



Impacts of COVID-19 on agriculture and food systems in Pacific Island countries (PICs): Evidence from communities in Fiji and Solomon Islands

Viliamu Iese^{a,*}, Morgan Wairiu^a, Gordon M. Hickey^b, David Ugalde^c, Diana Hinge Salili^a, John Walenenea Jr^a, Tammy Tabe^a, Milton Keremama^a, Chris Teva^a, Otto Navunicagi^a, Jioje Fesaitu^a, Robson Tigona^a, Deeksha Krishna^d, Hirdesh Sachan^d, Nigel Unwin^e, Cornelia Guell^f, Emily Haynes^f, Filipe Veisa^a, Linda Vaike^a, Zina Bird^a, Michael Ha'apio^a, Nasoni Roko^a, Soane Patolo^g, Annika Rose Dean^h, Sashi Kiranⁱ, Pitakia Tikai^j, Jowalesi Tuiloma^k, Siosiua Halavatau^l, Judith Francis^m, Alastair Christopher Ward^a

^a Pacific Centre for Environment and Sustainable Development, The University of the South Pacific, Fiji

^b McGill University, Canada

^c The University of Melbourne, Australia

^d Fiji National University, Fiji

^e European Centre for Environment and Human Health, University of Exeter; MRC Epidemiology Unit, University of Cambridge, United Kingdom

^f European Centre for Environment and Human Health, University of Exeter, United Kingdom

^g Mainstreaming of Rural Development Innovation Tonga Trust, Tonga

^h Unaffiliated, Australia

ⁱ Foundation for Rural Integrated Enterprises & Development, Fiji

^j Kastom Gaden Association, Solomon Islands

^k National Food and Nutrition Centre, Fiji

^l Unaffiliated, Tonga

^m Technical Centre for Agricultural and Rural Cooperation, The Netherlands

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ABSTRACT

CONTEXT: COVID-19 mitigation measures including border lockdowns, social distancing, de-urbanization and restricted movements have been enforced to reduce the risks of COVID-19 arriving and spreading across PICs. To reduce the negative impacts of COVID-19 mitigation measures, governments have put in place a number of interventions to sustain food and income security. Both mitigation measures and interventions have had a number of impacts on agricultural production, food systems and dietary diversity at the national and household levels.

OBJECTIVE: Our paper conducted an exploratory analysis of immediate impacts of both COVID-19 mitigation measures and interventions on households and communities in PICs. Our aim is to better understand the implications of COVID-19 for PICs and identify knowledge gaps requiring further research and policy attention.

METHODS: To understand the impacts of COVID-19 mitigation measures and interventions on food systems and diets in PICs, 13 communities were studied in Fiji and Solomon Islands in July-August 2020. In these communities, 46 focus group discussions were carried out and 425 households were interviewed. Insights were also derived from a series of online discussion sessions with local experts of Pacific Island food and agricultural systems in August and September 2020. To complement these discussions, an online search was conducted for available literature.

* Corresponding author at: The University of the South Pacific, Laucala Campus, Suva, Fiji.

E-mail addresses: viliamu.iese@usp.ac.fj (V. Iese), mwairiu@gmail.com (M. Wairiu), gordon.hickey@mcgill.ca (G.M. Hickey), david.ugalde@unimelb.edu.au (D. Ugalde), diana.salili@usp.ac.fj (D. Hinge Salili), john.walenenea@usp.ac.fj (J. Walenenea), tammy.tabe@usp.ac.fj (T. Tabe), robson.tigona@usp.ac.fj (R. Tigona), deeksha.krishna@fnu.ac.fj (D. Krishna), hirdesh.sachan@fnu.ac.fj (H. Sachan), nigel.unwin@mrc-epid.cam.ac.uk (N. Unwin), c.guell@exeter.ac.uk (C. Guell), e.c.haynes@exeter.ac.uk (E. Haynes), filipe.veisa@usp.ac.fj (F. Veisa), linda.vaike@usp.ac.fj (L. Vaike), haapio_m@usp.ac.fj (M. Ha'apio), nasoni.roko@usp.ac.fj (N. Roko), Soanejr@morditonga.to (S. Patolo), sashi@friendfiji.com (S. Kiran), halavatau@gmail.com (S. Halavatau), judithfrancis56@gmail.com (J. Francis), Christopher.ward@usp.ac.fj (A.C. Ward).

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RESULTS AND CONCLUSIONS: Identified impacts include: 1) Reduced agricultural production, food availability and incomes due to a decline in local markets and loss of access to international markets; 2) Increased social conflict such as land disputes, theft of high-value crops and livestock, and environmental degradation resulting from urban-rural migration; 3) Reduced availability of seedlings, planting materials, equipment and labour in urban areas; 4) Reinvigoration of traditional food systems and local food production; and 5) Re-emergence of cultural safety networks and values, such as barter systems. Households in rural and urban communities appear to have responded positively to COVID-19 by increasing food production from home gardens, particularly root crops, vegetables and fruits. However, the limited diversity of agricultural production and decreased household incomes are reducing the already low dietary diversity score that existed pre-COVID-19 for households.

SIGNIFICANCE: These findings have a number of implications for future policy and practice. Future interventions would benefit from being more inclusive of diverse partners, focusing on strengthening cultural and communal values, and taking a systemic and long-term perspective. COVID-19 has provided an opportunity to strengthen traditional food systems and re-evaluate, re-imagine and re-localize agricultural production strategies and approaches in PICs.

1. Introduction

Coronavirus (COVID-19) was declared a pandemic by the World Health Organization (WHO) on March 11, 2020. French Polynesia confirmed their first case the next day, while Fiji's first case was identified eight days later. Pacific Islands' authorities feared that the rise of COVID-19 cases in key trading partner countries, together with continued tourism, would provide an unacceptable risk of the spread of COVID-19 to Pacific Island Countries (PICs) – overwhelming limited health, water, sanitation and financial resources (Filho et al., 2020). Pacific Island governments responded by closing down borders and put in place rules to limit the introduction and spread of COVID-19 in PICs. To illustrate, in Fiji, borders were closed and lockdown was imposed in Lautoka in the Western Division on 20 March 2020 and in Suva in the Central Division¹ on 03 April 2020. Curfew hours were implemented, and all schools were closed. The crisis led to the closure of 93% of Fiji's tourism industry from late March and loss of approximately 115,000 jobs. In other PICs, even with no cases of COVID-19, mitigation measures (border lockdowns, social distancing, and restricted movements (travel for agricultural activities was allowed) had imposed several consequences. For the rest of this paper, interventions by governments to reduce the risk of COVID-19 introduction and spreading in PICs will be referred to as COVID-19 mitigation measures.

