

## CASE STUDY: COASTAL ZONE MANAGEMENT IN WESTERN SAMOA

Lui A.J. Bell  
 fisheries Division,  
 Department of Agriculture,  
 Forests and Fisheries, Apia,  
 WESTERN SAMOA

## INTRODUCTION

Fishing has always been an important subsistence activity in Western Samoa. Referring to Samoa's marine fish resource Kramer (1888) wrote 'naturally, there are fishes throughout the whole year, for the sea is as inexhaustible as the land'. How much truth this statement holds for the present is open to speculation. Jordan and Searle (quoted in Grattan 1948) referred to Samoa's fish fauna as one of the richest on the globe. This may have been true in the past but is not so now. Gilson (1970) writes that 'considering the Samoan pattern of life, along with the population, the physical environment seemed indeed to have provided, in the past, an ideal basis for comfortable and convenient settlement'.

In the past, human subsistence was derived mainly from agriculture and fishing, and these two sources of livelihood were especially protected by customary rights. Utilization of these resources was carefully controlled by tapu (prohibitions). Fishing grounds, including the mangroves, had their owners which were communities, families or chiefs, while fishing outside the reef was free.

Today, the subsistence fishery continues to be crucially important to the majority of those living in rural areas. But the land below the high water mark is now public. This shift in marine tenure seems to coincide with abuses of the coastal zone resources; uncontrolled cutting of mangrove trees for firewood, use of dynamite, derris and chemicals to catch fish, dredging and direct discharge of pollutants from factories into the adjacent waters.

Johannes (1982) notes that 'at present, development in the coastal zone is not planned or managed in any integrated way'. The 1980-1984 Five Year Development Plan recommends the establishment of an Environmental Management Unit with tasks such as:

- \* the establishment of procedures for the environmental assessment of development projects;
- \* the promotion of inter-departmental consultations on environment management;
- \* assisting in the further development of environmental education in schools, for the public and for decision-makers;
- \* the formulation of environmental management legislation appropriate for Samoan conditions;
- \* the collection and maintenance of data on the status of the Samoan environment.

The present Three Year Development Plan also recognises the need to protect the environment and conserve natural resources.

Johannes (1982) comments that 'plans for the acquisition and control of some of Western Samoa's few, precious and rapidly dwindling mangrove areas for national reserves are not proceeding satisfactorily at present'. Only one marine reserve is in existence at Palolo Deep in a fringing reef fold near Apia.

Zann (1983) notes that 'the documentation and the scientific interpretation of the traditional sea lore of the Pacific Islands is of crucial importance, particularly in the developing islands where many of the traditional ways have been lost, or will be lost, in this generation. Johannes (1981) further notes that traditional patterns of utilisation and of conservation may help in the formulation of modern reef (coastal) management strategies.

#### GEOGRAPHY AND HISTORY

Western Samoa (Map 1.) comprises four inhabited islands, two of which are small islands (Manono and Apolima). The main two islands are Savaii (1,810 sq km) and Upolu (1,115 sq km). The mountainous islands are volcanic in origin and lie below the equator between 13° and 15° South and between longitudes 171 and 173 West, just east of the International Dateline. They have a tropical maritime climate and pronounced wet and dry seasons. Narrow coral reefs, which fringe most of the coastline and enclose the mainly shallow lagoon, rapidly drop into very deep water.

The total population in the 1981 census reached 156,000, giving an annual growth rate of 0.6 as compared to the 3.3 annual growth rate in the 1961 census. The sharp reduction in the growth rate is attributed to the high level of emigration. About 21% of the total population live in the Apia urban area on Upolu while only 27% live on the biggest island, Savaii. The indigenous population is Polynesian and is relatively homogeneous. Approximately 89% are pure Samoans, but there is an admixture of Chinese, European, Fijian, Tongan and Tokelauan blood.

The Samoan Islands are believed to have been inhabited for about 3000 years. The pre-European population was estimated to be about 29,000 in 1880, and settlements were mainly on or near the shore, close to river-mouths or fresh water springs, with arable land readily accessible. Safe and easy access by seas was a determining factor in choosing a site for settlement as rocky coasts unprotected by off-shore reefs were sparsely populated, even where the land was capable of development. The basic social unit in a village was, and still is, the aiga (extended family), headed by the matai (chief). Like most others in Polynesia, Samoan society had no central political authority or government. Political organisation rested largely upon the village council in which the heads of the extended families and their chiefs joined in dealing with local problems and order. The staple foods from the land were taro, breadfruit and coconut while the supply of protein came from the lagoons, reefs and open sea where a great deal of edible marine life could be obtained. Pigs and fowls were kept mainly for feasts. The Samoans had a rich material culture which included a range of specialised canoes, hooks, traps and lures for fishing (Buck 1930).

