Steering a course for the future with sticks, stones, grass and a little sharkskin

The case for revitalisation of sail technology and sailing culture as a practical sea-transport response to climate change and fossil fuel dependence and supply issues in Fiji

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Abstract

The paper makes an initial case for a more detailed inquiry into and analysis of the role sail technology might play in seeking sustainable and Oceanian -centred sea-transport adaptations for the region. Immediate and pressing challenges that face the coastal and island communities of Oceania include increasing environmental degradation, the uncertain effects of a climate change future and increasing dependency on imported fossil fuel with related concerns of supply and price security. Global interest in alternative energy technologies is widespread but sea transport generally and sail technology in particular have not been seriously explored. Past lessons and recent research indicate strong potential for sail technology to provide practical and multiple benefits to island and village communities as a viable alternative, although substantial barriers exist to such a revitalisation. Sail has potential at all levels of local, national and regional sea transport. The example of a fleet of small-scale, village based, sail powered catamarans is explored. The research focus of this paper is geographically limited to a Fijian example but is expected to have regional applicability.

Key words Fossil fuel dependency; Oceania; sail technology; sea transport

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> The maritime history of the Pacific peoples is recognised as part of the shaping of Pacific societies but is also a basis for comparison in making changes for the future. Not least is the possibility of a renaissance of commercial sail under changing economic relationships between distance, rising cost of fuel, environmental concerns, and the always available Pacific wind systems for assistance in ship propulsion (Couper, 2009:208)

This paper argues the case for a more detailed inquiry into and analysis of the role that sail technology, arguably the greatest historical technological property legacy of Oceania, might play in seeking sustainable and Oceanian-centred adaptations for the region. The coastal and island communities of Oceania are beset by a number of immediate and pressing challenges including increasing environmental degradation, the uncertain effects of a climate change future and increasing dependency on imported fossil fuels with related concerns of supply and price security. There is widespread global interest in alternative energy technologies but sea transport generally and sail technology in particular have not been seriously explored. While the discussions in this article are limited to Fiji, its findings are assumed to have regional applicability, for the wind and relative isolation in the modern era are regional phenomena.

Sails are to Oceania as wheels are to continents. The capability to colonise one-third of the globe might be claimed as the greatest technological intellectual property right of Oceanian peoples. Historic maritime analysts (e.g. Finney, 1976, 1994, 2003; Irwin, 1992; D'Arcy, 2006, 2008; Howe et al., 2006; Couper, 2009) concur on a common picture at the time of European contact of an ocean heavily populated with indigenous sailing vessels of size and capacity comparable to or greater than those of the arriving Europeans. Such technology was highly developed, diverse in type, readily available and an essential facet to all aspects of life – from artisanal fishing and local village transport to inter-island and inter-archipelago warfare, trade and diplomacy. All were indigenously built, owned and operated and village or island centred. Yet in Fiji, within a space of only decades, this sail transport supremacy was almost entirely displaced with, first, European sailing technology and, ultimately, by largely externally-owned, carbon-fuelled, mechanically-propelled vessels. Today indigenously owned and operated sea-transport of more than nominal capacity is the rare exception at village level.

Issues of sea transport remain universal and primary to the peoples of Oceania. They appear to make a logical starting point when looking for sustainability adaptation entry points. Current transport options owe nothing to the Pacific's rich, indigenous, historic and sustainable legacy of vessel and sail technology development. They are also almost exclusively fossil-fuel powered. Small 'fibers ' and occasional launches aside, they are largely owned from urban centres outside of the village margins and village payment for their use disappears almost entirely from the village or island economy. Such maritime technology is not ultimately sustainable for small island communities, and reliance on such technologies makes the communities (at village, province and country levels) extremely vulnerable to changes in transport availability and fluctuations in fuel price and supply security.