For the Solomon Islands, the government declared a state of public emergency (SoPE) on 27 March 2020. Following the SoPE, local repatriation announcements resulted in the majority of residents in Honiara (the capital city of the Solomon Islands) returning to their respective provinces during the period from March to April. The government had organized mock lockdown and curfews in Honiara on two separate occasions (10–11 April and 20–22 May 2020) and the greater Honiara area was declared a “hot zone”. While border lockdown and travel restrictions in towns and to the provinces remained in effect, the tourism sector, the commercial sector (both domestic and international) and local markets continued to be negatively impacted. The majority of employees were laid off, which impacted the livelihoods and wellbeing of households. The loss and reduced income increased hardships, poverty and food insecurity in PICs. It is clear that COVID-19 has exacerbated (and still is exacerbating) many of the pre-existing challenges in PICs, such as declining agricultural production and increasing hunger and malnutrition.

Although agricultural production is declining in the last decade, it still remains an important sector supporting livelihoods, income and food security of Pacific Island people. About 90% of farmers are small-holder subsistence to semi-commercial farmers. The remaining 10% are commercial farmers, who contribute to export revenue and provide

employment for Pacific Islanders (Iese et al., 2020a; Sisifa et al., 2016). Agriculture contributes directly or indirectly to the income and food security of about 80% of Pacific Islands households (Allen, 2015; Haynes et al., 2020a; Iese et al., 2018, 2020a). Agricultural production investments and the contribution to GDP from the agriculture sector have been declining in the last decade in PICs. The decline of agricultural production has been attributed to a combination of loss of soil fertility, increasing pests and diseases, limited available land and the impacts of climate change and climate variability (Bourke et al., 2009; Sisifa et al., 2016).

There is an increasing reliance on food imports, and a decline in consumption of locally produced foods in PICs. For example, the contribution of imports to consumed food rose between 1990 and 2011 from less than 45% to 60% in PICs (Iese et al., 2020b). The reliance on imported and processed foods is worse in atoll nations (more than 80% of daily household meals) and urban populations (more than 60% of daily household meals) (Iese et al., 2018, 2020a; Sisifa et al., 2016). Poor dietary diversity, low consumption of fruits and vegetables, and an increasing reliance on relatively inexpensive, processed and imported foods high in fat, salt and sugar, are linked to the triple burden of malnutrition. Under-nutrition, overweight and obesity and micro-nutrient deficiencies, are challenging food and nutrition systems in PICs (Iese et al., 2020b). Declining agricultural production, high demand for processed and imported foods, high rates of non-communicable diseases, and impacts of climate change and natural hazards existed before COVID-19. COVID-19 adds to, and magnifies, pre-existing vulnerabilities in PICs (McGregor and Sheehy, 2020; Sherzad, 2020; Wairiu et al., 2020a; Wairiu et al., 2020b).

To address the impacts of COVID-19 mitigation measures on the economies of PICs and to support household food security, national governments have relied on a range of instruments, including adjusted national budgets, emergency funds, international aid and loans from development partners to fund stimulus packages. In this paper, we will refer to national responses to reduce the impacts of the COVID-19 mitigation measures described above as COVID-19 interventions. These have broadly aimed to: 1) increase production of local foods (as it was projected that border lockdowns and loss of income might increase food insecurity because people would struggle to afford imported and processed foods); 2) support people who lose their income through job losses and closure of markets and reduced demand/purchasing power. We present in this paper, the results of an exploratory analysis of the immediate impacts of COVID-19 mitigation measures and COVID-19 interventions on agricultural production and food systems across PICs. We then focus on the household-level impacts in peri-urban and rural households in Fiji and Solomon Islands to assess the immediate impacts of subsequent COVID-19 interventions on agricultural production, food systems and dietary diversity. Our aim is to better understand the implications of COVID-19 for PICs and identify knowledge gaps requiring further research and policy attention.

¹ Fiji is divided into four administrative divisions. The four divisions are made up of 14 provinces (excluding Rotuma). Western and Central Divisions are the largest divisions in Fiji.

2. Methods

2.1. Impacts of COVID-19 mitigation and intervention measures on agricultural production

The observed impacts of COVID-19 mitigation and intervention measures were derived from a series of online discussion workshop sessions with local experts of Pacific Island food and agricultural systems (including authors of this paper), in the last week of August and first week of September 2020. To complement these discussions, an online search was conducted for available literature (online journals and websites of Pacific Island governments, NGOs, regional organizations and international organizations; newspapers and press briefings) on the impacts of COVID-19 mitigation measures and interventions designed to reduce the impacts in PICs. The observed impacts were then categorized into impacts on agricultural production and impacts on markets and value chains.

2.2. Impacts of COVID-19 on communities and households

To more specifically understand the impacts of COVID-19 mitigation and intervention measures on peri-urban and rural households in PICs, 13 communities were studied in Fiji and Solomon Islands (Table 1) in July–August 2020. Nine communities were studied in Fiji, five from the Western Division (two informal communities² and three formal villages³) and four from the Central Division (two formal and two informal communities). Both divisions experienced lockdowns early in the COVID-19 pandemic and although total lockdowns have been lifted since May 2020, border lockdowns, night time curfews, and social distancing remain in force as of September 2020. Four communities (two peri-urban and two rural) were also studied in Solomon Islands. These communities are located close to Honiara City, which practiced two mock total lockdowns only (April 10–11, 2020 and May 20–22, 2020) in preparations for any confirmation of COVID-19 cases. Although

restricted movements have been eased in the central city area in the Solomon Islands, border lockdowns are still enforced as of September 2020.

2.3. Mapping the change of household food systems in communities in Fiji and Solomon Islands

A total of 30 focus group discussions (FGD) in Fiji and 16 FGD in the Solomon Islands were conducted to understand the impacts of COVID-19 on food systems in peri-urban and rural communities in the studied countries (Table 1). The Community Food and Health Focus Group guide (Guell et al., 2020) was modified and questions asked were based on households' food habits, preferences and food sources before and during COVID-19. Focus group discussions were conducted in local languages by two facilitators. The first facilitator asked the questions and led discussions and the second facilitator controlled the recordings and drew diagrams of food systems based on participants' responses. Transcripts were translated and analyzed using the Dedoose software (www.dedoose.com). Ethics approval for the application of the Community Food and Health tools and protocols was given by the University of the South Pacific Ethics Committee during the CFaH project.

