INSTITUT FRANÇAIS DE RECHERCHE SCIENTIFIQUE
POUR LE DEVELOPPEMENT EN COOPERATION (ORSTOM)

MISSION ORSTOM DE PORT-VILA

ORSTOM PARTICIPATION IN THE 3rd WORKSHOP ON THE DEVELOPMENT OF VILLAGE FISHERIES IN VANUATU

PORT-VILA, 4-8 NOVEMBER 1985

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THE FISHING INDUSTRY IN VANUATU

E. CILLAURREN

1. Geographical and socio-economic background

The Vanuatu archipelago is made up of some 80 islands extending over 13,840 sq.km, and is of volcanic and coralline origin. The country is surrounded by a narrow stretch of reefs. There are few lagoons, and the outer reef slope drops rapidly, which means that deep ocean borders the coast.

Over 90% of the population (113,000 inhabitants according to the 1979 population census) consists of Melanesians, generally found throughout the islands, whereas the two urban areas, Port Vila and Luganville, draw in the majority from Europeans, Asians and other races of the Pacific region.

Traditionally the ni-Vanuatu are agriculturally orientated. However, there is some subsistence fishing, mainly concentrated around the reefs. The Fishing census has brought to light a number of significant details on this subject (DAVID, 1985). The marine habitat has remained largely untouched thanks to the use of ancestral fishing methods (assegai, bow and arrow) and also to numerous ecological taboos. However resources of the reef shelf have been drastically exhausted because of urban expansion, tourism development and the introduction of modern fishing techniques (nylon fishing lines, spear guns, etc.). At the same time canoe fishing outside the reef areas has grown, as the flesh of deep-sea fish is highly desirable, being free of ciguatera toxin (commonly known as the "itch" or "scabies").

A Fisheries Department was set up in 1979 for the purpose of looking into the ocean potential of the waters surrounding Vanuatu and the possibilities of exploiting them. Around the same time the Government signed a principal agreement with ORSTOM to carry out, in conjunction with the Fisheries Department, a programme of research on the exploitable resources of the coastal waters and the deep sea.

2. Coastal resources

2.1 Subsistence fishing

Most of the families living along the coastlines do some subsistence fishing at one time or another. Because they mostly use traditional outriggers, their fishing activities are limited to the fairly shallow waters close to shore. The dwindling resources of the reef shelf, which are of easy access, and the allocation of subsidies from the sale of copra have encouraged interested fishermen to invest in modern equipment to enable them to catch the marketable species found further out to sea (David, 1985).

2.2 Mother-of-pearl shells

The most interesting shells from a commercial point of view are the trochus, *Trochus niloticus*, and the green snail, *Turbo marmoratus*. These

molluscs are collected for their flesh and for export or for processing the shell into mother-of-pearl buttons, as is done by a small local business. The stocks have been so exploited that the Fisheries Department plans to start a trochus hatchery to reseed the environment (Heslinga and Perron, 1983). Such a project calls for research into trochus growth which led ORSTOM to carry out a tracing programme. A document will be published on the subject in December 1985.

2.3 Live bait

Live bait consist of pole-and-line fish species which prefer shallow waters. They are used for fishing. A number of exploratory operations have been carried out in Vanuatu, especially by the JAMARC (Japan Marine Research Center), the SPC (South Pacific Commission), the Fisheries Department and ORSTOM. The results have been far from encouraging (operations in 1972, 1973, 1978 and 1982): they showed that live bait occur from time to time, seasonally, in the coastal areas of Vanuatu. The findings were considered too uncertain to continue the experiment (GRANDPERRIN *et al.*, 1982).

3. Deep-lying resources on the outer reef slopes

3.1 Deep-sea fish

These fish live at a depth of 200 to 400 metres on the slopes of reefs. Those which are most commonly found are of the ETELIDAE family (including the genus *Etelis sp.* and the *Pristipomoides sp*). They are particularly liked because they are free of ciguatera toxin. They are caught with lines and hand reels. The best bait is the bonito with a striped underbelly (*Katsuwonus pelamis*).

This small-scale fishery is destined to become commercialized. Modern methods of fishing (motor boats, reels, lines) are used in virgin areas. Co-operating closely with the Fisheries Department, ORSTOM carried out a first assessment of the extent of these stocks in order to establish th required parameters for future orderly management (BROUARD and GRANDPERRIN, 1984).

