



Fisheries

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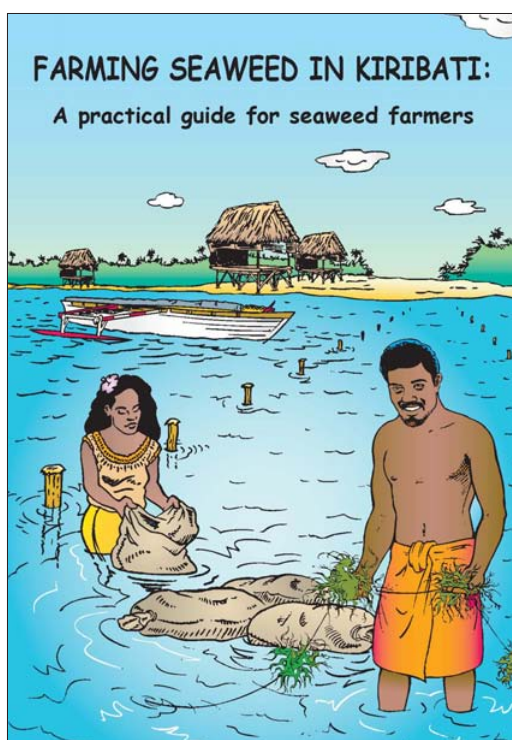
Editorial

Seaweed farming began more than 30 years ago in Southeast Asia. For some 20 years, attempts have been made in the Pacific with varying degrees of success but only two countries, Kiribati and Fiji, have been able to market their production over the past few years.

One of the objectives of the March 2002 meeting on “Building Capacity for Aquaculture in the Pacific” was to make a list of the most interesting species for aquaculture in the region and formulate action plans. Seaweed farming gained the attention of the participants, who wanted it to become a sustainable, income-generating activity for isolated village communities.

One of the points raised was informing fishers about this activity through the production of educational materials. The manual presented by Antoine Teitelbaum in this issue of the *Fisheries Newsletter* corresponds well to what was hoped for in the region and undoubtedly will become a reference document for small-scale seaweed farming.

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*The seaweed farming industry in Kiribati has been provided with new educational material. A booklet titled **Farming seaweed in Kiribati: a practical guide for seaweed farmers** will help local farmers to extend their seaweed farming skills.*



SECRETARIAT OF THE PACIFIC COMMUNITY

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SPC ACTIVITIES

■ FISHERIES DEVELOPMENT SECTION

Solomon Islands rural enterprises

Fisheries Development Officer William Sokimi spent the month of October completing his work with the rural fisheries centres being established in Solomon Islands under the EU-funded Rural Fisheries Enterprise Project, Phase III (RFEP III). In the previous months, William had worked with fishermen in Seghe, Afio and Semeghe. Yandina was the last centre to be assisted.

The Yandina fisheries centre had 11 fishermen who were issued loans under the RFEP III loans scheme. Aside from the 11 loan recipients, 22 other fishermen were trained to crew their fishing vessels. The crew were family members or village acquaintances selected by the loan recipients. The fishermen had only recently acquired their equipment and were in the process of building up capital to fund their fishing trips.

The first day was spent addressing the fishermen as a group to discuss the type of activities that would be undertaken during the project, and then meeting the individual fishermen to obtain information on their fishing experiences. A short workshop was conducted on the second day to discuss the gear (Figure 1) and the fishing methods that would be used during William's time in Yandina: deep-bottom fishing using the FAO design Samoan handreels; vertical long-lining; and night fishing methods using pressure kerosene lamps to attract fish and handline jigging for bait and target species. From the third day onwards, several fishing ground assessment surveys were carried out using a portable GPS and echo sounding unit, followed by fishing operations to gauge the potential of the fishing ground and to check the size of fish in the area.

Since the fishermen were familiar with the deep-water fishing methods and were good boat-handlers, more attention was given to practising quick turn-around fishing methods using fishing accessories that were part of their gear. The fishermen were encouraged to take note of the fishing months and the catch patterns over the months, especially noting the areas in which different species were caught and the sizes of fish in

these areas. Vessel cleanliness and proper fish handling, processing and icing methods were practised.

Sixteen fishing trips were conducted in 16 days, resulting in a total catch of 549 kg of mixed species and a gross income of SBD2959.85. The deep-bottom species that were caught weighed a total of 501 kg, with 44 kg of fish taken during three vertical longline trial sets and 4 kg of



*Figure 1 (top): Display of gear to be used during the workshop
Figure 2 (top): Unloading a catch of good size deep-water snappers*

fish taken during night fishing. Although only a small catch was recorded for the night fishing method (a 4 kg barracuda), about 20 kg scads and 3 kg squid were also caught and used for bait during the vertical longline sets and on some of the deep-bottom fishing trips.

During the fishing trips fish catches began very slowly, with

several of the first trips resulting in poor catches. Later fishing trips resulted in catches of 80 to 100 kg per trip. Several of the fishing trips were hampered by fuel shortage and poor weather conditions compelling the fishermen to fish only in the closer, sheltered fishing grounds. Fortunately, this situation improved towards the end of William's time in Yandina. The eastern

fishing grounds had an abundance of fish but the fish sizes were small and not marketable. However, bigger sized deep-water snapper (Figure 2) were eventually found off the southwest and western side of Russell Island.



Tuna fishery development planning in Marshall Islands

The Government of the Marshall Islands, through the Marshall Islands Marine Resources Authority (MIMRA), has been developing a tuna management plan for the country in collaboration with the Forum Fisheries Agency. MIMRA has also embarked on the drafting of a domestic tuna fishery development strategy or policy. This was a collaborative project between Forum Fisheries Agency (FFA), MIMRA and SPC, with FFA taking the lead in drafting the policy.

Fisheries Development Adviser Lindsay Chapman travelled to the Marshall Islands for two weeks to provide input to this

process. Lindsay specifically looked at infrastructure, training needs and options, and constraints to developing domestic tuna fishing operations. The Marshall Islands has substantial infrastructure, although the current wharf space is well used and there is little suitable land available for the construction of a new wharf complex. This is an issue that MIMRA will need to look at if domestic tuna fishing operations are to develop.

Suitable domestic vessels for tuna longlining are scarce in the Marshall Islands, as are qualified skippers and engineers for fishing vessels. The Fisheries

and Nautical Training Centre in Majuro can run the necessary courses for both fishing skippers and engineers, so there is scope to overcome the skills shortage in the near future. However, the shortage of suitable vessels will be an ongoing issue.

To raise awareness of tuna longlining in the Marshall Islands, MIMRA conducted some tuna longline fishing trials and training with assistance from the SPC Fisheries Development Section in 2003. This training is expected to continue in 2004.



Technical assistance provided to Kiribati

Fisheries Development Officer Steve Beverly has spent eight weeks on Kiritimati (Christmas Island) in the Line Islands group of Kiribati conducting a longline fishing workshop and an assessment of Kiritimati's new small-scale longliner. Early in 2003 Central Pacific Producers Ltd (CPPL), a Government of Kiribati enterprise, took delivery of F/V *Tekokona III*, the latest diesel powered outrigger canoe type longliner made by Betiraoi Boatbuilding in Tarawa (Figure 3). Steve and Fisheries Development Officer William Sokimi



Figure 3: F/V Tekokona III

had both previously worked with its predecessor, *Tekokona II*, in Tarawa (see *Fisheries Newsletter* #88 and #92).

F/V *Tekokona III* is a 13 m wood outrigger canoe powered by a 45 HP inboard diesel engine. It is equipped with a Seamech long-line reel and a Lindgren-Pitman line setter. Figure 4 shows the plan view with specifications and deck layout.

Before any fishing trials took place the crew made up a whole new set of longline gear. They rigged 800 branchlines, 40 float-lines, 40 floats, three radio buoys (Figure 5), and loaded 10 km of new 3.0 mm monofilament mainline on the longline reel. They also made up several trolling lines with braided tuna leader, 2.0 mm monofilament, and stainless steel wire leaders. These lines were used with hex head tuna jigs to troll for wahoo. Two trolling trips were made during the workshop and each time 13 wahoo were caught on the eastern side of Kiritimati.

At the time, the market for wahoo in Honolulu was reportedly better than the market for tuna.

Kiritimati is unique in Kiribati in that there is a direct air link to the market in Honolulu. Air Kiribati charts a flight once a week from Aloha Airlines to ferry fly fishermen to Kiritimati, who spend their leisure time catching and releasing bonefish in the many ponds and lagoons. CPPL takes advantage of the return flight to ship fresh fish to Honolulu. They market all of their fresh fish and frozen lobster tails through Fresh Island Fish, Inc. in Honolulu.

In December, when the market improved for fresh tuna in Honolulu, three longline sets were made using the new longline gear. It turned out that *Tekokona III* did not have to venture far from Kiritimati to find good catches. One set was made about eight miles northwest of Kiritimati and the other two were made just five miles to the west. A total of 1122 hooks were set during the three sets in 25-hook baskets using milkfish bait caught previously in the lagoon and frozen at CPPL. Longline setting and hauling techniques were mastered by the crew and they became more proficient with each subsequent day of fishing (Figures 6 and 7). They

also learned some new skills in on-board fish handling and in icing the catch properly.

Mr Kazu Inakoshi of Fresh Island Fish, Inc. accompanied the crew on the second set and got to see first-hand how tuna are caught and handled on a longliner. Before the fish were packed for shipping Mr Inakoshi graded all of the fish by making a tail cut and examining the flesh for colour, freshness and fat content. In all, eight yellowfin tuna averaging over 50 kg and one bigeye tuna weighing 30 kg were exported to Honolulu. The fish received grades ranging from 3+ to 2+.