2.4. Analysis of food production, and dietary diversity

A total of 339 households were interviewed in selected communities in Fiji and 86 households interviewed in Solomon Islands between 20 and 31 July 2020 (details of communities in Table 1). Households were randomly selected by local research partners and a representative of each household was interviewed. Representatives were > 15 yrs., and were chosen on the basis of contributing to household food production and preparation. The 24-h recall and food sources questionnaires were modified versions of the Community Food and Health Project⁴ quantitative tool (Haynes et al., 2020a). Questionnaires were loaded on Kobotoolbox (<https://www.kobotoolbox.org>) survey tool on tablets and

Table 1

Number of households interviewed during quantitative assessments and number of participants in each focus group from studied communities in Fiji and Solomon Islands.

Communities	Quantitative sampling			Qualitative focus groups			
	Total number of households	Total number of households surveyed	% coverage	Adult male	Adult female	Youth male	Youth female
Fijian communities							
Kalabu (CD) ^{PUF}	55	33	60	5	5	5	5
Muanikoso (CD) ^{PUF}	72	45	62.5	3	9	5	6
Molituva (CD) ^{RF}	47	33	70.2	5	5	4	7
Vusuya (CD) ^{RI}	110	70	63.6	3	3	4	3
Vakabuli (WD) ^{RF}	90	47	52.2	8	5	5	5
Matawalu (WD) ^{RF}	70	54	77.1	4	13	5	5
Naviyago (WD) ^{PUF}	50	29	58	5	8	5	–
Civicivi (WD) ^{PUF}	20	11	55	–	3	–	–
Bila (WD) ^{PUF}	21	17	81	5	–	–	3
Total	535	339	63.3%	38	51	33	34
Solomon Islands communities							
Burnscreek ^(PUF)	342	23	6.7	8	6	5	4
Barana ^(PUF)	106	24	22.6	5	6	5	5
Ngalimbiu ^(RF)	168	20	11.9	7	7	7	4
Panatina ^(RF)	104	19	18.2	7	5	2	8
Total	720	86	14.9%	27	24	19	21

(CD) – Central Division; (WD) – Western Division; PUF – Peri-urban formal village (Formal implies villages or communities that are traditionally governed, mostly indigenous population and are land owners); Peri-urban informal settlement (informal settlement implies lease holders or squatters); RF – Rural Formal village; RI – Rural informal settlement. Italicized communities are from Solomon Islands.

² Informal communities are communities made up of households who either lease or “squat” on lands they do not own.

³ Formal communities/villages are communities that own lands and are governed by the traditional village systems. These communities are mostly made up of indigenous populations.

⁴ <https://gtr.ukri.org/projects?ref=MR%2FP025250%2F1>

were administered by a trained enumerator at selected households. Food sources data were analyzed for each community to show the percentage of households producing different food groups.

Dietary diversity score (DDS) was calculated using R version 4.0.2. in line with guidance developed by the United Nations Food and Agriculture Organization (FAO) and USAID's Food and Nutrition Technical Assistance III Project (FANTA) (FAO and FHI 360, 2016), and defined as the number of standard food groups (of a possible 10) consumed over a 24-h recall reference period. Foods that were consumed in amounts less than 15 g were not included in the DDS. The scoring range of DDS was from 1 to 10. A household received one point if the respondent consumed at least 15 g from a unique food group in the past 24-h. A chi-square test of independence was performed to explore the relationship between DDS and food groups produced or purchased by each household.

3. Results

3.1. Immediate impacts of COVID-19 mitigation measures in PICs agriculture production

Information provided in sections 3.1–3.4 comes from interviews and discussions with agriculture experts unless otherwise stated or referenced. The impacts of COVID-19 mitigation measures on agriculture and households in PICs have mostly been negative (see observed impacts in Text Box 1). Communities have experienced loss of employment, markets and reduced purchasing power. Impacts of Tropical Cyclone (TC) Harold in April 2020, which destroyed crops and killed livestock in Tonga, Solomon Islands, Vanuatu and Fiji, increased hardships for households in the affected countries.

The lockdowns of urban areas have forced people with no employment to return to their villages and engage in agricultural activities. This has increased the availability of labour for farming. These new arrivals in rural areas have also increased the challenges of access to limited resources such as water and food, leading to disputes amongst relatives and other community members. Such disputes arise mainly around newcomers' access to land and clearing of forests unsustainably to increase cultivation of root crops and vegetables. Moreover, there has been a sharp increase in larceny, particularly theft of high-end products such as kava, fruits and livestock in communities. As a result, the deurbanization process is increasing agricultural production generally because of the contribution of new farmers, but also having negative impacts on old farmers in the village. Theft has caused loss of production, income and food, and discouraged farmers to plant crops and raise livestock for fear of wasted time and financial investment.

As the immediate demand for local foods has increased, farming and fishing equipment for households has become limited in supply. Demand for land has increased significantly, especially for urban and informal dwellers to plant root crops such as sweet potato, taro, cassava and fruit trees. However, unsustainable intensive cultivation is a major concern, with the potential to cause long-term soil infertility, thereby reducing agricultural production in the future. Households are also experiencing shortages of planting materials especially vegetables, non-seeds, crops, fruit trees and/or labour. This is because governments and development partners have purchased all seedlings and seeds for disaster response and recovery operations (both in response to COVID-19 and TC Harold). There has been an increase in available labour in rural areas because community members have returned from urban areas and also seasonal workers have been repatriated from Australia and New Zealand, but this has benefited only some households and commercial farmers who have the resources to hire extra labourers. Unfortunately, labour for farming and fishing is most needed for resource-poor single parents, elderly households and people living in urban informal communities. People with good access to land, planting materials and labour have experienced an increase in agricultural production. In contrast, for households unable to access land, planting materials and labour due to loss of

markets, agricultural production remains the same as before COVID-19 or has reduced, which has reduced access to foods and income. COVID-19 mitigation measures have therefore negatively impacted agricultural production and reduced income and food.

3.2. Immediate impacts of COVID-19 on agricultural markets, value chains and income

Lockdowns have decreased access to markets and disrupted the transportation of produce between rural and urban areas or between islands (Text Box 2). Recent assessments and surveys (McGregor and Sheehy, 2020; Wairiu et al., 2020a; Wairiu et al., 2020b) reported loss of markets and reduced purchasing power, and found that local farmers are suffering the double impacts of TC Harold and COVID-19 mitigation measures. Farmers are reducing the prices of vegetables and fruits in response to lowered demand arising from most households now owning a home garden and few people being able to afford to purchase foods from markets because of loss of income.

