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Stakeholders' vision and global goals for food systems in the Solomon Islands: identifying relevant indicators to track progress

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Research on food system framework development has increased substantially in recent years to better understand how we can best transform food systems. However, these frameworks generally take a one-size-fits-all approach, with food system indicators lacking relevance in many countries and territories. This research, centred on the Solomon Islands as a case study, employed a participatory approach involving stakeholders to identify context-specific indicators across three food systems pathways. These pathways, reflecting context-specific goals and a collective vision, encompassed strengthening and connecting rural food systems, enhancing the national policy environment, and advocating for food environments supporting healthy food accessibility, affordability, and convenience. The research identified a range of context-specific indicators and evaluated their alignment with existing data sources. Results underscored the need for data collection and analysis efforts to inform evidence-based decision-making. The study also emphasised the importance of engaging diverse stakeholders to ensure a comprehensive and representative set of indicators, aligning with regional and global efforts to advance food system resilience and sustainability. This research lays the foundation for future endeavours to enhance food system monitoring and assessment, acknowledging nuances and complexities specific to the Solomon Islands and similar contexts.

KEYWORDS

food system, framework, indicators, Pacific, data

1 Introduction

Food systems encompass food production, supply, and acquisition via the food environment (Fanzo et al., 2021). Food systems are under increasing pressure from economic, environmental and social crises, yet are key to meeting international targets such as the United Nations Sustainable Development Goals (SDGs; United Nations, 2015) and UN Convention on Biological Diversity (CBD; United Nations, 2022). Research on food system framework

development has increased substantially in recent years to better understand how we can best transform food systems to address the convergence of crises (including poor population health, cost of living, conflict, climate change) and to rise to future challenges. These frameworks generally outline a range of indicators including the influences (e.g., social), activities (e.g., production) and outcomes (e.g., human health, environmental sustainability, livelihoods) of food systems, and may be useful in characterising food systems, setting goals, tracking performance, identifying trade-offs and assessing the impacts of interventions. Recently, globally coordinated efforts, most notably The Food Systems Countdown to 2030 Initiative (FSCI; Schneider et al., 2023), the Sustainable Food System Country Profile project (Béné et al., 2022) and the Food Systems Dashboard (Fanzo et al., 2020), have developed frameworks and integrated data to support policymaking. The FSCI has identified a comprehensive set of indicators and relevant data across five themes including: diet, nutrition and health; environment and natural resources, and production; livelihoods, poverty and equity; governance; and resilience. Still, this initiative points towards insufficient data to establish local-to-global targets and drive progress towards desired outcomes in many countries and territories, including those in the Pacific region (Schneider et al., 2023). The Sustainable Food System Country Profile project has developed a common food system framework that can be adapted to inform decision-makers at national and sub-national levels (Béné et al., 2022). The feasibility of this framework was tested in Bangladesh, Ethiopia and Honduras and it is envisaged that this tool will be applied in the development of similar country profiles in a larger number of low- and middle-income countries (Béné et al., 2022).

Food systems in the Pacific are heterogeneous, cover a wide geographical area, and are extremely vulnerable to trade dynamics and climate change, limiting their ability to support healthy and sustainable diets (Andrew et al., 2022). Diet-related diseases in the Pacific are of major concern, with almost 3 out of every 4 deaths due to non-communicable diseases (World Health Organization, 2019). It is perhaps unsurprising that evidence indicates that Pacific Island Countries and Territories are not on track to end poverty and malnutrition by 2030 (FAO, 2021; FAO, IFAD, UNICEF, WFP and WHO, 2023). Given these challenges, and the rate at which they impact food systems and the health of Pacific populations, there is an urgent need for strengthening food systems in the region. However, the complex nature of food systems, relatively recent conceptualisation of the food system framework, and the limited and fragmented evidence, make it challenging to track food system performance and outcomes. Moreover, we posit that existing frameworks and indicators may not be relevant for the Pacific context for a number of reasons. Firstly, tracking particular indicators such as greenhouse gas emissions may be problematic, as it may imply that the relevant country or territory is responsible for, and has the capacity to, address emissions. This is especially pertinent in the Pacific given the region contributes to less than 0.03% of the world's greenhouse gas emissions [United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), 2022]. Secondly, current characterisations of food system activities such as sourcing foods from retail supermarkets and related value chains, are not as prominent in some Pacific food environments where consumers predominantly rely on cultivated or wild food sources, in particular for healthy food commodities such as fruit and vegetables (Bogard et al., 2021). Finally, a 'one-size-fits-all' global food

systems approach tracking a 'shopping' list (Béné et al., 2019b) of indicators with unclear relevance to many food systems, ignores the aspirations of those who live and interact with, and are impacted by, their relevant food systems every day. Moreover, it overlooks the perspectives of key in-country stakeholders such as government decision-makers who can help shape and drive food system transformation. There is a need to develop indicators that are context-specific to ensure that performance tracking, identification of trade-offs and strategies to support food system strengthening are relevant and realistic. This will require participatory approaches to ensure deeper legitimacy, ownership and accountability among stakeholders (Karlsson et al., 2018).

