Sustainable Sea Transport Research Programme: Toward a Research-based Programme of Investigation for Oceania

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Abstract

This paper sets out the background, rationale and aims of a newly-established University of the South Pacific (USP) research cluster programme investigating the role that renewable energy might play for sustainable sea transport in the region. Immediate and pressing challenges besetting Pacific Islands Countries (PICs) include the effects of climate change and high dependency on imported fossil fuels. Despite transport being the region's single largest user of imported fossil fuels by sector, the focus of programmes within the region to date to reduce such dependency has been on the use of renewable energy for electricity generation. Global interest in alternative energy technologies for shipping is growing, but renewable energy–powered sea transport at the small-scale level appropriate to the domestic needs of PICs has not yet been seriously explored. Past lessons and recent research indicate strong potential for such technology to provide practical and multiple benefits to PICs as a viable alternative.

USP's current current one-year interdisciplinary Sustainable Sea Transport Research Programme focuses on micro- and macroeconomic analysis of selected case studies and on maintaining momentum of a collaborative network of stakeholders and expertise established in 2012. It describes the need and potential for a longer-term programme of research, including practical trialling of two designs of renewable energy vessels in a 'real world' commercial scenario in the Pacific Islands.

1. Introduction

In 2013 the University of the South Pacific (USP) launched a new research programme designed to initiate long-term investigation and analysis of the potential for using renewable energy technologies for sea transport for the region. Sustainable sea transport is an emerging and growing research field globally; however, it has not been visible in the regional sustainability research agenda since the end of the oil crisis in the mid-1980s. Increasing concern over Pacific Islands Countries' (PICs) fossil fuel dependency, the search for low carbon futures for Oceania and the crucial role of sea transport to most aspects of economic, social and cultural wellbeing for Oceanian communities make the establishment of such a research agenda a logical priority.

In particular, the current one-year research programme will focus on preparatory economic studies using three selected Fijian routes as case studies, including potential for carbon credits to offset costs, as well as preparing a business case to trial Sustainable Village Vessels (SVVs) and a Greenheart 220 tonne wind/solar hybrid freighter on those routes. Data collection is one of the first tasks to be undertaken, focusing on data relevant to the three case studies, as well as carbon trading potential. A comprehensive business case for an expanded six-year programme of research, trial and teaching is the over-arching output expected from the initial twelve months of inquiry.

The USP programme builds on Fiji-focused research, ongoing since 2008 (Nuttall, 2013). That research proved catalytic to a small but growing collaboration of stakeholder interest. On behalf of that network and in preparation for meeting the challenge in this emergent field, USP hosted the Sustainable Sea Transport Talanoa (SSTT 2012) in November 2012, a three-day international workshop focused on the potential for developing alternative energy sea transport options for Oceania communities.[1] This was the first major conference on this subject since a similar event hosted by the Asian Development Bank (ADB) in Manila in 1985. The current USP pilot research, an outcome from the SSTT 2012, demonstrates commitment to the five-strand work programme identified in the resultant SSTT Outcomes Record. This paper discusses the rationale for prioritising this research field and sets out the programme's initial research objectives. It sets the framework for the current research and provides a benchmark against which the programme outcomes can be reported over time. A follow-up paper in one year's time will document the results of this stage of the research.

Despite sea transport being an obvious and essential basic need for many Oceanian communities, and often a core necessity for almost any economic, development or sustainability initiative in the region, investigation of more sustainable sea transport alternatives has not received any of the attention currently allocated to other energy sectors. The issue is currently invisible within the regional and local policy space at any level, which is surprising given the dominance of transport within current fossil fuel footprints for most PICs and the availability of technological solutions. The low priority given to sea transport within current sustainability discourse is not restricted to Oceania and recent research (Rojon, 2013) suggests it is a global phenomenon. The reasons are complex, largely perceptual and previously poorly characterised (Nuttall, 2013; Nuttall et al., 2013; Rojon, 2013). Recent doctoral research focusing on Fiji (Nuttall, 2013) concludes that while alternatives to current fossil fuel powered sea transport are either available or emergent, issues of

perception, policy and financing remain as critical barriers. These findings have been mirrored by Rojon's (2013) study at a global level that found issues of financing and policy infrastructure to be the critical barriers, rather than access to the technology as is often assumed.

The research agenda on Pacific shipping generally, and more sustainable alternatives particularly, is broad and sparsely populated. It is hoped that, by careful selection of manageable outputs, the current USP research initiative can provide sufficient results to be catalytic to a broader programme of research, trial and teaching. The research has been commissioned under the USP research cluster programme. It is unique in that it is spread across three related clusters, namely: Economic Growth, Trade and Integration; Pacific Oceans and Natural Resources; and Climate Change, Adaptation and Mitigation. The research approach is an interdisciplinary one and seeks to combine expertise associated with economics, marine science, technology and engineering and carbon management.