Consequently, there is very high food loss and wastage along agricultural value chains in PICs (McGregor and Sheehy, 2020; Sherzad, 2020). The lack of storage and processing facilities prior to COVID-19 has not helped farmers and countries to cope with excess supply of vegetables, root crops and fish that were produced for markets. In response, farmers and fishers are not farming or fishing at commercial scales of production. This reduced production of commercial crops, livestock and fish further reduces income and food supply.

Variations in prices of root crops, vegetables, fruits and kava have been observed in PICs (McGregor and Sheehy, 2020). The COVID-19 mitigation measures have negatively affected the arrival of tourists and stopped the demand for higher-end produce such as fruits, livestock, vegetables, spices and virgin coconut oil. For example, one supplier of pineapples in Fiji, who used to supply around 45–50 t annually to hotels, is now redirecting to local markets because of the closure of tourism markets. Instead of a farm gate price of FJD1.50 (USD0.71) per pineapple before COVID-19, the average price is now FJD0.75 (USD0.35) (McGregor and Sheehy, 2020). Furthermore, COVID-19 mitigation measures have reduced social gatherings and communal cultural and religious ceremonies that are normal in indigenous communities in PICs. For example, McGregor and Sheehy (2020) reported that restrictions on public gatherings such as weddings, traditional chiefly title bestowal, and annual church meetings in Samoa have reduced sales of eggs for one commercial producer by 63% because of reduced value and demand - an estimated loss of around SAT50,000 (USD19,200) per week. Reduced income is affecting people's ability to purchase foods and meet financial obligations such as paying bills, loans, and contributing to religious and cultural activities.

3.3. COVID-19 government interventions

Pacific Island governments have mobilised resources to address the impacts of TC Harold and COVID-19 (details in Text Box 1 and 2). Governments and local partners have invested in increasing the supply and distribution of seedlings, home garden tools and information to increase cultivation of early maturing root crops, vegetables, fruits and ornamentals (details of some interventions are in Text Box 1 and 2). An average of 22% of PICs' COVID-19 stimulus packages was spent on interventions to strengthen social safety nets (including support for home gardening) and 9% was spent directly on food security interventions (Howes and Surandiran, 2020). This is significant given that PICs generally spent less than 5% of their annual national budgets on agriculture prior to COVID-19 (Iese et al., 2020a). Distributing seedlings is a common disaster emergency response in PICs, especially after extreme events such as cyclones, floods and droughts (Iese et al., 2018). In these times, fast growing crops such as vegetables and sweet potato are distributed so that households can have access to foods as fast as possible. There is minimal distribution of livestock resources through

Box 1

Observed Impacts and interventions for subsistence and semi-commercial production.

Impacts on subsistence and semi-commercial production (as of September 2020)

- ❖ Lack of access to land for farming for urban and informal communities – **Reduced production, income and food**
- ❖ More people moving to rural areas has increased pressure on limited water supplies and local resources. New arrivals from urban areas have increased land disputes, theft of high value crops, fruits and livestock. “New farmers” practice unsustainable cropping systems – **Short and long term reduced production, income and food**
- ❖ Limited supply of planting materials especially vegetables, non-seed crops and fruit trees; no supply of livestock feed and breeding stock – **Decreased production, income and food**
- ❖ Intensive cultivation of land to increase production in a short period of time will cause a decline in soil fertility. Increase cutting down of forests for increasing farming and production – **Long term decrease of production**
- ❖ Lack of access to fertilizers and chemicals – **Reduced production, income and food**
- ❖ Not enough farming equipment and fishing gear and less labour – **Reduced production, income and food**
- ❖ Impacts of cyclones, floods, droughts – Fiji, Tonga, Vanuatu and Solomon Islands have suffered devastating impacts of TC Harold in April. Agricultural response activities are targeted at COVID-19 and TC Harold. Meteorological droughts are observed (May-September 2020) in central-western South Pacific countries. Cyclone season starts from October (2020) – April (2021) – **Reduced production, income and food**

Examples of opportunities and Interventions (as of September 2020)

- ❖ Communal farming, land sharing and arrangements from government, church, cluster farmers. For example, Mainstreaming of Rural Development and Innovation Tonga Trust (MORDI TT) NGO through Tonga Rural Innovation Project (TRIP) 2 is facilitating cluster-farming activities involving women farmers.
 - ❖ Increase in labour for farming but need resource management, water use efficiency. NGOs are conducting training for farmers and distributing farming tools and seedlings. E.g. MORDI TT in Tonga, Foundation for Rural Integrated Enterprises (FRIEND) in Fiji and Kastom Gaden Association (KGA) in Solomon Islands.
 - ❖ Increase in nurseries and skills in how to cultivate seeds/seedlings and increase home gardens.
Fiji: The Ministry of Agriculture’s Home Gardening Program provides gardening seed packages to all households in urban and peri-urban areas. The **Corporate Employee Seed Package (CESP)** provides planting materials for corporate employees who lost their jobs. **The Farm Support Package** provides planting materials and open-pollinated seeds to farmers around Fiji at no cost. One million Fijian dollars (around US\$ 452 thousand) was allocated for this latter initiative with aims to boost production of fast maturing crops (FAO, 2020; Ministry of Agriculture, 2020).
 - ❖ Cultural practices of sharing labour and helping each other, for example, *na solesolevaki* (communal support) in Fiji and the barter system (Wairiu et al., 2020a; Wairiu et al., 2020b).
 - ❖ **Tonga:** To increase local food production, TOP 3.2 million (US\$ 1.36 million) was allocated to the ministries managing agriculture and fisheries. MAFF targeted production and distribution of two weeks old 30,000 broilers and 6500 layers, sheep, goats and pigs (Tonga Broadcasting Corporation, 2020).
 - ❖ MORDI TT is widely distributing different varieties of vegetables, fruit tree seedlings and root crops in all islands.
 - ❖ Promote organic, use of composting and Integrated Pest Management. FAO is supporting Farmers Field Schools to learn composting and IPM skills in Tonga. Other NGOs are supporting farmers to promote organic and soil management practices.
 - ❖ **Vanuatu:** Department of Agriculture and Rural Development (DARD) introduced a “COVID-19 Food Security Response Plan” which prioritizes promoting backyard gardening (MALFFB, 2020).
 - ❖ The Fisheries Department is promoting backyard fish farms in an effort to respond to COVID-19. Fisheries Department made free Tilapia fingerlings and feed available to the public in Port Vila and Santo (MALFFB, 2020).
 - ❖ **Solomon Islands:** Ministry of Agriculture and Lands, The Kastom Gaden Association and Solomon Tobacco Company Limited have taken the initiative in the past five months to support the distribution of seeds to urban, peri urban and rural communities in the Solomon Islands (Sherzad, 2020).
 - ❖ The SID 2.7 million (US\$ 331 thousand) Solomon Islands government funding programme towards SAPE Farm Project (May 2020) has supported the farm in terms of farming machineries and tools (Sunday Isles, 2020).
 - ❖ Under the preparedness for response to COVID-19 the Ministry of Agriculture and Livestock (MAL) signed a contract with SAPE Farmers Group requiring that the SAPE Farmers Group cultivate Cassava on 40 ha of land to increase local food production and guarantee food supply for Honiara city (Sherzad, 2020).
 - ❖ **Samoa:** WST 1 million or US\$ 360 thousand (of US\$ 1.26 million) was allocated to increase local food production. Ministry of Agriculture and Fisheries (MAF) purchased seeds of short cycle crops [fruits, vegetables, etc.] and distributed these to families. A partnership between MAF and the Ministry of Women, Community and Social Development (MWCSO) also distributed planting materials [cassava, sweet potato and taro] in an effort to increase food production (Sherzad, 2020).
 - ❖ **Tuvalu:** The government is supporting home gardens through providing seedlings. The government is also fast-tracking existing agriculture projects in the capital and the outer islands.
 - ❖ The government has encouraged landowners and producers to practice customary food stockpiling techniques, including drying fish and root crops, preserving breadfruit, and storing coconuts. Local communities and chiefs were encouraged to organize community-based stockpiling and rationing (Devpolicy, 2020).
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Box 2

