, traditional climate-resilient, nutrient-rich foods<sup>(48)</sup>.

When a SMP may not be possible, or is being considered but not yet feasible, other school food and nutrition activities can be utilised to support nutritious food choice to students. Over the past five years, more evidence on the current situation, activities, and capacity for providing food in schools across the Pacific Islands has been collected and reported.

In 2019 a project mapped the current state of, and capacity for school food programmes (SFP, *that being SMP and other activities that provided access to food in primary and secondary schools*), across the Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, Marshall Islands (RMI), Nauru, Niue, Palau, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, and Vanuatu (Food and Agriculture Organization of the United Nations [FAO] Sub-Regional Office for the Pacific Islands countries)<sup>(3)</sup>. The purpose of the project was to scope and identify current activities, undertake a capacity needs assessment, analyse, and describe the capacity for SFP and propose recommendations at a local and regional level. Within this project a workshop was held to explore stakeholder perceptions of the opportunities and challenges associated with SFP. Findings from an initial scoping and interview process, alongside the FAO School Food and Nutrition framework, were

used to guide the workshop<sup>(3)</sup>. Key findings of the workshop included a perception that local food environments can support SFP, but that availability, cost, convenience, and preferences would likely impact the success of these<sup>(3)</sup>. The workshop also identified differing levels of policy support and government leadership, and that monitoring and evaluation are a challenge.

As interest in SMP has grown, more evidence on the use of local foods in Pacific schools is becoming available. However, research is required to address knowledge gaps and barriers and to understand the potential to link food provision to local agricultural production in the region, in particular, what does homegrown school feeding look like in the Pacific?

A recent regional activity utilised a scoping study to explore the current state of school food activities (school feeding, gardening, and other food provision activities) and any current, and potential links to local agriculture in the Pacific Islands<sup>(49)</sup>. The mapping activity, initially covering 22 Pacific Island countries included two steps: a desk-based scoping review (peer-reviewed and grey literature, date range 2007–2022) and semi-structured online interviews with 30 key country stakeholders (at least one from 15 countries). While limited literature was identified (*n* 12 sources), most of these were grey literature (*n* 9). The activities identified a range of school food activities, including school feeding programmes, school gardens and less utilised activities such as including taste/sensory education, food waste reduction, increasing canteen capacity for local foods, supply chain distribution between local agriculture and schools. The extent to which there were links to local agriculture varied across activities. Of 16 school feeding programmes, 8 required the use of local produce (a policy requirement for *n* 6, and a traditional requirement from leaders for *n* 2). Of the school garden programmes identified (*n* 12), *n* 6 reported using local or traditional produce, and *n* 5 involved local farmers in some capacity. Challenges identified by participants did vary by context, but generally included limited funding, inflation, COVID-19 impacts, inadequate supply of produce, limited farmer capacity, limited institutional support for local produce, low produce storage life, climatic conditions and disasters, water security, delayed procurement process, and limited professional development and upskilling opportunities. Similar to other work<sup>(3,8)</sup>, stakeholders reported that one of the most significant challenges is how modernisation and colonisation of food systems have resulted in a preference for hyperpalatable (ultra-processed) foods and how this makes it more challenging to incorporate local produce in a way that is accepted by students.

This work provides a starting point to explore and share ways to integrate local, traditional, climate-resilient, nutrient-rich foods in schools to support children and adolescents to value, utilise, prefer, and advocate for these foods. It appears that there is a need to support the utilisation of traditional, local foods in schools by advocating for policy (at various levels, right from a school level upwards) that drives the use of these foods and creates more supportive school food environments. There is also a need to consider how to support a desirability for these local, traditional foods. This evidence will be invaluable in developing a pathway to piloting and implementing models of SMP and promoting opportunities for shared learning and collaboration with key stakeholders across the region.