In Fiji only isolated examples of sail remain, either in a recreational tourism-related capacity or small remnant pockets of indigenous sailing knowledge in the Lau group and Rabi Island. Yet industrial application of sails and sail technology offers promise as a logical and rational alternative, being an accessible, cost effective, carbon-positive,[1] renewable, low impact technology, as rooted (anchored) in Oceania as coconuts and kava. Re-association, if it can be proved sustainable, would be a practical Oceanian response to critical issues of climate change adaptation and the region's extreme dependence on imported fossil-fuel as well as a much deeper reclamation or re-invigoration of a central iconic pillar of Oceanian identity and culture.

Industrial, small-scale sea-transport ventures in this part of the world are always at best only marginally profitable and high-risk.[2] Dick (1989) advises that 'sail technologies must be commercially viable if they are to be any more useful than wings for flying pigs' (in Couper (ed.) 1989:168). For an alternative approach to current fossil fuel powered options to be proved to be sustainable, the full scope of potential constraints, barriers and benefit needs to be assessed.

Why look for alternatives now? Sustainability, climate change, fuel dependency and adaptation

The population of Oceania is numerically minute, less than 0.1% of the world's total. At a global level their voices are almost unheard, drowned out by a cacophony of larger states and superpowers and alliances whose consumer development, fossil-fuel addictions and security interests easily outweigh any Pacific voice. Unfortunately, the same Oceanian states, along with indigenous communities at the polar extremes, will be in the front-line of casualties to the increasing threat posed by a largely anthropogenic global climate change not of the Pacific's design or making (Merson, 2010; Barcham, 2009).

> In the Pacific, the next few decades will see climate change of unprecedented rapidity taking place. Not only will temperatures rise but also the ocean surface, which will create new sources of stress for human livelihoods. Our understanding of what is likely to happen in the future allows humanity an excellent opportunity to plan ahead, to anticipate the probable changes and to take action to minimise their undesirable effects, (Nunn, 2010)

A number of authors (e.g. Hansen et al., 2010) have identified the ongoing burning of fossil fuel as the primary culprit, again with the rich nations contributing at a disproportionate rate. Merson (2010) is amongst those experts of the region who are increasingly saying that we need to move beyond considering measures of mitigation for the causes of climate change to developing and implementing adaption measures and technologies. Merson considers we have, at best, this decade in which to make and enact fundamental decisions about our resource consumption habits and environmental management or face an essentially bleak and uncertain future.

A focus on reduced reliance on fossil fuel for sea transport by exploring easily accessible alternative technologies is an achievable goal for Pacific states, particularly if research to identify areas in need of research and technology are identified soon so that finite funding can be used creatively in a targeted manner as soon as possible.

The uniqueness of the Pacific (ocean-centred, non-continental, scattered landmasses, village dominated, culturally rich but economically poor) suggests that such adaptations will need to be tailored to Oceanian needs and conditions to prove effective and durable. Continental centred or focused solutions may prove inadequate or highly inappropriate here (Barnett, 2001). Barnett (2001, 2002) provides a succinct overview on the need for adaption and highlights that the quintessential nature of Oceania means both problems and responses are likely to be markedly different than for the continental world. He considers 'adaption to be an imprecise policy goal' and that Pacific countries lack adequate 'development' of adaptive capacity to respond successfully. 'Small Pacific island states are not like small continental states, and standard development models often fail to deliver sustainable human development.' Barnett's closing shot is the most telling: 'Ultimately, environmental security for Pacific people requires human and institutional development policies that increase and complement the existing abilities of those people to do what they have always done with considerable success — adapt to change'.

Climate change is, of course, only the latest of a long list of incursions and introduced effects on both local cultures and ecologies to challenge the security of Oceania since its brutal exposure to an industrialised Christian west. Gun power, exposure to new diseases and disruption of traditional indigenous political and religious hegemony across Oceania came at a horrific cost to populations, cultures and ecosystems, although the cultural resilience and adaptability displayed in the wake of this onslaught gives some room for optimism today. Donald Denoon and Stephen Kunitz have demolished the myth of collapse and shown depopulation varied considerably and rebounds occurred soon in all but colonised lands such as New Zealand and Hawaii.