As part of a research-for-development project which conducted an integrated agri-food system analyses for the Pacific region (Australian Centre for International Agricultural Research, 2019), stakeholders from the Solomon Islands were asked to identify key pathways and recommended actions to support the strengthening of their agri-food systems (Farmery et al., 2023). The UN Food Systems Summit dialogues (United Nations, 2021) and regional directions articulated by the Pacific Community (The Pacific Community, 2023) also informed the development of these pathways and actions. It was acknowledged by stakeholders that the pathways recognise areas of strength already supported and that do not necessarily require transformation but strengthening to continue any positive trajectory. The three key pathways identified were: (1) Strengthen and connect rural food systems; (2) Strengthen the national policy environment; and (3) Advocate for food environments supporting healthy food accessibility, affordability and convenience. The Solomon Islands consists of over 900 islands which range in size and elevation (Nunn et al., 2016). Its food system is characterised by predominantly rural and traditional food systems, consisting mostly of small-scale farmers and fishers (Farmery et al., 2023). As current frameworks may not accurately reflect such food systems, the Solomon Islands is an example of where there may be a need to develop a more context-specific and relevant framework. The pathways and actions identified by the participatory process above provides a valuable framework to support the identification of relevant indicators which can be used to track progress towards context-specific goals and a collective vision, and move beyond current efforts which attempt to diagnose and characterise food systems.

This current research aimed to work with the stakeholders involved in the integrated food systems project (Australian Centre for International Agricultural Research, 2019) to identify a range of existing and potential indicators, which could be collected consistently through time to enable decision-makers to pragmatically track food system progress along pathways and towards relevant SDGs and CBD targets. This participatory process sought to identify: (1) nuances in relation to developing context-specific indicators; (2) existing available data; and (3) opportunities to support more targeted data collection efforts.

2 Methods

2.1 Data collection

2.1.1 Phase 1

Guided by the key pathways and actions identified as part of the integrated food systems project (Australian Centre for International

Agricultural Research, 2019), and consideration of existing structures and mechanisms (Farmery et al., 2023), a project team of food system experts involved in the agri-food system analyses, identified indicators from a range of sources that could be used in the Solomon Island context and mapped to the most relevant pathway (Dignan et al., 2004; Solomon Islands National Statistics Office, 2017; Solomon Islands Government, 2019; Brewer et al., 2021; Ministry of Finance and Treasury, 2023; Solomon Islands Government, 2023a; Solomon Islands Government, 2023b). Information on coverage level (i.e., national/provincial), data sources and data collection frequency was also collected. Indicators that could be utilised in monitoring progress towards the SDGs and the CBD targets were also identified (United Nations, 2015; United Nations, 2022). While the primary aim of this research was to identify context-specific indicators which could be used to track progress towards context-specific goals and a collective vision, indicators were also mapped to food system components in the commonly adapted framework developed by the High Level Panel of Experts on Food Security and Nutrition (2017). This process of data collection occurred over numerous discussions held among the project team between April and November 2022.

2.1.2 Phase 2

The next steps involved taking a participatory approach in seeking input from relevant stakeholders. Feedback on the identified indicators was sought from three regional food system experts via online consultations, before seeking further feedback from country stakeholders at a one-day workshop held in Honiara, Solomon Islands (March 2023). The workshop was attended by representatives from the national government [health ($n=3$), agriculture and livestock ($n=1$)], academia ($n=4$), the private sector ($n=3$) and a non-government organisation ($n=1$), with more female ($n=8$) than male ($n=4$) participants. The workshop participants were assigned into one of three groups, ensuring a mix of sectors across groups. Each of these groups represented one pathway. Following a presentation of the pathways, the groups identified indicators that they felt could be valuable in supporting the tracking of progress along each pathway. This activity was not guided by the indicators already identified in Phase 1, however where time permitted, some workshop participants could refer to these towards the end of the workshop to provide further feedback.

2.2 Data analysis

Following the workshop, the indicators identified were then compared to those indicators identified by the project team to identify synergies and differences. The indicators selected by the project team were assigned a number, with similar indicators identified by workshop participants assigned the same number. Indicators identified only by the workshop participants were assigned a new number. A set of agreed inclusion criteria identified in the relevant literature guided the selection of indicators (Table 1; Melesse et al., 2020; Fanzo et al., 2021). Indicators that met these criteria were then circulated to relevant stakeholders, including those who could not partake in the workshop, to seek further feedback. Indicators which were considered relevant by the project team and/or the workshop participants, however did not meet all selection criteria, were captured separately (Supplementary Material).

TABLE 1 Selection criteria for indicators.

Criterion	Definition
Relevant	Measures something related to the pathways and/or actions and during various time periods. Relevant for the Solomon Island context.
Measurable	Can be measured.
Interpretable	Comparable across time and easily communicated.
Available/achievable	Within reach of key stakeholders.
Clear, high-quality methodology	Details on methodology available, rigorous methodologies, representative.