Observed Impacts and interventions on markets and value chains.

Observed Impacts on markets and value chains (as of September 2020)

- ❖ Fewer markets – **Reduced income and food**
- ❖ Increase in food losses and food waste due to overproduction and pests and diseases – High food losses and wastage discourage farmers and therefore **reduced production, income and food**
- ❖ Fewer storage and processing facilities – **Reduced production, income and food**
- ❖ Decrease in purchasing power – **Reduced production, income and food**
- ❖ Poor transportation to local and overseas markets due to deteriorating access roads with government funding redirected to COVID-19 mitigation measures. **Reduced production, income and food**
- ❖ Lower prices because most households are producing the same products. **Reduced income for households and no incentive for increasing production**
- ❖ Reduced demand for livestock such as pigs and beef cattle. Lockdowns and bans on social gatherings and cultural practices reduce demand for livestock. Also, demand for top-end livestock from the tourism sector has stopped. **Reduced production, income and food**
- ❖ Reduction of prices of root crops such as cassava and taro at markets such as in Suva, Fiji (although there is an increase in prices of root crops on the western side of Fiji – an area that was not affected by TC Harold). An increase of vegetable growing areas and abundant supply of fast maturing vegetables in June led to a sharp fall of prices in market places. **Reduced production and income**
- ❖ Increased vulnerability to impacts of cyclones, floods, droughts on produce and value chains – **Reduced income and food.**

Examples of opportunities and Interventions to increase cash flow and support informal economies (as of September 2020)

- ❖ **Solomon Islands:** To increase access and supply of fresh food, SBD 1.2 million (around US\$ 144 thousand) was allocated to the Honiara City Council to rehabilitate Kukum market (Sherzad, 2020)
 - ❖ For tourism operators, a five-year tax holiday has been approved. Loan holidays and US\$ 8.5 million worth of subsidies for copra and cocoa export products were approved under the stimulus package (Radio New Zealand, 2020a).
 - ❖ **Tonga:** The Economic & Social Recovery Cluster (ESRC) received TOP 22.4 million (US\$ 9.35 million) to support three types of business (Primary, Secondary and Tertiary). The ESRC also supports farmers and fishermen (Tonga Broadcasting Corporation, 2020).
 - ❖ **Vanuatu:** Measures taken to stimulate and manage the economy in Vanuatu include the cancellation of road and rent taxes and business license fees and charges effective from 1 April 2020 (Vanuatu Customs Inland Revenue Department, 2020).
 - ❖ **Fiji:** The Reserve Bank of Fiji (RBF) approved US\$ 26 million worth of loans to banks at an interest rate of 1% making it possible for banks to allow loans to small and medium businesses and customers at a maximum of 5%. Through the organization 'Business Assistance Fiji', micro, small and medium enterprises (MSME) will receive concessional and financial support, as part of the government's ongoing COVID-19 assistance (Government of Fiji, 2020; Radio New Zealand, 2020b).
 - ❖ Improve airfreight to overseas markets and invest in improving roads (Government of Fiji, 2020).
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these interventions. The emphasis of post-disaster interventions tends to be on immediate needs, but there is also a need to expand the focus of such interventions to ensure long-term sustainability and resilience of agriculture production, agriculture business continuity and food systems to address upcoming cyclone seasons, droughts and climate change.

Government COVID-19 interventions have prioritised increasing food markets, storage and processing facilities. Stimulus packages aim to support commercial farmers and ensure value chains are functional. Key strategies involve increasing local market chains to supply overseas markets through shipping and airfreight in order to increase household income (details in Text Box 2). There is an increase of supply to overseas markets using airfreight. Unfortunately, as of September 2020, local markets are not recovering quickly, with many households producing the same crops, reducing local demand for agricultural produce.

3.4. COVID-19 interventions by non-government organizations (NGOs) and cultural interventions

Interventions by non-government organizations and traditional communities are complementing the government interventions to reduce the impacts of COVID-19 mitigation measures on farmers and households (shown in Text Box 1). For example, NGOs such as FRIEND in Fiji, MORDI TT in Tonga, and KGA in Solomon Islands are implementing projects that support the distribution of seedlings, medicine, farm equipment; conducting training (cooking, food preservation, nutritional diets and reducing NCDs) with farmers and households, including women, men and youth. Religious organizations are providing

relief supplies to households in need. Churches are making their own land available for households without land and are mobilizing members to plant more food crops. Traditions and cultures of communal support and sharing have been revived and strongly applied in PICs. For example, in Fiji, the practice of *na solesolevaki* or the spirit of working together and looking after each other has emerged strongly. Households share farming tools, lands and produce from farms to support each other. The barter system, which is a common traditional practice in PICs, has been revived during COVID-19. For example, the facebook based Barter for Better Fiji initiative was started (<https://www.facebook.com/group/s/2964591663604507/>), whereby facebook administrators facilitated barter exchanges between families such as fish for cassava, and root crops for processed foods such as noodles, canned fish and red meat. Services, skills and labour have also been exchanged between the members of households and communities. For example, the Tonga Rural Innovation Program 2 is encouraging and supporting the *toutu'u* practice of groups/clusters of farmers, including women groups in Tonga (MORDI TT CEO pers. comm).

