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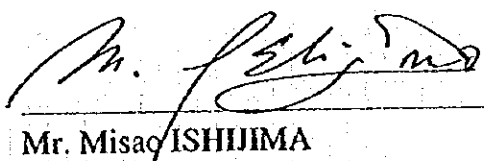
MINUTES
OF
THE JOINT EVALUATION MEETING
ON
THE AQUACULTURE RESEARCH AND DEVELOPMENT PROJECT
IN
THE KINGDOM OF TONGA


The Japanese Evaluation Team organized by Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Mr. Misao ISHIJIMA, visited the Kingdom of Tonga from April 12 to 19, 1996, for the purpose of evaluating the Aquaculture Research and Development Project (hereinafter referred to as "the Project").

The Japanese Evaluation Team and Tongan Evaluation Team headed by 'AKAU'OLA, Secretary for the Ministry of Fisheries, carried out the joint evaluation of the Project.

The Joint Evaluation Meeting for the Project was held on April 17, 1996, to discuss on the result of the evaluation, and the both sides agreed to convey to their respective governments the summary of the evaluation attached herewith.

Nuku'alofa, 18 April 1996


Mr. Misao ISHIJIMA
Leader,
Japanese Evaluation Team,
Japan International Cooperation Agency,
JAPAN


'AKAU'OLA
Secretary,
Ministry of Fisheries,
KINGDOM OF TONGA

**SUMMARY OF
THE FINAL EVALUATION OF
THE AQUACULTURE RESEARCH AND DEVELOPMENT PROJECT
IN THE KINGDOM OF TONGA**

I. Background of the Project

The Kingdom of Tonga traditionally depends heavily on the marine fisheries resources for the food supply to the people. Fisheries of the Kingdom can be classified into three categories, namely small-scale inshore fisheries conducted in and around the coral reefs, subsistence fisheries conducted on the reef flats and export-oriented modern fisheries operated in the Exclusive Economic Zone (EEZ) as wide as 700,000 km².

The small-scale inshore fisheries which include diving fishery, net fishery, fish fence fishery and hook and line fishery are most important in connection with the food supply to the people. The pressure on marine resources by the inshore fisheries has been increased by the recent advance of market economy and improvements in fishing gear. As a result, resources such as mullet, giant clam and sea cucumber have shown signs of decline and lobster has shown reductions in average size. As fish resources around coral reefs and shellfish resources on the reef flats are vulnerable to the intensification of fishing pressure, proper fisheries management measures including aquaculture should be taken for the sustainable development of the Tongan fisheries.

In 1978, the Mariculture Center was established by Japan's grant aid to promote the research and development of aquaculture in Tonga. The Center was severely damaged, however, by a cyclone in 1982 and its research activities were hindered. The Sixth Five-Year Development Plan 1991-1996 stressed the importance of aquaculture development and strengthening of scientific and technical support of the Ministry of Fisheries (MOF) for the fisheries development. The Tongan government requested the Japanese government to implement a technical cooperation project in the fields of aquaculture and fisheries management. The request included three fields, namely 1) Finfish Culture (pen culture of finfish), 2) Shellfish Culture (seed production and stock enhancement of shellfishes), and 3) Resource Survey and Management (survey and management of inshore fisheries resources).

In response to the request, Japan International Cooperation Agency (JICA) conducted a three-month Supplementary study from July 1990, a Project formulation study in October 1990 and a Preliminary study in March 1991. Based on the results of those studies, the

Record of Discussions (R/D) was signed between the two governments for the implementation of the Project type technical cooperation in August 1991. The five-year Aquaculture Research and Development Project started on October 2, 1991, when two long-term experts were dispatched to Tonga. Three more long-term experts were dispatched by February 1992 when the Project started full-scale operation.

OVERALL GOAL

The overall goal of the Project is to improve capabilities of Ministry of Fisheries (MOF) for the sustainable development of fisheries with well managed resources.

PROJECT PURPOSE

The purpose of the Project is to strengthen capabilities for the aquaculture and resource assessment of MOF.

II. EVALUATION OF THE PROJECT

II-1. INPUT

II-1-1. Japanese Side

II-1-1-1. Dispatch of Japanese Experts

(1) Long-term Experts

Chief Adviser	Dr. Yoshimasa Enomoto Mr. Hiromu Ikenoue Mr. Kazuo Udagawa	Feb. 24, 1992 - Dec. 16, 1993 Apr. 04, 1994 - Apr. 03, 1995 Mar. 13, 1995 - Oct. 03, 1996
Coordinator	Mr. Kazuhisa Takahashi Ms. Yoshie Satoh	Jan. 20, 1992 - Jan. 19, 1994 Feb. 28, 1994 - Oct. 01, 1996
Finfish Culture	Mr. Masanori Kawaguchi Mr. Tadashi Kimura	Oct. 02, 1991 - Oct. 01, 1993 Feb. 28, 1994 - Oct. 01, 1996
Shellfish Culture	Mr. Shigeaki Sone	Oct. 02, 1991 - Oct. 01, 1996
Stock Survey	Mr. Kazuo Udagawa Mr. Ken-ichi Kikutani	Jan. 20, 1992 - Jan. 19, 1995 Apr. 05, 1995 - Oct. 04, 1996

(2) Short-term Experts

Shellfish Culture	Dr. Masashi Yamaguchi	Mar. 11, 1992 - Apr. 05, 1992
Water Quality	Mr. Hiroshi Sumikawa	Oct. 07, 1992 - Nov. 14, 1992
Seed Production	Mr. Nobuhiro Oshiro	Nov. 19, 1992 - Dec. 12, 1992
Mollusc Culture & Stock Survey	Mr. Ken-ichi Kikutani	Dec. 07, 1992 - Apr. 08, 1993
Seed Production	Mr. Syozo Yamamoto	Nov. 10, 1993 - Dec. 13, 1993
Lobster Stock Survey	Mr. Taku Yoshimura	Jan. 17, 1994 - Feb. 19, 1994
Lobster Stock Survey	Mr. Masaaki Inoue	Mar. 10, 1994 - Mar. 27, 1994
Mollusc Culture & Stock Survey	Mr. Ken-ichi Kikutani	July 28, 1994 - Jan. 31, 1995
Finfish Culture	Dr. Jun Ohno	Sept. 02, 1994 - Sept. 26, 1994
Stock Survey (Audio Visual)	Mr. Masahiro Fukuma	Oct. 13, 1994 - Dec. 07, 1994
Mullet Feed Design	Mr. Kiyoharu Kobayashi	Sept. 18, 1995 - Dec. 20, 1995
Shellfish Habitat Survey	Dr. Hideo Oba	Mar. 11, 1996 - Apr. 6, 1996

II-1-1-2. Training of Tongan Counterpart Personnel in Japan

Shellfish Culture	Mr. Naita Manu	July 3, 1992 - Sept. 30, 1992
Observation on Fisheries Management System	Mr. Sione Mangisi	Mar. 24, 1993 - Apr. 17, 1993
Fishing Science & Technology	Mr. 'Ofa Fakahau	Apr. 02, 1993 - Dec. 01, 1993
Resource Analysis	Mr. Siosaia Tulua	Sept. 05, 1993 - Dec. 04, 1993
Natural Feed Production	Mr. Poasi Fale	Nov. 18, 1993 - Feb. 26, 1994
Marine Resource Management	Mr. Viliami 'Anitimoni Petelo	Sept. 20, 1994 - Oct. 15, 1994
General Aquaculture	Mr. 'Ofa Paongo	Jan. 10, 1994 - June. 25, 1995
Bivalve Seed Production	Mr. Tala'ofa Loto'ahea	July 17, 1995 - Sept. 28, 1995
Observation on Marine Resources Administration and Management	Mr. Taniela Koloa	Nov. 25, 1995 - Dec. 16, 1995

II-1-1-3. Provision of Machinery and Equipment

Machinery and equipment equivalent to about 105 million yen was provided by JICA from 1991 to 1995. The main items of the provision are shown in the attachment. The expenditure for each fiscal year is given in the table below.

Japan's Fiscal Year	1991	1992	1993	1994	1995	Total Amount
Amount (Unit: 1,000 Yen)	6,818	33,338	23,784	24,282	15,000	103,222

II-1-1-4. Expenditure for the Project Activities

The expenditure for the project activities in each fiscal year is given in the table below:

Japan's Fiscal Year	1991	1992	1993	1994	1995	Total Amount
Amount (Unit: 1,000 Yen)	6,869	7,259	12,939	11,843	16,904	55,814

II-1-2. Tongan Side

II-1-2-1. Provision of Facility and Land

Land (1 acre) equivalent to T\$6,000 was provided for the Project in 1991.

Fencing of the whole MOF compound including the JICA Project office was done in 1992, which cost T\$16,000.

II-1-2-2. Expenditure for the Project

The expenditure for the Project for each year is shown in the table below.

Description	Unit (T\$)				
	1991	1992	1993	1994	*1995
Water	1,200	1,400	3,000	3,500	3,150
Electricity	4,500	5,000	12,000	16,000	13,125
Wages/Salary	34,237	35,676	37,094	38,610	33,741
Development	10,500	9,000	12,000	13,150	15,500
Total Amount	50,437	51,076	64,094	71,260	65,516

* Estimated amount

The above stated expenditure for Water and Electricity was for the whole of MOF, but Wages/Salary and Development Budget was secured only for aquaculture development activities.

The income produced by Giant Clam has helped to cover a part of the running cost since 1995 and the MOF contributed (T\$ 24,000) for the Poster Competition in 1994.

II-2. RESULTS / OUTPUT

II-2-0. General Matters

Rehabilitation of the Mariculture Center's facilities which had been damaged by Cyclone Isaac in 1982 was undertaken during the first year of the Project. Due to the insufficient funds available for the rehabilitation, Japanese experts supervised the construction work while the MOF took responsibility to provide the work force, in order to minimise the cost for construction. Roofing of the hatchery and reservoir tank, replacement of water pumps, generator, and elevated tank were duly completed by November 1992. However, as there were other parts of the facility being damaged and rusted by age, renovation work continued to be an additional task for both parties. Twenty-ton rearing tanks were found to be leaking so extensively that the tanks were demolished and replaced by eight FRP tanks.

Water quality and quantity was found unreliable for culturing giant clams. In 1993, an emergency fund was utilised to extend the water intake pipe to the reef edge where better quality water is available at all times, and the water pit was raised to avoid the unsuitable sea water coming in during high tide. Further, a filtering system is being prepared to remove silt from the water.

An Awareness Promotion Facility which includes a lecture hall, a museum, and an audio-visual editing room was constructed with the materials provided by JICA and skilled labour provided by the MOF. The facility is aimed at the training of fishermen and educating school children in fisheries resource conservation.