R. Thaman (2002, 2004, 2007, 2008) is currently at the forefront of a large and articulate band of those who have regularly documented the region's environmental decline and increasing vulnerability, and stridently called for action to redress it. Other commentators repeat similar concerns through social, cultural, economic and political lenses and disciplines. Starting the search for solutions and direction by looking to the lessons of the past, re-honouring traditional associations with ocean, land, food and ecosystems, and recognising that Oceania is fundamentally different from continental Earth are considered primary steps by most Oceania-centred commentators.

Fiji, like all Pacific Island Countries (PIC), is precariously dependent on imported fossil fuel, which accounts for between 8 and 37% of total imports to Pacific Island states, raising critical issues of fuel price and security of supply (Woodruff, 2007b:3). PICs, despite their abundance of renewable energy resources, remain almost completely dependent on imported fossil fuels. Imported petroleum products account for an average of 40% of countries' GDP. Fuel imports for Fiji in 2005 totalled $US340M (Woodruff, 2007a:15). Such reliance represents a major drain on their economies, a barrier to development, and a source of vulnerability (Jafar, 2000). 'The size and structure of PIC economies also makes them vulnerable to trade shocks, which can compromise economic stability, by affecting variables such as the exchange rate, inflation and debt levels . . . [I]t is important to look at ways in which these chronic balance of payments problems can be eased, especially through the development of renewable energy technologies' (Woodruff 2007a:16).

Sea-transport efficiency – a global summary

Given current global awareness and debate on climate change and fossil-fuel dependency issues it is surprising that greater attention has not been given to developing alternatives to our current reliance on inefficient fossil-fuel powered sea transport options. There is little evidence that global initiatives will supply alternatives to current transport options. World transport predominantly relies on a single fossil resource, petroleum, which supplies 95% of the total energy used by world transport.

Shipping is estimated to use 9.5% of the world transport energy budget (Kahn Ribeiro, 2007:325, 328) and is a major contributor to greenhouse gas emissions.[3] Mid-range emission scenarios suggest that by 2050, in the absence of reduction policies, ship emissions may grow by 150% to 250% (compared to the emissions in 2007).[4]

It is also generally recognised by the world's shipping industry that fuel efficiency has not been a motivating factor for them and increased fuel charges are generally passed on directly to the consumer.

> [I]t has been suggested that, by 2020, a combination of regulatory, design and operational measures might possibly deliver a reduction of around 17 to 32 per cent in the fuel consumed by ships per tonne/mile of cargo transported. However, it is important to stress that work on these complex issues is still continuing, that more efficient and sophisticated ships will be more expensive and that many measures may not be cost-effective for a range of ships and trades. (Buhaug, 2009:6)

Of the reports available via the IMO website and related links reviewed thus far, only two mention, albeit briefly, any future potential for sail technology, and both are sceptical of its viability. The 3rd IPCC report has less than two pages of content (out of 56) devoted to sea-transport in its Transport chapter. This neglect of research has taken place despite international shipping producing more sulphur-dioxide emissions than the entire terrestrial vehicle fleet and around a quarter of all nitrous oxide. Sail is mentioned in regard to the possible potential to retrofit some large ships with auxiliary sails (Kahn Ribeiro, 2009). Globally, current efforts to increase sea-transport fuel efficiency are primarily limited to either improved motors, fuel or vessel hull design. There is interest in 'kite-sails' with a leading manufacturer claiming in 2007 that up to 60% of the world's approximately 100,000 Lloyds registered commercial transport vessels could be retro-fitted with such technology (www.skysails.com). There are as yet no large-scale commercially working models and numerous technical issues remain. Work, of course, has been ongoing in regard to nuclear propulsion technologies, led largely by the US military industrial complex and this still remains the Pentagon's, if not Congress's, preferred alternative ship fuel technology today (O'Rourke, 2006).

Sail powered sea transport – an Oceanian legacy

The use of wind power to supplement more conventional fuel-powered maritime propulsion noted above may help large commercial vessels in the Pacific with its reasonably reliable wind patterns. However, it is argued here that this might also be supplemented and complemented by the use of wind-only powered propulsion for local vessels to meet local demand and to feed cargo into these larger and more global commercial shipping networks.

