SOUTH PACIFIC COMMISSION

ADVISORY VISIT TO TOKELAU ON FUTURE FISH HANDLING AND PROCESSING ACTIVITIES AND REQUIREMENTS
(25 August - 14 September, 1988)

REPORT

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Advisory visit to Tokelau on future fish handling and processing activities and requirements

1. Introduction

Following a request from the Office of Tokelau Affairs (OTA) to the South Pacific Commission for a fish handling and processing expert, the Fish Handling and Processing Officer of SPC's Fisheries Programme visited the three Atolls comprising Tokelau, and also Apia, Western Samoa, where the OTA office is situated, between 25 August and 14 September, 1988 to undertake a programme based on the following outline terms of reference:

1.1. Look at existing refrigeration facilities on the islands and establish the need to improve these facilities for better handling and preservation of fish, making recommendations as to the type of refrigerated facility most suitable for the needs of each atoll community;

1.2. Advise on the need to improve traditional methods of curing fish and identify suitable value-added products which can be produced in Tokelau on a small scale for export to markets such as Western Samoa, as an income generating exercise. Tuna products, in particular, should be investigated. Subsequent advice should be given on the establishment of handling and processing facilities, if this is considered appropriate;

1.3. Identify and advise on the training requirements that may come out of recommendations made under sections 1.1. and 1.2. above.

2. Background

Each island community has approximately 500-600 individuals, depending primarily on fish for dietary protein. Traditionally, fishing was conducted at a subsistence level, and this is essentially still true today.

Since the installation of FADs through the FAO Regional Fisheries Support Programme, comparatively large catches of tuna are now possible (sometimes more than 200 kg per day for some fishermen), and catches are landed regularly. FADs are operating successfully at Fakaofo and Atafu, but the FAD at Nukunonu was lost in 1987. At other times of the year gluts are experienced of other species of fish such as rabbit fish, big-eye scad, and trevally.

With the increased quantities of fish landed, more fish ends up either stored in the few domestic freezers available or is processed by salting and drying. There is no tradition of selling fish in Tokelau, thus excess fish, whether processed or not, is given to relatives, neighbours and friends. Significant quantities of the cured fish are sent to relatives in Western Samoa, with small quantities ending up in New Zealand, where a Tokelauan community of approximately 4,500 lives.

The request therefore stems from the need to commercialise the fishery through the distribution and export of fish, to generate income for island Tokelauans. It was recognised that to develop this possibility, advice would be needed on requirements for refrigeration facilities, improved processing techniques for cured fish and, more importantly, on whether marketing opportunities do exist for traditional, improved or novel cured products.

3. Evaluation of present post-harvest fisheries activities

3.1. Refrigeration

The only refrigeration facilities available on each of the atolls are domestic refrigerators and freezers (chest type). There are 14 domestic freezers and 2 refrigerators on Atafu, 15 freezers and 2 refrigerators on Nukunonu, and approximately 40 freezers and refrigerators on Fakaofo (each atoll has about 100 separate households). Until very recently these were operated under limited and sometimes erratic electricity supply (e.g. on Atafu electricity supplies were limited to five hours a day, from 18.00 to 23.00; on Nukunonu, from 18.00 to 24.00; and on Fakaofo, from 19.00 to 23.00). Freezers out-number domestic refrigerators because the short duration of power supplies limits the usefulness of the latter. It was not possible to establish the effectiveness of freezers for maintaining good and acceptable frozen storage temperatures under these electric power regimes.

At the time of the visit, electrical supplies were in the process of being upgraded, and by October 1988 the main communities on each of the atolls should be able to receive electricity 24 hours a day, from newly installed diesel powered generators (75 KVA for each atoll). Effectiveness of all domestic refrigeration appliances will therefore dramatically improve under the proposed 24 hour power cycle.