3.2 Deep-sea prawns

This resource consists mainly of *Heterocarpus sibogae* and of *H. laevigatus*, which live between 400 and 500 metres. Fishing results show that the potential for exploitation is only very average and the limited local market does not warrant large-scale investment. In addition, these species are rather delicate and unable to withstand basic methods of storage. To exploit them it is necessary to find areas close to urban centers (REVIERS *et al.*, 1982).

4. Offshore resources

These mainly consist of THUNNIDAE (*Thunnus alalunga, T. obesus, T. albacares, Katsuwonus pelamis*). There are other species, but they are not caught as often (*Auxis thazard, Elagatis bipinnulatus, Sphyraena*

barracuda, Coryphaena hippurus, etc.). Such resources are exploited both through industrial and artisanal fishing. The latter is in full expansion since the appearance of fish aggregating devices (F.A.D's).

4.1 Industrial fishing

In 1958, because of the then expanding Japanese longline fishing, the SPFC (South Pacific Fishing Company) signed an agreement with the Government to set up a storage base for freezing and transhipping long-line tunas for export markets. It is situated at Palekula (Santo) and accounts for 9% of Vanuatu's exports. With the rising standard of living in Japan, the Japanese tuna fishery turned towards the more exclusive species (those for sashimi) which caused the Japanese ships to be gradually replaced by Taiwanese longliners under subcontract. Production reached 4,500 tonnes year, but is now on a downward trend. Longlining will no doubt be abandoned in due course, preference now being given to purse-seining. With respect to this technique, trials carried out over the last years throughout the Pacific have shown that the installation of F.A.D's has greatly improved the production rate per fishing team.

4.2 Artisanal fishing

This is nothing but trolling (using a hand reel). In recent years the wide-scale introduction of F.A.D's throughout the Pacific has enabled production to increase with a drop in costs because of a decrease in length of fishing trips. In addition, the F.A.D's ensure a regular supply of species of fish which are used as bait for deep-sea fishing, thus indirectly contributing to the development of this activity.

The Fisheries Department set up three F.A.D's south-west of Efate. Overall data on trolling and deep-sea droplining have been collected by ORSTOM. In December 1983 these data were analysed in detail, distinguishing between the catches from each FAD.

Thus we hope to :

- establish the aggregating force of the fish aggregating devices;
- draw comparisons between F.A.D's;
- identify the species they attract, their sizes and their distribution over the year;
- try to work out locations and movements for each aggregated species in time and space;
- study the biological characteristics of the species caught (their growth rate, reproduction process, etc.).

The methodologies and initial findings will be published in a paper in May 1986.

4.3 Radiometry and aerial prospecting

The ORSTOM Center has carried out over 300 hours of flying within the exclusive economic zone (E.E.Z.) of Vanuatu. The radiometric surveys have enabled us to establish the location of thermal fronts which are potentially favourable to the aggregation of THUNNIDAE, and this has been evidenced by the surveillance of shoals of tuna. According to the findings there is a fairly high potential. However, the world-wide slump in tuna has slowed down the development of a dynamic surface fishing industry as the government of Vanuatu has not entered into any agreements with foreign fleets, apart from longliners.

5. CONCLUSION

The radiometric surveys carried out by ORSTOM and the tracing operations followed up by the S.P.C. have shown that there is an exploitable stock of tuna. The lack of live-bait in the coastal areas of the archipelago would seem to preclude the practice of pole-and-line fishing. On the other hand purse seining seems to hold greater promise, especially if it involves the use of fish aggregating devices (F.A.D's). Longlining tuna living at lower levels apppears to have a somewhat doubtful future due to the decrease in production.

All of these fishing techniques require large-scale investments, which is beyond local financial means, and that is why planning in Vanuatu is aimed towards the development of simple small-scale techniques involving deep-sea fishing, as deep-sea fish are still a virtually untapped resource, and pelagic fish. These species will be destined both to be marketed locally, and used to provide a regular supply of bait.

The research carried out by ORSTOM has contributed significantly to the development of small-scale fishing in Vanuatu, both from the point of view of deep-sea fish and from the point of view of the aggregating effect of F.A.D's. Since the hydroclimatic factors of the waters surrounding this group of islands are almost the same as those found throughout the Pacific in general, this research work also has a significant impact on the whole region.

