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## Present Condition of Fisheries in the kingdom of Tonga and the Problem

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**Present Condition of Fisheries in the Kingdom of Tonga  
and the Problem**

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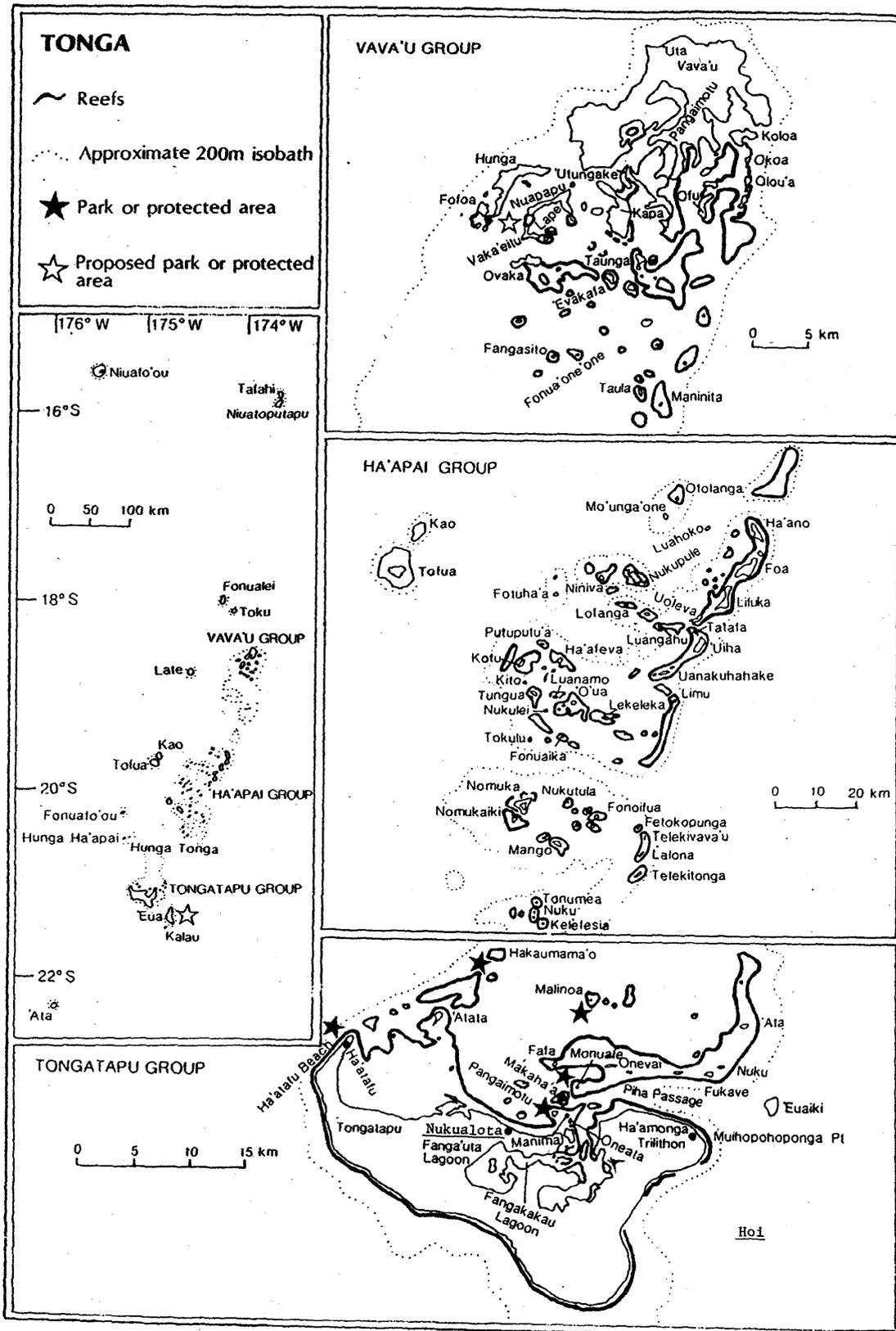


Fig. 1 Area Map of the Kingdom of Tonga  
(Wells, Susan M., 1988, P.294)

## Introduction

The Kingdom of Tonga consists of 171 islands with the total land area of 670 km<sup>2</sup>. However, inhabited islands are only 36 including the main island of Tongatapu (Fig. 1). In 1986, the total population of 94,535 included 63,000 residents in the Tongatapu Island and 29,000 people lived in the metropolis, Nukuálofa. The concentration of population in the metropolis is ascribed to migration from isolated islands such as the Haápai Islands and agricultural districts in the Tongatapu Island. The population in Nukuálofa has increased by 9,000 in the last 10 years.

Though a little under 30% of the total population has been progressively concentrated in the metropolis, the increasing rate of total population of the Kingdom of Tonga is considerably low as compared with other Oceanian island countries. Since the population in 1976 was 90,085, the mean annual increasing rate of population during the last 10 years is 0.48%, a considerably low value. On the other hand, emigrants to New Zealand, Australia, U.S.A., etc. are estimated to be 40,000-80,000 including those working away from home. The low increasing rate of population is thus also interpreted as the result of outflow of population to abroad.

In the Kingdom of Tonga, small industries have been positively promoted by the Government in 1980's. For practical examples, manufacturing factories have been constructed in the suburbs of the metropolis and rural areas. Individual factories have an extent of about 50-200 workers. Clothes, rubber products, toys, and folk crafts are manufactured in these factories. Despite of such a movement, the economic

foundation of the Kingdom of Tonga depends on farm products. In 1985, 7,053 out of 14,366 households in Tonga were engaged in agriculture.

The land system of the Kingdom of Tonga is the allocation of lands from the Nation to males. In the constitution established in 1875, all males not younger than 16 years old are conceded the right to be allotted up to 8.5 acres (3.4 ha) of farm land (api) and up to 0.4 acre (16 a) of home lot. Since 1970's, however, the shortage of national farm land which is able to be cultivated has been marked. In recently, it was reported that 4 acres (1.6 ha) of farm land is allotted to each of only 35% of adult males. In addition, the lands allotted are tended to be apart from the residential areas. It is a factor to accelerate the outflow of young population to abroad.

In present, those engaged in "commercial fisheries" that sell at least a part of their fish catches are estimated to be 2,333 households consisted of 3,000 persons (Statistics Department, 1988, 53). The 200 sea miles fishing grounds of the Kingdom of Tonga is as wide as 700,000 km<sup>2</sup>. People in Tonga perform fishing works mainly in the coral reef areas within the depth of water of 600 m. The areas occupy only 50,000 km<sup>2</sup>.

The total annual fish catch in 1984 was 1,400 tons. It was estimated that private fishermen caught 78% of the total fish catch and the rest by fishing boats owned by the Government (Central Planning Department, 1987: 183). Fishing in the coral reef areas within the depth of water of 75 m consists 65% of the total fish catch. Almost all the landed fishes are consumed in the Kingdom of Tonga.

In 1984, 221 tons of fish catches were exported to results in the income of foreign currency of 440,000 Tonga dollars (1 Tonga dollar = 0.8 US dollars).