The Fisheries Research Bulletin of Tonga (FRBT) commenced publication. By the end of December 1995, four volumes of the bulletin were published. The purpose of the publication is to ensure the preservation of the results of the research activities, encourage local counterparts in their research and to publicise the Project activities abroad as well as to local institutions. A brochure to introduce Project activities was also published in 1995.

Information exchange trips were undertaken three times. The first one was conducted in 1992 to study Australia's fish culture technique. One expert and his counterpart visited the Aquaculture Research Center on Bribie Island, Australia. The second trip was arranged to visit regional organisations to exchange information on aquaculture development. Two experts and two of their counterparts visited the Food and Agricultural Organization (FAO) in Suva, the University of the South Pacific (USP) in Suva, the South Pacific Commission (SPC) in Noumea, IFREMER in Noumea, the International Center for Living Aquatic Resources Management (ICLARM) in Honiara and the Forum Fisheries Agency (FFA) in Honiara, in November 1994. The third trip was to the International Workshop on Pacific Island Inshore Fisheries Management which was jointly organised by SPC and FFA from the end of June to early July in 1995. JICA and MOF sent 7 delegates to the workshop and presented 7 papers on resource management of mullet, giant clam, trochus, green snail and lobsters

An International Workshop in Aquaculture, "Present and Future of Aquaculture Research and Development in the Pacific Island Countries" was organised and held in Tonga in November 1995. The workshop attracted over 40 aquaculturists from neighboring countries as well as local staff from remote island groups. The Project staff presented 6 papers on mullet culture, giant clam culture and marketing, and green snail habitat and spawning trial, during the workshop.

II-2-1 Finfish Culture and Research

II-2-1-1 Biological and Ecological Survey

Sample mullets have been purchased from the fish market whenever available, in order to conduct studies on maturation, fishing grounds and fishing methods. Mulletts are primarily caught by fence net but also can be caught by gill net and dynamite fishing during the spawning migration, and the resource of *M. cephalus* has clearly declined because of high fishing pressure. The results also show that the spawning season of *M. cephalus* is confirmed to be during winter (June-July-August).

A fence net fisherman was selected to further investigate the fishing and migration pattern of the mullet species and the economic return of the fence net.

Surveys were conducted as scheduled. It was found that appearance of fry of target species (*Mugil cephalus*) has large annual fluctuation and specimens were not found during the first two years of the Project. Another mullet species, *Liza macrolepis* appeared throughout the year and it is available for culture. Further surveys suggested that the spawning season of *M. cephalus* was shorter than that of *L. macrolepis*, and the short spawning season caused the steep decline of *M. cephalus* resources.

Counterparts have learnt fry collection skills, species identification and survey planning procedures. They have developed their technique which enables the collection of 5,000 mullet fry a month. Their handling techniques have improved to a point where the survival rate of the caught fry is over 70%.

II-2-1-2 Finfish Culture Experiment

A number of feeding experiments in rearing tanks have been conducted to clarify rational formulation of supplementary feed using locally available materials.

Results of the initial experiments indicate that local products such as squash pumpkin and cassava do not help the growth of mullet fry, though copra may help. Further experiments show that animal protein content of feed is an important factor for the growth.

Counterparts have learnt how to make fish feed for the experiment as well as learning the experiment procedure.

The pen culture experiment had been tried from the early years of the Project but the nets were found not strong enough to withstand the wave action and connecting parts were easily

tom. The new net was introduced and enforcement of the bottom design prevented the escape of mullet. After this, the experiment progressed well from the third year of the Project. The pen has proved strong enough to last for more than 2 and a half years.

From the results of the rearing experiments of mullet culture in the pen, it was found that it took two years to raise *L. macrolepis* from fry to marketable size, and it was only one year when the juveniles of *L. macrolepis* larger than 10cm total length were used. It was also found that *M. cephalus* grow 2 to 3 times faster than *L. macrolepis*.

Two marketing surveys were conducted at Vuna wharf using cultured mullet (*L. macrolepis*) of about 80 to 100g body weight, and the taste was well-accepted by consumers.

Counterparts have learnt to construct durable pens. A manual of pen culture will be produced by the end of the Project.

An economic feasibility study of pen culture is under way. Extensive small-scale pen culture may be feasible but does not seem so attractive with the species *L. macrolepis* because of its slow growth. A further study is to be conducted using formulated or imported feed for small-scale pen culture.

The pen culture however, should take other aspects into account. Mullet culture should be considered in line with Tongan health care policy. Consumption of fatty animal meat seems to cause Geriatric disorders in young Tongan people. It is suggested that the Government should take necessary actions to subsidise the promotion of mullet pen culture to supply healthy protein foods, to improve the Tongan diet. Promotion of the pen culture could also be used as a tool to lessen the expected resistance of fishermen when the Ministry introduces stronger measures to conserve the mullet resources. The MOF is considering protecting *M. cephalus* resources during the spawning season (July - September). Surrounding gill net and fence net should not be used during this period. The mullet pen culture could be one alternative for mullet fishing during the closed season. The mullet pen culture could be introduced as compensation to those who abandon mullet fishing, with materials and technical assistance provided.

The pen culture could help protect mangrove forestry along Fanga'uta Lagoon which may otherwise be destroyed by reclamation.

II-2-2 Shellfish Culture

II-2-2-1 Giant Clam Culture

Biological information, spawning season and maturity size of giant clam species, mainly *Tridacna maxima* was obtained during the earlier part of the Project through periodical sampling examination from the fish market. *T. maxima* does not appear to have a clear spawning season whereas the larger clams such as *T. derasa* and *T. squamosa* have spawning seasons during the early summer months.

Counterparts learnt to identify giant clam species and obtained skills on biological examination such as determination of maturity of gonad.

Surveys for suitable releasing habitats were conducted together with the Resource Survey section. In order to safeguard the released juvenile clams, the releasing site needs to be environmentally suitable and safe from poaching by people. After a number of surveys, we have identified two locations where the environment is suitable for juvenile clams and the village people are willing to take care of the clams. With participation and cooperation of the villagers, we have established 'Atata Village Ocean Nursery (AVON) and Kolonga Village Ocean Nursery (KVON).

Seed production techniques of giant clams have been considerably improved. Despite the earlier successful seed production of *T. derasa*, *T. squamosa* and *T. tevoroa*, the Project concentrated on producing only *T. derasa* from the third year on, since this species is fast growing, less vulnerable to environmental changes and, above all, its resources are decreasing faster than others.

Counterparts have obtained skills to successfully conduct seed production by themselves. Seed production of 50,000 one-year-old clams have been achieved. Market research revealed, however, giant clams, such as ones with blue-coloured mantle, are highly valued in the market. In order to meet the demands, further investigation and experiments are necessary. Selection and combination of broodstock and spawning of *T. derasa* and *T. maxima* should be examined.

It is also suggested to improve coordination and management skills of the hatchery which will be producing more species in coming years.

The land nursery stage of giant clam culture has been vastly improved. Construction of 8 four-ton raceway tanks during the first year of the Project helped to manage the clams and maintain constant conditions. Introduction of herbivorous mollusks and fishes such as trochus and milkfish into the tanks has improved the algae control immensely.

Counterparts have demonstrated the ability to maintain the nursery stage of the giant clam culture.

There are three ocean nurseries in the Tongatapu island group: Sopa Ocean Nursery (SON), 'Atata Village Ocean Nursery (AVON) and Kolonga Village Ocean Nursery (KVON). SON is under direct management of MOF whereas the others are jointly managed by MOF and village communities. Though these three nurseries have different environments, the knowledge obtained from SON is basically applicable to the others. Survival rate of both Village Ocean Nurseries (VONs) is satisfactory. Management of clams in this stage should be simplified so that villagers are not hesitant to take care of them. Some encouragement should be given to keep their interest in taking care of the nursery until harvest time, such as regular visit by MOF staff and discussion with villagers.

There is to be at least one more Village Ocean Nursery (VON) in Tongatapu area before the end of the Project. Counterparts have taken a vital role in communicating with villagers and town officers as well as the hotel owners and the Noble of the village, in order to obtain full understanding and support for the program.

A manual of giant clam culture is to be published.

II-2-2-2 Transplantation of Trochus and Green Snail

Preliminary surveys were conducted during the first year to locate suitable sites for trochus and green snail transplantation. Detailed surveys were conducted in the second year to further select the suitable sites. The sites selected for releasing are 'Euaiki Island, Fukave Island, Vaini Liku and Uolanga Lalo in the Tongatapu Island group.

About one thousand adult trochus were imported from Fiji in May 1994. The survival rate of the trochus during the air transportation was 96%. Five hundred trochus, one hundred of which were tagged, were released off Fukave Island, and four hundred trochus were released off 'Euaiki Island.

Fifty adult green snails were imported from Vanuatu by air in August 1993 and all survived the transportation. Forty-one green snails survived in the concrete rearing tank at Sopus after one month, while 9 died due to the low salinity caused by heavy rain. Later in the year, those surviving were released in Vaini Liku and 'Euaiki Island.

Twenty-eight green snails were imported from Japan in March 1994 as a transportation experiment and another 300 were imported in August 1994. The survival rate was 39% and 85% respectively. One hundred and seventy of them were tagged and released off 'Euaiki Island in August and others were kept at Sopus for future seed production trials. To assist the management of the introduced species in 'Euaiki Island, meetings with island residents have been held to promote a better understanding. As a result of these meetings, released green snail and trochus have been protected by the island's people.

The shellfish release sites are watched and the fishing activities are recorded every day.

Counterparts learnt some aspects of transportation of these shellfish species.

Seed production experiments of trochus and green snail were successfully conducted in 1994. Trochus juveniles were reared together with giant clams as an experiment. Food algae for green snail after the larval stage was found to be available in Tonga. Green snail has shown faster growth than that in Okinawa and Amami in Japan.

The Project has achieved the first success in green snail spawning and larval rearing in the South Pacific, and the second in the world after Japan.

Counterparts experienced this important achievement and have been learning the procedure of seed production of these species.

Recapture surveys of these shellfish have been repeatedly conducted. Although a full-scale survey has yet to be successful due to unfavourable weather conditions, trochus and green snail appear well-adapted to the environment of the transplantation sites, and show good signs of growth. Further surveys with more staff will be conducted in the near future.

II-2-3 Stock Survey and Management

II-2-3-1 Giant Clam Stock Survey

Stock surveys were conducted to reveal the resource condition and fishing method of giant clams around Tongatapu Island. The result indicated that the decline of *T. derasa* and *T. squamosa* resource will continue if the hookah diving method continues to be used to harvest giant clams. In addition, shell length of *T. maxima* sold at fish market showed a noticeable decrease during the past 10 years.

Counterparts learnt the survey method using a manta board, line survey and free swimming survey.

Site surveys for giant clam releasing were also conducted and identified four suitable locations, two of which are now utilised.

Follow-up surveys of released giant clams have been conducted periodically. Survival as well as growth rate is monitored. *T. derasa* showed a better survival rate than *T. squamosa*.

