Case Studies of Previous Pacific Trials and Research into Sustainable Sea Transport

Lessons from the Past

"We carry the cultural and historical inheritance of ocean navigators of peerless skill and their courageous kin who crossed vast distances before the tribes of Europe had ventured forth from their small part of the earth."

Ratu Kamisese Mara, Prime Minister of Fiji, 1999

- **Lessons from the storehouse of culture and heritage**

  We start with the incredible legacy of Pacific seafarers, the peoples who developed the world's first bluewater technology.

- **The Story of the *SS Tokelau***

  This story comes to us from a century ago and from one of the smallest and most remote countries in the world – the atolls of Tokelau.

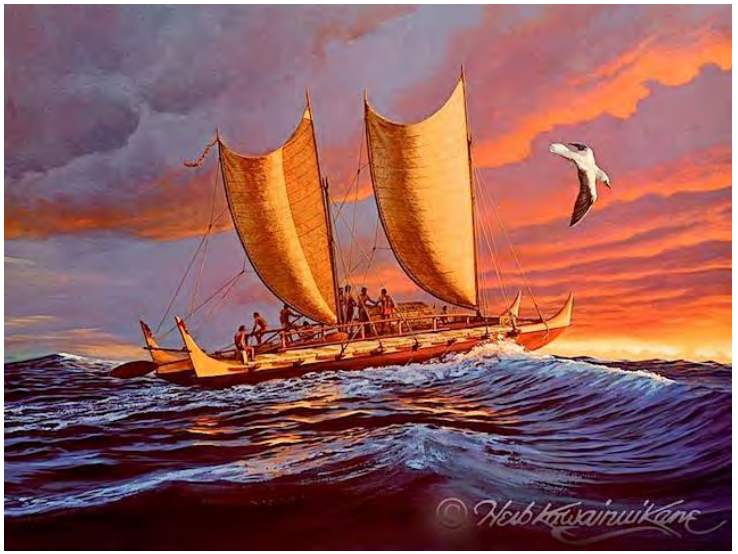
- **Lessons from Pacific responses to the 1980's oil crisis**

  We examine a range of experiments with renewable energy technologies in the Pacific from the oil crisis in 1973-1986. There were a number of critical trials in various Pacific locations. Some never got past design stage but in other instances they proceeded to full blown trials.

Source: Herb Kane, 1985

Source:http://acms.sl.nsw.gov.au/item/itemDetailPaged.aspx?itemID=825719

Source: ADB, 1985



Source: https://herbkanehawaii.com/image-catalog/canoes/

Look first to the Past: Lessons from heritage

With highly advanced understanding of sail and hull form and function ancestors of today's Pacific islanders created sophisticated deep ocean vessels centuries before humans anywhere else. On such craft they colonised the entire Pacific over millennia, made it their home and were at home on it - long before most other global cultures had learnt to sail over the horizon.

The sea transport solutions they crafted, designed, developed and perfected are arguably the greatest technological heritage of the Pacific Ocean.

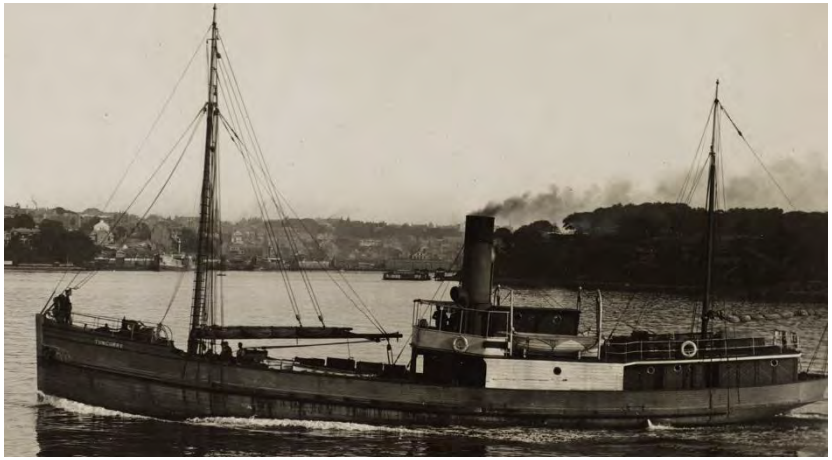
Source: http://forum.woodenboat.com/archive/index.php/t-148628.html

Source: www.canoesmarshallislands.com

Such technology was highly developed and functional, diverse in type, readily available and an essential facet to all aspects of life – from artisanal fishing and local village transport to inter-island/inter-archipelago warfare, trade and diplomacy. Historic maritime analyses 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 with or greater than that of the arriving Europeans.