The capacity of USP to maintain such a programme on its own is limited and the current research programme represents a significant investment from USP's overall internal research budget. . The project will need to produce sufficient results to secure both ongoing academic support and external research funding if it is to be progressed in terms of scale and longevity.. Ideally, a portfolio of research is needed that will require a collaborative investment from multiple research partners (locally, regionally and internationally) to be successful. USP, in making such a research investment at this time, is seeking to act as catalyst, navigator and facilitator. It is a role USP has played previously in other critical sectors, a leading example being the region's Local Managed Marine Area programme (see Veitayaki et al., 2003; 2011).

2. Why Research into Sustainable Shipping should be a Priority for the Pacific

At 95–99% for all PICs, the region's dependency on imported fossil fuel is the most chronic in the world (Woodruff, 2007) and concern over the use, cost and security of supply is increasing. The Pacific region is in the front line of global warming effects, to whose cause it has made, at most, a negligible contribution. Despite a marked increase in research, investment and implementation of renewable energy technologies across the Pacific, particularly as alternatives to fossil fuel generated electricity, the use of such technologies for sea transport has not generally been considered.[2] Recent (Nuttall, 2013) and past (ADB, 1985) research provides a strong basis for concluding that improvements in shipping service, particularly to smaller and more isolated island communities, can provide significant primary, secondary and tertiary benefits measurable across economic, environmental, social and cultural well-being

Sea transport is essential need for most Pacific countries and communities. The shipping sector in Oceania is unique, with multiple minute and economically-marginal centres separated by some of the longest sea-lanes in the world (AusAID, 2008; SPC, 2011; UNESCAP, 2010). All sources agree that the greatest priority is for domestic services rather than international shipping. For domestic shipping, fuel now accounts for ~40–60% of operating overheads (Rounds, 2012). Lack of adequate, reliable and affordable domestic shipping is a major impediment to socioeconomic development and provision of essential government services, particularly to remote and island communities.

There were a number of small but critically important experiments conducted in this field during the last oil crisis, several of which were situated in the Pacific, but the lessons of these have hitherto largely been lost to history (ADB, 1985; Brown, 1982; Clayton, 1987; FAO, 1987; Satchwell, 1985 UNESCAP, 1985). These experiments showed that for relatively modest investments, major savings in fuel use from existing proven technologies were available for local shipping.

To date, the issue of sustainable sea transport is invisible in all national, regional and donor strategies and policies for transport, energy and climate change response throughout the Pacific although there are encouraging signs that this may now change in Fiji as a direct result of our current research efforts.

Alternatives to current options include both retrofitting existing assets and new-build designs. A range of alternative technologies is under investigation internationally at various levels of the shipping sector. Most are directed at large scale, international vessels and routes with little attention to date on small-scale domestic transport, the priority need for Pacific Islands Countries. Our findings to date are that wind, solar and biofuels offer the greatest promise as alternative energy sources in a Pacific scenario. Potential application exists at all levels of service from village to inter-regional transport of people and cargo as well as fishing and specialist vessels.

Renewable energy powered vessels offer more than just a means of saving costs and reducing carbon footprints. Without the need to achieve economies of scale to rationalise increasing bunker costs, fleets of smaller vessels become viable allowing for different development scenarios for small, scattered communities and countries. There are opportunities for a range of related secondary and tertiary industry at this scale, from ship construction and maintenance industries to marketing and management. Other inferences include the potential for establishing future carbon trading frameworks or similar financing mechanisms, which could see the subsidisation of domestic sea transport change, from an ever-increasing drain through government subsidies for local services to an income generating one.

There is paucity of targeted research in any of these fields currently within the Pacific, and an almost total lack of reliable and comprehensive data to support analysis. This research programme is expected to highlight this key area and identify priorities and baseline data for future attention. Unlike other transport sector operations, shipping movements and operations tend to be poorly documented and reported. The number of operators is small, data is viewed as being commercially sensitive, and real world reporting to regulatory authorities is often either missing or fabricated. Shipping asset at this level tends to be second-hand, old and often in poor condition. The hesitancy of finance companies and donors alike to invest in this field leads to a perpetuation of the cycle. This position has to change for the future of the sector.