Tekokona III, despite having a few problems, was a vast improvement over *Tekokona II* and should do well as a multipurpose fishing vessel, trolling for wahoo when the season and market are good for wahoo and longline fishing for yellowfin and bigeye when the market is good for fresh tuna. With their newly learned skills and under the expertise of *Tekokona III*'s captain, Teboko Tarau, the crew are on their way to becoming the leaders in the newly developing domestic longline fishery on Kiritimati.

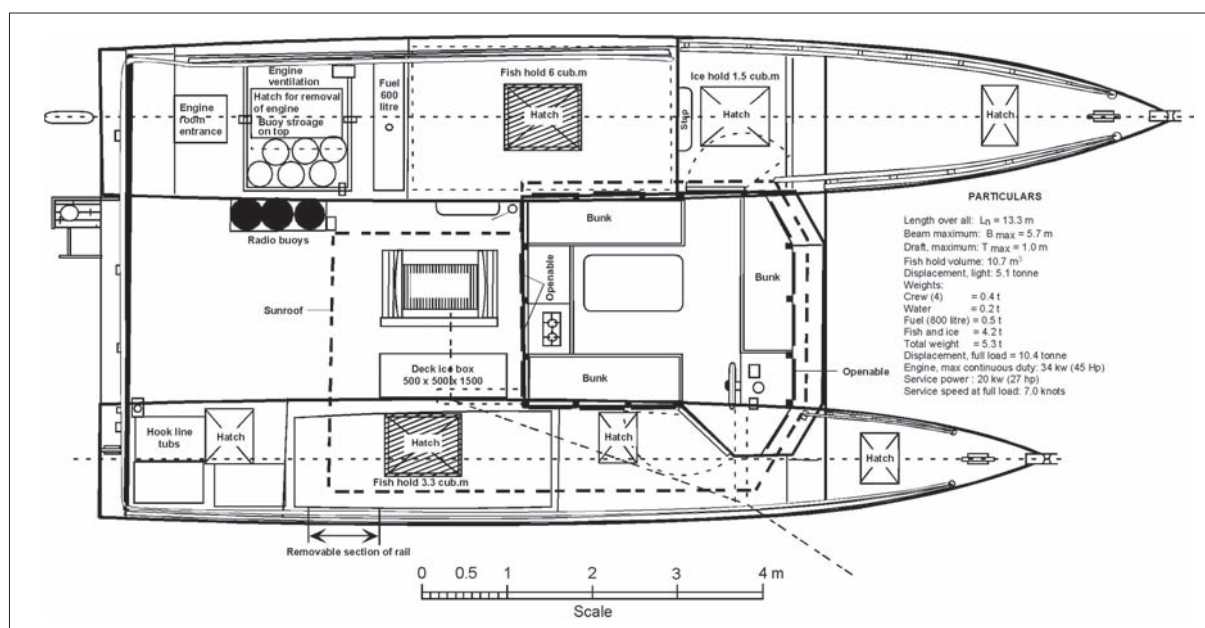


Figure 4: *Tekokona III* plan view with specifications and deck layout



*Figure 5 (top): Tekokona III crew rigging a radio buoy
Figure 6 (middle): Setting the line
Figure 7 (bottom): Hauling the line*

Indian Ocean longline workshop

Following an invitation by the Director of INFOFISH (an inter-governmental organisation for marketing information and technical advisory services for fishery products in the Asia Pacific region), William attended the "Workshop for the exploitation of large pelagic fish with small/medium size longliners and catch utilisation in the Indian Ocean" in Colombo, Sri Lanka, 16–19 December 2003, to help facilitate the workshop. He also presented a paper on small-and medium-scale tuna longlining development in the Pacific.

The workshop was attended by vessel operators and owners, representatives from the Indian Ocean Tuna Commission, techni-



Figure 8: Display of SPC training materials at the Colombo workshop

cal officers from relevant regional organisations, and manufacturers and suppliers of fishing equipment. The workshop examined the status of tuna resources in the Indian Ocean region, the status and possibilities of technological developments, and market opportunities for catch, with special focus on:

- the status of large pelagic resources, with emphasis on tuna;
- expectations and specific needs of the participating countries;
- assessment of existing conditions in the countries in relation to the development of the new fishery; availability and suitability of vessel, gear and equipment; supply of bait and ice; fish handling facilities; credit avenues; marketing infrastructure; and existing fisheries management structures;
- review of past or ongoing experiences in longlining and tuna fishing, identifying specific constraints and problems experienced;
- evaluation of market opportunities for the large pelagic species;

- identification of potential private sector partners for the programme; and
- a strategy agreed on by all the beneficiaries from the participating countries.

Participants at the workshop were from Sri Lanka, Maldives, Indonesia, Pakistan, Iran, Thailand, Italy, Malaysia, Seychelles and India (Figure 9). Experience with the development of fishing using small- to medium-sized tuna vessels was shared by William who represented the Western and Central Pacific region, Roland Baldeo for

the Caribbean and Sam Simorangkir for Indonesia.

Recommendations by the participants were used to develop an Indian Ocean regional project document aimed at facilitating the development of fishing for large pelagics (especially tuna) with small- to medium-size longliners and improved utilisation of the landings. Because of time constraints this document is still being formulated and will be forwarded to the workshop participants for comments before being finalised.



Figure 9: Workshop participants during one of the presentations

Small-scale deep-water fisheries workshop

A workshop on the management of small-scale deep-water fisheries was held in Dunedin, New Zealand, 27–29 November 2003. The workshop was a preliminary to the larger international "Deepsea 2003" conference, which was held the following week in Queenstown, New Zealand. Fisheries Development Adviser Lindsay Chapman presented a paper on the small-

scale and medium-scale fishing methods used or trialled in the Pacific to target deep-water snappers. This covered everything from handreels to bottom longlines and trotlines, to traps to trawls.

The workshop participants came from many countries including Fiji Islands, Samoa, Papua New Guinea, Cook

Islands, Tonga, Australia, New Zealand, Peru, Indonesia, Philippines, East Timor, Hawaii, Azores and Malta. Each participant presented the current state of deep-water fisheries in their country, and it was interesting to note the different stages of development and the basic gears that were being used in most countries.

The main issues raised were in regard to information and data collection, resource assessment and estimation of resource abundance, resource manage-

ment and the provision of harvesting advice, regulations, enforcement and compliance, governance, biodiversity and bycatch, and quality control of

product, and these were compiled into a paper presented at the main conference the following week.



Assistance provided to Niue

In early December, Lindsay went to Niue to work with the Fisheries Department to identify the infrastructure needs and government processes to be followed to permit a foreign tuna longliner to commence fishing to a new processing facility on the island. The processing facility was under construction while Lindsay was in Niue (Figure 10), with an expected completion date of April to May 2004.

Niue has no harbour and only a concrete wharf from which to base fishing operations. Vessels will need access to fuel, fresh water and electricity at the wharf. A crane will be needed to lift the fish off the vessels, and the fish will be trucked to the processing facility several kilometres away. Once the vessels have unloaded, they will need to move away from the wharf, so moorings will need to be installed for these vessels to tie up to. This will prevent damage to the reef from the vessels using their own anchor gear.

Under current arrangements, a fishing vessel would need to have contact with eight different government departments (fisheries, quarantine, police/immigration, customs, health, public works, telecom and environment) to be licensed and cleared to fish and land product in Niue.

The current processes in each government department were examined and suggestions on ways to streamline these were presented to the Minister for Fisheries.



Figure 10: Construction of the new processing facility on Niue

Update on FAD research projects

No FADs (fish aggregating devices) were reported missing over the fourth quarter of 2003: seven of the initial 15 FADs were still on station as of 1 January 2004. This means the FADs off Niue have been in the

water from 22 to 23 months, while the FADs off the Cook Islands have been on station for 20 to 21 months.

More fishermen in Niue and Rarotonga have been complet-

ing catch and effort logbooks. It is expected that the data will be analysed in early 2004, and the results sent back to the fishermen.



Note from the Editor

Niue was badly hit by cyclone Heta in early January 2004, and most if not all of the project FADs (four initial and one replacement) may have been lost as a result of the extreme weather conditions experienced during the cyclone.

■ COASTAL FISHERIES MANAGEMENT SECTION

Niue community-based coastal fisheries management

SPC's Coastal Fisheries Management Section was requested by the Fisheries Department of Niue to conduct an assessment of the possibilities for initiating community-based coastal fisheries management. Initial groundwork done on coastal fisheries management by the International Waters Programme of SPREP in 2001 provided a foundation for the SPC model. Consultations with the Fisheries Department in Niue in 2003 highlighted concerns about the declining state of the inshore fishery and the need for community-based management.

Fishing activity in Niue

Niue sits on an uplifted coral atoll, with an elevated rugged coastline. The narrow fringing reef that surrounds the island is accessible and is more utilised for fishing activities on the western coast. The eastern coast experiences huge waves and swells, limiting fishing to the few spells of calm weather when fishing is feasible during the year. As a result of this, fishers from the eastern villages fish regularly within the fishing areas of the western villages.

Fishing is a mainstay of people's lifestyle, with women fishing within the narrow reef areas and men fishing from canoes, dinghies and powered boats beyond the immediate reef areas. Women's fishing activities involve gleaning for shellfish, collection of crabs and other seafood, and using rods and line to catch reef fish along the reef edges. Men fish either from powered boats or from canoes, and mainly troll for pelagic fish, especially the migratory tuna species. The installation of FADs has assisted men's fishing activities beyond the immediate reef areas.

Commercial fishing is mainly small-business operations by fishermen with boats, who fish and sell to shops, the restaurants and hotels on the islands. The industrial fishing sector has not really been developed. The EEZ area is currently fished by foreign fishing vessels (New Zealand and Taiwan being the major distant water fishing nations).

A fish-processing factory is currently under construction in Niue and aims to sell frozen tuna fish to New Zealand.