No ice is available on any of the islands to preserve catches by the technically simplest method of extending shelf life of reasonably large quantities of fish. Presently it is only feasible to manufacture ice in the small number of domestic freezers and this is not done for use on fish. In practice, therefore, none of the catch is chilled with ice at sea or on land. This limits the choices available for handling and processing. During the periods when fish landed exceeds the daily needs of the Islanders, the excess fish is either given away to relatives and friends, stored in the limited number of domestic freezers or processed by salt/sun-dry curing. Sometimes fishing activities stop altogether until the excess stored frozen fish is used up. However, if ice were made available, fish could be stored chilled with ice for a week or longer (storage times depend on the species). This would help spread out the effect of gluts, ensuring that the fish remains in good condition over a period of days, thus assisting processors to plan their fish drying schedules better and helping to avoid periods of bad weather when natural drying is impossible.

3.2. Cured fish production

Fish curing in Tokelau is dominated by either salting/sun-drying or boiling/sun-drying of skipjack tuna. On Nukunonu it was reported that some processors preserved fish in salt brine in plastic containers (one plastic container of brined fish from Nukunonu was examined on Atafu - unfortunately the brine smelt "off", suggesting that insufficient salt was used in the preparing the brine that resulted in the fish becoming spoiled). An elder on Atafu also recalled a time in the 1960s when smoked/dried fish was produced and exported to Apia. The practice was apparently discontinued when the smoke-house, built by a New Zealand visitor, was damaged in a storm.

Fish curing is dominated by women processors - usually the wives of fishermen. They process fish predominantly by sun-drying as a means of preserving catches that are in excess of their daily family needs. The processing is carried out on a small and rudimentary scale within the bounds of their homes.

Sina Vili, housewife fish processor on Fale, Fakaofo, described the procedures that she preferred:

She would normally process big-eye scad (atule) which were plentiful at time of the visit, and yellowfin tuna (kaki). She did not like processing skipjack tuna because it spoiled too quickly (it was normally consumed on the same day it was caught). However others in the village did dry this species (pieces of the fish are boiled and sun-dried to a hard product). Sina described the salt-drying process:

a) Preparation - small fish such as the big-eye scads are headed, gutted and cleaned and split through the back on either side of the backbone to open a large area for drying. This results in three or four longitudinal pieces, attached to each other at the tail. Large tunas such as yellowfin tuna are cut into thin 75-100 mm (3 to 4 inch) pieces.

b) Salting - fine salt purchased from the local store (30c/lb) is rubbed into the flesh of the fish and the fish are left overnight in a coconut frond basket, allowing any liquid extracted from the fish to run off. The ratio of salt to fish was not measured. Excess water is then squeezed from the flesh. This was also said to force the salt into the flesh (Fig. 1).

c) Drying - salted fish are dried either by hanging them over narrow wooden beams, or by laying them on corrugated iron sheets on the roof of out-houses and on spare iron sheets placed on supports, close to the home (Figs. 2, 3 and 4). The fish are occasionally turned over. Sometimes prepared fish are placed on the tin roofs of small external ovens to "force" the drying procedure. Sun-drying lasted for 3-5 days, depending on the weather. Finished products are dry but still malleable, with irregular, distorted and inconsistent shapes. Salt crystals are frequently seen on the surface of dried fish.

d) Dried products were stored in local baskets, indoors, until needed.

No problems were said to be experienced with insect attack on processed fish (blow-fly larvae attack or beetle attack of dried fish - commonly seen in other parts of the world). Rarely was any product lost to spoilage due to extended periods of rain. The fine salt used for processing is of such a high quality that pinking due to halophilic bacteria is unlikely to occur (this organism causes red patches to appear on dried products, leading to putrefaction).

In general, procedures for processing fish were similar wherever fish was being processed, and finished products had a fairly consistent and similar appearance for each type of fish. Differences were mainly noted with the degree of salt crystal formation on the surface of fish and apparent small, but expected, differences in dryness of product. Quality of dried products was reasonably good, but improvements to quality and preparation techniques are needed to meet perceived export market standards. Much could be done to improve quality and hygienic processing (see section 4.2).

At the time of the visit, no marketing procedure was in place for exploiting cured fish commercially. Curing is used as a means of preserving a food commodity for home consumption or as gifts to friends and relatives. A significant quantity of excess cured products (no exact figures available) is sent to Apia each time the M V Wairua calls at the atolls. Some of the salted dried fish reaches the Samoan community (given away as gifts by the Tokelauan community in Western Samoa) and is apparently well received and liked, according to a number of Samoans interviewed by the author. Marketing opportunities may therefore be available and this needs evaluating.

