

Solodamu: A Survey of Fuel and Transport Use in a Coastal Village on Kadavu, Fiji

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Executive Summary

Sea transport is critical to all aspects of life in the Pacific, providing access to markets and health and education services, as well as enabling cultural and social connectivity. Current sea transport services are entirely dependent upon use of increasingly expensive fossil fuels.

The importance of transport in achieving sustainable development and “green growth” is being increasingly highlighted by Pacific Leaders, and particularly the need to find alternatives to reduce the region’s crippling dependency on imported fossil fuels.

Recent studies have highlighted lack of data, particularly at a village level, as being a major impediment to progressing a shift to more sustainable transport.

This paper provides a summary of the findings of a village-based assessment of transport and fossil fuel use in Solodamu Village, Kadavu. The objectives of the survey were to gauge the current overall sea, land and air transport use by the village and the fossil fuel footprint of the village by collecting data on a household by household basis.

The paper highlights the potential of using this assessment methodology in other locations, so building the data sets available for projects which seek to address the issue of sustainable transport for the Pacific.

Key Words: Sea transport, Village fuel use, Village transport demand, Sustainability, Community resilience, Fiji.

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1.0 CONTEXT

Transport is a priority for Pacific Forum Leaders under the Pacific Plan and its importance as a facilitator of economic growth is well recognised (ABD, 2007; SPC, 2011; UNESCAP, 2010). Sea-transport is essential at all levels of society from fishing and local transport needs of small isolated islands and villages to inter-regional shipping needs of nation states. Providing efficient, sufficient, safe and reliable domestic shipping is one of the most trying challenges for PICs.

Currently all maritime transport services are fossil-fuel powered and are becoming increasingly unsustainable as operational costs and the costs of fossil fuels in particular increase. Increasing prices have considerable effect socially and culturally, as well as economically.

The literature is thin and, historical analysis aside (Bayliss-Smith, 1988; Couper, 1968, 1973, 2009; D'Arcy, 2006, 2008), restricted largely to a few development agency reports. All agree however, that it is the intra-country domestic services that are in most dire need (AusAID, 2008; SPC, 2011; UNESCAP, 2010). Generally such shipping services are restricted to an aging and inefficient fleet. The marginal returns, especially for domestic services, means most operators are trapped in a cycle of replacing old ships with old ships or waiting for donated (and sometimes inappropriate) vessels.

Inter-island and coastal shipping services are usually run by governments or small, independent shipping companies. Many routes are commercially unviable and some are simply uneconomic. Governments are required to subsidize or otherwise provide for these with continually accumulating costs. SPC (2011) summarises that large distances, high fuel costs and low economies of scale make the cost of developing and maintaining transport infrastructure relatively high. Issues of constricted markets for local products and reliance on

international trade are exacerbated by global developments as well as resulting in fewer employment and livelihood possibilities.

Because the vast bulk of commodities and manufactured goods are transported by ship in the Pacific, and considerable domestic travel is by sea, the cost and quality of shipping immediately affects the welfare of the consumers and producers (SPC, 2011). Additionally, the marginal nature of the industry means that financing shipping investment, either for governments or private operators, is problematic (ADB, 2007; SPC, 2011).

Fijians are a highly mobile people; maintaining family connections is a vital concern and there is considerable travel between kin throughout Fiji. Any increase in transport costs immediately impacts maintenance of social and cultural connectivity.

Generally, on outer island systems, commercial or other economic activities are notably limited. The historical absence of commercial development within the outer lying islands has meant high biodiversity and cultural values have been preserved in most island communities. There are a number of existing projects and NGO work with a common aim of building resilience or ‘climate change proofing’ the local communities and their island environments. These projects are focused on assisting and supporting local communities to maintain well-being through improved reliance on local and natural assets (Veitayaki, et al, 2003). It is logical to add analysis of sea transport options to this portfolio of social, economic and environmentally focused initiatives (Prasad, et al., 2013).