School gardens are also used in the region. One of the more established and reported on programmes in the Pacific is the Republic of Marshall Islands School Learning Garden Program. In 2014, the Jikin kallib ilo jikuul RMI School Learning Garden Program was initiated, based on Kū 'Āina Pā: Standing Firmly in

Knowledge Upon the Land (KAP), a Hawaiian programme. A chapter in the book, *Agrobiodiversity, school gardens and healthy diets: Promoting biodiversity, food and sustainable nutrition*<sup>(50)</sup>, details how the RMI School Learning Garden was operationalised in the education system and includes several activities to ensure sustainability<sup>(51)</sup>. School garden teacher training is used in conjunction with a focus on curriculum through the RMI Learning Garden Curriculum Map, and capacity-building activities<sup>(51)</sup> as the programme seeks to include students, teachers and the wider community (parents and members) and support a healthier lifestyle through gardening practices<sup>(51)</sup>.

In 2020, a study aiming to understand the role of diets and food systems in the prevention of obesity and non-communicable diseases in Fiji explored local school food environments<sup>(8)</sup>. Data, including interviews with a school representative, were collected from 84 schools with World Health Organization (WHO) Health Promoting Schools (HPS) accreditation (2016–2019) from eight of the nine education districts. The study explored the presence of policy, although not compliance, food production in schools using gardens, food provision in schools, food and nutrition education and local school food environments. Food production was observed in most schools (84.5 %) using a school garden, although only half of the schools reported harvesting in the past month (although noting that the data collection overlapped with COVID-19 restrictions). The most common use of the garden produce was to provide food to students and the community<sup>(8)</sup>. Several schools (*n* 10) reported other food production activities including chicken/poultry, hydroponics, fruit trees, a fishpond, a piggery and bees. Just over half of the schools (*n* 47) reported having a kitchen, with some of these (*n* 32) currently using this area to prepare food for students (most commonly lunch)<sup>(8)</sup>. The garden was integrated into school curriculum in 68 of the schools; however, more detail on the mechanism for doing this was not explored. A canteen/tuckshop was available in 79 % of the schools, with the most commonly sold foods including fruit juice, boiled peas/peas, and beans/fried beans<sup>(8)</sup>.

More recently a case study by Walker *et al.*<sup>(52)</sup>, provides information on the process of setting up the Morobe school gardens project in primary and secondary schools in Lae, Papua New Guinea. The purpose of the school gardens was two-fold, addressing food supply chains and unemployment, and strengthening school capacity for developing knowledge and agribusiness skills<sup>(52)</sup>. The authors reflect on the role of hierarchy in the community and the impacts this has on student involvement in the planning and establishment of a programme, as well as its sustainability. This case study also provides opportunities for future steps for enhancing sustainability in this project, but they are also likely to be useful for other Pacific Island contexts.

### Nutrition education

While providing access to nutritious foods in schools is important to support healthy dietary behaviours, nutrition education plays an equally important role. Nutrition education is defined as 'any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition-related behaviours conducive to health and well-being; nutrition education is delivered through multiple venues and involves activities at the individual, community, and policy levels'<sup>(53)</sup>. Nutrition education aims to support healthy food choice, however like other aspects of Pacific Island SFNE, there is limited literature available on this topic.

Governments across the region appear to face many challenges in implementing such curriculum, including a lack of trained in country staff, limited infrastructure in schools for physical activity, culturally relevant information which can be easily understood by local populations, proper monitoring, and evaluation of the existing guidelines<sup>(54)</sup>. Community engagement and physical partnership with local health ministries and departments are crucial for the success of food, nutrition, and health curriculum. To fill this gap robust evidence on effectiveness and implementation of school-based nutrition intervention programmes in schools in Pacific Island nations is much needed.