4. Improvements to present post-harvest fisheries activities

4.1. Refrigeration

There is no doubt that there are insufficient means for chilling or freezing fish in Tokelau. The ratio of the number of domestic freezers and refrigerators per dwelling is low, particularly for Nukunonu and Atafu. Such domestic appliances are unlikely to meet the demand for adequate and effective tools for extending preserved status of fish catches, particularly if export marketing of cured products leads to increased fish landings.

Domestic freezers are suitable for freezing small quantities of fish, say one or two pieces weighing a kilogram each, for home use. However they are unsuitable for freezing bigger quantities put into the freezer together from a single catch, or large fish such as some of the tunas. Freezers are designed to maintain low temperatures of already frozen products. Putting in 10-20 kg of fresh fish from a morning's catch, for example, results in very poor freezing rates, overworks the compressors (increases electricity consumption and shortens life of mechanical machinery), and raises the temperature of other products in the freezer, affecting their quality.

The most suitable and easiest method for extending and preserving the quality of fish is by thorough, proper icing techniques. Ice, when used properly, can extend keeping quality of fish for 7-10 days, or even longer for some species. This should be sufficient storage time for an atoll fishing community to reduce the pressure for either same-day consumption or immediate processing by curing. However, this would require the installation of ice-making equipment on each atoll, as ice can not be made efficiently in domestic freezers. The alternative of installing a small blast-freezer and a cold store (running at -20 to -30°C) can be discounted as these would be prohibitively expensive to purchase and run, and be technically more demanding to operate and maintain.

Although quite a strong case can be made for a recommendation that each atoll community acquires a facility for ice-making, ice storage and chilled fish storage, in the first instance it is more appropriate to evaluate how useful, acceptable and effective such a facility will be. Sometimes new technologies are not very readily taken on. Therefore a trial project to undertake such an evaluation at one atoll site is recommended as a first step. This facility should comprise a small block ice plant, and a common insulated store, either refrigerated or non-refrigerated, for holding ice and chilled fish in boxes. The OTA should advise which atoll should be the site of the proposed trial.

An outline funding proposal for the trial project, including building, refrigerated/insulated equipment and training needs, for one atoll community is described in Appendix 1. This includes a more detailed technical description, including other miscellaneous equipment and materials needed to effectively run the facility. This outline project will tie in with recommended facilities and training for improved curing procedures for fish (see section 4.2).

A suitable ice-maker for atoll communities is a small self contained unit producing 400 kg of block-ice in 24 hours, manufactured by Nordon Pty, of Australia. This self-contained piece of equipment is simple to install and operate, requiring only connection to an electric power supply and piped fresh water, and has minimal servicing requirements. The ice should be stored in a chill store and two options can be considered for this:

a) Refrigerated to 0 - 2°C with an insulation of 100 mm. This refrigerated temperature, although more suitable for the storage of chilled, iced fish, will be adequate for storing the 16 kg ice blocks with minimal melting rates. The main advantage is that excellent storage temperature is continuously maintained. However, the equipment is comparatively expensive to run and will require continuous maintenance, which in the long term could prove a major problem.

b) Non-refrigerated but with insulation of 150 mm, thus simplifying mechanisation, which will reduce maintenance problems and running costs (very little saving will be made on capital input because of increased cost of freight for the thicker insulated panels). Temperature inside the store will, however, be more variable, depending on how much ice and iced fish is held in the store, and the number of times during the day the door is opened or, even

worse, left open. Although more care will needed to ensure that the fish is continuously surrounded by ice, and ice utilisation will be greater because of increased melting rates, savings will be made on running costs and maintenance of refrigeration machinery.

The second of the two alternatives is recommended. The design of the chill store in both cases should allow for ice to be stored on one side and boxed fish on the other. The floors should be sloped so that melt-water from the iced fish cannot reach the block-ice, and drain holes suitably placed to drain away the accumulated liquid. This could be achieved by storing the block ice and boxed fish on separate wooden pallets. The area allocated for the storage of iced fish should be used on a communal basis, with fish stored in plastic fish boxes (stacking/nesting), labelled with the owner's name.