Despite the obvious correlation between sea transport and almost any other development sector in the region, shipping is globally considered 'mitigation' rather than as an adaption target in climate change responses. This, coupled with the marginal economic viability of domestic shipping in almost any non-tourist related field in the Pacific and the inherent high-risk investment nature of the industry to any financial institution, makes sourcing funding for research or financing of 'field trial' projects extremely difficult. There has also been a predisposition of key agencies to

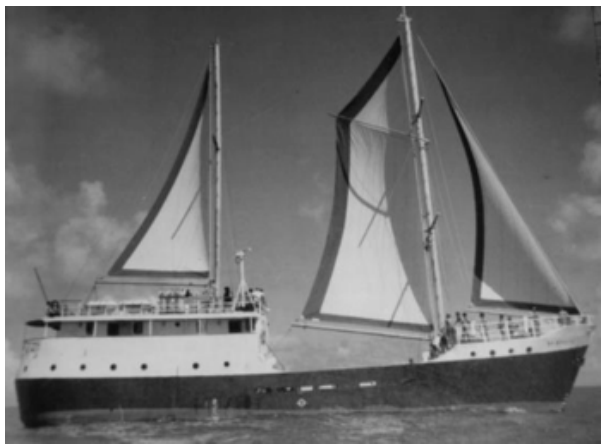
consider that provision of domestic shipping services, as opposed to the infrastructure to support them (such as wharves, jetties and navigational aids), should be the preserve of the private sector and therefore generally considered to be outside the ambit of donor or development assisted finance (see for example ADB, 2007).

3. What Happened in the Past?

Renewable energy, principally sail technology, powered shipping globally for centuries, until only a little more than a hundred and fifty years ago. In Oceania such technology is a central icon of cultural heritage; Pacific peoples colonised approximately one-third of the globe over thousands of years of exploration under sail, developing advanced vessel and seafaring knowledge in the process, and treated the ocean as a highway and connector rather than a barrier (see in particular Couper, D'Arcy, Finney, Howe, Irwin, etc.). Steam ships, powered mainly by coal, were becoming common by the 1880s and the modern diesel or fuel oil powered turbines were dominant by World War II and now hold a virtual monopoly. Globally, innovation in the use of non-fossil fuel technology has followed each period of rising raw fuel price or threatened scarcity, most notably in the early 1920s and the late 1970s. In the past decade global concerns over greenhouse gas emissions and peak oil have been a major driver of technological innovation, although investment in such research for renewable energy alternatives and innovation is only a minute fraction of investment in development of conventional shipping (Buhaug et al., 2009; Faber et al., 2009; Ribeiro et al., 2007.

A small number of critical experiments occurred in the Pacific following the oil crisis of the 1970s. These include work by Save the Children Fund (Brown, 1982) and FAO/UNDP (FAO, 1987 on sail assisted artisanal fishing vessels and small-scale multi-hulls for village transport; a UN agency and ADB sponsored study of the Haʻapai group in Tonga recommending wind powered catamarans and small-scale freighters (ADB, 1985); ADB funded retrofitting of medium scale cargo/passenger ferries in Fiji (Palmer and Corten, 1985; Satchwell, 1985); and square sail auxiliaries for coastal oil tankers in Japan (Clayton, 1987; UNESCAP, 1985). In 1985 ADB hosted a conference for the Asia–Pacific region that brought together much of the thinking and innovation of that period; similar conferences were also held in Europe and the US (ADB, 1985). Such innovation ceased abruptly as oil prices fell to record lows in 1986.

Figure 1: Na Mataisau



Source: ADB (1985).

This body of work practically demonstrated that fuel savings of at least 25% as well as a number of significant secondary benefits (such as increased safety, decreased engine wear, and increased stability) were easily attainable at rates that showed highly favourable investment rates of return (ADB, 1985; Satchwell, 1985). A portfolio of Pacific-orientated vessel designs is part of its legacy and these designs appear to be as applicable today as they did in the 1980s (Philp et al., 2013). It is also critical to note that the same barriers to investigation and prioritisation were found in this earlier period as today; notably a lack of profile and priority in financing mechanisms for such technology development and a lack of institutional policy frameworks (Nuttall et al., 2013). FAO (1987) also found that those communities with a living tradition of sail were more likely to adopt using sails as alternative propulsion.

