

■ AQUACULTURE SECTION

SPC Pacific-Asia Marine Fish Mariculture Technical Workshop: Farming Marine Fishes for our Future

MARINE FINFISH FARMING IN THE PACIFIC ISLANDS REGION

Rapid advances are being made in marine fish aquaculture. Traditionally, large commercial interests — such as the European salmon farming industry — have taken the lead. More recently, however, the strong market demand in Asia for live reef fish has led to a rapid increase in localised production. According to the FAO State of the World Fisheries and Aquaculture, 2004, the quantity of farmed marine fish in Asia is 900,000 mt in Asia, and is 1.5 million mt for the rest of the world. These well developed industries pose relevant issues for the Pacific Islands region.

There has been considerable interest within Pacific Island countries to investigate options for marine fish aquaculture in order to supply domestic and/or international markets for food and ornamental species. Several countries have achieved commercial production of high-value species and there is an increasing list of public and private sectors involved in the industry.

At the 2nd SPC Regional Aquaculture Meeting (held in November 2006), SPC member countries identified marine finfish as an important commodity for development. Subsequently, SPC has become more involved in this field. One recent example is a three-week course in marine finfish hatchery training for Pacific Islanders held in Thailand in May 2007. In addition, SPC wishes to provide sound advice on marine finfish aquaculture by using its Asian, Australian and Pacific counterparts.

SPC later decided to organise a consultative forum among technical experts to enable a face-to-face exchange of ideas and a discussion of issues. While the situation differs from country to country within the region (and between regions), there are some strategic issues of common concern in which the sharing of technical information could be of mutual benefit.

MARINE FINFISH AQUACULTURE IN THE PACIFIC

In December 2007, SPC's Aquaculture Section hosted the Pacific-Asia Marine Fish Technical Workshop, at SPC's headquarters in Noumea, New Caledonia. Selected countries with prospects of developing a marine finfish aquaculture industry were invited to attend the workshop, together with a regional group of experts.

Government fisheries agencies representative from French Polynesia, New Caledonia, Marshall Islands, Palau, Papua New Guinea and Solomon Islands were invited to attend the workshop. The following regional organisations from Australia, the Pacific and Asia also attended: IFREMER, Network of Aquaculture Centers in Asia-Pacific (NACA), University of the South Pacific, Queensland Department of Primary Industry – Northern Fisheries Centre, The WorldFish Center and the Australian Department of Agriculture, Fisheries and Forestry. Private sector investors for the region were also represented by Good Fortune Bay Fisheries (Australia) and Aqualagon (New Caledonia).

The workshop was a technical consultation between marine

finfish aquaculture experts and SPC member countries that are active in marine finfish aquaculture. The workshop's goal was to provide SPC with advice on the most feasible options for marine fish aquaculture and identify a regional framework for collaboration to address priority research and development needs in the Pacific.

Workshop objectives included:

- Providing an update on the status of marine finfish farming within selected Pacific Island countries;
- Assessing global trends of the industry in terms of production and markets;
- Considering niche opportunities for the Pacific region, for example in terms of export and domestic markets and ensure food security;
- Identifying priorities for research, development and training requirements; and
- Establishing programmes for further regional and inter-regional collaboration.

PRESENTATIONS AND ACTIVITIES

On the first day of the workshop, each organisation presented its work and emphasised their involvement in marine finfish aquaculture development. After a short and much appreciated visit to the "Aquarium des lagons", the official country representatives illustrated the latest marine finfish aquaculture development in their area of work.

Country and organisational presentations are summarised in the table below.