Prices for ice and storage fees are difficult to set at this stage. Electrical use under the present regime on the atolls is charged at a set fee per appliance. However, an estimate can be made based on the fuel consumption of the newly installed generators, and knowing the power ratings of the proposed ice machines. Ice cost in the atoll generator use alone will be about 5c/kg. The cost price of ice could therefore be two to three times this, approximately 10-15c/kg. Whether the calculated price for ice will prove to be an obstacle to it being accepted will be established during the proposed trial, and different options can be considered at that time in consultation with community leaders and OTA.

The building (approximately 30 sq m in area) to house this equipment should be constructed to hygiene standards expected of a seafood handling and storing facility (include rain water collection system for ice making and wash-down water). An outline of these recommendations is given in Appendix 2.

4.2. Cured fish production

A number of improvements should be made to the traditional procedures for curing fish on Tokelau. Some could be introduced immediately, while others will need techniques introduced by a suitable processing technologist.

Improved procedures that can be quickly introduced with little effort include the following:

a) Washing the fish in fresh water after completing the salting process, to remove concentrated salt solution from the surface of fish. This should be carried out just before laying the fish out to dry and will stop solid salt crystallising on the surface of fish during drying. This helps to extend storage and improve appearance because salt crystals are hygroscopic (they attract water from the atmosphere) and wherever they are found on the surface of fish small wet areas can develop, where moulds will grow, followed by spoilage bacteria.

b) Good air-flow over the surface of drying fish is probably the most important condition for good drying. Improved drying will therefore result if fish are sun-dried on a mesh rack supported off the

ground. Drying will then take place on both upper and lower sides of the fish. Mesh racks, or better still mesh trays (in a 1 m x 1 m wooden frame) placed on wooded supports, can be made from woven net (fishing net), or galvanised chicken wire.

c) Buildings hinder and interfere with natural flows of air under windy conditions. Drying would be improved in open areas away from buildings and trees. This will obviously depend on the availability of open areas not too far away from the home, where the fish are prepared. This is likely to be a problem for Fale, Fakaofo, because of the densely populated nature of this small island.

Training by a post-harvest fisheries technologist will be needed to introduce other technical improvements such as using brines to salt fish (using cheaper coarse salt), preparing the fish differently for salting and drying, and proper packaging/storage of finished products. Attempts can also be made to manufacture novel cured products from tuna by different curing methods and inclusion of a variety of ingredients, such as coconut cream, garlic, pepper, citrus marinade, etc.

Smoking the fish is not, however, thought to be suitable for Tokelau because quality smoked products require hardwoods for smoke production, and the limited hardwood resources on the atoll islands may not be able to sustain heavy utilisation for very long.

It is worth considering developing a communal facility or even a communal enterprise for cured fish production. The communal facility could operate with individuals processing their own fish and possibly paying a fee for the use of the site, or as an enterprise with individuals working together processing fish (probably bought from fishermen) and sharing the profits of the business. Both systems would require the following components to function effectively:

- Covered open building with tables for washing, sorting, splitting/cutting and brining fish, including an area for loading mesh trays with fish (include rain water collection system);

- Drying area with fish dried on mesh trays placed on wooden supports. (approximately 100 m in total length, allowing for fish to be laid on 20-25 trays, over a 4-5 day drying cycle);

- Covered building for storing dried fish, with an area for weighing and packing (include rain water collection system);

- The site will need to be fenced to keep out pigs and chickens.

An initial trial to look into the feasibility of such an operation should be linked with the refrigerated facility trial. All processors should receive training in appropriate technologies for chilling and improved curing of fish. The most appropriate system for utilising the fish curing facility can be evaluated at the time of the proposed trial.