Although Roggewein was the first European to sight Samoa in 1722, La Perouse was the first to set foot ashore in 1787 in Tutuila. Little was known about Samoa then, and Western impact was minor until 1830 when the London Missionary Society, traders, beachcombers etc, began to arrive. The whole group was supervised tripartitely by Britain, America and Germany under the Treaty of Berlin in 1889, up to 1900 when Britain withdrew.

Germany achieved dominance in Western Samoa and the smaller eastern islands were given to the United States. New Zealand troops took possession of Western Samoa in 1914 owing to the state of war between Germany and Britain. New Zealand rule continued after World War I, initially under the League of Nations. Political independence for Western Samoa was finally achieved in 1962.

Today, a National Parliament, which is elected by the matais governs Western Samoa. Although basic medical care and education are available, employment is limited and the majority of the population continue to live as semi-subsistence farmers and fishermen. Exports include coconut oil and cream, copra meal, cocoa, bananas, taro, timber, veneer, fruit juices, beer and cigarettes and some re-export items. Imports include fuel, canned food and all consumer goods.

## FISHERIES

Western Samoa has very few patches of mangroves on its coast. An estimation from Government maps of the total mangrove and swampy areas came to approximately 1,000 hectares. The island of Upolu is almost entirely surrounded by barrier reefs which enclose the mainly shallow lagoon.

In some places, the lagoons are shallow and require the rise of tide to allow passage of a canoe, while in other places, particularly where there are openings in the reef, they are a few fathoms deep. Barrier and patch reefs are well developed only along the northern and western coastline of Upolu. Johannes (1982) reported an estimated 23,100 hectares of total reef and lagoon area for Western Samoa, viz, the area of water less than 50m deep.

Traditionally, Samoans are known to be inshore fishermen and gleaners as well as ocean fishermen. Roggewein, seeing the natives move about so much in canoes, gave the group the name of the "Isles of the Navigators". Methods of fishing varied from simple groping between the rocks with bare hands to skilled devices with traps, nets and hooks. The canoe took men outside the reef to seek the deep sea fish. But the waters within the bounding reefs provided the main source of fish. The majority of Samoans today still rely on the sea-foods for subsistence. Because of the limited continental shelf area due to the steep decline just off the reefs, and the small Exclusive Economic Zone (EEZ) area (the smallest in the region, see Table 1), the feasibility of large-scale commercial fishing around the islands is still questionable. However, the introduction of motorised fishing using aluminium catamarans has been effective in supplying Apia with fresh fish. Fish aggregating devices, a United Nations funded project, have been moored around both Upolu and Savaii.

The 1978 Statistics Department Fishery Catch Assessment Survey for Western Samoa indicated an inshore catch of 666.233 mt, comprising 61.12% of the total.

A preliminary survey done in 1984 indicated that total consumption of local seafoods in the urban area averaged to about 100g/capita/day while in the rural area, the consumption of seafood was found to be about 240g/capita/day, and also, that reef fish comprise about 87% of total rural consumption but only about 60% of total urban consumption (Zann et. al in prep).

## (a) Subsistence fishery:

Buck (1930) described a wide range of fishing methods that were used traditionally. These include groping between rocks with bare hands, various snares, lures, weirs and dams, fish spears, poisoning, nets, hooks etc. Dug-out canoes were used for fishing and a specially designed canoe (called a vaaalo) was used for bonito fishing.

Nylon, goggles and rubber and steel hocks have replaced the traditional gear.

Fishing involving the whole or most of the community has declined as the fisherman now thinks more of his personal gains.

The usual method used today, apart from the gleaning of invertebrates, involves diving underwater utilising a mechanically propelled spear, spearing (hand-thrown), gill-netting and fencing using chicken wire, handlining and trolling. However, the dug-out canoes are still used.

Almost everything from the sea is taken regardless of its size. The fish catch includes lagoon and reef species but mainly mullet, small snapper, scad and surgeon fish, while invertebrates include a variety of bivalves, snails, holothurians, jellyfish and seaweeds.

The everyday gleaning involves mostly the women and children while men are responsible for providing the fish.

## (b) Commercial Fisheries:

The inshore small-scale artisanal fishery is based on one or two canoes with two to four fishermen, using a large fence trap or gill nets. The fence trap is usually fixed in one spot for one or two weeks, but sometimes months, and is then shifted. The installation and shifting is labour intensive and often inefficient. An estimated 100 short ton total catch from this fishery was taken in 1984 together with 30 tonnes of shellfish.