The number of designs and innovations globally is growing, though, especially post-2006 when the International Maritime Organization (IMO)–led efforts to reduce shipping emissions and to use cleaner fuels began to gain traction. The greatest centre of effort has been in improved engine and hull designs for large-scale new ships. LNG-powered shipping is widely seen as a transition step for global shipping. Globally, shipping is a major greenhouse gas (GHG) emitter (in the order of 4+% of global totals) and a particularly high contributor to SOx emissions. Domestic shipping of less than 10,000 dwt, much of which is aging fleets in developing world settings such as the Pacific Islands, carries only 4% of world cargos but contributes 26% of all global shipping emissions (Gilpin, 2012). There is little focus on the needs of domestic-scale shipping (including fishing as well as passenger/cargo vessels) for developing world and small island state scenarios. Promoting seafaring heritage is a powerful way of highlighting the issue and an effective mechanism for engaging local communities. Our research to date in Fiji is the only known current programme in the Pacific.

Prosecution of global-scale mitigation measures currently in train under IMO leadership, while promising to have a favourable impact on the global industry's emission profile, is likely to lead to increased costs and barriers in Oceania, whose contribution to the global emissions is so minute as to be irrelevant, resulting in a double penalty for no visible regional benefit (Nuttall, 2013). Pacific Islands cannot afford to lose much needed income in this way.

Figure 2: Container ship entering Suva Port

The changes to the MARPOL[3] Annex VI regulations, aimed at cutting levels of SOX emissions from global shipping, will alone contribute a ~60% price increase in marine fuel for PICs at current oil prices by 2020 for all vessels over 400 gross tonnes (Nuttall et al., 2013). Current domestic shipping, despite being often financially marginal and employing aged assets, maintains sufficient control of the industry to continue to use fossil fuel technology because there is a lack of sufficient incentive to adopt new technologies and a lack of research and working models of viable alternatives (Nuttall et al., 2013). This research programme aims to examine some of these options.

This is the backdrop against which USP hosted the SSTT 2012. In seeking to raise the profile of this subject, the SSTT 2012 included both celebration of Oceanian seafaring heritage and consideration of the future application of sustainable sea transport. Participants included representatives from communities, women and youth, Pacific seafarers, universities (including leaders in this field such as University College of London), international agencies and NGOs (such as UNESCAP, UNDP, Secretariat of the Pacific Community (SPC), IUCN, WWF and Greenheart), industry (including leading naval architects, B9 Shipping, Germanischer Lloyd and Det Norske Veritas), government departments (including heritage, maritime safety, transport, and energy), donors, and country representatives. The SSTT 2012, a Pacific first, was an enormous success in bringing together important stakeholders from across the globe, many attending electronically. International participants expressed strong interest in working collaboratively in the Pacific and in attending a more formal conference in 2014.

4. Priorities for a Future Research Programme: SSTT 2012 Outcomes Record

Most focus and innovation in renewable energy use for sea transport globally is on the developed world and international large-scale shipping scenarios. Domestic shipping is the central priority for Oceanian communities (ADB, 2007; AusAID, 2008; SPC, 2011).

The Pacific is home to an immense diversity of countries, each with its unique characteristics as well as the commonalities they share, and this applies equally to transport and infrastructure scenarios as it does to any other sector. Researching the potential of renewable energy transport has illuminated a seemingly sound rationale for focusing on Fiji as a regional incubator and development hub (Nuttall, 2012; 2013). The current USP programme is focused on Fijian case studies and analysis because of this. While acknowledging the regional diversity of domestic shipping scenarios, there is also sufficient homogeneity to suggest that lessons learned from Fiji will have relevance and application to many other Pacific settings. It is also assumed that if Fiji can be established as a centre for developing policy, designs, vessels and infrastructure (including research and training), this would be beneficial to other PICs as a vector for acquiring such technology.

The Outcomes Record emanating from the SSTT 2012 (as shown in table 1) identifies five core areas as priorities for attention in an integrated programme of future research. While the SSTT 2012 has been successful in bringing together a caucus of expertise and increasing the focus on the topic, it is obvious that ongoing collaborative effort is required if this momentum is to be maintained. We also argue it requires catalytic research leadership initiative and that USP is the best-positioned agency to facilitate this.

Table 1: Work Stream Priorities agreed by SSTT 2012

Work Stream	Keywords	Themes
Heritage	Drua, iconic, culture, tradition; excellence in seafaring and vessel design and construction; ocean as highway not barrier.	Cultural history, archaeology, traditional revival, carving, weaving, navigation, seafaring, voyaging