Customary management

Most natural resources are owned through customary tenure. Land is family owned, and cannot be bought or sold but can be leased on long-term agreements. Fisheries resources are under general government jurisdiction, but there exist unwritten rules of jurisdiction and use of the fisheries resource that people have utilised for generations. The coastal area directly beyond a village is considered as "belonging to that village" and, under traditional resource use understandings, people seek permission from the village elders or the village council to fish in village fishing areas. Such agreements by local villages for access to local fishing areas are not specified under any of the existing regulations. Management initiatives would impinge on the village's authority and areas of jurisdiction, so there is need to define boundaries for each village fishery, and draw up conditions for fishing access.

At a discussion with women from a village on the western coast, concerns were expressed about fishing activities by "other races". In Niue there are

migrant Tuvalu communities who were brought in under a government scheme to assist in resettling the island. There remain some differences and minor tensions between locals and the Tuvaluans on the use of marine resources, especially concerning respect for customary checks that are in place. If not addressed at this stage, this could be an area of conflict in the future for villages that have the more accessible and favourable fishing areas.

Village councils

Most of the work proposed under this plan will depend significantly on the support of the people and the village councils. The village councils are responsible for environmental and development issues and provide the link between the government and the people.

The current powers of the village councils allow them to make decisions on resource use and management. For example, when the striped goatfish *kalowama* is in season from December through to February, village councils can impose bans on swimming in certain areas when the fish is in their locality. Bans can be imposed on other species or fishing methods. Bans are also placed on certain reef or fishing areas following the death of a prominent person. The imposition of a ban is usually announced on the radio for the general public's benefit. Thus, there already exist structures and a governance system to enhance community-based management initiatives.

Existing legislation

Niue's Domestic Fisheries Act 1995 and the Domestic Fishing Regulations cover most of the

areas of the inshore fishery. The offshore fishery is covered by the Territorial Sea and Exclusive Economic Zone Act. Local area fisheries use and management is generally regulated through by-laws under the Niue Village Councils Ordinance of 1967. Village councils are allowed to make by-laws under this ordinance "for the protection of fish resources" specific to each village. These by-laws can be specified to cover quotas, licensing, fishing technology, prohibitions, and other such community-specific regulations.

Most of the existing regulations are known to the people, but

enforcement of them and awareness education may be needed if they are to be adapted into village management plans as village by-laws.

Application of the model

The Fisheries Department is small, with limited capacity, and there is little scope for hiring extra staff to assist in community management work. The people who use and own the resources would be the best people to be involved in management of their resources. From discussions and consultations, it was apparent that there was a general consensus on the

need for community based management initiatives. The management model developed by SPC provides a guideline that can be adapted and modified to suit the different local contexts in Niue.

Specific village-based discussions and further assessments will need to be conducted on the factors contributing to the decline of the inshore fishery, in order to formulate the appropriate by-laws to protect the resources and to plan further monitoring. As well, there is a need to educate young people on conservation and the value of resources.



Marshall Islands gender and social study

The Coastal Fisheries Management Section conducted a gender and social study from 29 November to 14 December 2003, as a component of the tuna development and management study being done for the National Fisheries Authority in the Republic of the Marshall Islands.

Consultations were held with people from both the public and private sectors to gauge general views on the development of the tuna industry. There were also meetings with NGOs and church groups to get their views

on the industry and its social implications or benefits.

Visits and discussions covered trans-shipment and ships in port, the post-harvest sector and conditions of workers in the fish processing factories. There were

also visits to night spots frequented by crew members of the boats and visits to motels and accommodation where crew members are usually accommodated while waiting for their flight out of the country or when arriving in the country.



*Fishing vessels in Majuro (top)
The making and sale of handicrafts generates income for the women in Marshall Islands (left)*

Although the problems of sex workers were present, as in other areas where shipping vessels regularly call into port, there was a general complacent attitude towards the issues associated with it. The police expressed concern that there are

no specific way of monitoring these activities and that there are still loopholes in mechanisms currently in place to address these issues.

While in the Marshalls for this work, SPC staff also visited pearl

and clam hatcheries on Majuro and adjacent islands, and also met with the Japanese International Cooperation Agency (JICA) to discuss some planned work on community-based management in an outer island.



■ AQUACULTURE SECTION

Tilapia and freshwater prawn manuals

The Institute of Marine Resources at the University of the South Pacific have collaborated with SPC to write manuals on culture of tilapia and freshwater prawns.

The manuals provide simple guidelines on hatchery opera-

tion, pond construction, pond preparation, feeding, fertilisation and pond management for small-scale tilapia and prawn pond culture. Small-scale tilapia and prawn farmers in the Pacific, especially Fiji Islands, Samoa, American Samoa, Cook Islands and Vanuatu, will bene-

fit from these manuals to increase tilapia and prawn production and achieve higher economic returns.

The manuals will be pilot-tested in a training programme scheduled for April–May 2004 before being published.



Rural Fijian women learn hatchery operations

Lack of technical training has been cited as a major reason for the low outputs of fish ponds in Fiji Islands. This lack has been observed at all levels—from farmers through to extension agents working in the field.

A collaborative group made of University of the South Pacific, SPC, Fiji Fisheries Department and Fiji Ministry of Women, with funding from the Canada-South Pacific Ocean Development Program II, has decided to support groups of women in rural areas of Bua Province in Fiji interested in learning to farm tilapia more effectively in their existing village ponds.

Raising fish will provide an important source of protein to the local community, as well as generate income which could then be used to fund village projects. A project in Driti Village has been in operation since late 1980s but production has been erratic due to lack of tilapia fingerlings and skills in managing fish ponds.

The support and assistance uses a two-pronged approach: providing the women with necessary start-up materials for semi-intensive culture (fish seeds, feed and fertiliser) while providing training to teach women how to manage the aquaculture activities on their own.

Activities conducted so far include pond improvement work using an excavator, construction of a dam and piping, delivery of tilapia and prawn seeds as well as tilapia brood fish, provision of fish feed, a one-week workshop on fish farming for 35 women of Driti village, and provision of fertilisers, buckets, scales, scoop nets and seining nets.

In 2004, some of the women will tour the Naduruloulou tilapia hatchery near Nausori to observe hatchery operations and learn live fish marketing operations. They will also learn to keep records and financial accounts. Fisheries staff will make regular visits to discuss problems and progress.

The only difficulty encountered so far is that some of the ponds do not have properly constructed inlets and outlets, which could be a problem during rainy seasons. Repairing inlets and outlets is difficult when water is in the pond, and must be done during harvesting when pond is dry. In addition, the construction of a holding tank (cement tank) has not been completed due to insufficient materials. The construction of this tank is important, as tilapia have to be kept live for 6–12 hours before marketing.

The latest news received is that tilapia have been sold for a total value of FJD 1000 from one of the five ponds. Now that the fish have been harvested from this pond, Fisheries Officer Maleli Dawai plans to repair the inlets and outlets for this pond. He will follow through with repairs to other ponds as they are harvested.



Tilapia fingerling production in Vanuatu, Samoa and Fiji

In Vanuatu, a central issue for tilapia farming development is that there is no tilapia hatchery. For Samoa, it is a shortage of fingerling supply. In Fiji Islands, farmers in remote places have reported difficulties in obtaining fingerlings from the only source, the Naduruloulou government hatchery. The hatchery is having difficulties due to increase in demand for fingerlings by exist-

ing and new commercial farmers. The few private producers of fingerlings in Fiji Islands are generally only geared to supply their own large-scale commercial operations.

SPC will provide technical and financial assistance so that the agencies involved can produce tilapia fingerlings to stock their own fish ponds and supply any

surplus to other farms. SPC will give technical instruction in how to operate a tilapia hatchery using floating holding nets called hapas, will provide financial support for essential equipment (hapa and related materials) and will carry out further technical training. More news in the next issue of *Fisheries Newsletter*.



Vanuatu study on tilapia and prawns

The SPC Aquaculture Officer has completed a feasibility study on farming of tilapia and prawns in Vanuatu, with funding support from FAO and SPC. During the field visits the

Aquaculture Officer assisted the Vanuatu Fisheries Department with the construction of two medium sized ponds to use for demonstration grow-out trials of tilapia and freshwater

prawns. There are some exciting developments planned for Vanuatu in 2004. More news in the next issue of the *Fisheries Newsletter*.



Demonstration freshwater shrimp ponds in Vanuatu

■ TRAINING SECTION

Farming seaweed in Kiribati: a practical guide for seaweed farmers

A large and growing global demand for carrageenan, the extract from kappaphycus seaweed (also known by the trade names cottonii and euchema) gives high hopes in aquaculture.

The need for regional training and extension services to support the industry expansion and transfer of technology stimulated, both at SPC and in Kiribati, the idea of a practical guide.

In Kiribati, Antoine Teitelbaum (a Technical Adviser for Oceanic Développement) and staff from the Atoll Seaweed Company designed and compiled a cartoon-type booklet illustrated on front page of this issue. SPC staff from the Fisheries Training Section and the Aquaculture Section provided assistance to produce this guide. The colourful illustrations were done for SPC by Sébastien Lesire in Nouméa.

Two versions (I-Kiribati and English) have been published by SPC with the financial support of the EU. From this manual which was originally intended for local use in the Kiribati language, SPC extended the initiative to the regional level. Since then, SPC has been requested by PNG to assist with the publication of a similar booklet in local Pidgin language.



Expert consultation on sea safety in small fishing vessels

Fishing at sea is probably the most dangerous of occupations. Data from those countries that collect accurate accounts show that occupational fatalities in their fishing industries far exceed their national average. Typical fatality rates for fishermen are as follows:

United States: 160 fatalities per 100,000 (25 to 30 times the national average)

Australia: 143 fatalities per 100,000 (8/100,000 is the national average)

UK: 77 fatalities per 100,000 (23/100,000 in next highest category—mining)

In some Pacific Island countries the accident rate for fishers is among the highest in the world. Over the last four decades various UN agencies, regional organisations, donor agencies and others have made efforts to address the situation. There have been several safety programmes and initiatives during the past decade.

