Geoforum 75 (2016) 40–51

Contents lists available at ScienceDirect

Geoforum

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

Spatialising the Melanesian *Canarium* industry: Understanding economic upgrading in an emerging industry among three Pacific small island states

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ARTICLE INFO

Article history:
Received 11 January 2016
Received in revised form 4 July 2016
Accepted 4 July 2016
Available online 9 July 2016

Keywords:
Economic upgrading
Pacific
Small island states
Micro-enterprise
Core-periphery relations
International development

ABSTRACT

This paper examines economic upgrading in the *Canarium indicum* (*Canarium*) nut industry in Vanuatu, the Solomon Islands and Papua New Guinea. *Canarium* is a tree that is indigenous to Melanesia, and has been the subject of several commercialisation attempts since 1988. The paper assesses the outcomes to various actors in the *Canarium* supply chain from attempts to upgrade industry products and processes by: (1) increasing the available resource in suitable locations; (2) improving nut products and processing techniques; (3) increasing actors' knowledge and supply chain coordination; and (4) establishing product standards. A two-phase data generation process was implemented. Document analysis and participant observations of industry workshops initiated a set of four economic upgrading interventions that were adaptively implemented. A second stage of workshops and 76 interviews enabled outcomes to be assessed at the project's end. Findings suggest that a small number of urban-based entrepreneurs benefit and subsequently are lead actors in industry development, but at the expense of benefits being distributed to a larger, more spatially disparate group of smallholder and small commercial growers. These economic upgrading outcomes are circumscribed by core-periphery relations in Pacific small island states and the scale of industry in each country. Thus, spatial inequalities are reproduced through the emerging *Canarium* industries. We argue that different routes to industry development are required in each country. Development initiatives that capitalise on the benefits of micro-enterprise clusters, joint action and regional institutional arrangements are proposed to overcome the impediments imposed by the particular geographies of Pacific island states.

1. Introduction

In accordance with agricultural globalization, Pacific island states are encouraged through development imperatives to establish commercial agricultural export sectors (Storey and Murray, 2001; Murray, 2000, 2001; Connell, 2007), the outcomes of which have tended to negatively impact on rural households, and result in industries that have not been sustainable over the long term (e.g., Tongan squash pumpkin, Niuean Taro; see Murray, 2001). Subsequent development recommendations have remained export-oriented, but there is also a focus on the development of niche products (AusAID, 2009). With a few exceptions (e.g., FIJI Water; see Jones, 2012), niche products have not featured significantly in Pacific economies and evidence of the impact on rural households is scant. Niche commodities–high quality and value-added agricultural products–may become increasingly important for Pacific island states as subsidized exports such as textiles and sugar lose government protection and market share (Connell, 2007).

Canarium indicum (*Canarium*) is a tree indigenous to Melanesia, providing edible nuts that have traditional and customary significance (e.g., nutrition, building material for canoes and other wooden items, resin for light, traditional medicines) as well as commercial potential, comparable to the international macadamia nut industry (Thomson and Evans, 2006). The development of *Canarium* as a cash crop and potential niche product is widely viewed as an effective means to improve the livelihoods of rural Melanesian households (Evans et al., 1996; Nevenimo et al., 2007; Bunt and Leakey, 2008; Wallace et al., 2012). Its industry potential arises from the abundance of *Canarium*, the commercially attractive characteristics of the nuts (e.g., thin shells, large kernels,

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http://dx.doi.org/10.1016/j.geoforum.2016.07.003
0016-7185/

ease of opening, and oil content), and unmet local demand (Thomson and Evans, 2006; Nevenimo et al., 2008; Bunt and Leakey, 2008). This paper uses economic upgrading as the conceptual lens to examine the impacts on actors in the fledgling *Canarium* nut industry in the Melanesian nations of Vanuatu, the Solomon Islands and Papua New Guinea (PNG), shown in Fig. 1.

The research reported here comprised one component of an Australian overseas aid project involving the first author, implemented in the three island nations. The entire aid project involved market research about consumer preferences for various nut products (e.g., dried, salted, chocolate-coated etc.), agricultural science research into improved processing (e.g. different nut crackers, processing standards such as drying temperatures and packaging requirements for different products) and social science research into the opportunities and constraints for participation by different actors in the *Canarium* supply chain. The latter is the focus of this paper.

First, we survey the challenges of socio-economic development in small island developing states. Second, we explore the theoretical and empirical literature relating to economic upgrading in developing countries. The methods used to implement the exploratory, qualitative study are described in Section Four, and we present a country-by-country synthesis of our research findings in Section Five. Finally, in Section Six, we emphasise the influence of core-periphery relations that may be observed in Pacific small island states and their role in shaping the outcomes of economic upgrading in industries of different scales. We also propose alternative development trajectories for each country that capitalise on the benefits of micro-enterprise clusters, joint action and institutional arrangements to improve livelihoods in the Pacific. In doing so, we provide–to the best of our knowledge–the first analysis of economic upgrading in a Pacific context, and we demonstrate that upgrading efforts in a single industry produce spatially and socio-economically uneven outcomes shaped by core-periphery relations in small island developing states. Thus, the case studies reported here provide a contrasting perspective to the extensive upgrading literature that tends to be dominated by 'success stories' (Milberg and Winkler, 2011).

2. The challenges of socio-economic development in small island developing states

Small island developing states (SIDS) contend with a range of unique socio-economic development challenges, but these challenges are not necessarily a reflection of their small size (e.g., populations less than three million) or 'islandness' (Armstrong and Read, 2003, 2006). Armstrong and Read (2003, 2006) illustrate the lack of explanatory power of these factors, explaining that states with small population sizes are disproportionately represented at the high end of gross national income per capita in comparison with large states. Instead, the development challenges faced by SIDS tend to be shaped by: (1) limited natural resources, which is partly a function of their small geographic size; (2) small domestic markets, which have limited the development of a critical mass of domestic economic activity; (3) low diversification of exports, creating high dependence on the limited number of economic activities and export markets; and (4) a high dependence on imports to satisfy domestic consumption needs, which renders low-cost trade links vitally important (Tisdell, 2002; Armstrong and Read, 2003; McGillivray et al., 2008).

These challenges are compounded for Pacific SIDS because they tend to be more distant from major global markets (e.g., Japan, USA and European Union) in comparison with the global cohort of small states. Armstrong and Read's (2006) analysis reveals that 73% of Pacific SIDS are located more than 5000 km from their nearest 'global' market compared with 37% of all small states. These spatial disparities may be viewed as corollaries of an international core-periphery dynamic in which highly developed countries are the core of economic, political and social dynamism and lesser developed nations remain peripheral (Krugman and Venables, 1995). Internal core-periphery relations may also be observed within

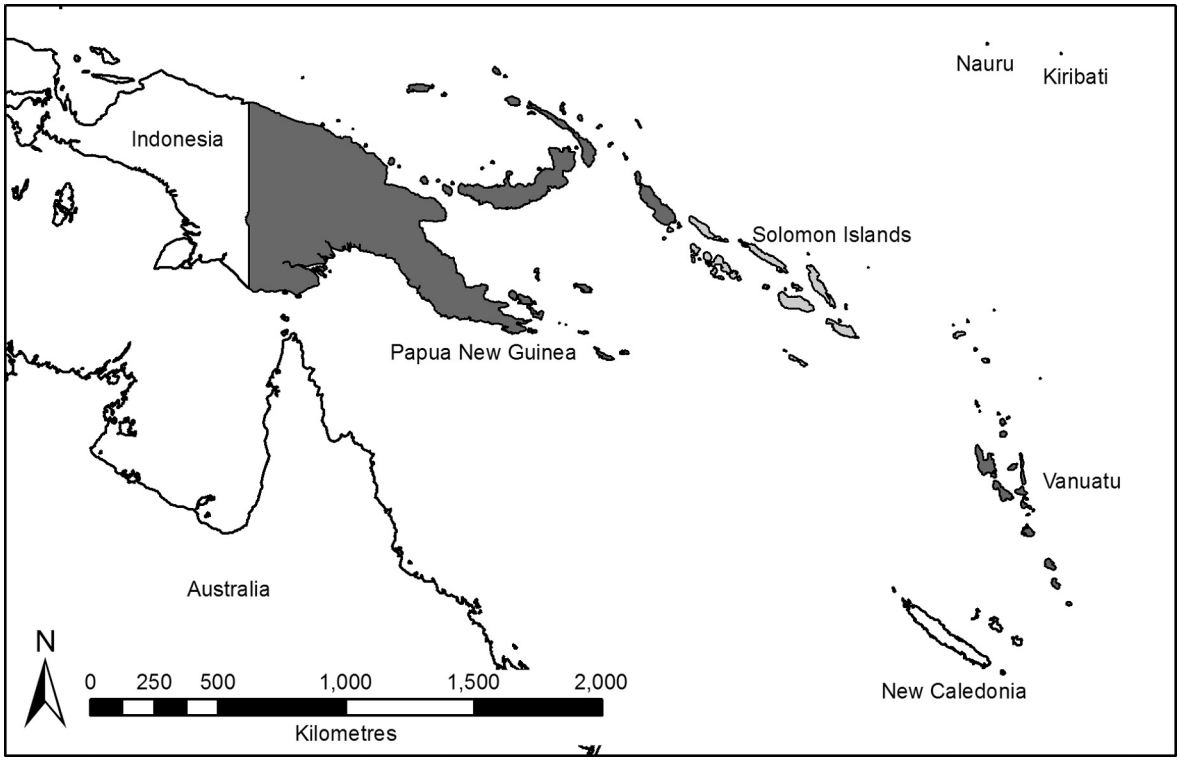

Fig. 1. The Melanesian region showing Papua New Guinea, Solomon Islands and Vanuatu.