That sustainable transport is essential to developing “blue/green economies” is also becoming increasingly recognised. The outcomes from the 2013 inaugural meeting of the Pacific Islands Development Forum include: *“Sustainable transport: We prioritize alternatives to existing petroleum driven land and sea transportation that significantly reduce fuel imports. Sustainable shipping approaches are to be promoted and adopted as an alternative to provide effective services for remote island communities.”* (PIDF, 2013).

There is no reliable data to calculate what percentage of fossil fuel use is attributable to sea transport but Mayhew (2011) considers it could be as high as 75% of all fuel used for some PICs. Whilst there has been significant effort by Pacific countries to reduce fossil fuel used for electricity generation in recent years, there has been little focus to date on the transport sector which uses significantly more fuel (Nuttall et al, 2013; Prasad et al, 2013). Using Fiji as an example, 64% of imported fuels are used for transport compared to 19% for electricity generation (Economic Consulting Associates Ltd, 2013).

Recent research (Nuttall et al, 2013; Prasad et al, 2013) has highlighted the need for more data to support research and analysis into the fossil fuel used by the maritime transport sector in the Pacific. This paper is offered as a contribution, giving insight into how much fossil fuel is used annually by one small coastal village in Fiji, and of that what proportion is used for maritime transport. We then look at how this may be replicated at an island group level.

2.0 SOLODAMU TRANSPORT AND FUEL USE SURVEYS

2.1 Survey Location: Solodamu Village, Kadavu

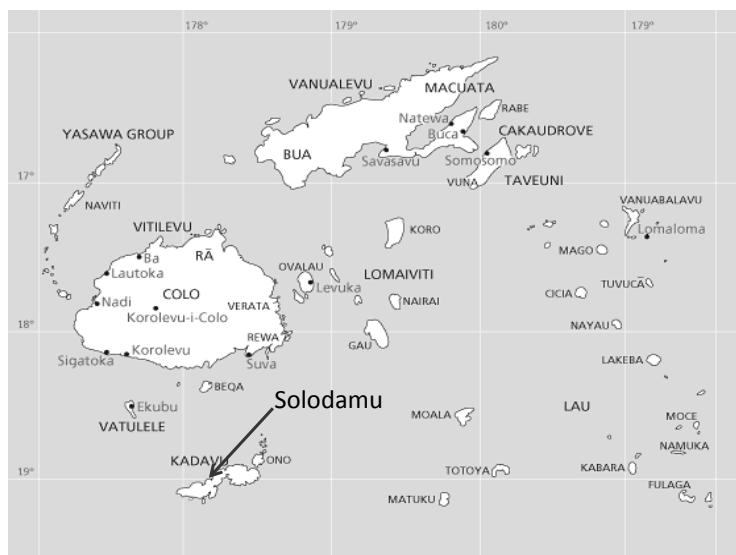


Figure 1: Solodamu Location Map

Solodamu is a small village on the north-western coast of Kadavu, approximately 60 nautical miles (110km) from Suva the capital on the main island of Viti Levu. Solodamu is approximately 6 km to the west of Vunisea, the nearest town with a small hospital, post office, government offices, market, schools, jetty and airport.

The 2007 census showed Kadavu had a population of approximately 10,000 residents, most of whom were *iTaukei* (there were 8 Indo-Fijians) residing in 75 villages and one small town, Vunisea (Fiji Bureau of Statistics, 2010). Solodamu has 22 households and is the second smallest of 6 villages in Tavuki Bay that form the Tavuki tikina.



Figure 2: Solodamu Village

There is one village store and no permanent industry or business, and the village relies primarily on subsistence farming, fishing, and yaqona (kava) for the Suva market. Yaqona is the primary cash export for which the island is famous. Whilst no information was collected on household income during these surveys, Sofer (2007) noted that the average annual household cash income for Nalotu (a similar-sized village to Solodamu) was FJ\$3014.1,

42.3% of which came from yaqona sales.