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VILLAGE FISHERIES AND NATURAL ENVIRONMENT

G. DAVID

1. Fish and their habitat

Fish are present throughout the sea, but their number varies according to te and depth. The coastal waters hold the largest percentage, being rich in food resources. Not all coastal waters show the same concentration of fish. The mouths of rivers, mangroves and reefs are the richest areas.

The mouths of rivers owe their abundance to the mineral salts carried along by the fresh water following soil erosion. These nutritious components, which are present in large numbers, encourage the growth of tiny microscopic floating sea-weed, i.e. phytoplankton. These plants represent food for a whole range of microscopic living beings, i.e. zooplankton, which are in turn food for small fish such as sardines, which are themselves the prey of larger fish, such as horse-mackerels.

Mangroves are a generous source of food due to (a) the presence of numerous roots emerging from the ground, covered by tiny sea-weed which is excellent nourishment for herbivorous fish; (b) the quantity of leaves, twigs and inflorescences which fall into the sea every year, as a rule at the rate of 8 to 11 tons per hectare. Therefore the 2500 to 3500 ha of mangroves growing in Vanuatu release each year some 20,000 to 35,000 tons of plant material into the sea. The leaves soon decompose in the water and turn into food for a mass of fish, crustaceans, shells, and worms, which absorb the most easily biodegradable portion and expel the cellulose and lignin, the components of leaves which can only be broken down by bacteria. The excreta is first set upon by the bacteria, and then later by a host of microscopic animals which live off them. Thus covered in micro-organisms, the excreta represent a choice food for such filter shells as clams, oysters and mussels, and for those crustaceans and fish that thrive on offal such as prawns and mullet.

The reef draws its wealth from the nature of coral which constitutes an association between certain animals: polyps, microscopic algae that live in the tissue of polyps, and fibrous algae that congregate in the calcareous skeleton surrounding polyps. The benefits are mutual: the plants provide nourishment to the animals, which in turn contribute to the growth of the plants. Due to this association of animal and vegetable life these corals have the highest level of productivity in the world, thus enabling the development of a dynamic marine life on and around the reefs. A reef consists of two different zones:

- the shelf, which is revealed during low tide, and which contains only small fish, except during high tide when small predatory fish come up to hunt there;
- the reef slope, which may drop steeply towards ocean depths, and which is the richest section of the reef, and hence the most interesting for the fisherman who has hopes of catching fish down to 400 metres, the zone between 100 to 400 metres being that of such deep-sea fish as the red snappers (poulet fis).

The offshore waters belong to the pelagic fish which live either close to the surface or within the first hundred metres of water, for instance tuna and mahi-mahi (dorado). As a rule offshore waters are nutritionally poor, which means that fish have to be on the move continuously, looking

for nourishment. Occasionally a sudden increase in the water's nutrient value may be noted between two neighbouring islands, for instance between Maewo and Pentecost, or between Pentecost and Ambrym, when turbulences, of which little is known as yet, caused by what is called the "island effect", change the currents in the sea. When this happens, the bottom waters, rich in mineral salts, surge to the surface, causing the phytoplankton to multiply rapidly and attracting lots of pelagic planktophonageous (plankton-eating) fish, such as sardines, and in their wake, their predators, such as tuna.

2. Fishing grounds

Where there is a habitat, or an area of food resource for fish, there is a fishing ground for man. As shown above, it is not possible to pinpoint any constant fishing area for pelagic fish, which are always on the move. At the most, a fisherman may, by persistently monitoring the waters, discover some sites which seem to be productive more often than others. These zones of transfer would appear to be ideally suited for the installation of Fish Aggregating Devices (1). However, fishing sites along the coast can be classified according to the presence of rivers, mangroves, reef shelves, and the outer reef slope extending on the one hand from 10 to 100 metres and on the other hand to depths of 100 to 400 metres.

Table 1 shows for each island the number of rivers where the flow would appear to be strong enough to fertilise the coastal area surrounding the river mouth. It may thus be noted that the most favoured islands in the country are Santo and Malakula.