SIDS. Urban centres (generally capital cities) within each of the Pacific SIDS function as the core, fulfilling the major commercial and administrative functions and providing the majority of waged employment, while the remote periphery comprises physically isolated communities and particularly outer islands with significant disparities in population; all characterised by small-scale, traditionally-based production systems of cropping and animal husbandry for food, socio-cultural purposes and cash (Sofer, 1988, 2007; Weaver, 1998).

This internal core-periphery pattern influences the development and sustainability of micro-enterprise based on the commercialisation of perishable raw commodities. Irregular and unreliable transportation, particularly between islands, inadequate service provisioning (e.g., electricity, communications), relatively high costs of agricultural inputs for remote communities, and scarcity of investment jeopardises product supply and quality, hindering the effective co-ordination of all actors in supply chains across islands and between neighbouring countries (Tisdell, 2002; McGillivray et al., 2008).

Pacific Islanders are thus susceptible to the particular geographies of their island nations which typify those of small, spatially dispersed communities separated by distance from urban centres and often large tracts of ocean. In turn, there is a geography to the distribution of benefits arising from economic upgrading in commodity supply chains. The concept of economic upgrading holds utility for understanding these dynamics, but to date has not been applied in Pacific contexts. In the absence of a Pacific-based literature, we explore the extant literature reporting economic upgrading in developing country contexts in the next section.

3. The prospects for economic and social upgrading in Pacific small island states

Upgrading "is largely about gaining competitiveness in higher value added processes" (Milberg and Winkler, 2011, 361). The term is typically used in an economic sense, that is, upgrading refers to "the ability of producers to make better products more efficiently, or to move into more skilled activities" (Pietrobelli and Rabellotti, 2006, 1). More recently, examinations of upgrading have considered social upgrading, which refers to the implications of economic upgrading for "living standards, including wages, working conditions, economic rights, gender equality and economic security" (Milberg and Winkler, 2011, 341); and environmental upgrading which is the "process of improving the environmental impact of value chain operations" (Poulsen et al., 2016, 60). Nonetheless, economic upgrading is a useful initial concept to examine how the activities of enterprises may be improved (Barrientos et al., 2011) and is particularly pertinent given the developmental stage of the *Canarium* industry in Melanesia.

The processes of economic upgrading are influenced by: (1) decisions and effort made at the level of the firm (Giuliani et al., 2005); (2) the environment in which firms operate (Giuliani et al., 2005); and (3) the degree of joint action between producers and other local actors such as consultants and input suppliers (Gomes, 2006; see also Damiani, 2008). Thus, while capabilities and resources of the individual enterprise level matter, the relationships between lead actors and enterprises, other enterprises in the sector, governance institutions and communities are the most significant when seeking to understand economic upgrading processes (Murphy, 2007). The importance of effective institutional arrangements to upgrading has been demonstrated in a range of agricultural and other primary industry contexts. The expansion and resilience of small to medium fresh-fruit grower businesses in Brazil was effectively facilitated by long-term state government research and extension programmes (Gomes, 2006). Similarly, Oddone and Padilla's (2014) value chain analysis demonstrates that professional and supporting services provided at critical nodes in the supply chain were likely to improve economic outcomes (e.g., productivity, efficiency, quality and revenues) for shrimp farmers (El Salvador), non-traditional vegetable growers (Guatemala) and fine wood producers (Guatemala). Crucially, these authors recognise that emerging primary industries in developing countries may be solely reliant on public support to foster a conducive institutional environment because private services are either not available or too expensive for rural producers.

There are two pressing issues in the context of agricultural research and development projects in Pacific SIDS. First, there is little research on the outcomes for rural households arising from economic upgrading of niche products in agricultural supply chains. This lack of research attention directed towards the agricultural sector may reflect a similar bias to the one Damiani (2008) observes in the broader literature on economic clusters in which analyses of manufacturing industries tend to dominate. Second, there is a lack of attention paid to the likely spatial disparities in the distribution of benefits for micro-enterprises, workers and local communities resulting from economic upgrading initiatives, that is, how locational disadvantage affects particular individuals or communities in the process of upgrading. The particular geographies of SIDS compel exploration of the local-scale impacts of economic upgrading in the Pacific (see previous section). Our research on economic upgrading in the *Canarium* supply chain helps to illuminate the geography of these benefits.

There is little agreement about how best to measure the concept of economic upgrading (Milberg and Winkler, 2011), partly reflecting an issue of scale.[2] Choosing appropriate measures of economic upgrading is further complicated in fledgling agricultural industries in developing countries where there is either little or no statistical data to aid analysis. In turn, we adopt a qualitative, inductive research approach to examine economic upgrading in the *Canarium* industry. Our assessment of economic upgrading focuses on product and process upgrading; an approach that is consistent with an enterprise-level of analysis (see Milberg and Winkler, 2011) and the most common forms of upgrading in primary industries (Giuliani et al., 2005).

Product and process upgrading are two of the four types of economic upgrading processes commonly identified in the literature (Humphrey and Schmitz, 2002; Giuliani et al., 2005).[3] Product upgrading involves producing more sophisticated (i.e., higher-value, niche) products. In small-scale agriculture, product upgrading might comprise the production of higher value products such as the shift to organic coffee production in Mexico (Damiani, 2008). Process upgrading involves changes to production systems to increase efficiencies such as the timely use of pesticides to produce higher quality tobacco in Yunnan Province, China (Damiani, 2008). In practice, product and process upgrading are closely intertwined and are highly dependent on the advancement of science and technology (Giuliani et al., 2005).

The *Canarium* research reported in this paper involved a range of actors including smallholder, subsistence growers with a few trees in their plots; and mixed plantations which are usually cocoa and coconut commercial growers. Many smallholders sell raw kernels in roadside stalls and village markets. Processors are single or

[2] See Milberg and Winkler (2011) for a list of a wide range of variables used to assess economic and social upgrading at country, sector and enterprise scales.

[3] The other two types of upgrading are: (1) functional upgrading which involves changes to the functional mix to increase the overall skill content; and (2) intersectoral or chain upgrading which is the application of expertise in a particular function within a new sector (Humphrey and Schmitz, 2002; Giuliani et al., 2005).

family businesses who collect the nuts and sometimes added value, then on-sell these products to larger enterprises including oil pressers, cafes and restaurants. Marketing may occur by these actors or independent actors. The agricultural and marketing research resulted in improved, stable, marketable products such as dried or salted nuts in different sized packets, while processes such as mechanised cracking and small solar driers were trialled with several actors. A set of processing standards was produced by the research team to guide growers and processors about the optimum processes required for each product. In the next section, the research methods used to explore the opportunities and constraints for participation by different actors in the *Canarium* supply chain are outlined.

4. Methods

4.1. Data generation and analysis

The research and development initiative occurred during 2008–2014, funded by the Australian government. Data generation for the social research occurred in two phases. Phase One involved a document analysis and a series of four workshops to establish baseline data about the initial state of the industry and best strategies for upgrading (Table 1). Twenty-nine key policy and research documents from across the participant countries were sourced from government officers. The workshops were attended by a range of *Canarium* stakeholders (e.g., smallholder and commercial growers, processors, marketers, national government officers, researchers and representatives from the macadamia nut industry from Australia[4]) during which observations and semi-structured conversations were recorded. The array of stakeholders attending each workshop stimulated discussion about similar developments in related successful industries such as the Macadamia nut industry. Workshops were designed to collaboratively help share insights and challenges about upgrading *Canarium*. Data were pooled from the documents and workshops and subjected to thematic analysis. Four key industry upgrading interventions were identified from the data and adaptively implemented during the project. The interventions were used to benchmark the status of the industry at the start of the project and then evaluate changes during the project based on the available data at each time. Thus, the interventions were designed to both develop the programme from year one, and then to assess its progress at the project's end.