Organisation	Summary
SPC (Ben Ponia)	SPC briefly presented its strategic plan and reported that marine finfish aquaculture was ranked as a medium priority commodity for the region. Also reported on were the actions related to this activity in 2007.
IFREMER (Dominique Buestel)	IFREMER presented its work in French Polynesia with the batfish, in collaboration with French Polynesia's fisheries department. The IFREMER tropical marine fish network was presented and illustrated by work done in La Réunion, Martinique, Mayotte and France.
USP (Tim Pickering)	An overview was given of freshwater and marine aquaculture-related activities at USP. USP's training/course programme was introduced to workshop participants.
NACA (Sih Yang Sim)	Most NACA-focused activities were presented and an emphasis was made on the Asia-Pacific Marine Finfish Aquaculture Network, a strong potential link for SPC and its region.
QDPI and NFC (Richard Knuckey)	The Queensland Department of Primary Industries (QDPI) has three research facilities focusing on both freshwater and marine aquaculture in Queensland: Bribie Island Aquaculture Research Centre, Walkamin Research Centre and the Northern Fisheries Centre (NFC) in Cairns.
WorldFish Center (Warwick Nash)	The WorldFish Center presented its position on profitable aquaculture in rural Pacific Island countries as a priority for livelihood and food security.
DAFF (Clayton Harrington)	The Australian Department of Agriculture, Fisheries and Forestry (DAFF) presented a concise overview of the aquaculture industry in Australia, including challenges and opportunities.
New Caledonia Northern Province (Nathalie Baillon)	The upcoming marine finfish hatchery project in New Caledonia's Northern Province (which will be aimed at export markets) was presented.
New Caledonia Southern Province (Frank Legarrec)	The Aqualagon rabbitfish (<i>Siganus lineatus</i>) hatchery was introduced. The project is based in New Caledonia's Southern Province and aims at producing fish for local markets.
Palau (Percy Rechellul)	The potential for aquaculture development was described in this presentation. Most aquaculture sites, production, current and future status were outlined.
Solomon Islands (Alex Meloty)	Milkfish (<i>Chanos chanos</i>) and rabbitfish (<i>Siganus</i> spp.) (capture-based aquaculture) were species that were of great interest to rural areas in the Solomon Islands. It was stressed that the live reef fish food trade is happening in the Solomon Islands.
French Polynesia (Georges Remoissenet)	The marine fish aquaculture situation in French Polynesia was presented along with details regarding the actions of both the private and the public sector. A development forecast was also described.
Papua New Guinea (Gideon Pama)	Commercial barramundi (<i>Lates calcarifer</i>) farming experiences in PNG were described. Potential and expectations were also outlined, especially the potential for fishmeal based on the Fly River herring fishery.
Fiji (Tim Pickering)	Mangrove jack (<i>Lutjanus argentimaculatus</i>) and grouper hatchery trials were done in Savu-Savu some years ago by commercial operators. Nowadays, there is new hope for marine fish species thanks to USP's work in isolating and mass culturing phyto- and zooplankton.

After these country and organisational sessions, Being Yeeting, SPC's Live Reef Fish Specialist, presented the live reef food fish trade in the Pacific Islands. He stressed the limitations of this fishery, as well as its potential future development in supplying sought-after high-value reef fish species such as groupers.

On the second day of the workshop, Johann Bell presented a paper entitled, "Fish for the Future". The need for fish for both livelihood and food security

in the Pacific region was discussed. This presentation also pointed out that the Pacific is not yet as advanced as its neighbours in Asia or Australia in terms of making aquaculture development a priority. Food security and basic cash income remain a major priority for the region.

Sih Yang Sim from NACA provided participants with a very detailed presentation on the status and trends of marine finfish aquaculture in Asia, including the markets, industry econom-

ics, farming practices used in the different countries, and future development. Asia is often used as a model for the Pacific Islands region, which must learn from Asia's mistakes and successes.

In the Marshall Islands, a large-scale fish grow-out project is currently being implemented by Good Fortune Bay fisheries (based on importing fingerlings from their hatchery in Australia). The production will target the live reef fish market (grouper –



Figure 1. Barramundi floating cage units in Madang.

Figure 2. Batfish in a floating cage in Tahiti.

Figure 3. Canulating rabbit fish broodstock.

Figure 4. Hatchery reared juvenile rabbitfish.

Figure 5. Juvenile hatchery reared siganids in Palau.

Figure 6. Plate size barramundi produced in Madang.

Cromileptes altivelis and others) as well as the white filet market (cobia – *Rachycentron canadum*). Provan Crump, the Good Fortune Bay’s representative described the project, which is still in its initial phase, and explained how development was being forecasted and the place this industry was taking in the Marshall Islands’ economy. The project is aiming at being in full commercial scale within five years.

Most up-to-date hatchery techniques were described by Richard Knuckey, from Cairns Queensland Department of Primary Industries-Northern Fisheries Centre. Research, challenges and current findings from this high-tech aquaculture centre were presented, including broodstock management, larval culture, diet development, grow-out culture (especially pond culture) and technology transfer to the private sector. The species of major interest in Cairns at the moment are *Plectropomus leopardus*, *Epinephelus coioides*, *E. lanceolatus* and *E. fuscoguttatus*.

