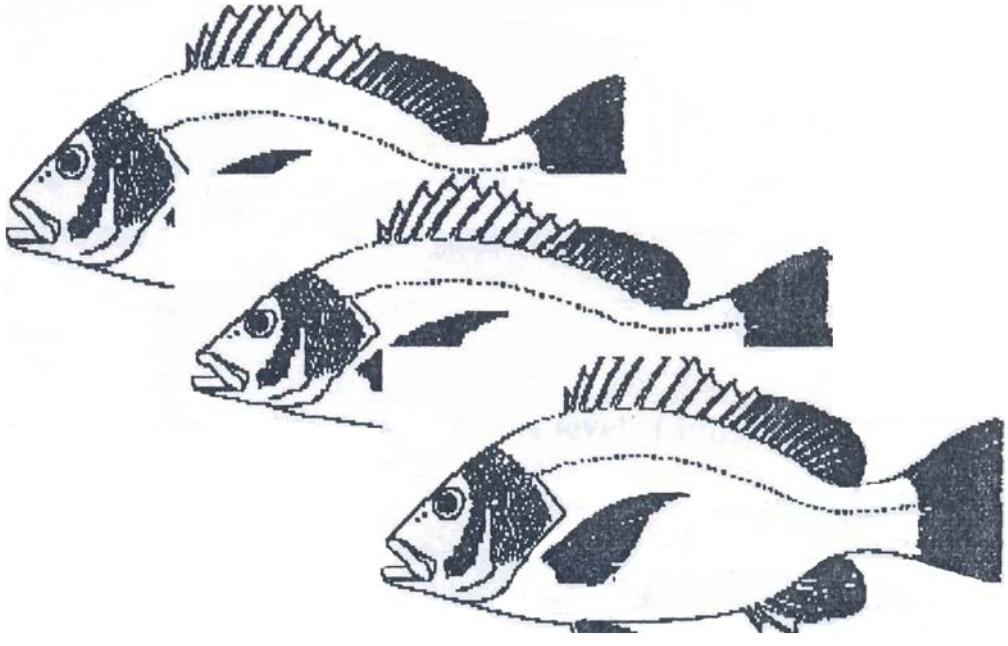
AFULILO RESERVOIR FISHERIES PROJEC
CONSTRUCTION OF FRESHWATER AQUA
WESTERN SAMOA.



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Department of Agriculture, Forests and Fisheries
Apia, Western Samoa
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FOREWORDS:

This report serves to brief the Cabinet on the current condition of the Afulilo reservoir and to seek approval for the development of the reservoir into a major fishing farm area in Western Samoa. The report is also prepared to go in line with the Cabinet instruction given in its meeting on Wednesday 23 February 1994 in that the Chief Fisheries Officer was to report back to Cabinet within 3 weeks time with a project proposal as to how this reservoir be utilised for a fishery development.

ASSESSMENT OF THE RESERVOIR

Following the Cabinet instruction on 23 February 1994, Fisheries team attended to the assessment of the reservoir on 24 February the very following day.

Four sites were sampled to determine the level of PH, contents of Calcium (Ca) Potassium(Na) and Sodium (Na) in the water. Samples have now been analysed at Alafua campus and we are expecting results shortly. The pH content have been determined and the water is around 6.7 acidic. This pH level is quite appropriate for fish farming.

The reservoir is around 844 acres (250 hectares) and it is estimated that the depth of the water close to the dam outlet is 30ft; 10ft in the centre and 3ft along sides. The sketch for the reservoir is attached.

By observation the clarity of the water is generally greenish but clear. According to the care-taker, a fouling smell was observed during the initial stage when the dam was flooded, but gradually vanished. The smell referred to is simply caused through the decomposition of remaining vegetation and soil in the basin. The greenish colouration observed is caused by colonies of green algae and fresh water plankton now inhabited the reservoir which are the main food for fish in freshwater.

Large number of insects (mosquito, dragon flies etc) were seen occupying the surface water with their larves at top water zone. Wild ducks were also seen and a large prawn was caught while the team were carrying out their work. The presence of these initial inhabitants at the reservoir signifies existence of a food chain which would be of good value for fish farming.