In 2018 a project broadly mapped the current state of, and capacity for school nutrition education programmes (SNEP), across the Cook Islands, Federated States of Micronesia (FSM), Fiji, Kiribati, Marshall Islands (RMI), Nauru, Niue, Palau, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, and Vanuatu (FAO Sub-Regional Office for the Pacific Islands member countries)<sup>(54)</sup>. The purpose of the project was to scope and identify current activities, undertake a capacity needs assessment, analyse, and describe the capacity for SNEP and propose recommendations at a local and regional level. The scoping study identified a range of SNEP activities, including those linked to school curriculum, gardening activities and other (for example, sport-based or linked to school food provision). The capacity needs assessment, undertaken using semi-structured interviews with 88 stakeholders from education, agriculture and health sectors provided insights into challenges and solutions, enabling environments, organisations and individuals within functional capacities of policy, knowledge, partnerships and implementation. Limited capacity for SNEP was identified. As detailed above, a lack of supportive policy appeared to be in place, however this did exist at some levels, in some countries. There were considerable challenges with accessing, generating and sharing knowledge, particularly in areas where there is considerable geographic reach, or communication systems that may not always work effectively (for example reliable internet connectivity). There were also limited opportunities for upskilling/professional development. However, it was reported that a high level of motivation for SNEP exists across the region and the current examples suggest that these can be successful if supported appropriately.

Following on from this project, a purpose-built website (The Pacific School Food Hub) was funded by FAO-UN Sub-regional Office for the Pacific Islands and developed by researchers at the University of the Sunshine Coast (Queensland, Australia), to provide a repository of teaching resources that teachers across the region can access. This project used a systematic desk-based mapping activity to identify food and nutrition curriculum materials and professional development/upskilling activities available for Pacific Island educators, again across the 14 FAO Sub-Regional Office for the Pacific Islands member countries<sup>(55)</sup>. The findings indicate that limited food and nutrition resources and professional development activities exist for Pacific Island teachers. Where resources were available, they were generally related to cooking, food in schools, food safety, gardening, healthy eating, ocean and waterway foods, research, sustainability, teaching practice and WASH (Water, Sanitation and Hygiene)<sup>(55)</sup>. This website is available at: <https://pacschoolfoodhub.com/>.

When considering more specific nutrition education interventions, the Healthy Child Promising Future pilot project undertaken in Fiji (1 school) and Wallis and Fortuna (all schools), provides one example of a specific programme of nutrition education work<sup>(56)</sup>. The project aimed to assess knowledge, attitude

and practices of students and their caretakers in the selected schools and to develop and test the effectiveness of the intervention in changing knowledge, attitudes and practices related to healthy food consumption and physical activity. Students were provided with face-to-face sessions, based on 15 pre-identified themes every week and a 30-minute physical activity session was conducted every day in all schools. The themes used for education were identified in a workshop attended by representatives from Ministry of Health and Medical Services (Fiji), Ministry of Education, Heritage and Arts (Fiji), Sanitary and Social agency of New Caledonia's (ASSNC), Department of Education (Wallis & Futuna), Department of Health (Wallis & Futuna) based on the needs of the students in the participating countries<sup>(56)</sup>.

The caretaker's intervention was based on 5 themes, also identified during the same workshop. In both the countries the intervention has shown significant improvement in knowledge, attitude and practice scores both for caretakers and students related to the healthy diet consumption and promotion of physical activity<sup>(56)</sup>. The results indicate that the developed intervention package had a positive impact on knowledge, attitude and practice scores for students and their caretakers and can be successfully replicated in other schools in other Pacific Island Countries. The findings of this study demonstrate that age appropriate, easily understandable nutrition education sessions can play an important role in improving the health status of the population including primary school children.

Nutrition education is also provided through school curriculum in the Pacific Islands region, however the approach and integration of this varies by country and year/age level<sup>(54)</sup>. To the best of the authors knowledge, there is no other current literature available on this topic, highlighting a significant gap in our understanding.