A detailed analysis of post-larval capture and culture for marine food fish was provided by Tim Pickering from the University of the South Pacific. He analysed, together with research partners, the technical feasibility of relying on this technique for domestic food fish aquaculture development in both Fiji and the Solomon Islands (with reference to the French Polynesian experience). Other alternatives to capture-based aquaculture, which relies on wild-caught juvenile rabbitfish and natural seaweed as a feed source, was also discussed and appeared to be a viable option for rural aquaculture in the Pacific.

Two delegates presented the state of advancement of marine finfish culture in their countries

with details. Georges Remoissenet from French Polynesia’s fisheries department, provided a full report on the batfish aquaculture project in Tahiti. An emphasis on biosecurity issues and a comparison of batfish production between Thailand and Tahiti was made. Percy Rechelluul from Palau described the production cycles and the most up-to-date findings related to grouper aquaculture in Palau. He also discussed the hatchery production of rabbitfish (*Siganus fuscescens*), which raised considerable interest among some workshop participants.

On the third and final day of the workshop, a special topic on training was presented by both NACA and SPC. Sih Yang Sim from NACA introduced and illustrated various training activities proposed by NACA, such as the grouper hatchery training course, the study programme on marine aquaculture and seafood market in China, the tailor-made marine fish aquaculture course, and the forecasted marine ornamental course in 2008. Finally, Antoine Teitelbaum, from SPC’s Aquaculture Section provided a report on the marine fish hatchery training that SPC and NACA co-organised in Thailand.

Each day, workshop participants got together in small groups and worked on the following subjects:

- Developing linkages within the Asia-Pacific region. Three groups (representing Asia, Australia and the Pacific)

analysed the strengths, weaknesses, and opportunities of those three regions towards providing guidance to the Pacific.

- Designing a regional strategic plan for marine finfish development in the Pacific Islands region (establishing objectives, strategies, action and indicators).
- Developing project concepts to address bottlenecks in the industry within the Pacific region.

WORKSHOP OUTCOMES

As a result of this workshop, an interactive CD that includes all PowerPoint presentations as well as the results of the working groups has been produced and is available on request from SPC’s Aquaculture Section (contact marieangeh@spc.int).

A marine finfish aquaculture development strategic plan will also be developed in 2008, compiling the different experiences of the Pacific and using the results of the working groups. It will be posted online on the aquaculture portal at:

www.spc.int/aquaculture

Continuous technical assistance will also be provided to countries on a case-by-case basis based on the knowledge that emerged from this very helpful workshop, for the benefit of a profitable development of this industry.



Plectropomus leopardus

French Polynesia shares post-larval fish capture and culture technology with Cook Islands

The French Pacific Fund has agreed to support a cooperative project between French Polynesia and the Cook Islands, which will share skills in post-larval reef fish capture and culture. SPC's Aquaculture Section, together with experts from French Polynesia (Aquanesia), has taken the lead in implementing this year-long project.

SPC's Aquaculture Officer, Antoine Teitelbaum, and Emmanuel Malpot from French Polynesia visited the Aitutaki Marine Research Center (AMRC) in the Cook Islands, and worked with Richard Storey (AMRC manager) and Korora Raumea (Director and aquaculture specialist of the Cook Islands Ministry of Marine Resources, MMR) as well as AMRC technical staff.

The main aim of this trip was to:

- Introduce post-larval fish collection techniques to MMR's staff;
- Trial the efficiency of two post-larval fish capture techniques;
- Train MMR and AMRC staff in collecting, sorting, identifying and growing-out commercially valuable fish species;
- Develop a database to record the catch;
- Explore the possibilities of accessing a reliable source of fingerling supplies for developing low-cost food fish culture; and
- Develop "eco-friendly" ornamental fish grow-out techniques to provide juvenile reef fish that can complement coral gardens supplied to hotels in Aitutaki.



Top. Channel net fishing at Akitua.

Bottom. Emptying the cod end into the catch barrel.



Top. Sorting fish at AMRC.

Bottom. Surgeonfish catch.