As a result of five years planning and fund raising by the village, the village installed a communal diesel generator in 2009 that supplies reticulated electricity to all houses. In 2009 the village generator ran for 3 hours each evening, although this had dropped to 2 hours in 2011, the cost of the fuel being given as the reason for this. The electricity is for basic household use only and is primarily used for lighting being insufficient to allow use of appliances such as refrigeration, washing machines and irons.

2.1 Existing Transport Services

Vunisea is comparatively well-serviced by air and sea transport with flights to both Suva and Nadi on small twin engine aircraft and twice-weekly roll-on/roll-off ferries to Suva. Transport from Vunisea to Viti Levu costs \$170-490 one-way via plane and \$35-55 one-way on the ferries. Although Kadavu is relatively well serviced when compared with other islands and communities in Fiji, Sofer (1985 and 2007) highlights the vicious circle caused by marginal returns for shipping operators who service Kadavu resulting in ship operators being unwilling to service the route and the lack of sea transport services means local communities do not grow excess crops and other products for market.

Villagers travel to Vunisea over a “dry weather” road on foot (1½-2 hour walk), by horse or by 4WD vehicle (a 30 minute drive costing \$50 for the vehicle one way) or by sea using “fibres²” (also a 30 minute trip costing \$50 per fibre one way). At the times the surveys were undertaken no vehicles were owned or stationed in the village and 3 households owned fibres. Fibres have been known to travel from Kadavu to the mainland but this voyage is hazardous and is only likely to be attempted in favourable weather or when prompted by high cultural need (e.g. to attend important funerals).

² A “fibre” is a small (23 – 36 ft) open skiff, usually of made of wood or fibreglass and powered by an outboard engine of typically 40 or 60 horsepower.

2.2 Survey Need

In 2008 the village population was dropping, with a predominance of elderly and single males and a falling school role due to villagers migrating to Suva for education and employment opportunities. The village sought assistance from Sailing for Sustainability Trust (a New Zealand charity) to investigate opportunities for employment to attract young families back to the village.

In order to identify potential opportunities, first the village looked back to what they had done in the past. The Youth Committee had successfully run a motor launch that they chartered around Kadavu, built with help from the Methodist Church. Due to management issues the launch ended up rotting on the beach. Despite this the village was keen to further investigate sea transport as a potential income earner and employment opportunity and held several workshops to discuss whether a new village boat was an option.

In answering whether it would be feasible and viable, data on the village's transport demand was needed, in particular:

- How much cargo needs to be moved and to where?
- How many passengers?
- How often?

As the village's launch had been fossil fuel powered, and the costs of fuel were increasing, the village also wanted to know if renewable energy powered vessels were an option, and so wanted data on fuel use for the village.

An internet search was undertaken to see if there was any information that would assist and found nothing that was useful. Without data, decisions as to the type of boat that would be most appropriate become guesswork. Therefore the only option was to collect data as a priority.

2.3 Survey Methodology

The research need and process was identified by a working party (of both villagers and international volunteers) set up by the village chief. The objective was to gauge the current overall sea, land, and air transport use by the village and the fossil fuel footprint of the village by collecting data on a household by household basis and aggregating the totals. The research need and process were discussed with and agreed to by the village at their regular monthly meeting. A questionnaire template was designed and agreed by the working party.



Figure 3: Solodamu Village Meeting Designing Questionnaire

In September 2009 structured questionnaires were conducted in 20 of the 22 households. This survey was repeated using 17 households in June 2011.

Most interviews were conducted with a number of household members present, in all cases including at least the mother of the house. Invariably the interview process included tea and kana and was open ended in terms of time taken.

Participants were advised that the only information to be made available was of overall village totals and not individual household data. Data collected was entered into a pre-prepared spreadsheet on a laptop during the surveys.

Individual household surveys collected detailed data on passenger and cargo transport to and from Solodamu (both within Kadavu and beyond) and fossil fuel use. The surveys were undertaken by a team of village researchers paired with international volunteers sanctioned by the village and conducted in both Fijian and English. In 2011 data was also collected on firewood use for cooking.