II-2-3-2 Research on Economically Important Species

Biological and ecological surveys were conducted for the following species and the results will provide useful information for formulating appropriate fisheries regulations. Those surveyed species are, *Anadara spp.* (2 species), *Gafrarium spp.* (2 species), *Turbo spp.* (3 species), *Holothuria sp.*, *Panulirus spp.* (3 species) and *Tripneustes sp.*

Counterparts have learnt survey methodologies and skills for preparation of reports.

II-2-3-3 Resource Management

Establishing the routine work for reliable inshore fisheries statistics has been completed. Annual statistics for 1993 and 1994 have been published.

Techniques of data collection and analysis have been transferred to counterparts.

Several economic surveys were conducted to help make reasonable fisheries management plans. The survey team consisted of JICA, MOF and Japan Overseas Cooperation Volunteers (JOCV), who visited fishing villages in the Vava'u Island group and the Ha'apai Island group to conduct interview surveys, as well as fishing trial surveys in 1992. The interview surveys revealed a part of the lifestyles and economic activities of fishermen and their families. Four reports have been finalised at this time and 2 more reports are to be

prepared before the end of the Project. The survey benefited the Team by helping them to understand socio-economic conditions of the fisheries sector in Tonga.

Awareness and educational activities were considered important to achieve the Project's overall goal, of striving for appropriate management and sustainable utilisation of fisheries resources. It cannot be realised without the cooperation of fishermen. Released giant clams, trochus and green snails will be wasted if fishermen harvest without consideration of the effect of their action. General public (consumers) and students also need to be aware of conserving vulnerable fisheries resources.

Methods used for awareness promotion includes producing video tapes for showing on TV, at MOF, and at schools, as well as organizing events such as the trochus releasing ceremony and a poster competition. Four video programs, and 4 designs of T-shirts and posters, each in both English and Tongan languages have been produced. A releasing ceremony was conducted in the presence of H.R.H. 'Ulukalala Lavaka Ata, and this was televised and publicised in several journals. Some small ones were kept at Sopu for future seed production experiments.

JICA also sponsored a weekly Fisheries radio news program. Each program consisted of a 15-minute announcement and news from the MOF. Counterparts have the ability to initiate awareness programs by themselves.

II-3. CONCLUSION

II-3-1. Impact of the Project

II-3-1-1. Technical Impacts

The activities of the Project have been primarily to train the MOF staff through technology transfer, and appropriate technology has been applied in each area.

Since there were no private fish farming activities in Tonga and because of the popularity of the target fish, experimental mullet culture introduced by this Project has attracted many inquiries from local people. As small-scale pen culture has proved to be technically feasible, people may start this form of fish culture.

Giant clam culture is relatively simple during the ocean nursery stage. People of the village ocean nursery learnt how to thin the overcrowded clams and remove dead shells from the nursery. 'Atata people have managed broodstock clams well by replacing weak clams with healthy ones. They appear to understand the importance of the giant clams for tourism and for the future.

The information obtained from various biological and ecological studies was useful for formation of new Fisheries Conservation and Management Regulations. Technical advice on implementation of the regulations helped to obtain reasonable alternatives for both fishermen and the MOF.

The Fisheries Research Bulletin and the Inshore Fisheries Statistics Annual Report made a great impact on the MOF and also had a strong impact on the regional research institutes such as SPC, USP and FFA.

The International Aquaculture Workshop was also organised and held in Tonga and made a great impact on the region's aquaculturists who exchanged knowledge and skills during the one-week workshop.

II-3-1-2 Institutional Impacts

The Aquaculture and Research Section of the MOF has become one of the central areas of the MOF. The MOF hopes that Tonga will be one of the leading countries in the South Pacific in the field of aquaculture by the year 2000.

The above Workshop provided a good opportunity for the MOF to demonstrate their excellent planning and organising skills. Also, the new fisheries regulations was established in September 1994, with the scientific information provided by the Project.

II-3-1-3 Economic Impact

Because of the unexpected shortcoming of *M. cephalus* fry, pen culture of mullet has not shown clear economic benefit.

Juvenile giant clam, has been sold in American aquarium markets since July 1995 and there is also potential for sale to the Japanese market. Giant clam exports currently do not make a profit but they can help support part of the running costs of the hatchery.

Commercially important species introduced to Tonga are expected to provide a good source of foreign currency once they firmly establish their population.

II-3-1-4 Socio-cultural Impact

The marine resource conservation awareness campaign, poster competition, news release and the MOF radio programs have been slowly educating people who in the past harvested fish and shellfish without considering the finite resources. Now, people understand that they need to wait until the fish grow to maturity.

This type of environmental awareness promotion has been increasing throughout the South Pacific region.

II-3-2 Sustainability of the Project

II-3-2-1 Technical Sustainability

Finfish Culture

The counterparts have learnt all the techniques of pen culture. They can now initiate the extension of pen culture techniques to the local people.

When initiating pen culture, the following facts must be stressed in addition to technical feasibility.

- i) pen culture will contribute to the conservation of fishing resources
- ii) pen culture may contribute to the improvement of people's health
- iii) pen culture will be more profitable when applied to *M. cephalus*

Overall, pen culture can be considered to be a sustainable technology.

Shellfish Culture

Techniques of giant clam seed production, land nursery and ocean nursery stages are well-established and the counterparts will be able to maintain the present level of giant clam production.

In order to secure the sustainability in the near future, however, there is a need to develop further seed production techniques to produce the giant clams with bright-blue-coloured mantles. Also the expertise to manage the whole hatchery is not yet fully developed.

Though seed production of trochus and green snail was found to be promising, the counterparts have little experience in seed production and releasing of green snail.

Stock Survey and Management

All aspects of stock survey and management skills were transferred to the counterparts. They can conduct any providing activity if there is sufficient funds for research. The only remaining areas in this field to be developed are video taking and editing skills.

II-3-2-2 Financial Sustainability

The budget allocated for the MOF is limited considering their wide range of activities, and therefore it will be difficult to maintain the same levels of activity if JICA withdraws from Tonga at this moment. The policy of the Tongan government is to give priority to money generating projects. MOF therefore will be able to manage this Project when giant clam and other aquaculture products can produce revenue and support a certain portion of the running costs.

II-3-2-3 Organisational Sustainability

Tonga's MOF is a new and rapidly-growing institution. Its responsibilities are becoming more significant with an increased range of activities, without a corresponding increase in capability and number of staff. In order to bear those heavy and wide-ranged responsibilities, the MOF has been making every effort to improve the capability of its staff by providing the opportunity for training, scholarships and overseas meetings. Such an effort is beneficial for the MOF in the long run, but it has imposed a heavy burden on the remaining staff by causing a shortage of workers.

The MOF is expected to secure more staff in order to overcome this problem and for the smooth development of the Project.

III. RECOMMENDATIONS

The Project has been implemented successfully and is expected to attain most of the project goals within the five-year cooperation period. In order to accomplish the technical establishment in shellfish culture, however, follow-up technical cooperation is recommended as follows;

-Follow-up Areas-

1. Giant Clam Culture and Hatchery Management

- a) Seed production techniques of highly valued *Tridacna derasa* for the aquarium market in the USA and Japan in addition to clams for restocking Tongan waters
- b) Seed production of highly valued *Tridacna maxima* for the aquarium market
- c) Establishment of a management system to optimise the usage of the hatchery facility as a whole
- d) Technical advice to the MOF on the establishment and management of village ocean nurseries

2. Seed Release and Management of Trochus and Green Snail

- a) Mass seed production techniques of trochus and green snail
- b) Poly-culture technique with giant clams
- c) Seed releasing technique for trochus and green snail
- d) Recapture survey technique for released trochus and green snail
- e) Establishment of appropriate resource management scheme

-Follow-up term: 2 years

-Japanese expert:

- 1) One long-term expert for giant clam culture and hatchery management
- 2) One long-term expert for seed release and management of trochus and green snail
- 3) Short-term experts for each area as the need arises

-Counterpart training in Japan-

- 1) One counterpart a year in the field of shellfish culture

-Provision of machinery and equipment-

- 1) The purchase of machinery and equipment should be done after consultation both with the Japanese and the Tongan parties in order to smoothly accomplish the anticipated follow-up cooperation.

添 付 資 料

(2) プロジェクト実施に関するR/D

THE RECORD OF DISCUSSIONS
BETWEEN THE JAPANESE IMPLEMENTATION SURVEY TEAM
AND
THE AUTHORITIES CONCERNED OF
HIS MAJESTY'S GOVERNMENT OF THE KINGDOM OF TONGA
ON
JAPANESE TECHNICAL COOPERATION
FOR
AQUACULTURE RESEARCH AND DEVELOPMENT PROJECT IN TONGA

The Japanese Implementation Survey Team (hereinafter referred to as "the Team") organised by the Japan International Cooperation Agency (hereinafter referred to as "JICA"), headed by Mr. Yasuho Tadokoro, visited the Kingdom of Tonga from August 1 to August 8, 1991 for the purpose of working out the details of the technical cooperation for Aquaculture Research and Development in Tonga.

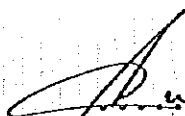
During its stay in the Kingdom of Tonga, the Team exchanged views and had a series of discussion with the authorities concerned of His Majesty's Government of Tonga in respect of the desirable measures to be taken by both governments for the successful implementation of the above-mentioned project.

As a result of the discussions, both parties agreed to recommend to their respective Governments the matters referred to in the document attached hereto.

Tongatapu, August 7, 1991.

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.....
MR. YASUHO TADOKORO
Team Leader
Implementation Survey Team,
Japan International Cooperation
Agency



.....
MR. TANIELA KOLOA
Acting Director of Fisheries
Ministry of Fisheries
His Majesty's Government of
Tonga

THE ATTACHED DOCUMENT

I. COOPERATION BETWEEN BOTH GOVERNMENTS

1. The Government of Japan and His Majesty's Government of Tonga will cooperate with each other in implementing the Aquaculture Research and Development Project in Tonga (hereinafter referred to as "the Project") for the purpose of strengthening aquaculture and resource assessment capabilities at the Mariculture Centre, Sopa in Tongatapu Island of the Kingdom of Tonga.
2. The Project will be implemented in accordance with the Master Plan which is given in ANNEX 1.

II. DISPATCH OF JAPANESE EXPERTS

1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA to provide, at its own expense, services of the Japanese experts as listed in ANNEX II through the normal procedures under the technical cooperation scheme of Japan.
2. The Japanese experts referred to in 1 above and their families will be granted in the Kingdom of Tonga the privileges, exemptions and benefits as listed in ANNEX III and will be granted privileges, exemptions and benefits no less favourable than those granted to experts of third countries or international organizations performing similar missions.