During the visit, two types of trapping devices were used: a "hoa" (or channel) net, which was deployed in a reef channel near AMRC (at Akitua), and two

light-traps, which were moored south of the main pass at Aitutaki, a five-minutes boat ride from the town centre. A temporary sorting area was installed in

AMRC's hatchery, consisting of a 1 tonne tank prepared with floating trays in it to receive the catch and sort the fish.

The eight days of collection (during the new moon period of November 2007) showed promising results; a wide variety of fish and invertebrate species were recorded. The most abundant and potentially valuable families collected were surgeonfish (acanthurids) and mantis shrimps (stomatopods). During the sampling period, the channel net generally yielded higher catches than the two light traps.

The main field tasks of this preliminary study were to train MMR staff in installing, maintaining, harvesting, sorting and identifying fish species. The SPC/Aquanesia team ensured that MMR staff were fully efficient in most operations, in order for them to repeat the operation during the fish colonisation period (from spring to summer).

MMR staff showed great diligence and skills in all these operations and were able to carry out all steps by themselves in only a few days. The bottleneck of this technology lies in the laborious task of identifying all larval fish species that are collected. Although it was fairly easy to identify the larger post larvae to the genus level, identifying to the species level was not an easy task. Fortunately, two post-larval fish identification guides were published in 2007¹ and the coral reef fish identification book by Myers and Lieske was very useful for this exercise.

A database to log all catch data was also installed on AMRC's computer and Richard Storey was trained in using it. At the

¹ Juncker M. 2007. Young coral reef fish of Wallis Islands and the Central Pacific, identification guide. Book from the Environment Department of Wallis and Futuna for the CRISP Programme. 170 p.
Maamaatuaiahutapu M., Remoissenet G., Galzin R. 2006. Guide d'identification des larves de poissons récifaux de Polynésie française. Éditions Téthys. 104 p.

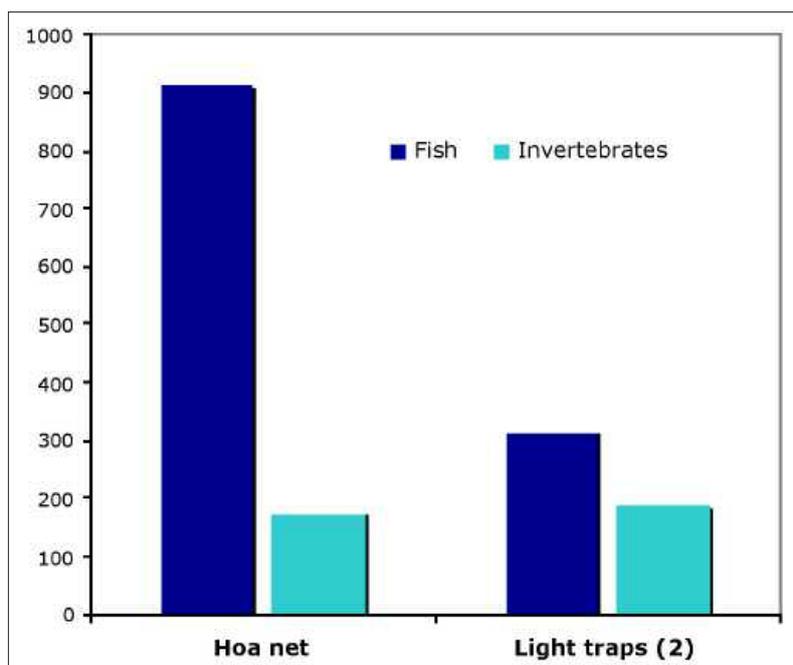
end of every sampling period, fish were recorded by species, site, abundance and status, whether they were dead or live.

Rearing commercially valuable fish was also dealt with during this trip. Most surgeonfish that were selected for nursery culture were isolated and placed in a clam raceway. That way, they could feed on turf algae growing on the sides of the tank although an artificial diet was also supplied to the fish. A small *Artemia* culture unit was also set up and AMRC staff were trained in hatching and harvesting *Artemia*, using plastic bottles and sieves.

Most non-commercial fish were released into the lagoon and a small diversity of reef fish were kept in a separate tank for display. Early trials were made with mantis shrimps, which were placed in small (10 litre) plastic containers with substrate and fed with minced fish. These immediately showed good burrowing and feeding behaviour.

The overall results of this first trip were encouraging; however, the total yield and the amount of commercially valuable organisms collected were not sufficient to prove any commercial viability at this stage.