2.4 Results and Discussion

2.4.1 Fuel Use

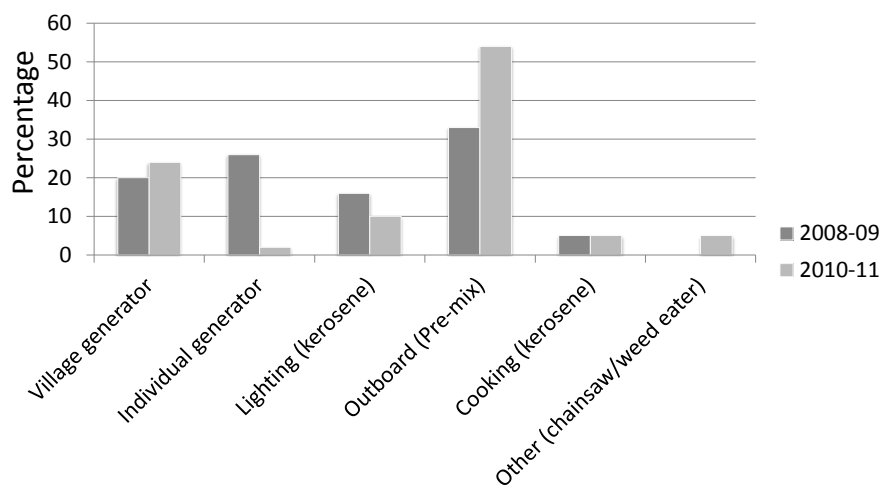


Figure 4: Solodamu Fuel Use

As this graph shows, the largest single user of fossil fuel was sea transport (outboard motors) and increased over time as a proportion of the total fuel used by the village (from 33% in 2009 to 54% in 2011).

A small amount of solar use aside, all electricity was fossil fuel derived, diesel for the communal generator and pre-mix for household generators (26% of fuel used was for electricity generation in 2011 having dropped from 46% in 2009). Interestingly there was a

rapid decrease in fuel used for individual household generators from 26% of all fuel used in 2009 to 2% in 2011.

In 2009 the village reported that the number of private generators had increased steadily as had the use of electrical appliances (lights, stereos, TV/video/DVD players, telephone and cell phones, power tools, a few washing machines and at least one chest freezer). This had changed in 2011 however with fewer households using individual generators. More households were using solar lamps and torches in 2011.

Other fuel uses included kerosene for both lighting and cooking, petrol for chainsaws/weed eaters, and LPG by one household for cooking, with firewood remaining the primary fuel for cooking (households used on average ½ tonne of firewood/month).

2.4.2 Transport Demand

Between 2009 and 2011 there was an increase in goods transported from Solodamu (food crops to Vunisea and kava to Suva). Significantly these cargos were mostly transported by fibre to Vunisea rather than by road, then via ferry to Suva (rising from 54% of cargo being transported in 2009 to 100% in 2011). Plane was the only means used to get produce to Nadi, this being a very small percentage of overall cargo transported.

	2008 – 09			2010 – 11		
	Cargo to Suva	Cargo to Nadi	Cargo to Kadavu	Cargo to Suva	Cargo to Nadi	Cargo to Kadavu
Ferry	7283	0	0	21740	0	0
Plane	590	611	0	180	60	0
Yacht	105	0	0	0	0	0
Fiber	0	0	7500	0	0	32810
Truck/4WD	0	0	11770	0	0	0
Total Cargo	7978 kgs	611 kgs	19270 kgs	21920 kgs	60 kgs	32810 kgs
Total Exports	27859 kgs			54790 kgs		

Figure 5: Cargo Transported from Solodamu

The quantities of cargo transported to the village (mostly hardware/building supplies and household groceries) did not change significantly. Most goods were brought by ferry from Suva to Vunisea and then by fibre or 4WD to the village (71% of goods were transported by sea in 2009 rising to 95% in 2011 and use of 4WD declined).