The offshore small-scale commercial fishery has recently been rapidly expanded. The present success of this fishery has come about because of two United Nations component projects, namely (i) fishing boat building (locally known as Alia) and (ii) fish aggregating devices. A repair workshop for outboard motors, fish holding refrigeration, a fish market, subsidised fuel, and fish coolers available to fishermen, also contribute. This fishery is based on the aluminium catamaran (Alia) equipped with outboard motors and line reels for tuna trolling or for offshore nightbottom fishing. Fuel is expensive, particularly for tuna trolling. The fishermen sell their own fish either direct to the government fish market or to the public at the government fish market.

The total catch of tuna in 1984 was estimated at 510 short tons worth WS\$363,600 as compared to the 2,550 short tons worth WS\$4,080,000 estimated for 1983. The drop was believed to be due to the shortage of fish aggregating devices deployed in 1984. The total catch for bottom fishing in 1984 was estimated to be 1,100 short tons worth WS\$2,640,000 compared to 850 short tons worth WS\$1,700,000 estimated in 1983 (see Table 2).

At present, these fisheries are not earning foreign exchange but are helping in import substitution.

#### SEA TENURE, LIMITED ACCESS, AND TRADITIONAL MANAGEMENT

##### (a) Past

For as long as Europeans have known them, the Samoans have been predominantly a coast-dwelling people. Easy and safe access by sea was a determinant in the establishment of a settlement (village). Traditionally, the village's bordering lagoon or shallow water was a special preserve in which the village maintained rights of use and access in much the same way as it controlled its lands (Gilson 1970), viz, the lagoon, as far as the reef, was considered to be the property of those near whose village it was situated. Furthermore, 'fishing grounds, like landed property have their owners' (Kramer 1888). It seems that the highest ranking chief or chiefs of a village regulated fishing by boat and net and imposed conditions upon outsiders who wished to use, or traverse, the villages' inshore waters, and travellers were given access as a matter of courtesy. Members of a village without a safe fishing ground could be permitted to use the fishing ground of a neighbouring village but were expected to give a portion of the catch to the villages that owned the fishing ground. Utilisation of most resources was carefully controlled by tapu. Von Bulow (1902) lists five general duties of a fishing ground owner as being:

- "(1) If he catches certain large species of fish (e.g. turtle) he has to turn them over to the village assembly or in some villages to particular chiefs or orators.
- (2) In addition he has to follow the orders of the village assembly if for a certain period it forbids the catching of atule (scad) in order for the assembly to gain time to prepare to catch this fish in the lauloa (large drag-net) or,
- (3) If the assembly declares the ocean 'forbidden' - sa - because a high chief has died or because during the transfer of the remains of a long-deceased person from the present grave to a new grave, his bones were 'bathed' by the sea.
- (4) The owner has to allow his own village or neighbouring localities to cast their large drag-net, but to do so without searching through the stone heaps he has set up himself.
- (5) As well, he has to allow everyone to cross his fishing ground while dragging a fish lure, pa, any time of day or night.

The open sea fishing is free for the use of all men, but there were valid rules even for fishing outside the reef, particularly for shark and bonito fishing. These were determined by the guild of fishermen, the tauti, and were enforced by the latter (von Bulow 1902).

When a chief died, traffic through the village by the lagoon was prohibited until the funeral rites had been performed. Fishing in general, except scavenging off the reef and lagoon-floor, was a communal effort led by the village's tautai (principal fisherman). Authority was given to this expert to restrict boat-fishing to parties which he organised or sanctioned. In turn, he was bound to

ensure that all catches were fairly divided among the households of the village and that species of fish reserved for chiefs were given only to those who had a right to them (Gilson 1970).

All persons using the reef or channel were required to bring a food offering to the alii (highest ranking chief in the village) or else they would lose their lives at sea!

(b) Present

By around 1850, fishing had become a much less essential occupation because the Samoans had acquired a taste for preserved beef, salmon and pilchards stocked by the trade store. Also, the property rights had been altered considerably by colonial governments as Europeans would not accept private restrictions upon the free use of Samoa's waters. Furthermore, 'in the 1870's it happened that native fishing grounds were surrendered to strangers' (von Bulow 1902).

Today, Article 104 of the Constitution provides that all land lying below the line of high-water mark is public land, and that all persons have a right to navigate over the foreshore and to fish in the sea within the limits of the territorial waters of the State. The public right rises by virtue of the ownership by the State of the soil of the territorial tidal waters.

Thus the law states that since the Constitution and Acts of Parliament, having vested all the soil below the higher-water mark in the State, the right of fishery therefore is common to all citizens of the country. But the public right to fish must be exercised reasonably and so as not to damage the fishery.