The team also visited the rest of the island and surveyed the reefs for potential collection sites. Although there were many protected reef areas on the leeward side of Aitutaki that



Total abundance of fish and invertebrates collected in both traps devices during November sampling period.

would be suitable for mooring light traps, there was only a limited amount of crest/channel areas suitable for collection.

MMR staff will continue post-larval fish collection during the new moon periods of December, January, February and March, and the results will be analysed at the end of the collection period. According to these results and the potential for commercial activities in Aitutaki, more funds could be directed towards extending the project.

A study tour for both Richard Storey and Koroa Raumea is being organised. These MMR representatives will be sent to

Bora Bora in French Polynesia, specifically to Bora Eco Fish, a company specialises in post-larval capture and culture (PCC) activities and is currently involved in several related projects. An article discussing the outcome of this short training will appear in the next issue of the *Fisheries Newsletter*.

In mid- to late 2008, it is expected that an analysis of the potential for developing small-scale industries based on PCC in the Cook Islands will be jointly produced by MMR, local Aitutaki authorities, and external advisers.



Quality seaweed fetches better prices

A seaweed quality booklet aimed at Solomon Island seaweed farmers is now available in English. The booklet, titled "Seaweed quality manual, Solomon Islands: A practical guide for seaweed farmers, buying agents, fisheries officers and

exporters", is a simple 16-page leaflet that illustrates the various aspects of seaweed quality encountered: from planting to transportation. Topics such as drying seaweed, sorting impurities, and protecting seaweed from the rain, are discussed.

Recommendations for farmers, buying agents, fisheries officers and exporters are also included.

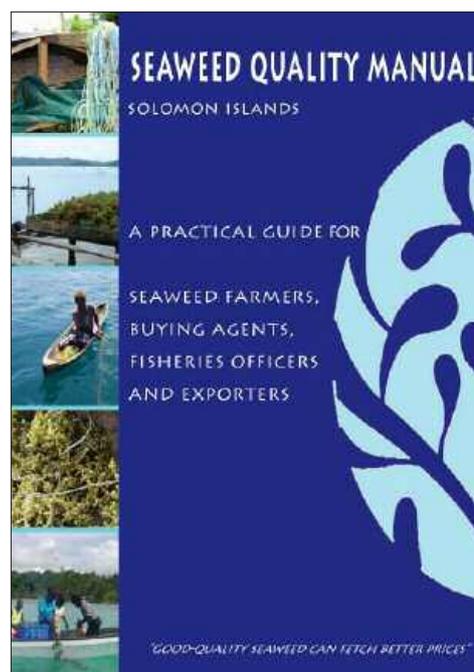
The booklet contains drawings by different Solomon Island artists (Steven Danifona, Timothy Kale and Ezikiel Tuke)

as well as photos taken in various production areas of the Solomon Islands. The drawings and photos are helpful for people with limited ability to read English. A Pidgin manual may be produced in the future.

The booklet is a joint effort by the EU-funded Commercialisation of Seaweed Production, Solomon Islands (CoSPSI) management and SPC's Aquaculture Section. In recent years, quality has become a growing concern of the Solomon Island seaweed industry, which is interested in fetching better prices for seaweed and becoming more competitive on the international market.

Two hundred copies of the booklet have been sent to the Solomon Islands, and will be distributed in the farming areas of Waghena, Rarumana and North Malaita. The CoSPSI management expects that this booklet will help farmers and other stakeholders involved in the seaweed industry to improve the quality of their production.

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Potential applications of GIS in strategic planning for freshwater aquaculture

Nadia Chagnaud, Geographic Information System (GIS) consultant for Aquaculture Planning, is leading a GIS analysis to assist in the planning of freshwater aquaculture development in Fiji. Fiji was selected as a potential site because of the strong potential for freshwater aquaculture and the availability of information regarding some of the human and environmental parameters that influence aquaculture development. The development of freshwater aquaculture has the potential to benefit both food security and livelihoods, and could provide alternatives to Fiji's declining sugar cane industry.

The project started in October 2007 and should be finalised in February 2008. Fiji's Fisheries Department and Dr Tim Pickering from the University of the South Pacific's Marine Studies Programme are the main collaborators. Dr Pickering is providing essential technical support

Tilapia ponds, Waidra (Viti Levu, November 2007).

relating to small pond freshwater aquaculture.