3.5. Shifts in household food systems

Studied household food systems in Table 2 show a shift towards traditional foods as a response to COVID-19 mitigation measures.

In Fiji, households have increased the amount of food they get from home gardens, nearby rivers and the sea and wild harvests from forests. The quantity of fruits harvested remained the same because they are fruit trees grown in the wild and were in season during the field

Table 2

Food sources used by households before and during COVID-19 as reported by focus group participants from studied communities in Fiji and Solomon Islands.

Country/community	River	Village Store	Sea	Home Garden	Wild fruit trees	Family Plantations	Municipal Market	Supermarket
Fijian communities								
Molituva Village	↑	↓	↑	↑	↔	↑	↓	↔
Vusuya Settlement	↑	↓	N/A	↑	↔	↑	↓	↔
Vakabuli Village	↑	↓	N/A	↑	↔	↑	↓	↔
Matawalu Village	↑	↓	↑	↑	↔	↑	↓	↔
Civicivi Settlement.	↑	↓	N/A	↑	↔	↑	↓	↔
Kalabu Village	↑	↓	N/A	↑	↔	↑	↓	↔
Muanikoso Settlement	↑	↓	↑	↑	↔	↑	↓	↔
Naviyago Village	↑	↓	↑	↑	↔	↑	↓	↔
Bila Settlement	↑	↓	↑	↑	↔	↑	↓	↔
Solomon Islands communities								
Burnscreek	↑	↓	↔	↑	↔	↑	↓	↓
Barana	↑	↓	N/A	↑	↔	↑	↓	↓
Ngalimbiu	↑	↓	N/A	↑	↔	↑	↓	↓
Panatina	↑	↓	N/A	↑	↔	↑	↓	↓

↑ increased; ↓ decreased; ↔ no change; N/A not a source.

research. Households from informal settlements in the Western and Central Divisions are not relying on the sea because they do not have fishing rights and would need to purchase a license to catch fish. Vakabuli and Kalabu villages surveyed in Fiji are both inland communities, located away from the sea and therefore households from these villages are not active in fishing. All the communities who had no access to fishing before and during COVID-19 are shown as N/A in Table 2. Households have generally reduced the quantity of foods purchased from village stores and municipal markets away from the village because of low income during COVID-19. Households are purchasing cheaper products such as sugar, salt, rice, flour, noodles and oils from supermarkets. As one focus group participant described;

“Yes, the quantity of food sold has decreased as not a lot of people are buying compared to before” (FG_FJ06).

Solomon Islands communities are displaying a similar shift to traditional food systems during COVID-19 as reported in Fiji. However, due to the severe reduction of income from cascading impacts of COVID-19 mitigation measures and increases in the price of foods, households' food purchases are declining from village stores, markets and supermarkets. Households in both peri-urban and rural communities in Solomon Islands are experiencing difficulty accessing markets to sell produce during COVID-19. As the national government sent most city dwellers to their home provinces as a COVID-19 mitigation measure, market outlets were closed because sales were in decline. Focus groups of women shared that they could only travel once a week to the nearest market at the border of Honiara city. Before COVID-19, these women used to travel almost daily to sell their produce at the markets.

3.6. Increased household production

Studied households in both countries shared that agricultural production from home gardens and plantations has increased during COVID-19. TC Harold and COVID-19 national interventions, as explained in sections 3.3 and 3.4 above, are increasing the availability of vegetable seedlings and planting materials to households for early maturing root crops. Households have learned farming skills and have received farm equipment, chemicals and fertilizer support from NGOs, faith-based organizations and neighbours during COVID-19. As shown in Table 3, most households' agricultural activities involve producing root crops, tubers and plantains (75–100% of households in Fiji; 100% in both rural communities and 80% in Barana in Solomon Islands), vegetables (75–100% in Fiji; 90–100% in Solomon Islands) and fruits (40–60% in five rural communities and 10–30% in peri-urban communities in Fiji; about 75% in rural communities and 100% in Barana and

30% in Burnscreek settlement in Solomon Islands).

The Barana community in Solomon Islands owns a national park with many fruit trees, which is in contrast with Burnscreek who have access to limited land and fruit trees. Burnscreek is not producing many root crops and tubers because of the limited farmland they have access to. Some have to walk for seven miles to an allocated area of land to farm. Participants in the focus group discussions shared that they are increasing the sizes of their farms and are mostly planting the seedlings distributed from the Ministry of Agriculture and local partners. As a result, the increase in household agricultural production during COVID-19 is mainly comprised of root crops, vegetables and fruits.

The production of certain food groups by households was low before COVID-19 and remained so during this study period. The informal community Civicivi in Fiji is not producing root crops and tubers because they are Fijians of Indian descent, whose staple foods are rice and roti made from flour. They are also sugar cane farmers. Only 10–20% of households in Burnscreek and Naglimbiu in Solomon Islands and 25–60% of households in four communities in Fiji reported being involved in fishing activities. Three informal communities studied in Fiji were not involved in fishing activities. In both countries, few households were involved in growing pulses/legumes, cereals/grain-based foods, nuts and seeds. In Fiji, there were very few farmers producing livestock products such as dairy, eggs, unprocessed meat and processed meat. No households studied in Solomon Islands are producing livestock products such as eggs, dairy and processed meat.

3.7. Impacts on household dietary diversity

The mean DDS for Fiji was 3.86 in July–August 2020, which is lower than the 4.27 recorded in 2019 (Iese et al., 2020b) but close to 3.7 recorded in 2018 (Haynes et al., 2020a). The Central Division communities in this 2020 study was the core group for the 2018 study while the Western Division communities were studied in 2019 (Guell et al., 2020; Haynes et al., 2020b; Iese et al., 2020b). Women of reproductive age reported a mean DDS of 3.9 in 2020 compared to 4.2 in 2019 (Iese et al., 2020b). This means that during COVID-19, households in Fiji consumed an average of three to four different food types. There is a significant relationship between household food production of three food groups, namely, root crops and tubers, vegetables and fruits and DDS (highlighted in Table 3). There is also a significant relationship between households that purchased cereals and grains (especially rice) and DDS (highlighted in Table 3). There is no major difference between DDS of formal and informal or rural and peri-urban communities in Fiji. Households from the Western Division communities of Naviyago (a formal peri-urban community) and Bila (an informal community) recorded the lowest mean DDS of 3.1 and 3.8 respectively. The Central

Table 3

Percentage of households producing various food groups. The light grey highlighted percentages of food groups indicate significant relationships between what households produced and DDS according to the chi-square test. The dark grey highlighted percentages of the food group with significant relationship between purchase and DDS.

