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THE INSHORE RESOURCES OF WESTERN SAMOA: COASTAL INVENTORY AND FISHERIES DATABASE

by

L.P. Zann & A. Mulipola
Fisheries Division
Apia, Western Samoa

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A paper on inshore resource survey methodologies and findings prepared for the SPC/FFA Workshop on the Management of Inshore Fisheries.

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by:

Leon Zann(1) and Antonio Mulipola(2)

(1) Inshore Fisheries Management Adviser, Western Samoa
Professor of Conservation Technology
Southern Cross University
Lismore, NSW
Australia.

(2) Fisheries Divsion
Department of Agriculture, Forestry, Fisheries and Meteorology
Apia, Western Samoa.

INTRODUCTION

The inshore estuaries, shores, lagoons and coral reefs traditionally supplied Western Samoa and other Pacific islands with the bulk of protein the islander's diets. In rural areas they continue to be essential for the subsistence and health of rural people, and an important source of income. However, increasing island populations and increasing commercialisation of inshore fisheries has placed increasing pressure on inshore resources, and there have been widespread reports that Western Samoa's inshore fisheries are declining.

This paper briefly describes the methods and major findings of an FAO project assessing Western Samoa's inshore resources undertaken in 1990-1991. The major part of the project was the production of a coastal resources inventory for Upolu (population 100,000), the main island of Western Samoa. This describes the inshore resources (environmental and fisheries); human and natural impacts on the environment; fishing patterns and techniques; health, social and economic importance of inshore fisheries; catch and effort; fisheries yields; and trends in landings.

METHODS

A range of low technology methods developed by the senior author of a 15 year period for rapid environmental and fisheries assessment were used to produce the inventory.

1. Mapping of inshore resources

The inventory was map-based, at a 1:20,000 scale using Department of Lands, Surveys and Conservation demographic and land-use maps. Based on coastal geomorphological and socio-political boundaries, Upolu was divided into 22 different regions.

2. Demographic information

Demographic information for each village was obtained from national census data collected for the project on population; number of households; numbers of fishing households; numbers of fishers; numbers of canoes. These information were databased (in Excel) and summarised for each village and region.

3. Environmental assessment

Existing aerial photography (1985 and 1990) was used to map shores, lagoons, seagrass, coral reefs and other marine features on the base maps. Bathometry was added from navigation charts and SOPAC surveys.

Major habitat types evident in aerial photographs were described through shore and underwater surveys. Cross-shelf transects were undertaken from shores to outer reefs, and major features in the aerial photograph were 'ground truthed' by diving. Coverage of physical substrata (rock, sand, mud, etc.) and biotic dominants (coral, seagrass, algae, etc.) were identified and coverage estimated. Abundance of indicator and commercial organisms such as recently dead coral. crown-of-thorns starfish, giant clams, commercial beche-de-mer, etc. were recorded. The main community assemblages were identified and mapped from the aerial photographs, (Figure 1 as attached at the back of this paper).

Macro-scale (large-scale) changes in cover of coral, seagrass, mangrove and coral rubble were determined from aerial photograph series (1954, 1970, 1986, 1990). Major features showing alteration in size or composition were ' ground truthed' as above.

4. Fisheries surveys.

Creel surveys were undertaken in selected villages in each district for four, one-week periods per year to cover seasonal variations. Returning fishers were interviewed and their catch documented, weighed and measured.

Because of limited manpower at the Fisheries Division, Junior Secondary High Schools were given class projects to survey fish consumption and fishing effort in their households, using a simple, pre-printed daily record sheet or ' diary', (Figure 2. as attached at the back of this paper).

More detailed household surveys on diet, fish consumption, and fishing activities were undertaken by a team of 15 part-time fisheries assistants. At least ten households in each of 40 villages around Upolu were surveyed four times per year using a standard questionnaire, (Figure 3. as attached at the back of this report). As this survey had been first trailed in 20 villages in Upolu in 1983, the same villages were resurveyed at the same time of the year in 1991 to determine trends over this period.

Associated with this project, commercial market landings of inshore and invertebrates have been monitored at the Apia municipal fish market since 1985, and at other commercial and roadside outlets less regularly. Details of these are described in the SPC/Inshore Fish. Mgmt/BP 57 A, (Norsman and Mulipola, 1995).

Underwater visual census of reef fish, as developed by the Australian Centre for International Agriculture Research (ACIAR) were undertaken at three sites around Upolu subject to compare fish sizes and biomass on the more heavily reef shallows and less heavily fished upper reef slopes, and at more densely populated and less densely populated coasts (Samoilys and Carlos, 1991).