Generally today, the village adjacent to a lagoon and reef would be responsible for those areas - I have seen fishermen from a village chasing away fishermen from another village who were poisoning fish on the reef adjacent to the former fishermen's village. It is also sometimes broadcast over the radio that a village was banning certain fishermen, or certain methods from being used in the lagoon and reef adjacent to their village. But still, much of the 'my lagoon', 'my village reef' sense has gone.

As far as the very limited mangrove resource is concerned, three systems of ownership - each clashing with the other - seem to exist. Firstly, the State by law owns the land below the highwater mark, thus giving the public a right to the mangroves. Secondly, the individuals who bought land along the coast which had mangrove areas during German rule when the low-water mark was recognised, consider the mangrove area as their private land. Thirdly, the village or family in a village which has adjacent mangroves, regulates the cutting of trees - The writer has heard of a village stopping outsiders from cutting the adjacent mangrove trees. However within the village there seems to be no regulation stopping its villagers from cutting mangrove trees which are adjacent to an individual's land.

## PRESSURES ON COASTAL RESOURCES

- (a) Dynamite Fishing - the seriousness of this is recognised in the Samoan name for dynamite - "fanaia".

Von Bulow (1902) reported fishing using dynamite, so it seems that this has been a widespread problem for at least 80 years in Western Samoa. Dynamite is often set off on coral heads, reducing them entirely or in part to rubble.

Johannes (1982) describes two methods presently used in Samoa. "One method involves throwing dynamite from a boat at free-ranging fish schools (notably mullet and scads) in midwater. Three to four sticks are usually used. Matches are taped in the fuse and lit with a cigarette. Sometimes chopped up fish is used to lure schools near the boat". The second method is used for bottom fish and employs a larger charge (eight sticks), wires and detonator cap. "the charge is placed by a diver on a coral head - the wires leading from the charge to the boat are usually covered with sand for a distance of 10 - 20 metres from the charge. Four torch cells in the boat provide the power to detonate the blast" (Johannes 1982). This last type is the worst of the two, and inflicts considerable damage to the marine environment.

"Dynamiting fish was somewhat decreasing due mainly to reduced availability of dynamite and to the actions of the Pulenuu - village leaders who have been given more responsibility by the government in recent years to enforce government laws" (Johannes 1982). This is true in some cases but locals are known to smuggle in dynamite from American Samoa in ingenious ways. The writer is aware of a few cases where sons of Pulenuus were involved in the dynamiting.

Thus this problems remains as one of the greatest threats to the marine environment in Western Samoa. A number of fishermen have been prosecuted for selling dynamited fish at the Apia Fish Market.

- (b) Fish Poisoning

The plant *ava niukini* (*Derris elliptica*) thrives in the bush of Western Samoa. Its roots are pounded and used as poison to obtain fish for consumption. *D. elliptica* is known to kill small reef fishes, juvenile fish, shellfish and even corals at high concentrations. However, its usage has declined in the past few years probably due to the disappearance or decline of the target species fishery.

*Barringtonia* plant is also used as fish poison but is not as effective or widely used as the *Derris* root. Household bleach and the herbicide Paraquat, have been reported as being used to kill fish on occasions.

- (c) Manual Destruction of Corals

Breaking corals apart in order to extract fish and invertebrates for food has been a long-standing custom in Western Samoa (Johannes 1982) and still prevails today. In addition, a fishing method, locally known as *faamo'a*, involves a number of people equipped with wooden poles. The poles are driven into corals, smashing them, to drive the fish out and into a waiting net.

## (d) Soil Erosion

Johannes (1982) states that "the soil that is a precious resource on the land becomes a pollutant when deposited on corals". Land clearing for development, bad land management and cutting of firewood along the banks of rivers in Western Samoa have contributed to accelerated soil erosion.

Destruction of reef communities and deterioration of fishing in some districts in Western Samoa are suspected as being associated with soil erosion due to land clearing.

Gauss (1981) reports that comparison of seabed depth contours from bathymetric surveys done in 1975 and 1981 for the Apia harbour, suggest that the seabed has shallowed by up to five feet in the central and eastern parts of the harbour in six years.

## (e) Industrial and Waste Disposal and Pesticides

Wastes from the country's feed mill, brewery and recently the beef canning factory, are discharged directly into the adjacent marine environment.

The steady increase in population in the urban area of Apia has resulted in an increased load of human waste although at present, waste from septic tanks is still disposed of on land. There is a proposal for Apia's sewerage to be discharged of Mulinuu Point with a discharge point 800m clear of the reef in about 40m of water.

The urban area garbage disposal is on the coast in a mangrove marsh about half a mile from the city. There is also a new garbage disposal nearer to the city, at Fugalei, also in a mangrove marsh.