POTENTIAL YIELD OF THE RESERVOIR

From results carried out else-where in the work, the annual yield from tilapia pond range from 6-60t/h/year. The reservoir having 250 hectares will have a potential if we get $^1/_5$ of the lower limit 300t/year. This is about two times more than all the reef fish sold through the Government Fish Market every year. So the reservoir realistically will have the potential of earning the Government revenue of $1.182m per year.

RECOMMENDATION

The Cabinet is requested to approve the project proposal submitted as part of this report and direct Fisheries to start implementing the project as soon as possible.

AFULILO RESERVOIR FISHERIES PROJECT: FISH STOCKING AND CONSTRUCTION OF FRESHWATER AQUACULTURE CENTRE FOR WESTERN SAMOA

1. INTRODUCTION

1.1 Status of Western Samoa's fisheries

Western Samoans traditionally relied on fish and shellfish from the inshore reefs and lagoons for their daily subsistence. Consumption of fresh fish still remains high (about 30 kg/capita/year) and about half of all rural dwellers on Upolu but more in Savaii still fish at a subsistence level. However, Western Samoa's inshore resources are limited and fish stocks have been seriously depleted in recent decades by overfishing use of dynamite and poisons, and loss of fish nursery site (mangrove, tidal swamps etc).

Commercial landings on inshore fish at Apia's Fish Market are rapidly declining (from about 250t in 1986 to 40 in 1990) and subsistence landings of inshore species has declined by about 35-40% since 1983.

Because the inshore fisheries are limited in area and are essential for the subsistence of rural Samoans, the offshore resources have been targeted for commercial fisheries. A small-scale tuna fishery and a deepwater snapper fishery was developed by FAO and SPC in the 1970's. Tuna landings were about 2,000t in 1980 at the height of the fishery but declined to about 300t in 1990. Many boats left the fishery because of high vessel and fuel costs, and half the remaining fleet was destroyed in cyclone Ofa in 1990. The deepwater bottomfish (snapper etc) are more limited and have already been

overexploited. The annual catch is about 80t, about the estimated sustainable yield of the fishery.

Because of the declining inshore catches, the FAO survey has recommended that fishing pressure on reefs and lagoons be relieved through the greater use of offshore resources, and through the development of commercial and village-level aquaculture. (Zann, 1991)

1.2 Potential of fish farming in Western Samoa

While the capture fisheries are static or in decline worldwide, freshwater aquaculture is on the ascent, particularly in Asia. However, the development of aquaculture has been slow in the Pacific Islands for many reasons (Uwate, 1985)

The African tilapia (*T. mossambica*) was introduced into the Pacific Islands in the 1960s for aquaculture and into Western Samoa before Fisheries was established. Because of their "stunting" (ie small size when crowded), poor taste when grown in confined waters, and their predation on the fry of more useful native fish, they are now regarded as a pest in many areas, including Western Samoa. The larger and better tasting Israel tilapia (*tilapia niloticus*) offers greater potential for aquaculture in the Pacific Islands. It has been very successfully aquacultured in much of tropical SE Asia and has been successfully established at a commercial and semi-subsistence level in Fiji in recent years.

The potential of fish farming in Western Samoa was investigated in 1990 and 1991 by the FAO South Pacific Aquaculture Development Programme. This recommended that freshwater pond culure of mullet and Israel tilapia would be most suitable in rural areas of Western Samoa (H. Tanaka, pers. comm.).

However, possible constraints to fish farming in this country are the lack of permanent freshwater bodies suitable for aquaculture, and a widespread prejudice against eating freshwater fish (because of a "poor taste" or "muddy flavour"). The problems are not insummountable. The development of the Afulilo Reservoir will provide for the first time a permanent large body of freshwater (more than doubling Western Samoa's freshwater area), while small fish ponds can be constructed in areas with suitable soil and water supply like one in Salani. It is important to note that a similar prejudice about eating tilapia was initially held by Fijians, but today Israel tilapia sell in the upper range of sea fish prices (ie. $3-4/kg).