Canned fishes and processed fishes imported have been reduced year by year from the maximum of 528 tons in 1982 (as a part of relief foods for the damages due to cyclones) to 197 tons in 1985. The amount of money for the import in 1985 was 440,000 Tonga dollars.

In the "Fifth Five-year Development Program (1986-1990)" of the Government of Tonga, the decreasing tendency of processed fishes to be imported was reported to be the results of "Artisanal Fisheries Development Program" promoted during 1980's.

The purpose of "Artisanal Fisheries Development Program" is the exploitation of line fishing to the depth of of water of 600 m in the coral reef areas. The objective is to be achieved by the construction and diffusion of small diesel fishing boats via the fisheries aid of the Japanese Government since 1979. The development is aiming to achieve not only the expansion of fishing grounds and developments of fishing boats and their equipments or fishing implements but also the collective modernization of fisheries such as constructions of shipbuilding yards, ice plants, refrigeration/freezing facilities, and fish markets. This program has been carried out steadily. In 1983, the first new type line fishing boat was launched. Until now, 42 fishing boats have been constructed.

By the aid of the European Community (E.C.), construction of a new fishing port in the Fua District of Nukuálofa and

settlement of a fish market equipped with refrigeration/ freezing facilities were carried out. Construction of these facilities was completed in June 1987.

Now, development of such fishery environments has been completed, the fish catch is estimated to be 650 tons in 1989 by the line fishing with new type line fishing boats. On the other hand, present fisheries in the Kingdom of Tonga is still occupied by the majority of fish catch of "traditional fisheries". Seventy percent of fish consumption in 1987 was occupied by those caught by the traditional fisheries. The ratio was not so much different from that in the latter 1970's. Namely, there is an aspect that the line fishing advanced with the aid of other countries does not directly contribute to the food lives of people in the Kingdom of Tonga. The reasons of this problem are considered to be as follows:

- 1) Many fish species obtained by the new type line fishing are unfamiliar to the food lives of people in Tonga.
- 2) Those fishes are priced high.
- 3) Marketing system is not developed yet.

This report will focus the traditional fisheries in the Tongatapu Island in respect to the fishing methods, organization of fishermen, selling methods, etc. In addition, the food lives of farmers concerning fish eating will be discussed as well as the relationship of subsistence economy and fisheries. Finally, several problems in fisheries of the Kingdom of Tonga will be pointed out.

## I. Type of Fishing Activities

In the fisheries of the Kingdom of Tonga, fish resources in the coral reef areas surrounding the Tongatapu Island have become markedly exhausted since the latter half of 1970's. The depletion is largely ascribed to the reckless fishing of fish resources due to the concentration of population in the metropolis. According to the investigation by the Fisheries Division in 1987, the rate of fish catches in the coral reef areas of the Tongatapu Island was 50 kg/ha. The value is considerably lower than that in Western Samoa, i.e., 80 kg/ha.

The Fisheries Division is groping for countermeasures to prevent the depletion ascribed to over-fishing. However, it is impossible to require fishermen to regulate themselves in respect to fishing period, fishing grounds, fishing methods, fishing implements, etc. under the conditions that the common ownership of fishing grounds and neither registration nor organization of fishermen. Cultivation works had been performed experimentally. However, they are not being continued because of the damages of facilities due to cyclones.

The Government of Tonga has been promoted the political measures to increase the fish catches via the modernization of fishing boats, fishing implements, and facilities concerning fisheries giving precedence to extension/development of fishing grounds rather than to protection of fish resources and promotion of cultivation

fisheries. The policy was clearly indicated in the priority objectives of the area of fisheries in the Fifth Five-year Economic Development Program (Central Planning Department, 1987:181-182). As described above, the policy has been carried out as the promotion of coastal line fishing by the aid of Japan and E.C.

Fishermen engaged in commercial fisheries in making fishing grounds to be coral reef areas of the Tongatapu Island were reported to be 1,025 households consisting 1,640 persons in 1987 (Felfoldy-Ferguson, 1988). This statistical reference did not include fishermen specialized in line fishing with modern line fishing boats. Fishermen engaged in so-called traditional fisheries consisted the numbers in this reference. However, there are about 250 fishermen engaged in fishing works 3 days or more in a week throughout the year. Others engaged in fisheries are mainly farmers who catch and sell fishes during the slack season or when they need cash money. There are also people engaged in fisheries mainly for household consumption but sell excess amount of fishes in market. As described above, those engaged in fisheries in the Tongatapu Island consists about 20% of professional fishermen and the other majority engaged in fisheries as a part of subsistence economy.

Modern line fishing is performed by a fishing boat with modern equipments manned by a shipowner and 3-4 members of the crew. Therefore, total number of fishermen engaged in this type of fishing is estimated to be about 200.

Fishermen engaged in fisheries making the fishing grounds to be coral reef areas surrounding the Tongatapu Island catch fishes by spear in diving, net fishing, and seasonal wire trapping (see Table 1). Quantities of fish catches by the above methods are estimated to constitute the maximum 256 tons by net fishing, 200 tons by spear in diving, and 42 tons by wire trapping (see Table 2).

1. Spear in Fishing (toutai ukn)

There were 394 fishermen engaged in diving and spear- ing in the Tongatapu Island in 1987. Those engaged in fishing throughout the year were 254. The total fish catch obtained by this method and sold in the market was next to that of net fishing and estimated to be 200 tons/ year. Diving and spearing fishing is divided to the following 3 kinds of methods: night diving (amauk), daytime deep water diving (ukuloloto), and daytime shallow water diving (ukumamaha). Since no diving equipments are used in any of these methods of spear in diving, they are limited in lagoons, fringing reefs, and reef slopes with the depth of water of 10-15 m.

Fishermen specialized in diving are almost exclusively the emigrants from the Haápai Islands with no farm land in the Tongatapu Island. During their living in the Haápai Islands, they experienced the spear fishing. In addition, a small amount of money is required for the purchase of fishing gears. These are the reasons that they select this fishing method. On the other hand, there are fishermen in the agricultural districts who are engaged in spea fishing. In addition to spearing, they collect sea cucumbers and

shellfishes as well as performing line fishing.

1) Night-Time Spear Fishing (amauku)

Fishermen specialized in diving and spearing at night use a fishing boat with an outboard engine manned by 3-6 members of the crew. In present, 53 fishermen engage in this type of fishing. Members of the crew are formed with the shipowner as the central figure.

Fishermen with their fishing gears gather in the pier of Nukuálofa, the moorings of the fishing boats, at 4:00 p.m. or later. When all the members of the crew gather, they sail off fishing to the fishing grounds about 5:00 p.m. The shipowners decide the fishing grounds based on the conditions of fishing grounds yesterday and past results of fish catches. The fishing grounds are coral reef areas within the depth of water of 10 m on the north side of Nukuálofa from the Atata Island to Tau Island. Fishing grounds precedent are those within the district which does not take more than 2 hours for a fishing boat with an outboard engine of 25-40 horse powers.

On arrival to the fishing grounds, the crew takes meal in the boat or on the land of the near island before short sleep until about 11:00 p.m. Their meals are bread, canned foods, and soft drink.