The Story of the *SS Tokelau*

- *SS Tokelau*, 165 gt, 33hp steam screw.
- Purchased by British Administration to service Tokelau and Gilbert lslands 1909-16.
- Converted to ketch auxiliary rig due to fuel supply shortages.
- Performed flawlessly.
- Maritime transport bunker is the single largest energy use for Tokelau today.



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Pacific responses to the 1980s oil crisis

In the oil crisis of 1973-86 there were a small number of critical experiments into RE shipping in several Pacific island countries:

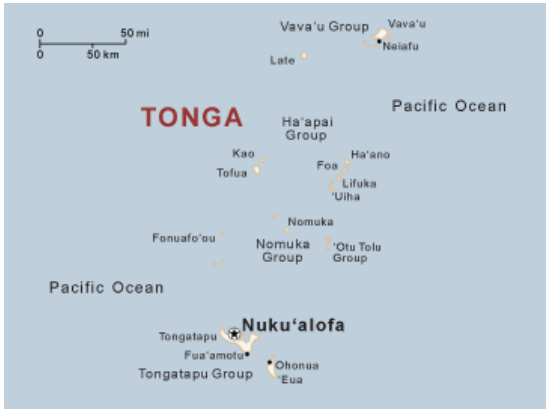
- Trials involved vessels to 300 gt and targeted local transport and artisanal/small scale commercial fishing.
- Japanese trials of fixed wing sails showed similar results.
- These demonstrated that significant fuel savings and additional benefits were achievable for low investment cost.
- Projects were discontinued at the end of the crisis – however designs and data analyses are highly relevant today.
- Multiple agencies were involved including UNCTAD, UNESCAP, EU, UNDP, FAO, ADB.

Pacific Trials of Low Carbon Sea Transport Solutions during the 1980s Oil Crisis

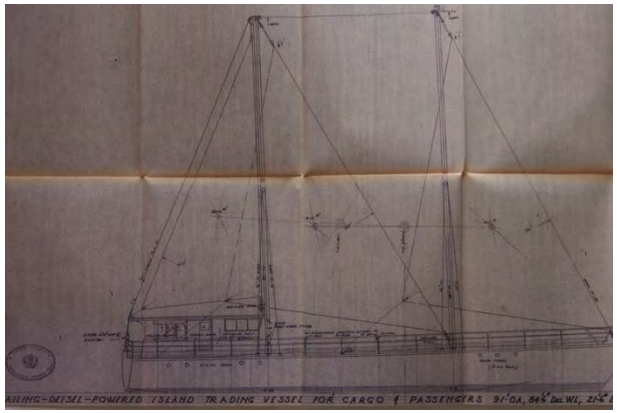
PROJECT	Description	Outputs	Agencies	Comments
Ha'apai Freighter	Needs assessment and design analysis led to commissioning of build plans for a 100 ton energy efficient freighter	Needs assessment, transport census and full build plans for a 100 ton energy efficient freighter.	UNESCAP, UNDAT, UNDP, ADB	Vessel never constructed due to end of crisis. Similar needs assumed today.
Fiji soft sail retrofit	Auxiliary rig retrofitted to two government vessels of ~300t. Rigs built and installed in-country	Fuel savings 23-30%, but also 30% engine/prop wear reduction, greater stability, incr passage times. IRR on best route = 127%, average route = 33%	ADB, Southampton University, McAllister Elliot	Southampton University collated historical wind data for all Fiji routes and produced fuel saving ratios for all routes.
Japanese fixed wing sails	A series of vessels from small oil tankers to large bulkers fitted with computerised fixed wing sails	Fuel savings to 30%, increased passage speed, greater stability in extreme weather, decreased engine wear	JMMDA/NKK	Discontinued due to low fuel and high computer costs. Early PPP example.
FAO/UNDP	A multi-county fisheries programme to develop RE artisanal and small-scale commercial vessels for local community benefit.	A portfolio of 10 designs from single dugouts to 11m trimarans. 350 vessels built in 8 countries. Demonstrated need for vessels to be affordable and locally appropriate.	FAO UNDP	Uptake ceased with end of project and falling fuel prices. Communities with 'living tradition' of sail had greatest uptake.
SCF/Jim Brown	Save the Children Fund Tuvalu employed catamaran designer Brown to develop locally built boats for Tuvalu/Kiribati	A range of designs and processes for locally built/operated catamarans for artisanal and commercial fishing and local and inter-island transport. Training of local shipwrights. Local materials favoured	SCF	This project closely associated with the FAO/UNDP project. Local build/materials used wherever possible. Fuel savings of up to 60%.
Lau Passenger / cargo	50 ton primary sail powered trading vessel, designed and built on Kabara by local builders (1984-87). First of 3 planned vessels to service Lau and Lomaiviti Groups.	*Tai Kabara* became the main vessel operating on the Sth Lau route until she was scuttled in 2006. Used local materials wherever possible.	European Union	Construction of the other two ships was cancelled when the oil crisis abated.