Trial rearing of tilapia commenced in Western Samoa in November 1990. After a farmer at Alofiosalani on Upolu expressed interest in fish farming advice and African tilapia fry were supplied by the FAO for initial trials. The trials produced a good flavoured fish, readily accepted by local Samoans. Israel tilapia were imported for this farmer in June 1991, and construction of larger ponds are now completed in the second phase of the project. This venture will be an important experiment in fish farming in Western Samoa for small interested farmers.

2. PROPOSAL FOR AQUACULTURE AT AFULILO RESERVOIR

At a request of the Hon. Minister of Electric Power Corporation (EPC) Cabinet at a meeting held on 23 February 1994 where the Director of Agriculture and the Chief Fisheries Officer was invited, directed Chief Fisheries Officer to provide a project proposal for the establishment of Afulilo reservoir into an aquacultural farm.

In 1991/1994 DP7 Fisheries submitted a proposal for utilization of the Afulilo reservior similar to what the Hon. Minister of EPC has suggested.

2.1 Stocking of Afulilo reservoir

The reservoir be initially stocked with Israel tilapia. Depending on the subsequent development of filamentous water weed (algae), other species such as grass carp might be introduced as the reservoir "matures" (ie. as the organic material in the submerged vegetation rots, it will develop a climax community of plants and animals). The introduction of predators such as perch is **not recommended** as a far greater biomass can be harvested of a fish species from the lower end of the food chain (ie. a herbivore of planktivore).

2.2 Israel tilapia (*Tilapia niloticus*) I'a Isaraelu (S)

The Israel tilapia is a native of north Africa which has been selectively bred for aquaculture in recent decades. It is a fast growing species, reaching maturity and marketable size (about 0.3 kg) in about six months under optimal conditions. It is an omnivore, feeding as adults on plankton and organic detritus but readily takes artificial foods in captivity (eg poultry meal, fish meal, flour, cooked rice, cassava, taro, coconut meal etc). Unlike its close relative, the African tilapia (*T. mossambik*), it does not "stunt" in high population densities (ie. cease growing and commence breeding at a small size).

When they breed, Israel tilapia build small circilar nests in the mud in shallow breeding where they tend their eggs and fry. The Israel tilapia and the African tilapia can interbreed with ease and the hybrid has intermediate characters of the two species. It is therefore essential that the two species are not mixed.

2.3 Stocking

The Afulilo reservoir should be examined for African tilapia, and any located should be eradicated. Large numbers (ie. several thousands) of Israel tilapia should be introduced as soon as possible to ensure they establish and out-populate any African tilapia which may be accidentally introduce in the reservior but can not be eradicated completely .

The Israel tilapia for the initial stocking would be ordered from consighment of fingerlings imported from Fiji by the Western Samoa Fisheries Division. These fish are of a proven tropical strain, selectively bred in Thailand and subsequently used in the successful Fiji farms.

2.4 Yields

As the Afulilo reservoir bias now filled with water for sometime organic material from the remaining vegetation and soil in the basin have begun to decompose. The reservoir is now turned green as algae and freshwater plankton, the main food for adult Israel tilapia, gradually build up. the tilapia will not require supplementary feeding feeding at the beginning.

The fish stocks will increase gradually as the natural food increases, reaching a maximum biomass after several years. Numbers may decline somewhat after some years as the organic material from the original rotting vegetation is biologically removed from the reservoir.

The size of the fish stocks which establish in the reservoir cannot be anticipated with any accuracy. In pond aquaculture yields of tilapia may range from 6-60 t/ha/year but it is unlikely that these yields will be reached in the reservoir. If yields one tenth of the lower are attained, the annual yield from the reservoir would be about 150t. (Note: This approximates the total annual commercial annual landings of reef fish at the Apia Fish Markets).

2.5 Management

After several years the reservoir should be able to support a sustained seine and gillnet fishery, with landings of tens to hundreds of tonnes of fish pa. It is probable that the fishery would be self-sustaining as Israel tilapia breed year-round. However, if the annual rise and fall of the water level is rapid, and if insufficient shallow water is available for nesting, supplementary restocking may be necessary. The fishery should be closely managed and reservoir should be under constant surveillance.