Table 2 indicates the main areas of mangroves and their ratio to the overall area of the respective islands. It seems that Malakula and Hiu, in the Torres group, hold 86% of the country's mangroves, but that Emae and Aniwa are also well endowed, since they represent 2% of the emerged area of land. Tables 3a and 3b show in detail, by island, the distribution of reefs and their proportion to the land. In all, out of the 23 islands or groups of islands mentioned in Table 3, 14 are surrounded by reefs extending over a larger area than the actual island which is a particularly strong factor in favour of fishing operations. From this point of view the Banks-torres group, the shephards and the Paama-Epi group, together with the southern islands (Aniwa, Futuna, Aneityum) would appear to be the best; they represent only 7%, 4.5% and 1.5% respectively of the emerged surface of the whole country, but they also contain 12%, 14% and 4,5% of the reef areas.

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(1) See previous article by E. CILLAURREN.

Table 1 : Area distribution of the rivers in the archipelago

Island	rivers - low to medium flow		rivers - medium to high flow	
	number	%	number	%
Torres	0	0	0	0
Mere Lava	0	0	0	0
Mota	0	0	0	0
Mota Lava	1	0,4	0	0
Santa Maria	4	1,5	0	0
Vanua Lava	17	6,3	0	0
Santo	72	26,5	8	47
Malo	1	0,4	0	0
Maewo	30	11	0	0
Ambae	0	0	0	0
Pentecost	38	14	0	0
Malakula	46	17	4	23,5
Ambrym	2	0,8	0	0
Paama-Lopévi	0	0	0	0
Epi	15	5,5	0	0
Shephards	0	0	0	0
Efaté	11	4	1	6
Erromango	20	7,4	4	23,5
Tanna	12	4,4	0	0
Aniwa	0	0	0	0
Futuna	0	0	0	0
Aneityum	2	0,8	0	0
VANUATU	271	100	17	100

Table 2 : Area distribution of the main mangroves in the archipelago

Island	mangrove area (ha.)	%	Area of islands (ha.)	mangrove area to island area - %
Malakula	1975	78	205 300	1
Hiou	210	8,5	5 280	4
Efaté	100	4	92 300	0,1
Emae	70	3	3 280	2,1
Epi	60	2,5	44 500	0,1
Vanua Lava	35	1,5	33 100	0,1
Ureparapara	30	1	3 900	0,8
Mota Lava	25	1	3 100	0,8
Aniwa	15	0,5	800	1,9
Total	2460	100	391 560	0,6

Table 3 : The reefs in the archipelago

a) Area distribution

Island	SURFACE AREA OF Island	Shelf		Slope - 10 to 100m		Slope - 100 to 400m		Total Reef Area	
	(ha)	(ha)	%	(ha)	%	(ha)	%	(ha)	%
Torres	12 000	1 604	3,6	26 125	9,9	20 596	2,7	48 325	4,5
Ureparapara	3 900	275	0,6	1 650	0,7	5 149	0,7	7 074	0,7
Vanua Lava	33 000	1 635	3,7	6 500	2,5	16 391	2,2	24 526	2,3
Mota	1 500	110	0,2	850	0,3	3 175	0,4	4 135	0,4
Mota Lava	3 100	566	1,3	2 450	0,9	4 119	0,6	7 135	0,7
Mere Lava	1 500	30	0	550	0,2	1 775	0,2	2 355	0,2
Santa Maria	33 000	1 511	3,4	3 275	1,2	16 992	2,3	21 778	2
Rowa	10	2 633	5,9	1 700	0,7	4 275	0,6	8 608	0,8
Santo - Malo	424 800	4 500	10,0	60 000	22,7	142 970	18,9	207 470	19,5
Maewo	28 000	781	1,7	6 025	2,3	33 468	4,4	40 274	3,8
Ambae	41 000	232	0,5	3 850	1,5	11 843	1,6	15 925	1,5
Pentecost	49 000	1 735	3,9	8 950	3,4	25 000	3,3	35 685	3,4
Malakula	205 300	10 110	22,6	45 100	17,1	101 344	13,4	156 554	14,7
Ambrym	66 500	703	1,6	7 250	2,7	26 650	3,5	34 603	3,3
Epi-Paama-Lopévi	47 800	2 497	5,6	19 125	7,2	76 512	10,1	98 134	9,2
Tongoa - Tongariki	5 000	146	0,3	4 725	1,8	16 530	2,2	21 401	2
Emae-Makura-Mataso	3 600	2 017	4,5	4 650	1,8	30 824	4,1	37 491	3,5
Efate	92 300	8 068	18	28 450	10,8	95 330	12,6	131 848	12,4
Erromango	88 700	1 341	3	4 250	1,6	55 658	7,4	61 249	5,8
Tanna	56 100	1 311	2,9	7 450	2,8	42 438	5,6	51 199	4,8
Aniwa	800	310	0,7	1 150	0,4	5 125	0,7	6 585	0,6
Futuna	1 100	102	0,2	1 400	0,5	3 700	0,5	5 202	0,5
Aneityum	16 000	2 576	5,8	18 450	7	14 816	2	35 842	3,4
VANUATU	1 218 900	44 793	100	263 925	100	754 680	100	1 063 398	100