Ha'apai Group, Tongan Government Energy Efficient Freighter 1982-85

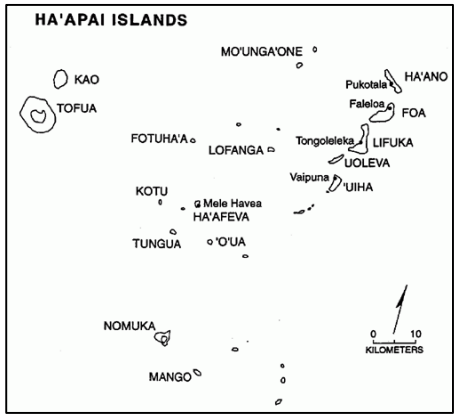
- Ha'apai is an archipelago in Tonga: 51 high and coral islands (17 inhabited) population: 8000. 200km north of capital Nuku'lofa.
- UN agency studies to find energy efficient transport for Ha'apai.
- Recommended small government freighter and network of trading catamarans.
- UN/ADB commissioned build design plans for a 92' freighter sail/diesel auxiliary capable of carrying 30 tonnes and 30 passengers.
- Similar study done with same conclusions for Lau Group of Fiji.



Source: http://images.nationalgeographic.com



Source: UNDAT, 1982



Source: http://www.haapai.to

Fiji Government Shipping Service
Soft Sail Retrofit Trials 1984-86

- Fiji – 330 islands, 100 inhabited. Many routes classed “uneconomic”. Longest route 1000km+.
- Auxiliary sail rigs designed and installed on 2 government inter-island ferries, *Na Mata-i-sau* (274 gt) and *Cagidonu* (300 gt).
- Experiment overseen by Southampton University and paid for by ADB ($US40,000).
- 23-30% fuel savings, 30% reduced engine wear, increased stability, increased passenger comfort.
- Folding propeller would have greatly increased fuel savings.
- IRR 123% on best routes, IRR 35% average routes.
- In 1985 , *Na Mata-i-sau* escaped developing cyclone under sail power alone and saved life of Fiji PM.
- Extensive project data recorded by Southampton.

Source: http://www.mapsofworld.com/fiji/maps/fiji-map.jpg

Source: ADB, 1985

Japanese Fixed Wing Sails 1980-88

- JMMDA and NKK trialled air foil-rigged ships, initially on a 1600 dwt oil tanker, the *Shin Aitoku Maru.*
- Computers were used to control the rigs to minimise extra crew requirement.
- Reported fuel savings of 30%, increased passage speeds and stability, reduced engine wear.
- In 1984 two larger ships used: the 31,000 dwt bulk carrier *Aqua City* and the 26,000 dwt *Usuki Pioneer*.
- The vessels were able to maintain course in typhoons where sister vessels had to heave to.
- The initiative was taken by the private sector supported by government research funding - an early example of a public private partnership.