4.2.1. Marketing trials for cured fish

During the visit to the atolls it was proposed that a quantity of cured fish be taken back to Western Samoa for a marketing trial at the General Market, Apia. On the atolls of Nukunonu and Atafu cured fish were purchased from local women at NZ$ 1.50/lb (NZ$ 3.30/kg). This proved to be a popular scheme, with some of the women complaining that if given more advanced warning they would have had more fish available. The dried fish purchased were of mixed species, predominantly rabbit-fish from Nukunonu and big-eye scad from Atafu. Some dried tuna and reef fish were also evident.

In Apia the OTA acted as wholesalers. Some dried fish was sold from OTA's warehouse within the first few days of returning to Apia. Plans were in hand to set up an individual with a stall at the general market, with a set selling price of WS$ 6.60/kg (WS$ 3.00/lb). The author left Apia before this trial had started.

5. Recommendations

5.1. It is recommended that marketing trials for traditional salt/dried fish from Tokelau, started at the end of this visit, be continued in Apia. It is perhaps surprising that marketing trials have not been previously conducted in Western Samoa. This is probably due to the fact that there is no tradition for trading in fish and fish products in the islands. Consequently, no pricing structure or monetary value has been attributed to fish as the excess is usually given away to relatives and friends. An exercise to establish the marketability of Tokelau's cured products would therefore be a valuable and informative undertaking and a good indicator of the extent to which any future projects in cured fish operation should develop.

5.2. It is recommended that improved procedures for processing dried fish be introduced into each of Tokelau's atoll communities, including developing novel dried products for tuna. This would require a visit of 6-8 weeks by a Fish Processing Technologist to introduce the improved techniques and train suitable personnel. A report, together with the results of the marketing trials recommended in 5.1, should also be sent to the Fish Handling and Processing Officer at SPC so that he can assist in evaluating to what extent any proposal on this topic should proceed. An outline proposal to introduce new facilities and train women processors is given in Appendix 1, and is included with the recommended trial for the refrigeration facility, which will involve choosing a trial site for fish curing on one atoll. Women processors from other atolls can travel to the trial site for training. A marketing component is also included in the proposal.

5.3. It is recommended that a trial facility be installed on one of the atolls to evaluate an ice-making/refrigerated storage facility comprising a 400 kg/24 hours, electric block ice-maker (Nordon N400 Block Ice Machine or similar); insulated ice/boxed iced fish store; and electric ice-block crusher for 16 kg ice blocks (see Appendix 1 for outline specifications and funding proposal). These should be housed in a building designed and

built for hygienic operations (see Appendix 2). The trial should run for a period of 12 months, during which time the effectiveness of the facility, and any modifications for other atoll communities' facilities, can be assessed. At the beginning of the trial period and in conjunction with the trial on cured fish, a Post-harvest Fisheries Technologist should train a single supervisor for the facility, fishermen in the use of ice at sea, and women in chilling methods for preserving fish.

Appendix 1

Funding Proposal for a Tokelau Atoll Community Post-harvest Fisheries Production and Marketing Trial

1. Introduction

Between 3 and 14 September, 1988, the Fish Handling and Processing Officer (FHPO) of the South Pacific Commission visited the atolls of Fakaofo, Nukunonu and Atafu, which constitute the New Zealand dependency of Tokelau. The aim of the assignment was to evaluate the present status of post-harvest fisheries on Tokelau, with regard to utilising fish catches more effectively, and to determine whether traditional and new fisheries products can be commercialised.

As a result of the visit by SPC's FHPO, recommendations were made for a trial project to assess the suitability of installing fish processing equipment, erection of seafood handling buildings and training of supervisors, fishermen and women processors in one of the three atoll communities as a Post-harvest Fisheries Trial Project. The result of the trial will be used to make recommendations for similar facilities for the other two atolls of Tokelau.

This Funding Proposal therefore seeks financial support for the recommended Project outlined in Section 3, which describes technical and financial requirements.

2. Background

Each of Tokelau's three island communities have approximately 600 individuals, depending primarily on fish for dietary protein. Traditionally, fishing was conducted at a subsistence level, and this is essentially true today. Since the installation of FADs (fish aggregation device), comparatively large catches of tuna are now possible (sometimes up to 200+ kg per day for some fishermen) and catches are landed regularly. FADs are operating at Fakaofo and Atafu, but the one at Nukunonu was lost in 1987. At other times gluts are experienced of other species of fish such as rabbit-fish, big-eye scad, trevally, etc.