During Phase Two, interviews with the key government or non-governmental organisation (NGOs) partners from each country were conducted to confirm the themes generated in Phase One were appropriate interventions that would be useful for assessing progress. Then, 73 one-on-one or group interviews were conducted in situ (i.e., in a government office, local village or on farm) with representatives from eight government or non-government organisations (NGOs); 55 smallholders and commercial growers; and 10 processors and marketers. Interviews were followed by four workshops designed to communicate the progress of the research and its interventions and gather input from stakeholders about their efficacy (Table 1). Thematic analysis was again deployed to analyse the notes recorded during these interviews and workshops to assess whether and how the indicators changed between the two time periods, focusing upon differences and/or similarities between stakeholders and across space.

[4] Macadamia nuts are grown in a similar climate in Queensland, Australia, and the development of the industry started with small-scale growers, meaning that important lessons might be shared.

Table 1
Fieldwork conducted during Phase One and Phase Two of data generation. Source: Wallace et al. (2015).

Stakeholder group	Vanuatu	Solomon Islands	Papua New Guinea
Phase one			
Workshops[a]	2	3	2
Documents analysed	5	9	15
Phase two			
Interviews to confirm information from Phase One			
Government and NGOs	1	1	1
Interviews to investigate the impacts of the interventions			
Government and NGOs	2	3	3
Smallholders and commercial growers	20	30	5
Processors and marketers	3	4	3
Workshops[b]	1	2	1

[a] Numbers reported here record the number of workshops attended by representatives from each country. Workshops were held at the following times: Papua New Guinea (November, 2009; PNG and SI); Vanuatu (2× April, 2009; SI and V); Vanuatu (April 2010; PNG, SI and V).

[b] Numbers reported here record the number of workshops attended by representatives from each country. Workshops were held at the following times: Papua New Guinea (September 2014; PNG); Vanuatu (April 2012; V); Solomon Islands (April 2011; October 2013; SI).

4.2. The interventions

The four interventions are described below and linked to product or process upgrading.

4.2.1. Available resource

The first intervention, available resource, refers to the number and spatial distribution of trees available to growers to commence supply in the industry. While increasing the number and spatial dispersion of *Canarium* trees could be considered as a contribution to biodiversity and thus environmental upgrading, it is possible that some larger commercial growers will plant monocultures of the tree and contribute to biodiversity reduction. We therefore use this intervention only to assess product upgrading in terms of commencement of the supply of, and value-adding to, nuts to a commercial industry that would conform to industry standards under development by the agricultural scientists.

Prior to the project, *Canarium* production was generally limited to small-scale harvesting for subsistence and sale in roadside and village stalls. In Vanuatu and the Solomon Islands, government staff perceived the dispersed and distant nature of the resource, and informal harvesting practices, as prohibiting the development of a commercial industry. Participants requested national *Canarium* planting programmes to increase the available resource. Government-led interventions increased the number of trees, along with their spatial concentration, through a seedling propagation programme and distribution of high producing varieties of *Canarium* in Vanuatu and the Solomon Islands. In PNG, there were government-led and private sector-led planting programmes. The widely dispersed nature of many smallholders' trees did not allow for accurate measurement of changes in the available resource beyond the number of seedlings distributed during the planting programmes.

4.2.2. Infrastructure and equipment

Participants considered it necessary to improve the availability, quality and reliability of infrastructure in order to transport nuts between producers, processing facilities and distribution centres (e.g., ports, airports), as well as electricity supply for processing. Equipment refers to the availability and suitability of storage facilities for the nuts, buckets or crates for transporting raw nuts, and

other inputs needed for business operations and compliance with standards. Thus, this intervention focused on promoting and assessing supply chain efficiencies or process upgrading.

Transport infrastructure tends to be sparse throughout Melanesia, and often unreliable in that flights or shipping can be cancelled due to inclement weather, particularly on outer-lying islands, which in combination with a lack of suitable on-farm equipment to gather and transport nuts (e.g., buckets) and prevent spoilage (e.g., driers, storage facilities), disrupts product flows between growers and buyers. The interventions were: (1) tree planting programmes and the relocation of government staff in Vanuatu to spatially concentrate and expand the industry near essential infrastructure; (2) development and testing of suitable nut drying techniques to stabilise the nut until it could be transported to essential infrastructure; and (3) construction of a processing factory in PNG.

4.2.3. Knowledge and supply chain coordination

The third intervention, 'knowledge and supply chain coordination' refers to the dispersal of knowledge regarding best practice for cracking nuts so they can be transported and stored immediately to prevent spoilage. It also refers to the establishment of effective connections between growers, processors and marketers to produce and market the product. Process and product upgrading is therefore demonstrated by increased knowledge and skill levels among *Canarium* actors in relation to these efficiencies in the supply chain.

Prior to the project, growers in Vanuatu and the Solomon Islands typically sold *Canarium* nut-in-shell (NIS) because the dominant method for cracking nuts–traditional hand cracking–was labour intensive. Smallholders are self-employed, and labour-intense agricultural techniques divert their attention from subsistence farming and other daily livelihood needs; while commercial growers have other products (cocoa, coconut) requiring labour efficiencies. Connections between growers, processors and marketers were scarce in all countries, with marketing primarily led by processors. Activities implemented for this intervention were: (1) the distribution of knowledge and training for alternative nut cracking techniques through workshops and brochures; and (2) the development of grower organisations to provide training and coordination of supply and marketing. Training and supply chain networking were also facilitated through the Phase One and Two workshops.

4.2.4. Product specifications and standards

Product specifications and standards is the final intervention. It refers to the development of standardized product specifications and techniques for growers and processors/marketers to best create value-added products and, therefore, focuses on product and process upgrading. Prior to the project, there were no protocols or guidelines for product quality, processing requirements, or labelling in any of the participating countries. Consequently, the *Canarium* nut supply had been highly variable in terms of quality, nut size and taste which were barriers to expanding the industry beyond local markets into the cruise ship tourism, restaurants, or export markets. The primary intervention to address these challenges was the development of written protocols for raw product, processing techniques, and labelling standards for marketable items. Training in the design of product labels with appropriate information was also provided at the research workshops.

5. Results

This section provides a country-by-country analysis of the economic upgrading outcomes derived from the industry development interventions. A comparative summary of the pre-project status and the impacts of each intervention at the end of the project is provided in Table 2 at the end of the section.

5.1. Vanuatu

Vanuatu is a country of more than 80 islands with a total land area of approximately 12,000 square kilometres (United Nations, 2015). The country has the smallest population (234,023) of the three case study countries. Although the population is increasingly concentrated in the main urban centres (Port Vila and Luganville), the majority of the population (76%) reside in rural areas (VNSO, 2009). The agricultural sector contributed 22% of gross domestic product in 2014 (VNSO, 2014).[5] The combined primary sector (agriculture, forestry and fishing) is the dominant employer of ni-Van (demonym for citizens of Vanuatu), employing 61% of the working population, although this increases to 75% of the rural working population. In turn, 60% of rural households rely on sales of crops, fish or handicrafts as their main source of income (VNSO, 2009), although many also rely on subsistence activities.

In 2015, the Government of Vanuatu launched its Agriculture Sector Policy, which outlines how it intends to bring sustainable development to the sector to 2030 (Vanuatu Agriculture Sector Policy, n.d.). Although the Department of Agriculture and Rural Development recognises the potential of new cash crops such as *Canarium* to diversify rural incomes and exploit overseas niche markets, the government is yet to initiate a national-level tree nut policy (Department of Agriculture and Rural Development, n.d.).

Canarium (or *nangai* as it is locally known) is predominantly grown in the western provinces of Vanuatu (Sanma, Malampa and Shefa provinces; Fig. 2). The harvesting season typically occurs between October and January (Thomson and Evans, 2006). *Canarium* has been previously exported to Australia, Japan and Hawaii; development of the industry in the 1990s was driven by the private sector through the South Pacific Nuts Company based in Port Vila. This company has since re-branded as the Kava Shop, but continues to successfully market nuts to the local retail and tourism markets. Despite this success, the local air and cruise ship tourism markets offer significant potential for industry growth (Nevenimo et al., 2007; Bunt and Leakey, 2008). The main products produced by the Vanuatu *Canarium* industry are snack packs, honey and sugar coated nuts and *nangai* nut cookies.

5.1.1. Evidence of economic upgrading in Vanuatu

Prior to the project, the *Canarium* resource in Vanuatu primarily comprised domesticated trees surrounding villages and wild stands harvested by smallholders. Despite the government-led seedling distribution, most production at the end of the project continued to be from wild and small-scale harvesting because the distributed seedlings had not yet reached maturity.

