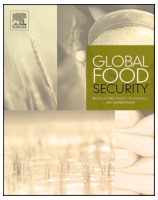
Global Food Security 32 (2022) 100608

Contents lists available at ScienceDirect

Global Food Security

journal homepage: www.elsevier.com/locate/gfs



Continuity and change in the contemporary Pacific food system

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ARTICLE INFO

Keywords:
Pacific Island country
Food regime
Food system
Food trade

ABSTRACT

The Pacific food system has become progressively more integrated into global food regimes. This integration has had impacts on availability and consumption of food, population health, and vulnerability to external drivers. We describe major elements of the contemporary food system to provide a foundation for analysis of food system transitions and public health outcomes. Although crop production has doubled in the last fifty years, it has not kept pace with population growth. This deficit is increasingly filled by imported foods, particularly staples, meat and sugar. The burden of malnutrition and poor health outcomes are increasingly apparent. We propose seeds for transitioning the Pacific food system to a hybrid form that supports historical continuity with healthy regionally-produced food.

1. Introduction

Calls for a 'Great Food Transformation' (Willett et al., 2019) to combat rising global malnutrition and environmental impacts will need to be addressed at a global level as well as at regional scales. As calls for radical change gather momentum (e.g. Fanzo et al., 2020; Herrero et al., 2020) focus will increasingly shift to how such change happens, the extent to which such complex systems can be 'designed' (and if so 'by' and 'for' whom), and the resilience of food systems and people to shocks such as the Covid-19 pandemic and systemic change such as climate change (e.g. Farrell et al., 2020; Herrero and Thornton, 2020; Golden et al., 2021). Meaningful progress will require approaches that consider the linkages among the production and consumption of food and their environmental, social and public health outcomes (Rockström and Sukhdev, 2016; Niessen et al., 2018). To support such initiatives, an analytical focus is needed on the political and institutional processes that shape the production, distribution and consumption of food and how they may be opposed or harnessed for a more purposive transition to the sustainable provision of nutritious food (Oliver et al., 2018).

The contemporary Pacific food system is heterogeneous and covers a significant geographic area, yet remains poorly described. The region is profoundly dependent on fisheries as well as globalized trade in food commodities, and food systems are vulnerable to trade dynamics and a range of other external drivers, most notably climate change and

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https://doi.org/10.1016/j.gfs.2021.100608
Received 16 August 2021; Received in revised form 20 December 2021; Accepted 21 December 2021
Available online 6 January 2022

urbanization. Despite the uniqueness of the region, the 22 Pacific Island Countries and Territories (PICTs) are often subsumed into 'Asia-Pacific' or included with Australia and New Zealand as 'Oceania', and thereby marginalized in global discourses around issues such as climate change, malnutrition, and even the Sustainable Development Goals.

Climate change has negatively impacted agriculture and fisheries production, and has resulted in reduced access to some food species due to declining yields, availability of arable land, fresh water, and availability of aquatic food species (Bell et al., 2011; SPC, 2017; Bell and Bahri, 2018). Urbanization has led to increased demand for – and dependence on – imported staple foods that are more convenient and less bulky than traditional staple root crops, in response to reduced time for production, and lack of access to land in increasingly crowded urban areas (Thaman, 1982; Thow et al., 2010). Globalized food trade has substantial impacts on diets and public health outcomes (Friel et al., 2020). This relationship is nowhere more apparent than in the Pacific region where imported foods play a critical role in bridging production shortfalls, particularly in atoll nations, and where the importation of non-traditional foods has been linked to the non-communicable disease (NCD) crisis (Thaman, 1982; Hughes and Lawrence, 2005; Estimé et al., 2014). Given this context, there is a surprising dearth of region-scale analyses of food trade trends. Previous national case studies have shed light on patterns and linked these to historical political events and trade policy, including in the Pacific region (e.g. Thow et al., 2011), but regional and sub-regional analyses have been largely absent.

The challenges facing PICTs range across all dimensions of the food system, and impact on PICTs' ability to provide healthy and sustainable food in the face of a changing environment. For low-lying coral atoll nations, these forces combine to present existential threats. As elsewhere, the production and consumption of food in the region is undergoing profound change that will be felt for generations (Evans et al., 2001; Hughes and Lawrence, 2005; Snowdon et al., 2013; Sievert et al., 2019). Dietary diversity, where described, is low (e.g. Albert et al., 2020; Horsey et al., 2019; Farmery et al., 2020).

The aim of this paper is to contribute to the literature that characterizes the contemporary Pacific food system. To achieve this aim, we describe major elements of the Pacific food system for which data are available —agricultural and fisheries production, and international food trade. These elements, along with the public health outcomes that flow in part from this configuration, provide a foundation for analysis of food system transitions toward improved health and sustainability. Given the path dependence of complex socio-ecological systems, understanding how the Pacific food system has evolved will better inform consideration of present realities, and serve as a guide to how it may co-evolve in the future.

Our analysis is at a regional scale and so we cannot adequately deal with diverse social and local attributes (preferences, prohibitions, etc.), food environments, and production and supply chain sustainability dimensions of food systems (Coyne et al., 1984; Pollock, 1992, 2017). These considerations are best dealt at national levels or, as in the case of the region's diverse food environments, at local scales (e.g. Bogard et al., 2021). We begin by conceptualizing the food system within the broader socio-ecological regime that has shaped its current configuration and led to the stabilization and dominance of regional food system drivers. We then draw on this conceptualization to propose seeds for transitioning the Pacific food system to one that better serves its people.

2. Theoretical framing - food systems within food regimes

A food system (Fig. 1a) is the set of interacting activities, outputs and outcomes that encapsulate the production, processing, trade, and consumption of food (Sobal et al., 1998; Ingram, 2011; HLPE, 2017). Food systems are influenced by both internal dynamics and by external politics, processes and events and may be conceptualized and described at a range of scales, from the global food system down to national or local systems such as a coral atoll. Each scale of description brings its own granularity, hiding important heterogeneity at smaller scales, offering different intervention opportunities and requiring different evidence to catalyze action. For example, food environments are key components of food systems (HLPE, 2017; Turner et al., 2018) but the focal scale of local food environments is too small to be adequately addressed in regional planning and policy.

Food system models may be critiqued as being static and ahistorical; yet useful insights can be drawn from understanding the way food systems evolve and are shaped by larger forces as well as innovations and threats within their domain. Two conceptual framings are used here to provide a basis for more contextualized analysis. Firstly, the 'food regime' concept (Friedmann, 1993; Friedmann and McMichael, 1989) has been used at larger, global scales to theorize the political economy of agrarian change. Friedman (1993, p. 30) defined a food regime as a '*rule-governed structure of production and consumption of food on a world scale*'. Regimes are recognized as long periods of relative stability in the forces that shape and define the production and consumption of food, with particular reference to the role of state and market power in production and distribution. The broader political, social and governance context of a food system may usefully be framed as a regime, but at smaller temporal and spatial scales than conceived by Friedman and McMichael (Friedman (1993, p. 30)).

'Regimes' also appear in a second body of theory, concerning the transition of socio-technical and socio-ecological systems from one configuration to another. The multi-level perspective on socio-technical transitions (Rip and Kemp, 1998; Geels, 2002, 2019; Smith et al., 2005) views a food regime as the *set of rules, norms, technologies, events and interactions acting within and on the food system that maintain its structure and functions* – its current configuration. Within this framing, food systems are stabilized by alignments among technologies, policies, consumer behaviors, infrastructures and cultural discourses, and these system elements are reproduced, maintained and incrementally altered by a range of actors such as producers, governments, retailers, trade organizations, aid agencies and consumer groups, to name a few (Fig. 1b). Innovation and change are mostly incremental and path dependent because of lock-in mechanisms, such as investments in skills and infrastructure, routines and mind-sets that constrain change. Vested interests and their leverage on policies also dampen innovation.

Radical change within food regimes, it is thought, tends to emerge in small *niches* that are then amplified (or marginalized where change is resisted), externally as shocks (e.g. wars, financial crises, disease, extreme weather events), or in the interaction between the two. Transitions from one food system configuration to another thus develop as a result of processes operating at multiple levels - niche, regime and external drivers (Fig. 1b; Geels, 2002, 2019; Schot and Geels, 2008). Niche innovations could take many forms, Pacific examples include non-traditional agricultural exports (Murray, 2001; Connell, 2013), Federated States of Micronesia's 'let's go local!' campaign (Englberger et al., 2013) and the TV program *Pacific Island Food Revolution* (https://www.pacificislandfoodrevolution.com/) that seeks to disrupt trends in foodscapes and promote local foods. Blending food regime and socio-technical transitions concepts to food systems analysis may help overcome some of the static/descriptive nature of food system analysis to better identify pathways of change both within and outside the system (see also Gaitán-Cremaschi et al., 2019).