The excess fish from good catches is either given away to relatives and friends, stored in the limited number of domestic refrigerators/freezers or processed by drying (salted and sun-dried or boiled and sun-dried). In general an excess of dried product is produced and much of this is given away too, often sent to relatives in neighbouring Western Samoa. There is no tradition of selling fish in Tokelau, and none of the cured fish was commercially marketed in Western Samoa, until a recent simple marketing trial, carried out by the Office of Tokelau Affairs (OTA), indicated that cured products could possibly be sold successfully there.

To develop this potential market for dried fishery products, two factors have to be addressed: the quality of traditional dried products should be improved, and novel dried products, particularly from tuna, need to be developed.

In addition there is a requirement for the high quality of the fresh raw materials for drying to be maintained. At present preserving the catch through chilling is impossible in Tokelau. No ice is available on any of the islands to preserve fish catches. Ice can only be produced in the small number of domestic freezers. This means none of the fish catch is chilled with ice at sea or on land. This limits the choices available for handling and processing fish. If ice were made available fish could be stored chilled with ice for a week or longer, depending on the species. This would help spread out the effect of any gluts, assist processors to plan their fish drying schedules better and help avoid periods of inclement weather.

3. Project description

The aim of the trial project is to commercialise fish handling and processing activities to generate extra income on one of Tokelau's Atolls. This will be achieved through the installation of ice-making and ice and fish storage facilities on one atoll, in association with a communal fish curing operation. The ice will be used for chilling fish catches effectively, and fishermen and women processors will need to be trained in the proper techniques for this. The communal fish curing facility is expected to help women process their fish more efficiently, with improved quality and more diverse products. The dried products will be marketed initially in Western Samoa, and later, markets further afield will be sought.

One of the three atolls of Tokelau should be chosen for the trial (OTA to advise which one). In the first instance the trial will last 12 months, and will require two visits by a post-harvest fisheries expert. The first visit, at the beginning of the project, will take 8-10 weeks: 6-8 weeks will be spent at the chosen atoll in Tokelau, with a further two weeks in Apia, Western Samoa, helping OTA set up a marketing trial of the improved traditional and novel dried products (plus report writing).

A second visit of ten days duration should be planned at the end of the twelve month period to evaluate the effectiveness of the trial, and draw up recommendations for facilities for the other atoll communities of Tokelau (some flexibility will be needed in the duration of both assignments due to infrequent connections between Apia and the atolls of Tokelau).

The Project will be divided into four components:

3.1. Purchase, supply and installation of ice-maker (Nordon 400 kg/24 hours block ice plant), insulated store and erection of building to house the facility (see Table 1 for details and estimated budget).

3.2. Development of a communal site for cured fish production. This will include a covered area for washing, preparing, and brining fish; a cured fish store, including packing and weighing area; and approximately 100 mesh trays (1 m x 1 m) and 100 m of tray supports (1 m high, 0.9 m wide).

3.3. Development of 2-3 novel cured tuna products that can be easily manufactured on the atoll (some initial product development work will be necessary prior to the assignment). Establishment of a marketing trial for the novel products in Western Samoa during the last two weeks of the first assignment period of the post-harvest fisheries expert. (OTA to supervise continuation of the marketing trial after the departure of the expert).

3.4. Training by the post-harvest fisheries expert for:

- a supervisor of the ice-making facility
- fishermen, in the chilling of fish with ice
- women processors in improved fish curing, new cured products, and use of the drying facility to its best effect.

The expert's first task will be to supervise the installation of the equipment and facilities described in 3.1 and 3.2 (the building for the ice maker and insulated store should be erected prior to the arrival of the consultant). Once the facilities are ready, the training programme for the supervisor, fishermen and women processors should begin. A counterpart officer from the island should also be trained to continue the supervision of the trial after the departure of the consultant (this person could be the ice plant supervisor).

Estimated budget for the trial project is given in Table 2.