In 1991 FAO undertook a regional survey of sea safety issues in 16 countries in the Pacific. That work concluded that "education through publicity campaigns, repeated and reinforced over a long period of time and backed up by a good supply of equipment and spare parts, and training seems to offer the best chance for improving safety at sea for artisanal fishers".

This survey was followed by initiatives of SPC's Fisheries Training Section, which developed programmes in the areas of awareness raising and statutory training relating to small vessel sea safety. Although SPC's Regional Maritime Programme is primarily focused on shipping legislation and provision of maritime training, it also has some fisheries-oriented sea

safety activities. The SPC Fisheries Development Section also promotes sea safety as part of the work assignments of its Fisheries Development Officers.

In a survey in early 2003, FAO found that the majority of loss of life in Pacific Islands is associated with small fishing boats—which have received the least attention in terms of legislation, construction standards, enforcement strategies, regional discussions, training on proper use, and other schemes to improve safety.

Issues include:

- appropriate sea safety regulations for small fishing vessels;
- improvements in the SPC sea safety awareness programme;
- mechanisms for generation of political will to improve sea safety;
- improving the safety of fibreglass skiffs;
- enhancing systems of sea accident data recording;
- considerations on improving enforcement of sea safety regulations in both urban areas and remote locations; and
- achieving an appropriate balance between legislation and awareness for improving sea safety

These issues, although crucially important in improving sea safety, have no easy solution. As a result, it was decided to convene an FAO/SPC Regional Expert Consultation on Sea Safety in Small Fishing Vessels.

The purpose of the Expert Consultation was two-fold:

1. To address and progress four important issues in fisheries sea safety from the perspectives of several relevant disciplines. These issues were:
 - *appropriate sea safety regulations for small fishing vessels;*
 - *improvements in sea safety awareness programmes;*
 - *improving the safety of fibreglass skiffs through construction standards;*
 - *enhancing systems of sea accident data recording.*
2. To formulate plans for future sea safety programmes.

Artisanal fishers, legal specialists, boat-builders, and government fisheries and maritime workers were the experts who gathered in Suva, Fiji Islands, 9-13 February 2004, to compile lessons learned from their own experiences. Their report will be circulated ahead of the next meeting of the Association of Pacific Islands Maritime Training Institutions and Maritime Authorities (APIMTIMA) in May, at which countries will report on how they plan to develop and implement national sea safety strategies for small fishing vessels.

Later, in July, the Heads of Fisheries meeting will also consider the consultation outcomes and consider whether to formulate a request to the donor community for supporting national sea safety initiatives.

The expert consultation recommended that improved small boat safety will best be achieved through the development and implementation of coordinated national strategies, which should include:

1. Provision of support to a consultative national stake-

- holder framework (e.g. national sea safety coordinating group) and motivated people or "drivers".
2. Generation of commitment and political will at a national level to address small vessel sea safety.
 3. Increasing the effectiveness of ongoing sea safety awareness programmes, with special emphasis on the development of channels for the efficient distribution of appropriate and updated materials, and evaluation of impact.
 4. Development, enactment and implementation of appropriate and sensitive legislation for small fishing vessels, including the carriage of safety equipment, training and certification requirements, and construction standards.
 5. Determination of minimum mandatory requirements for
 - each class of small fishing vessel, with due regard to operational circumstances.
 6. Full use of existing institutions and community-based structures for increasing compliance, data collection, training and awareness, taking into account the time and resources required.
 7. Development and phased implementation of appropriate enforcement procedures to ensure compliance.
 8. Development and maintenance of national sea accident databases.
 9. Support for the establishment of an SPC special interest group on fishing vessel safety at sea, with an associated newsletter and the development of additional sea safety awareness resource materials.
 10. Investigation of the advantages and disadvantages of
 - the establishment of small fishing vessel registration and inspection schemes.
 11. Formal and informal training directed at fishers, fishing communities, government staff, NGOs, the private sector and other stakeholders.
 12. Consideration of the inclusion of sea safety as an integral part of fisheries management and development initiatives.
- This is far too important a matter to let die on the vine. The first steps have been taken, and now it is up to all of us to generate the necessary interest, awareness, community support and political awareness to make it happen. SPC will keep readers up-to-date on future developments in subsequent issues of *Fisheries Newsletter*.



REEF FISHERIES OBSERVATORY

Invitation to a scientific roundtable

A scientific roundtable will be held to mark the completion of the DemEcoFish project, the MacArthur Foundation funded project implemented by the Secretariat of the Pacific Community in cooperation with the Institut de recherche pour le développement, which finishes in mid 2004. The workshop will be held at SPC's headquarters in Noumea, New Caledonia, 2-4 June 2004.

The goal of DemEcoFish was to find ways of assessing how reef fishery resources interact with human population growth and fish harvesting. The roundtable will give participants an opportunity to summarise major experiences of the project along-

side with experience from elsewhere in the Pacific.

The DemEcoFish major objectives were to select methods and approaches to reliably, effectively and quickly assess the status of the marine resource, using socio-economic survey data as indicators or proxies. Identification of suitable socio-economic indicators or proxies required joint analysis of resource and socio-economic data. Selection of best methods and approaches demanded scientifically based comparison of a range of options.

Taking the overall framework, the objectives and experiences into account, the roundtable will have the following aims:

- a) Present results of DemEcoFish to the wider regional and international audience for discussion and consideration.
- b) Use the DemEcoFish output as an opportunity to assess state-of-the-art in amalgamating socio-economic and ecological data in pursuit of a means to identify status of coastal resources and their value for the livelihood of coastal people in the South Pacific.
- c) Assess the value of such efforts in formulating effective management strategies aiming at sustainable and equitable use of marine resources.

d) Determine and prioritise gaps to be addressed in the future.

The roundtable meeting will also provide an opportunity to identify future needs and opportunities for working together. Some questions to be considered will be:

- Socio-economic data—what is it, what is needed and why?
- Marine resources—what to consider and why?
- Methodological approaches and techniques used—which works best under which conditions and for what purposes?

- What information is available for the South Pacific region—is it comparative?

- Multidisciplinary and interdisciplinary approaches—how to make ecological and socio-economic data complementary?

Persons interested in participating in the roundtable are requested to submit their application including name, title, institution/organisation, by 20 February 2004 together with (a) the title and an informative summary of their proposed contribution to the meeting, and (b) a short description of framework and background of their work and how this fits into the objective of this roundtable, to

Dr Mecki Kronen, Community Fisheries Scientist, PROCFish/C, Reef Fisheries Observatory, email MeckiK@spc.int. Further information is available from the same address.

Applicants should also indicate whether or not funding is required. Funding will be available under the MacArthur Foundation budget to enable participation of a selected number of professionals from the region. It is stipulated that professional staff from donor funded projects and programmes will provide their own funding. Observers are welcome on their own funding.



Socio-economic survey, talking to reef fishers

■ COUNCIL VOTES FOR A MODEL SWORDFISH FISHERY

The Western Pacific Fishery Management Council (Council) took action on long-term management of the Hawaii-based longline fishery and voted unanimously in favor of implementing a model swordfish fishery. The establishment of the model fishery is an important milestone for the Council. The swordfish component of the longline fishery was closed by the National Marine Fisheries Service in 2001 because of its impacts to protected sea turtles. Restoring swordfish fishing will benefit Hawaii's fishing industry and will serve as an example, to the much larger foreign longline fleets in the Pacific, that it is possible to have a viable longline fishery that has minimal impacts on sea turtles.

The model fishery will consist of a total of 2,120 swordfish sets per year, or about half of the average annual number of longline sets targeting swordfish prior to the 2001 ban. There will also be a "hard limit" on the number of sea turtles that can be taken by the fishery. Should this limit be reached, the fishery would close for the remainder of the year. Instead of J-hooks and squid bait, the fishery would be required to use large (18/0) circle hooks and mackerel-type bait. These have been shown to reduce captures of

leatherback and loggerhead turtles in the Atlantic by 67% and 92% respectively.

The Council has also undertaken a range of turtle conservation projects at turtle nesting beaches and foraging grounds in partnership with conservation organisations in Central America, Indonesia, Papua New Guinea and Japan. These measures will assist in reversing the decline of these sea turtle populations, which would offset any future negative impacts from the longline fishery. Other requirements of the new fishery include the use of approved dehooking devices to safely release sea turtles, and provisions governing shallow-setting above 23°N to avoid any potential interactions with protected seabirds.

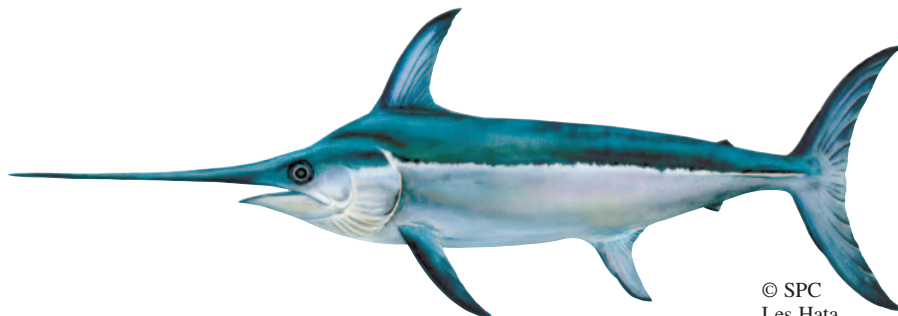
The closure of the swordfish element of the Hawaii longline fishery stems from concerns about the number of turtles taken in the Hawaii-based fishery, particularly leatherback and loggerhead turtles. Some estimates have suggested that over 20,000 turtles are caught annually in Pacific longline fisheries, with perhaps half this number being killed. Prior to 2001, the Hawaii fishery was estimated to annually catch 113 leatherback and 418 loggerhead turtles. A biological opinion

published by the National Marine Fisheries Service in 2001 concluded that the Hawaii longline fishery represented a serious risk to leatherbacks and loggerheads. This opinion obliged the Council to introduce a series of measures, chief of which was a complete ban on shallow set swordfish longline fishing in the North Pacific by the Hawaii based fleet. While this and other measures reduced accidental turtle catches significantly, it had a severe negative impact on the Hawaii fishing industry which, according to Jim Cook of Hawaii Longline Association and Pacific Ocean Producers, has cost Hawaii about USD 100 million and affected as many as 500 jobs over the past two years. Cook also expressed optimism about the new technology and the opportunity it represents for the Hawaii longline industry to demonstrate to other Pacific fleets that it is possible to fish responsibly for swordfish and not pose a threat to turtles.