3. The contemporary Pacific food regime

A discussion of historical periods of stability in food regimes and the political ecology of the Pacific region is beyond the scope of this article (see Pollock, 1992; Campbell, 2015; Connell, 2013;, and Supplementary text for a brief summary). The contemporary food regime (sometimes referred to as the Corporate Food Regime) is generally considered to have arisen in the 1980s in a wave of trade liberalization under the World Trade Organization (Friedmann and McMichael, 1989; Firth, 2000; Murray, 2001; Plahe et al., 2013). There is general consensus that

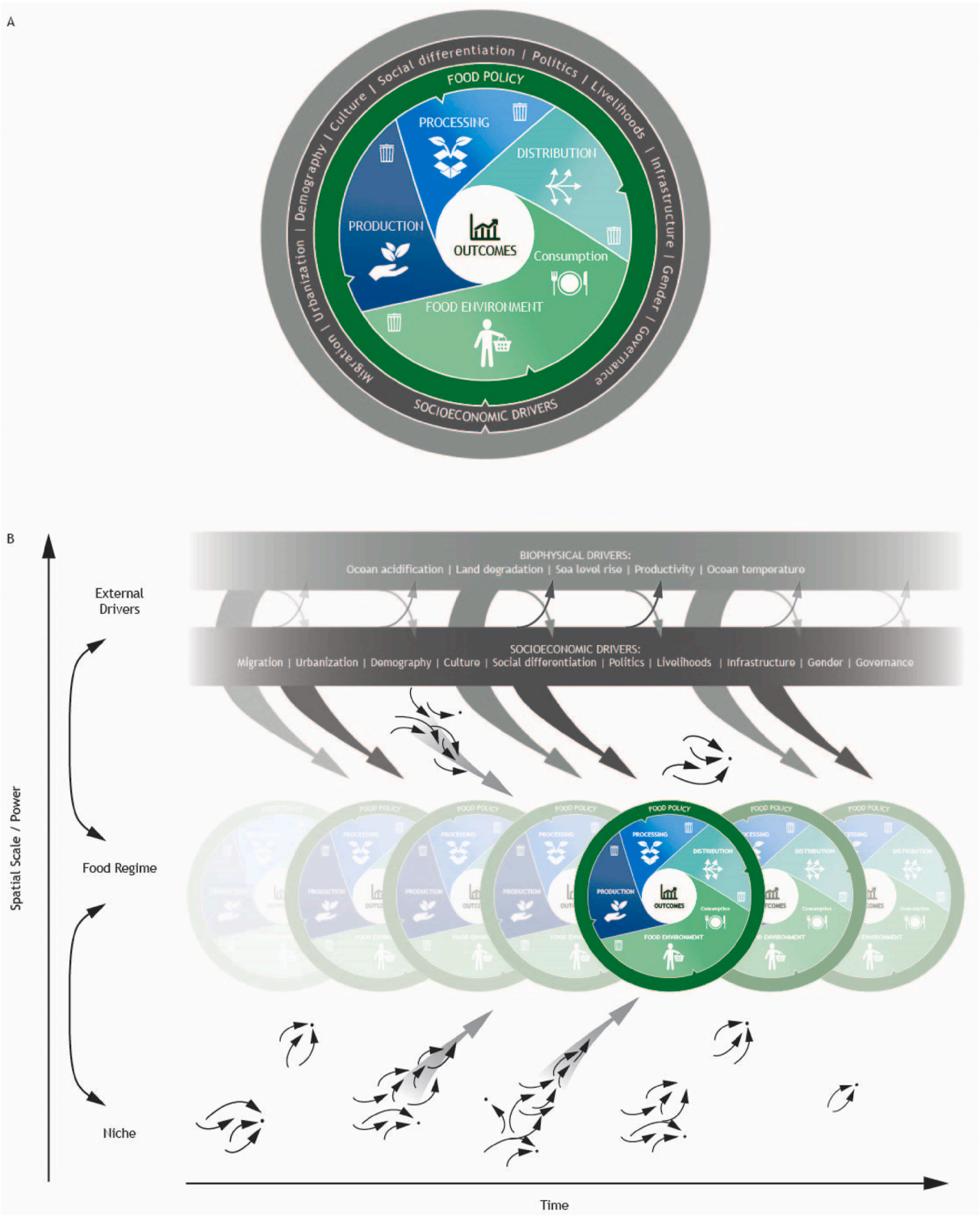

Fig. 1. (A) A food system is the set of interacting activities, outputs and outcomes that encapsulate the production, processing, trade, and consumption of food. The food system is influenced by both internal dynamics and by external politics, processes and events. Waste occurs at all stages – symbolized by a trash can. **(B)** A food regime refers to the set of rules, norms, technologies, events and interactions acting within and on the food system that maintain its structure and functions. Within the food regime, innovations can be viewed either as niche events that fizzle out (graphically as '.'), are absorbed or accommodated by the system, or are radical enough and gather sufficient momentum to disrupt the system. Similarly, innovations in policies, shocks, and other external processes may align to amplify or dampen changes to the food system. Collectively, these processes co-evolve as the food system transitions from one configuration to another. Adapted from Geels (2002) and Berg et al. (2018).

in the 40+ years of the contemporary food regime, food systems in the region's diverse island states and territories have become more exposed to global forces, more reliant on imported food, and that the people of the Pacific have become less healthy. This apparent consensus notwithstanding, the underlying evidence is fragmentary and often missing. Although a host of case studies at local scales provide support for elements of this narrative, broad patterns in the dimensions of food systems are poorly described.

Below we summarize crop production, trade, and national public health metrics to headline regional and sub-regional-scale trends. This regional/sub-regional overview is the first in a series of planned analyses of food commodities and national case studies within the region. We use the common and useful categorization of three sub-regions – Melanesia, Polynesia and Micronesia to provide updated and improved estimates of regional patterns in food trade for the last 20+ years from 1995 to 2018 (Fig. 2; Table S1 and supplementary text). Broadly, Melanesia is dominated by high islands, Micronesia is mostly comprised of archipelagic coral atoll states, and Polynesia is a mix of geologies and geographies.

Unless stated, our analysis excludes Papua New Guinea (PNG), the largest PICT both geographically and economically. PNG occupies the eastern half of the second largest island in the world as well as many smaller islands and atolls; its economy is more than twice the size of all other PICTs combined and nearly three quarters of Pacific Island residents live there. Further, in contrast to other nations, the great majority of people in PNG live more than 10 km from the coast (Andrew et al., 2019) and do not have the same historical and cultural links to the ocean that dominate the cultures and economies of the smaller nations. Combined, these attributes mean that PNG would overwhelm patterns and trends described for the remaining 21 PICTs where proximity to the ocean, geographical distance from large food-producing land masses and important trading economies, are major drivers of food production and cultures of acquisition and consumption. The territories of the USA are excluded from summaries of international food trade because they cannot be separated from the USA.

3.1. Crop production

Based on data from the Food and Agriculture Organization of the United Nations (FAO, 2020), crop production in the region has approximately doubled in the last 50 years, and at the regional scale is keeping pace with population growth. In 2018, agricultural production was equivalent to 0.54 kg per capita (p.c.) per day. This broad pattern is driven by PICTs comprised mostly of high islands - total production in Melanesia and Polynesia was steady or increasing only slightly while production in Micronesia remained at very low levels. Data that would allow a deeper understanding of whether these patterns were driven by increasing productivity or increasing area under production are unavailable for the region. Subsistence production and that for local exchange and markets accounts for the greatest proportion of agricultural activity. During the last decades there have been many examples of niche innovations, either through the export of traditional crops (e.g. kava and taro; Murray, 2001; Connell, 2013) or through the development of new export crops such as squash, vanilla, and ginger, but none have scaled sufficiently to disrupt overarching national food regimes (Connell, 2013).

These overall patterns change substantially when presented on a per capita basis and without the influence of PNG. Per capita production of root crops and other starchy vegetables (SV) has been declining in the region for fifty years (Fig. 3a), most dramatically in Polynesia. In Melanesia, production amounts to 0.56 kg p.c./day whole food equivalent. In Micronesia and Polynesia, it amounts to 0.12 and 0.33 kg p.c./day respectively. Production of SV in Micronesia is, and has always been, small (<40 kg p.c./year). In terms of calories available, and based on a daily energy requirement of 2100 kcal p.c. per day (i.e., food poverty line; Bellù and Liberati, 2005), domestic SV production would be sufficient to meet 25%, 6% and 15% of dietary energy needs in Melanesia, Micronesia and Polynesia, respectively. In lieu of Pacific-produced cereals and grains and other high-energy locally produced foods (e.g., coconuts and aquatic foods), all PICTs (except for Niue) are dependent on imports to meet dietary energy requirements.