3. ESTABLISHMENT OF HATCHERY AND FISH FARMING DEMONSTRATION CENTRE:

Israel tilapia fish farming has a great potential in Western Samoa to supplement the declining reef and lagoon fisheries. It is recommended that an Aquaculture Centre be establishd adjacent the reservoir as a demonstration centre to promote fish farming in this country.

3.1 The Aquaculture Centre should comprise

3.1.1 Ponds

- a nursery area (ten small ponds 3m x 5m) to produce Israel tilapia for restocking the reservoir if it is required, and for supplying to other fish farms

- a demonstration fish farm (four growout ponds of 10m x 15m) for rearing adults for subsistence or sale

- an area for future expansion (eg. ponds for any future aquaculture of grass carp, giant Malayan shrimps etc)

3.1.2 Buildings

- pump shed, pumps (diesel and electrical)
- lockup work shed for equipment, instruments, freezer etc
- office and visitor's centre
- staff residence
- security fence enclosing above

3.1.3 Equipment

- basic scientific equipment (oxygen, ph, temperature)
- nets
- small boat and outboard
- pick up truck

3.1.4 Maintenance

- Operational costs (fuel, food etc)

3.2 Staffing

The Aquaculture Centre should be established and staffed by the Western Samoa Fisheries Division. The project should be under the general control of the Chief Fisheries Officer, and under the direct control of the Aquaculturist The salary of the Aquaculturist employed in the project should met by bilateral aid preferably UNDP for at least the first four years of the project. This is requested through the UNDP volunteer scheme.

Two Assistant Fisheries Officers (AFOs) should be recruited for the project. Casual labour should be employed as required. (Possible duty statement for AFOs: Under the direction of the Chief Fisheries Officer and Fisheries Officer (Aquaculture), the AFOs should be permanently attached to the Aquaculture Centre with the responsibilities for the day-to-day operation of the Centre, feeding fish, checking water quality, maintenance of pumps and ponds, production of fry and adult fish as required, patrolling the reservoir, assessing stock, lecturing visitors, and passisting farmers establish ponds elsewhere in Western Samoa. If possible, one of the AFOs should be from the Afulilo land-owning group).

3.3 Training

The Assistant Fisheries Officers (Aqauaculture) should visit areas with existing freshwater fish farming (Scheduled to attend 30 day workshop on this subject in Republic of China visit Israel tilapia farms in Fiji).

One of the Assistant Fisheries Officers will take over the responsibilities of the Fisheries Officer when his terms terminates.

4. BUDGET:ESTABLISHMENT, AND FOUR YEARS OPERATIONAL (USD, approx)

4.1 UNDP

	Year 1	Year 2	Year 3	Year 4
4.1.1 Salary				
(Aquaculturist-Volunteer)	19,000	20,900	22,990	25,289
	19,000	20,900	22,990	25,289

4.2 Economic Development Fund (EDF) FFA

4.2.1 Site preparation pond construction etc	10,000		
4.2.2 Equipment			
. diesel pumps (2)	4,500		2,500
. submerge cable electrical pumps (2)	1,500		3,500
. blower	1,500		2,000
. pipes, plumbing etc	6,000		7,500
. vehicle	18,000	-	-
. refrigerated truck		20,000	