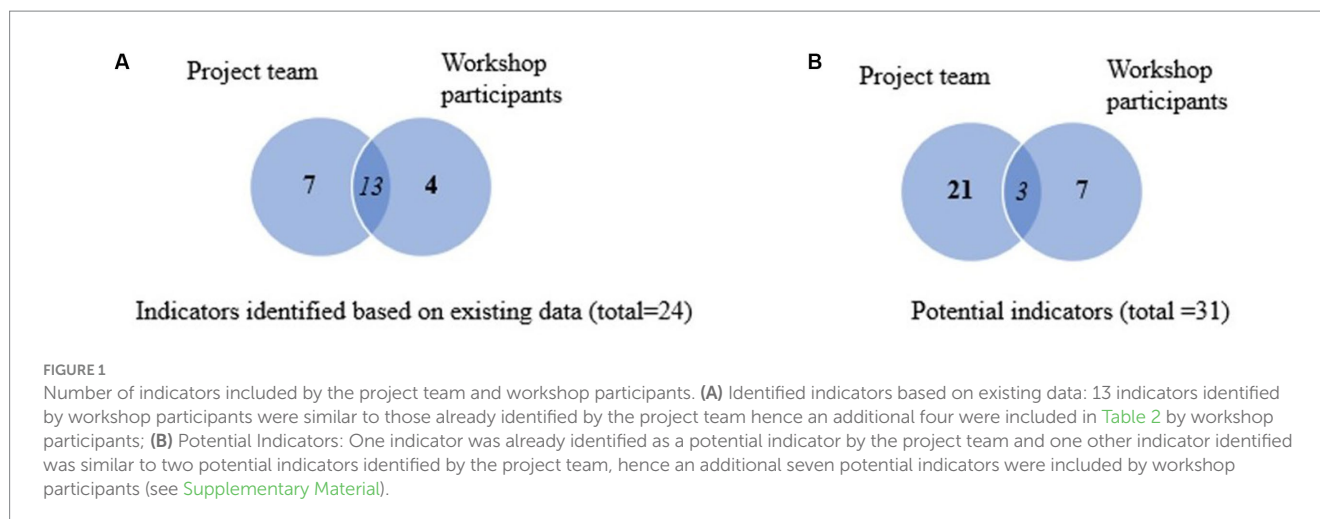
3 Results

3.1 Potential indicators

A total of 31 potential indicators were identified as relevant, however they were not included as they did not meet all criteria (Supplementary Material). There were no *existing* data sources identified for any of these indicators, however *potential* data sources were identified. The project team and workshop participants identified 24 and 10 potential indicators, respectively (Figure 1). Only three potential indicators identified by both groups were similar. Seven of those identified by workshop participants were not identified by the project team. Most of the indicators (16) were related to Pathway 1 (Strengthen and connect rural food systems), seven indicators were related to Pathway 2 (Strengthen the national policy environment), and eight indicators were related to Pathway 3 (Advocate for food environments supporting healthy food accessibility, affordability and convenience).

3.2 Identified indicators based on existing data

A total of 24 indicators were identified as meeting all the selection criteria (Table 2). Twenty of the indicators were identified by the project team and 17 indicators were identified by the workshop participants, however most (13) of the latter overlapped with over half (11) of the indicators identified by the project team (Table 2; Figure 1). An additional four indicators were identified by the workshop participants. Most of the indicators (15) related to Pathway 1 (Strengthen and connect rural food systems), only two indicators were related to Pathway 2 (Strengthen the national policy environment), and seven indicators were related to Pathway 3 (Advocate for food environments supporting healthy food accessibility, affordability, and convenience). Twelve of the indicators have national data available, five indicators have both national and provincial data available, five indicators have national, provincial and village data available and two indicators have village level data only. The frequency of data collection for the identified indicators ranges from every 1 to 10 years with some being collected once or on an *ad hoc* basis. All of the indicators identified could be used to track progress towards the SDGs, in particular SDGs 2 (Zero Hunger), 3 (Good Health and Wellbeing), 8 (Decent Work and Economic Growth), 9 (Industry, Innovation and Infrastructure) and 11 (Sustainable Cities and Communities; United Nations, 2015). A fewer number of identified indicators could support



monitoring progress towards the CBD targets (United Nations, 2022), in particular Target 16 (encouraging and enabling sustainable consumption choices). Most of the indicators were related to drivers (13), followed by food supply activities and actors (5), food environments (5), diets (1) and outcomes (2).

4 Discussion

The aim of this research was to identify a range of existing and potential indicators, which could be collected consistently through time whilst pragmatically accounting for the context including bureaucratic burden of excessive indicators, which could enable decision-makers to track progress along the food system pathways. Application of existing research, engagement of a project team with extensive contextual experience, including knowledge of data sources and their suitability, and multi-sectoral engagement of country stakeholders enabled the identification of a set of indicators aligned with food system transformation pathways which emerged through ongoing partnership. Project team and country stakeholder indicator lists were largely complementary, rather than conflicting, and reflect a level of pragmatism required for realistically tracking change over the next decade, given the context of inadequate resourcing for data collection, collation, analysis, and reporting (Mauli et al., 2023). We suggest that the approach taken here could be used as a template for comparable contexts, including across the Pacific region and in other Small Island Developing States.