'Pesticides and herbicides are used widely and rather indiscriminately in Western Samoa' (Johannes 1982). Paraquat is available to everyone. Dr Karl Marschall of Western Samoa was reported by Johannes as performing some experiments demonstrating that exposures to low levels of DDT can, over a period of weeks, lead to the gradual deterioration and ultimate death of reef corals. The other threat of pesticides is that even at sublethal levels, they can concentrate in edible bivalves to the point where they become unsafe for human consumption.

## (f) Crown of Thorns Starfish

Infestations of Western Samoa's reefs by the *Acanthaster* dates back to the early 1930's. A recent invasion was in the late 1960's through to the early 1970's. This occurred at several points on the south, west, and east coasts of Upolu.

Because focal points of infestation appear to be directly opposite villages, and Crown-of-Thorns starfish are rarely found on stretches of reef between the villages (Garlowsky and Bergquist 1970), it has been hypothesised that infestations appear to be associated with an upset of the reef environment and damage to the food chains due to the effects of pollution, dredging, reef-blasting operations, and soil erosion from land development.



## (g) Over-fishing

Johannes (1982) reports that the catch rate from Western Samoa's reef was not low by the standards of coral reef fisheries, though in the same report he notes that the fish are much smaller on the average.

Certain stocks of fish species, particularly mullet and scad, are known to be decreasing and becoming scarce. Whether this is due to over-fishing using nets or other means, in particular dynamiting, or the pressures mentioned earlier, or a combination of these, remains unknown. In addition to these species there are a variety of sea cucumbers, a limcoid known locally as gau, as well as the edible seaweeds which are under threat.

However, populations of a number of the more vulnerable organisms have in fact declined because of over-fishing. These include the *Tridacnas* and certain other bivalves. Divers as well as fishermen almost invariably comment on the lack of large fish in the lagoon and reefs of a Samoan village. Turtles, which were formerly relatively common, have become uncommon to rare.

Heavy Crown-of-Thorns infestation was reported from Satoalepai village this month (June 1985).

## (h) Cutting of Mangrove Trees

Western Samoa has a very limited mangrove area. It is estimated (from Government maps) that the total coastal swampy areas and mangroves come to less than 1,000 hectares. At present, the cutting and filling of the mangroves proceeds almost uncontrolled. Fortunately, there are indications of existing ownership rights over mangroves in some areas on Upolu.

## (i) Dredging

The major dredging of lagoon sand for use in construction occurs in Mulinu. It is suspected that the failure of the gau (*Dolabella sp*) fishery in this area is due mainly to the extraction of the sand. Wells (1984) reports that "such activities increase turbidity, alter water circulation and even cause the destruction of entire reef systems".

## 6. COASTAL ZONE FISHERIES AND FISHERIES RELATED REGULATIONS

A number of laws and customs regulating aspects of fishing activities and coastal management are operating in Samoa at present.

Although traditional fishing rights have largely disappeared, there are indications that they still exist in some areas. Fishing for atule (scad) during its run is the exclusive right of the people of Satoalepai village, in their lagoon. But outsiders who are permitted to fish are not expected to give a portion of their catch, and they can even sell part of their catch to villagers.

Van Pel (1960) reports that around Manono Island only the inhabitants may catch mullet and atule, while in Savaii, "during the whitebait runs in Gataivai river, whitebait fishing is the exclusive right of one village".

The custom of 'protectorship' of adjacent lagoon and reefs is respected by people from a different village in some areas, i.e. a village may chase away fishermen who may be fishing destructively in the lagoon or reef adjacent to the village, or even ban certain fishing techniques e.g. diving on the reef at night using underwater torches.

Fearing damage to the reef and the small reef fish, the government has enacted legislation banning the use of *Derris* or poison to obtain fish. Section 2 of the Fish Dynamiting Act 1972 makes it an offence for any person to use dynamite or other explosives to catch fish. Under section 4(f) of the Police Offences Act prohibits the use of the plants *ava niukini* (*Derris*) or *futu* (*Barringtonia*) or any derivative thereof for the purpose of capturing fish. However, although the penalty for violation of the law is imprisonment, the law is rarely honoured in the villages away from the town.

"Where a right of navigation exists the right takes precedence over the right of fishing and a navigator may place his ship in a fishery and stay there as long as is reasonably necessary for the purposes of navigation, but he must not abuse his right by acting wantonly or maliciously so as to damage the fishery. It follows therefore that fishing must not be carried on so as to cause a nuisance or obstruct navigation" (Vaai 1984).