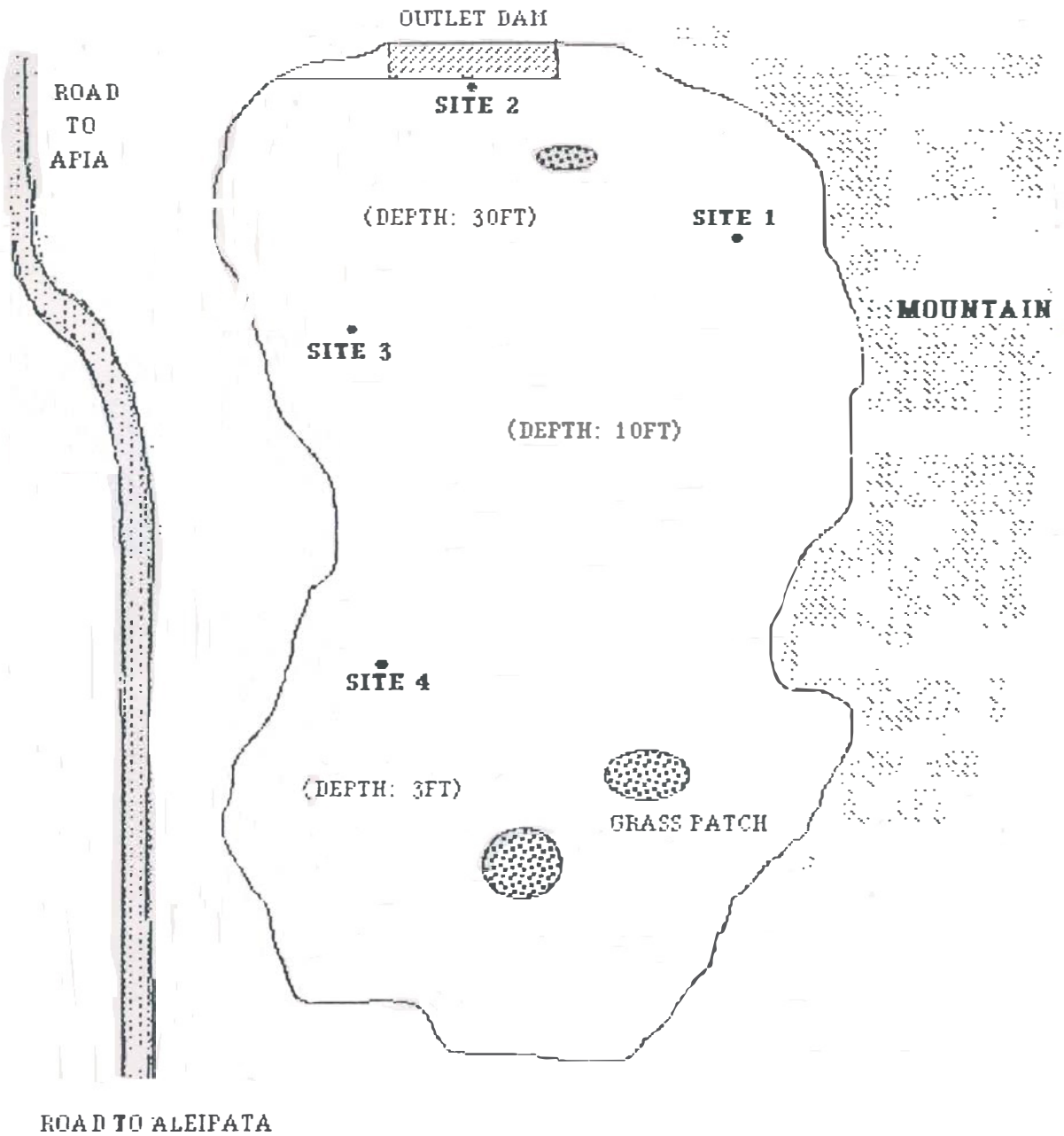
. water quality metres, lab ware	7,500		5,000	
freezer, balances etc				
. misc. tools, nets etc	5,500		4,000	
. small boat & outboards	12,000		5,000	
4.2.3 Buildings				
. workshop, office/visitors centre	40,000	-		
lockup shed, staff residence				
	$106,500	$20,000	$29,500	

4.3 Western Samoa Government

4.3.1 Salaries				
. Assistant Fisheries Officers (2)	8,000	8,800	9,680	10,648
. Casuals (3)	7,000	7,700	8,470	9,317
4.3.2 Maintenance				
fuel, electricity, food, operating	30,000	33,000	36,300	39,930
expenses etc				
	$45,000	$49,500	$54,450	$59,895

4.4 SUMMARY

	Year 1	Year 2	Year 3	Year 4
UDNP	19,000	20,900	22,990	25,289
EDF (FFA)	106,500	20,000	29,500	-
WS Government	45,000	49,500	54,450	59,895
	$170,500	$90,400	$106,940	$85,184



MAP (AERIAL VIEW) OF THE AFULILO HYDROELECTRIC DAM RESER