III. PROVISION OF MACHINERY AND EQUIPMENT

1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measure through JICA to provide at its own expense such machinery, equipment and other materials necessary for the implementation of the Project as listed in ANNEX IV, through the normal procedure under the technical cooperation scheme of Japan.
2. The articles referred to in 1 above will become the property of the His Majesty's Government of Tonga upon being delivered c.i.f. to the Tongan authorities concerned at the ports and/or airports of disembarkation, and will be utilized exclusively for the implementation of the Project in consultation with the Japanese experts referred to in ANNEX II.

IV. TRAINING OF TONGAN PERSONNEL

1. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA toward technical training in Japan through the normal procedures under the technical cooperation scheme of Japan.
2. His Majesty's Government of Tonga will take necessary measures to ensure that the knowledge and experience acquired by the Tongan personnel from technical training overseas will be utilized effectively for the implementation of the Project.

V. SERVICES OF TONGAN COUNTERPART AND ADMINISTRATIVE PERSONNEL

1. In accordance with the laws and regulations in force in the Kingdom of Tonga, His Majesty's Government of Tonga will take necessary measures to secure at its own expense the necessary services of Tongan counterpart and administrative personnel as listed ANNEX V.
2. As to the Tongan counterpart personnel, His Majesty's Government of Tonga will allocate the necessary number of suitably qualified personnel corresponding to each Japanese expert to be dispatched by the government of Japan as specified in ANNEX II to fulfil the effective and successful transfer of technology under the Project.

VI. MEASURES TO BE TAKEN BY HIS MAJESTY'S GOVERNMENT OF TONGA

1. In accordance with the laws and regulations in force in the Kingdom of Tonga, His Majesty's Government of Tonga will take necessary measures to provide at its own expense:
 - (1) Land, building and facilities as listed in ANNEX VI;
 - (2) Supply or replacement of machinery, equipment, instruments, vehicles, boats, tools, spare parts and any other materials necessary for the implementation of the Project other than those provided through JICA under III-1 above;
 - (3) Transportation facilities and travel allowance for the Japanese experts for the official travel within the Kingdom of Tonga;
 - (4) Suitably furnished accommodations for the Japanese experts and their families.

2. In accordance with the laws and regulations in force in the Kingdom of Tonga, His Majesty's of Government of Tonga will take necessary of measures to meet;
 - (1) Expenses necessary for the transportation within the Kingdom of Tonga of the articles referred to in III-I above as well as for the installation, operation and maintenance thereof;
 - (2) Customs duties, internal taxes and any other charges, imposed in the Kingdom of Tonga on the articles referred to in III-1 above;
 - (3) All running expenses necessary for the implementation of the Project.

VII. ADMINISTRATION OF THE PROJECT

1. The Director of Fisheries, Ministry of Fisheries will bear overall responsibility for the administration and implementation of the Project.
2. The Japanese chief advisor will provide necessary recommendations and advice on technical and administrative matters concerning the implementation of the Project to the Director of Fisheries, Ministry of Fisheries.
3. The Japanese expert will give necessary technical guidance and advice to the Tongan counterparts on matters pertaining to the implementation of the Project.
4. In order to ensure smooth and successful implementation of the Project, the Tongan authorities will establish a coordinating office properly staffed to ensure timely delivery of Tongan inputs to the Project and liaise with Japanese Project Coordinator.
5. For the effective and successful implementation of the Project, a Joint Committee and a Steering Committee will be established with the functions and composition as referred to in ANNEX VII and VIII.

VIII. CLAIMS AGAINST JAPANESE EXPERTS

His Majesty's Government of Tonga undertakes to bear claims, if any arises, against the Japanese experts engaged in the Project resulting from, occurring in the course of, or otherwise connected with the discharge of their official functions in the Kingdom of Tonga except for those arising from the willful misconduct or gross negligence of the Japanese experts.

IX. MUTUAL CONSULTATION

There will be mutual consultation between the two Government on major issues arising from, or in connection with this ATTACHED DOCUMENT.

X. TERM OF COOPERATION

The duration of the technical cooperation for the Project under this ATTACHED DOCUMENT will be five (5) years from October, 1991.

ANNEX I. MASTER PLAN

1. The Project will be implemented for the purpose of strengthening aquaculture and resource assessment capabilities at the existing Mariculture Centre, Sopa in Tongatapu Island.
2. The technical cooperation will be implemented through technical guidance and advice to the Tongan counterpart personnel in the following fields:
 - A. Aquaculture Research and Development for Finfish
Mullet, rabbit fish and milkfish are targeted. Among the three, mullet has the first priority, rabbit fish the second and milkfish the third.
 - A-1. Biological and ecological research on natural stocks to identify distributions, spawning season, seasonal occurrence, growth rate, etc.
 - A-2. Identification and development of proper methods of natural seed collection.
 - A-3. Experiment of finfish culture by using tanks (nursery) and pen-culture system (grow-out).
 - A-4. Examination of economic feasibility of mullet culture in tanks (nursery) and pen-culture system (grow-out).
 - B. Aquaculture Research and Development for Shellfish
Aquaculture research and development are conducted by transplantation of valuable species and stock-enhancement of depleted species.
 - B-1. Transplantation experiment of trochus and red-lipped stromb.
 - B-2. Stock-enhancement experiment of giant clams, mainly Tridacna squamosa and Tridacna derasa by planting seed clams produced in the hatchery.
 - C. Basic Fisheries and Biological Research in Coral Reef and Lagoon for shellfish
Basic fisheries and biological research on shellfish resources in coral reef and lagoon are conducted for rational fisheries management.
 - C-1. Surveys to obtain reliable fisheries statistics of giant clams and other important shellfish in the Kingdom, especially in Tongatapu Island.
 - C-2. Research on status of shellfish stocks and their living environment before releasing seed-shell of giant clams.
 - C-3. Research on ecological and environmental conditions for transplantation of trochus and red-lipped stromb.
 - C-4. Follow-up surveys after releasing seed-shells of giant clams and transplanting trochus and red-lipped stromb in order to establish appropriate stock-enhancement techniques.
 - C-5. Resource assessment study for stock management of important shellfishes, mainly Anadara spp., Tectus pyramis.

ANNEX II. JAPANESE EXPERTS.

1. Chief advisor
2. Project Coordinator
3. Experts in the field of:
 - (1) Fish Culture
 - (2) Seed Production
 - (3) Shellfish Culture
 - (4) Stock Survey

Note:

- (1) Chief advisor may serve as an expert in one of the field mentioned above.
- (2) Short-term experts in the fields of technical cooperation as listed in ANNEX I will be dispatched when necessity arises for the smooth implementation of the Project.

ANNEX III. PRIVILEGES, EXEMPTIONS AND BENEFITS

1. Exemption from income tax and charges of any kind imposed on or in connection with the living allowances remitted from abroad.
2. Exemption from import and export duties and any other charges imposed in respect of personal and household effects (including one vehicle) which may be brought into the Kingdom of Tonga.
3. Free medical and dental services and facilities at Governmental hospital and health centres.

ANNEX IV. SUMMARY LIST OF EQUIPMENT AND MATERIAL

1. Machinery, equipment and material for seed production, seed collection and pen culture.
2. Machinery, equipment and material for stock survey.
3. Work boats with outboard motor and vehicles.
4. Other equipment, material and spare parts necessary for the implementation of the Project.

ANNEX V. LIST OF TONGAN COUNTERPART AND ADMINISTRATIVE PERSONNEL

1. **The Head of the Project**
Director of Fisheries, Ministry of Fisheries.

2. **Counterpart**
Suitably qualified personnel on full time basis to each Japanese expert as specified in ANNEX II.

3. **Administrative personnel**
Typists, clerks, drivers, watchmen, etc.

ANNEX VI. LIST OF LAND, BUILDING AND FACILITIES

1. Land

Mariculture Centre, Sopo, Tongatapu.

2. Building and Facilities

- (1) Office space for Japanese experts
- (2) Pen culture sites
- (3) Experimental tanks and water supply system
- (4) Storage house and workshop
- (5) Other facilities necessary for smooth implementation

ANNEX VII. THE JOINT COMMITTEE

1. Functions

The Joint Committee at policy level will meet at least once a year :

- (1) To formulate annual work plan of the Project ;
- (2) To review annual activities of the Project;
- (3) To review all problems arising from the implementation of the Project and recommend corrective measures;
- (4) To examine the local draft budget necessary for the implementation of the Project;
- (5) Staffing of the Project and ;
- (6) Others.

2. Composition

The Joint Committee will be set up consisting of:

- (1) Chairman : Secretary of Ministry of Foreign Affairs
- (2) Members :

a. Tongan side :

- Chief Secretary to Government, Prime Minister's Office.
- Director of Fisheries, Ministry of Fisheries
- Secretary, Ministry of Labour, Commerce and Industries.
- Secretary, Ministry of Finance.

b. Japanese side :

- Chief advisor
- Project Coordinator
- Experts assigned to the Project as needed
- Deputy Resident Representative of JICA in the Republic of Fiji
- Other personnel concerned to be dispatched by JICA, as appropriate

Note: Official(s) of the Embassy of Japan in the Republic of Fiji may attend the meeting of the Joint Committee as observer.

ANNEX VIII. THE STEERING COMMITTEE

1. Functions

The Steering Committee at working level will meet every two months:

- (1) To review the progress of the Project;
- (2) To formulate on a detailed work plan; and
- (3) To settle any issues that might arise.

2. Composition

The Steering Committee will be set up consisting of :

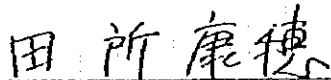
- (1) Chairman : Director of Fisheries, Ministry of Fisheries
- (2) Members :
 - Principal Fisheries Officer, Taniela Koloa
 - Chief advisor
 - Project Coordinator
 - Experts assigned to the Project
 - Other personnel concerned as needed.

TENTATIVE SCHEDULE OF IMPLEMENTATION
OF
THE TECHNICAL COOPERATION
FOR
AQUACULTURE RESEARCH AND DEVELOPMENT PROJECT
IN
TONGA

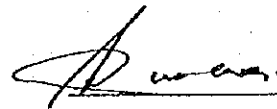
The Japanese Implementation Survey Team and the authorities concerned of His Majesty's Government of Tonga have jointly formulated the Tentative Schedule of Implementation and staffing schedule of the Project as annexed hereto.

This has been formulated in connection with the Attachment of the Record of Discussions signed between the Japanese Implementation Survey Team and the authorities concerned of His Majesty's Government of Tonga for the Project on the condition that necessary budget will be allocated for the implementation of the Project by both sides, and the schedule is subject to change within the framework of the Record of the Discussions when necessity arises in the course of the implementation of the project.