4.1 Included indicators

The type and number of indicators varied significantly across pathways. Pathway 1, 'Strengthen and connect rural food systems', emerged as being highly compatible with existing quantitative data collections. This may be explained by the historic global focus, to date, on productivity as opposed to other key strategies to strengthen and transform food systems such as cross-sectoral policy and food environment interventions. Many of the indicators in Pathway 1 are counts of material objects (e.g., quantity and diversity of food production, distance to markets) or socio-demographics relating to food system engagement (e.g., % employment). Strengthening policy

(Pathway 2) and advocacy for food environments with better social, economic and environmental outcomes (Pathway 3), while equally important, are arguably less explicit and measurable consistently through time. However, there is momentum building in both the food policy and food environment space across the Pacific region (Bogard et al., 2021; Thow et al., 2022; Webster et al., 2022).

While others have proposed evidence of clear and desirable direction of change as criteria for indicator selection, this may be context dependent (Fanzo et al., 2021). This research found that there were numerous trade-offs to consider when examining the directionality of food system change expected to occur. For example, cash income from food production (indicator 14) may not lead to multiple benefits for nutrition, environment and livelihoods if producers use the income to purchase desirable, yet unhealthy, imported produce, or non-nutritious products such as alcohol, kava or tobacco, or if producers are using unsustainable practices. Similarly, the direction of change due to government expenditure on agriculture and fisheries (indicators 2 and 3) may be commodity-dependent. For example, the expenditure on export-driven cash crops versus the expenditure on domestically consumed seafood may have different implications for nutrition, environment and livelihoods. These possible, yet difficult to predict, outcomes, which could vary in space and time within the Solomon Islands, are inevitable given the complex and dynamic nature of food systems. Other nuances were identified. For example, determining the relative merit of specific quantitative indicators to reflect market access (indicator 7, e.g., less than 30 min by foot or less than 30 min by motorboat) was difficult to discern and would depend on more local factors such as cost of fuel, terrain and sea conditions. The former may indicate closer proximity to a market, however it could also indicate a lack of access to motorised transport to support food transport. It was also apparent that market access in Solomon Islands depends on various types of infrastructure (e.g., wharfs and air strips) which may not be considered when developing conventional indicators and therefore omit the tracking of important food system activities. Trade-offs are unavoidable given the multi-dimensional objectives of food systems, especially in the Solomon Islands where the 'food system' is a multi-layered dynamic system operating across a gradient from highly informal to formal. A better understanding of these trade-offs could help communities navigate these more efficiently and equitably (Béné et al., 2019a).

TABLE 2 Identified indicators based on existing data collection processes already underway in the Solomon Islands.

#	Indicators identified by project team (Phase 1)	Level	Food system component	Source(s) [†]	Current data collection frequency	International targets (UN SDGs and CBD targets)	Indicators identified by workshop participants* (Phase 2)
Pathway 1: Strengthen and connect rural food systems							
Context: Food production primarily happens at the village level and governance over productive spaces is generally held at a local level. Building connections between local practices and initiatives at provincial and national levels will be important to progress.							
1	Domestic crop produced (%) meeting <i>per capita</i> requirement for fruit and non-starchy vegetables (400 g per adult/day)	National	Food Supply (production, distribution, retail) Diets	FAOSTAT; MAL; HIES	7–10 yrs	SDG 2,8,9 CBD 6	<ul style="list-style-type: none"> • Crop production increase (volume) • Meals in household/day (#) • Types of nutrients consumed (diversity)
2	Government expenditure on agriculture and livestock (% of development budget)	National	Driver	MoFT	1/yr	SDG 8,9	Government support: National Budget going to rural production (%)
3	Government expenditure on fisheries and marine resources (% of development budget)	National	Driver	MoFT	1/yr	SDG 8,9,14	Government support: National Budget going to rural production (%)
4	'Unhealthy' food imports, e.g., ultra-processed food (tonnes/ <i>per capita</i>)	National	Food supply (distribution)	PFTD and INFORMAS categories	1/yr	SDG 2,3	<ul style="list-style-type: none"> • Import of unhealthy foods (# licensed/registered suppliers) • Import restrictions on unhealthy food (Y/N)
5	Investment in agriculture extension and training (% of total budget)	National	Driver	MAL; MoFT	1/yr	SDG 4,8,9 CBD 20	<ul style="list-style-type: none"> • Government support: National Budget going to rural production (%) • Education/skills/ knowledge (investment (\$)/# of projects/programmes)
6	Households sourcing food from wild, cultivated and kin and community (%)	National / Provincial	Food environment	HIES	7–10 yrs	SDG 2,3,11 CBD 6, 16	<ul style="list-style-type: none"> • Availability of food at a local level (diversity)
7	Communities with access to a fresh food market less than 30 min away (%)	National / Provincial / Village	Food environment	National Agriculture Survey; SIVRS	<i>Ad hoc</i> 1/10 yrs	SDG 2,3,11 CBD 16	<ul style="list-style-type: none"> • Market centres (#) • Infrastructure (# wharfs; # roads; # shipping services (frequency of shipping service to rural areas); # air strips to transport products from rural areas to provincial/capital) • Availability of food at a local level (diversity) • Local food suppliers (location, demographics, gender, age, ethnicities) & supplies (# varieties; # market areas)
8	Rao's quadratic entropy, i.e., Diversity of nutrients provided by the system, weighted by the relative abundance of each food	National / Provincial / Village	Food Supply (production, distribution, retail); Food environment; Diets	Pacific Food Composition Tables; HIES; SIVRS	7–10 yrs. (HIES); 1/10 yrs. (SIVRS)	SDG 2,3	<ul style="list-style-type: none"> • Local food suppliers (location, demographics, gender, age, ethnicities) & supplies (# varieties; # market areas) • Crop diversification (# of farmers and # of foods produced)
9	Aquatic food types available for local consumption/markets (#)	Village	Food environment	SIVRS	1/10 yrs	SDG 2,14 CBD 16	<ul style="list-style-type: none"> • Local food suppliers (location, demographics, gender, age, ethnicities) & supplies (# varieties; market areas)