It is suggested that valuable lessons for the future can be learned through examination of traditional past Oceanian practice (e.g. Overton, 1994; Clarke, 1990).

> It is essential for those who wish to help these Pacific island communities, to acknowledge that they will achieve far more by seeking first an understanding of the social organisation and social geography of Pacific seafaring than by continuing with policies of Eurocentric ideas of the sea business and virtually ignoring the wealth of the maritime heritage of the Pacific islanders. (Couper, 1973:247)

D'Arcy (2006:173) offers similar directives:

> The many requirements for seafaring were hard to maintain, and communities were always vulnerable to forces from beyond the horizon and beyond their control. Islander societies needed flexibility and adaptability to deal with external influences. Survival in the sea of islands also involved a high level of organisation. Islanders should not only have pride in the achievements of their ancestors, but also learn from them.

Over the past 6,000 years, ancestors of today's Pacific Islanders found, explored, and where viable colonised, all known islands in the world's largest ocean by exploiting learned knowledge of navigation, ship design and construction and particularly the ability to sail to windward on an apparent wind (Lewis, 1972, 1978 ; Howe et al., 2006). Despite some initial academic debate in the latter half of the twentieth century (Sharp, 1956) it is now generally held that such voyaging was widespread, diverse in use of technological adaption, and deliberate. Finney (1976, 2003), Irwin (1992), Howe and others (2006), D'Arcy (2006), Couper (2009) and others have now extensively documented this incredible legacy, made on a variety of vessels employing a wide range of approaches to vessel design, construction and operation.

The Pacific was an ocean of sails, a truly sustainable transport technology built out of renewable resources and exploiting self-renewable wind energy as its primary motive power. Not only were iconic large vessels used for ocean exploration and naval domination across vast distances, but sailing and sailing technology were also an integral part of daily life, essential for all levels of social interaction, transport, warfare, trade and fishing. The sheer volume of vessels needs to be appreciated; early European explorers reported encountering fleets of hundreds of vessels carrying thousands of men.

The renaissance in the past 40 years of Pacific Islanders' interest in Oceanian sailing and voyaging has focused largely on long-distance exploration and the role that seafaring technology and navigation played in initial exploration and dispersal across the Pacific. There is evidence of an enormous range and complexity of vessel design. It is sufficient to note here that Fiji (Viti) sailing culture is sparsely recorded at any academic level. The Fijian *drua*, I argue, represents the apex of Pacific sailing technology. These vessels (called *kalia* in Tonga and '*alia* in Samoa) were large (with examples of over 100' length) blue-water ships capable of speeds in excess of 15 knots while carrying loads in excess of 200 passengers and up to 50 tonne of cargo and could sail within 3 points of the wind. Haddon and Hornell (1936) and Clunie (1986, 1987) have provided comprehensive characterisation of these vessels. Hocart (1952), Thompson (1949) and Sahlins (1962) are amongst those ethnographers and geographers who have paid detailed attention to the political and economic networks of the central Pacific since the mid-1700s. Couper (1968, 1973) discusses the use and importance of sail within the old Tonga–Samoa–Fiji trade routes, summarising (1973:230–232) that:

> [t]he Europeans who first came to the Central Pacific found established networks of trade linking the archipelagos of Fiji, Tonga and Samoa. Within each of these island groups were complex local trading chains which operated through intermediate villages and even through professional middlemen. Commander Wilkes in 1841, for example, described communities of trading specialists in Fiji which had no fixed place of residence. The missionary Thomas Williams also remarked on these seafaring 'Levukians', and he noted the important role

> of women as traders and ordinary seamen . . . European travellers also describe Tongan traders who voyage between Fiji, Tonga and Samoa.