For more information, contact the Council at:

info.wpcouncil@noaa.gov
<http://www.wpcouncil.org>

(Source: Council Press Release, 26 November 2003)



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Les Hata

■ GLOBAL STUDY OF NON-INDUSTRIAL TUNA FISHERIES

FAO is implementing a project on the management of world tuna fishing capacity. As part of this project, a study was undertaken of non-industrial tuna fisheries to describe what these fisheries are, where they occur, and their relative importance.

Rationale for the study

Although fishing capacity specialists generally feel that it would be impractical to estimate the fishing capacity for a multitude of types of non-industrial tuna fishing, it is necessary to know at least the magnitude of non-industrial tuna catches in order to evaluate how important to the success of the overall capacity study it would be to not have the non-industrial capacity estimates.

Tuna species covered

This study was concerned exclusively with the "principal market species of tuna": skipjack tuna, yellowfin tuna, big-eye tuna, albacore, northern bluefin tuna, and southern bluefin tuna.

Categories of tuna fishing used in the report

Industrial-scale: Mechanised purse seining, conventional freezer longlining, distant water fishing, and most baitboat fishing.

Very small-scale: Includes all handlining, trolling from open vessels, rod/reel fishing, sport-fishing, all kinds of tuna fishing

from vessels which are undecked, unpowered, or use outboard engines or sail and mostly "unclassified surface gear".

Medium-scale: Operations of a larger scale that fall between the definitions of industrial-scale and very small-scale given above.

Major output of the study

Estimates of the catches of tuna by non-industrial fishing were made in 148 countries and a closer examination was undertaken of tuna fishing in the Philippines and Indonesia.

Relative importance

The results of this study show the amount of tuna caught in the world by very small-scale fisheries is about 320,200 mt, or about 8% of the global catch. It was not possible to make a similar compilation for the medium-scale tuna fisheries—in most regions, the readily available information did not allow certain gear types to be broken down into industrial and non-industrial components.

Further thoughts on classifying tuna fishing

With the benefit of hindsight, it appears that the best option for a "clear division of scales" in the future would be to use a vessel length of 24 m to establish a division between the industrial and non-industrial components, while using gear/vessel-based features

to define very small-scale and medium-scale as subsets of non-industrial tuna fishing. Such a scheme would, however, require catch data partitioned by vessels larger/smaller than 24 m, something that was not available for the present study.

Improving the estimates of catch by non-industrial tuna fishing

The accuracy of the information in the appendix tables could be greatly improved by scrutiny by specialists with knowledge of national tuna fisheries. It is especially important for those experts to resolve the uncertainty associated with whether certain categories belong to medium-scale or to industrial-scale fisheries.

(Source: based on the work of Bob Gillett, Gillett, Preston and Associates, FAO, January 2004)



WHERE'D YOU GET THAT FISH?

(This article originally appeared in Pacific Fishing, October 2003—reprinted with permission)

Jeb Wyman

Starting in 2005, all seafood entering Europe will require documentation from boat to retailer. Will you be ready?

Rocked by outbreaks of mad cow disease and dioxin in chicken feed, and keen to support global stewardship of marine resources, a health- and eco-conscious Europe is taking steps to ensure the integrity and ethical nature of its food supply. By January 1, 2005, all fish and shellfish entering the European Union must be fully traceable, from the waters out of which they are landed to the restaurants or retailers that sell them, states Article 18 of Europe's General Food Law. The harvest, production, and distribution history of every seafood item—from cans of tuna to breaded fillets—must be documented and immediately accessible at every point in the chain.

"There are increasing demands for detailed information on the nature and origin of food products," says Tracefish, the consortium of 24 entities within government, industry and research sectors that developed the guidelines for Europe's program. "Traceability is becoming a legal and commercial necessity."

The U.S. Food and Drug Administration and the Department of Agriculture remain officially opposed to full traceability, arguing that existing regulations adequately guarantee food safety. Yet Europe's declaration to enforce traceability requirements promises to change the way U.S. fisheries operate.

While the Pacific fisheries have long regarded Japan as the foremost destination for their catch, Europe has become an increasingly vital market. Consider that, in 2002, Germany imported 41,371 metric tons of pollock fillets; France, over 8,300 mt of surimi; Britain, 620,000 cases (48-tall) of canned sockeye; Spain, 3,429 mt of albacore; and Greece, 2.2 million kilos of California squid—among many other examples.

Europe's new regulation will require full traceability of all seafood not only destined for Europe but also trans-shipped through Europe to places like North Africa and the Baltic. All U.S. seafood exported to a processing country such as China that eventually finds its way to Europe must be traceable to its U.S. origins. Moreover, Japan appears to be embracing the traceability concept as well, and has instituted a traceability program for its beef industry. Despite opposition by the U.S. government, segments of industry and influential organizations such as the National Fisheries Institute, traceability will almost certainly become part and parcel of the U.S. fishing industry. "It will definitely have a major impact on the world's fisheries," says Chris Bjerregaard, the U.S. manager for Scanvaegt, which is offering technical solutions to comply with the new E.U. mandate.

The key to seafood traceability is the marriage of barcode technology from the 1970s with databases and the Internet. A seafood producer will create a

unique barcode ID for each individual seafood product, affixing it to a box—or, in the case of whole frozen fish, possibly a fin. The producer records and stores a series of product specifications accessed via the barcode ID, before shipping it off. From that point on, every freight forwarder, distributor, wholesaler, caterer—any entity that handles the product—will scan the product, recording and storing data on its handling of the product. In concept, all this crucial information is stored in databases which can be accessed by authorities.

What to record

What information would fishermen and processors need to provide? In the case of whole frozen albacore shipped directly to Spain, for example, the Tracefish process is fairly straightforward. Every box of fish would receive a barcode ID that was keyed to these mandatory data:

- Name and address of the company that owns the vessel;
- Nationality, name and registration number of vessel;
- Seafood unit (single fish, box, block etc.), net weight, and species;
- Where caught;
- Product form (fillet, H&G, etc.), condition (live, chilled, frozen);
- Date of capture or sailing;
- Name and address of the next business to receive the product;
- Location and date of that transaction.

What about a tenderload of salmon, where dozens of gill-netters offload their hauls into a

common tank? How about a box of breaded halibut fillets, which might have come from any of a hundred longliners? Thankfully, the current Tracefish scheme "does not demand perfect traceability". Instead it recognizes that batches of fish get mixed up all the time during reprocessing operations, auctions, and tendering. In these situations, any business doing the mixing records the IDs of the fish that constitute a mixed lot. They also create a new ID for the new product. That product—cases of canned sockeye, perhaps—is then traceable back to "a finite number of vessels or farms".

Tracefish has also identified other data it considers advisable or optional to include in each product's documentation: a temperature log during storage; fishing gear type; trawl or soak time; refrigeration method; and any food safety schemes employed aboard the vessel.

Perhaps more importantly, Tracefish recommends also recording of "the names of sustainable fishing schemes by which the fishery is certified, and specific environmental benefits of fishing gear" such as dolphin-friendly seine panels. The prime example of sustainable certification is, of course, the Marine Stewardship Council, which was founded by Unilever and World Wildlife Fund in 1997. While Brussels is baring its regulatory teeth on traceability, gargantuan market players like Unilever may be the reason why U.S. seafood producers will ultimately embrace the concept. Unilever has declared its intent to buy fish only from demonstrably sustainable stocks by 2005 and is "working with suppliers to meet this target". If you're going to use Unilever as a conduit to your markets, be ready to flash your products' sustainability credentials. And Tracefish is jockeying to become

the official vehicle for proving the eco-friendly pedigree of your fish.

Food businesses are often wary of releasing information about their ingredients and processes. Here the Tracefish scheme runs headlong into serious proprietary issues.

In the event of a food safety incident, processors must be able to produce a full list of ingredients used in their products. But companies that have invested a king's ransom into R&D to develop their salmon burger or special sauce will be loath to release those secrets—possibly to a foreign authority—without good reasons to compel them and solid guarantees that the corporate files aren't leaked to their competitors.

Tracefish is encouraging industry members to make their information "visible" at the various points along the chain, so a wholesaler can research stock he's purchasing, or so a consumer can learn the origins of a pound of swordfish. Again, the scheme comes perilously close to violating the privacy of information. No Tracefish mechanism appears to protect producers from the risk that "links in the chain" above them might share their information. You might not want competitors to know where your reprocessing operations are located, for example, or what freight routes you use. A brand's success and reputation is on the line, yet freight forwarders, distributors, wholesalers, traders, and others don't have the same investment in the brand that owners want to protect. At some level, Tracefish opens up the traditional wilderness between producer and customer. That can be good for food safety, but it can make seafood businesses vulnerable.

The U.S. fishing industry is in fact already adopting traceability

concepts, both government- and industry-driven. The U.S. Bio-terrorism and Response Act of 2002, for example, requires all foreign and domestic food facilities supplying food to the U.S. to register themselves. The law also mandates "one step forward, one step back" documentation of all food products: every link in the chain must record who they got the food from and who they're selling it to. It's tantamount to Tracefish's traceability, but without obligatory, systematized barcode IDs on every product.