(Continued)

TABLE 2 (Continued)

#	Indicators identified by project team (Phase 1)	Level	Food system component	Source(s) [†]	Current data collection frequency	International targets (UN SDGs and CBD targets)	Indicators identified by workshop participants* (Phase 2)
10	Varieties of fruit and vegetables grown (#)	National / Provincial / Village	Food Supply (production, distribution, retail);	National Agriculture Survey; SIVRS	<i>Ad hoc</i> 1/10yrs	SDG 2,3,11 CBD 12, 16	<ul style="list-style-type: none"> Local food suppliers (location, demographics, gender, age, ethnicities) & supplies (# varieties; # market areas) Crop diversification (# of farmers and # of foods produced)
11	Targets for import substitution (rice, poultry, pork, beef, eggs.) (# with export target tonnes/yr. decreasing)	National	Driver	Agriculture Sector Growth Strategy and Investment Plan; PFTD	1/yr	SDG 2,3, 8,9,11 CBD 6	-
12	Women employed as agricultural extension workers (%)	National / Provincial	Food supply (actor)	MAL; SINVRS	1/yr (MAL); 1/10yrs. (SIVRS)	SDG 4,5 CBD 20, 23	-
13	Proportion of coastal villages with community fishing regulation (%)	Village	Driver	SIVRS	1/10 yrs	SDG 9,11,14 CBD 1,2,3,4,5,9,10,14	-
14	Cash income from food production (\$ average; male:female)	National / Provincial / Village	Driver	HIES; SIVRS	7–10 yrs 1/10yrs	SDG 1,8	-
15	Youth wages for food production (\$ average)	National / Provincial / Village	Driver	HIES; SIVRS	7–10 yrs 1/10yrs	SDG 1,8	-
Pathway 2: Strengthen national policy environment							
Context: Implementing food system policy is challenging. Food policy at a cross-ministerial level would be ideal. It will also be important to integrate NGO activities and policies with local processes.							
16	Evidence of cross-sectoral engagement within a food system framing, e.g., via policies and programmes (Y/N) †	National	Driver	MHMS National Food Security and Food Safety Plan	1/yr	SDG 1–17 CBD 14, 16	-
17	Structure for devolution to provincial level established in national policies, e.g., Fisheries Management Policy (Y/N) †	National / Provincial	Driver	FAOLEX (policies from relevant Ministries including MAL, MHMS, MFMS)	1/yr	SDG 1–17 CBD 14, 16	-
Pathway 3: Advocate for food environments supporting healthy food accessibility, affordability and convenience							
Context: Most of the population produce their own food, however there is not enough healthy food being produced per capita to meet recommended dietary intakes. More and more people are consuming unhealthy imported foods. Advocacy is important, however understanding and improving local food environments is vital to support healthier and more sustainable diets.							
18	Investment in nutrition improvement programme (\$)	National	Driver	MoFT; MHMS	1 yr	SDG 2,3 CBD 16	Government investment in nutrition programmes/ health promotion (\$)

(Continued)

TABLE 2 (Continued)