The general public has no common right to fish in waters that are not tidal even though such waters happen to be navigable. The owner of a fishery may, of course, give general permission to the public to use his fishery or he may by reason of ignorance, generosity, carelessness or indulgence take no steps to prevent the public fishing in his fishery. Even so the public as such cannot acquire a general right to fish (Vaai 1984).

In common law the public has a right to fish in the tidal reaches of rivers and in the sea and arms of the sea within the limits of the territorial waters of the State. This right also extends to the EEZ defined by Section 3 of Exclusive Economic Zone Act 1977. The public right to fish must, however, be exercised reasonably and in conformity with the law.

Section 4 of the Fisheries Protection Act 1972 prohibits foreign fishing vessels from engaging in fishing, possessing any fish or engaging in activities in support of a foreign fishery fleet within Western Samoan waters except as expressly provided in an agreement or convention to which Western Samoa is a party. Exemptions may be granted if they are for purposes of fishery research or otherwise in the national interest. The use of a foreign fishing craft for fishing in the Exclusive Economic Zone is prohibited by Section 4 of the Exclusive Economic Zone Act 1977 unless it has been issued with a licence under the Act. Section 5 of the Act authorises the Minister to issue licences to owners of foreign fishing craft subject to conditions specified under the Act. Section 13 of the Exclusive Economic Zone Act 1977 allows a foreign fishing craft to be used for fishing without a licence in the EEZ for the purpose of fishery research or for experimentation or sport provided that prior approval in writing is obtained from the Minister.

## 7. MARINE RESERVE

The 1974 National Parks and Reserves Act prompted the establishment of the Palolo Deep Marine Reserve. In December 1979, the Western Samoa Government approved the establishment of this reserve. The Palolo Deep Reserve (Map 2.) is located on the north coast of Upolu at Pilot's Point, Matautu, about a mile east of Apia city.

Palolo Deep is a 'hole' about 200m in diameter and 10m deep within a fold in the fringing reef which surrounds Pilot Point, but the reserved area extends to the surrounding reef to the north and north-east and 500m east off the fringing reef.

At present, the Palolo Deep Reserve is supposedly under the management of the Parks and Reserve sector of the Forestry Division of the Ministry of Agriculture Forests and Fisheries.

## 8. MARICULTURE

It is generally believed that as isolation increases from west to east in the tropical Pacific, there are possibly unoccupied habitats existing where the introduction of useful species would do little harm.

In 1981, investigation on the possibility of culturing the Philippine green mussel (*Perma viridis*) was initiated. Mussel spats were imported from CNEOX AQUACOP, Tahiti (Bell and Albert 1983).

The failure of the initial trials near the city led to a second importation of spats in early 1983. These were then put in more remote areas (Safata Bay on Upolu and Asau Bay in Savaii). These second trials in the new selected sites were very successful and marketable size mussels of 5.0 - 8.0cm were obtained 5 - 6 months after implantation (Bell and Albert 1983).

A partial harvest showed promising production as well as a good local market (Bell and Albert 1984). Natural spatfalls from the imported mussels have been recorded in one site (Bell 1984) and the species offers promising development.

Surveys for locating other suitable areas for the culture of the green mussel are on the way, while a proposal had been submitted for funds to introduce mussel farming to villages with suitable sites, at a small-commercial level.

## 9. CONCLUSION

As Johannes and others have put it "development in the coastal zone is not planned or managed in any integrated way". Jordon and Searle (quoted in Grattan 1948) said that Samoa's fish fauna was one of the richest on the globe, and Kramer (1888) wrote that 'naturally, there are fishes throughout the whole year, for the sea is as inexhaustible as the land'. More recently Gilson (1970) said that "considering the Samoan pattern of life, along with the population, the physical environment seemed indeed to have provided an ideal basis for comfortable and convenient settlement". Unfortunately these views do not seem applicable to the present situation.

Apart from a recommendation in the Fourth Five Year Development Plan (1980 - 1984) to establish a small Environmental Management Unit to look into the environment situation and be responsible for setting up environmental management legislation, little has been initiated. Western Samoa's Fifth Development Plan (1985 - 1987) also recognises the need to protect the environment and conserve the natural resources (Government of Western Samoa 1984).

At present, the Palolo Deep Marine Reserve is under the National Parks and Reserve Section of the Forestry Division, and as Johannes (1982) notes, "the reserve is clearly being fished surreptitiously" and that "a swim around the periphery of the park indicated that the fish were more wary than they would be in a completely protected preserve" and that "there was a noticeable absence of larger fish". Whether the area was properly surveyed to protect the most important reef section in this area is also questionable.

Information on the coastal zone status as well as its resources is virtually non-existent.