Trends in production of fruit and non-starchy vegetables (FNSV; e.g., fresh fruit, brassicas) were similar in Polynesia. In both SV and FNSV, production in the last two decades appears to have stabilized (Fig. 3a and b). Further, the sub-regional aggregate volume of agricultural production over time, as expressed by FAO's PIN index of relative disposable production for any use except as seed and animal feed, has decreased (Fig. 3c). At the national scale, few PICTs produced a surplus of FNSV (i.e., >0.4 kg/p.c./day; FAO, 2020) and 12 are in deficit, particularly the coral atoll nations of Micronesia. Fruit generally dominates FNSV production in the region, principally in Melanesia and high

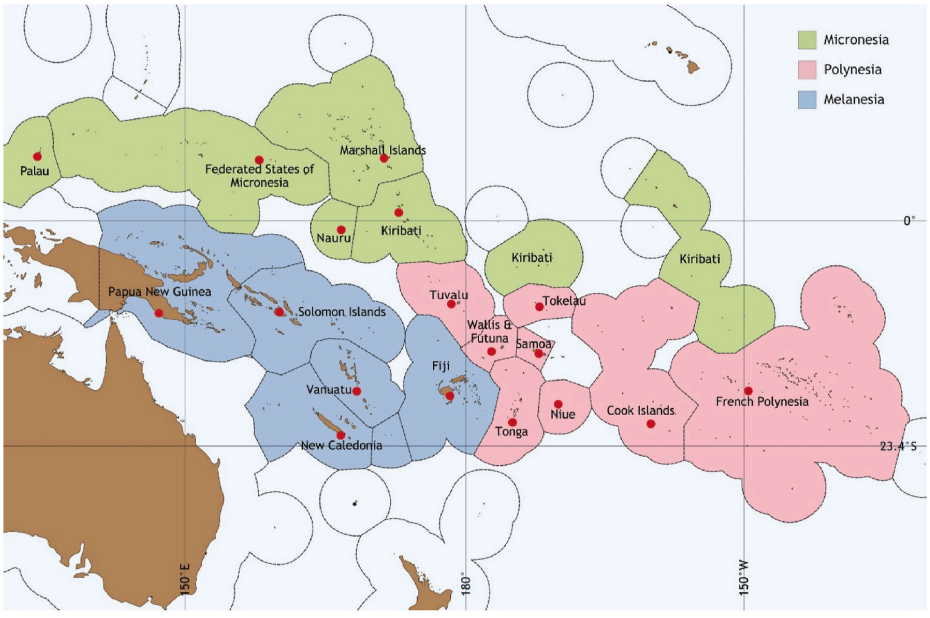

Fig. 2. Map showing locations and Exclusive Economic Zones in the Pacific region. The three commonly recognized sub-regions are also shown for PICTS. Red dots indicate capital cities. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

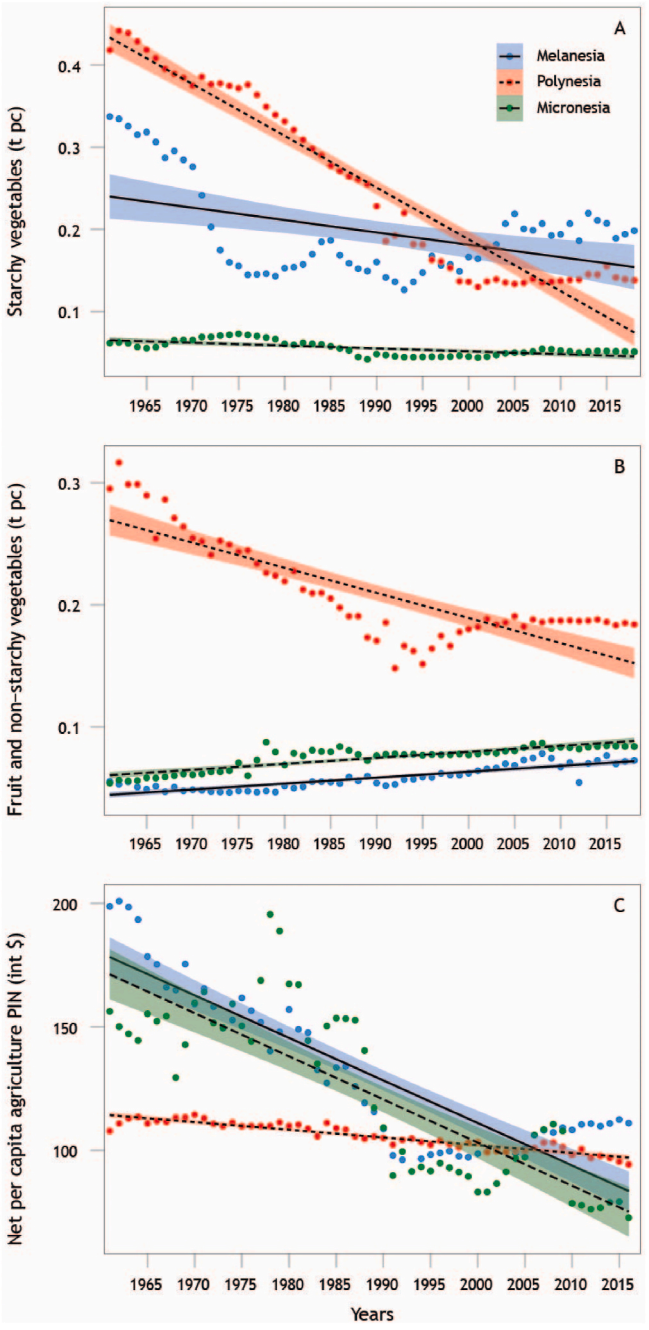

Fig. 3. Per capita agricultural production (t) of (a) starchy vegetables, and (b) fruit and non-starchy vegetables. In (c), the FAO production index number (PIN) of per capita agriculture production (international dollars, int$; FAO, 2020) is shown for three subregions during the period 1961 to 2018. Fitted curves are conditional means linear regression lines with 95% confidence intervals.

islands where fruit accounts for more than four-fifths of production. Bananas accounted for 44 percent of total regional production in 2018. We note that unripe bananas may be categorized as SV, but retain the FNSV coding as used in FAOSTAT (see Supplementary text for further details on the production data used and the PIN index).

Based on estimates by FAO (2020), domestic production in the region is currently insufficient to supply the amount of FNSV required for good human health. Preliminary analyses suggest this deficit may be in excess of 250,000 t p.a. across the Pacific nations. Analysis at smaller scales is required to reconcile these statistics with net imports of FNSV and also to understand sub-national patterns in availability between, for example, urban and rural populations.

3.2. Fisheries

Aquatic food is a key source of food, dietary protein and micronutrients in many PICTs, particularly where access to other animal source foods is limited. Fisheries in the region have traditionally been divided into the great offshore oceanic fisheries, mostly for tuna, and the diverse coastal fisheries. These categories differ in their trajectories, level of fishing pressure, effective regulation for sustainability, and their role in the regional food system.

The majority of fish eaten by Pacific Islanders are harvested from coral reefs, lagoons and estuaries and are a critical element of the diet of most Pacific Islanders (Charlton et al., 2016; Farmery et al., 2020). These fisheries are generally considered to be declining, but this inference is not universally true and considerable uncertainty remains around production and sustainability of most coastal fisheries in the region (Bell et al., 2009; Gillett, 2016). Gillett's (2016) comprehensive summary indicates no clear trend in production through time at either national or regional scales. Many coastal fisheries, which contribute substantially to the food system through provision of food and livelihoods, are being overfished. In some places fisheries have collapsed, but in others, generally further from urban centres (Brewer et al., 2009), stocks are considered to be fished sustainably. Other oceanic and coastal pelagic fishes, particularly those in the family *Carangidae* (jacks, mackerels and scads), are also caught and potentially have a much greater role to play in food security in the region, particularly for islands without lagoons or where the reef falls away quickly to great depth (Bell et al., 2015; Albert et al., 2020). Aquaculture production is modest and makes minimal direct contributions to food security.

The advent of EEZs following declaration of the UN Convention on the Law of the Sea in 1982 profoundly changed the use rights and control that PICTs have over fisheries in vast areas of the ocean (see also Fig. 2) and brought license fees to nations with tuna stocks in their EEZ (Aqorau, 2019). About a third of the world's tuna are caught in the waters surrounding PICTs - in 2015, 587,000 t of tuna, principally skipjack, yellowfin, albacore, and bigeye were caught in the region. Almost all of this catch is directly transshipped to Pacific rim nations and beyond where it was processed for distant markets. This harvest does not appear in international trade statistics and with the exception of the western Pacific ports of Pohnpei, Majuro, Rabaul, Honiara, and Tarawa where small and damaged tuna and bycatch is offloaded, makes negligible direct contribution to food or nutrition security in the region (Cassels, 2006). These fisheries do, however, make substantial contributions to the national revenues of PICTs in the Western Pacific through licensing (mean 37% of government revenue, excluding grants; Bell et al., 2021). Initially, license revenues were modest, but have substantially increased in recent decades as nations and regional institutions have asserted resource rights (Aqorau, 2019). The ambition to increase the direct contribution of tuna to nutritional security, by 'domesticating' or diversifying the oceanic tuna fisheries, has been widely canvassed and remains an active area of policy debate (e.g. Bell et al., 2009, 2015). Canned tuna globally is an important and growing source of fish, much of which is caught in the Exclusive Economic Zones of PICTs and canned in PNG, Solomon Islands, Fiji, or South East Asia and imported to PICTs (Bell et al., 2019).