Table 3 (cont'd): The reefs in the archipelago

b) Reef area in relation to the area of land a.s.l.

Islands	shelf 10 to 100 m	slope 10 to 100 m	slope 100 to 400m	total reef area
Torres	0.13	2.18	1.72	4.0
Ureparapara	0.07	0.42	1.32	1.81
Vanua Lava	0.05	0.20	0.50	0.74
Mota	0.07	0.57	2.11	2.76
Mota Lava	0.18	0.79	1.33	2.3
Mere Lava	0.02	0.37	1.18	1.57
Santa Maria	0.05	1.0	0.51	0.66
Rowa	263.3	170.0	427.5	860.8
Santo - Malo	0.01	0.14	0.34	0.49
Maewo	0.02	0.22	1.20	1.44
Ambae	0.005	0.09	0.29	0.39
Pentecost	0.035	0.18	0.51	0.73
Malakula	0.05	0.22	0.49	0.76
Ambrym	0.01	0.11	0.41	0.52
Epi-Paama-Lopevi	0.05	0.40	1.60	2.05
Tongoa-Tongariki	0.03	0.95	3.31	4.28
Emae-Makura-Mataso	0.56	1.29	8.56	10.4
Efate	0.09	0.31	1.03	1.43
Erromango	0.02	0.05	0.63	0.69
Tanna	0.02	0.13	0.76	0.91
Aniwa	0.39	1.44	6.41	8.23
Futuna	0.09	1.27	3.36	4.73
Aneityum	0.16	1.15	0.93	2.24
VANUATU	0.04	0.22	0.62	0.87

3. Outings to the fishing grounds

As a rule outings to the fishing grounds depend on two factors: the distance to the grounds from the fishermen's village, and the sheltered or exposed nature of the location in relation to weather, especially wind and sea conditions. Actually the question of fishing is considered from a different angle than for coastline fishing grounds, i.e. at the mouths of rivers, in mangroves and on the reef shelf, which are usually little affected by weather conditions, and that of the reef slope, sometimes located several nautical miles from the coast.

Like the mouths of rivers, which are mostly protected by a sand bank or by a bar of pebbles, the mangrove area is sheltered as mangroves require fine sediments to grow, which are only deposited in places sheltered from ocean swells and from the waves whipped up by the

prevailing winds (DAVID, 1985). The shelves are always accessible by foot at low tide, and at high tide the fishing crafts used are of a sufficiently broad range (1) to allow for at least one or two fishing methods to be adopted irrespective of weather and sea conditions. The main deterrent therefore is the distance between the fishing grounds and the fishermen's villages (2).

As for the reef slope, the determining factors are south-easterly swells and atmospheric conditions, especially the direction and force of the prevailing winds, the trade winds. Throughout the wole of the cool season the trade winds blow from east to west in the southern part of the country, and in the north, from the south-east to the north-west. On the eastern and southern coast of the islands the seas are often rough, and fishing outings are less frequent than on the leeward coasts, which are sheltered from the winds. Figure 1 shows how the southern and western coasts of Malakula, Ambae and Santo are sheltered from the open ocean swells by the islands of Maewo, Pentecost, Ambrym, Paama, Epi and Emae. Malakula has an added trait, an unusual one - the whole of its western coastline runs parallel to the prevailing winds. Whilst the degree of exposure to the elements is of far greater importance, the distance of the fishing grounds from the villages cannot be ignored. Indeed this factor may make a major difference, for instance when production drops significantly in one site, due to overfishing, thus compelling the fishermen to explore other locations.

Trolling is subject to the same weather uncertainties as reef fishing, but the major impediment to this form of fishing is the extreme mobility of the pelagic fish species, which causes fishing to extend over a wide expanse of sea.