At fishing works, individual fishermen spear fishes using a spear with a rubber propulsion equipment under the light from a water proof electric torch. Spearfish species vary among individual fishermen. One searches mainly lobsters and octopuses and another

トンガタブ島の漁民人口(1987年)

Table 1 Number of fishermen in the Tongatapu Island in 1987

Methods of Fishing (漁法)	Nos. of Fishermen (漁民人口)
<b>Diving</b>	
1. Night diving (amauku)	53
2. Daytime deepwater diving (ukuloloto)	52
3. Daytime shallow water diving (ukumamaha)	289 (149) <sup>①</sup>
<b>Netfishing</b>	
1. Driving in net (silita)	} 164
2. Driving in net (tapo)	
3. Set gillnet (fakamohetali)	
4. Set tidal net (fakamaha)	81
<b>Trapping</b>	
Weire	42 (24) <sup>②</sup>

(Felfoldy-Ferguson, 1988)

Note 1 年間漁業従事者数  
(Number of persons engaged in fishery throughout the year)

1 現在利用されているえりの数  
(Number of weire used in present)

Table 2 Estimated Catch for Individual Methods of Fishing  
(Tongatapu Island, 1987)

漁法別推定漁獲高(トンガタブ島, 1987年)

Methods of Fishing	Quantity of Catching (Metric Tons)	Value (Tonga \$)
Line① (底釣り)	63.83	105,319
Netfishing (網漁)	42.15	430,685
Wire trap (えり漁)	42.15	73,735
Spear, Spear gun (突き漁)	199.78	409,553
Other gear (その他)	27.03	30,477
計 (Total)	591.13	1,049,769

(Felfold-Ferguson, 1988)

Note 1. 近代的小型漁船による底釣り漁は含まれない。  
(Excluding bottom line fishing with small modern boats)

searches surgeon fishes (Acanthuridae spp.), rabbit fishes (Siganus spp.) and parrot fishes (Scaridae spp.) etc. The extent of fishing grounds also depends on individual judgments. Speared fishes are linked to a string from a rubber tube life buoy connected to the waist of a fisherman by another string.

Except winter, the fishing is continued until about 4:00 a.m. When the place of fishing ground is changed, fishermen rest on the fishing boat for a while. In winter with low water temperature, fishing is suspended 2-3 times and fishermen warm themselves around the fire on fishing boats.

Speared fish species are mainly surgeon fishes, rabbit fishes groupers (Serranidae spp.), soldier fishes (Myripristis spp.), octopuses, and lobsters (Panulirus spp.). After fishing, fishermen string together speared fishes with similar size for sale. Before dawn, they return to the pier, display fishes, and wait shoppers.

Irrespective of the fish species, 15-20 small fishes with the body length of less than 15 cm or 7-10 larger fishes are linked to a string. The former is about 5 kg in weight and sold for 5 Tonga dollars. The latter is about 7-8 kg in weight and sold for 10 Tonga dollars. The number of fishes in a string may differ about 1-2 depending on the fish catches of the day. However, the price of a string does not change. Octopuses are sold individually. Those with the body length of 40 cm are sold for 4 Tonga dollars and

larger ones 10 Tonga dollars, etc. Spiny lobsters are priced also according to the body length such that a string of 10 lobsters for 20 Tonga dollars and a string of 3 lobsters for 10 Tonga dollars.

Fishermen do not sell all the fish catches. About 10% of the fish catches are left for household consumption or presents to relatives.

Shoppers do not bargain the prices of fishes. They directly hand money to the fishermen for the prices. In the pier, there are fish shops of individual fishing boats here and there. Up to 150 strings of fishes are displayed at once, and about 60% of them are sold within 1 hour.

Fishes remained not sold in the pier are transported by trucks to a grocery market next to a bus terminal. They are sold directly from the load stands of trucks. The fish market is apart from the center of town, shoppers are small in number, and 1% of the sales is charged as the rent. Therefore, fishermen engaged in diving do not use the fish market. The grocery market opens at 6:00 a.m. Shoppers buy fishes by the way they buy staple foods such as taros and yams as well as vegetables and fruits. By the street peddling, all fishermen sell out their fishes until about 9:00 a.m. They use the obtained money to buy taros, etc. and go home.

As described above, fishermen living in the Tongatapu Island and engaged in diving work themselves from fishing to selling the fish catches. It takes 16

hours from 5:00 p.m of the day before. The practical fishing of spear in diving takes 5-6 hours. A night fishing is performed every day except Saturday and Sunday. The two days taken off a week is based on religious reason that Sunday is the Sabbath. In addition, some fishermen elder than 40 years old take another day off in order to heal physical fatigue such as knee pains.

When the daily sales of 6 fishermen fro 3 weeks from April 11 were averaged a mean value of 60 Tonga dollars a day was obtained. Each fisherman pays 5 Tonga dollars to the shipowner with 2-3 Tonga dollars for the practical cost of gasoline. Other daily costs for a fishing work are 4 Tonga dollars for meal and 3 Tonga dollars for batteries. Subtracting these costs, fishermen have the average daily income of 45 Tonga dollars.

From the income, they should prepare funds to purchase the following fishing gears and other equipments: 3 spears to be held regularly, 1 spear costs 35 Tonga dollars and usable for 3 months; a pair of fins costs 40 Tonga dollars and usable for 1 month; diving goggles and a schunorkel cost 25 Tonga dollars and usable for 6 months; and an electric torch costs 80 Tonga dollars and usable for 6 months.

Considering these expenses to be invested, the income of fishermen engaged in diving amounts 300 Tonga dollars biweekly. It is considerably high as compared with the average income of employees in

Tonga. (A 35 years old male government employee is paid about 150 Tonga dollars biweekly in average.)

Only a part of fishermen engaged in diving possess automobiles. However, in almost all of their houses, there are a television set, a video tape recorder, a washing machine, a sawing machine, etc. They purchase more electric products than agricultural households in Tonga.

2) Day-time Spear Fishing in deep water (ukuloloto)

Except for the time of fishing, namely, the daytime and the night, spear in daytime deep water diving is basically the same fishing method as described in the above "amauku". About 7:00 a.m., 4-5 fishermen sail out fishing in a fishing boat. The fishing grounds are limited to coral reef areas within 3 hours for a round trip. In order to spear in reef slopes of fringing reefs or lagoons with the water depth exceeding 10 m, effective spear-guns are used.

Until about 5:00 p.m., they return and sell fishes in the pier of Nukuálofa or the street along the beach. Fish species sold are almost similar to those obtained by spear in night diving and mainly consist of rabbit fishes, trevally (*caranx* spp.), large groupers, snappers (*Lutianidae* spp.) etc.

Since swimming fishes are speared in daytime diving, the fish catches are smaller than those obtained by fishermen engaged in night diving. The rent for shipowners is not fixed but the average is 3-4 Tonga dollars. In present, there are 52 fishermen

engaged in spear in daytime deep water diving.

On the other hand, there is a group of fishermen specialized in spear of green turtles (Chelonid mydas). Four fishermen in a fishing boat with an outer engine catch green turtles with the fishing implements of hand spears and automatic spear-guns. They search turtles swimming on the surface of reef lakes or around the reef skirts and spear them in diving.

They sail out fishing about 3 days except Sunday in a week and catch 2 green turtles a week in average. After dissecting, the meat of green turtles is sold in the pier of Nukuálofa for 3 Tonga dollars per kg. One fishing work drives them the income of 300 Tonga dollars. So, the only 1 group of fishermen specialized in turtle spear in the Tongatapu Island gains the highest income among fishermen engaged in diving.