4. Benefits

At the time of the visit to Tokelau by SPC's Fish Handling and Processing Officer in September 1988, only two income generating activities of significance were evident, i.e. export of copra and handicrafts. It is believed that this trial project in utilising and marketing marine products will lead to a third income generating activity. Additionally, the provision of ice to the community should help preserve fish catches longer, particularly during periods of high catches. With proper chilling techniques, fish will be safer to eat and sicknesses such as scombroid fish poisoning (sometimes seen with stale/spoiled tunas, dolphinfish, etc), should not occur.

Table 1 - Budgetary requirements for the ice-making and refrigerated storage facility at the project site

Item	Qty	Est Budget (A$)
Small block ice plant producing up to 400 kg of ice per 24 hours (16 kg blocks), including spare parts (Nordon)	1	10,565
Small insulated ice and fish store (with 150 mm of insulation), to hold up to 800 kg of block ice, and 1,000 kg of boxed iced fish on opposite sides, designed so that melt-water from the fish can not reach the ice within the same store. Including spare parts.	1	8,150
Block ice crusher for 16 kg sized ice blocks	1	2,115
Fish boxes, plastic, stacking and nesting type. 2 sizes: 60 cm x 25 cm x 10 cm, suitable for small fish (scads, rabbit fish and other reef fish), and	20	3,200
120 cm x 35 cm x 35 cm for large ocean fish such as tunas, wahoo, maimai, etc.	20	3,500
Insulated fish boxes for mobile storage of fish - approx 120 litres volume each	10	2,000
Platform weighing scales, up to 100 kg	1	2,000
Barrow or trolley	1	300
Shovels for crushed ice - preferably stainless steel	1	120
Cleaning equipment - brushes, hose, detergents, steriliser (chlorine compounds)		600
Protective clothing - apron (heavy duty), gum boots	for 2 pers.	200
Building approx 30 sq m in size, including rain water catchment and storage system	1	10,000
		======
TOTAL in A$ (all equipment quoted from Australia)		42,750
		======
TOTAL in NZ$ at 0.69 = 1 A$		61,957
		======

Table 2 - Estimated budget for a Tokelau atoll community post-harvest fisheries production and marketing trial

Item	Estimated Budget (NZ$)
Facilities for ice-maker and ice and fish storage (including miscellaneous equipment and material - see Table 1)	62,000
Fish curing facilities (covered fish preparation area, cured fish store and packing area, drying trays and supports, and fencing)	20,000
Consultant's visits: airfares (2 visits)	25,000
fees 1st visit - 70 days	20,000
2nd visit - 10 days	3,000
per diem (2 visits)	4,500
Miscellaneous equipment and materials	3,000
Contingency (15%)	20,625
TOTAL	NZ$ 158,125

Appendix 2

Food standard processing and retail premises - brief outline recommendations for building structure for hygienic operations

1. Floors

Ideally, should be covered in high impact resistant floor tiles, but concrete will do, with non-slip surface and sloped evenly towards the drain (slope about 1:40 = 2.5%) to stop water/blood/slime accumulation. Junction of floors to walls should be coved (15 cm diameter) for ease of cleaning.

2. Walls

Should be tiled to a height of at least 2 m above floor level, preferably white in colour. Upper tile edges should be flush with the wall or finished with a sloped edge so that dust cannot accumulate. All remaining wall surfaces should be painted in white in high quality paint that will not flake.

3. Windows

A large single pane is preferable to a number of small panes, and designed for ease of cleaning. Window sills should be sloped (30° to 45°) to stop dust and dirt accumulation. Windows must be fly screened.

4. Doors

Screened doors should be designed to close automatically from both directions. Two sets may be required - a solid outer security door and an inner swing door with upper portion screened and lower portion protected with GI sheet (kick-plate). Door surfaces should be smooth and flush finished.

5. Ceiling/lighting

Ceiling should be smooth with no protrusions, with all ceiling fittings flush with the surface, including the lights. Good lighting is important for good and safe working conditions, helps in showing up dust/dirt, improves efficiency of cleaning, and creates a pleasant and bright environment for employees and customers - therefore use plenty of fluorescent lighting.