RESULTS

Results of the above surveys were used to produce the Coastal Inventory. This comprised a broad, national and island over-view, and detailed information on each region. A typical region description is show in Figure 4 (Map, text descriptions and fisheries database of one of 22 regions of Upolu island) as attached at the back of this report.

1. State of marine environment

Because of its oceanic, volcanic origins, Western Samoa has a relatively small area of coral reefs and island shelf. The length of reef front on Upolu is 271 km, and the area of reef (to 40 m depth) is 470 sq km. Fringing and barrier reefs are present, and lagoons are characteristically very shallow, with restricted circulation on the leeward (northern) side).

The survey found that the state of Upolu's marine environment was 'not good' (Zann, 1994). Major impact coral was the 1990 cyclone Ofa, the worst cyclone on record. This reduced coral cover to near zero in many areas and created 41 km of emergent cyclone banks on the reef top, and damaged or destroyed almost half the alia fleet. Crown-of-thorns starfish outbreaks in 1967-1975 and 1980-1990 had also reduced coral cover in many sites. Increased sediment and nutrients were probably also responsible for the widespread die-back between 1970 and 1985 of lagoon corals on the northern reefs, and an increase in seagrass and algae. The majority of Upolu's estuaries and wetlands (important fish nurseries) had been degraded by road causeways and land reclamations in the 1960s.

2. State of fisheries

2.1. Fishing effort

The survey found that almost half the rural households on Upolu (i.e. 3,250 of 6,630 households) fish regularly each week. Around 108 of Upolu's 140 villages were classed as fishing villages (i.e. over 33% of household fishing). There were around 1,900 fishing canoes, the subsistence fishing unit, and 55 alias, the commercial offshore fishing unit.

Fishing households averaged 4.2 fishing trips per week, and total of 550,000 for the island each year.

2.2. Fish consumption

Fish was eaten on an average of 2.6 days per week in rural areas (but up to 6 days per week in some fishing villages), and 1.8 days per week in urban areas. Average annual consumption of fish was 36 kg/person in rural areas, and 19 kg/person in urban areas. In both areas fish consumption had declined by about 30% between 1983 and 1991.

2.3. Fishing techniques

A variety of fishing techniques were used. These included spearfishing (50%); gill netting (30%); hook and line (15%); and collecting (4%).

2.4. Fishing areas

Most fishing was undertaken in inshore waters; shore (11%); lagoon and lagoon reefs (50%); barrier reefs (31%); and open sea (8%).

2.5. Catch, and catch effort

The fishing unit averaged around 2.3 fishers. The average time of each fishing trip was 5.1 hours and the average catch was 4.1 kg per trip. The average catch per unit effort was 0.8 kg/person/hr.

2.6. Total landings.

The total landings of inshore species from Upolu was estimated to be 2,000 mt per year (range of estimates 1,850 - 2,260 mt). A preliminary estimate of landings from other major island, Savaii was 1,000 mt per year.

2.7. Fisheries yields

The average fisheries yield from Upolu's inshore areas was estimated to be 113 kg/hectare/year. In the 22 different regions examined, they ranged from 28 kg/hectare/year in the degraded and overfished urban areas of Apia, to 250 kg/hectare/year in a semi-enclosed, eutrophic lagoon at Fusi, Safata.

2.8. Status of fish stocks

Almost 80% of around 1,000 fisherfolk interviewed considered that catches had declined in the past 10 years. This was supported by a sharp decline in commercial market landings between 1985 - 1990. For example, between 1985 and 1990, landings of big-eye scad from 12.5 to 0.5 mt; mullet dropped from 27 mt to 2.5 mt; and parrotfish from 27 mt to 5 mt. Giant clams dropped from 10 mt to 0.1 mt and field surveys indicate that they are now so rare that *Tridacna squamosa* is functionally extinct, and *T. maxima* is endangered.

Underwater visual census surveys of reef fish indicate that total biomasses and mean sizes are smaller in shallower, and more heavily fished areas, and that highest biomasses were found in less-fished, deeper reef slopes.

While a decrease in fishing effort (around 35% between 1983 and 1991) is considered to be partially responsible for the declines in landings, overfishing of inshore stocks, use of destructive fishing techniques (explosive and poisons) and declines in inshore environments and loss of fisheries habitat probably also contributed.

SUMMARY AND CONCLUSIONS

Effective, long-term fisheries and marine environmental planning requires accurate baseline information and regular monitoring at both local and national scales. The FAO Coastal Inventory and Fisheries Database provided a detailed, cost-effective assessment of Upolu's inshore resources. A similar inventory for Savaii is now being produced.