3) Day-time spear Fishing in shallow Water (ukumamaha)

In present, 289 fishermen are estimated to engage in spear in daytime diving making the fishing grounds to be the water depth of about 5 m in the coral reef areas. About 149 of them perform this type of fishing throughout the year. The majority of these fishermen live in the agricultural districts and are also engaged in farm works.

Fishing mates are usually formed by relatives. Therefore, a fishing boat and an outer engine are purchased and maintained in cooperation with them and no charge of rent is demanded.

Their fishing grounds are near the village and spear in diving is carried out mainly in the places where wahoo (*Acanthocybium solandri*) migrate or the gathering points of groupers, trevally species, seabass and snappers. The fishermen move from point to point. When the fish catches are small, they also collect sea urchins, sea cucumbers giant clams, etc.

They return to the beach in the evening and sell fishes in the beach of their village. Sea cucumbers, sea urchins, etc. may be sold in the fish market next day.

There is a fisherman who bought 3 years ago an engine of 25 horse powers priced 1,800 Tonga dollars and a fishing boat priced 1,200 Tonga dollars 3 years ago. In April, he sailed out fishing with 2 other fishing mates 3 times a week in average. At each time of fishing, he obtained about 60 Tonga dollars of sales. The costs required for a fishing work are 20 Tonga dollars for gasoline and 5 Tonga dollars for meal.

He stops fishing during the period to implant yams (May to June), but engages in fisheries 3 times a week in average during the other period. Cultivation of staple foods is charged to his wife, his son, and the son's wife. It is a general tendency that fishermen in the agricultural districts establish their household economy by allotting agricultural and fishery works to family members.

Fishermen engaged in fisheries through the above described 3 kinds of diving are estimated to be 400 in the Tongatapu Island. Among them, about 100 fishermen make their living by selling their fish catches. Especially fishermen engaged in spear in daytime shallow water diving near reef lakes are almost farmers. For them, collection of fishery products for household consumption takes precedence of commercial purposes.

Fishermen specialized in spear in diving say that large fishes decrease in the shallow coral reef areas as compared with those 5 years ago. Sufficient fish catches are obtained only in farther fishing grounds and by deeper diving. Fishing in the water depth of 10 m is very hard resulting in marked fatigue and pains in their knees and waists. Among fishermen aged more than 40 years old, there were many planning to change their occupation to other fishing methods or other works on the land.

In the Haápai Islands and Vavaú Island other than the Tongatapu Island, 634 and 171, respectively, fishermen are estimated to engage in diving.

## 2. Net fishing (toutai kupenga)

Among methods of the traditional fisheries in Tonga, gill net fishing is the most extensively performed and gains the largest fish catches. Casting net fishing as well as gill net fishing has been performed for a long time not only for the purpose of commercial fisheries but also as a part of subsistence economy in the agricultural districts.

Fishermen have developed traditional techniques to weave nets from thin strings made by the fibers of coconuts or inner skin of hibiscuses. The kinds of fishing nets vary from turtle catching net, casting net, various gill nets, to dragnet (Tupou, 1981). In recently, nylon nets imported from Japan, etc. are widely diffused.

Based on the investigation of the Fisheries Division, fishermen engaged in net fishing in 1987 are 489 including those engaged in casting net fishing and dragnet fishing. The total fish catch of them is reported to be 256 tons in the year. For these 10 years, fishermen in profession to engage in net fishing for commercial purposes have increased. It is because elder emigrants from the Haāpai Islands engage in this type of fishing in profession. They include a considerable number of fishermen changing their occupations from diving to net fishing due to physical conditions

Fishing grounds for net fishing are the north coast of the Tongatapu Island and around the Fafa Island either in the reef lakes or near the canal of reef skirts. Relatively shallow sea areas with the water depth of 10 m or less even at high tide and with sandy sea bed are selected. Net fishing performed in present is divided to the following 4 kinds of gill net fishing: fakamamaha, silita, tapo, and fakamohe tali.

1) Fakamamaha

The net is spread at high tide in reef lakes and

fishes caught in the net are speared by spears or knives at low tide. This fishing method requires no specific techniques and can be performed by a single person. The length of the net is not fixed, too. When fishes are needed in individual households, 2-3 males perform fakamamaha and excess fish catches are sold.

By the investment of 100 Tonga dollars to obtain the net, a fish catch enough for household consumption and presents for relatives and neighbors is available by a fishing for 2-3 hours. It is a part of subsistence economy of farmers.

2) Silita

Silita is a fishing method to catch specific fishes or seasonal migrating fishes in certain points. It is performed with several fishing mates. A fishing implement called "au" is used in silita. Au is ropes connected with coconut leaves into which the fishes are chased. Based on the shape of sea bed and tidal current, a gill net is spread at the final point where the fishes are chased into. Ropes are connected to the gill net at both sides and extended. The widely spread ring of ropes are gradually narrowed to chase fish flocks into the gill net.

This fishing method is an effective one since the fishes are chased utilizing ropes (au) under the supervision of a fisherman familiar to the gathering points of fishes and habits of fishes. However, au needs replacement of coconut leaves every 10 days and

labor is required to transport the long au in a boat. Therefore, silita is not suitable for commercial fishing. It is performed as the cooperative fishing when many fishes are required for big events and feasts in villages.

3) Tapo

Tapo is a fishing method to chase fishes into the gill net spread around the fish flocks searched by a fishing boat with an outer engine. The fishes are chased into the direction of the gill net by the beating of water surface performed by 5-6 swimming fishermen. Some fishermen are using gillnet of 500 m in length. One fishing work takes about 30 minutes from spreading to landing of a gill net. Fishing grounds are changed several times in a day.

Fishing mates for tapo are formed making the boatman (owner of the fishing boat and net) in the central figure who has knowledge about the fishing grounds, shape of the sea bed, habits of fish species, etc. based on his long time experiences. It is a custom that the boatman is responsible for the selection of fishing grounds and other members of the crew never make any opinions.

A great amount of money is required for the investments to purchase a fishing boat, an outer engine, and a gill net. Therefore, a certain level of fish catch is required to repay the debt for the investment. It is thus difficult to make a living by tapo provided that the fisherman is familiar to fishing grounds, timing of migration of various fish

species, habits of fishes, etc.

The relationship of the boatman and members of the crew is not fixed. There is a strong tendency that many fishermen gather in the crew of a fishing boat owned by an excellent boatman.

4) Fakamohe tali

A gill net is spread in the channel near the reef skirt at high tide and fishes migrating from the reef lake to deep sea areas are caught at low tide.

Fakamohe tali is mainly performed in night. The net is spread in the evening and landed at the dawn. This fishing method is employed during the cold season from June to September. The spreading and landing of nets are performed from the boat.

There are also fishermen who spread and land the net at an interval of 2 hours in various fishing grounds during the low tide period in daytime.

3. Organization of Commercial Net Fishing

Net fishing is ordinarily performed by 4-5 fishing mates. Among them, one is the owner of the fishing boat with an outer engine and the net. The owner (boatman) has all the responsibility and authority concerning the date, time, and fishing ground of fishing. He also asks the members of the crew to repair or produce the net even in the day off from fishing.