Work Stream	Keywords	Themes
SSTT 2014	International symposium and drua festival.	Celebrate the Past, Plan for the Future
Strategic Blueprint	Policy frameworks. Regulatory frameworks; economic analysis; quadruple bottom- line reporting; industry-wide assessment; data gathering and management; integrated approach; initial route identification; collaborative relationships.	Carbon credits, cost–benefit, Project v programme, biofuel and/or solar and/or wind, Owner/operator option analysis, Private/public, Markets/uneconomic
Demonstration Models	USP research vessels; targeted destinations – Gau, Kadavu, Lau, Rotuma.	Intra-island: sustainable village vessels (SVV), inter-island: Greenheart (GH), barges, fishing vessels, inter-state: B9 shipping, disaster relief
Gender and Youth	Leadership, capacity building, skill development, business opportunities, community focus.	Training, mentoring, team building

The success of the SSTT 2012 means that the first hurdle of simply establishing a profile for this critical research area has now been addressed. A small but significant and broad ranging body of background work has been highlighted and disseminated amongst key stakeholders to the extent that we are now seeing the subject raised in forums such as the Fiji National Energy and Transport strategies and plans. Maintaining momentum from the SSTT 2012 means a number of parallel and inter-related priorities must now be addressed if the issue is to be sheeted home and to be more widely considered and expanded on, addressing both heritage and future sustainable sea transport options. Significant barriers still exist.

The lack of comprehensive and reliable data for all aspects of research and dedicated funding for ongoing research and practical trialling remain as critical constraints in developing a forward-seeking research agenda.

5. The Current USP Sustainable Sea Transport Research Programme

USP's current research programme commits research funding and staff for an initial twelve-month programme. This is seen as a seed investment designed to attract resourcing toward a much more comprehensive six-year programme. The design and business planning for such a programme are core components of the initial research agenda. The current research is designed to address three core areas, recognising that others are engaged in other aspects of the work streams identified, such as seafaring heritage.

5.1 Planning for the SSTT 2014

First, there is the need to widen the collaborative network and increase the profile and promote the importance of Oceania's seafaring heritage and sustainable sea transport for the future through hosting a larger second SSTT in 2014 that will draw together regional expertise, policy makers and shipping industry, with leading innovators and researchers from around the world. Interest in co-sponsoring such an event has already been received from several sources and strong interest in attending shown from several leading European research universities and institutions. Prior to the SSTT 2012 global researchers in this field understood little of the unique issues Pacific Islands Countries face and the potential that renewable energy innovation offers the local shipping industry. As a result of the SSTT 2012 we are now engaged in negotiations with universities in the UK and Germany in particular, although interest has been indicated in aspects of our work from sources as far away as Boulder University in Colorado.

5.2 Economic Analysis – Four Case Studies

Secondly, there is need to establish reliable data sources and to undertake preliminary economic analysis of the potential costs and benefits accruable by renewable energy shipping. Ultimately, there will not be substantial financial investment at any scale until the economic viability of the technology can be practically demonstrated to both industry regulators and operators. A comprehensive overview is beyond the resources currently available and so a series of four complementary case study evaluations will be used to highlight potential in differing operating scenarios.

Figure 3: Map showing Fijian case study locations

5.2.1 Kadavu

The first of these case studies is focused on the western Kadavu–Suva route and builds on village-scale research ongoing since 2009 (Newell, 2013; Nuttall, 2013). Kadavu, approximately 60 nautical miles south of the main island of Viti Levu, is a large island of 75 rural, subsistence farming villages. Transport services to Viti Levu are either by aged Ro-Ro ferries running between Suva and two nodes at Vunisea in the centre of Kadavu and Kavala at the eastern end, or by air from the airstrip at Vunisea. Repeating the representative village transport and fuel use surveys undertaken there in 2009 and 2011 will allow the establishment of a credible baseline of current transport need and usage (Newell, 2013). It is thought no in-depth village analysis of this type has been attempted previously in Fiji. Extrapolation from this data will give a general and conservative use assessment at island-scale. The Suva–Kadavu route was demonstrated to be one of the most viable for wind-assisted shipping in wind-route analysis supervised by Southampton University in 1984–85 (Satchwell, 1986). In addition to repeating the previous surveys it is planned to add a survey of fiber[4] operators for the north-western quadrant of the island.

The western-most *tikina* or district of Kadavu, Nabukelevu, has recently acquired a converted fishing vessel to service the villages in this area. The project is the result of several years of planning and fund-raising by the *tikina*. We intend working with this initiative to identify the cost of fuel as an overall component of their operating expenses and to model the costs and benefits either to use a new ship design or to retrofit the existing vessel with renewable energy auxiliaries to reduce the fuel consumption.

The work undertaken with retrofitting similar scale passenger/cargo vessels in 1984–85 suggests such modifications could be achieved using auxiliary sail rigs or possibly Flettner rotors. As with other locations in Fiji and elsewhere in the Pacific, the cost of sea transport within Kadavu island from outlying villages to the shipping nodes is as expensive as or more expensive than shipping from the nodes to the centre in Suva.