On the bases of the findings of the FAO survey, a $3 million Australian aid program was commenced in 1995 for the long-term management of the national's inshore fisheries. A strategic plan for the management of Western Samoa's inshore environment and fisheries is currently being prepared.

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MAP 12. SAFATA (FROM VAIE'E TO SIUMU)

INSHORE RESOURCES

SUMMARY STATISTICS:
shore length: 10 km ocean coastline (excluding Safata Lagoon shoreline: 9.5 km)
mangroves: 6.5 km shoreline (Safata Lagoon:=25 ha; Mulivai 5 ha)
reefal area: 1,156 ha (670 ha off Vaie'e/Fusi/ Fausaga; 260 ha off Mulivai; 100 ha off Siumu)
Estuarine area: 140 ha (Safata Lagoon)
reef edge length: *21 km*

ECOLOGICAL DESCRIPTION:
The Safata reefs are typical windward reefs, with relatively shallow (0.5-1.5 m) and wide lagoons (to 2 km wide), broken by inlets at Safata, Tafitoala, Maninoa and Siumu which have been formed by inhibition of coral growth by streams.

A large productive estuarine lagoon is formed by the Vaie'e Peninsula. Safata Lagoon is a shallow (0.5-2 m), highly productive estuary. The landward shores are lava; the seaward shores are terriginous muds fringed by mangroves (one of the largest wetlands in Samoa). The lagoon is moderately eutrophic, and dominated by filamentous algae and seagrasses. It is rich in bivalves, crabs, mullet and other fish, and supports a major, intensive fishery. A smaller estuary at Mulivai is spring fed.

The ocean shores are coral sand, with lava flows and low cliffs commencing at Siumu eastwards. The inner lagoon off Fusi is dominated by seagrass beds (expanding in recent years, probably because of seepage of eutrophic estuarine waters through peninsula). The outer lagoon off Fusi has low coral cover, probably from crown-of-thorns starfish predation. The exposed reef crest off Fusi has a tidal cyclone bank (30 m wide); the upper reef slope has a relatively low coral cover (*Acropora; Montipora*), possibly also from crown-of-thorns predation.

From Mulivai to Siumu the inner lagoons have a moderate coral cover (*Pavona; Porites lutea* and *P. cylindrica* assemblages) and the outer lagoons have a high coral cover (*Porites; Acropora*). The lagoons at eastern Siumu are unusually deep (to 5 m). The reef tops in exposed high wave energy areas are mainly coral rubble (encrusted by coralline algae) and cyclone blocks. Those in protected areas have a high coral cover (branching and tabulate *Acropora*). The reef slopes have an exceptionally high coral cover (*Acropora; Montipora*) but a low diversity.

ENVIRONMENTAL CONSIDERATIONS:
Cyclone Ofa: Damage slight to moderate. A low tidal cyclone bank was formed off Fusi. About 5-10% of corals on upper reef slope at Siumu were dislodged or overturned. Severe erosion of sandy beach along Vaie'e peninsula
Crown-of-thorns starfish: Outbreak in 1979-87, hindering night fishing in lagoon. *Controls undertaken by villages off Fusi. Serious* damage to lagoon and reef slope corals but recovery of Acropora evident.
Human impacts: Minimal. Eutrophic conditions in Safata Lagoon probably from sewage etc and changing landuse.
Shore reclamations: Minimal. Small harbour excavated in Vaie'elai.
Tourism: *Tourist resorts at Vaie'elai (opened* 1991); Mulivai (Hideaway Hotel: not currently operating), and Maninoa (Coconuts Beach Club, opened 1990).

HUMAN POPULATION PRESSURE:
population: 3,911 (9 villages)
popn per shore length: 391/km (ocean shore) (195/km incl. Safata Lagoon)
popn per reef area: 3.0/ha

SENSITIVE SITES: Safata Lagoon wetlands (moderately disturbed, but important fish *nursery). Coral gardens at Maninoa and Siumu* recovering from crown-of-thorns starfish predation.

FISHERIES DATABASE

SUMMARY
The windward reefs of Safata to Siumu support a *moderately heavy subsistence fishery* (65% of households regularly fish) which is based primarily on the shallow lagoons and protected outer reef slopes. Spear diving and hook and line are more common in outer lagoons and upper reef slopes while netting was most common in Safata estuary and inner lagoon. Fishing pressure is generally moderate (43 trips/ha/yr) but is very *high in Safata Lagoon. Fisheries yields are high* (130 kg/ha/yr) and catch rates are high (1.1 kg/man/hr).