In respect to the allocation of fish catches, the boatman takes a half of the whole fish catch at first. Then, the rest of fish catches is equally divided among the members of the crew joining in the fishing work

including the boatman. Therefore, the crew for net fishing commonly consists mainly the relatives of the boatman with 2-3 other persons.

There is a fisherman (boatman) engaged in tapo (gill net fishing by chasing) from the base port of Nukuálofa. He sailed out fishing only 3 times in April and get the mean income of 80 Tonga dollars per a fishing work. The four fishing mates including him are all emigrants from the Haápai Islands. They sail out fishing in the morning and return in the evening. The wife of the boatman sells the fishes in the street near the port.

Majority of the fishes consists of small horse mackerels (*Selar spp.*), rabbit fishes (*Siganus spp.*), mullets (*Mugilidae spp.*), and emperors (*Lethrinus spp.*) are also included. A string of 25 small horse mackerels with the body length of about 15 cm is sold for 5 Tonga dollars. A string of 20 target whistling sea breams is priced at 8 Tonga dollars.

Costs required for a fishing work are 20 Tonga dollars for gasoline and 10 Tonga dollars for meal.

His fishing boat was produced by an acquaintance and sold to him for 500 Tonga dollars including the material cost. An outer engine of 15 horse powers was purchased at the price of 1,500 Tonga dollars. The nylon gill net of net size of 2 inches (about 5 cm), 1.2 m in width, and 200 yards (about 180 m) in length was purchased at the price of 200 Tonga dollars. He also made investments of floats, weights, and ropes to be passed through the upper and lower sides of the net.

They required expenses of 50 Tonga dollars.

The costs required for the above investments were not able to be fully covered by the sales of fish catches. So, he obtained a loan from a bank and assistance from his relatives. The cash assistance from the relatives are not expected to be repaid. He pays back by the presents of fishes. This boatman, obtaining the total sales of 80 Tonga dollars per a fishing work, gains about 20 Tonga dollars of cash remained.

It is not known how many fishermen make a living by net fishing. There are a few fishermen in the agricultural districts who are specialized in this type of fishing. It is generally performed by a single or a group of farmers in the case of feasts when a large amount of fishes is consumed or for household consumption. According to the investigation by the Fisheries Division in 1985, numbers of fishermen engaged in gill net fishing in the Haápai Islands and Vavaú Island were 444 and 231, respectively.

#### 4. Line Fishing

Fishermen engaged in line fishing in the lagoons using canoes and fishing boats are said to be 702 by the investigation of the Fisheries Division. The number is more as compared with fishermen engaged in fisheries with other fishing methods. However, the number includes farmers sail out fishing 1-2 days a week for household consumption as well as those fishing for selling the fish catches.

In the latter half of 1960's, there have been

fishermen specialized in line fishing making the fishing grounds to be reef slopes 100 km apart from islands and with the water depth of about 200 m not like the conventional line fishing in the coral reef areas around the Tongatapu Island. At the investigation in 1976, there were 62 fishermen engaged in this type of line fishing sailing out fishing from the base port of Nukuálofa (Halapua, 1982).

The line fishing at that time is performed with a fishing boat of about 8 m in length equipped with an engine but not the cabin. It was manned by 10 fishermen and anchored on the sea for 3-4 days for fishing. There was an ice cooled storage equipment for fishes but there was no place for the crew to rest. The working condition was thus not good. Except for the shipowner, many of the fishermen gathered tentatively to obtain cash moneys required for the educational expenses for children or donation to churches.

Fish species landed were mainly emperors, snappers, and groupers. The fishing gears were made by fishermen themselves. It was a weight connected to the catgut attached with 2 hooks. The shipowner advanced the fishing boat to the fishing grounds located to the south of the Haápai Islands using a compass and other primitive methods.

In order to improve the fishery environments of such line fishing, "Artisan Fisheries Development Program" is performed in order to raise fishermen in profession through the introduction of much modernized

fishing boats and fishing implements. The purpose of this program was to extend the fishing grounds and increase in fish catches by the construction of small fishing boats of 8-12 m in length individually equipped with an inside diesel engine, a fish detector, a radiotelephone, a gyrocompass, a hand-operated lifting machine, a refrigerating equipment, and cabin.

1) Modernization of Line Fishing

Obtaining the gift of materials from the Japanese Government, the first small fishing boat was launched in the shipbuilding yard of Nukuálofa in 1983. Since then, 42 fishing boats have been constructed until now. By the work of these fishing boats, modern line fishing in Tonga advances to the real operation system.

Fishermen can be shipowners only to provide a half cost of the construction expenses of the fishing boat itself (15,000-20,000 Tonga dollars) since engines are given without charge. The cost to be paid is able to be financed by Tonga Development Bank as the loan to be repaid for 5 years with low rates of interest. The shipowners can engage in line shipping with a small amount of expenses such as cash investment for the purchase of fishing implements, etc.

The fishing work is performed 3-4 days in a week with 5-6 members of the crew. They sail out fishing on Monday and came back to the port on Thursday or Friday. During the fishing period, the shipping boat

is anchored on the sea and line fishing is repeated. Fishing grounds are 200-300 km apart from Nukuálofa and around the Haápai islands. The depth of water for line fishing is within 600 m.

On the tip of a weight of 0.5-1 kg, a fishhook with bait (mackerel pike) is attached. The fishes caught are landed with a hand-operated lifting machine. The landed fishes are stored in an ice room or ice boxes.

Fish species caught are groupers, long-tailed snappers, amberjacks, red finned opakapaka, yellow finned opakapaka, long tailed sea breams, and

A fishing work requires the costs of at least about 330 Tonga dollars which consist of the following items: 50 Tonga dollars for baits (imported mackerel pikes, 20 kg), 50 Tonga dollars for fuels (diesel heavy oil, 180 l), 150 Tonga dollars for ice blocks (300 kg), 40 Tonga dollars for fishing implements such as fishhooks, and 40 Tonga dollars for meals of the crew.

Although there are no published data concerning these type of fishing activities, according to the sampled data of Fisheries Division the total annual fish catch of 34 fishing boats in Tongatapu Island is estimated to be 650 tons in 1989. The boat which got biggest catch engaged in fishing 52 times and landed 68 tons of total annual catches. However, the average of landing of all fishing boats is only 19 tons.

The author obtained data during the investigation in April 1989. Based on these data, the practical fish catch and fishery operation will be roughly described here. There were 16 fishing boats sailing out fishing from the base port of Nukuálofa that performed fishing activities during April 1989. The other 10 fishing boats sailing out fishing from the base port of Vavaú. In Nukuálofa, the fish catches are sold in the fish market, fish shop or to brokers. In Vavaú, they are also sold to beach sellers and fishermen's cooperative association.

Four fishing boats in Nukuálofa are sampled. For 3 weeks in April, the sales of fish catches per a fishing work varied from the maximum of 650 Tonga dollars to the minimum of 195 Tonga dollars.

Shipowners of these 4 fishing boats contracted with brokers to sell almost all of the fish catches. When the boats come back to the port, the brokers buy fresh (with good storage condition) large red finned opakapaka, groupers, amberjacks, long tailed snappers, etc. and export them to Hawaii and Samoa of United States territory. These fishes are bought at the price of 2.50-2.80 Tonga dollars per kg.