Our working assumption, again based on the 1980s research in Tonga and Fiji and the more recent fieldwork in Kadavu (Nuttall, 2013; Newell, 2013), is that small-scale renewable energy shipping is capable of servicing directly from village to centre at greatly reduced effort and cost, as well as increasing safety and comfort. If such service can be realised there will be a great effect on the options available to farmers and artisanal fishermen in increasing frequency and access to markets for excess produce. As with the previous work, this case study draws on a quadruple bottom-line approach, incorporating consideration of the effects on economic, environmental, social and cultural well-being.

5.2.2 Southern Lomaiviti

For the second case study, the southern Lomaiviti group has been selected. These islands lie some 30–50 nautical miles to the east of the main island, Viti Levu, and some 65–90 nautical miles from the commercial port of Suva. There is no major commercial or other economic activity on any of the islands and the approximately 2,500 residents of the 25 villages are primarily subsistence farmers and fishermen. The largest island, Gau, is serviced infrequently by commercial ferries, regularly by air via a small airstrip and locally by a number of fiber operators. The two outlying islands, Batiki and Nairai, have no secure access for large vessels, requiring travellers and cargo either to make the blue water passage to the single jetty on Gau or transit direct to the mainland in their small vessels, usually fibers. Mishaps and tragedies on such passages are reported frequently.

The historical lack of commercial development within the group has meant high biodiversity and cultural values have been retained and there are a number of current projects on Gau with a common aim of building resilience or 'climate change proofing' the local communities and their island environments. Such projects are focused on assisting and supporting local communities to maximise their ability to maintain well-being through enhanced reliance on local and natural assets. It is therefore logical to add analysis of future renewable energy sea transport options to this portfolio of social, economic and environmentally-focused initiatives. Surveys related to sea transport can be integrated into other socioeconomic surveys currently being carried out as part of other projects. There are numerous similarities between the scenarios for Kadavu and southern Lomaiviti that will allow a comparative analysis between the two case studies.

Using data analysis from existing sources *(iTaukei* Affairs, Department of Statistics, Lomaiviti Provincial Council, Ministry of Health) combined with in-depth surveys of existing service providers and two representative village communities, the research will compile a footprint of current island transport needs and use. The field surveys will use the Kadavu survey templates as a starting point to allow comparison between the two case study sites. As with the Kadavu example, analysis will include consideration of the economic development potential to villages that more dependable, safer and cost-effective sea transport services offer.

In the Lomaiviti example, renewable energy powered vessels offer the potential of improving transport services by accessing the mainland via the 'backdoor' to the mainland using the shallow-draught Bau Waters route. Current services provided by government ships or commercial ferry operators, constrained by their draught and size, are required to use the significantly longer transit route around the southern coast of Viti Levu to Suva. A transport route via Bau Waters will also need to consider the road linkage from the eastern coast to Suva, the sea transport component being only one stage in the overall transport network.

5.2.3 Fiji–Tonga

The third case study will model the potential for using small-scale renewable energy-powered container shipping to allow direct transport of export goods between Fiji and Tonga. Currently inter-country shipping within the region is constrained by the lack of such small-scale services. Economies of scale mean that most current container services between PICs must tranship via major nodes in New Zealand or Australia, greatly adding to the cost of exporting goods and in many cases making such intra-regional trade uneconomic (SPC, 2011).

The research programme is working with international partners currently designing small-scale freighters targeted particularly at this type of trade. These offer a promise of regular transport of small loads cost effectively directly between intra-regional nodes and it is hoped that the case study can be catalytic in encouraging such innovators to commit prototype vessels to this region for trialling.

There is potential for any number of routes to be modelled, including between Fiji and the growing economic potential of the Melanesian Spearhead countries. Ultimately we have selected the Fiji-Tonga route because of the geographical closeness of the two countries, the historical and cultural linkages between them, and the availability of data and analysis of these historic trade routes. The primary benefit of this exercise, assuming it shows cost savings over currently available services, is the promise of reduced charges and improved transport times for cargos. But there are numerous secondary benefits accruable under this scenario such as increased safety. Expanded inter-regional trade and associated decreased reliance on imports from Pacific Rim countries, particularly Australia and New Zealand, has been a long held objective of most PICs. Not only would this be of benefit to island exporters and traders but it would also serve to reinvigorate trade relationships that existed a century and more ago as well as open the way for new relationships and increased PICs' independence and regional self-reliance. Additionally, the smaller scale of the vessels opens possibilities for such assets to be maintained and even constructed within the region.