At the start of the project, *Canarium* stakeholders invited to attend workshops by their national governments and the project team suggested that some degree of spatial concentration of the industry around urban areas with access to electricity infrastructure for processing and transport facilities (e.g., airport, port) was necessary to overcome the challenges associated with low quality essential infrastructure in many areas of the country. Spatial concentration was pursued through the distribution of seedlings around the main urban areas of Luganville and Port Vila, and the transfer of a government agricultural officer to Luganville to help establish the industry. Despite these efforts, process upgrading

[5] The contribution of the agricultural sector to Vanuatu's gross domestic product is expected to be severely reduced in 2016 following Cyclone Pam (category five) in March 2015.

Table 2
Reported changes from the interventions.

	Pre-project benchmark	Intended intervention/s	Post-project comparison
Available resource	Domesticated trees around villages (V, SI)	Distribution of seedlings by government agencies among landholders (V, SI, PNG)	Distribution of high kernel varieties to mixed plantation landholders and smallholders (V, SI)
	Wild stands (V, SI)		
	Small-scale growers with garden plots (PNG)		150,000 seedlings distributed to small-scale growers (PNG)
	Small number of stands from previous *Canarium* development projects (PNG)		46,000 trees planted by commercial plantation companies (PNG)
Infrastructure and equipment	Lack of reliable transport/electricity infrastructure (V, SI, PNG)	Spatial concentration of the industry (V, SI)	Concentration of industry near key infrastructure (V)
	Lack of equipment to dry, store and transport nuts (V, SI)	Government efforts to secure investment partners (V, SI, PNG)	Processing factory constructed in 2014 (PNG)
	Limited capital/cash flow available to processors to fund business operations and compliance (V, SI, PNG)	Drying regimes for value adding tested (V, SI, PNG)	On-farm cocoa infrastructure not suitable for *Canarium* (PNG)
		Processing factory constructed (PNG)	Processors sourced drying equipment (V, SI)
			Some growers value-add by drying nuts using traditional methods or dried kernels in glass jars (V, SI)
Knowledge and supply chain co-ordination	Traditional hand cracking of nuts (V, SI, PNG)	Project workshops to facilitate supply chain networking (PNG, SI, V)	Traditional hand cracking continues to dominate (V, SI)
	No supply chain co-ordination (SI, PNG)	Grower and/or industry associations to facilitate supply chain co-ordination (V, SI, PNG)	Chinese hand crackers to be used in factory (PNG)
	One processor coordinated supply chain near Port Vila (V)	Training and quality control guidelines for cracking nuts (V, SI, PNG)	Training and supply chain co-ordination led by existing and new processors (V, SI)
		Range of nut cracking methods tested by NARI (PNG)	Cocoa industry to co-ordinate supply networks (PNG)
Product specifications and standards	Lack of quality standards for product, processing and product labelling (PNG, SI, V)	Development of standardised product specifications and descriptions (PNG, SI, V)	Standardised processing specifications and product descriptions distributed in final year of project (V, SI, PNG)
			Processors are also marketers and source product suitable for their specific market/s (V, SI)
			Product labels created for commercial packs (SI)

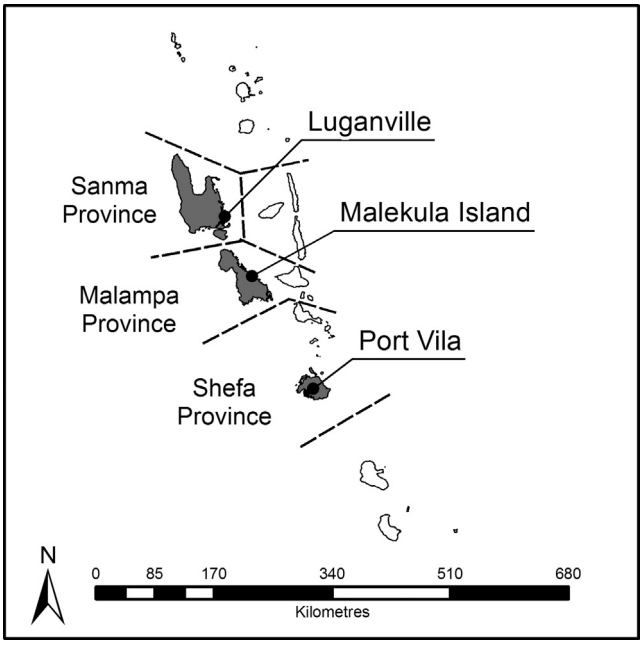

Fig. 2. Main *Canarium* growing areas (shaded) in Vanuatu and key locations.

remained problematic for some growers such as The Summit mixed planation, who did not have mains power supply for on-site processing. Thus, there was little incentive to increase plantings and adopt more efficient processing technologies and product upgrading. Unsurprisingly, processing and logistical efficiencies remained difficult for growers on more remote islands (e.g., Malekula Island; Fig. 2) and even smaller, more remote islands. For example, one grower on Malekula Island collected his harvest, dried it and took the nuts to the regional airport to crack and transport within the required 24 h timeframe to prevent nut spoilage, only to have the flight to Port Vila cancelled due to a storm and his entire harvest was destroyed.

At the end of the project, there was no evidence of on-farm process upgrading–and by extension, product upgrading–for farmers around Luganville, despite the potential of solar driers to enable growers without access to electricity to value-add on-farm and increase their returns by providing cracked and dried nuts instead of low-value NIS. The number of growers supplying the processor/marketer increased from a single family to more than 100 farmers, suggesting a larger number of ni-Van near Luganville were attracted by renewed government interest in the industry and the topicality of conversations about *Canarium*. However, the lack of grower value-adding meant they received relatively modest increases to their household income from *Canarium* supply. Prices received by farmers increased from 200 vatu/kg NIS in 2010, to 250vatu/kg NIS in 2014, an increase over the four years of only US$0.45/kg. When deflated by inflation rate, estimated at an average of 1.3% per year (VNSO, 2016) over the four years, the real increase is approximately 37 vatu or 0.05% of the average monthly household income in rural Vanuatu (VNSO, 2012). In contrast, there was evidence of greater product and process upgrading for the small-scale processor/marketer. After receiving training in improved drying techniques, a processor/marketer established in Luganville, funded her own drying equipment, and developed a list

of suppliers known to her. She then sold dried kernel and bulk raw oil to an oil presser, who returned some of the kernel cake to her to use in *nangai* nut cookies. She then developed her own product specifications customized to her market needs, and increased her sale prices from 2500 vatu/kg kernel (shelled nuts) to 3000 vatu/kg raw kernel or approximately US$4.45/kg over the same four years. When deflated by inflation rate, estimated at an average of 1.3% per year (VNSO, 2016) over the four years, the real increase is approximately 344 vatu or 0.35% of the average monthly household income for urban Vanuatu (VNSO, 2012). While no individual supplier data is available to ascertain the total income derived from *Canarium* for growers, the processor/marketer increased her output 50-fold between 2010 and 2014. Over the same time, she increased her supplier base 100-fold, thus on average, individual growers are unlikely to have accrued the same magnitude of revenue increase as the processer/marketer.

The other processor/marketer located near Port Vila had been a long established one with local growers who supplied his business prior to the project. In 2011, the proprietor paid suppliers 40 vatu/kg NIS and 1000 vatu/kg kernel that had been dried using traditional methods of smoking over the fire. By 2014, in an attempt to encourage higher value product (on-farm, dried kernel, packaged in glass jars) from growers around Port Vila, he offered 2000 vatu/kg kernel solar dried in glass jars, an increase of approximately US$9.20/kg, although most growers continued to supply NIS. At the project end he had decreased his purchase of raw product from 5000 tonnes to 3000 tonnes NIS per year. Although reasons for this are unclear, it may relate to the emergence of a new buyer in the market.

At the end of the project, six of the grower/industry associations that were intended to provide training in nut processing techniques (drying and cracking) and perform marketing and supply functions had been established, which suggests that growers had some support to increase their skills and knowledge of the industry. Processors directed growers as to the standards they required for their respective products. Growers had few opportunities to influence the development of the industry.

Although further process upgrading may be achieved by the use of solar driers that would enable growers to value-add on-farm and increase their returns, many growers cannot afford this equipment. Connections between growers and processors/marketers were sustained by one long established processor/marketer who continued to work with local growers and a new entrant to the industry who located elsewhere and developed her own standards and trained growers as to what she needed. Despite the connections instigated by the lead actors (processors), most growers continue to sell *Canarium* NIS to processors rather than dried kernel to avoid nut spoilage or due to costs of equipment.