In fact, barcodes are fast entering the seafood business, but that's due to industry, not government, demands. While Unilever is imposing traceability on suppliers so it can market sustainable seafood, other large companies like SYSCO, the leading U.S. food service provider, are imposing barcodes to simplify inventory management. "We now put barcode labels on pollock boxes," says an executive in the Bering Sea pollock industry. "Some U.S. distributors wanted the barcode. They're dealing with huge numbers of products, and they wanted to read cartons as they went through conveyor lines." They said, "We have thousands of products going through our buildings. If you want to sell to us, you gotta have it."

Tools for traceability

A host of software companies now offer tools to the seafood industry so they can manage inventory, generate barcodes, and account for traceability. Wisefish, with offices in Norway, Iceland, Canada, and England, has been in the seafood software business for 15 years, and is adapting its products for full compatibility with the Tracefish scheme; the company's product FarmControl is designed for aquaculture compliance with the pending E.U.

rules. Both Astra Information Systems and Disc Design & Data, whose signature product is Fishmonger software, tailor their products to the seafood industry, coordinating digital weighing systems, inventory and shipping information, bar-code labeling, and other operations. C-Trace, based in Scotland, has created Trace 2000, a shipboard traceability program. Using Trace 2000, a vessel sends its data to shore fully encrypted; via an Internet portal called Webtrace, the home office and potential customers can access real-time traceability information. Net-Yield, which began in 1987 as a software effort for an East Coast seafood producer, now claims 2,200 users in 270 seafood companies, including Ocean Beauty. With advances in hand-held wireless computers and portable printers, Net-Yield says its Net-Yield 2003 system facilitates on-site bar code scanning and printing "for even small companies".

Scanvaegt not only offers software systems, but also weighing and processing equipment that integrates with their software. The company's principal software product, ScanFish, has

been on the market since 1993 and has been expanded to address all requirements of Tracefish. ScanFish Logistic will build a database that includes all mandatory and optional information specified by Tracefish. "All the things you need to comply with Tracefish are already considered in the system," says Scanvaegt's Chris Bjerregaard. "It is much more comprehensive than other systems, but it is extremely easy to use. You can go back two years and see where you caught fish and what the temperature of the water was. It is unlike any other system in the world."

Still, major software products typically cost USD10,000 and up. How can small boat owners who can't come up with that investment comply with Tracefish? Fortunately, small operators have an advocate in Michael Thompson, a graduate student at Oregon State University. Working with Michael Morrissey, director of OSU's Seafood Laboratory, Thompson has taken on the traceability issue with an eye to finding solutions for small business owners, in particular albacore fishermen.

"We're looking at this in terms of being proactive," says Thompson. "A lot of albacore is shipped to the E.U. each year, and in order for them to sell their product, they will have to institute a program of traceability. We're trying to look at ways to make a system that is relatively inexpensive that meets the standards. We're trying to use standard, ordinary software that they can purchase and send in a data format."

"More and more countries are gravitating towards traceability," says Thompson. "Whether or not the U.S. makes it mandatory, many companies are going to require it. If we can develop a system that brings costs down and makes it affordable to boat owners and smaller processors, we can help them stay competitive. It might be a boon to them to offer certain information to consumers. They might be able to get better prices in Europe, but if they aren't prepared to meet the traceability requirements, that's obviously going to have a big impact on their business. It's going to affect fishermen in the near future."



GPS TOOLKIT: SPECIALISED SOFTWARE DEVELOPED FOR PROCFISH

One of the traditional challenges of doing field research was accurately locating one's field research sites on maps and charts. With the advent of the satellite-based global positioning system (GPS), part of this problem was solved, as GPS technology makes it possible to determine one's location anywhere in the world at the push of a button, using a handheld receiver no larger than a mobile phone. The increasing sophistication of computer-based mapping programs was a separate development that greatly enhanced the ability of researchers to analyse and conduct comparative research utilising geographic data. But even with these advances considerable room for error remained, as coordinates (latitude and longitude) of locations had to be manually retrieved from the GPS receiver and entered into spreadsheets. This is a tedious task prone to errors, and data checking and verification are often difficult.

Combining GPS and MapInfo for the PROCfish project

Franck Magron (Reef Fisheries Information Manager for the PROCfish project) has developed a software to assist PROCfish scientists transfer their data from handheld GPS receivers to geographic information system (GIS) software, such as MapInfo®, a GIS product commonly used in the Pacific region by Fisheries and Lands and Surveys departments.

Scientists working in the field use their handheld GPS to establish and store in memory the position of each sampling station by entering a waypoint

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for each transect. Any biological data they subsequently collect is consequently geo-referenced; both raw data and results can be plotted on charts, or spatially analysed using GIS software.

Adaptability

PROCFish scientists and their partners in various organisations and Pacific Island countries use different types of Garmin® handheld GPS receivers, so the code developed by Franck had to be compatible with different models (it has been successfully tested on 10 models to date). The code thus took the form of a "communica-

tion library", which enables communication between different types of Garmin receivers and the various software programmes developed for the project. The data is downloaded from the GPS receiver using the appropriate data cable (this cable is often sold separately), once the communication protocol has been set to "Garmin" on the receiver (the default one is often NMEA).

The SPC programmes that use this communication library include React (used for underwater census taking) and GPS Toolkit (described below).

GPS Toolkit

GPS Toolkit was first developed to serve as a test base for the communication library, but Franck soon realised that it would be useful if developed into a stand-alone tool. GPS Toolkit now includes a graphic user interface that facilitates the export of GPS waypoints and tracks in a format (MIF) that is readable by MapInfo.

GPS communication protocols

NMEA 0183 is a communication standard supported by various brands of GPS, but is more adapted to real-time acquisition of data by chart plotters because data is sent continuously as an uninterrupted flow of NMEA packets called sentences. A device connected to a NMEA-enabled GPS receives continuously sentences corresponding to different kinds of data (time, position, number of satellites in sight etc.), discards the corrupted or unnecessary ones and extracts data from the remaining sentences.

The constraints of PROCfish field surveys are a little bit different from navigation constraints: only positions of a limited number of sampling stations have to be stored, but the data must be retrievable at later time to avoid exposing computer equipment to the harsh salty environment of fishing boats. The solution was to enter a waypoint at each sampling station and download the waypoint's location straight into the database and GIS using a communication protocol that allows retrieval on-demand of data stored in the GPS. Most GPS manufacturers have developed a proprietary, partially documented, communication protocol to handle these kinds of tasks. Garmin, for example, provides such a protocol and the communication library developed by PROCfish/C acts as a standard proxy for applications to retrieve waypoints and tracks from the various supported devices.

The software is available in French and English, and can be downloaded from the SPC web-site at:

<http://www.spc.int/coastfish/Sections/reef/gpstoolkit/index.htm>

Earlier versions of the software have been provided to Fisheries and Lands departments of some countries during PROCFish site selection field trips. Additional features have been added to the software during these trips, at the request of users.

GPS Toolkit in use

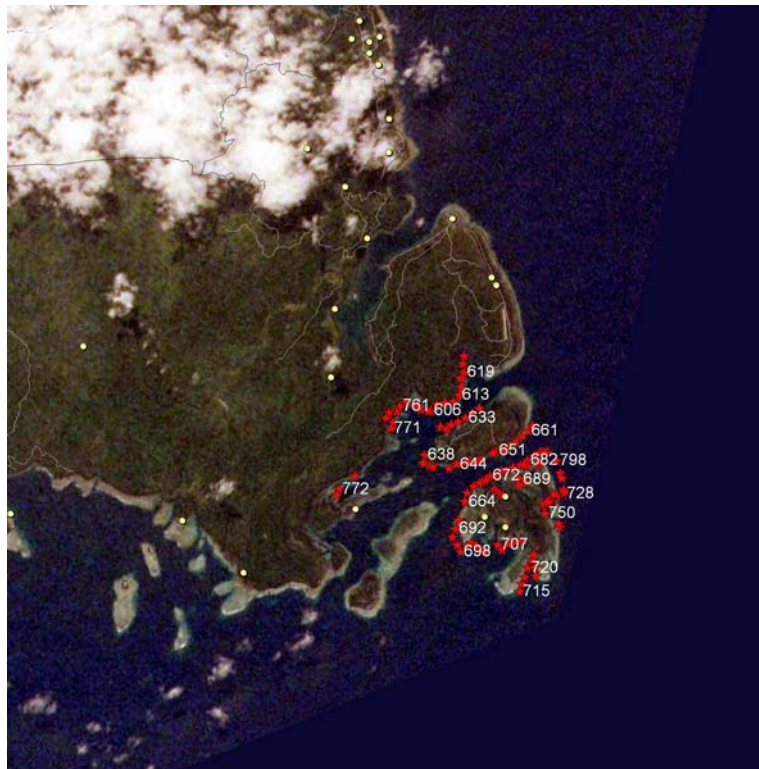
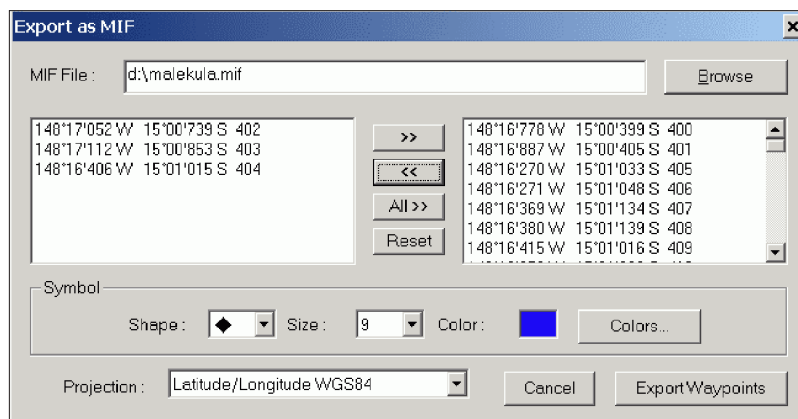
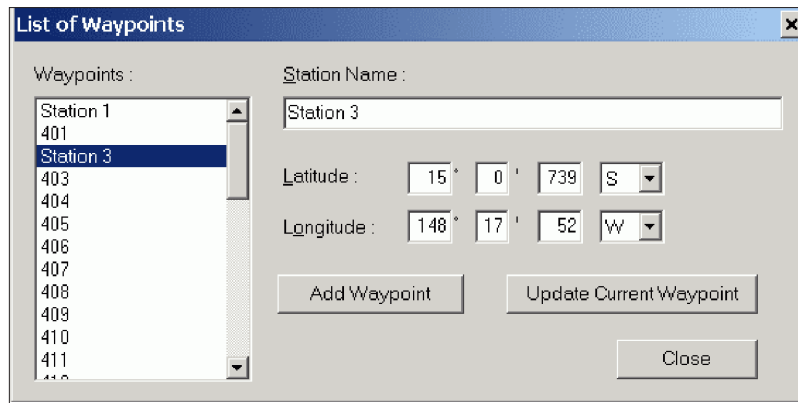
Once the waypoints have been downloaded from the GPS it is still possible to modify their label or manually add new waypoints. The labels will be exported along with the locations and so can be displayed under MapInfo after exporting to MIF file format and importing under MapInfo.