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(1) Fishing census reveals that there are eight different kinds of fishing methods used along the coast. In decreasing order of importance: line fishing, spear fishing, spear-guns, bow and arrows, mesh nets, cast-nets, pots, leaves or roots used for poisoning and fish enclosures (DAVID, 1985).

(2) It should be noted that in many parts of the archipelago, particularly on Pentecost, the customary traditions which prohibit fishing on the reefs within the village territory, for periods of several weeks or even years, are a far more powerful deterrent than any of the physical factors.

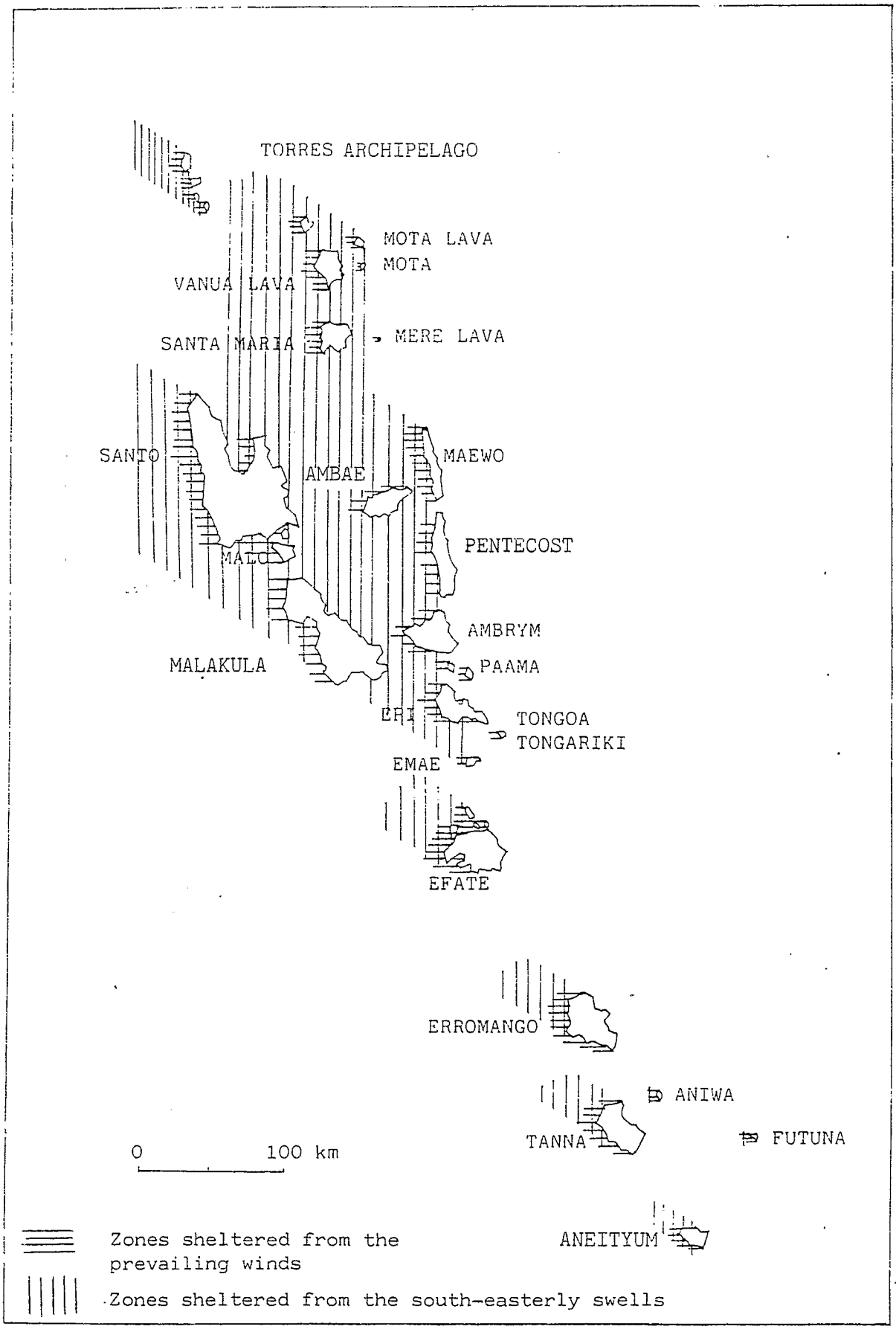

Fig. 1 – The Vanuatu archipelago
Fishing zones in relation to swells and prevailing winds.