Tongatapu, August 7, 1991



Mr. YASUHO TADOKORO
Team Leader
Implementation Survey Team,
Japan International Cooperation Agency



Mr. TANIELA KOLOA
Acting Director of Fisheries
Ministry of Fisheries,
His Majesty's Government of Tonga

STAFFING SCHEDULE

	1st	2nd	3rd	4th	5th
1. Japanese Side:					
(1) Dispatch of Long-term Experts					
a. Team Leader/Seed Production					
b. Project Coordinator					
c. Finfish Culture					
d. Shellfish Culture					
e. Stock Survey					
(2) Dispatch of Short-term Experts		-----(When necessity arises)-----			
(3) Provision of Machinery and Equipment		-----			
(4) Counterpart Overseas Training		----- (Two or three personnel every year) -----			
2. Tongan Side:					
(1) Staffing of Tongan Counterpart		-----			
(2) Expenses for The Implementation of The Project		-----			
3. Joint Committee	---	---	---	---	---
4. Steering Committee		----- (When necessity arises) -----			

NOTE: Short-term Experts in the fields of technical cooperation as listed in 1. above will be dispatched when necessity arises for the smooth implementation of the Project.

TENTATIVE SCHEDULE OF IMPLEMENTATION		I				II				III				IV				V			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Programs	Sub Programs	Subject																			
1. Aquaculture Research and Development for Finfish	(1) Research on Biology and Ecology (by species)	A. Species Distributions																			
		B. Spawning Season																			
		C. Natural Seed Occurrence																			
		D. Other Biology and Ecology																			
	(2) Culture Experiment	A. Natural Seed Collection																			
		B. Tank																			
		C. Pen-culture (Grow-out)																			
		D. Local Feed Development																			
	(3) Study on Economic Feasibility	A. Production Cost																			
		B. Economic Feasibility																			
		A. Breeding Experiment with Available spp. (Rabbit fish etc.)																			
2. Aquaculture Research and Development for Shellfish	(1) Seeds Releasing of Giant Clam	A. Survey on Necessary Condition for Seed Releasing																			
		B. Mass Production Techniques																			
		C. Seed Releasing Methods																			
	(2) Experiment on Transplantation of Exotic Species (Trochus, Red-tipped stromb)	A. Survey on Necessary Condition for Transplantation																			
		B. Releasing Methods																			
3. Basic fisheries and Biological Research in Coral Reef and Lagoon Shellfish Resources	(3) Experiment on Seed Production	A. Biology and Ecology																			
		B. Artificial Breeding																			
	(1) Stock survey of Giant Clam	A. Survey of Coral Reef Ecology																			
		B. Survey of Seed releasing Results																			
	(2) Stock survey of Economically Important Species	A. Survey of Coral Reef Ecology																			
		B. Marketing Research																			
	(3) Resources Management	A. Study on Planning of Resources Management System																			
		B. Economic Study of Resource Management																			
4. Training Program	(1) Overseas Training and Study Tour	A. Fields of Aquaculture																			
		B. Fisheries Resource Management																			

添 付 資 料

(3) 計画打合せ調査団ミニッツ

THE MINUTES OF THE FIRST JOINT COMMITTEE MEETING
FOR
THE AQUACULTURE RESEARCH AND DEVELOPMENT PROJECT IN TONGA

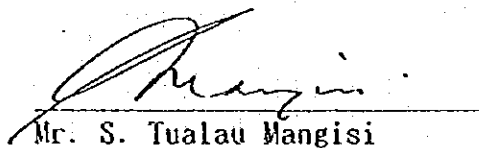
The First Joint Committee Meeting for the Aquaculture Research and Development Project was held on June 30, 1992 to review the progress report of the project for the period from October 1991 to June 1992 and discuss the detailed cooperative plan for the period from 1992 to 1993 and also the Tentative Schedule of Implementation for five years.

Documents attached hereto are signed as a summary record of the meeting.

Nuku'alofa, July 1, 1992.



Dr. Yoshimasa Enomoto
Chief Adviser
Japanese Expert Team
Japan International
Cooperation Agency (JICA)



Mr. S. Tualau Mangisi
Director of Fisheries
Ministry of Fisheries
His Majesty's Government of Tonga

A. RECORD OF ATTENDANCE

TONGAN SIDE

Mrs. Fekita 'Utoikamanu	Acting Secretary for Foreign Affairs Ministry of Foreign Affairs
Mr. S. Tualau Mangisi	Director of Fisheries Ministry of Fisheries
Mrs. Luseane 'Ofa	Deputy Secretary Prime Ministers Office
Mr. Saulala Mateaki	Acting Secretary for Finance Ministry of Finance
Mr. Tevita Kolokihakaufisi	Senior Assistant Secretary Ministry of Foreign Affairs
Mr. 'Ulunga Fa'anunu	Fisheries Officer Ministry of Fisheries

JAPANESE SIDE

Mission team

Mr. Nakaji Kojima	Mission Leader
Mr. Akito Sato	Fisheries Cooperation
Mr. Hiroshi Kohno	Finfish Culture
Mr. Kenichi Kikutani	Shellfish Culture
Mr. Motoo Taki	Coordinator

Expert

Mr. Yoshimasa Enomoto	Chief Advisor/Seed Production
Mr. Masanori Kawaguchi	Finfish Culture
Mr. Shigeaki Sone	Shellfish Culture
Mr. Kazuo Udagawa	Stock Survey
Mr. Kazuhisa Takahashi	Coordinator

B. MINUTES OF MEETING

1. The meeting was held at the Ministry of Foreign Affairs on June 30, 1992 and started at 10:00 AM.
2. The meeting was presided by Ms. Fekita 'Utoikamanu, Acting Secretary for Foreign Affairs.
3. The chairperson opened the meeting by welcoming the mission and introduced the participants from the Tongan side.
4. The mission leader of JICA consultation survey team, Mr. Nakaji Kojima, greeted the meeting and introduced the participants from the Japanese side.
5. The meeting adopted the agenda as proposed by the Japanese side. (See Annex 1)
6. The chief adviser of JICA expert team, Dr. Yoshomasa Enomoto, reported the progress made on finfish culture and presented Implementation Plan as attached Annex 2, which was agreed at the meeting with Ministry of Fisheries on the previous day.
7. The mission leader added the following two notes :
 - 1) it is important to have the support of Tongan government in selecting pollution free sites for mullet culture; and
 - 2) this activity may generate revenue in future and economic feasibility study would be conducted by the Project. The income should be used to defray the local cost of the Project.
8. The chief adviser then reported on shell culture in the same way as above (See Annex 3). It was decided to replace red-lipped stromb with green snail (See Annex 5).
9. The mission leader added two points:
 - 1) Green snail fetches high price in the international market, but it is possible to transplant only when the required number of the adult shells are obtained for this activity.
It is also important to set up sanctuaries to protect against poaching.
 - 2) Australian Centre for International Agricultural Research (ACIAR) also has a giant clam program at the centre, and should it be decided to continue the program, it would require an adjustment in the project plan to avoid an overlapping.
10. Finally, the chief adviser reported on stock survey in the same way as above (See Annex 4).

11. The mission leader added two points:
 - 1) Survey of sea cucumber does not fall into the Terms of Reference of the Project and it has no competence in this field. It is recommended to conduct a preliminary investigation with the JOCV staff at the Centre assisted by Mr.Udagawa. A full-time JOCV staff should be requested in due course (See Annex 5).
 - 2) It would be very useful for the Project if the oceanographic data collected by the Tonga Defence Service could be obtained.
 - 3) Lobster is one of the commercially important species and the Project should, after a survey, indicate the specific resource management measures.
12. The meeting agreed with the proposed implementation plan. The Tongan authorities together with the JICA team will follow up on the points raised.
13. A member of the team, Mr.Motoo Taki explained the measures taken by the Japanese government for the Project as spelled out in Annex 6, attached herewith.
14. The mission leader expressed serious concern over the possible delay of construction of the office building, the pumping station and the water tower for the Project. It was agreed that all concerned should do everything possible to complete them on time.
15. The mission leader also asked the Tongan side to install telephone and facsimile line in the office as soon as possible when the office building is ready.
16. The director of the Ministry of Fisheries, Mr.S.T.Mangisi explained on the measures taken by the Tongan government and the budget table for 1991/1992 fiscal year as shown in Annex 7.
17. The mission leader requested the Tonga authorities to increase the 1992/1993 budget to support the increased activities of the Project. He emphasized the importance of full-time counterpart personnel assigned to each of the JICA expert if the Project activities are to be sustained after the JICA support is terminated.
18. The mission leader informed that Mid-Term Evaluation would be fielded in 1993 or 1994, when the Technical Guidance Team is dispatched to Tonga.
19. Finally, the mission leader expressed a hope that the Centre becomes a center of excellence in these fields for the south pacific small island states.

20. The director of the Ministry of Fisheries stressed the fisheries policy of promoting revenue generating projects and expected this Project to contribute in this respect.
21. The mission leader considered that after three-four years, economic viability of the mullet culture could be determined.
22. The chairperson thanked all the participants and closed the meeting at 11:00 AM.

Purpose(P) and Activities (A) of TSI
(Finfish culture)

Ecological survey

P: To obtain data on wild mullet fry

- Species identification
- Usefull species for grow-out
- Fish amount and size available

A: To make sampling twice a month in five (5) stations
To identify species and get species composition
To measure body weight and body length of each species

Notes: The mullet species to be cultured (grow-out in pen) will be determined, and the seasonal fluctuation of amount and size of the candidates are understood, which should be an important, basic factor for the project. The survey will be once a month on and after the third year.

Environmental survey(water quality)

P: To collect data on water quality in wild fry collection sites and proposed sites for grow-out (pen)

A: To do periodical survey, twice a month, in five (5) wild fry collection sites and in five (5) sites of Panga Uta Lagoon, the proposed area for pen-culture
- WT, pH, Salinity

Notes: The data on wild fry collection sites provide usefull information to intermedial culture in tank and those on pen-culture sites to pen-culture site selection. Water quality is monitored twice a month in the first two (2) years and once a month thereafter. A short-term expert is planned to be dispatched in October 1992 to check detailed water quality and to transfer the water-check technology to C/P.

Survey on fisheries

P: To understand fishing methods
To obtain catch-amount in spawning season

A: To hire fishermen in spawning season of the first two (2) years.

Fish market survey

P: To confirm spawning season

A: To purchase fish in fish market at irregular intervals
To measure body weight and body length
To weigh and examine gonad

Notes: In order to make a plan of wild fry collection and pen-culture, the spawning season should be confirmed. The biological minimum size and other data of reproductive biology are also obtained.

Growth experiment of fry

P: To know possibility to rear small-size fry in tank
To obtain suitable fry size for pen-culture

(Finfish Culture)

- A: To construct six (6) 7-ton and two (2) 20-ton concrete tanks
To rear small-size fry with supplemental food
To obtain data on growth, mortality, food conversion ratio, and so forth

Notes: The know-how of fry rearing in tank is expected to be obtained. A short-time expert being dispatched make a research on artificial food using cheaper materials available locally. The fry reared in tank are transferred to pen on size-by-size basis, which provides useful information of suitable size of fry for pen-culture.