On exporting the waypoints to MapInfo Interchange Format, you can select which waypoints you want to export, and give them a default shape and colour. You can also set the settings (datum) that were used during acquisition of waypoints.

The MIF file can be imported under MapInfo and displayed on top of existing layers, such as reef or coast outline.

Future developments

Future plans call for extension of the communication library, enabling the transfer of waypoints and routes to the GPS; a graphic interface will be incorporated into GPS Toolkit for this function. Franck is also waiting for additional feedback from users, so that he can address their needs in future releases of GPS Toolkit.



AQUACULTURE IN FIJI ISLANDS: FOCUS ON TRAINING

Introduction

While there had been some formal training in aquaculture in the past, at present there is hardly any training offered to meet the needs of Fiji's aquaculture industry. This low level of formal training is affecting the development of the aquaculture sector in Fiji. Some strategies for meeting the future needs and opportunities for regional cooperation in aquaculture are provided.

Historically, aquaculture in Fiji dates back to 1940 but it was not until 1962 that the Government of Fiji introduced the Inland Fisheries Programme, which included fish culture. In 1970, the UNDP-sponsored project known as the South Pacific Islands Fisheries Development Agency (SPIFDA) had as an objective, among others, to assess the potential of aquaculture in Fiji.

Although fish culture was a promising enterprise at that time, development was limited by lack of expertise, experience, and suitable technology. From the mid 1970s, development accelerated. Several projects were implemented in the framework of various programmes with focus on different fields of freshwater aquaculture—introduction of new species, improvement of infrastructure and development of rural aquaculture.

A concerted effort to develop aquaculture in Fiji began in the mid 1970s, through government programmes on freshwater prawns, tilapia, carp and shrimp. The Naduruloulou Aquaculture Station was established near Nausori, north of Suva, in 1975.

Satya Nandlal,
Aquaculture Officer,
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It was mainly involved with breeding of carp for biological weed control in rivers. Later, in the early 1980, it added breeding and distribution of tilapia fingerlings to subsistence farmers, and also prawns.

A marine aquaculture station was built on Makogai Island in the mid 1980s. It conducted research and extension on giant clams, trochus, beche-de-mer and turtles.

Contribution of aquaculture to the national economy

At present, almost all of the edible aquaculture products (tilapia, carp, prawns and shrimps) are sold locally, while seaweed, aquarium-sized giant clams and pearls are exported.

In 1999, the Fisheries Division recorded production of 300 tonnes of tilapia valued at FJD 1 million, some carp, 2.2 tonnes

of *Macrobrachium* prawns and 300 tonnes of seaweed valued at FJD 150,000. No information is available on production of pearls.

Aquaculture production in Fiji is therefore still very small but is expected to increase greatly within the next 2 or 3 years.

Aquaculture education in Fiji

Since the late 1980s, aquaculture education has received increasing attention and hence fisheries officials have been given the opportunity to participate in various training programmes. These trained staff now form the core staff tasked to implement the research and extension programmes, although they still need training to get acquainted with latest developments.

Successful aquaculture involves skilful management of the stock and the environment in which it is raised. This calls for sound knowledge of the requirements and habits of the cultivated organisms and expertise in the methods of maintaining conditions favourable to their rapid growth and high survival.

Infinite patience and attention to detail are considered essential for successful farming. Whether this is really so or not, it certainly is true that the fail-

Aquaculture in Fiji is dominated by small- to medium-scale production of tilapia (*Oreochromis niloticus*) by semi-intensive culture methods. In 1999, a total of 296 tonnes of tilapia valued at FJD 1,000,000 was produced (Fisheries Division 1999 Annual Report) and sold domestically. Apart from *O. niloticus* culture, freshwater prawn culture is receiving increasing attention. There are a number of mariculture and brackish-water activities, mostly at the research and establishment phase. These include prawns (*Penaeus monodon*), milkfish (*Chanos chanos*), seaweed (*Kappaphycus alvarezii*), pearls (*Pinctada margarifera*), giant clam and trochus. Research on trochus is on stock enhancement, while for giant clam it is for stocking as well as for culture for the thriving aquarium and sushi market in the US and Japan. Milkfish research is targeting baitfish for the tuna longline industry, while prawn research is targeting the local market, estimated to be 600 tonnes annually.

ure of some aquaculture programmes in Fiji and the Pacific can be traced to lack of necessary expertise and trained personnel. While successful farms cannot be developed through mere training, most of the theoretical as well as practical knowledge that an aquaculturist needs can be imparted through appropriate education and training programmes.

In general, aquaculture education in Fiji has been insufficient. Most of the staff involved in aquaculture have received some level of training in fisheries. Many are holders of a Diploma of Tropical Fisheries certificate from the University of the South Pacific and some have also attended short courses in aquaculture at overseas institutions. A course unit in Aquaculture in the Diploma in Tropical Fisheries used to represent the formal part of training in aquaculture. This diploma programme stopped in 1987. A vocational school (Monfort Boystown) was offering training in basic tilapia culture in the early 1990s, but this too has stopped due to a lack of staff to teach the course.

Current status of aquaculture education

1. **Freshwater aquaculture.** This programme covers projects on tilapia, polyculture, ornamental fishes and integrated farming systems. Currently 4 technical staff and 20 support staff are involved in research, development, extension and training in aquaculture, with over 300 fish farms in operation. Of the four technical staff, two hold the Diploma in Tropical Fisheries and have attended short courses in aquaculture and the remaining two have a Bachelor of Science degree from the University of the South Pacific. Short course training on various aspects

of aquaculture has been funded through the assistance of UNDP/FAO, Japan International Cooperation Agency (JICA) and the Fiji government. Most of the support staff have received practical training on hatchery and grow-out methods for specific tasks they are assigned to. The Naduruloulou Aquaculture Station offers a series of extension courses to fish farmers. The farmers also maintain close contact with scientists from the research station.

2. **Brackishwater culture.** This programme covers projects on shrimp and milkfish. At present there are 4 technical staff with over 20 support staff. There are two commercial shrimp farms in operation and a government demonstration milkfish farm. Of the four technical staff, two have the Diploma in Tropical Fisheries and all have attended short courses at overseas institutions.
3. **Mariculture.** This programme includes research and extension work on seaweed, pearl, trochus and giant clam projects. Currently 13 technical staff are involved with over 40 support staff. There are over 500 individual seaweed farms, 2 experimental pearl farms and a government operated giant clam hatchery and

grow-out farm. Of the 13 staff, one has a Bachelor of Science degree, four have the Diploma in Tropical Fisheries, and a majority of the staff have attended short courses and on-the-job training at overseas institutions.

Future needs in aquaculture education

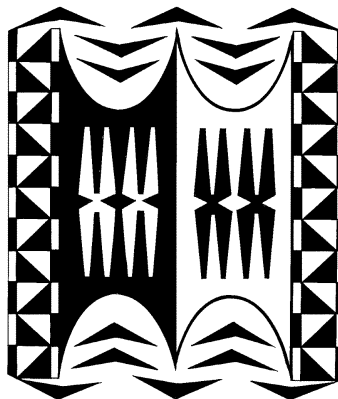
Aquaculture has been identified in Fiji's Fisheries Plans; however, the track record of aquaculture development has so far fallen short of expectations. One factor contributing to this is the lack of any course or regular training programme on aquaculture in Fiji. The training needs range from those at the community level to tertiary and postgraduate levels.

An aquaculture industry requires the support of training and research programmes if it is to succeed. There is a critical need for managers and technical staff. In Fiji, the need for technical staff is often recognised while the key role of managerial staff is generally disregarded. Most of the aquaculture installations are managed by technical staff who have had hardly any specialised farm management or business management training.

As Fiji is now attempting large-scale aquaculture development projects, researchers need a high level of scientific training in the principles of biology and in research methodology applicable to their cultured species and culture methods. Extension workers and technical support staff require more practical training in hatchery and grow-out methods for specific commodities.

Strategies for meeting the future needs

Almost all the short-term training or courses have been carried out outside Fiji, and this has to



some extent limited the value of some of the training given. Most of it has been given outside the

tropics, remote from local farm situations. While training in overseas institutions has been

and remains vital in providing higher qualifications for Fijian trainees, it is clear that more training should be done in contact with real farm situations in Fiji.

The University of the South Pacific has introduced a new course, Aquaculture in Pacific Island Countries, as an elective course for the Bachelor of Science degrees in biology and in marine science. The university also offers in-service short courses and community training, and is continuing with curriculum development of training materials. It is hoped that development of these courses and materials will contribute greatly towards the development of aquaculture in Fiji and also towards implementation of the Regional Aquaculture Strategy in the Pacific.