Communities	CG	W/cr	Puls	Nuts	Dairy	U/pm	Pmea	Fish	Eggs	Vege	Fruits
Fijian communities											
Bila	0	73	0	7	0	13	0	33	7	100	67
Civicivi	9	18	9	0	0	9	9	0	18	82	36
Kalabu	0	100	16	4	0	0	0	4	0	76	28
Matawalu	11	85	4	0	11	4	4	63	7	85	52
Molituva	5	91	18	0	0	0	0	18	0	86	32
Muanikoso	0	72	3	0	0	0	0	9	0	91	6
Naviyago	3	83	3	0	8	0	3	45	13	95	65
Vakabuli	6	91	3	9	0	0	3	41	3	88	47
Vusuya	4	77	14	2	4	4	4	4	4	92	37
Solomon Islands communities											
Barana	13	83	25	13	0	4	0	4	0	96	96
Burnscreek	0	61	0	4	0	4	0	22	0	100	44
Ngalimbiu	5	100	15	0	0	0	0	15	0	100	70
Panatina	5	100	11	32	5	16	0	0	0	100	74

CG - Cereal/grain based foods; W/cr - White roots, tubers and plantain; Puls – Pulses; Nuts – Nuts and seeds; U/pm – Unprocessed meat; Pmea – Processed meat; Vege – Vegetables; Italicized communities are from Solomon Islands.

CG - Cereal/grain based foods; W/cr - White roots, tubers and plantain; Puls – Pulses; Nuts – Nuts and seeds; U/pm – Unprocessed meat; Pmea – Processed meat; Vege – Vegetables; Italicized communities are from Solomon Islands.

Division community of Molituva, which is a rural formal community, recorded a mean DDS of 3.8 (Table 4).

For Solomon Islands, the mean DDS was 3.76 in 2020 compared to 4.28 in 2019 (Iese et al., 2020b). Women of reproductive age had a mean DDS of 3.76 in 2020 compared to 3.8 in 2019 (to interpret this information correctly, it is important to note that only households from Burnscreek community were included in the 2019 research). Like Fiji,

households in studied communities in the Solomon Islands consumed on average three to four food groups during the study. The chi-square test showed a significant relationship between production of root crops and tubers, vegetables and fruits and DDS. Purchase of rice (cereal and grains) was significantly related to DDS (as highlighted in Table 3). Burnscreek peri-urban informal settlement showed the lowest DDS compared to rural and peri-urban formal communities (shown in Table 4).

Table 4

Summary of dietary diversity score for Fijian and Solomon Islands communities.

Communities	Dietary diversity score Mean (SD) Range 0–10	Communities	Dietary diversity score Mean (SD) Range 0–10
Fiji whole sample	3.86 (1.58)	Solomon Islands whole sample	3.76 (1.22)
15–49 years (WRA*, n = 150)	3.9 (1.5)	15–49 years (WRA*, n = 43)	3.76 (1.36)
Bila	3.8 (1.6)	Barana	3.79 (0.97)
Civicivi	4.6 (1.1)	Burnscreek	3.56 (1.22)
Kalabu	4.0 (1.8)	Ngalimbiu	3.98 (1.09)
Matawalu	4.4 (1.7)	Panatina	3.74 (1.62)
Molituva	3.8 (1.2)		
Muanikoso	4.3 (1.1)		
Naviyago	3.1 (1.2)		
Vakabuli	4.1 (1.8)		
Vusuya	4.0 (1.4)		

* Women of reproductive age.

4. Discussion

This study has shown that households in both Fiji and Solomon Islands have been impacted by COVID-19 mitigation measures through loss of markets, incomes and livelihood. Households have experienced food losses, production losses, social-cultural impacts and hardships as direct consequences of early actions by Pacific Island governments to mitigate COVID-19 risks. Households have increased access to gardening materials and seedlings provided by national governments and development partners through COVID-19 interventions. This has led to increases in farm sizes and numbers, increased production of root crops, vegetables and availability of seasonal fruits. Households are consuming what they are producing and are purchasing fewer food items from shops and markets. Unfortunately, the dietary diversity of households appears to remain low. The shift to traditional food systems and revival of cultural practices such as barter systems, land and resource sharing between households, has helped households cope with

food and livelihood stresses.

4.1. Hardships at the household level

Household hardships and poverty existed in PICs before COVID-19 (World Bank Group, 2014). For communities that are mainly relying on agricultural production for food and income, and for households with members relying on low-paying jobs, COVID-19 has increased hardships. Evidence from households in formal, informal, rural and peri-urban households in Fiji and Solomon Islands showed that household involvement in sales of agricultural produce has declined. This decline has occurred because of inaccessible markets, low purchasing power, low prices and – in the case of Solomon Islands – fewer people in Honiara city because the government instructed urban dwellers to return to their rural villages/islands to reduce the risk of COVID-19 spreading quickly if it were to arrive in the Solomon Islands. One farmer from a focus group explained:

“Yesterday, I sent my wife to the market to sell our cabbage. We sell for \$10.00 and because of fear of wastage, we later reduced the price for \$5.00 but still we cannot sell them all. In the evening I saw the truck load of cabbage coming back unsold and I was disappointed. It is very disheartening for us farmers as we would have to meet the transport cost for nothing. It is a costly loss for us and all our effort. We really need a way to store our cabbage and avoid wastage in the future”.

Households feel the impacts of COVID-19 mitigation measures differently. The peri-urban informal community households that have relied heavily on urban market systems for their livelihoods are suffering more than most in rural areas. Peri-urban households used to purchase food products from markets or rural farmers and then re-sell them for a profit. This type of business is no longer viable during COVID-19. COVID-19 is increasing inequality in terms of access to income, resources and food for vulnerable groups in rural and urban environments. These results confirm previous research findings reported in other PICs (McGregor and Sheehy, 2020; Sherzad, 2020) and also in other regions of the world (Han et al., 2020; Martin et al., 2020; Sumner et al., 2020; The World Bank, 2020).

4.2. Strength of traditional systems and connectivity of island communities

The traditional and cultural systems in PICs have become more valuable than before COVID-19 in assisting households in need. The shift to traditional food systems has mainly benefited rural communities with access to land, rivers, sea and forests. For peri-urban settlements with limited land access, the cultural support systems of sharing land, barter systems and communal caring has assisted households to cope with the negative impacts of COVID-19. As one focus group member shared:

“In the village the spirit of working together has come out again strong, more solesolevaki where families look out for each other by farming together and supporting each other with the available resources from the farms. Fathers spend more hours as well in the farms now and are extending their farmlands as well” (FG_FJ04).