Grow-out experiment (I)

- P: To confirm suitable species for pen-culture
A: To construct two (2) 10m x 10m pens
To stock fry of several species
To examine and compare growth of each species

Grow-out experiment (II)

- P: To obtain basic data of pen-culture
A: To construct four (4) 5m x 5m pens in the second and third years
To make examination of growth, stocking density, food conversion ratio, and so on

Notes: This experiment provides basic data on pen-culture. The artificial food developed by a short-term expert (see growth experiment of fry) will be also used in this experiment.

Grow-out feasibility trial

- P: To establish suitable method of pen-culture
To evaluate commercial feasibility
A: To construct a total number of 10 several-size pens
To conduct actual pen-culture
To estimate factors related to investment and income

Notes: This trial should be a final goal of the project. In parallel with the trial, feasibility study will be carried out.

Remarks

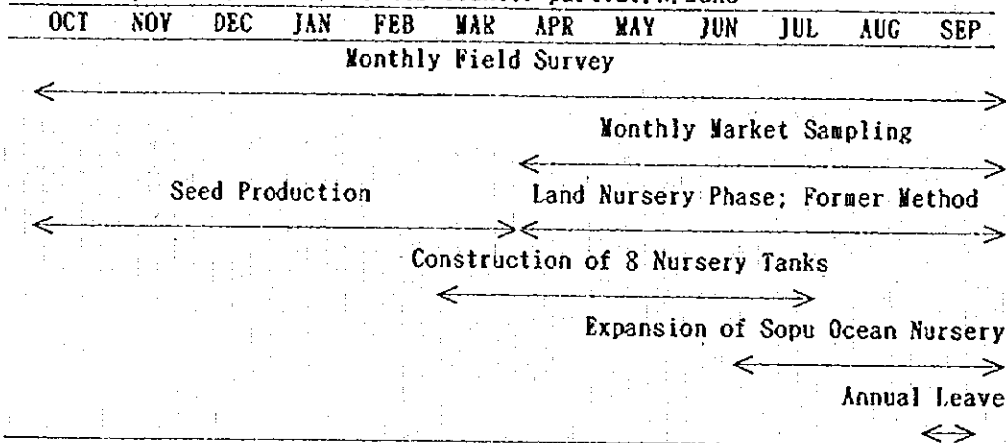
Rabbitfish and milkfish are also targeted in the project. Survey on rabbitfish fry collection is done in the spawning season, and, if possible, polyculture trial of mullet and rabbitfish will be conducted in the above-mentioned Grow-out experiment (I) or (II). Regarding milkfish, fry collection survey is conducted with that of mullet.

1. GIANT CLAM CULTURE

ANNUAL PLAN

1) From October 1991 to September 1992 (Year1)

Expert: Mr. S. Sone, Chief counter part: Mr. N. Manu



Goal for the year of 1991-1992

- * To understand the natural condition of giant clams
- * To build a new land nursery tank
- * To produce 500,000 seed clams

Activities

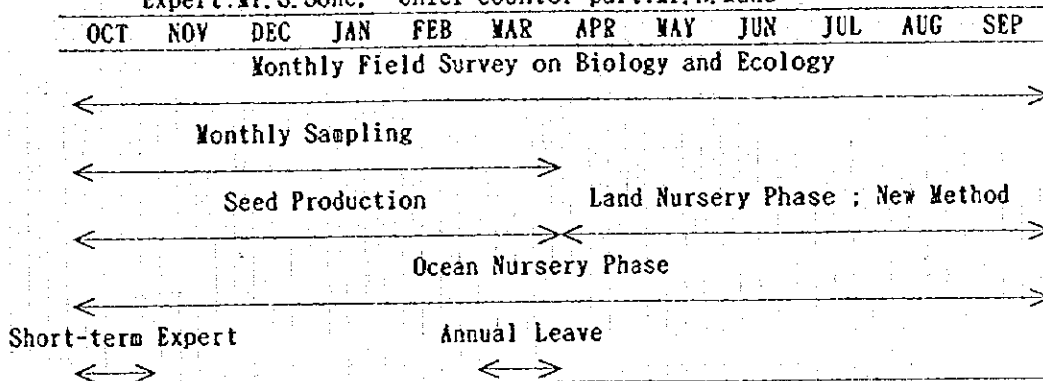
- * Monthly Field Survey (12 times)
 - Select suitable Cultivating sites for ocean nursery phase in Tongatapu group.
 - Survey contents: Water temperature, Current, Wave exposure, Topography, Depth, Salinity, Water quality, predators etc.
 - Vehicle trip JICA expert;2(w/Mr. Udagawa) Counter part;2
 - Boat trip JICA expert;2(w/Mr. Udagawa) Counter part;3
 - Equipment;no vehicle and Boat arrived

- * Monthly Sampling (6 times)
 - Sample giant clam specimens at shellfish market in Vuna wharf.
 - Survey contents; Shell measurements, Weight of total, shell, fresh, gonad Gonad condition
 - Expert;2(w/Mr. Udagawa) Counter part;2
 - Equipment;arrived

(Shellfish Culture)

2) From October 1992 to September 1993 (Year II)

Expert: Mr. S. Sone, Chief counter part: Mr. N. Manu



Goal for the year of 1992-1993

- * To understand the natural condition of giant clams
- * To select the suitable cultivating sites
- * To make clear the breeding mechanism of natural stocks

Activities

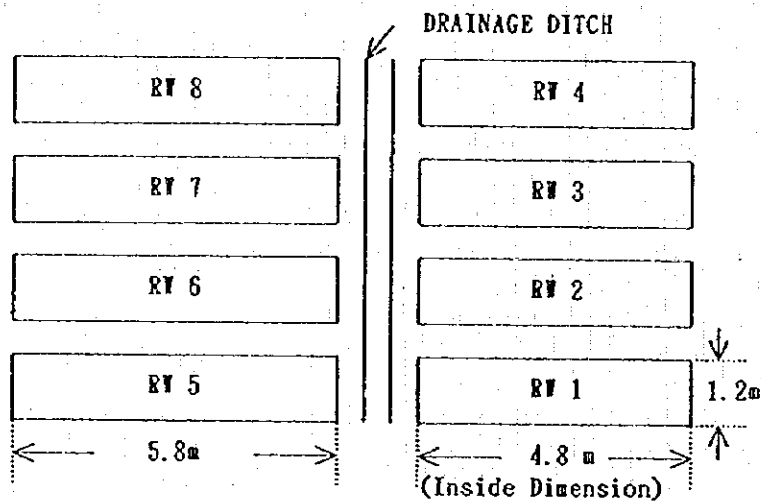
- * Monthly Field Survey (12 times)
 - Continued from previous year
- * Monthly Sampling (6 times)
 - Continued from previous year
 - This research programme can be continued if it is required.
- * Spawning Induction (October 1992)
 - Produce 500,000 1cm-seed. Carry out the larval releasing if surplus eggs will be collected.
 - JICA expert;1 Counter part;5
 - JICA short term Expert;1 (Mr. N. Oshiro)
 - Expenditure; ¥25,000 (Applied for purchasing brood stocks)
 - Equipment; Not arrived
- * Land Nursery Phase
 - Continued from previous year

- * Rearing Experiment for the Ocean Nursery Phase (According to growth)
Compare the survival and the growth of clams with clams in the land nursery using same batch.

Others

- * To maintain a relationship with JCU for the field of seed production.
- * JICA Project is focusing on research on stock enhancement, so that our activities will be shifted to the field in following years.

Fig.1 Land Based Giant Clam Nursery Tank



TANK#	AREA	VOLUME(0.4m Depth)	FLOOR BANK
RV1 ~ RV4	5.8 m ²	2.3 t	0.829%
RV5 ~ RV8	7.0 m ²	2.8 t	0.687%
TOTAL	51.2 m ²	29.6 t	-

TANK#	STOCK CAPACITY (NO. OF SEEDS)		
	1cm-CLAM	3cm-CLAM	5cm-CLAM
SEED DENSITY	1.000/m ²	500/m ²	250/m ²
RV1 ~ RV4	5.800	2.900	1.450
RV5 ~ RV8	7.000	3.500	1.750
TOTAL	51.200	25.600	12.800

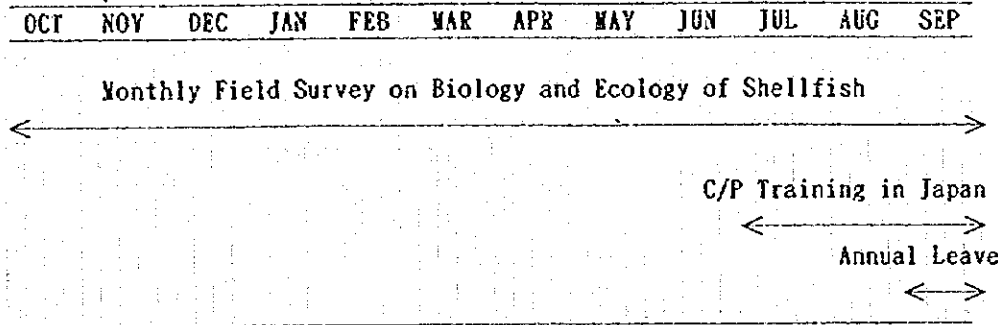
* 8 tanks can accommodate Land-based Nursery Phase and up to 51,200 seedling.

2. TRANSPLANTATION

ANNUAL PLAN

1) From October 1991 to September 1992 (Year I)

Expert: Mr. S. Sone, Chief counter part: Mr. N. Manu



Goal for the year of 1991-1992

- * To understand the shellfish habitat in Tongatapu group
- * To decide the suitable sites for releasing of Trochus and other Commercial Important Speceise (CIS)

Activities

- * Monthly Field Survey (12 times)

Survey contents; Water temperature, Current, Topography, Substrate type
 Vegetation, Local variety etc.
 Collection of shellfish specimen

-Vehicle trip	Expert; 2(w/Mr. Udagawa)	Counter part; 2
-Boat trip	Expert; 2(w/Mr. Udagawa)	Counter part; 3
	Equipment; Not arrived	

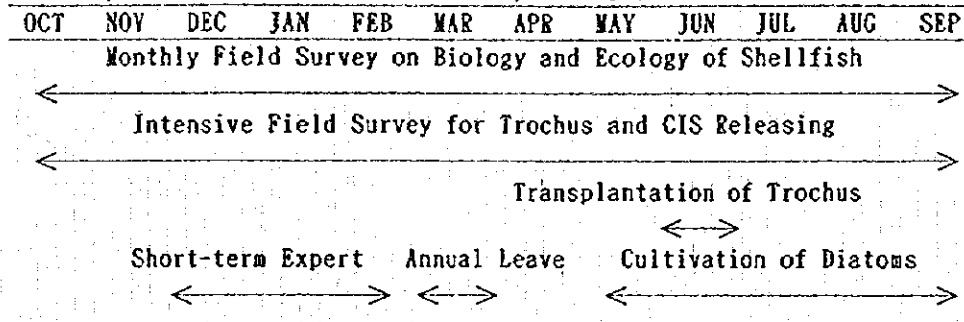
Others

- * Counter part training in Japan ; Mr. N. Manu (Jul-Sep 1992)
- * Formulation of a detailed schedule of Trochus and CIS transplantation
- * Negotiation with international organizations about this program
- * Study on Trochus marketing

(Shellfish Culture)

2) From October 1992 to September 1993 (YearII)

Expert:Mr. S. Sone, Chief counter part:Mr. N. Manu



Goal for the year of 1992-1993

- * To make detailed surveys for Trochus and CIS releasing sites
- * To educate the local people and fishermen
- * To carry out the Trochus transplant

Activities

- * Intensive Field Survey
Final decision of the Trochus releasing site
Survey contents; Current, Topography, Vegetation, Predators, etc.
JICA expert; 2 (w/ Mr. Udagawa) Counter part; 3
JICA short-term expert; 1 (Mr. K. Kikutani)
Equipment; Not arrived Expence; T\$2,000
- * Transplantation (June 1993)
Trochus stocks will be collected in appropriate neighboring countries.
Estimation of cost ; T\$20,000

-A detailed schedule is formulated.