5.2. The Solomon Islands

The Solomon Islands has a land area of 29,000 square kilometres (United Nations, 2015). The population is just over half a million (550,000) and has increased on average 3.0% per annum between 1999 and 2009. The growth rate of the urban population (4.7%) is much higher than the growth rate of the rural population (1.8%) (SINSO, n.d.). Notwithstanding this urbanisation trend, the majority of the population lives in rural areas (80%) and are widely dispersed across the hundreds of islands, islets and atolls that comprise the country (SINSO, n.d.).

The agricultural sector contributed 29% of gross domestic product in 2012 (SINSO, 2013). The dominant occupation among Solomon Islanders is 'subsistence farmers/fishers/hunters & gatherers' (52%), and 44% of all households rely on sales of crops, fish or handicrafts are their main source of income (SINSO, n.d.). The Solomon Islands government has made rural development its policy priority, which resulted in the Agriculture and Rural Development Strategy. This strategy recognises the potential of high-value niche products, such as indigenous nuts, to contribute positively to rural development over the medium to long term (2020) (Ministry of Development Planning and Aid Coordination, 2007). A subsequent policy for Indigenous fruits and nuts has been drafted, but is yet to be adopted by the government.

Canarium (or *ngali* in the Solomon Islands) is grown throughout most of the Solomon Islands (Fig. 3), with the fruiting season beginning around August and peaking in September/October (Thomson and Evans, 2006). The first attempt to commercialise *Canarium* was instigated by the Solomon Islands government in 1988 through the Commodities Export Marketing Authority, a government entity that purchased and processed NIS. Later, the government also provided shipping subsidies to support an international marketing initiative. The initiative met with mixed success because of supply challenges, and social tensions arising from customary ownership of trees and decreasing access to a traditional protein and energy sources (Bunt and Leakey, 2008). The main products were snack packs and kernel oil for cosmetics and pharmaceuticals (Nevenimo et al., 2007; Bunt and Leakey, 2008). Although these activities were not sustained in the long term, there remains potential for the industry through demand from domestic food service, hotel and retail sectors, as well as opportunities for export (University of the Sunshine Coast and The University of Adelaide n.d.).

5.2.1. Evidence of economic upgrading

Prior to the project, resource availability in the Solomon Islands was similar to the situation in Vanuatu (i.e., primarily domesticated trees surrounding villages and wild stands harvested by smallholders). A government-led programme propagated and distributed high kernel *Canarium* varieties. Seedlings were principally distributed to lead growers in the Western Province and some of the central islands (Fig. 3). The resource availability outcomes of this programme are similar to the outcomes in Vanuatu because the seedlings had not begun producing by the end of the project. Thus, most production continues to be from wild and small-scale harvesting. Nevertheless, the seedling distribution programme

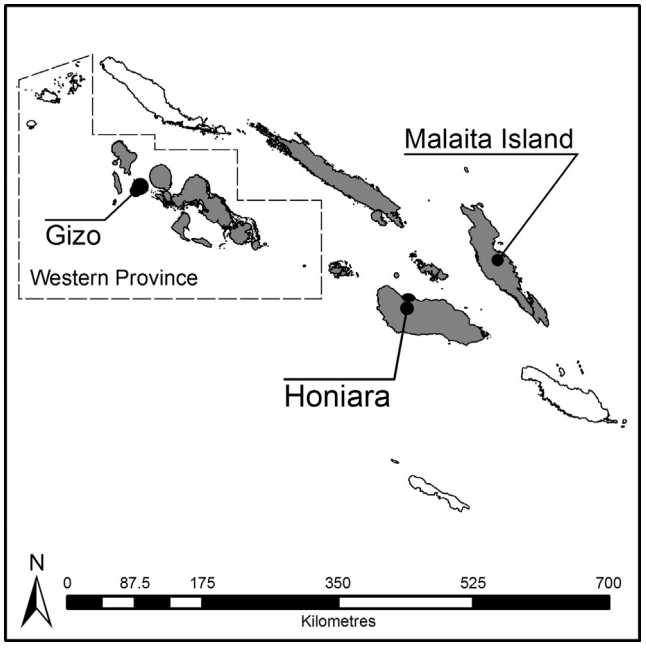

Fig. 3. Main *Canarium* growing areas (shaded) in the Solomon Islands and key locations.

means, at least in principle, that increased numbers of rural residents may be able to participate in the industry.

Consistent with developments in Vanuatu, actors from the Solomon Islands also suggested that some degree of spatial concentration of the industry around essential infrastructure was necessary. In turn, seedlings were distributed to growers on islands along shipping routes between the capital, Honiara, and Gizo in the Western Province (Fig. 3). Beyond these shipping routes, inadequate and unreliable infrastructure continued to constrain industry expansion to more remote locations (e.g., Malaita Island; Fig. 3) and outer islands.

There is some evidence of on-farm process upgrading in the Solomon Islands. Processors/marketers worked with growers, encouraging them to dry nuts using traditional methods. Despite these emerging connections along the supply chain, many growers continue to sell roasted *Canarium* kernel in 20 L buckets at local village markets and roadside stalls, or when they occasionally travel to Honiara for other reasons, but these activities remain constrained by limited numbers of buckets. Again, most growers cannot afford the solar driers.

There is some evidence of product upgrading for processors/marketers. Following one of the project workshops, the two Solomon Islands processors designed their own labels with nutritional information for their commercial products. Examination of supply and price data suggests that no increased returns to growers have materialised. During the tenure of the project, there was a marked contraction in nut volumes purchased by processors/marketers. This was primarily due to the disestablishment of the Australian military mission 'Regional Assistance Mission to Solomon Islands', which decreased demand from the temporary Australian residents in Honiara with high disposable incomes for snack nuts and cooking oils used in Honiara restaurants. The prices set by growers in 2014 increased to an unprofitable level (from SI $2.50/100 g to SI$3.00–4.00/100 g) for processors, possibly because local people can sell a string of 10–15 kernels at a roadside stall (a practice that was common throughout the Solomon Islands well before the project) for SI$2.00 at times or quality that are suitable to their circumstances. A grower reported that he preferred to keep his kernels for subsistence and ceremonial use rather than invest money or time in equipment to further add value; however, one processor continues to believe there are opportunities to supply dried nuts to muesli factories that have not yet been canvassed, and he intends to distribute the project standards along with labels to growers in the future.

At the end of the project, one of the grower/industry associations had been established. New connections between growers and processors/marketers had emerged. These connections were principally led by the owner of one of the two processing/marketing micro-enterprises. After he attended the first project workshop, the processor/marketer contacted growers and made arrangements to secure nuts that were suitable for his intended markets. However, consistent with the outcomes observed in Vanuatu, most growers continue to sell *Canarium* NIS to processors rather than kernel to avoid nut spoilage, which indicates that increases in knowledge about value-adding through mechanical cracking and drying did not eventuate in product and process upgrading by growers in the Solomon Islands.

5.3. Papua New Guinea

Papua New Guinea is the largest of the three case study countries with a land area of 462,840 square kilometres (United Nations, 2015) and a population of 7.3 million (NSOPNG, 2011). Although the PNG economy has become heavily dependent upon mineral and gas resources in recent years, the agricultural sector is crucial in terms of generating jobs, with 85% of the population dependent on agriculture for their livelihoods (PNG Department of National Planning and Monitoring, 2010). A key objective in PNG's National Agriculture Development Plan (2007–2016) is to promote economic growth in the agricultural sector, including the promotion of the local horticultural industry (nuts, root crops, vegetables, fruits, flowers and grains) "to serve both domestic and overseas niche markets and also to support household and national food security" (PNG Ministry of Agriculture and Livestock, n.d., 22).

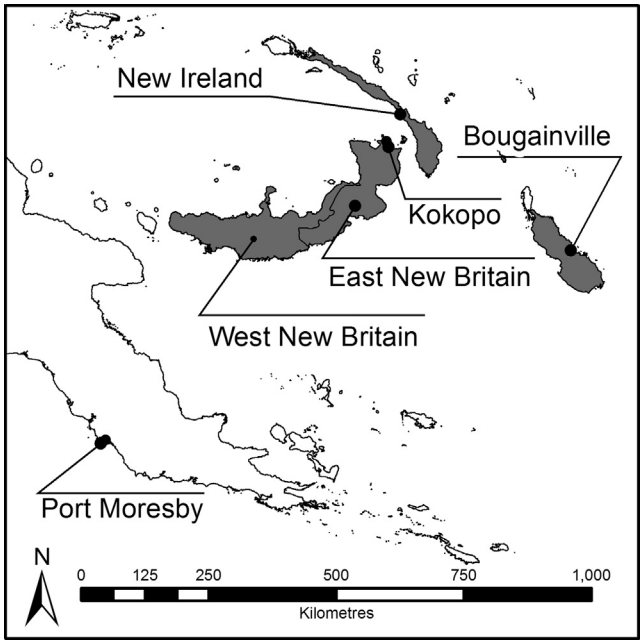

Fig. 4. Main *Canarium* growing areas (shaded) in Papua New Guinea and key locations.