With a few notable exceptions the use of sail has largely disappeared at village level throughout the Pacific Islands region. Over the past 40 years, many PICs have established voyaging societies dedicated to re-establishing this traditional legacy. The renewed interest in voyaging and *drua* that the vessel and training programme *Uto Ni Yalo*[5] has generated in Fiji recently means it is probably inevitable that discussion will now turn to reconstruction of a proper *drua* as well as greater validation of the past role Fiji and Fijians have played in the region's sailing heritage. One of the key barriers to re-introduction of a modern adaption of this historic legacy is a perceptual one – bigger and faster motors are seen as a step toward 'development', sails are seen as part of a quaint past, a step back not forward. The success of initiatives such as *Uto Ni Yalo* can only be positive in leveraging cultural history, pride and achievement toward greater acceptance of the technology and acting as iconic sustainability flagships.

Previous sail power experiments

The 1970s oil crisis led to several important experiments in the use of wind powered or sail-assisted sea transport which have salient lessons for any future attempts to reintroduce this form of technology. Unfortunately, the low cost of fuel as an overall component of the industry and the relatively short duration of the event[6] saw some rhetoric but little action on either making current modes of sea transport more efficient or developing alternative technologies to fossil-fuel powered propulsion. Attempts since the 1970s crisis have ranged from large-scale industrial applications of sail to small single vessel, built-on-beach models. They have also ranged from attempts to use sail as an auxiliary to conventional propulsion to new designs for pure-sail transport. Three representative examples of these initiatives are discussed below.

In Fiji in 1984 the Asian Development Bank funded Southampton University to experiment with retro-fitting a 300-ton cargo/passenger ferry with auxiliary sails. Contrary to predictions the vessel performed exceptionally well, realising none of the initial concerns over ultimate stability and leeward and resulting in 23% overall fuel savings plus multiple benefits in terms of increased stability, greater passenger comfort, and greatly reduced engine wear (Satchwell, 1985). Unfortunately, the vessel was lost on Maola reef in a developing cyclone in early 1985, but not before she was able to escape the cyclone under sail after the engines failed and thus preserve the life of the Fijian Prime Minister, on board at the time .

In a similar experiment, Japanese oil tanker owners trialled modern square sails on 900-tonne vessels using aircraft wing manufacturing technology and computer controlled rigs. Again the results were impressive with overall fuel savings of more than 30%, increased passage speeds, increased stability and greatly reduced engine wear. Contrary to initial concerns, the sail-fitted vessels were able to maintain course safely in typhoon conditions where sister vessels had to heave to (UNESCAP, 1985). Over three years a fleet of eight such ships ranging from 600 to 31000 ton nes was established. However, plummeting oil prices meant the investment rate of return (IRR) on the technology was uneconomic and the experiment was discontinued. The results of both experiments, though, have been well documented, including full wind route planning data for Fijian waters, and should prove invaluable in the future (Satchwell, 1985, 1986).

In work led by FAO (1986) in this period, an experimental fleet of more than 350 artisanal fishing vessels ranging from single-fisher outriggers to 11-m trimarans was built in eight Pacific Islands countries, many as either pure sail or wind assisted designs. The uptake of the sail-powered vessels, however, was minimal (R. Gillett, pers. comm. 2010). FAO concluded that 'the only places where a new type of sailing craft has gained acceptance are those where there is a living tradition of the use of sail' (FAO, 1986). Other key lessons learned include the need for any alternative technology to be proven to have direct overall economic benefit or saving to the user and the need for an entire sailing culture to be re-instilled.

Lessons learned

There appear to be three initial lessons to be learned from the past:

Sea transport is a primary concern of Oceanian peoples and connects most Oceanian communities, and over millennia Oceania has developed a capacity to adapt to sea-transport issues through a lateral ability to evolve design and application of technology, seamanship and organisation from a minimalist resource base. There is no reason to suppose that this adaptive capacity is diminished today, even with more than a century of increasingly limited practical usage. If this is true there is no reason why it should not allow Oceania to lead the world in a renewed approach to sustainable sea transport for the future.