- * Cultivation of Diatoms
Preparation for seed production
Equipment; Not arrived. Cultivation room; available

Others

- * Negotiation with the authorities concerned

AQUACULTURE RESEARCH AND DEVELOPMENT FOR GIANT CLAMS IN TONGA

1. TENTATIVE SCHEDULE OF IMPLEMENTATION

1		2		3		4		5	
PHASE	1991	1992	1993	1994	1995	1996			
YEAR	O N D J F M A M J J A S O N D		O N D J F M A M J J A S O N D		O N D J F M A M J J A S O N D				
MONTH	O N D J F M A M J J A S O N D		O N D J F M A M J J A S O N D		O N D J F M A M J J A S O N D				
	Monthly Survey on Biology and Ecology		Survey for Ocean Nursery						
	Sampling								
	Seed Production(1991)		Seed Production(1992)						
	Construction of Nursery Tank				Land Nursery Phase				
	Expansion of Sopa Ocean Nursery				Ocean Nursery Phase				
	Short Term Expert				Construction of New Ocean Nursery (2sites)				
							Supply and Release		

TRANSPLANTATION OF TROCHUS AND OTHER COMMERCIAL IMPORTANT SPECIES TO TONGA

1. TENTATIVE SCHEDULE OF IMPLEMENTATION

PHASE	1993			1994			1995			1996														
YEAR	1993			1994			1995			1996														
MONTH	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S
Field Survey																								
Releasing Site Survey	↔																							
Transplant(TR) Transplant(CIS)	↔																							
Seed Production	↔																							
Activities for Collecting Information	↔																							
Recapturing Trial	↔												↔											
Evaluation	↔												↔											
C/PTR	↔												↔											
STE	↔												↔											

*TR: Trochus, CIS: Commercial Important Species, C/PTR: Counter Part Training, STE: Short Term Expert

Activity Plan of Stock Survey and Management 1st year

Activity	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Interview Survey	Arrival of Expert '92.1.23						Sales amount, time MKT obs. 3 c/p	Consumer surv. 2 c/p \$500		Producer surv. 26 fish vill. 2 c/p	
Fish MKT Survey				2-3 days/week: Observe fish & shellfish spp. and amount 1 c/p							
Biological Survey	Joint project w/Mr. Sone			Once/month mollusks (8 spp.) 2 c/p							
Ecological Survey	Joint project w/Mr. Sone			Twice/month Anadara, Galaterrium, Tridacnidae -Habitat. Population, Ecology- Tridacnidae, Trochus -Optimal releasing site- 2 c/p --Short t. expert							
Growth Experiment	Joint project w/Mr. Sone										Once/2 month Follow up survey
Resource Management											Write scenario For fishermen, students, others 1 c/p

Target and indicator of achievement for the 1st year

- 1) To understand market activities in Tonga (daily & hourly variations: Price, Amount, Fishing ground)
- 2) To understand fish consumption trend (amount, changes from the past)
- 3) To understand fishing activities (production, CPUE, life style)
- 4) To start Anadara tagging experiment
- 5) To start video tape recording for educational software
- 6) Improve present fisheries statistics
- 7) Write two short reports and three scenarios

Necessary equipment: A Video cum recorder, A boat, A Computer, A Car, A Camera, Balance, Calipers

(Stock Survey)

Activity Plan of Stock Survey and Management 2nd year 1992.10 - 1993.9

Activity	Oct.	Nov.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Fish-MKT Survey	2-3 days/week: Observe fish & shellfish spp. and amount 1 c/p										
Biological Survey	Once/month mollusks (8 spp.) Lobster (5 spp.) -Maturation & breeding season study- Joint project w/Mr. Sone 2 c/p										
Ecological Survey	Twice/month Anadara, Gafrarium, Tridacnidae -Habitat, Population, Ecology- Tridacnidae, Trochus -Optimal releasing site- Joint project w/Mr. Sone 2 c/p										
Releasing Experiment	Joint project w/Mr. Sone 2 c/p										
Growth Experiment	* Once/Two months Joint project w/Mr. Sone 2 c/p										
Lobster Survey	2 c/p Short t. expert: Establish research meth., Capture live lobster, Aquarium rearing \$600										
Video soft. Production	Recording during various survey 1 c/p Under-water video recording, Aquarium observation Editing the video tapes Short t. expert? Education before trochus introduction										

Target and indicator of achievement for the 2nd year

- 1) To produce a distribution map & estimation of economically important mollusks (Joint project w/Mr. Sone)
- 2) To explicate maturation size and breeding season of economically important mollusks (Joint project w/Mr. Sone)
- 3) To establish appropriate field survey methodology for lobster study
- 4) To start under-water video recording
- 5) To assist Mr. Sone for releasing Trochus & follow up survey of giant clam ocean nursery
- 6) To start aquarium rearing of lobsters
- 7) Writing three short reports, and drawing a mollusks distribution map
Necessary equipment: in addition to the previous year's equipment, Aquarium and Video editing machine

(Stock Survey)

Tentative schedule of implementation -Stock survey and management-

Sub programs and Subjects	I	II	III	IV	V
Research on Giant clam stock					
Ecology, and biology	-----				
Survey of seed releasing result		-----			
Research on Economically important spp. (lobsters, ark shells, Trochus, turbo shell)					
Ecology and biology	-----				
Survey of transplantation result		-----			
Resource management					
Reliable fisheries stat	-----				
Economic study	-----				
Education	-----				

Subject and activities relationship

Giant clam

- Ecology and biology ----- Biological survey (sample), Ecological survey (field) (breeding, maturation) (distribution and population)
- Releasing ----- Releasing experiment

Economically important species

- Ecology and biology ----- Biological survey (sample), Ecological survey (field) Growth experiment of Ark shell Lobster survey
- Transplantation ----- Releasing experiment (transplantation) of trochus and other economically important species

Resource management

- Reliable statistics ----- Fish market survey
- Economic study ----- Interview survey
- Review and amend fisheries regulations (Lobster, Giant clam, Trochus)
- Education ----- Producing Video soft ware, pamphlet, posters and etc

添付資料

(4) 投入実績

日本側投入実績総括表

プロジェクト名：トンガ水産増産プロジェクト

投入年度	1991年 (H3)	1992年 (H4)	1993年 (H5)	1994年 (H6)	1995年 (H7)	1996年 (H8)
投入	10.11.12.12.3	4.5.6.7.8.9.10.11.12.12.3	4.5.6.7.8.9.10.11.12.12.3	4.5.6.7.8.9.10.11.12.12.3	4.5.6.7.8.9.10.11.12.12.3	4.5.6.7.8.9.10.11.12.12.3.4.5.6.7.8.9.10
細目	<p>長期間事業派遣 (H2.7月から3ヵ月) 渡辺威男 団長 佐々木直樹 他5名 事務所開設派遣 (H3.3.11-H3.3.23) 団長 田所麻穂 他3名 実地研修派遣 (H3.7.29-H3.8.13) 団長 小島伸治 他4名 計画打ち合わせ派遣 (H4.6.24-H4.7.5) 団長 森知文 他3名 巡回指導派遣 (H6.10.24-H6.11.7)</p>					
調査団派遣	2/24	植本 誠正	12/16	4/4	池ノ上 宏 3/13	10/3
長期専門家		高橋 和久	1/15	2/28	植藤 よし江	10/1
コーディネーター	10/2	川口 正徳	10/1	2/28	木 村 区	10/1
魚類増養殖	10/2	會 橋 重 昭				10/3
餌料増養殖	1/20	平 田 川 和 夫	1/19	4/5	菊 谷 賢 一	10/4
資源管理	3/11-1/5	山 口 正 士				
短期専門家		10/7-11/14 澤川祐史				
貝類増殖		11/19-12/12 大塚531				
水質調査		12/7-1/8 菊谷賢一				
シャコ貝移植生産		3/10-3/27 井上正昭				
貝類増殖/資源調査		11/10-12/13 山本重法				
イセエビ資源調査		1/17-2/19 吉村祐				
魚卵検査		7/28				
イセエビ資源調査		9/2-9/26 大塚博				
貝類増殖		10/13-12/7 植藤正浩				
魚卵検査/稚魚検査		9/18				
資源調査/稚魚検査		12/20 小島伸治				
ボラ餌料設計						