The fishes not bought by brokers are sold in the fish market at a price of 2.50 Tonga dollars per kg. The Fisheries Division (the fish market) does not work positively to collect, sell, and export cargoes of fishes. Therefore, retail in the fish market is performed by the wife of each shipowner.

The large fishes such as groupers, amberjacks, and long tailed snappers have appeared

in the market since the modern line fishing came into regular operation. These fishes are unfamiliar to the fish eating habits of people in Tonga. Therefore, they are bought in the fish market only by foreign residents or proprietors of hotels and restaurants.

The sales of fish catches are allocated as follows: At first, 50% of the total sales are allotted to the shipowner. The rest 50% subtracting various costs required for a fishing work (costs of baits, fuels, etc.) are divided equally among members of the crew.

As described above, about 300 Tonga dollars are required as the costs for a fishing work. In addition, the shipowner repay 150-200 Tonga dollars per week to the bank for the loan. Therefore, the shipowner should obtain at least 500 Tonga dollars at a fishing work apart from the allotted money to members of the crew. However, repair and maintenance of the fishing boat and purchase of fishing gears require further investments.

A shipowner who needed 1,000 Tonga dollars in March for the repair of the fishing boat asked a broker to pay for him. Another shipowner who obtained only 395 Tonga dollars in a fishing work borrowed money from a broker to pay for baits and ice blocks to the market, and loan to the bank.

From the information of shipowners, the line fishing boats sail out fishing 200-250 days at maximum in a year and the fish catch in a fishing work is 200-250 kg. Even when 300 kg of fish catch is obtained and all

received by the brokers, the sales are only 750 Tonga dollars. The sales is not enough to pay for the maintenance of the fishing boat, repayment to bank loans, and moneys allotted to members of the crew. In April, 6 fishing boats were seized because the shipowners got no prospects to repay the bank loans.

The Fisheries Division investigated the individual fish species landed to search for the tendency of fishery resources. From the reports, the body length of the fishes decreases year by year. Under such fishery condition, shipowners only hope to get more fish catches in the next fishing work. There are also shipowners who want to have a larger fishing boat and develop offshore fishing grounds.

Five years have been passed from the regular operation of modern line fishing. The fishery operation is not fully changed favorably.

## 2) Public Fish Market

In June 1987, the National Fish Market was completed in the Fua District of Nukuálofa by the financial aid of European Community (E.C.) mainly with the aid of West Germany. The fish market is attached a newly constructed fishing port. There are 4 freezing/refrigeration storehouses of 30 tons content each, ice making machines, and broad fish stores in this modern fish market.

This fish market is managed and operated by 8 staffs. The major operation is freezing and storage of fishes, production and selling of ice blocks, selling of baits, and lease of stores. Freezing costs

4 Tonga cents per kg fish per day, ice blocks 50 Tonga cents per kg, baits (mackerel pikes) 50 Tonga dollars per 20 kg, and rent of store 1% of the sales.

Fishermen using the stores are not only the shipowners of line fishing boats but also fishermen from the agricultural districts who catch or collect seashells such as Ryukyu ark shells, polishing shells, and giant clams; sea cucumbers (their salted entrails); dried octopuses or fishes; and crabs. However, fishermen engaged in diving or gill net fishing do not use this market.

For 1 week from March 23 to March 29, the operational income of the fish market was 3,580 Tonga dollars consists of rent of stores (43 Tonga dollars), rent of freezers (675 Tonga dollars), and sales (export to Western Samoa) of fish catches of a Governmental fishing boat, Rofa (2,862 Tonga dollars). Though the sales of ice blocks and baits are not included in the above income, it is enough to know the outline of the operation in the fish market.

The total sales of fishery products sold in the stores of the fish market are 4,300 Tonga dollars. Fishes stored in freezing storehouses are about 17 tons. These fishes are mainly the fish catches of the Governmental long line fishing boat "Rofa" since fish catches of line fishing boats are generally not frozen but sold in the ice packed condition. Among the total sales of fishery products in the stores, those of fishes landed by line fishing boats are included.

The sales of 4,300 Tonga dollars correspond to

about 1.6 tons of fishes when the fish price is converted at a rate of 2.5 Tonga dollars per kg. Based on these values, the annual fish catches sold in the fish market is estimated to be about 80 tons. This amount of fish catches less than 100 tons is revealed to be considerably low as compared with the amount of fish catches not collected in the fish market, namely, 200 tons obtained by spear in diving and 256 tons obtained by gill net fishing.

Therefore, the National Faua Fish Market proud of its modern equipments is indicated not to exhibit the sufficient functions in the present condition of Tonga fisheries.

On the other hand, there is also a fish market equipped with freezing/refrigeration storehouses and ice making machines in the Vavaú Island. Though the facilities are of national proprietary, the management and operation are performed by a fishermen's cooperative association. The fishermen's cooperative association sells fish catches in the fish market and also wholesales them to hotels and retail shops. The mean weekly fish catches dealt in the market is about 1.5 tons.

In addition, the refrigerated fish catches are transported in fishing boats to Nukuálofa 1 or 2 times in a month. The transport is performed by the use of fishing boats of the Fisheries Division. Consignors are the fishermen's cooperative association and brokers. Since the freshness of the fishes is lost by 22 hours of sailing time, no good results are

obtained. Some brokers transport fishes to Nukuálofa by plane. However, since there are problems in the load of planes and cost, they have not yet gain profits.

In present, there are about 10 line fishing boats landing their fish catches to the fishing port of Vavaú. However, the ice making machines in Vavaú are not enough capacity to provide ice blocks to all these fishing boats. It is also a serious problem for the maintenance of the quality of landed fishes.

## II. Fish Eating Habit of Farmer's Household

The subsistence economy in the Kingdom of Tonga depends on the agricultural production. Staple foods of people are mainly taros, yams, cassavas, and plantains. Sweet potatoes (kumala) and breadfruits are also used as a part of various staple foods (Table 3). Among these foods, breadfruits and yams are farm products obtained in a limited season. Other foods are able to be obtained throughout the year. The population of agricultural households cultivating these farm products occupies about 50% of the total population in Tonga.

In this section, the subsistence activity of agricultural households is discussed concerning the fish eating habits in their food lives. To obtain the basic data concerning the living of farmers, the author participated and observed for 2 weeks in April 1989 at Hoi village facing the northeastern beach of the Tongatapu Island.