5.2.4 Carbon Trading

In addition to the three route-focused and site specific case studies, a fourth case study has been included to look at the potential for future carbon trading. It is possible to envisage a future scenario where the use of renewable energy for shipping can be used on sufficient scale to claim carbon credits or use similar cost-offsetting mechanisms to allow for domestic shipping to gain

income from fuel savings. Currently, global carbon credit trading mechanisms have not proved effective and the international price of carbon is low, as is the immediate potential for increasing trade in this area. However, given global concerns over GHG emissions and the broader field of global warming, as well as concerns over peak oil and projected ever-increasing costs of this fuel, this situation can be expected to change in the future.

As part of the current research programme, USP will undertake an initial scoping study into the potential for carbon credit trading or similar mechanisms. This work will utilise and build on recent work looking at carbon credit frameworks for sustainable forestry in New Zealand, Fiji and Vanuatu.

All the above case studies highlight the need for access to reliable baseline data on all aspects of domestic sea transport usage and need. The research programme anticipates working with the relevant government stakeholders to attempt to assemble a cleaner set of data from government records (e.g. Departments of Statistics and Transport, Maritime Safety Authority of Fiji and Fiji Islands Customs and Revenue Agency) and to supplement this with the data generated from the programme to develop more realistic estimates of Fiji-wide marine fuel use. The Fiji Commerce Commission has recently undertaken a major evaluation of the Fiji Shipping Franchise Scheme, which promises to be the most reliable data set of commercial operators, and it is hoped to access this data in the near future. As with all aspects of this research programme, building and maintaining relationships with all stakeholders in the industry, and government regulators in particular, are a critical priority.

5.3 A Six-year Research Programme Business Case

The third focal point for the current programme is to generate a comprehensive 'business case' for ongoing research, trial and teaching in this field. A broad programme needs to include all the priority areas identified in the SSTT 2012 Outcomes Record, including policy and regulatory issues, economic analysis, practical trialling of pilot vessels and technologies, combined with relationship building both within the region and internationally. While research, both theoretical and action-based, is the nexus of the proposed programme, consideration of teaching and training of future expertise for this emergent field will also be included. It is anticipated this will focus primarily on postgraduate-level directed study but there is also need for a co-ordinated undergraduate teaching programme. Given the interdisciplinary nature of the field, courses could be either custom written or brought together by selecting relevant existing curricula in Marine Studies, Economics, Climate Change and Technology schools.

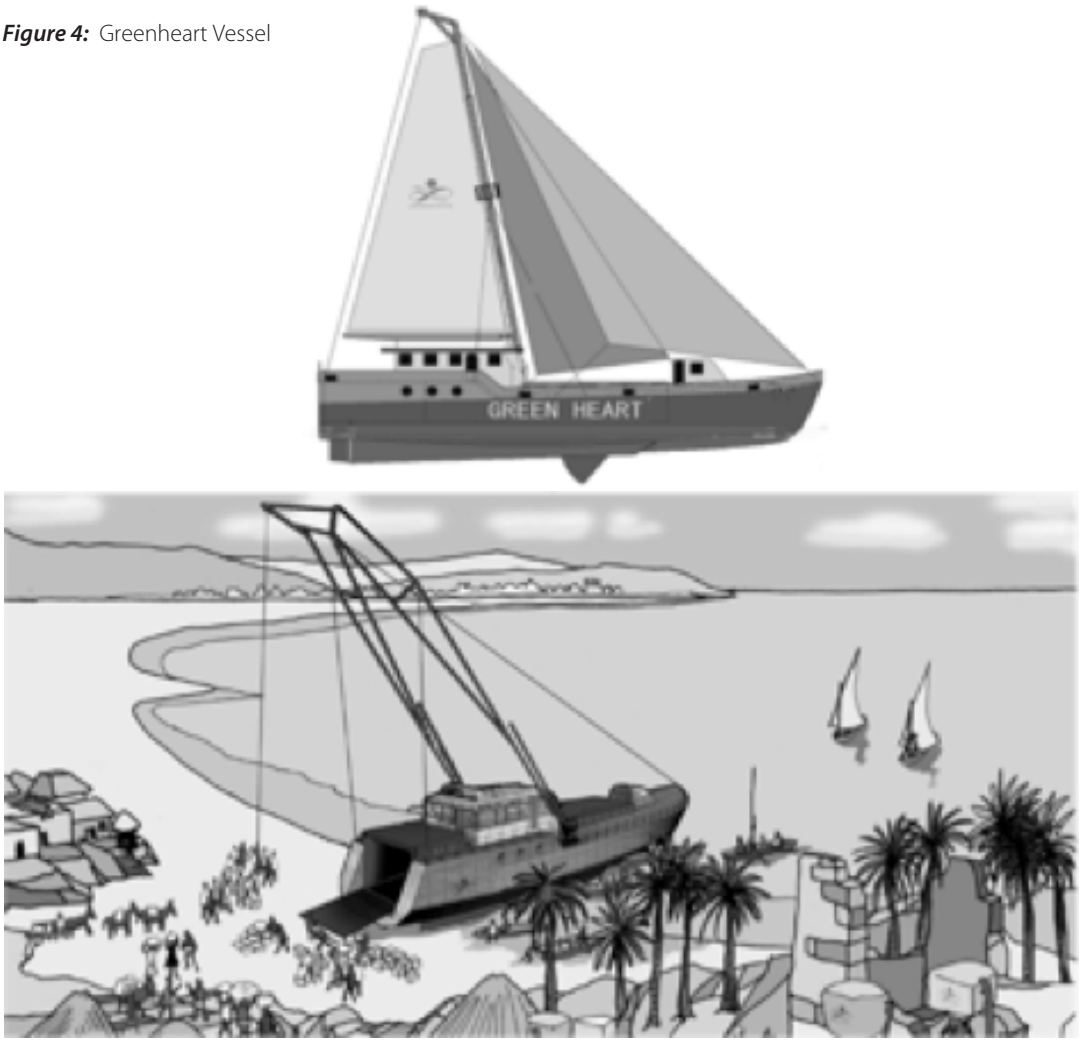
While this is an ambitious programme, it is considered that the importance and scope of the field warrants such effort. The extent to which such a broad scope of research, trial and teaching can be sustained obviously requires securing dedicated resourcing and the business case will form the basis of negotiations with donors.