日本側投入実績総括表

年度 月	1991年 (H3)		1992年 (H4)		1993年 (H5)		1994年 (H6)		1995年 (H7)		1996年 (H8)	
	10	11	12	12	12	12	12	12	12	12	12	12
投入	10	11	12	12	12	12	12	12	12	12	12	12
総目	7/3-----9/20Mr. Naito Masuo (異議控除)											
	3/24---4/17Mr. Stone Maagist(水産行政システム構築)											
	4/2-----12/1Mr. Ofa Fakahu(漁具漁法)											
	9/5-----12/4Mr. Siomia Tulua(漁具漁法)											
	11/18-----2/28Mr. Potal Fala(天然飼料生産)											
研修買受入れ	1/10-----6/25Mr. Ofa Paongo(養豚一般)											
	Mr. Maiofa Lotachan(2枚貝種衛生) 7/17-----9/23											
	Mr. Tanjela Kotos(水産資源管理) 11/25---12/16											
予算年	1991年 (H3)	1992年 (H4)	1993年 (H5)	1994年 (H6)	1995年 (H7)	1996年 (H8)	合計	備考 *1, *2とも見込額				
本邦購送分	6,818 船舶、開機機他	28,809 野用製造機他	18,653 オートクレーブ他	17,021 漁政ボート他	14,103 トリカルネット他	5,200 異議控除機材他	90,404	本邦購送分(船舶運賃を含む)				
現地調達分		4,729 FRP和船他	5,131 小型トラック他	7,261 畜糞処理機材他	897 海水用器具他	500 水産冷蔵機他	18,618					
合計	6,818	33,538	23,784	24,282	15,000	5,800	109,022	千円 水産研究センター・リハビリ用 異議材				
無償フォローアップ	平成3年度 第一期分 15,661千円 第二期分 1,581千円											
細目	1991年 (H3)	1992年 (H4)	1993年 (H5)	1994年 (H6)	1995年 (H7)	1996年 (H8)	細目別合計	備考 *1 水産研究センター *2 異議材				
一般現地業務費	631	2,842	3,643	9,487	10,950	5,478	33,031	*1 一般現地業務費、現地研究費、異議材 *2 異議材				
現地研究費	793	1,151	1,199				3,143					
畜産園地業務費	545	1,387	1,413				3,345					
応急対策費	*1 4,900		*2 6,684				11,584	*1 各種施設修繕費、異議材 *2 海水導入設備工事費				
技術交換費		987		2,183	1,928		5,078					
特別対策セミナー費							4,026					
臨時現地業務費	*1 892			*2 193			1,085	*1 異議材 *2 ハンズオン研修センター・水産研究センター				
細目合計	6,669	7,259	12,939	11,863	16,904	5,478	61,292					

トンガ側投入実績

トンガ側投入実績一覧

子算年	1990.7-1991.6 (1T\$=102円)	1991.7-1992.6 (1T\$=90円)	1992.7-1993.6 (1T\$=80円)	1993.7-1994.6 (1T\$=78円)	1994.7-1995.6 (1T\$=80円)	1995.7-1996.6 (1T\$=80円)	トンガの予算年度は 7月から翌年6月迄	
国家子算	4,534,633千円 (T\$44,457,184)	4,269,416千円 (T\$47,437,957)	4,086,788千円 (T\$51,084,855)	4,025,959千円 (T\$51,614,855)	4,231,595千円 (T\$52,894,932)	4,655,049千円 (T\$58,188,115)		
水産省 子算	44,065千円 (T\$482,014) なし	40,825千円 (T\$453,614) 13,284千円 (T\$1,476,004)	40,710千円 (T\$508,870) 42,080千円 (T\$528,010)	41,763千円 (T\$535,480) 45,100千円 (T\$578,214)	40,882千円 (T\$585,394) 79,488千円 (T\$993,350)	54,051千円 (T\$675,641) 49,747千円 (T\$621,835)		
合計	44,065千円 (T\$482,014)	54,109千円 (T\$592,618)	82,790千円 (T\$1,034,886)	86,863千円 (T\$1,113,644)	126,300千円 (T\$1,578,744)	103,798千円 (T\$1,297,476)		
支出実績(総括部門)	Water (T\$1,200) Electricity (T\$4,500) Wages/Salary (T\$34,237) Others (T\$10,500) 合計 5,146千円 (T\$50,437)	Water (T\$1,400) Electricity (T\$5,000) Wages/Salary (T\$35,876) Others (T\$9,000) 合計 4,997千円 (T\$51,076)	Water (T\$3,000) Electricity (T\$12,000) Wages/Salary (T\$37,094) Others (T\$12,000) 合計 5,126千円 (T\$64,094)	Water (T\$3,500) Electricity (T\$16,000) Wages/Salary (T\$38,610) Others (T\$13,150) 合計 5,558千円 (T\$71,260)	Water (T\$3,150) Electricity (T\$13,125) Wages/Salary (T\$33,741) Others (T\$15,500) 合計 5,241千円 (T\$65,510)			
施設及び土地 (増設研究開発プロ ジェクト用)	1 エーカーの土地 (T\$6000=612千円)	全棟用 (亦産産敷地全体) (T\$18000=1,882千円)					*1 1995年度は12月末迄 の実績 *2 水産省予算全体の1/3 とする支出実績比率	
資器材購入	2 Computer & Printer (T\$21,000=1,890千円)	Repair Infrastructure (T\$65,000=5,200千円)	New Store for Boatyard (T\$15,000=1,170千円)	30隻船(VETE) (T\$30,000=4,000千円) Painting of the Office (T\$15,000=1,200千円) Office Equipments (T\$5,000=400千円)				
C/P 配置数	魚類増設班 3名 貝類増設班 2名 資源管理 3名	魚類増設班 3名 貝類増設班 2名 資源管理 4名	魚類増設班 5名 貝類増設班 2名 資源管理 5名	魚類増設班 5名 (内1名は海外留学中) 貝類増設班 2名 資源管理 5名 (内1名は海外留学中)	魚類増設班 2名 貝類増設班 2名 資源管理 2名 水産行政観察 2名		日本研修受講者人数 魚類増設班 2名 貝類増設班 2名 資源管理 2名 水産行政観察 2名	

添 付 資 料

(5) トンガ水産省組織図

STAFF - MINISTRY OF FISHERIES

1. PRINCIPAL FISHERIES OFFICER - Mr. Tanlela Koloa

ADMINISTRATION / FINANCE PERSONNEL / TRAINING

2. Losaline Tafea - Senior Fisheries Officer
3. Tevita Talakai - Clerk Gr.II
4. Makalita Vakalahi - Clerk Gr.II
5. Katalina Tonga Fifita - Clerk Typist Gr.II
6. Henisolo Maea - Driver

(5 Labourers)

'Anaseini Tu'uholoaki
Uaniva Fonua
'Ana 'Akau'ola
Simole
Siaosi Halalilo

FINANCE

7. Vacant - Accountant

COMPUTER

8. Sosaia Tulua - Computer Programmer
9. Lavinia Vaikona - Computer Operator Gr.III
10. Losilini Koloa - Computer Assistant

(1 Computer Trainee)

Hinemoa Moli

OPERATIONS

AQUACULTURE / RESEARCH

11. 'Ulunga Fa'anunu - Senior Fisheries Officer
12. Naita Manu - Technical Officer Gr.II
13. Tala'ofa Loto'zhea - Fisheries Assistant
14. Poasi Fale - Lab Assistant
15. Tupou Tu'avao - Lab Assistant
16. Vea Kava - Fisheries Trainee
17. Feauini Vi - Fisheries Trainee
18. 'Ofa Paongo - Fisheries Trainee

(1 Labourer)

Siosaia Niumeitolu

BOATYARD

19. 'Aisea Tupou	-	Senior Fisheries Officer
20. Pouvalu Blake	-	Boatyard Engineer
21. Tevita Taulafo	-	Technical Officer Gr.II
22. Toma Kauvaka	-	Carpenter Boatbuilder
23. Lupe Fakalelu	-	Fisheries Trainee

(8 Labourers)

Moniai Motuliki
Vuna Maea
'Uluaki Vaipuna
Sekope Tiueti
Pauliasi Kata
Sesoni Foliaki
Sioeli Valu
Siva Fisi'ipeau

ENGINEERING

24. Siotame Vaipuna	-	Technical Officer Gr.I
25. Lomio Tonga	-	Technical Officer Gr.II
26. 'Aiveni Ngatuafe	-	Fisheries Trainee
27. Siosifa Fisi'ipeau	-	Fisheries Trainee

(4 Labourers)

Timote Napa'a
Popoaki lavulavu
Siosaia Fisi'ipeau
Tonga Tei

EXTENSION / LAW ENFORCEMENT

28. 'Anitimoni Petelo	-	Fisheries Officer
29. Peter Hurrel	-	Fisheries Officer
30. Sione Vailala Matoto	-	Fisheries Officer
31. Sione Kolo	-	Technical Officer Gr.I
32. 'Aisea Tu'ipulotu	-	Technical Officer Gr.II
33. Uanoa 'Ahoafi	-	Technical Officer Gr.II
34. 'Ofa Moala	-	Technical Officer Gr.II
35. Silivenusi Ha'onga	-	Technical Officer Gr.II
36. 'Otenili Fisikava	-	Technical Officer Gr.II
37. Silika Ngaha	-	Technical Officer Gr.II
38. Tevita 'Ahoafi	-	Senior Fisheries Assistant
39. Solomone Malafu	-	Senior Fisheries Assistant
40. Sione Holopulu	-	Fisheries Trainee
41. Palometa Pomale	-	Fisheries Trainee
42. Matafonua Langi	-	Fisheries Trainee ('Eua)
43. Sailosi 'Alofi	-	Fisheries Trainee
	-	Fisheries Trainee(N.T.T)

(1 Labour)

Sione Mailau

FLEET

44. Siosua Finau	-	Technical Officer Gr.I
45. Afemui 'Ufi	-	Master / Ekiaki
46. Sositani 'Akau'ola	-	Master / Ngutuloi
47. Haani Lave	-	Master / Albacore
48. Sieli Pesikala	-	Engineer / Albacore
49. Sione Moeaki	-	Engineer / Ekiaki
50. Paea Mapu	-	Engineer / Ngutulei
51. Samuela Paongo	-	Mate Fisherman (Ekiaki)
52. Siosifa 'Utumoengalu	-	Mate Fisherman (Albacore)

AB Fisherman (Non - Established Post)

(13)

'Ofa Kale
'Atapani Lavemai
Heamoni Tukuafu
Hapakuki Talasinga
Peni Maea
Kolo Fe'ao
Vili Vaka
Seloi Palu
Sunia Tukia
Avenihou Tukuafu
'Ofa Napa'a
Petuliki 'Unga

TU'IMATAMOANA

53. Po'uha Hasiata	-	Technical Officer Gr.II
54. 'Isileli Ula	-	Fisheries Assistant

(3 Labourers)

Matupo Moala
Kulisi Hefa
Penisimani Faleako
Mafi Havea
Paula Fifita

HA'APAI

55. Tevita Latu	-	Fisheries Officer
56. Tevita 'Atana	-	Fisheries Assistant
57. Tevita Tonga'onevai	-	Fisheries Assistant
58. Sione Fine	-	Fisheries Trainee
59. Pala'a Mausia	-	Fisheries Trainee
60. Veisia Vea	-	Clerk Typist Gr.II

(3 Labourers)

Sosefina
Viliami 'Utumoengalu
Talia'uli
Kali

VAVA'U

61. Villmo Pakalolo	-	Senior Fisheries Officer
62. Siola'a Malimali	-	Technical Officer Gr.II
63. Hame Taufalele	-	Senior Fisheries Assisitant
64. Sio 'Ofanoa	-	Fisheries Assistant
65. 'Aisea Vaifea	-	Fisheries Trainee
66. Koli Hafoka	-	Fisheries Trainee
67. Saane Faletau	-	Clerk Typist Gr.II

(4 Labourers)

Fotu Tu'i'onetoa
'Alamoti Tu'svao

JICA

LIE