3.3. International food trade

Between 1995 and 2018, 80 million t of food and beverage products worth US$78 billion was traded by PICTs (excluding PNG, bottled water, and fresh and frozen tuna, see supplementary text). Imports of food increased substantially over the period (Fig. 4a, Table S1). At the scale of the region, these increases have been relatively linear, with imports nearly trebling over the period. Much of this trend is driven by Melanesia, with imports to Micronesia and Polynesia being both smaller and

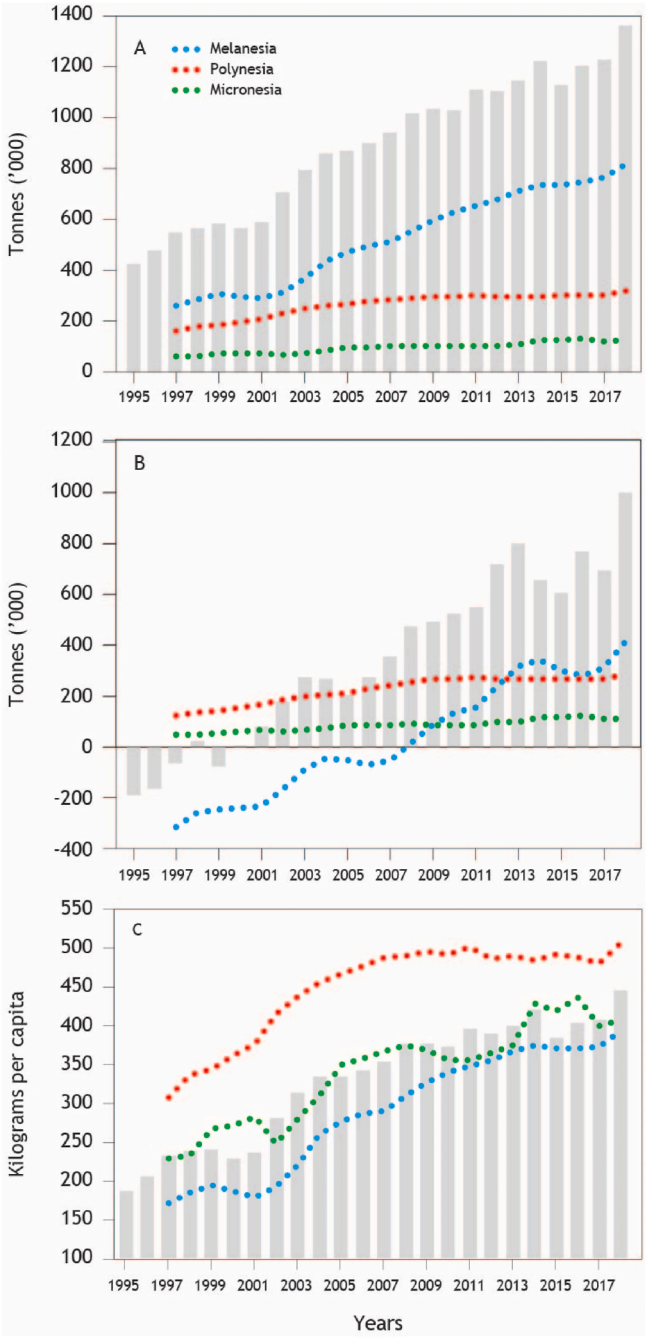

Fig. 4. Time series of trade in consumable food commodities (total of 569 unique HS codes) (A) total imports, (B) net total imports (imports minus exports), (C) per capita imports. PNG and USA territories excluded from analysis, as were bottled water and tuna (see Supplementary information). Data includes trades between PICTs. Data shown as regional estimate (grey bars), Polynesia (red), Melanesia (blue) and Micronesia (green). Population estimates derived from United Nations Population Division (https://population.un.org/wpp/Download/Standard/Population/). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

more consistent (Fig. 4a). Over the whole period, cereals other than rice (14%), rice (12%), sugar and sugar confectionary (7%), wheat and meslin flour (5%) and poultry meat and offal (5%) dominated import tonnage of food and beverages for the region.

Over the same period food and beverage exports have declined. Much of this pattern can be explained by declines in exports of sugar from Fiji which, although increasing early this century, have been in long-term decline. Across the whole period, sugar and molasses (50%), bottled water (17%) and copra (7%) accounted for the majority of export tonnage from the region (excluding tuna). The net effect of these trends in international trade is that the region overall became a net importer of food at the turn of the century and has become increasingly reliant on imports since (Fig. 4b). This trend is, again, mostly driven by Melanesia. Within the period of the dataset, Polynesia and Micronesia have always been net importers of food.

Per capita trends in imports and exports highlight the increasing reliance on imported foods, particularly in Polynesia. On a per capita basis, exports have declined over the 20 years of data, particularly in Melanesia since 2005, which is largely driven by Fiji's declining sugar industry and the dissolution of preferential trade agreements. On a per capita basis, the region became a net importer twenty years ago and has remained so since (Fig. 4c).

The rise of imports since 1995 is consistent with patterns in liberalized trade for food and other commodities since the inception of the World Trade Organization in 1995. Six PICs have acceded to the World Trade Organization, most recently Samoa in 2011 and Vanuatu in 2012. In 2001 the intra-regional Pacific Island Countries Trade Agreement and Pacific Agreement on Closer Economic Relations (PACER, including Australia and New Zealand) were signed, aiming to support regional integration. The sub-regional Melanesian Spearhead Group Free Trade Area became operational in 2013. In 2017, an updated PACER + Agreement was finalized, signed by several countries, although notably not Fiji and PNG. These international instruments have continued trends toward more open economies in the region, which have accelerated since World War II. The associated benefits for Pacific Island economies, however, have been limited (Morgan, 2018).

Overlaid on these global and regional trade and investment-related agreements, and perhaps in response to them, a major shift has occurred in the origin of imported food, most notably the rise in imports from Eastern and South-Eastern Asia, which, in 2018, were comparable to those from Australia (Fig. 5). The majority of these imports by weight were rice (42%), sweetened and flavoured beverages (8%), raw and refined sugar (7%) and prepared or preserved fish (mostly canned tuna and mackerel (5%). Rice, in particular, has become a key import in Melanesia and Micronesia.

In 1995, early in the current regime, New Zealand was the most important exporting country, but has slipped in importance as its exports have stabilized and imports from Australia and Eastern and South-

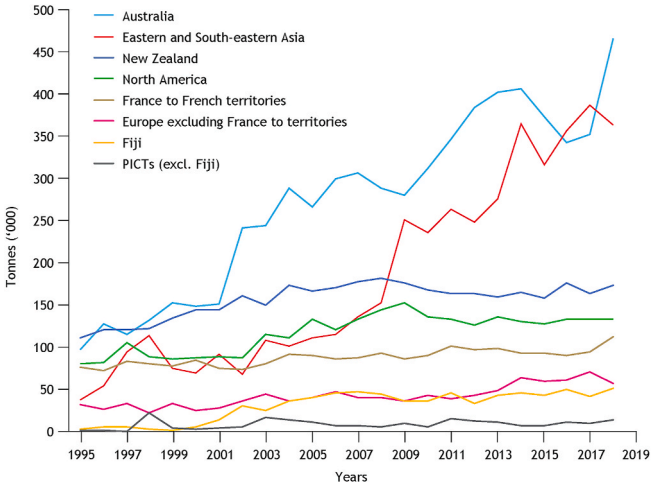

Fig. 5. Annual import (t) of food commodities by PICTs from major exporting nations and regions. Africa, Central and Western Asia, Latin America and the Caribbean, and PNG (to the rest of the region) are excluded as collectively they comprised only 2.7% of export volume for the period. Country assignment to global regions derived from United Nations Statistical Division classification (https://unstats.un.org/unsd/methodology/m49/overview/).

Eastern Asia have more than doubled. The majority of exports from Europe to the region were from France to its territories (Fig. 6). Intra-regional trade in food accounts for a minor proportion of the total food imported to PICTS (mean = 4.3% for the period 2014–18, including Fiji). The most significant regional exporter is Fiji (mostly sugar). Smaller PICTs, including Nauru, Wallis and Futuna, Niue, Tuvalu and Tokelau, import from a limited number of countries and are generally more dependent on food re-traded through other PICTs, notably Fiji and Samoa (Fig. 6). Fiji, with a 2018 population of 883,490, imported the greatest quantity of food and beverages, primarily wheat from Australia. Wheat and wheat flour from Australia and rice from Vietnam and Thailand are important elements of the contemporary Pacific food system.

Globally, trade liberalization has had both positive and negative impacts. The main negative impact of trade liberalization for food security and nutrition has been 'uneven dietary development' (Hawkes, 2006; Bezuneh and Yiheyis, 2014). Food categories that have become consistently more available following trade liberalization include vegetable oils, meat, highly processed foods and sugar-sweetened beverages (Schram et al., 2015; Lopez et al., 2017). Trade liberalization can also exacerbate problems with solid waste in the region through increased imports of single-use, non-recyclable packaging, or potentially recyclable packaging for which there is currently no infrastructure or viable market (Farrelly et al., 2016). Positive implications include availability of an increased diversity of foods, including fruits and vegetables, and reduced volatility in food availability (Gillson and Fouad, 2014), although challenges exist in the distribution and storage of fresh foods (Thow et al., 2011).