#	Indicators identified by project team (Phase 1)	Level	Food system component	Source(s) [†]	Current data collection frequency	International targets (UN SDGs and CBD targets)	Indicators identified by workshop participants* (Phase 2)
19	Affordability (food price and income) of healthy food relative to 'unhealthy' food (total average cost (\$) of healthy:unhealthy food)	National / Provincial	Food environment	HIES; PGHL	7–10 yrs	SDG 1,2,3	-
20	Policy/policies addressing food affordability (Y/N) ‡	National	Driver	FAOLEX (policies from relevant Ministries including MAL, MHMS, MFMS)	1/yr	SDG 1,2,3,17 CBD 16	-
21	-	National / Provincial	Driver	FAOLEX (policies from relevant Ministries including MAL, MFMS, MMFR)	1/yr	SDG 3,17 CBD 16	Policies implemented and monitored [‡] to regulate unhealthy food marketing and promote local, healthy food (#)
22	-	National	Driver	PFTD	1/yr	SDG 8,9	Export local food products (# varieties)
23	-	National	Outcome	UNICEF; WHO; World Bank	1/yr	SDG 2,3	Malnutrition (% by age/gender) (stunting, wasting, overweight)
24	-	National	Outcome	NCD Risk Factor Collaboration	1/yr	SDG 3	Non-communicable diseases (% by age/gender)

[†]HIES (Household and Income Expenditure Survey); SIVRS (Solomon Island Village Resource Survey); MAL (Ministry of Agriculture and Livestock); MHMS (Ministry of Health and Medical Services); MoFT (Ministry of Finance and Treasury); MFMS (Ministry of Fisheries and Marine Resources); PGHE (Pacific Guide to Healthy Eating); NCD (Non-Communicable Disease); INFORMAS (International Network for Food and Obesity/Non-communicable Diseases) (NCDs) Research, Monitoring and Action Support; SDG (Sustainable Development Goals); CBD (Convention on Biological Diversity). [‡]While it may be possible to identify implemented policies, it may not be possible to examine whether monitoring of these policies exist. *Some indicators identified by workshop participants are listed multiple times in the table as they align with more than one of the indicators identified by project team (see [Figure 1](#)).

Modelling and analytical techniques to quantify trade-offs, together with monitoring of indicators against local level targets, could help manage trade-offs with undesirable consequences (Herrero et al., 2021).

Other potential indicators were identified in relation to Pathway 1, however there is either a current lack of data available or further research required to track these effectively. In relation to Pathway 1, the Ministry of Agriculture and Livestock (MAL) and the Solomon Islands Village Resource Survey were identified as sources of data for many of the potential indicators.

There were limited indicators identified in relation to Pathway 2, largely due to the inadequacy of potential indicators to fulfil the selection criteria. Reeve et al. (2022) found that while there were coherent policy aims to produce enough food to meet dietary requirements and support an environmentally resilient food supply, operationally, policies were more focused on food exports and import subsidisation (Reeve et al., 2022). However, the National Food Security, Food Safety and Nutrition Policy has recently been updated which offers an opportunity for the development of a series of indicators to map the progress of policy implementation within Pathway 2. Workshop participants suggested the need for a National Food Council including representatives from various sectors to support policy implementation. The MAL has committed to establishing a multistakeholder and cross-sectoral food council at both national and provincial levels. It has been proposed that this council oversee implementation of the United Nations Food Systems Summit (UNFSS) recommendations which were discussed at part of national dialogues (United Nations, 2021).

Pathway 3 indicators focus on the retail food environment (e.g., affordability, access). While there are a range of indicators that could be used to monitor the community and consumer food environments (Story et al., 2008), indicators that measure the wild and cultivated food environments are of critical importance in Solomon Islands as these are the major sources of food (Bogard et al., 2021).

This current research identified indicators across meso (e.g., unhealthy food imports), micro (e.g., varieties of fruit and vegetables grown in villages) and individual levels (e.g., malnutrition). There is currently little sub-national data (i.e., provincial-or community-level) represented in current food system frameworks, yet these data may be needed to understand progress in various contexts and across various population groups, including the most vulnerable. This is particularly relevant in the Solomon Islands which is characterised as a predominantly rural and traditional food system, where farming and fishing are mainly done on a small-scale, and agricultural yields are typically low (Farmery et al., 2023). In the Solomon Island context, village-level data may also be averaged to obtain provincial and national estimates, increasing its utility in tracking progress at various levels.

Existing frameworks predominantly include sentinel indicators which offer a basic way to monitor complex processes, however as a proxy they provide incomplete information (e.g., crop yield; USAID, 2021). While the framework used in this research reflected stakeholder's collective vision, the indicators identified as part of this research captured food system components of existing frameworks, including drivers, food supply activities and actors, food environment, diets and outcomes (High Level Panel of Experts on Food Security and Nutrition, 2017). However, some components were not reflected by the included indicators, including activities such as food processing and packaging, promotion, quality and safety, and outcomes such as environmental, social or economic. Approaches to complexity-aware

monitoring (USAID, 2021) could help inform indicator development. This current research has applied a couple of these approaches including stakeholder feedback (e.g., via workshopping), and the consideration of process-monitoring indicators [e.g., evidence of cross-sectoral engagement within a food system framing (indicator 16)]. Process-monitoring indicators are useful in identifying processes considered relevant for the achievement of a specific outcome. Additional approaches such as 'Most Significant Change' may be helpful in identifying indicators that a range of stakeholders feel are important in identifying a change in progress (USAID, 2021). As this process does not necessarily identify what the change may look like, it is less prescriptive and may lead to a more diverse range of indicators.