Connectedness of islands was identified both as a risk factor to the spread of COVID-19 and also a mitigation factor, especially for isolated and rarely visited places (Filho et al., 2020). However, connectivity represents the connectedness of people's relationships and systems in small Pacific Island communities – through communal living. The strong social safety net, including the cultural practice of sharing resources, has functioned to increase resilience in the face of climate change and disasters in PICs (ADB, 2010; Holland et al., 2018). These practices are also proving to be a key strength for households during COVID-19 times.

4.3. Increased production but decreased dietary diversity

A positive impact of the COVID-19 interventions on food security is the increased production of root crops, vegetables and fruits at the household level. Households are consuming more food from the garden than from shops. This change in pattern of production and consumption has long been the target of food security strategies and interventions in the region (FAO, 2018; Iese et al., 2020b). However, as the results of the dietary diversity survey show, households are consuming a lower diversity of foods during COVID-19 than before the pandemic. We recognise that the DDS was low before COVID-19 in both rural and urban populations in Fiji and Solomon Islands (Haynes et al., 2020b; Horsey et al., 2019; Iese et al., 2020b; O'Meara et al., 2019; Vogliano et al., 2021). However, it appears that COVID-19 impacts are further lowering dietary diversity. This is likely because households are only producing three to four different food groups. What households are producing reflects the resources being distributed by governments and partners as COVID-19 interventions. The production of many key food groups such as pulses/legumes, nuts, livestock products and fish is missing. Low DDSs also reflect that households are purchasing fewer foods from stores and markets such as unprocessed red meat, processed red meat, eggs, pulses and cereals and grains. The key interventions in PICs have, to date, been based on emergency response approaches designed to increase food availability, whether from local gardens and early maturing crops or through food aid – a response amplified by the compound effects of TC Harold and COVID-19. This short-term focus might increase the vulnerability of Pacific agricultural production and food systems to ongoing climate change and climatic extremes.

4.4. Implications for agriculture, food systems and SDGs in PICs

The identified impacts of COVID-19 measures and interventions in PICs at the national level, especially on households, offer three main messages for improving the planning of interventions. First, COVID-19 mitigation measures have exacerbated the pre-existing food and agriculture system challenges households face, such as low income, high reliance on food imports, low dietary diversity, low diversity of markets and heavy reliance on tourism and remittances (FAO, 2019; Farrell et al., 2020; McGregor and Sheehy, 2020; Sherzad, 2020). Future interventions would benefit from taking a more systemic and long-term perspective in order to avoid unintentional additional negative impacts on the fragile livelihoods, health, soil health, and ecosystems of PICs. Interventions have so far mainly focused on an “emergency response” approach; However, it is now time to shift to more integrated assessments and development of longer-term recovery and resilience-enhancing strategies in diverse communities.

Second, diversity is needed in all aspects of COVID-19 interventions. Diversity in partnerships including NGOs, local communities (farmers) in designing and implementing interventions to address impacts on agricultural production and food systems is critical. Working together based on cultural and communal values will be important. There is strength in partnership, as shown by sharing of land, foods, labour and resources at the community level. Increasing the diversity of interventions is also needed to target different purposes – increasing dietary diversity and nutrition to address hunger and malnutrition; increasing diversity of products for local and export markets to improve income and reduce poverty; diversification of agricultural production systems to include livestock, aquaculture and multi-cropping to improve resilience against pandemics as well as climatic and financial shocks.

Third, COVID-19 has provided an opportunity to strengthen traditional food systems and re-evaluate, re-imagine and re-localize agricultural production strategies and approaches in PICs. Many Pacific Islanders, especially youth, have forgotten about Pacific traditional farming and food systems. These systems are based on values of respect for nature and living in harmony with the environment. Traditional production systems rely on use of organic and conservation agriculture

techniques, agroforestry, climate smart agriculture and ridge to reef approaches to manage the limited resources available and accessible to households. This is an opportunity to strengthen food sovereignty of PICs and reduce the vulnerability of food systems to global climatic stresses, economic recessions and pandemics.

4.5. Knowledge gaps

As COVID-19 mitigation measures remain in place, PICs will need to be more proactive and plan for the longer-term impacts on agricultural production, food systems and livelihoods of households. There are knowledge gaps that need urgent research in order to provide further evidence of not only the impacts of COVID-19 measures, but also the effectiveness of COVID-19 interventions to improve livelihoods and food security of households in PICs. Such evidence is needed to support decision-making and to optimize the utilization and distribution of limited resources to improve agriculture production, food and nutritional security and income of households. Specifically, there is a need to understand the following:

- The impacts of COVID-19 mitigation measures and interventions on atoll islands and isolated rural communities. Atoll islands and nations such as Tuvalu, Kiribati and the Republic of the Marshall Islands are low-lying with poor soils, have limited tourism, and have high exposure to climate change and heavy reliance on food imports.
- How COVID-19 mitigation measures and interventions contribute to challenges for Pacific Islands to report and achieve SDGs. There is some evidence of increasing poverty, increasing food insecurity and hunger, declining access to water, and challenges to health and the environment. Redirecting national budgets, aid and loans away from sustainable development priorities to emergency response further complicates achievement of the SDGs.
- The contribution of COVID-19 to pre-existing vulnerabilities of Pacific Island communities to climate change and natural hazards. This knowledge will help build communities adaptive capacity against future climatic and pandemic impacts.
- The medium and long-term direct impacts of COVID-19 on agricultural production, food systems and cascading impacts on income, diets and nutrition, gender, social cohesion and sustainability of communities in PICs.
- Further monitoring of the income and food security status of households in urban, rural, formal, informal, island-level and isolated communities in all PICs to provide early warnings of household hunger and hardships and inform intervention design.

5. Conclusion

National COVID-19 mitigation measures have been effective so far in reducing the spread of COVID-19 in Fiji and PNG and preventing the arrival of COVID-19 in other PICs. Impacts on national economies and agricultural production, markets, food systems and socio-cultural processes have been experienced at the household level, increasing poverty and hardship. COVID-19 interventions from diverse partners, including government, NGOs, faith-based organizations, schools and local communities have proven useful to address the immediate impacts on agriculture and food systems in Solomon Islands and Fiji. Shifting to traditional food systems and utilising social protection safety nets has been valuable in the COVID-19 response. However, more monitoring is needed to understand both the immediate and long-term impacts of COVID-19 mitigation measures and interventions on agricultural production, food systems and livelihoods of diverse households in PICs. Such knowledge is required to inform strategic interventions that leverage the limited available resources at the national and household levels for maximum benefit and resilience.

Declaration of Competing Interest

I declare there is no conflict of interest in conducting the research and producing this paper.

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