A central component of the business case is the practical trialling of pilot renewable energy vessels. This is the most difficult part of the research field to attract funding for, but it is arguably the most critical. In reality, much theoretical analysis can be done and 'talkfests' held, but until

there is physical proof of actual vessels operating under commercial conditions, real traction will not be achieved.

The intention, assuming funding is secured, is to trial renewable energy shipping technology and operation using different vessel types on up to three selected Fijian routes as part of the six-year research programme, with the trials progressing from forward planning, to controlled field research and ultimate transfer to community managers/owners. Two types of vessel design are anticipated as the initial focus: village-scale catamarans of between 4 and 10 dwt load-carrying capacity and small freighters capable of carrying between 60 and 100 tonne payloads. Both vessel types were identified as being the most appropriate in previous research during the 1980s and these findings have been mirrored in the more recent Fiji-situated research. Several designs exist and are the focus of current build experiments by our international partners. The small scale of such vessels means they can be maintained and, ultimately, built in Fiji.

Figure 4: Greenheart Vessel



Source: Greenheart Project.

As the initial research has clearly demonstrated, the issues of ownership, management and operation of such vessels are the critical areas to grapple with now, as much as the technology itself, which is well characterised and understood.

6. Conclusion

This programme positions USP as the major research leader in this area for the Pacific. It is targeted largely at scoping studies in several key areas: micro- and macroeconomic modelling of three representative Fijian shipping routes; establishing the potential and parameters of carbon trading vis à vis the shipping sector; establishing baselines for quadruple bottom-line reporting of future interventions; and developing a comprehensive business case for implementing practical working demonstration models.

The current research and the projected further research programme set an ambitious agenda. Achieving it will require a collaborative effort from stakeholders and funders alike. However, such courage is likely to be rewarded with enormous benefit in what is often a forgotten area of critical importance to a large number of Pacific Islands Countries and communities.

Excellence in seafaring and vessel technology is arguably the greatest technological legacy of Pacific peoples and cultures. Initiatives relating to seafaring heritage are also critical in raising awareness of and gaining traction on the issue. The obstacles to the Pacific again leading this vital field are as much perceptual as practical.

Notes

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1 See https://www.usp.ac.fj/index.php?id=12456 for the SSTT 2012 programme, Outcomes Record, presentations, etc.

2 The Pacific Energy Forum held in Auckland in March 2013 saw NZ$635 m of donor funding committed to reduce the Pacific's dependency on imported fuel. All funds are for replacements for fossil fuel generated electricity production.

3 The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978.

4 Open fibreglass punts, commonly of 23–28′ length powered by 40–60 h.p. outboard motors. Fibers are the equivalent of the village taxi or truck and can carry approximately 800 kg payloads.-

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