4.2 Alignment with global goals and initiatives

The indicators identified may be useful in tracking progress towards international targets, in particular the SDGs (United Nations, 2015) and to a lesser extent the CBD targets (United Nations, 2022). The Paris Agreement targets (United Nations, 2018) may be less relevant given the country's low greenhouse gas emissions (World Bank, 2023). It could be worthwhile further exploring how to better align specific international targets with tracking food system performance as, in many low-and middle-income countries, governments are tasked with ensuring food system policy aligns with sustainable development objectives, yet policies and programmes implemented have significantly different objectives and limited resourcing. In fact, The Solomon Islands Voluntary National Review mapped the SDGs against the National Development Strategy (2016–2035) objectives (Solomon Islands Government, 2020). While this process indicates that alignment between national and international targets may be possible, the Review acknowledged the need to strengthen data and statistical systems and capacity (Solomon Islands Government, 2020). Mapping the indicators identified by this current research against other relevant national strategies could be of value.

In relation to the FSCI (Schneider et al., 2023), regional expert consultations consisted of representatives from both Asia and the Pacific, however no stakeholders from the Solomon Islands participated. Many indicators recommended as part of these regional consultations were also identified in this research study, including indicators related to NCD prevalence, policy indicators (i.e., regulation of unhealthy food marketing, cross-sectoral policies), social and cultural norms, food affordability, knowledge, and inclusion-related indicators (e.g., youth participation, salaries, gender, access to finance and technology). As fostering gender inclusion has been shown to have positive impacts on food systems, there is also a need for gender-based indicators. While some gender-based indicators were identified by the project team, it has been acknowledged that the positive impact of gender inclusion may not be fully recognised due to a lack of sex-disaggregated data (Giner et al., 2022). As there were similarities in the indicators identified in this research study and those suggested as part of the FSCI consultations, there may be an opportunity to engage stakeholders from the Solomon Islands and coordinate efforts (regional collaboration was recommended at the FSCI regional consultations). There were also indicators suggested at the FSCI consultations which were not identified as part of this research study—these may be worth validating with a wider range of Solomon

Island stakeholders as part of further research. These include indicators related to the proportion of energy consumed from ultra-processed foods, food safety, the environment (e.g., pollution, land, soil, water, climate), the proportion of migrant workers, social protection mechanisms and rights (e.g., land tenure). The FSCI consultations also recommended that resilience indicators reflect the entire logistic system, however the inclusion of resilience indicators in food system frameworks has been questioned due to its latent nature and the lack of consensus on how to measure it (Béné et al., 2019b). While the Sustainable Food System Country Profile project has not yet developed country profiles in the Pacific, there is an opportunity to apply the tool in the region, using a reproducible methodology (Béné et al., 2022). This could allow for better comparison between countries over time.

It is also important to consider the fragmentation and costly duplication of efforts that may produce conflicting, or redundant, findings. Globally and regionally, there are several initiatives that are coordinating data collation to track food system performance (and parts thereof), including the FSCI and the Pacific Community Coastal Fishery Report Card (Pacific Community, 2023). It is clear from these initiatives and from this study, that relevant data is lacking in the Solomon Islands. In acknowledging this however, it is important to distinguish the need for more data versus supporting more targeted data collection which is relevant, timely and useful.

4.3 Supporting indicator measurement

The agri-food system analysis project (Australian Centre for International Agricultural Research, 2019) integrated several data sources which could help track the identified indicators across all three pathways (i.e., indicators 1, 4, 6, 16, 17, 19 and 20). However, there is a need to consider how efforts may be sustained in-country to support data collection and integrated data analysis of more complex indicators (e.g., indicator 8, Rao's quadratic entropy). Slow information flows, inadequate resourcing and skill gaps at all levels of government have been recognised as capacity challenges in relation to food governance in the Solomon Islands (Mauli et al., 2023). While there may be an opportunity to repurpose data from existing surveys, data is often collected infrequently or on an *ad hoc* basis, making it challenging to compare across temporal scales, and varying survey objectives may not support tracking of food system strengthening. Data collection and analysis must be encouraged as a priority and supported both technically and financially. Investment in capacity, structures and institutions is warranted to ensure effective, streamlined and relevant data collection. To support investment, a demand for data must be created, e.g., by estimating costs associated with decisions not informed by up-to-date and relevant data (High Level Panel of Experts, 2022). The need for data and capacity building was also recognised as part of the FSCI consultations (Schneider et al., 2023). While this support may be derived from international organisations and donors, it is important that country ownership is considered. To ensure agency, it will also be important that data is shared via open-access at all levels and across all relevant sectors (not just agriculture and health), including the National Statistic Office and organisations (e.g., businesses, non-governmental), and that sensitive data and privacy are protected via accountability systems. One example is the Pacific Food Trade Database (Brewer et al., 2021) developed for researchers and national and regional agencies to better understand

trade patterns relevant to decision making (e.g., how food and beverage trade can better serve the Pacific Island Countries and Territories). There is also an opportunity to build on the commendable regional efforts of the Pacific Community's Statistics for Development Division (The Pacific Community, 2023) and the Pacific Data Hub (2023).