## Opportunities

While there is increasing interest in schools being supported to provide healthy and sustainable food environments across the Pacific Islands region, there is a lack of robust evidence to guide the design, implementation and monitoring of development and national programmes to enable these to be efficient and effective. Contextualised evidence is crucial for policy change and without this, the enabling policy environment may lag other initiatives. There is a need to advocate for evidence, however there are still questions about how best to consistently measure school food environments generally, let alone in the Pacific context<sup>(33)</sup>. The authors believe that an all-encompassing SFE conceptual framework to inform collection of data and create consistencies in measurement is required as there is still little consistency in how these are measured within the region, making tracking change over time difficult. Another gap is the availability of data on child and adolescent eating behaviours, as well as health and nutrition status, with some of this limited in representativeness, scope, and currency. The Global School Health Survey (GSHS), Multiple Indicator Cluster Survey (MICS), Demographic Health Survey (DHS) are periodically done in the region, however, the majority of the information currently available is for young children, with significant data gaps for adolescents. Much of the data that is available is often older than 10 years and likely no longer valid.

A 'whole of community', as opposed to a 'whole of school' approach to school food and nutrition environments has been proposed for the region<sup>(3)</sup>, however there are opportunities to explore what this looks like, and how it is community-driven, alongside other aspects of Pacific Island culture. There could, for

example, be opportunities for community members to be involved in the design and delivery of educational curriculum that supports the integration of traditional, local foods and supports school or community gardens. Over time, this may support children and adolescents to value, utilise, prefer and advocate for these foods, and support food literacy for students, teachers and school staff, and the broader community. Families of students involved in farming could be offered opportunities to supply food to the school programme, be involved with supplying seeds or other planting material or even be employed to provide farm labour where schools opt for production on school grounds.

Nutritious school food environments require a multisectoral approach. There is an opportunity to further identify and share successful examples to facilitate learning (for example multi-sectoral policy), however there is a need to clarify the role of various sectors and organisations and identify those who may currently be missing from these discussions. Given the vast Pacific Islands area and at times limited connectivity, discussing and testing mechanisms for sharing and learning is an important step forward.

One area where there appears to be a dearth of information is that of advertising and marketing within the school environment zone and the potential impact this has on food choice. As marketing influences children's eating preferences and behaviours<sup>(57)</sup>, this is an area of future research and could serve as a foundation for evaluating potential regulations.

There is a growing global focus on school food and nutrition, illustrated by the creation of the School Meals Coalition, FAO's School Food Hub, and the activities of the Global Child Nutrition Foundation (GCNF). There is a critical need to consider how the voice of the Pacific Islands can be raised in global dialogues and activities. Alongside this body of work, and recognising the need for a mechanism to connect, collaborate and share experiences, the Pacific School Food Network (PSFN) was formed in late 2019 with a vision to 'improve the health of Pacific Island children, their families and their communities through healthier school food and nutrition environments'<sup>(12)</sup>. The PSFN aims to provide a 'regional coordinated and multisectoral approach'<sup>(12)</sup> with a focus on 'policy, practice and action'<sup>(12)</sup>. The PSFN provides webinars and hosts a newly developed 'School Food Activities database'<sup>(58)</sup>. The PSFN also provides an opportunity to promote research opportunities for collaboration and networking for those interested in school food activities.

In conclusion, there is broad regional interest and momentum from numerous stakeholders to enhance SFNE in the Pacific Islands, with several opportunities for future activities. While there are frameworks to explore food environments available<sup>(59,60)</sup>, there is a need for a Pacific Islands school food environment conceptual framework that captures aspects, both within and around schools, that can guide research and assessment for robust comparable data collection. More research employing integrated and mixed methods to effectively assess SFNE, including lived experience work with students, parents, teachers, and the wider school community, using participatory photography, geo-spatial work with vendors around schools, in-depth interviews, and validated instruments is needed to explore the characteristics of, and success of SFNE activities in the region. With more robust data and evidence, which can then be used to advocate and lobby for policy change, there is a need for policy forums and stakeholder engagement to achieve policy change and address policy gaps. Finally, there is also an opportunity to build more awareness of

SFNE research, and capacity for both researchers and translation of research into practice, for example into school curricula.

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