In Fiji, most inland aquaculture farms produce tilapia, although freshwater prawn production is becoming increasingly popular. A census undertaken in 2004 by SPC identified 133 active farms on Viti Levu and Vanua Levu, but the geographic location of these farms was not accurately recorded.

In November 2007, the geographic locations of various aquacul-

ture facilities in different coastal and inland environments were recorded using global positioning system (GPS) equipment. Eighty farms, three hatcheries, two food supply shops and one prawn shop were visited in two days.

During the course of the field mission, staff met farmers and discussed their needs, investigated factors that must be taken into account in the GIS analysis, and determined some of the advantages and limits to the use of GIS data.



On a medium scale, GIS tools will be useful for highlighting the overall suitability of various areas for freshwater aquaculture. This analysis will take into account: 1) human factors (such as population density based on the 2007 census; existing land use, distance to hatcheries, retail food outlets and markets; and the presence of a road transport network) and 2) environmental factors (such as soil drainage and pH, forest density, slopes and temperature). The main environmental factors will be analysed to determine an indicator of suitability that takes into account the requirements for tilapia and prawn farming.

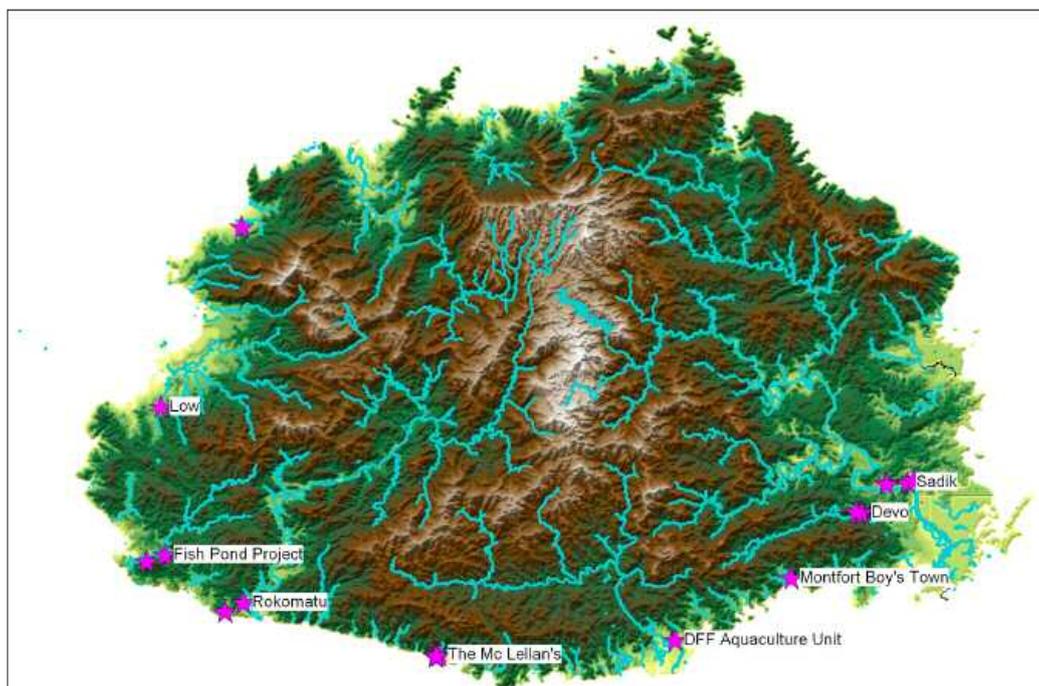
The organisations that will most likely house the GIS data include Fiji's Ministry of Agriculture, Ministry of Fisheries and Forests, the University of the South Pacific's geography department, Fiji's Department of Land and Survey, statistics department and the South Pacific Applied Geosciences Commission (SOPAC).

The last stage of this project will be to analyse the human and environmental factors, and interpret the results in order to assist decision-makers in determining preferred locations for freshwater aquaculture. In the future, additional data and field

work will support more precise analysis of the potential for freshwater aquaculture development. The GIS platform could also function as a tool to display maps, allowing users to view specific parameters for various areas and make their own interpretations.

A draft of this project was presented in Fiji for the annual GIS-RS user's conference, in December 2007.

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Some farm positions by GPS in Viti Levu (elevation model and main rivers in background, Source SOPAC).