4.4 Strengths and limitations

This current research provided an opportunity for stakeholders from the Solomon Islands to inform indicator development based on context-specific goals and a collective vision. The value of this approach is evident, as it not only supported the identification of relevant existing and potential indicators, but also identified indicators beyond the conventional sentinel indicators often included in existing food system frameworks. It also provided a space to discuss various context-specific nuances which are often missing from current framework development yet are important considerations for effective progress monitoring. Participatory approaches are recognised as an important endeavour in research addressing complex sustainability challenges (Karlsson et al., 2018). While some research has used participatory methods to identify visions for desirable food systems (Andress et al., 2020; Belisle-Toler et al., 2021; Foresight4Food, 2024) or food system indicators (Woodley et al., 2009; Carey and Dubbeling, 2017; Allen et al., 2019; Community Social Planning Council and Capital Region Food and Agriculture Initiatives Roundtable, 2020; Chaido Anthouli et al., 2022), we have only identified one food system-related initiative, on coastal fisheries, which has applied these methods in the identification of pathways to change along with relevant indicators (Secretariat of the Pacific Community, 2015). Another initiative worth noting here, is the Food Systems Analysis Toolkit, which has used participatory methods to develop indicators for three African countries to track progress along the UNFSS Action Tracks, however it also mapped these using adapted conventional frameworks (The Rockefeller Foundation, 2023). There is an opportunity to further engage with Pacific multi-level and multi-sectoral stakeholders, building upon the UNFSS dialogues, to identify relevant indicators and target data collection. It has been recommended that the proposed National Food Council could an accountability framework aligned with the UNFSS as well as the SDGs (Farmery et al., 2023).

This research describes the participatory process for indicator identification and does not attempt to undertake a food system assessment as such. A comprehensive food system assessment of the Solomon Islands has already been undertaken (Farmery et al., 2023), however there is an opportunity to incorporate the indicators identified in this current research in further food system assessments. A more diverse range of indicators may have been identified if there had been input from a wider range of stakeholders. For example, post-harvest food loss is significant in the Solomon Islands (Underhill et al., 2019), however this was not identified as an indicator in this current research. It is also evident from this research, that there was an absence of indicators to track many important food system components (e.g., food safety), consumer behaviour and outcomes (e.g., environmental). This could again reflect the representativeness of workshop participants. In addition, it is possible that industry stakeholders who were not represented in this current research, may have access to relevant indicator data. It is recommended that further

research undertake a more comprehensive participatory approach that co-creates/co-produces with a wider range of stakeholders using a structured process for developing and maintaining partnerships and evaluating outcomes (Cargo and Mercer, 2008; Voorberg et al., 2015). The Sustainable Food System Country Profile project undertook a participatory approach in co-selecting indicators with key public and private stakeholders following a structured protocol (Béné et al., 2022). This approach is one of the most rigorous to date, and as mentioned previously, provides an opportunity for application and framework validation in the Pacific region. Over half of the indicators identified by the project team were similar to those identified by the workshop participants, with those identified by latter group being more general than those identified by the project team. This may have been due to the representativeness of workshop participants and limited time to workshop indicators. While this current research team attempted to avoid replication between indicators, e.g., affordability of healthy food (indicator 19) and policies to address such (indicator 20), this was not addressed during stakeholder discussions. These correlations would need to be validated by further research. It is also acknowledged that as much of the data available relates to Pathway 1, there is a high risk of artificial overweighting (Béné et al., 2019b).

5 Conclusion

This study highlights the importance of considering context-specific and participatory approaches in developing relevant food system indicators. The development of the pathways considered a strength-based framing. This research took a similar approach to indicator development, optimising and repurposing existing indicators where relevant. However, this research also highlights the need for more investment in streamlined data collection and analysis efforts along with the development of data governance frameworks to protect privacy, individual rights and support ethical access to data. Further research may be warranted to better understand the barriers and enablers of relevant data collection and analysis across various sectors in the Solomon Islands.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by CSIRO Social and Interdisciplinary Science Human Research Ethics Committee (CSSHREC). The studies were conducted in accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation because while an information sheet and consent form were provided to participants, participants were not required to sign the consent form as participation in the workshop was indicative of their consent.

Author contributions

SB: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Writing – original draft, Writing – review & editing, Visualization. TB: Conceptualization, Methodology, Writing – review & editing. PF: Conceptualization, Methodology, Writing – review & editing. MS: Conceptualization, Methodology, Writing – review & editing. SM: Investigation, Methodology, Writing – review & editing. AT: Writing – review & editing. EB: Writing – review & editing. AF: Conceptualization, Methodology, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2024.1308144/full#supplementary-material>

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