Those Oceania cultures that have managed to maintain 'a living tradition of the use of sail' (FAO, 1986) have a distinct advantage over other communities in successfully adopting sail-based adaptations to sea transport. A transition from fossil fuel power to sail-based sea transport, no matter whether at individual fisher or inter-state cargo level, requires far more than changing the means of propulsion. A true sailing culture must be re-instilled in both transport operators and users, effecting a change from 'mariners' to 'sailors'. Flexible route planning becomes essential, and increasingly so if the vessels are pure-sail as opposed to sail-assisted motor-vessels, with predicted wind direction and strength at least as important as regular timetabling in determining course and time of sailing. Similarly, if maximum sustainability and fuel reduction is desired, passengers and freight customers will need to accept that some passages will vary in duration and possibly course. Crews will need to have new and additional skill sets with sails and rig being monitored as closely as engine performance is currently. These skills and mentality are already instilled in cultures for which sailing is as normal as swimming in their primary cultural environment. Such communities are now as rare as historically they were prevalent.

Historically, it would appear that it was the challenges of balancing socio-cultural needs of sea transport with economic business imperatives and changing scales of vessel ownership that restricted Oceanians from successful management of commercial sea transport, not a failure in seamanship or vessel management. While the scope and scale of such interrelationships may have changed during the process of colonisation and post-colonisation, the issue is still strong and achieving the balance is essential. 'There was a complex spatial component in the economies of the pre-colonial Pacific, demanding considerable planning, extensive geographical knowledge and a relatively high degree of technological skill . . . [This] should have been a basis for successful participation in the maritime trade which arose from the introduced commercial economy. But this happened only partially and with a record of failures that outran the successes' (Couper, 1973:229).

What course to steer?

Sail has potential at least for efficient fuel and emission saving at all levels of maritime shipping in Fiji and across the region. The example I next explore below, a managed Fijian fleet of pure sail vessels targeting local village and small island demand, is only one of numerous sea transport options where sail could be considered; including fishing vessels both artisanal and commercial of varying sizes either as pure-sail or sail-assisted motor vessels, sail-powered or -assisted cargo barges for timber, copra, fuel and water supply and sail or kite axillaries for all types of national and regional passenger and cargo vessels. Ultimately all options should be assessed. An initial focus on small-scale village and island level with a primary local passenger and cargo market has been adopted as it appears to make a manageable and achievable entry point for the technology.

One of the biggest challenges with exploring sail as a viable modern propulsion method is the cultural perception that sail belongs to an (albeit romantic and historic) past and inferior period of development. The success of the latest traditional voyaging fleet, and in particular the inclusion of a designated vessel for Fiji, *Uto ni Yalo*, has done much to alter this perception to less negative connotations in Fiji. Buoyed by this success, though amongst the FIVS (Fiji Islands Voyaging Society) and supporters, this has now turned, naturally, to what application sail might make at a more industrial and local level, particularly in inter-island, inter-village trade.

Simultaneously, research in Kadavu, an island of 50+ villages to the south of the main island Viti Levu, has shown that a small (50', 3–4 tonne carrying capacity) sail-powered cargo catamaran could provide multiple benefits (environmental, social, cultural as well as economic) at a local level while providing a commercially viable transport alternative to current options.[7] Such an endeavour, though, would be at high risk, primarily because a single-vessel operation would lack the operational flexibility and the economy of scale savings that a managed fleet of boats would provide.

Establishing such a pilot fleet would of course be no small undertaking and involves consideration of multiple issues, summarised in Table 1. Achieving a sustainable trading enterprise that must marry cultural imperatives with commercial realities while competing in a high risk, intensely competitive market, such as sea transport in Fiji, is much more than simply building and launching a boat and raising the sail.

It is also increasingly obvious that there is a large number of potential linkages with other value-resonant existing programmes. This is especially true for conservation and sustainable resource management programmes, (such as FLMMA,[8] Ministry of Fisheries), and social service, education and health delivery programmes in outer villages where sea transport consumes a high percentage of project budgets.

Given the above, it would appear safe to conclude that the venture with the best potential of success as a working model will be one that is locally-led, has the greatest possible degree of willing collaboration by a wide range of internal and external stakeholders, and is given adequate support to allow for a realistic lead-in time in which to prove viability. Investment needs to be made at the front-end of planning and research. Continual relationship building between multiple stakeholders, many with divergent interests, including government agencies (especially Fiji Islands Maritime Safety Agency and Ministry of Transport), local communities (at koro and tikina levels), regional specialists (e.g. SPC), relevant business interests (e.g. boat builders, cargo operators), NGOs and donors (whether government, NGO or private) is the highest priority. Researchers need to be involved to ensure the programme is monitored and evaluated, particularly in the event that the initiative fails, so that clear navigational records can be left for the next intrepid voyagers on this route.