3.4. 'Healthiness' of food and beverage net imports

Although liberalized trade may improve dietary quality, reduce undernutrition (García-Dorado et al., 2019), and reduce food insecurity at an aggregate level (Kerr, 2011), evidence that it has benefited the region is weak (Connell, 2007). As a measure of the healthiness of food trade, we calculated an index of food categories considered to be either 'healthy' (e.g. fresh fruit, fresh vegetables including staple root crops, pulses, nuts and seeds and staple whole-grain cereals) or unhealthy (e.g. fatty meat, energy dense beverages, ready-to-eat snacks and meals, and sugars and other caloric sweeteners). Broadly, these food groups represent the extremes of healthy and unhealthy food, and have been developed by the International Network for Food and

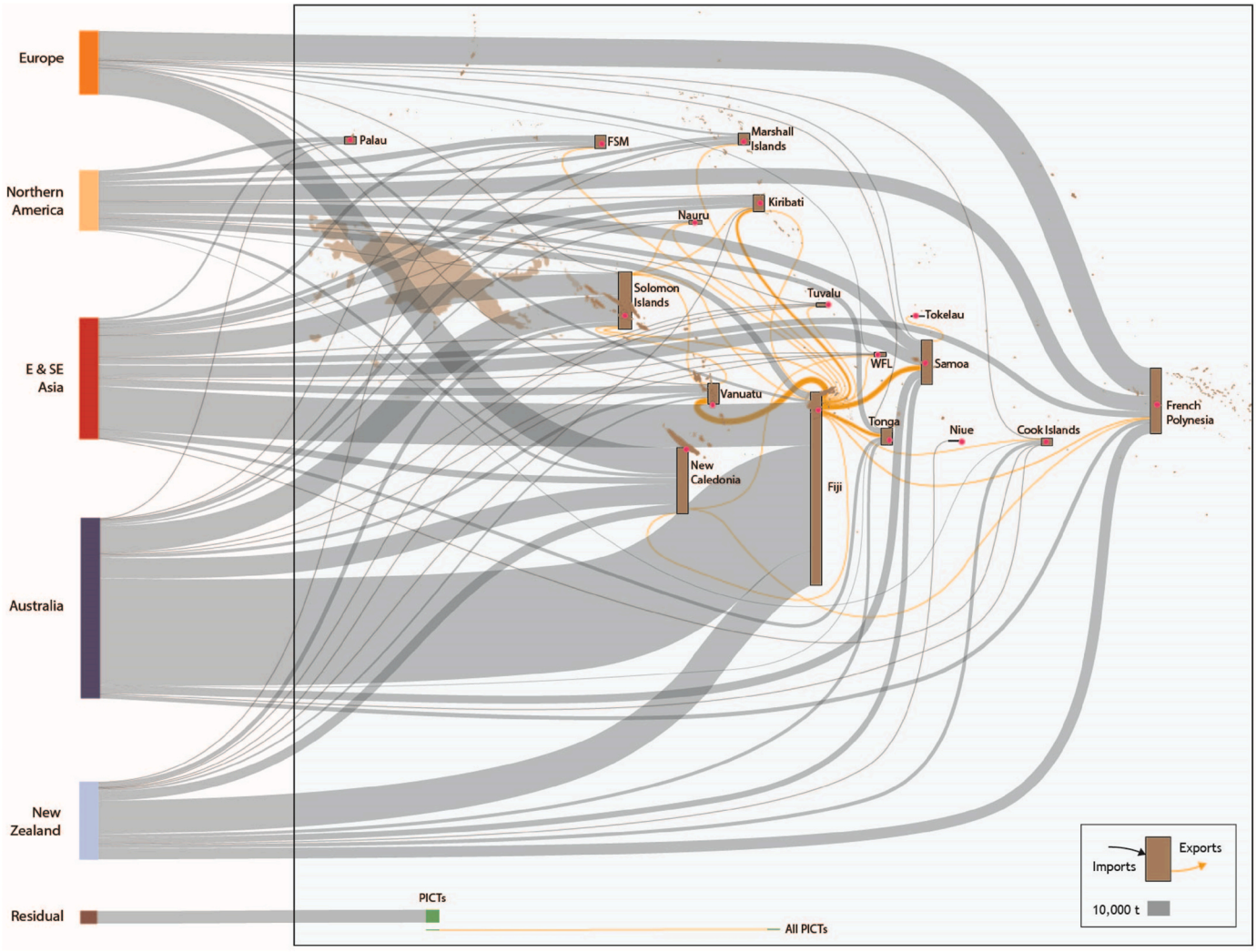

Fig. 6. Imports of food commodities from major export regions to PICTs and trade flows between PICTS (in gold). Shown are mean annual trade flows for the period 2014–2018 pooled for all food commodities included in this study (see Table S1 for exclusions). Trade flows to and from Papua New Guinea not shown. Red dots indicate relative geographic position of PICT capitals. Residual trade flow into the region includes imports from Africa, the Middle East, South America and South Asia and flows that sum to less than 100 t. Also shown is a residual PICT-PICT trade flow which is the sum of all trade flows <50 t p.a. for each PICT-PICT pairing. The width of lines and height of columns are proportional to quantities traded. Lines representing flows of less than ca. 100 t are not visually distinguishable. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Obesity/non-communicable diseases Research, Monitoring and Action Support (Friel et al., 2013; see Supplementary information). We recognize the difficulty of categorizing foods in isolation of other elements of the diet and so used only those foods that could unambiguously be categorized as healthy or unhealthy (23% of the 579 HS6 codes in the dataset, Supplementary text). The index was calculated as the sum of all unhealthy food categories subtracted from the sum of all healthy food categories, normalised to −1 to 1.

Overall, the region imported more healthy than unhealthy food until a sharp reversal in 2007–08 (Fig. 7). This pattern was driven by Melanesia, which saw a precipitous fall in the net importation of healthy food, primarily driven by a surge in sugar imports to Fiji from 2008 onward. In preceding years the influence of sugar tapers off, as imports of other unhealthy commodities increases. This increase coincided with the Asian Food Price crisis and supports the proposition by Weinberger et al. (2009) that the crisis contributed to a shift to low-quality food. Large declines in net healthy imports were also observed in Polynesia, in the period 1997–2003 which was largely driven by the collapse of Tongan exports of squash to Japan (which fell from 23,000 t in 1998 to 1500 t within five years), and total exports from 2009 in Micronesia, which fell sharply from 2013 (Fig. 7).

4. Public health outcomes

The rise of NCDs has major implications for regional economic development, in addition to the tragedies of foreshortened lives and lengthened periods of living with diet-related morbidity. Globally, 80% of NCD deaths occur in low- and middle-income countries (WHO, 2014), and an estimated 75% of adult deaths in the Pacific region are due to NCDs, with the majority of deaths occurring among adults in the economically active age bracket (SPC, 2011). PICTS are disproportionately affected by obesity, taking all spots of the top-ten most overweight or obese nations on earth (WHO, 2020). This trend does not show signs of slowing. In some PICTs, between 1980 and 2008, the mean adult BMI rose by more than 2.0 kg/m^2 per decade, five times the mean increase in BMI worldwide over the same period (Finucane et al., 2011; Hawley and McGarvey, 2015). The incidence of diet-related NCDs continued to rise between 1990 and the present, with Type 2 Diabetes Mellitus more than doubling, and ischemic heart disease and stroke rising by 25–50% (Fig. 8). All of these trends indicate severe diet-related dysfunction, and are only expected to worsen under climate change (Savage et al., 2020).