	2008 -09		2010 – 11	
	Cargo from Suva	Cargo from Kadavu	Cargo from Suva	Cargo from Kadavu
Ferry	6030	0	5360	0
Fiber	0	6480	0	13610
Yacht	6	0	0	0
Plane	100	0	0	0
Truck/4WD	0	5028	0	0
On foot/horse	No data	No data	0	1000
Total Cargo	6136 kgs	11508 kgs	5360 kgs	14610 kgs
Total Imports	17644 kgs		19970 kgs	

Figure 6: Cargo Transported to Solodamu

The number of trips made by villagers within Kadavu increased (reflecting villagers including trips to their farms and/or school in the 2011 survey). Interestingly, no one used ferries for transport within Kadavu, despite the ferries calling at both Vunisea and Kavala. The data shows an increase in fibre use for passenger transport and decrease in use of 4WD, similar to that for cargo transport.

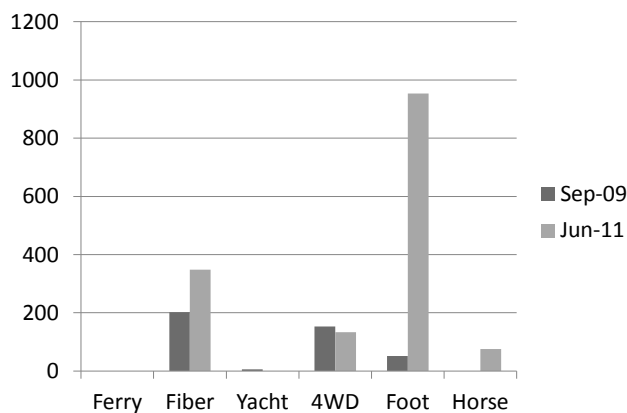


Figure 7: Number of One-way Trips Made (in one month) by Solodamu Villagers within Kadavu

The number of trips made by villagers beyond Kadavu declined, although ferries remained the primary form of transport (57% in 2009 and 54% in 2011). Figures of plane use to/from Suva are significantly affected by one individual who flew to/from Suva frequently for work purposes.

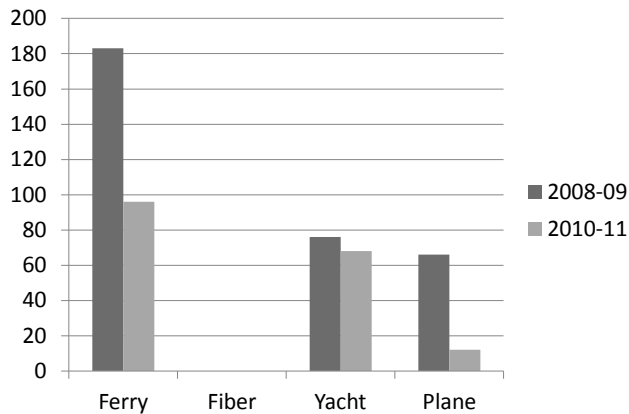


Figure 8: Number of One-way Trips Made (in one year) by Solodamu Villagers outside of Kadavu

Solodamu has been regularly visited by a small number of yachts in the past 5 years. Villagers have made increasing use of these for transport of people and goods to and from Suva (increasing from 23% to 39%). Despite fibres being capable of making the trip from Kadavu to Suva, no villagers used fibres for transport beyond Kadavu. This is probably due to the cost of the fuel, the length of the trip and the fact that is essentially a blue-water passage that should only be undertaken during extremely fine weather. Overall there has been a significant decrease in the number of trips made by Solodamu villagers to locations beyond Kadavu.

The number of visitors to Solodamu per month did not change significantly, although the surveys showed that use of fibre decreased and use of 4WD and walking increased. Again the ferry was not used by visitors from elsewhere on Kadavu.