Canarium (or *galip* as it is known in PNG) growing is concentrated in eastern PNG, on the islands of New Britain, New Ireland and Bougainville (Fig. 4). It is considered to be a complementary crop for local cocoa plantations by providing shade and additional sources of income, as well as a replacement crop to overcome the adverse impacts of cocoa pod borer disease, which has decimated cocoa production since 2006 (Nevenimo et al., 2008). The harvesting season typically occurs between May and July (Thomson and Evans, 2006), and the main products traded at village markets are traditionally dried, unpackaged NIS, raw unpackaged dry kernels, and raw kernels packaged in coconut frond baskets (Nevenimo et al., 2008). Despite this existing trade activity, research indicates that there is considerable potential to expand the industry due to unfulfilled domestic demand and opportunities for export (Nevenimo et al., 2007, 2008). Research and development of *Canarium* is led by the PNG National Agricultural Research Institute (NARI) which has established a seedling nursery and a pilot processing factory near Kokopo (East New Britain), and a *Canarium* industry development plan.

5.3.1. Evidence of economic upgrading

Prior to the project, *Canarium* production was limited to small-scale harvesting. The available resource increased during the tenure of the project via government-led seedling propagation and distribution programmes and commercial companies establishing plantations. In the case of the former, the NARI established a nursery with the aim of distributing 600,000 seedlings to growers by 2016; 150,000 seedlings had been distributed to smallholders (rural residents with small garden plots [average 3–4 trees] and cocoa growers [average 10–20 trees]) prior to the project timeframe. In the case of the latter, the East New Britain Development

Corporation planted 27,000 trees and Agmark (a PNG-based agribusiness that operates machinery and cocoa plantations) planted another 19,000 trees. Although the seedlings were distributed widely throughout New Britain, Bougainville and New Ireland, it is unclear to what extent this has influenced rural residents' access to and, therefore, their opportunities for income diversification through *Canarium* nut supply or processing. This is due to a combination of factors including: (1) insufficient time for the seedlings to mature; (2) ambiguity concerning exactly who received the seedlings (smallholders or cocoa producers with some growers still not planting the trees at the project end due to other interests); and (3) limited processing facilities.

Spatial concentration of the *Canarium* resource was less of a concern in PNG compared with Vanuatu or the Solomon Islands. Instead, an approach that harnesses existing cocoa infrastructure and supply networks is being pursued. Cocoa growers are already familiar with drying cocoa product on-farm as each cocoa grower over a certain size owns a fermenter to dry cocoa to the required moisture content for delivery to the buyers. However, trials during the project revealed that the driers and holding bins used for cocoa cannot be used for *Canarium* because of the risk of cross contamination. These challenges indicate that little process upgrading has occurred on-farm in PNG. To overcome these challenges, a processing factory funded by international development support was opened in Kerevat in 2014 (35 km southwest of Kokopo; Fig. 4) to receive and process large volumes of nuts once production volumes increase. This centralized processing location is enabled by an existing fleet of vessels (owned by Agmark) that service East New Britain and the surrounding islands. Process upgrading was also implemented by the NARI testing programme to determine the most efficient nut cracking technology. Chinese hand crackers were selected for use in the factory because trials showed that these devices can double the cracking rate of traditional hand cracking methods.

An industry group that was mooted to promote universal quality standards is yet to be established. It is hoped that once the seedlings mature, supply will increase and the existing cocoa networks will facilitate the distribution of product standards and descriptors to initiate product upgrading throughout the supply chain and ensure *Canarium* products are able to meet stringent export standards imposed by other countries. At the end of the project, mobilisation of the existing cocoa networks to create a coordinated industry group had not occurred, thus there was no evidence of rural residents being able to influence the development of the industry nor increases in rural residents' knowledge of suitable nut processing techniques. Nuts are sporadically purchased by NARI staff who telephone in advance to let villagers know they need nuts to supply the factory tests, and again, it is possible more rural residents will be able to supply the factory in years to come.

6. The socio-spatial outcomes of upgrading the Melanesian *Canarium* industry

The empirical evidence reported above points to modest economic upgrading outcomes arising from development efforts to upgrade the *Canarium* nut industries in Melanesia. The impacts of the interventions demonstrate a complex mix of outcomes that are shaped by core-periphery relations in Pacific small island states, as well as industry scale, which are outlined below.

6.1. The influence of core-periphery relations on economic upgrading

The core-periphery pattern of the Pacific SIDS, and the impacts of the interventions in this research, draw attention to the socio-economic disparities between urban centres and physically isolated–and marginalised–islands. These disparities are further reproduced through the development of the *Canarium* resource in the three case study countries. The extent to which rural Melanesians may participate in the emerging industry is dependent upon their location relative to urban areas and/or essential infrastructure. Growers in Vanuatu, who lived near urban areas in which processors/marketers are located, were able to continue to supply nuts, and in one region more growers supplied nuts. Where growers supplied dried kernel, they preferred to dry and crack nuts using traditional methods rather than improved techniques as driers, and probably mechanical crackers, were prohibitively expensive for most growers. Processors, however, rather than growers, were the main recipients of product and process upgrading, and increased revenues, as they were able to dry the raw kernel, produce packaged products, and some oil, to industry standards and on-sell these to other markets in some cases. The standards developed by the processors, such as shape, size, and colour of nuts to pick as well as length of time for drying (mostly traditional) methods, were individualised to their own product requirements. While some growers have been able to engage in product upgrading, economic upgrading outcomes have primarily been captured by a very small group of urban-based processors/marketers.

Notwithstanding the connections between growers and processors/marketers, economic upgrading benefits (e.g., providing higher value products) have accrued primarily to select groups of growers whose locational advantage permits supply according to these standards, while growers located on more remote islands remain disadvantaged. In PNG, locational disadvantage is less apparent than in the two smaller countries because of earlier investments in essential infrastructure (e.g., the shipping network operated by Agmark), meaning a centralised supply chain around a single, large-scale processing node is feasible, although only supply driven by NARI has commenced.

The significance of intra-country location to uptake of certain economic activities and, therefore, participation in upgrading reflects findings from the French bean industry in Senegal (Maertens and Swinnen, 2009). In that context, more growers living in regions closer to exporting companies and shipping facilities tended to be involved in French bean export production compared with growers in neighbouring regions, despite the geographic distances being less than 60 km. These concerns also bear resemblance to the scholarship examining the role and impact of alternative food networks in rural change. Alternative food networks that rely on niche products or markets, fair trade and organic certification are championed for redistributing income to marginalized smallholders (see, for example, Goodman, 2004; Morgan et al., 2008). Yet these benefits do not always materialize, with some scholars questioning the worth of these agri-food alternatives following evidence that they ultimately reproduce socio-economic inequalities at the point of production and elsewhere (see, for example, Watts et al., 2005; Mun Bbun and Thornton, 2013). The particular geography of Pacific SIDS will affect the ways in which an industry based upon a niche commodity may be developed because spatially dispersed communities are enrolled differently into core-periphery relations.

6.2. The influence of scale on economic upgrading

Differences in economic upgrading trajectories also point to the significance of scale of industry development. First, the domestic markets in Vanuatu and the Solomon Islands may be too small for such initiatives to offer substantive advantages, however, this may differ in PNG where the focus is on developing a large-scale industry with products destined for foreign markets.

Second, few growers adopted the use of mechanical crackers despite trials demonstrating increased time efficiencies. Smallholders in Vanuatu and the Solomon Islands who were able

to supply cracked nuts to processors/marketers continued to use hand cracking techniques because of financial limitations to acquiring mechanical crackers and the very high rate of damaged nuts (~two-thirds) incurred through mechanical cracking (Bunt and Leakey, 2008; Long Wah, 1996). Particularly in the case of the latter, economic upgrading may adversely impact financial returns because the use of mechanical crackers can jeopardise the production of high value produce, a point reinforced by some growers who felt they were more skilled in traditional hand-cracking techniques. Thus, mechanical crackers increase production risks for small-scale growers in Vanuatu and the Solomon Islands who produce very small harvests and may end up receiving lower (or even no) returns because of the absence of domestic markets for damaged, low value nuts. Thus, grower awareness of new methods for cracking *Canarium* and the value-adding process is not a major impediment to industry development in these countries. In light of the core-periphery dynamics reported above, development initiatives should focus on addressing the obstacles to industry participation for growers located on remote islands.