6. Drainage/cleaning

Use plenty of water for cleaning, with industrial standard detergents and sterilisers. Get employees into the habit of cleaning regularly. Try and work out a daily, weekly and monthly cleaning schedule for staff, particularly for the fish handling area. A cess-pit and soakaway will be required for waste water, to avoid any fouling of the coastal waters.

7. Ventilation

Important for good working conditions for employees to provide a cool odour free environment.

8. Electrical

All electrical points should be at least 1.5 m above ground-level and be of the water-proof type - essential for area where water is continuously in use for washing.

Figure 1. Salting pieces of tuna on Atafu

Figure 2. Woman processor drying big-eye scads on a corrugated iron sheet adjacent to her home on Fakaofo

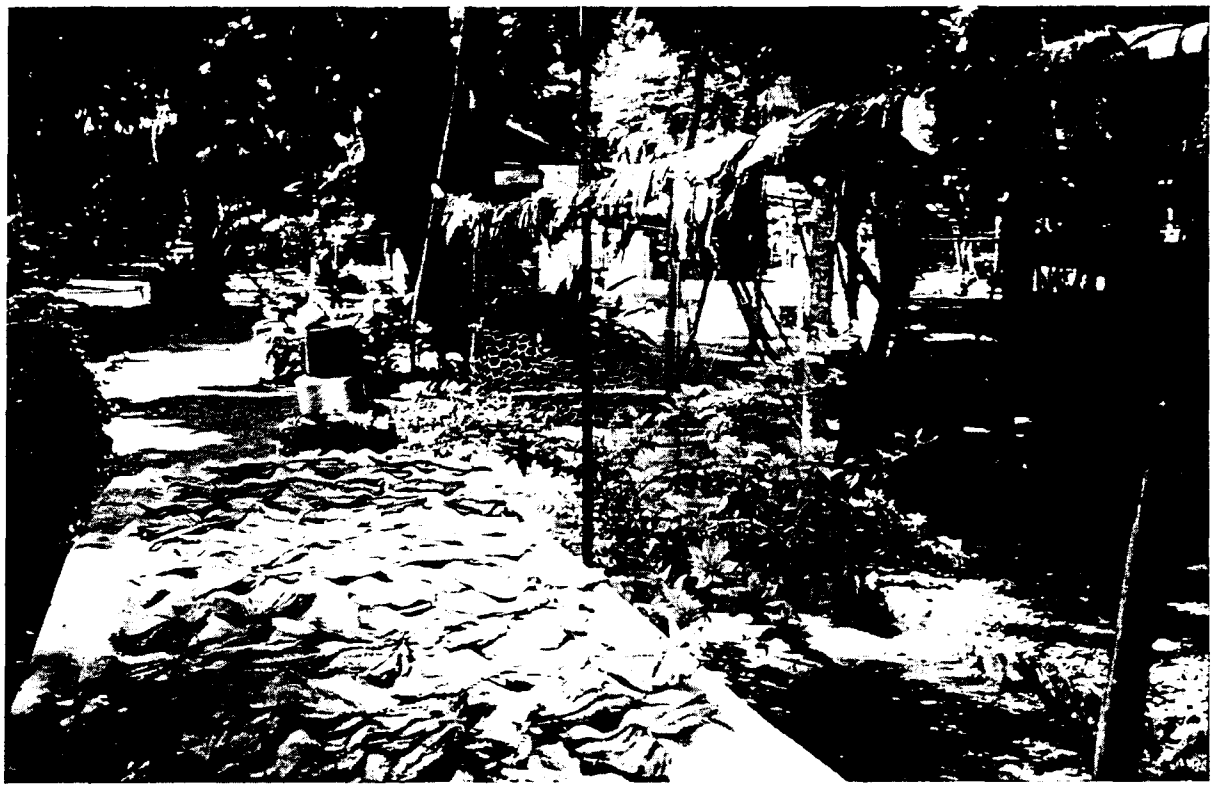

Figure 3. Two methods of natural drying on Fakaofo: salted fish (i) laid out on corrugated iron sheets and (ii) draped over a wooden beam high off the ground

Figure 4. Pieces of salted tuna laid out to dry on a corrugated iron sheet on Atafu