The data shows a significant drop in visitors to Solodamu from beyond Kadavu (from 145 in 2009 to 53 in 2011). Interestingly, there was an increase in visitors arriving by yacht

(from 12% in 2009 to 47% in 2011), which means that even fewer visitors came to Solodamu by more “conventional” means. 56% of visitors used ferries in 2009 dropping to 34% in 2011. Visitors using plane decreased from 32% to 19%. No visitors used fibres.

2.5 Discussion

Interisland transport is critical for Solodamu. Combined with coastal movements, it makes sea-transport crucial to every aspect of village well-being. It is essential for transport of both people and goods and is currently the single largest user of fossil fuel in Solodamu and is increasing (54% of fossil fuel used in 2011 rising from 33% in 2009). The increase in fuel used was primarily attributable to increased use of fibres for sea transport. These figures do not include the fuel used by the ferries for sea transport from Vunisea to Suva. Nor do these figures include fuel used for air or land transport so the total fuel used for transport is likely to be significantly higher than recorded.

Electricity demand had increased up until 2009 but declined by 2011 this being attributable to the decline in use of individual household generators as the cost of fuel increased.

Fossil fuel is an increasingly expensive commodity. After a period of relatively stable prices, the cost of pre-mixed petrol (50:1 oil/petrol mix suitable for outboard motors) increased during the 2008 world oil price hikes to over \$FJ3 a litre in the village for a period. These prices have fluctuated since this extreme and at the time of the survey was retailing in the village at around \$FJ2.50 a litre in 2009 and 2011. Villagers also report that it is an increasingly used commodity. A small amount of solar use aside, all electricity is fossil fuel derived. Firewood is the principal source of fuel used for cooking.

Using this data and assuming that Solodamu comprises around 1% of Kadavu’s overall population then by extrapolation of the Solodamu data we calculate the island as a

whole consumes more than 67 tonnes/month (800+ tonnes per annum) of fossil fuel for sea transport around Kadavu.

2.6 Survey Limitations

The survey has only been carried out twice, although it is intended to repeat the exercise in the future. It therefore has no real baseline against which to show changes in annual trend. The survey gives data for the months of September and June. It does not therefore show monthly or seasonal variation. Interisland travel is known to have marked seasonal variation with the Christmas period and national events (especially Diwali when there are large sales in Suva and the annual Methodist conference) being key drivers of increased transport use.

Figures of plane use to/from Suva are significantly affected by one individual who flies to/from Suva frequently for work purposes. Villagers have made increasing use of visiting yachts for transport of people/goods to and from Suva and it is not known to what degree this has skewed “normal” village movement patterns.

Not everyone in the village was interviewed. However, all households were canvassed and sufficient spread of village members was surveyed to suggest a high degree of accuracy in the final results. It provides a baseline for future surveys to determine trend over time.

3.0 TAKING THE SURVEY FROM VILLAGE TO ISLAND GROUP

In spite of the importance of domestic shipping to Pacific Island Countries, there has been almost no research or programmes to collect the necessary data for research. Recent work on profiling village transport need and fossil fuel footprints has been non-existent except for the surveys in Solodamu discussed above.

In 2013 the University of the South Pacific launched a new research programme, the Sustainable Sea Transport Research Programme (SSTRP), designed to initiate long-term

investigation and analysis of the potential for using renewable energy technologies for sea transport for the region (Nuttall et al, 2013; Prasad et al, 2013). 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-1980's. Increasing concern over the region's fossil fuel dependency, the search for low carbon futures and the crucial role of sea transport to most aspects of economic, social and cultural wellbeing make the establishment of such a research agenda a logical priority.

In particular, the current one-year research programme focuses on preparatory economic studies using three selected Fijian routes as case studies, including potential for carbon credits to offset costs.

3.1 Building the Baseline of Data

Data collection is one of the first tasks to be undertaken, focussing on data relevant to the three case studies, as well as carbon trading potential.