Opportunities for regional cooperation in aquaculture education

The key to closing most of the gaps between training needs and opportunities is for the University of the South Pacific and institutions involved with aquaculture to continue to upgrade their research and teaching programmes, and ultimately for all technicians to be trained through graduate programmes and technical courses.

Another possibility is to develop new international aquaculture centres devoted to specific commodities, as has been successful for rice, wheat, maize etc. under the Consultative Group for International Agricultural Research (CGIAR) system. Such centres have been shown to be very effective in concentrating research and training. As aqua-



Lime being applied to marine prawn ponds in Vanua Levu (top)

Montfort Boys fish-duck farming system, Suva (middle)

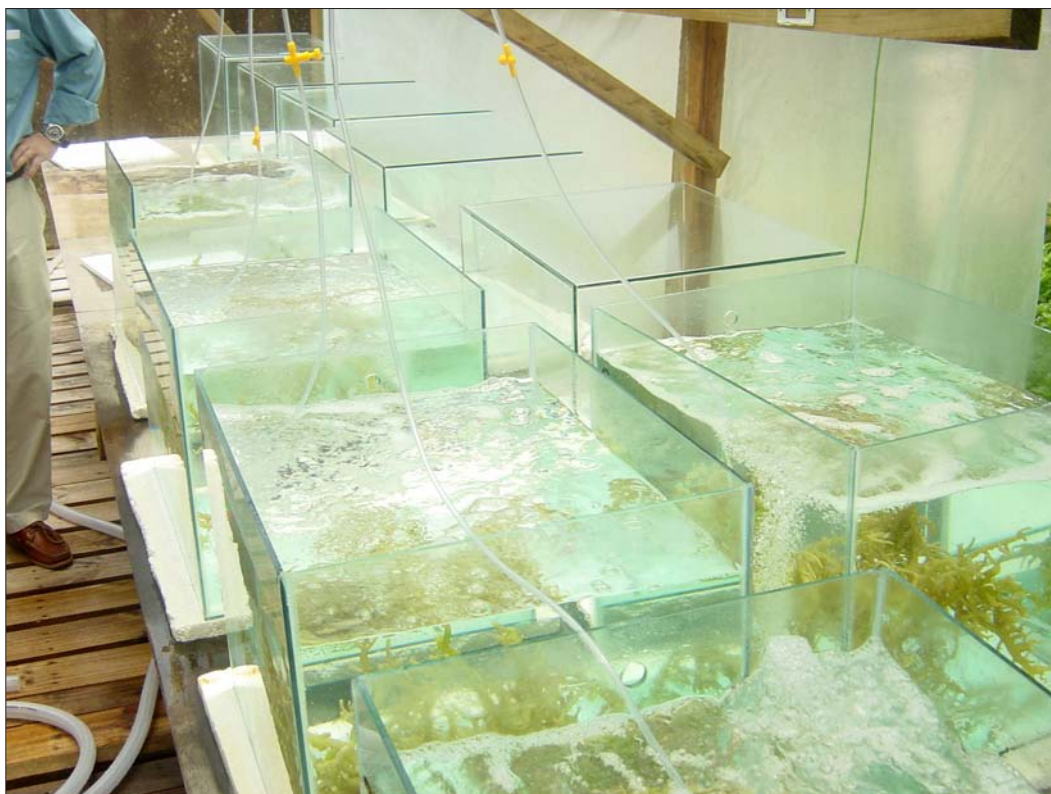
Black pearl farm at Savusavu Bay (bottom)

culture follows the pattern of agriculture and focuses on the few important commodities, we may see similar developments.

In the end it all comes down to money, manpower and facili-

ties. Increased expenditure on aquaculture research and development, including training programmes, can only be justified by increased production. For this reason, the cooperation of smaller island nations, institu-

tions and private sector in training programmes should be encouraged.



USP seaweed quarantine research

PRACTICAL HELP FOR THE SEAWEED FARMERS OF KIRIBATI

The seaweed farming industry in Kiribati has been provided with new educational material, thanks to the financial support of the European Union and the assistance of the SPC. A booklet titled "Farming seaweed in Kiribati: a practical guide for seaweed farmers" has been published by SPC. The booklet was designed and compiled in Kiribati by Antoine Teitelbaum (Technical Advisor with the international technical consultancy company Oceanic Développement) and staff from the Research, Extension and Development group of the Atoll Seaweed Company. It was translated into Gilbertese by Ienimoa Kiatoa and Kamatiie Kautu from the Kiribati Ministry of Fisheries and Marine Resource Development. The illustrations were done by Sebastien Lesire in Noumea, for the SPC. Although the book is designed to suit Kiribati, it will be useful throughout the Pacific in islands where the seaweed industry is being developed, such as Fiji Islands or Solomon Islands.

The book is in cartoon style, showing the lagoons, the farms, the landscapes and the people of Kiribati and their traditions. We follow the story of Teborou, the wife, and Taira, the husband, who are a young farming couple keen to revive seaweed farming on their island. They take us on a trip in the lagoon of their atoll and demonstrate all the activities required to farm seaweed. Site selection, seedling handling, farm layout, plot construction and also harvesting, post-harvest, marketing of the dried products in the outer island station and all the other steps of farming *cottonii* sea-

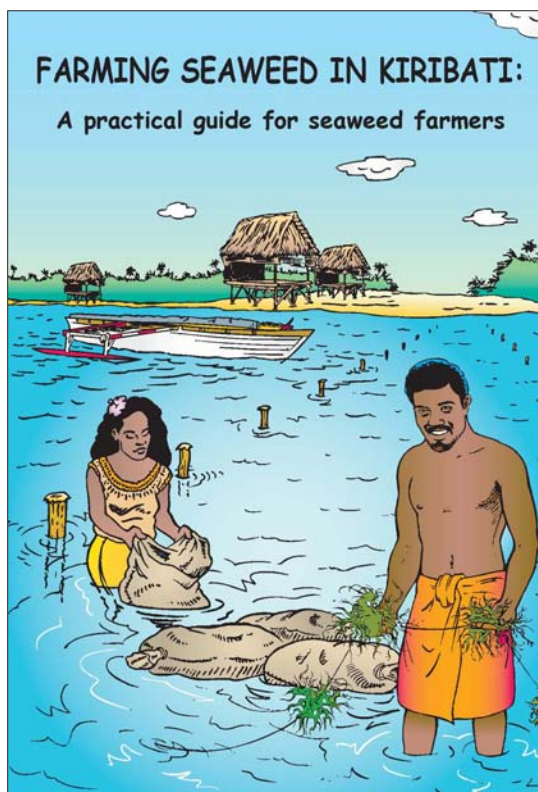
*Antoine Teitelbaum,
Technical adviser,
Oceanic Développement*

weed are illustrated. Taira and Teborou also show the reader the different problems encountered while farming, such as rabbitfish grazing, epiphytes and *ice-ice* disease. As this book is designed for the farmers themselves, the illustrations are very comprehensive and the text is written in a humorous way, avoiding long sentences and complicated Latin names!

This booklet plays a key role in the Kiribati Support to Seaweed Industry Project (SSIP). The SSIP is a four-year project financed by the European Union and implemented with the help of Oceanic Développe-

ment, a French company. The overall aim of the project is to increase the production of *cottonii* seaweed in Kiribati. A large component of the project is dedicated to research, extension and development (RED) in order to improve working conditions of the farmers and the buying agents in the outer islands and also to avert environmental damage on the farming sites in the lagoons of the atolls.

Extension officers and seaweed agents work in the field with the farmers. This book will help them in extending their seaweed farming skills to as many people as possible. The booklet will be of great support to the farmers and the agents in the outer islands, as there has been little educational material available to the farming communities in the last 20 years of the industry. This booklet is the third educational tool since the 1991 manual by James Uan from the Kiribati Fisheries Department published with the FAO entitled *Aron Unikakin Te Tiwita*



("How to plant seaweed") and the 2001 video produced by SPC titled *Grow seaweed, grow your money*.

Atoll Seaweed Company and the SSIP team have introduced the new booklet to farmers in the outer islands seaweed farming communities of Kiribati and the Line Islands. Two-day workshops were organised for farmers, who gathered in the *mwaneaba* (the communal village house) at Nukamotu village in Nuotaea island, Borotiam in Abaiang, Tabiang in Abemama, Aiaki and Otoae in Onotoa and Buota in Tabiteuea North. More workshops will be held in the near future.

Extension officers Linh Nguyen Quoc and Vincent Potier (from the international volunteer development charity VSO), Oceanic

Développement Technical Advisor Antoine Teitelbaum and Atoll Seaweed Company RED staff Ienimoa Kiatoa and Tealoe Sese led the theoretical and practical sessions with groups of farmers. Between 10 and 40 people attended each workshop, both male and female farmers (whether ex-farmers or future farmers but all very keen!) as well as the *unimwane* and the *unaine*, the men and women elders of the villages. The participatory learning approach and games were employed to make the workshops lively. All the steps of seaweed farming were demonstrated in the *mwanaeaba* and in the field.

Farmers who received the booklet all seemed very excited to recognise their islands, houses and boats and be offered their first cartoon in I-Kiribati. Lots of

questions were asked. Particular issues raised by the farmers included marine tenure in Nuotaea, seedstock supply in Abaiang and equipment purchase in Tabiteuea.

Several attendees were so convinced by the booklet and the workshop that they purchased their own farming equipment after the sessions.

With the increase of the seaweed price to AUD 0.60 and the arrival of the booklet, it is expected that more and more households of the Gilbert Islands and the Line Islands groups of Kiribati will start their own farms and contribute to making the industry sustainable. Surely, Teborou, the main character of the booklet will soon get her motorbike and her store in the outer island!



Top left: Abemama elders having a look at the booklet
Top right: Bringing seedlings ashore, Tabiteuea North
Bottom left: Checking the seaweed plots, Tabiteuea North
Bottom right: Tying lines, Onotoa



Seedlings, Tabiteuea North



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