A survey of reef fish stocks between Maninoa and Siumu in Jan 1991 using underwater visual census techniques indicates that the fish abundance, biomass and diversity is moderately high on the reef slopes (but less than sites examined at Nu'utele Island and Aleipata reef slope: Map 17). Biomass was estimated to be approx 250 kg/ha (major groups: acanthurids 45; lethrinids 25; lutjanids 48; scarids 120; serranids 20).

Offshore fishing for tunas and deepwater bottomfish *is an important industry at Siumu where a small* alia fleet is based.

Safata lagoon supports a very rich fish and invertebrate fishery for Vaie'e, Fusi and Fausaga villages. Hourly observations over 28 days indicated that an average of 4.5 canoes and 5.8 fishermen fish the lagoon each hour of daylight; the *average trip is 3.8 h, and fishing unit is 1.8. About* 7,000 fishing trips pa are made each year. Most common fishing techniques are gill netting, drag netting and cast netting (51%), collecting or gleaning (19%), hook and line (19%) and underwater spearfishing (15%). Finned fish (mullet, trevallies, majorras, milkfish etc) were taken in an average 85% of fishing trips and invertebrates (mainly the mangrove crab *Scylla* and bivalve *Gafrarium)* in 22% of trips. The *Scylla* fishery is of considerable commercial importance; the entire catch is sold in Apia. The average catch is 5.6 kg of finned fish, or 3 kg of *invertebrates. Catch per unit effort of fish is about* 1.2 kg/man/hr. The annual harvest from the lagoon is about 40 mt, a yield of ,300 kg/ha/yr. This appears to have been sustained.

FISH CONSUMPTION:
Frequency of fish meals: 2.9 days/week
Per capita annual consumption:
36 kg/person/yr
Total consumption: 155 mt/yr

FISHING EFFORT:
No. fishermen: 402
No. fishing households (& % total):
300 (65%)
No. canoes: 230
No. in fishing unit: 1.7 (90% men)
Aver. duration fishing trip: 3.4 h
No. trips/yr: 47,476 (over-estimate?)
No. trips/reef area/yr: 37 trips/ha

CATCH:
Aver catch fish/trip: 5.2 kg
Catch per unit effort: 1.1 kg/man/hr
Major groups: mullet> surgeonfish> trevally> parrotfish> goatfish> majorras> herrings
Annual fish landings: 175 (150-200) mt/yr

FISHING DETAILS:
Techniques: collecting (5%); spear/diving (30%); netting (38%) ; hook & line (27%)
Place: shore (10%); inner lagoon (43%); outer lagoon (37%); reef (10%)
Time of day: a: 0%. b:53 %. c: 40%. d: 7%.

ECONOMICS
% catch sold: 17%
% fish bought: 30-40%

FISHING EFFORT (1989 Agriculture census)

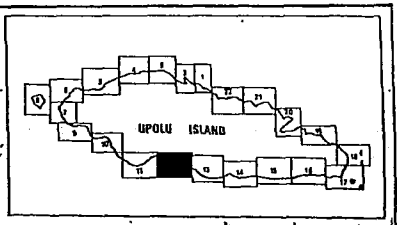
VILLAGE	POPN	F/MEN	H/H	FISHIN	% FISH SOLD					CANOE	ALIA	TRIPS/
				H/H	0%	25%	50%	75%	100%			WEEK
NIUSUATIA	371	24	33	22	16	1	5			12		56
VAIEE	527	57	56	36	23	9	1	3		25		100
FUSI	543	55	72	50	28	3	5	14		52		157
FUASAGA	294	19	36	17	17					16		63
TAFITOALA	320	56	45	31	31					15		81
MULIVAI	385	32	44	29	29					10		52
MANINOA	320	36	28	25	19	3	1	1	1	12		107
SIUMU	561	37	65	30	20	2	6	1	1	34	2	97
SIUMU UTA	590	45	52	29	24	3			2	23		99
TOTAL	3911	361	431	269	207	21	18	19	4	199	2	812

SURVEY NOTES: Safata lagoon well sampled: 10 households surveyed each in Vaie'e, Fusi, Siumu in Dec 1990 and May 1991; 39 creel samples and 55 household surveys in Fusi, July 1990.

REEF AND LAGOONAL YIELDS:
Aver. annual catch/reef area (10 m):
130 kg/ha/yr (ocean reefs and lagoon);
250 kg/ha/yr (Safata lagoon).

Figure 1. Example of the text (above) and the resources map (overleaf) from the Upolu fisheries database

MAP 12. SAFATA (FROM VAIE'E TO SIUMU)



Niusuatia
Vaie'e
Fusi
Fausaga
MAIN SOUTH COAST ROAD
10
15
Tafitoala
Mulivai
Maninoa
Si'umu