Solodamu village's sea-transport scenario provides a representative case study of the issues faced by many Oceanic remote coastal communities. It underscores the argument that coastal/island communities that are reliant on externally controlled and determined transport are heavily restricted in their development options. Non fossil-fuel powered options offer an economically viable alternative that would increase the range and control of community over transport and thus increase community resilience. However, practical and deep-rooted obstacles exist to realising this, some of which pose challenges to existing socio-cultural customs within the community. This village survey, along with a current Master's thesis assessing the local transport needs of Southern Lomaiviti, are arteries integrating with other aspects of the SSTRP to generate and gather the much needed data for the country's transport sector.

The Southern Lomaiviti case study builds on the village survey of Solodamu and widens its scope to determine the current transport need of a group of islands and the options available to those communities for their future sustainable transport. As with the Solodamu survey work, the Southern Lomaiviti study aims to establish the sea transport demand and fuel use of the islands of Gau, Batiki and Nairai, to inform comparisons of the current and alternative sea transport options. Household level surveys of transport use will be developed from the Solodamu survey templates as a starting point to allow comparison between Kadavu and Southern Lomaiviti. Drawing from the survey data, evaluation of transport use and expenditure for transport and fuel will be determined.

Further to gathering data on household fuel use, a census of fibre/outboard boats will be conducted for the three islands where up to 10 representative fibre operators will be asked to fill out logbooks over a 6-week period to determine fuel and transport usage by the overall village community. Averaging of these and extrapolation using the fibre census data will allow a profile of small-scale vessel use for the three islands and establish a fossil fuel use by sector profile for the islands. Additionally, by gauging the views at each level, i.e. village (e.g. Turaga-ni-Koro), businessmen (e.g. Goundar Shipping Services), and government (e.g. Lomaiviti Provincial Council, Department of Transport), the information affords a more holistic view of the country's transport profile. To the best of our knowledge, this is the first time that structured field research of this nature has been attempted in Fiji.

An initial baseline assessment was conducted in July 2013 to gauge the current transport demand of a selection of representative villages on Gau Island. Throughout the five villages surveyed, it was found that the main mode of transportation is by fibres, whether to Suva or around the island. Fibres are the primary source of travel because of the ill-maintained road on the island, infrequent air services and irregular ferry services. It is well understood by the locals that this is a risky mode of travel, but it is the only dependable

means to move goods and people. There are regular media reports of fibres breaking down, running out of fuel or being lost. This all too familiar picture is replicated in many outer lying islands in the country.

Adapting the village-based survey to island/national level determines whether the methodology is replicable in other locations or scenarios. This is an integral “missing link” in setting the baseline for transport and fuel data. Almost all attention on new technologies for sustainable sea transport internationally has focused on large-scale, new generation shipping primarily servicing the international routes. Such technologies have, to date, focussed little attention in the development of alternative energy solutions for the Pacific. All sources agree that the priority for Pacific shipping lies on the domestic front. The Kadavu and Southern Lomaiviti case studies begin to provide, for the first time, reliable data on village-level transport use, need and fuel consumption in order to start addressing this priority. A key outcome is to develop survey tools that are replicable for other Fijian communities and then wider Pacific application.

7.0 CONCLUSION

It is important for community-based initiatives to look at how fuel is used when determining the priorities for renewable energy projects to ensure focus is given to the area of greatest need.

Regionally, and within Fiji, the majority of renewable energy projects currently target electricity generation. However, for most island and coastal communities it is probable that sea transport is a significantly greater user of fossil fuel. This is despite tried and tested renewable energy technology for shipping being available (Nuttall et al, 2013, Nuttall, 2013).

Compiling and analysing reliable data on transport need is an essential pre-requisite for determining appropriate solutions for sustainable sea transport, and such data is scarce.

Data collection and analysis of sea transport is a priority if we are to truly tackle the Pacific's dependency on fossil fuels.

These surveys found that intra and inter-island sea transport is critical for Solodamu and is crucial to every aspect of well-being. It affects access to health, education, and markets, and social and cultural practices. Sea transport is currently the single largest user of fossil fuel in the village.

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