These findings are consistent with research reporting the ways in which industry actors may strategically opt out of upgrading to ensure long term sustainability through consistent, albeit, lower returns (Gereffi, 1995, cited in Barrientos et al., 2011; Ponte and Ewert, 2009). In contrast, the larger-scale industry involving regional collection points and factory production envisaged for PNG may be more suited to process upgrading with mechanical crackers because the higher nut volumes open up opportunities for other products such as flakes to be produced from damaged kernels (Nevenimo et al., 2007) and employment for people in urban areas. Given the recency of the factory operations, the rights of workers and other aspects of social upgrading within the factory setting are yet to be investigated, as is environmental upgrading.

6.3. Canvassing alternative routes to industry development

Understanding the influence of these factors on economic upgrading suggests alternative routes to industry development are required in each of the case study countries. The spatial and scalar disparities evident in the outcomes of the emerging *Canarium* nut industry suggest that it is unlikely that a single development approach focused exclusively on economic upgrading will lead to the development of sustainable *Canarium* industries in Melanesia. In Vanuatu, there is a basic lack of infrastructure and critical population and industry mass. Yet, Vanuatu's tourism market provides a point of differentiation in which the deficiencies and challenges of a nation-wide production system can be reworked or transformed into unique, localized experiences.

In contrast, in PNG, the move is toward commercial monoculture. A large-scale, long food-chain, export industry that utilizes existing cocoa industry infrastructure and networks may be suitable to small-scale production over a wide area; however, disparities of scale, proximity, and the costs of inputs and resources for growers, and particularly remote growers, seem likely to entrench inequalities that were present in previous commodity-based industries (e.g., cocoa, copra, and coffee), privileging large-scale, plantation production at the expense of small-scale, rural households.

The Solomon Islands *Canarium* industry may be positioned, both geographically and in terms of scale, between Vanuatu and PNG. Some of the same factors that affect Vanuatu will apply in the Solomon Islands, with its small, dispersed population and low level of infrastructure development, compared with the large investments made in PNG. The country's close proximity to PNG may allow for integration with the export-oriented industry there while also capitalizing on a tourism niche, mimicking the unique local tourist experiences present in Vanuatu.

From theoretical and practical perspectives, the processor-led, or factory-led, decisions and effort were present; however, the collective efficiency, envisaged pattern of governance and learning and innovation for growers did not materialise (Giuliani et al., 2005). Joint action remains a missing factor in economic upgrading in this research (Gomes, 2006; Murphy, 2007; see also Damiani, 2008), despite the fact that it may help to mitigate the inequalities entrenched by the geographies of Pacific SIDS. Alternative routes to industry development may be facilitated by micro-enterprise clusters and joint action at multiple scales. "Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate" (Porter, 2000, 15). The concept of joint action describes the influence of conciously pursued cooperation (e.g., sharing equipment or establishing business associations) on effective cluster functioning (Schmitz, 1995). With the exception of the PNG case, large-scale processing factories are not a feature of the *Canarium* industry, and reasons for the limited influence of the intervention to establish grower organisations for training and coordination of supply and marketing were unclear. Over time a *Canarium* cluster may develop around the PNG factory, but the factory has not been operating sufficiently long enough to draw any conclusions. In Vanuatu and the Solomon Islands, in particular, facilitating micro-enterprise clusters requires alternative strategies.

Initiatives that encourage increased cooperation and coordination between actors along the *Canarium* supply chain may help overcome the impediments imposed by the particular geographies of Pacific island states. In Vanuatu–and to a lesser extent in the Solomon Islands–this may involve short chain micro-enterprise clusters where products are developed for specific consumer markets that come to the sites of production (e.g., tourists), overcoming the particular constraints of distance, price and lack of infrastructure throughout so much of these island nations. These clusters could also be facilitated by the ubiquitous nature of the *Canarium* tree in Melanesia, and cooperative contracts among many growers to ensure continuity of supply while alleviating contract risks for individual growers. In contrast, cooperation and coordination among small-scale growers in PNG will likely be required to facilitate production volumes and quality acceptable to large-scale, international food chains, although growers are yet to see the establishment of organisations that will foster their coordination.

Global production of tree nuts more than doubled between 2000 and 2013 to 15.5 million tons (with shell), to which, the Pacific region contributed just 1% of the total, or 200,610 tons (Food and Agriculture Organization of the United Nations, 2015). Thus, in world terms, the Pacific tree nut market is small, and much is required before *Canarium* growers and processors/marketers might successfully link into global value chains and benefit from the growing worldwide demand for tree nuts. Implementing alternative routes to industry development that align with the socio-economic contexts of each country may, however, raise integration challenges for developing a broader regional *Canarium* supply chain in Melanesia as suggested by previous researchers (Bunt and Leakey, 2008). While a regional approach to industry development appeals because it could "take advantage of the differences in timing of the fruiting season across the region" (Bunt and Leakey, 2008, 271) and achieve the necessary economies of scale, the core-periphery relations within and between small island developing states in the Pacific reproduced the spatial inequities for growers in this research, and needs careful consideration and trans-national policy cooperation. Such institutional arrangements are critical (Gomes, 2006; Oddone and Padilla, 2014) to coordinate efforts within and between the nations to achieve the necessary

economic, social and institutional interconnectivity for a regional scale Melanesian supply chain and global value chain that forefronts the socio-spatial equalities needed for Pacific SIDS agricultural development.

7. Conclusion

While the extent to which the Melanesian *Canarium* industry can contribute to global tree nut production in the future remains unclear, the critical questions orient around how economic benefits are distributed across space and throughout supply chains, and by extension, the extent to which upgrading activities are reproducing and further entrenching already existing inequalities. The findings of this research illuminate the unequal spatial distribution of economic upgrading outcomes in Pacific SIDS. The benefits to growers of product and process upgrading are circumscribed by location and access to essential infrastructure, as well as industry scale. In the absence of essential infrastructure (including adequate storage facilities, low-cost, low-maintenance driers, reliable transport), growers in peripheral regions in particular are constrained to producing low-value, raw *Canarium* in kernel that cannot be value-added nor generate social benefits, and they may choose to opt out for subsistence activity or supply only roadside stalls for cash. These limitations to upgrading are compounded by a lack of micro-enterprise clusters in strategic locations, joint action and regional institutional arrangements to develop intra- and inter-country networks that integrate spatially disparate smallholders into supply chains. This opens up space for a small number of urban-based entrepreneurs to reproduce capitalism and develop individual businesses that harness the major benefits of commercialising *Canarium* at the expense of a larger, more geographically dispersed group of stakeholders. These established dynamics require careful negotiation on the part of industry stakeholders and international aid donors if the Melanesian *Canarium* industry is to better engage peripheral growers and provide opportunities for livelihood improvements throughout the region.

Acknowledgements

The authors sincerely thank the anonymous reviewers for their comments on the manuscript which improved its quality. We also gratefully acknowledge the input from all participants and funding from the Australian Centre for International Agricultural Research (project numbers: FST/2006/048; FST/2010/013).

References

Armstrong, H., Read, R., 2006. Geographical 'handicaps' and small states: some implications for the Pacific from a global perspective. Asia Pacific Viewpoint 47 (1), 79–92.

Armstrong, H.W., Read, R., 2003. The determinants of economic growth in small states. Round Table 92 (368), 99–124.

AusAID, 2009. Pacific Economic Survey 09: Engaging the World. Commonwealth of Australia, Canberra.

Barrientos, S., Gereffi, G., Rossi, A., 2011. Economic and social upgrading in global production networks: a new paradigm for a changing world. Int. Labour Rev. 150 (3–4), 319–340.

Bunt, C., Leakey, R., 2008. Domestication potential and marketing of *Canarium indicum* nuts in the Pacific: commercialization and market development. For., Trees Livelihoods 18 (3), 271–289.

Connell, J., 2007. Towards free trade in the Pacific? The genesis of the 'Kava-Biscuit War' between Fiji and Vanuatu. Geograph. Res. 45 (1), 1–12.

Damiani, O., 2008. Social upgrading in agriculture-based clusters: Common lessons from cases in Asia and Latin America. In: de Oliveira, J.A.P. (Ed.), Upgrading Clusters and Small Enterprises in Developing Countries: Environmental, Labor, Innovation and Social Issues. Ashgate, Farnham, England, pp. 65–84.

Department of Agriculture and Rural Development, n.d. Department of Agriculture and Rural Development: Background [online]. <http://www.malffb.gov.vu/index.php?id=1>.

Evans, R.R., Bourke, R.M., Ferrar, P., 1996. Introduction. In: Stevens, M.L., Evans, R. R., Bourke, R.M. (Eds.), South Pacific indigenous nuts: Proceedings of a workshop 31 October – 4 November 1994 Le Lagon Resort, Port Vila, Vanuatu, vol. 69. Australian Centre for International Agricultural Research, Canberra, Australia.

Food and Agriculture Organization of the United Nations, 2015. FAOSTAT [online]. <http://faostat3.fao.org/download/Q/QC/E>.