主要農作物の生産農家と生産高（1985年）

Table 3 Number of Producing Households, and Quantity Harvested of Major Farm Products

Kinds of Plants	Nos. of Producing Households	Quantity Harvested (Tons)
Taro Futuna (タロイモ, コロカシア)	3,594 (2,097) <sup>①</sup>	4,060 (2,602)
Kape (タロイモ, コロカシア)	3,719 (1,762)	5,816 (1,976)
Taro Tonga (タロイモ, アロカシア)	832 (551)	538 ( 375)
Cassava (キャッサバ)	6,391 (3,632)	15,391 (8,630)
Yam (ヤマ)	3,285 (1,719)	3,225 (1,716)
Plantain (料理バナナ)	3,812 (1,831)	3,852 (2,077)
Kumala (サツマイモ)		

(Tonga Agricultural Census 1985, Statistic Department 1988, pp. 121-128)

注① カッコ内はトンガタブ島の数値

(Number in parentheses is of that of Tongatapu Island)

## 1 Living of Farmer's Household

Hoi village is an agricultural village consists of 70 households. The administrative chief of this village is Mr. K. holding 21 family members. In addition to his own children, he maintains the children of his elder sister passed away. He has 8 sons and 3 daughters. Three elder sons live in the United States, Australia, and New Zealand individually. The fourth son remains in Tonga as a governmental official. The other sons are all high school or junior high school students. One daughter lives in the United States. Mr. K. and his wife go by a coach to his farm in the hilly section of the village for farm works 4 days a week. He possesses farm land of about 8 acres (approximately 3.2 ha).

Mr. K. cultivates taros and yams only for the household consumption. He does not sell them in the market. However, in every Saturday, he transports the leaves of taros to the market and sell them. The leaves are used in "umu" (earth oven cooking). People live in town buy the leaves for the cooking. Mr. K. obtains 40 Tonga dollars weekly by selling the leaves. From Monday to Saturday, there are 2 meals in the morning and evening in a day. In the breakfast, they eat bread or biscuit and drink coffee. When Mr. K. goes to his farm, he brings mutton with bone or corned beef and eats them with baked potatoes or breadfruits. In the evening, they eat mainly potatoes and cassavas with side dishes of fishes when exist. However, no animal proteins are taken in many days. Fishes are

eaten only 1-2 times a week. Fishes are obtained when his son(s) sail out fishing or as the gifts from neighbors or relatives. In the ordinary food lives, fishes are rarely bought. In place of fishes, corned beef or mutton (mutton flaps) come up to the table about 3 times a week in the vegetable soup or as field dishes. The price of 1 can of corned beef or 1 kg of mutton is less than 2 Tonga dollars. They are cheaper than the fishes which are sold for at least 5 Tonga dollars even by beach seller of this agricultural district.

On Saturday, family members allot each part of the preparation for the "umu" cocking on Sunday. Mr. K. and his wife with their younger sons go to the farm and collect potatoes, copras, and fire woods. Elder sons and daughters go to sea at low tide and catch fishery products. Males fish Siganus species and spear mullets. Females collect bivalve, sea cucumbers, and sea urchins. The sea urchins are eaten in the evening of Saturday. Other foods are retained for the cocking on Sunday.

## 2 Meal on Sunday

In the Kingdom of Tonga, Sunday is a complete Sabbath. People in Tonga has the habits to go churches for worships and has rich meals. From about 7:00 a.m., all the family members start to prepare the earth oven cocking. Young males put fire woods into the ground hearth and fire them. Stones are put on the hearth to be heated. At the same time, they extract coconut oil by slicing the copras and prepare taros, yams, cassavas, and breadfruits for steaming. Females

slice meats and mix them with vegetables, dissect fishes, and wrap these foods in the leaves of taros. In the household of Mr. K., the earth oven cocking needs 20 kg of farm products such as potatoes and 7-8 kg of animal proteins for side dishes. Meats used are mutton and canned corned beef. When the fishes are not enough in amount, 2-3 raised chickens are used for cocking. One piglet is barbecued once a month. Foods for earth oven are arranged on the heated stones and covered with leaves of banana or thick paper followed by the covering with soils. They are then left for about 3 hours.

At 11:00 a.m. or later when the worship service in the church finishes, the cover of earth oven cocking is removed and foods are transported into the house. They are arranged on the earth floor and all the family members take the meal together. A part of this cocking is presented to neighbors and relatives. Gifts from neighbors and relatives are also sent. The meal on Sunday with the set of staple foods and side dishes consists of 10 or more kinds of foods and the amount is also large. Meals from Monday to Saturday frequently lack side dishes of fishes or meals. However, the earth oven cocking on Sunday provides too much amount of animal proteins.

At present, there is a tendency that mutton and corned beef are purchased rather than more expensive fishes. Raised chickens are preferred to fishes bought. People in Tonga has a custom to eat 1 fish by 1 person.

The household with many family members as that of Mr. K. resigns to have expenses as high as 20 Tonga dollars for each of all the family members eats 1 fish. On the other hand, mutton and corned beef are able to be subjected to earth oven cooking with vegetables after slicing. The amount of these foods are not so much taken seriously in such cases. They are thus used as essential animal proteins in the side dishes.

The food lives of farmers in Tonga are characterized by the weekly cycle of 6 days with plain foods and Sunday with gluttony.

### 3 Household Economy of Mr. K.

The household economy of Mr. K. is managed by the self-supply of staple foods, sales of farm products (leaves of taros), salaries of sons and daughters, and allowances from abroad. Mr. K. raises 15 pigs including piglets. They are raised for gifts to relatives in the cases of feasts and thus not sold in the market.

The wife of Mr. K. eagerly works to make "tapa" (bark cloth) by tapping and extending the inner skin of paper mulberry when she does not go to the farm. Tapa is not prepared for selling but based on the traditional sense of values that it is a honor for females to have many pieces of tapa. The honor is socially recognized in the occasion of wedding and funeral ceremonies of relatives when she presents a large piece of tapa with coloring of complex patterns.

Apart from such "prestige economy", the household economy of Mr. K. is managed based on the cash incomes.

The mean monthly income of Mr. K. is about 450 Tonga dollars. He himself gets 30 Tonga dollars of pays from the Government as the administrative village chief. He also gets 120 Tonga dollars by the sales of farm products. In addition, his fourth son and the wife get 120 Tonga dollars per month as the governmental officials. Two daughters work in a sawing factory and get 80 Tonga dollars of wages. The total 200 Tonga dollars are given to Mr. K. Three sons in abroad send him about 100 Tonga dollars of allowance in a month. The allowance is used for the educational expenses of children in boarding schools. The salary of his fourth son and the wife is returned to them for their household economy.

Thus, Mr. K. himself manages about 230 Tonga dollars a month. Since the household economy of 21 family members is managed with this amount of money, there is not so much economic margin.

In this village, the household of Mr. K. belongs to a level with many cash money incomes with balanced family man powers. In such a household, animal proteins are taken only 2-3 times a week as the side dishes. Especially concerning the fish eating, it is limited to self-supply extent. They have no idea to buy and eat fishes. It is partly due to the fish eating custom of people in Tonga.

However, a major reason of it is the problems of the price of fishes and the marketing systems. Fish selling in the agricultural districts depends on beach

sellers. Fishermen sell fishes immediately after their return to the port within a short time. Therefore, only a limited person can use the stores. There are retail stores in the agricultural districts selling frozen or refrigerated muttons. If a market system is developed to sell fishes in such stores, the chances to buy fishes will increase and the method to purchase them will become simple. For fishermen, such a system enables more stable selling of fishes by the refrigeration and storage methods in place of the one chance selling method. However, it is necessary to change the fish eating custom of people in Tonga that places values in eating fresh "raw fishes" for the diffusion of retail system of refrigerated/frozen fishes.