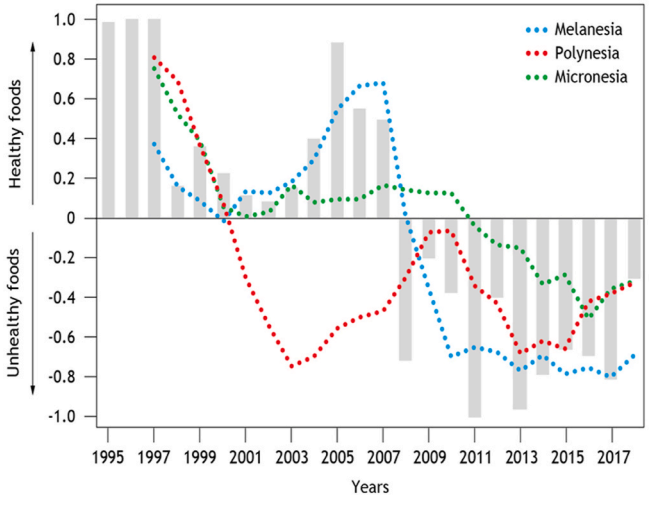

Fig. 7. 'Healthiness' of food and beverage net imports through time, including regional estimate excluding PNG (grey bars) and 3-point moving averages for Polynesia (red), Melanesia (blue) and Micronesia (green). Healthy foods included fresh fruit, fresh vegetables including staple root crops, pulses, nuts and seeds and staple whole-grain cereals. Unhealthy foods included fatty meat, energy dense beverages, savoury ready-to-eat snacks and meals, sweet snacks (e.g. biscuits, pastries, confectionary) and sugars and other caloric sweeteners. Fiji export of cane sugar and sugar-derived foods to non-PICTs are excluded. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

5. Seeds of transition to a healthier and just Pacific food system

Elements of contemporary Pacific food production, notably fish and root and tree crops, are critical to meeting subsistence needs and have adapted and survived through the centuries. These old foods, embedded in cultural obligations of reciprocity and kinship will continue to be a source of resilience for Pacific food systems (Campbell, 2015). Overlaid on this continuity, the rise of new foods has impacted on the system to such a degree that traditional foods compete with imported foods in the diets of Pacific people (e.g. Pollock, 1992, 2017; Hughes and Lawrence,

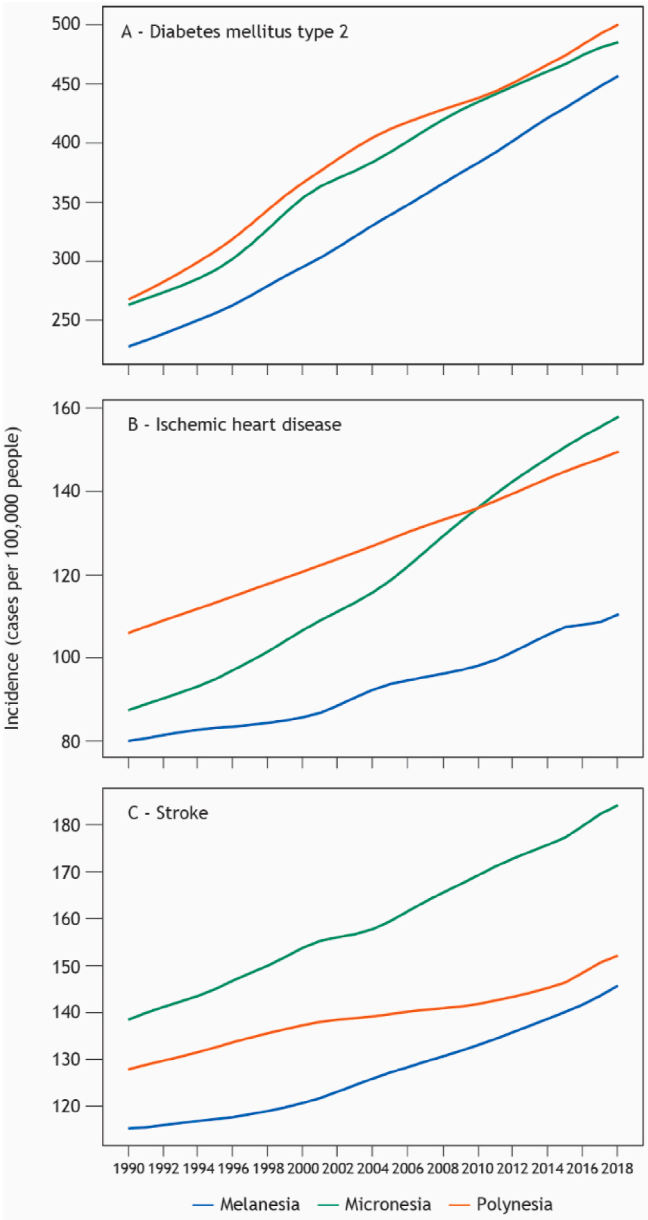

Fig. 8. Incidence of (a) type 2 diabetes mellitus, (b) Ischemic heart disease, and (c) stroke in Polynesia (red), Melanesia (blue) and Micronesia (green) between 1990 and 2018. Source: Global Burden of Disease (2019). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

2005).

Under the current global industrialized regime, the Pacific food system and its national components is not providing the people of the region with adequate nutritious food. Per capita agricultural and coastal fisheries production are declining, and imports of staples, sugar, and other foods are increasing. These trends, along with a host of external drivers such as the long shadow of colonialism, urbanization, climate change, labour mobility, trade liberalization and a search for 'modernity' combine to accelerate the nutrition transition that has been underway in the region for nearly a century. All of these drivers of change have impacted on diets through associated demographic, social and cultural shifts, including changes to food environments. Less healthy foods, primarily imported, have become increasingly convenient, cheaper, heavily marketed and readily available (relative to healthy traditional foods), shifting incentives for consumers towards unhealthy diets (Hughes and Lawrence, 2005; Sievert et al., 2019; Savage et al., 2020).

Trade and other policies affecting the food system have been relatively stable over the last 35 years yet the regional food system continues to evolve, partially driven by imported foods. This trajectory suggests a high degree of path dependence, or 'lock-in', that buffers and resists change (e.g. Costanza, 2014). Radical change of the type needed to give effect to national and regional visions for the Pacific of a healthier, more sustainable system is unlikely to occur without external shocks and/or a greater degree of purposive evolution.

COVID-19 is a 'live' example of the type of shocks that may disrupt the regime, possibly into a new configuration. It is premature to draw conclusions about the impacts of COVID-19 on the Pacific food system and its governing regime, but it is certain to cause profound economic and social shocks to national food and health systems already struggling to cope (Farrell et al., 2020). Whether this shock will put sufficient pressure on the Pacific food regime to create windows of opportunity for novelty and radical change will be a critical question in the coming months and years.

Visions for change may crystalize from participatory scenario development processes that explore 'what if' questions around possible future trajectories of food systems in the PICTs (e.g. SPC, 2015). Any visioning or scenario process would need to confront the political economy dimensions of change, and in particular the trade-offs inherent in any change, both environmental and social (Mausch et al., 2020). Consensus would greatly facilitate the development and implementation of regional food system investment. Recent literature highlights climate-resilient development pathways as a framework for identifying development trajectories that integrate adaptation and mitigation to realize the goal of sustainable development (IPCC, 2019). In light of the climate change impacts on PICTs, both observed and projected, and the threat they pose to livelihoods, agriculture, fisheries and human health (Bell et al., 2016; Savage et al., 2020), using participatory scenario processes to explore climate-resilient pathways offer a potentially useful methodology for reaching the consensus needed implement the actions and transitions that regional food systems will require.

The broader literature on social practice and the governance of complex adaptive social-ecological systems stresses the limits to which the configuration of such a system can be designed and governed (Jentoft, 2007; Shove and Walker, 2007), and 'by' and 'for' whom. The subset of the socio-technical systems transitions literature concerned with governing transitions to sustainability (e.g. Rotmans et al., 2001; Smith et al., 2005) identifies strategies for doing so, ranging from choosing among possible trajectories, supporting particular niche innovations, investing in capacity for innovation, or seizing windows of opportunities while resisting blueprint solutions. The literature converges on the view that transitions can be governed to avoid, for example, transgressing 'planetary boundaries' and maintaining societies within a 'safe operating space' (Galaz et al., 2012; Springmann et al., 2018). It advocates a set of principles for effective governance: that it should not only be efficient, but ethically sound and socially just, embedded in local or regional political and social contexts, interactive and multi-stakeholder driven; requiring of governing institutions and agents sensitivity, inclusiveness, flexibility and caution. Acceptance that in any complex system there is a 'limit of governability' (Jentoft, 2007) requires rejection of an instrumental, rational model and an embrace of institutional experimentation and learning by doing.

Harnessing the energy, creativity and moral force of grassroots movements—whether of extended kinship networks, traditional leadership, churches, municipal authorities, or diaspora networks—will be an important element in any transition. Innovations in production do not have to take the form of new farming systems, such as aquaculture and hydroponics, or novel processed foods; they can be reassertions of earlier, perhaps better adapted institutions and technologies, such as local management of fisheries, and growing root crops that survive cyclones and saline water intrusions and diverse multi-tiered agroforestry systems. Following indigenous American and Australian practice (Bodirsky and Johnson, 2008; Grey and Patel, 2015), it may be useful to identify these technologies and practices under a political vision to 'decolonize' the food system.

Such a framing does not mean abandoning trade and resisting new foods and technologies, but rather an evolution towards a 'localized modernity' (Arce and Long, 2000; see also Ritzer, 2003; Pollock, 2017) - a negotiated accommodation to take advantage of the environmentally and nutritionally best of imported foods within an evolved local food system (see also Murray, 2001). Elements of the globalized food system such as fortified rice, canned fish and greater use of the oceanic tuna harvest could augment coastal fisheries and root crops in a hybrid food system that is neither 'traditional' or 'modern' (see also Connell, 2013). To paraphrase Arce and Long (2000), through such a framing it becomes possible to mobilize local wisdoms and social history to remake the food system in a globalized and changing environment; rejecting the worst of the food that comes over the horizon and celebrating what is local and good. The search for hybrids that work creatively within constraints invokes a form of bricolage (Lévi-Strauss, 1962; Cleaver, 2012) – piecing together what is available in new ways to forge a set of interdependent national hybrid food systems that better serve Pacific peoples.