Giuliani, E., Pietrobelli, C., Rabellotti, R., 2005. Upgrading in global value chains: lessons from Latin American clusters. World Dev. 33 (4), 549–573.

Gomes, R., 2006. Upgrading without exclusion: lessons from SMEs in fresh fruit producing clusters in Brazil. In: Pietrobelli, C., Rabellotti, R. (Eds.), Upgrading to Compete: Global Value Chains, Clusters and SMEs in Latin America. Inter-American Development Bank, New York, pp. 71–107.

Goodman, D., 2004. Rural Europe redux? Reflections on alternative agro-food networks and paradigm change. Sociol. Ruralis 44 (1), 3–16.

Humphrey, J., Schmitz, H., 2002. How does insertion in global value chains affect upgrading in industrial clusters? Reg. Stud. 36 (9), 1017–1027.

Jones, C., 2012. Weaving Niche Production Into Pacific Economies: The Social, Economic and Environmental Impacts of FIJI Water on Local Communities, School of Geography, Environment and Earth Sciences. Victoria University, Wellington, New Zealand.

Krugman, P., Venables, A.J., 1995. Globalization and the inequality of nations. Q. J. Econ. 110 (4), 857–880.

Long Wah, C., 1996. Marketing Indigenous nuts in Vanuatu: a private enterprise perspective. In: Stevens, M.L., Evans, R.R., Bourke, R.M. (Eds.), South Pacific indigenous nuts: Proceedings of a workshop 31 October – 4 November 1994 Le Lagon Resort, Port Vila, Vanuatu, vol. 69. Australian Centre for International Agricultural Research, Canberra, Australia.

Maertens, M., Swinnen, J.F.M., 2009. Trade, standards, and poverty: evidence from Senegal. World Dev. 37 (1), 161–178.

McGillivray, M., Naudé, W., Santos-Paulino, A., 2008. Small island states development challenges: Introduction. J. Int. Dev. 20 (4), 481–485.

Milberg, W., Winkler, D., 2011. Economic and social upgrading in global production networks: problems of theory and measurement. Int. Labour Rev. 150 (3–4), 341–365.

Ministry of Development Planning and Aid Coordination, 2007. Solomon Islands Agriculture and Rural Development Strategy: Building Local Foundations for Rural Development. Solomon Islands Government, Honiara.

Morgan, K., Marsden, T., Murdoch, J., 2008. Place, Power and Provenance in the Food Chain. Oxford University Press, Oxford.

Mun Bbun, T., Thornton, A., 2013. A level playing field? Improving market availability and access for small scale producers in Johannesburg, South Africa. Appl. Geogr. 36, 40–48.

Murphy, J.T., 2007. The challenge of upgrading in African industries: Socio-spatial factors and the urban environment in Mwanza, Tanzania. World Dev. 35 (10), 1754–1778.

Murray, W.E., 2000. Neoliberal globalisation, "exotic" agro-exports, and local change in the Pacific Islands: a study of the Fijian Kava Sector. Singap. J. Trop. Geogr. 21 (3), 355–373.

Murray, W.E., 2001. The second wave of globalisation and agrarian change in the Pacific Islands. J. Rural Stud. 17 (2), 135–148.

Nevenimo, T., Johnston, M., Binifa, J., Gwabu, C., Angen, J., Moxon, J., Leakey, R., 2008. Domestication potential and marketing of *Canarium indicum* in the Pacific: producer and consumer surveys in Papua New Guinea (East New Britain). For., Trees Livelihoods 18 (3), 253–269.

Nevenimo, T., Moxon, J., Wemin, J., Johnston, M., Bunt, C., Leakey, R.R.B., 2007. Domestication potential and marketing of *Canarium indicum* nuts in the Pacific: 1. A literature review. Agrofor. Syst. 69 (2), 117–134.

NSOPNG (National Statistical Office Papua New Guinea), 2011. 2011 National Population and Housing Census of Papua New Guinea (Final Figures). National Statistical Office Papua New Guinea, Port Moresby.

Oddone, N., Padilla, R., 2014. Upgrading Value Chains Through Professional and Supporting Services: Lessons From Three Agro-Industry Chains in El Salvador and Guatemala. United Nations, Mexico.

Pietrobelli, C., Rabellotti, R., 2006. Clusters and value chains in Latin America: in search of an integrated approach. In: Pietrobelli, C., Rabellotti, R. (Eds.), Upgrading to Compete: Global Value Chains, Clusters and SMEs in Latin America. Inter-American Development Bank, New York, pp. 1–40.

PNG Department of National Planning and Monitoring, 2010. Papua New Guinea Development Strategic Plan 2010–2030. Department of National Planning and Monitoring, Port Moresby.

PNG Ministry of Agriculture and Livestock, n.d. National Agriculture Development Plan 2007-2016, vol. 2. PNG Ministry of Agriculture and Livestock, Port Moresby.

Ponte, S., Ewert, J., 2009. Which way is "up" in upgrading? Trajectories of change in the value chain for South African wine. World Dev. 37 (10), 1637–1650.

Porter, M.E., 2000. Location, competition, and economic development: local clusters in a global economy. Econ. Develop. Quart. 14 (1), 15–34.

Poulsen, T.P., Ponte, S., Lister, J., 2016. Buyer-driven greening? Cargo-owners and environmental upgrading in maritime shipping. Geoforum 68 (1), 57–68.

Schmitz, H., 1995. Collective efficiency: growth path for small-scale industry. J. Develop. Stud. 31 (4), 529–566.

SINSO (Solomon Islands National Statistical Office), n.d. 2009 Population and Housing Census: National Report, vol. 2. Solomon Islands Government, Honiara, Solomon Islands.

SINSO (Solomon Islands National Statistical Office), 2013. Gross Domestic Product 2007–2012 (Statistical Bulletin 13/2013). Solomon Islands Government, Honiara, Solomon Islands.
Sofer, M., 1988. Core-Periphery Structure in Fiji. Environ. Plan. D: Soc. Space 6 (1), 55–74.
Sofer, M., 2007. Yaqona and the Fijian periphery revisited. Asia Pacific Viewpoint 48 (2), 234–249.
Storey, D., Murray, W.E., 2001. Dilemmas of development in Oceania: the political economy of the Tongan agro-export sector. Geogr. J. 167 (4), 291–304.
Thomson, L.A.J., Evans, B., 2006. Canarium indicum var. indicum and C. harveyi (canarium nut) - Burseraceae (torchwood family). In: Elevitch, C. (Ed.), Traditional trees of Pacific Islands: Their culture, environment, and use. Permanent Agriculture Resources, Holualoa, Hawai'i, USA, pp. 209–228.
Tisdell, C., 2002. Globalisation, development and poverty in the Pacific Islands: the situation of the least developed nations. Int. J. Soc. Econ. 29 (12), 902–922.
United Nations, 2015. UNdata [online]. <http://data.un.org/>.
University of the Sunshine Coast and The University of Adelaide, n.d. Canarium Nut Value Chain Review. Australian Centre for International Agricultural Research, Canberra.
Vanuatu Agriculture Sector Policy, 2015 [online]. <http://www.malffb.gov.vu/doc/Vanuatu_Agriculture_Sector_Policy.pdf>.
VNSO (Vanuatu National Statistics Office), 2009. 2009 National Population and Housing Census: Analytical Report, vol. 2. Vanuatu National Statistics Office, Vanuatu.
VNSO (Vanuatu National Statistics Office), 2012. Vanuatu: Household Income and Expenditure Survey 2010. Vanuatu National Statistics Office, Vanuatu.
VNSO (Vanuatu National Statistics Office), 2014. Statistics Pocket Book 2014. Vanuatu National Statistics Office, Vanuatu.
VNSO (Vanuatu National Statistics Office), 2016. Statistics Update: Consumer Price Index (March Quarter). Vanuatu National Statistics Office, Vanuatu.
Wallace, H., Carter, J., Austin, J., Poienou, M., Moxon, J., Walton, D., Randall, B., Viji, I., 2012. Processing of Canarium Indicum Nuts: Adapting and Refining Techniques to Benefit Farmers in the South Pacific (final report). Australian Centre for International Agricultural Research, Canberra.
Wallace, H., Carter, J., Jones, K., Randall, B.E.G., Bunt, C., Pauku, R., 2015. Developing Markets and Products for the PNG and Pacific Canarium nut Industry (final report). Australian Centre for International Agricultural Research, Canberra.
Watts, D.C.H., Ilbery, B., Maye, D., 2005. Making reconnections in agro-food geography: alternative systems of food provision. Prog. Hum. Geogr. 29 (1), 22–40.
Weaver, D.B., 1998. Peripheries of the periphery tourism in Tobago and Barbuda. Ann. Tourism Res. 25 (2), 292–313.