There is a need for research on the marine resources in the country to include the status of coral reefs, fisheries and mangroves. Management-oriented research would also be of great benefit.

Enforcement of existing legislation concerning the use of dynamite and poisons (including chemicals) through the village Pulenuu is highly desirable. It seems that the immediate improvement of Samoa's reef and lagoon resources depends on the reduction of marine pollution and destructive fishing practices (Johannes 1982).

Management of a multi-species fishery is complex and expensive but efforts should be made to monitor at least a few species (e.g. mullet) which form an important part of the catch. Sound coastal developments (e.g. the creation of marine parks) can only be well accepted when villagers themselves are involved and when traditional marine tenure is understood and recognised by government. Thus "efforts should be made to investigate and record the remaining marine tenure and fishing rights as they pertain to all coastal waters. Some of these traditions may prove to be of great value in terms of sound reef and lagoon resource management and if so they should be legally recognised". (Johannes 1982).

Although conservation and creation of marine parks looks attractive at present, there is a need to assess the implications of coastal conservation as for the majority of those in rural areas, about 70% of the nation's population, subsistence fishing is crucially important. Fairbairn (1973) reported that 72% of Samoans were engaged in village agriculture. Most of these households are also actively engaged in subsistence fishing. Mariculture, in addition to a reduction of marine pollution and destructive fishing practices, offers an alternative means of increasing marine production, particularly in places where there is no 'room' for conservation, Mariculture would also lessen the pressure on marine resources.

Western Samoa needs to conserve or at least manage its precious but very limited mangrove resource. But the traditional tenure concerning the mangrove areas must be documented and recognised before initiation of such a project.

The injection of environmental concern into education would greatly assist in creating public awareness of the importance of environmental management.

There may even be a need to establish a Research Unit to deal with the marine environment either in the Fisheries Division or as part of the Environmental Management Unit recommended in the 1980-1984 Five Year Development Plan (which has not materialised yet). Its tasks would include carrying out all research concerning the coastal environment, arranging for overseas organisations to carry out local research, providing materials for research, advising individuals or overseas organisations on local research, publishing research results, as well as drawing up and advising government on legislation concerning the coastal environment.

TABLE 1

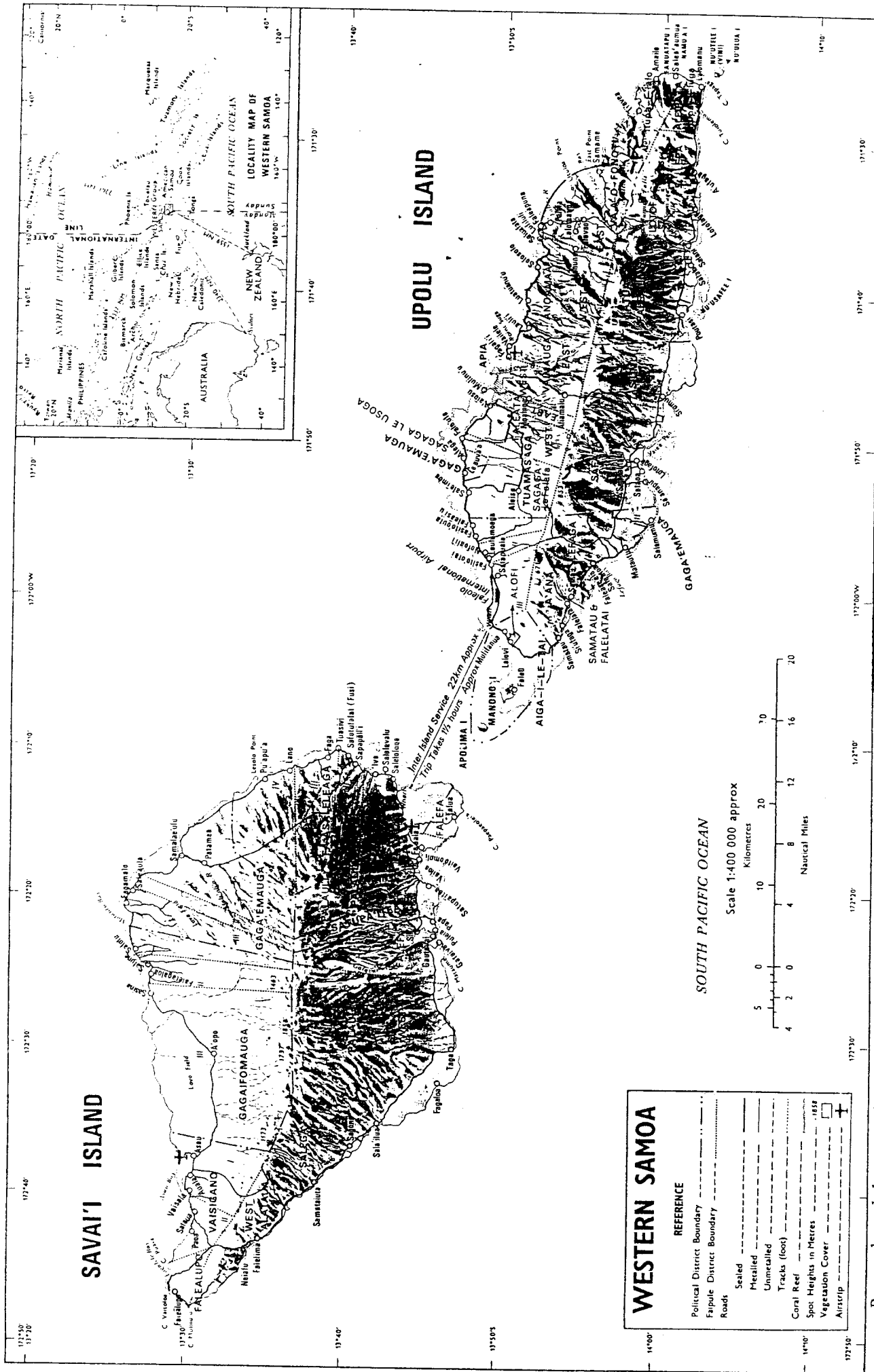
Country	Land (Sq.m)	EEZ (Sq.m)	Population	Population Density (Sq.m)
Cook Islands	94	715,000	18,500	197
Micronesia	716	2,422,000	132,500	185
Fiji	7,138	504,000	619,000	87
Kiribati	270	1,387,000	57,300	212
Niue	14	105,000	3,500	250
Nauru	8	125,000	7,300	913
PNG	180,564	1,219,000	3,079,000	17
Solomon Is.	11,145	523,000	221,200	20
Tonga	273	273,000	95,800	351
Tokelau	7	180,000	1,100	157
Tuvalu	10	352,000	7,400	740
Vanuatu	4,641	266,000	114,500	25
E. Samoa	105	135,000	31,000	295
W. Samoa	1,146	37,000	158,000	139