Funding

This study was funded by the Australian Government through ACIAR projects FIS-2016-300 and FIS-2018-155, and The University of Wollongong. We are also grateful for the financial support of the National Science Foundation (CNH, 1826668 to JGE, JAG, CDG and KLS).

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Neil Andrew, Tom Brewer, Hampus Eriksson, Anna Farmery, Michael Sharp, Anne Marie Thow, and Jillian Tutuo reports financial support was provided by Australian Centre for International Agricultural Research. Christopher D. Golden, Jessica Gephart, Katherine Seto, and Jacob Eurich reports financial support was provided by National Science Foundation.

Acknowledgements

We are grateful to Eleanor McNeill for graphics, and an anonymous reviewer, Ann Fleming and Dirk Steenbergen for comments on the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.gfs.2021.100608.

References

Albert, J., et al., 2020. Malnutrition in rural Solomon Islands: an analysis of the problem and its drivers. Matern. Child Nutr. 16, e12921 https://doi.org/10.1111/mcn.12921.

Andrew, N.L., et al., 2019. Coastal proximity of populations in 22 Pacific Island countries and territories. PLoS One 14, e0223249. https://doi.org/10.1371/journal.pone.0223249.

Aqorau, T., 2019. Fishing for Success: Lessons in Pacific Regionalism. Australian National University, Canberra.

Arce, A., Long, N., 2000. Anthropology, Development, and Modernities: Exploring Discourse, Counter-tendencies, and Violence. Routledge, London.

Bell, J.D., et al., 2015. Diversifying the use of tuna to improve food security and public health in Pacific Island countries and territories. Mar. Pol. 51, 584–591. https://doi.org/10.1016/j.marpol.2014.10.005.

Bell, J.D., et al., 2021. Pathways to sustaining tuna-dependent Pacific Island economies during climate change. Nat. Sustain. 4, 900–910. https://doi.org/10.1038/s41893-021-00745-z.

Bell, J., Bahri, T., 2018. A new climate change vulnerability assessment for fisheries and aquaculture. SPC Fish. Newsl. 156, 43–56.

Bell, J.D., Johnson, J.E., Hobday, A.J., 2011. Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change. Secretariat of the Pacific Community, Noumea, New Caledonia.

Bell, J.D., et al., 2009. Planning the use of fish for food security in the Pacific. Mar. Pol. 33, 64–76. https://doi.org/10.1016/j.marpol.2008.04.002.

Bell, J.D., et al., 2016. Climate Change and Pacific Island Food Systems. CCAFS and CTA, Copenhagen, Denmark and Wageningen, the Netherlands.

Bell, J.D., et al., 2019. Realising the food security benefits of canned fish for Pacific Island countries. Mar. Pol. 100, 183–191. https://doi.org/10.1016/j.marpol.2018.10.034.

Bellù, L.G., Liberati, P., 2005. Impacts of Policies on Poverty. Absolute Poverty Lines. Food and Agriculture Organization of the United Nations, FAO. Available at: http://www.fao.org/3/a-am386e.pdf.

Berg, A., et al., 2018. Circular economy for sustainable development. Reports of the Finnish Environment Institute 26, 20.

Bezuneh, M., Yiheyis, Z., 2014. Has trade liberalization improved food availability in developing countries? An empirical analysis. J. Econ. Dev. 39, 63–78. https://ideas.repec.org/a/jed/journl/v39y2014i1p63-78.html.

Bodirsky, M., Johnson, J., 2008. Decolonizing diet: healing by reclaiming traditional indigenous foodways. Cuizine 1. https://doi.org/10.7202/019373ar.

Bogard, J., et al., 2021. A typology of food environments in the Pacific Region and their relationship to diet quality in Solomon Islands. Foods 10, 2592. https://doi.org/10.3390/foods10112592.

Brewer, T.D., et al., 2009. Thresholds and multiple scale interaction of environment, resource use, and market proximity on reef fishery resources in the Solomon Islands. Biol. Conserv. 142, 1797–1807. https://doi.org/10.1016/j.biocon.2009.03.021.

Campbell, J.R., 2015. Development, global change and traditional food security in Pacific Island countries. Reg. Environ. Change 15, 1313–1324. https://doi.org/10.1007/s10113-014-0697-6.

Cassels, S., 2006. Overweight in the Pacific: links between foreign dependence, global food trade, and obesity in the Federated States of Micronesia. Glob. Health 2, 1–8. https://doi.org/10.1186/1744-8603-2-10.

Charlton, K.E., et al., 2016. Fish, food security and health in Pacific Island countries and territories: a systematic literature review. BMC Publ. Health 16, 1–26. https://doi.org/10.1186/s12889-016-2953-9.

Cleaver, F., 2012. Development through Bricolage: Rethinking Institutions for Natural Resource Management, first ed. Routledge, London. https://doi.org/10.4324/9781315094915.

Connell, J., 2007. Towards free trade in the Pacific? The genesis of the 'kava-biscuit war' between Fiji and Vanuatu. Geogr. Res. 45, 1–12. https://doi.org/10.1111/j.1745-5871.2007.00425.x.

Connell, J., 2013. Islands at Risk? Environments, Economies and Contemporary Change. Edward Elgar Publishing, Cheltenham, UK and Northampton, USA.

Costanza, R., 2014. A theory of socio-ecological system change. J. Bioecon. 16, 39–44. https://doi.org/10.1007/s10818-013-9165-5.

Coyne, T., Badcock, J., Taylor, R., 1984. The Effect of Urbanisation and Western Diet on the Health of Pacific Island Populations. South Pacific Commission, Noumea, New Caledonia.

Englberger, L., et al., 2013. Documentation of the traditional food system of Pohnpei. In: Kuhnlein, H., et al. (Eds.), Indigenous Peoples' Food Systems: the Many Dimensions of Culture, Diversity and Environment for Nutrition and Health. United Nations Food and Agriculture Organisations, Rome, pp. 191–220.

Estimé, M.S., Lutz, B., Strobel, F., 2014. Trade as a structural driver of dietary risk factors for noncommunicable diseases in the Pacific: an analysis of household income and expenditure survey data. Glob. Health 10, 1–15. https://doi.org/10.1186/1744-8603-10-48.

Evans, M., et al., 2001. Globalization, diet, and health: an example from Tonga. Bull. World Health Organ. 79, 856–862.

Fanzo, J., et al., 2020. A research vision for food systems in the 2020s: defying the status quo. Glob. Food Sec. 26, 100397 https://doi.org/10.1016/j.gfs.2020.100397.

FAO, 2020. FAOSTAT Database. UN FAO. Retrieved rom. http://www.fao.org/faostat/en/. (Accessed 3 March 2021).

Farmery, A.K., et al., 2020. Aquatic foods and nutrition in the Pacific. Nutrients 12, 3705. https://doi.org/10.3390/nu12123705.

Farrell, P., et al., 2020. COVID-19 and Pacific food system resilience: opportunities to build a robust response. Food Sec 12, 783–791. https://doi.org/10.1007/s12571-020-01087-y.

Farrelly, T., Schneider, P., Stupples, P., 2016. Trading in waste: integrating sustainable development goals and environmental policies in trade negotiations toward enhanced solid waste management in Pacific Islands countries and territories. Asia Pac. Viewp. 57, 27–43. https://doi.org/10.1111/apv.12110.

Finucane, M.M., et al., 2011. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. Lancet 377 (9765), 557–567. https://doi.org/10.1016/S0140-6736(10)62037-5.

Firth, S., 2000. The Pacific Islands and the globalization agenda. Contemp. Pacific 12, 177–192.

Friedmann, H., 1993. The political economy of food: a global crisis. N. Left Rev. 197, 29–57.

Friedmann, H., McMichael, P., 1989. Agriculture and the State System: the rise and decline of national agricultures, 1870 to the present. Soc. Rural. 29, 93–117. https://doi.org/10.1111/j.1467-9523.1989.tb00360.x.

Friel, S., et al., 2013. Monitoring the impacts of trade agreements on food environments. Obes. Rev. 14 (Suppl 1), 120–134. https://doi.org/10.1111/obr.12081.

Friel, S., Schram, A., Townsend, B., 2020. The nexus between international trade, food systems, malnutrition and climate change. Nat. Food 1, 51–58. https://doi.org/10.1038/s43016-019-0014-0.

Gaitán-Cremaschi, D., et al., 2019. Characterizing diversity of food systems in view of sustainability transitions. A review. Agron. Sustain. Dev. 39, 1. https://doi.org/10.1007/s13593-018-0550-2.

Galaz, V., et al., 2012. 'Planetary boundaries'—exploring the challenges for global environmental governance. Curr. Opin. Environ. Sustain. 4, 80–87. https://doi.org/10.1016/j.cosust.2012.01.006.

García-Dorado, S.C., et al., 2019. Economic globalization, nutrition and health: a review of quantitative evidence. Glob. Health 15, 1–19. https://doi.org/10.1186/s12992-019-0456-z.

Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res. Pol. 31, 1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8.

Geels, F.W., 2019. Socio-technical transitions to sustainability: a review of criticisms and elaborations of the Multi-Level Perspective. Curr. Opin. Environ. Sustain. 39, 187–201. https://doi.org/10.1016/j.cosust.2019.06.009.

Gillett, R., 2016. Fisheries in the Economies of Pacific Island Countries and Territories. Pacific Community, Forum Fisheries Agency, and Australian Aid, p. 684. http://www.spc.int/fame/en/component/content/article/237-benefish-study-2016.

Gillson, I., Fouad, A., 2014. Trade Policy and Food Security: Improving Access to Food in Developing Countries in the Wake of High World Prices. The World Bank, Washington DC.

Golden, C.D., et al., 2021. Social-ecological traps link food systems to nutrition outcomes. Glob. Food Sec. 30, 100561 https://doi.org/10.1016/j.gfs.2021.100561.

Grey, S., Patel, R., 2015. Food sovereignty as decolonization: some contributions from Indigenous movements to food system and development politics. Agric. Hum. Val. 32, 431–444. https://doi.org/10.1007/s10460-014-9548-9.

Hawkes, C., 2006. Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases. Glob. Health 2, 1–18. https://doi.org/10.1186/1744-8603-2-4.

Hawley, N.L., McGarvey, S.T., 2015. Obesity and diabetes in Pacific Islanders: the current burden and the need for urgent action. Curr. Diabetes Rep. 15, 1–10. https://doi.org/10.1007/s11892-015-0594-5.

Herrero, M., Thornton, P., 2020. What can COVID-19 teach us about responding to climate change? Lancet Planet. Health. 4, e174 https://doi.org/10.1016/S2542-5196(20)30085-1.

Herrero, M., et al., 2020. Innovation can accelerate the transition towards a sustainable food system. Nat. Food 1, 266–272. https://doi.org/10.1038/s43016-020-0074-1.

HLPE, 2017. Nutrition and Food Systems. A Report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on. World Food Security, Rome.

Horsey, B., et al., 2019. Dietary diversity of an adult Solomon Islands population. Nutrients 11, 1622. https://doi.org/10.3390/nu11071622.

Hughes, R.G., Lawrence, M., 2005. Globalisation, food and health in Pacific Island countries. Asia Pac. J. Clin. Nutr. 14, 298–306.

Ingram, J., 2011. A food systems approach to researching food security and its interactions with global environmental change. Food Sec 3, 417–431.

IPCC, 2019. Climate Change and Land: an IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems Summary for Policy Makers. Report. Geneva, Switzerland. https://bit.ly/2U1gzza.

Jentoft, S., 2007. Limits of governability: institutional implications for fisheries and coastal governance. Mar. Pol. 31, 360–370. https://doi.org/10.1016/j.marpol.2006.11.003.

Kerr, W.A., 2011. The role of international trade in achieving food security. Estey Centre J. Intl. Law Trade Pol. 16, 1–13.

Lévi-Strauss, C., 1962. La pensée sauvage, vol. 289. Plon Paris.

Lopez, A.M., et al., 2017. Is trade liberalization a vector for the spread of sugar-sweetened beverages? A cross-national longitudinal analysis of 44 low-and middle-income countries. Soc. Sci. Med. 172, 21–27. https://doi.org/10.1016/j.socscimed.2016.11.001.

Mausch, K., Hall, A., Hambloch, C., 2020. Colliding paradigms and trade-offs: agri-food systems and value chain interventions. Glob. Food Sec. 26, 100439 https://doi.org/10.1016/j.gfs.2020.100439.

Morgan, W., 2018. Much lost, little gained? Contemporary trade agreements in the Pacific Islands. J. Pac. Hist. 53, 268–286. https://doi.org/10.1080/00223344.2018.1475832.
Murray, W.E., 2001. The second wave of globalization and agrarian change in the Pacific Islands. J. Rural Stud. 17, 135–148.
Niessen, L.W., et al., 2018. Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. Lancet 391, 2036–2046. https://doi.org/10.1016/S0140-6736(18)30482-3.
Oliver, T.H., et al., 2018. Overcoming undesirable resilience in the global food system. Global Sustain 1, E9. https://doi.org/10.1017/sus.2018.9.
Plahe, J.K., Hawkes, S., Ponnamperuma, S., 2013. The corporate food regime and food sovereignty in the Pacific Islands. Contemp. Pac. 25, 309–338. https://doi.org/10.1353/cp.2013.0034.
Pollock, N.J., 1992. These Roots Remain: Food Habits in Islands of the Central and Eastern Pacific since Western Contact. Institute for Polynesian Studies Honolulu, Honolulu, Hawaii.
Pollock, N.J., 2017. Diversification of foods and their values: Pacific foodscapes. In: Gnecchi-Ruscone, E., Paini, A. (Eds.), Tides of Innovation in Oceania: Value, Materiality and Place. Australian National University Press, ACT, Australia, pp. 261–293.
Rip, A., Kemp, R., 1998. Technological change. In: Rayner, S., Malone, E.L. (Eds.), Human Choice and Climate Change: Vol. II, Resources and Technology. Battelle Press, Columbus, Ohio, pp. 327–399.
Ritzer, G., 2003. Rethinking globalization: glocalization/grobalization and something/nothing. Soc. Theor. 21, 193–209. https://doi.org/10.1111/1467-9558.00185.
Rockström, J., Sukhdev, P., 2016. How Food Connects All the SDGs, vol. 14. Stockholm Resilience Centre.
Rotmans, J., Kemp, R., Van Asselt, M., 2001. More evolution than revolution: transition management in public policy. Foresight 3, 15–31. https://doi.org/10.1108/14636680110803003.
Savage, A., McIver, L., Schubert, L., 2020. The nexus of climate change, food and nutrition security and diet-related non-communicable diseases in Pacific Island Countries and Territories. Clim. Dev. 12, 120–133. https://doi.org/10.1080/17565529.2019.1605284.
Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technol. Anal. Strat. Manag. 20, 537–554. https://doi.org/10.1080/09537320802292651.
Schram, A., et al., 2015. The role of trade and investment liberalization in the sugar-sweetened carbonated beverages market: a natural experiment contrasting Vietnam and the Philippines. Glob. Health 11. https://doi.org/10.1186/s12992-015-0127-7.
Shove, E., Walker, G.P., 2007. Caution! Transitions ahead: politics, practice, and transition. Manage. Environ. Plan. A 39, 763–770.
Sievert, K., et al., 2019. Processed foods and nutrition transition in the Pacific: regional trends, patterns and food system drivers. Nutrients 11, 1328. https://doi.org/10.3390/nu11061328.
Smith, A., Stirling, A., Berkhout, F., 2005. The governance of sustainable socio-technical transitions. Res. Pol. 34, 1491–1510. https://doi.org/10.1016/j.respol.2005.07.005.
Snowdon, W., et al., 2013. Processed foods available in the Pacific Islands. Glob. Health 9, 1–7. https://doi.org/10.1186/1744-8603-9-53.
Sobal, J., Khan, L.K., Bisogni, C., 1998. A conceptual model of the food and nutrition system. Soc. Sci. Med. 47, 853–863.
SPC, 2011. Food security in the Pacific and East Timor and its vulnerability to climate change. Noumea, New Caledonia. http://www.environment.gov.au/system/files/pages/275228c5-24db-47f2-bf41-82ef42cda73d/files/food-security-report.pdf.
SPC, 2015. Alternative Futures for the Pacific Food System. Secretariat of the Pacific Community, Suva, Fiji.
SPC, 2017. Agriculture and Climate Change in the Pacific Island Region. The Pacific Community, Noumea, New Caledonia.
Springmann, M., et al., 2018. Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. Lancet Plan. Health. 2, e451–e461. https://doi.org/10.1016/S2542-5196(18)30206-7.
Thaman, R.R., 1982. Deterioration of traditional food systems, increasing malnutrition and food dependency in the Pacific Islands. J. Food Nutr. 39, 109–121.
Thow, A.M., et al., 2010. Trade and food policy: case studies from three Pacific Island countries. Food Pol. 35, 556–564. https://doi.org/10.1016/j.foodpol.2010.06.005.
Thow, A.M., et al., 2011. Trade and the nutrition transition: strengthening policy for health in the Pacific. Ecol. Food Nutr. 50, 18–42. https://doi.org/10.1080/03670244.2010.524104.
Turner, C., et al., 2018. Concepts and critical perspectives for food environment research: a global framework with implications for action in low-and middle-income countries. Glob. Food Sec. 18, 93–101. https://doi.org/10.1016/j.gfs.2018.08.003.
Weinberger, K.M., et al., 2009. Food crisis in the Asia-Pacific region. Asia Pac. J. Clin. Nutr. 18, 507–515.
WHO, 2014. Global Action Plan for the Prevention and Control of Non-communicable Diseases 2013-2020. WHO, Geneva, Switzerland.
Willett, W., et al., 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. Lancet 393, 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4.