Source: http://moremhod.users.photofile.ru/photo/moremhod/150879737/xlarge/166195098.jpg

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UNDP/FAO Artisanal Fishing Craft 1982-89

- UNDP/FAO undertook a number of artisanal boat building projects globally.
- In the Pacific, FAO produced designs for ten different vessels, from a one-person paddling canoe to an 11m transport trimaran.
- Experimental fleet of more than 350 artisanal fishing/village level transport vessels built in eight PICs, many as either pure-sail or sail-assisted designs.
- The uptake of the sail-powered vessels, however, was minimal and did not survive the life of the officially funded project once fuel prices dropped.
- *"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"*.

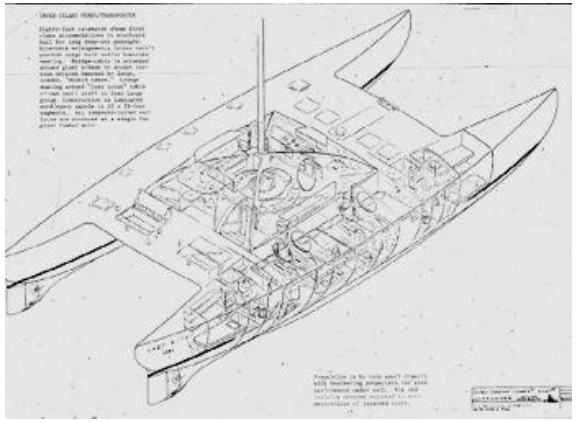
Source: Gulbrandsen, 2012

Source: Gillett et al , 1995

Save the Children, Tuvalu, and Jim Brown

- Acclaimed multi-hull designer Jim Brown designed alternative vessels and production methods in Africa, the Philippines, and then Tuvalu.
- Working for Save the Children, Brown adapted from local designs using local materials - experimenting with first catamarans and then *proa* designs
- Brown left a legacy of designs that are as valid candidates for further investigation today as they were 30 years ago.
- Brown identified a prioritised list of applications for alternative vessels for Tuvalu, noting that all but the last represent a return to former capabilities:
  - Subsistence fishing canoes
  - Intra-lagoon taxi service
  - Short-range community fish boats
  - Inter-atoll ferry/transporters
  - Long range commercial fish boats

Source: Gulbrandsen, 2012



Source: Brown, 1981

Tai Kabara
Sail Auxiliary, Lau Group, Fiji

Vessel:	*Tai Kabara*
GRT:	50
Type:	Interisland pax/cargo trader
Owned:	Lau Provincial Council
Funder:	European Union

- The *Tai Kabara* was built on the remote island of Kabara in the southern Lau group of Fiji by traditional boat builders between 1984-87.
- Initial proposal was for an inter-connected fleet of three vessels servicing the Lau and Lomaiviti groups.
- She was operated for the first three years under sail alone.
- Scuttled in 2006 after 20 years of hard service.

Source: sites.google.com/site/kpnmarineservices/photos

Source: greenheartproject.org/en/southern-lau-group-pt-1/

Lessons Learnt

- Collectively these experiments provide ‘proof of concept’ with impressive fuel savings for minimal investment.
- In the last oil crisis assistance to reduce Pacific fuel dependency was available from several sources by 1976 for a range of initiatives but such funding wasn't invested in shipping until 1982. By 1986, when most funding terminated, the small investment was demonstrating significant results at defendable rates of return.
- It is important to note the list of agencies that were involved in exploring low carbon initiatives in the 1982-86 period. Despite the most recent oil crisis between 2006-14, the growing need driven by climate change and the region’s crippling dependency on imported oil, none of these agencies have prioritised investment into practical research in this sector since.
- The research from the 1980s provides a well-marked starting point for a fresh phase of work; it is not necessarily a case of having to reinvent the wheel. Collectively there is an impressive range of designs and data emanating from the experiments of the 1970-80s oil crisis.
- The research also shows strong potential for multiple benefits from re-visiting this body of practical work, especially given recent technological advances in biofuels, rotor technology, sail design, photovoltaics and battery storage.

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