(From Forum Fisheries Agency Report 1983)

TABLE 2WESTERN SAMOA ESTIMATED TOTAL CATCH

TONS = SHORT TON		\$ = WS TALA			
<u>YEAR</u>	<u>TUNA</u>	<u>BOTTOM FISH</u>	<u>SHELL FISH</u>	<u>OTHERS</u>	<u>TOTAL</u>
1975	650	900	25	80	
Value	\$420,000	\$630,000	\$30,000	\$40,000	\$1,120,000
1976	700	950	20	100	
Value	\$525,000	\$760,000	\$35,000	\$50,000	\$1,370,000
1977	700	900	20	100	
Value	\$595,000	\$900,000	\$50,000	\$70,000	\$1,615,000
1978	750	850	20	100	
Value	\$675,000	\$1,020,000	\$60,000	\$80,000	\$1,835,000
1979	950	800	20	100	
Value	\$855,000	\$960,000	\$65,000	\$90,000	\$1,970,000
1980	1,800	800	20	100	
Value	\$1,620,000	\$1,040,000	\$80,000	\$100,000	\$2,840,000
1981	2,200	850	20	100	
Value	\$3,300,000	\$1,000,000	\$100,000	\$110,000	\$4,610,000
1982	2,400	600	20	100	
Value	\$3,840,000	\$1,000,000	\$100,000	\$120,000	\$5,060,000
1983	2,550	850	20	100	
Value	\$4,080,000	\$1,700,000	\$100,000	\$120,000	\$6,000,000

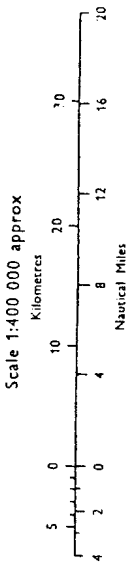
NOTE: Sustainable yield of bottom fish caught in known areas suitable for this type of fishing is estimated to be about 1,100 tons/year.



**WESTERN SAMOA**

**REFERENCE**

- Political District Boundary ————
- Faipule District Boundary - - - - -
- Roads:
  - Sealed ————
  - Metalled ————
  - Unmetalled ————
  - Tracks (foot) - - - - -
- Coral Reef - - - - -
- Spot Heights in Metres 1874
- Vegetation Cover [Symbol]
- Airstrip [Symbol]



NZMS 279 Reproduced by permission of the Departments of Lands & Survey, Wellington, New Zealand



FIGURE 2.