### III. Summary and Several Problems

In present, the commercial fisheries in the Kingdom of Tonga is performed mainly with traditional fisheries such as diving-spearing and seasonal gill net fishing as well as modern line fishing. In addition, long line fishing is performed with a fishing boat "Rofa" possessed by the Government. Traditional fisheries are conducted around the lagoons, fringing reefs, and reef slopes. The line fishing is performed in fishing grounds within the water depth of 600 m. The long line fishing is performed offshore. As described above, the different kinds of commercial fisheries are performed in different fishing grounds.

The Government estimated the annual fish catches in

1984 to be 1,400 tons. Since the specialized line fishing is performed regularly at present, the annual fish catches are supposed to be about 2,000 tons including the fish catches by the specialized line fishing. The fish catches by the specialized line fishing are calculated to be 650 tons per year from the assumption that 40 fishing boats sail out fishing 45 weeks annually and the fish catch of one boat per a fishing work is averaged to be 250 kg. The annual fish catch of "Rofa" is about 400 tons. Summing up the fish catches of specialized line fishing and long line fishing, they are still less than the fish catches obtained by traditional fisheries.

The Government of Tonga has introduced a modernization program in fisheries to perform stable self-supply of fishes based on the financial aids from abroad since 1980's. The modernization program has been almost concluded with the improvements of fishing boats, fishing implements, and fishing methods as well as the construction of new fishing port and fish market.

Though the fundamental development of environments of fisheries has been completed, there are still many problems to be solved concerning the investigation and protection of fishery resources, storage and management of landed fishes, and stable supply and marketing of them.

Here, I will indicate these problems in focusing the following 4 points in place of the conclusion of this report: collective grasp of fishery resources, development of marketing system of landed fishes, stabilization of fisheries economy, and protection of

fishery resources.

1 Investigation and Research concerning Marine Resources

At present, there are only little detailed information in the statistic references published by the Government of Tonga concerning fisheries. In the "Fifth Five-year Development Program (1986-1990)", estimation of the possibility of fishery resources, proprietary condition of various fishing boats, and estimated private fish catches with a few comments are the whole published. In the "Tonga Agricultural Census (1985)", the results of investigation of number of households engaged in commercial fisheries are included. These facts indicate that the Government of Tonga does not investigate and research the present condition and tendency of fisheries systematically.

However, the Investigation Department of the Fisheries Division have performed experimental researches concerning the reproduction, cultivation, and protection of giant clams based on their ecological investigations by special researchers for several years. At the same time, the administration started the collective investigation concerning the fishing gears and fishing methods in the coral reef areas. However, staffs for such basic investigations and researches are small in number and financial foundation to promote these projects has not been developed.

It is the most important for the development of fisheries in Tonga that investigations and researches

concerning the fishery resources and fishing activities of fishermen are performed continuously to accumulate data.

## 2 Development of Marketing Network for Landed Fishes

In the Kingdom of Tonga, the imported amounts of processed fishery products show marked decreases in recent years. The Government concluded that it was due to the increased fish catches obtained by line fishing with small modern line fishing boats. In fact, the development of line fishing contributes to the self-supply of fishes. However, the imported amounts of muttons for these 4 years show a high increasing ratio. Based on statistical references, the increase in imported amounts of muttons compensate the decrease in imported amounts of processed fishery products. Therefore, it is unlikely to say that the fish catches obtained by line fishing is sufficiently utilized in the food lives of individual households in Tonga.

In the background of this phenomenon, there are problems such as the price of fishes, marketing methods, liking of people in Tonga concerning the fish species and sizes of fishes. Among them, the most important problem to be improved is that concerning the marketing system.

The present marketing method is the direct selling of landed fishes by the fishermen, their family members, or beach sellers on the streets or in the fish market. Fish landed by traditional fisheries are immediately sold on beach. Fish landed by line fishing are sold

in the fish market or a small fish shop. Thus, many people have no chance to buy fishes. Especially the fish market equipped with modern freezing/refrigeration systems is located away from the residential area of Nukuálofa. No public transportation method is developed to get to the fish market. Thus, only a few people can use the market.

Therefore, it is necessary to develop a marketing system to supply fish to the majority of people in Tonga. In order to achieve this, formation of marketing networks is necessary both in the towns and agricultural districts for landed fishes obtained by traditional fisheries and line fishing. For example, a marketing method is suggested that fishes are transported to retail shops equipped with refrigerators.

### 3 Stabilization of Fisheries Economy

The fish catches of "Rofa", the Government possessed long line fishing boat, are tunas and almost all are exported. In respect to the fish catches obtained by private fishing boats, only a very small part of them is exported. The fish species obtained by the modern line fishing positively promoted by the Government are especially hopeful for the fishes to be exported. In present, export of the fish catches is performed by 2 private traders and the annual trading amounts are about 50 tons consisting only 10% of the total fish catches by the modern line fishing.

In order to export fishes landed by line fishing,

problems in techniques and transportation have to be solved for the maintenance of freshness of fishes and rapid transportation to markets, respectively. When these problems are solved and transportation system is developed, they contribute to the expansion of market of landed fishes and stabilization of fishery economy. From this meaning, the development of functions concerning the marketing of landed fishes in the fish market is important.

#### 4 Preservation of Marine Resources

Due to the overfishing of fishery resources in the coral reef areas, the fisheries in Tonga is changed to the direction of the expansion of fishing grounds and increases in fish catches via the modernization and construction of larger fishing boats as well as improvements of fishing equipment and fishing methods.

By the development of modern line fishing, coral reef areas within the water depth of 600 m have been developed as the fishing grounds for these 5 years. However, fish catches in these fishing grounds already show decreasing tendencies. There are some fishermen who want to have larger fishing boats to advance offshore fishing. This expansionism concerning fishing methods and fishing grounds is not necessarily appropriate for the purpose of stable supply of fish catches to the Kingdom of Tonga from the long term point of view.

At present, the main part of the fisheries in Tonga is occupied by the traditional fisheries in coral reef areas around islands. The development and expansion of these traditional fisheries are considered to be more important problems in conversely. For these purposes, stabilization of fish catches is necessary to be actualized such as the protection of fishery resources.

One method to protect fishery resources is the enactment of countermeasures to prevent reckless fishing. A rigid restrictive regulation should be established concerning marine preserves, closed seasons, limitation of fishing gears and fishing methods, etc. Traditional fisheries in Tonga have been performed not only as the commercial fisheries but also as subsistence economy and household fishing. Irrespective of the forms of fisheries, it is important to organize fishermen such as to make all the persons engaged in fisheries are to be registered. It is necessary to regulate the organization such as fishermen's cooperative association to be an entity with authority to inhibit or control fishing activities of fishermen.

Another way of protection of fishery resources is mariculture. The most favorable and valuable fish species and seashell species in the food lives of people in Tonga are gray mullets and giant clams, respectively. The landed giant clams in 1978 was reported to be as many as 150 tons. In present, they are at the almost destroyed condition due to reckless

fishing. Gray mullets are caught by gill net fishing from June to September. Due to the poor catches, the number of gill nets used in present is only the half of 42 used in 1978.

Researches concerning the cultivation of giant clams and gray mullets have been advanced in South Eastern Asia and pacific ocean areas to a degree to have considerable results. In the Kingdom of Tonga, it is necessary to perform basic investigation concerning these cultivation works and advanced studies and researches for their initiation.

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