Table 1 A managed fleet of sail-powered boats for Fiji? Opportunities and challenges

Opportunities	Challenges
To establish the most sustainable sea trading fleet in the world: a network of Fijian built, owned and operated sail-powered trading vessels, providing environmental, social, economic and cultural benefit for current and future generations.	What type of trading structure can be adopted that will both provide benefit at village level and still be commercially viable over time?
Fiji has a proven track record of small ship manufacture, support and maintenance infrastructure.	How long will a new technology take to be universally accepted?
It has the business and commercial base to support a technological revolution if it can be proven viable.	Should it be centrally owned? managed? Should the village be beneficiary? owner? partner? operator?
The potential Fiji market for this type of transport option is sufficiently large to allow economies of scale.	Is there a 'one-size-fits-all' vessel or are multiple designs needed?
The success of *Uto ni Yalo* means there is a surplus of crew asking to be trained.	How will a pilot programme be resourced? What is the role of carbon credits in establishing commercial viability?
A centrally operated fleet, with vessels leased to village and island trading networks, would provide numerous benefits to both villages and a budding boatbuilding and training industry.	How long will it take to prove viable? How will sustainability be measured and monitored?
If successful in Fiji it can be replicated in many other parts of Oceania.	How can this initiative achieve maximum synergies with other programmes? (e.g. fisheries management, marine conservation, village alternative energy projects, sustainable businesses, marine safety). Will stakeholders and donors collaborate? Or compete?

This article has focused, to the exclusion of other dialogues, on a potential industrial application of sail for Fiji. There are of course many other discourses, undoubtedly of equal or greater importance – the uplift, for instance, that re-association with sail could deliver for cultural identity. As Couper (2009) notes, prophetically, '[f]or the future of these island countries, few areas of enterprise are more important than the marine sector, for without an effective presence on the sea they are but fragments of land and people in a foreign ocean'.

A serious and coordinated programme to investigate fully and trial a range of sail-powered sea transport options for Fiji and Oceania would entail a relatively small investment of time, resources and energy. The result could, for all modern Oceanian communities, be a revolutionary approach to a central issue, one that provides truly sustainable solutions from a local base built on a remarkable regional heritage.

Notes

[1] Or at least neutral, depending on how much use is made of sail rather than fuel powered axillaries, the type of material used for vessel construction and the process of building.

[2] By way of example of the extreme risks involved in island shipping, Fijian government records for the period 1956–64 show 52 major shipping incidents, most involving loss of vessels (Couper, 2009:170).

[3] Estimates of total emissions vary, reflecting systemic issues of data capture, between 1.8 and 3.5%, making the industry an emitter on the scale of Germany and on a par with aviation (Buhaug, 2009: www.carbonwarroom.com). The most authoritative figures for the impact of shipping on GHG emissions are to be found in the Second IMO GHG Study, (Buhaug, 2009). It is essentially a monopoly industry, which moves 90% of the world's goods and raw material (Kahn Ribeiro, 2009:335).

[4] In terms of CO_2 emissions per tonne of cargo transported one mile, shipping is recognised as the most efficient form of commercial transport.

[5] See the Fiji Voyaging Website (http://www.fijivoyaging.com/) for details on this vessel and its inspirational inaugural voyages. Ships and journeys such as this have been pivotal in invigorating a cultural renaissance in Oceanian sailing and navigation across the Pacific.

[6] By 1985 oil was at its lowest wholesale price since WWII.

[7] See www.sailingforsustainability.org for more details of this research.

[8] FLMMA – Fiji Local Marine Management Area Programme, an internationally recognised and highly successful collaborative, multi-stakeholder marine protection initiative, (see Veitayaki et al., 2003).

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