4. Fishing operations at the fishing grounds

The fishing census has enabled us to assess the number of fishermen, the number of fishing gear, the number of fishing outings and the annual productivity (DAVID, 1985). There are four parameters which can serve to measure the fishing activities:

- the density of the fishing gear, i.e. the amount of gear used in comparison to the area of the fishing zone,
- the number of outings per year and per hectare of exploitable sea surface,
- the density of fishermen,
- the number of fish caught per year and per hectare.

To be clear and avoid any confusion we shall only examine the last two parameters in this paper. In Table 4, the density of fishermen was calculated firstly in relation to the areas of reef shelf and mangroves, being the most popular fishing grounds, and then secondly, in relation to the total area of the exploitable fishing zone. Over the whole archipelago the density of the fishermen on the reef shelf and in the mangroves is 18 per sq.km. Out of the 23 islands or groups of islands included in the table, 11 show a density above average: 600 to 100 fishermen per sq.km at Mere Lava, Ambae, Tongoa, Tongariki; 50 to 35 fishermen per sq.km at Tanna, Futuna, Ambrym, Pentecost; and 35 to 20 fishermen per sq.km at Mota Lava, Maewo and Santo Malo. On an average the density in the reef slopes is 80 times less: 0.23 fishermen per sq.km for the whole country. Mere Lava, Tanna and Mota Lava show the highest density.

Table 5 shows that fish yield per hectare in the shelf areas and mangroves is 60 times more than on the reef slope. These results do not indicate that there is a difference in the productivity of these areas, but that the fishing activities vary considerably. In decreasing order of importance: Mere Lava, Tongoa-Tongariki, Ambae, Malakula and Tanna are the five islands with the highest rate of return in coastal areas, which is understandable as they have the highest deneity of fishermen, apart from Malakula, where the high level of production per hectare is due, we feel, to the productivity in the environment, higher than in other islands because of the wide expanse of mangroves and the number of rivers. Mere Lava, Tanna, Mota lava, Ambae and Malakula and Efate are recorded as having the highest rates of return on the reef.

Table 4 : Density of fishermen at the fishing grounds

Island	Mangroves and shelves			Outer slope - 10 to 400 m		
	number of fishermen(1)	surface area (ha)	households density/km²	number of fishermen(2)	surface area (ha)	households density/km²
Torres	63	1 814	3,6	?	46 721	
Ureparapara	41	305	13,4	?	6 799	
Vanua Lava	170	1 670	10,2	25	22 891	0,11
Mota	85	110	77,3	5	4 025	0,12
Mota Lava	200	591	33,8	38	6 569	0,58
Mere Lava	165	30	550	90	2 325	3,9
Santa Maria	137	1 511	951	45	20 267	0,22
Rowa (3)	?	2 633		?	5 975	
Santo - Malo	1 074	4 500	23,9	165	208 945	0,08
Maewo	255	781	32,6	81	39 493	0,2
Ambae	416	232	179	52	15 333	0,34
Pentecost	700	1 735	40,3	34	33 950	0,1
Malakula	2 230	12 025	18,5	738	146 444	0,5
Ambrym	310	703	44,1	25	39 900	0,07
Epi-Paama-Lopévi	286	2 557	11,2	105	95 637	0,11
Tongoa-Tongariki	224	146	153,4	38	21 255	0,18
Emae-Makura-Mataso	149	2 087	7,1	5	35 474	0,01
Efate	1 380	8 168	15,8	407	123 780	0,32
Erromango	140	1 341	10,4	27	59 908	0,04
Tanna	635	1 311	48,4	386	49 888	0,77
Aniwa	57	325	17,5	15	6 275	0,24
Futuna	45	102	44,1	5	5 100	0,09
Aneityum	89	2 516	3,5	72	33 266	0,21
VANUATU	8 853	47 253	18,7	2 358	1 018 605	0,23

(1) The number of fishermen has been accounted for in relation to households.
(2) Those fishermen households taking regular trips in outriggers or boats have been categorized as fishing on the outer reef incline.
(3) The Rowa atoll formation is now no longer inhabited. 20 people were recorded as living there in 1944. They have settled on the island of Ureparapara where they held customary land rights (VIENNE, 1984).

Table 5 : Returns on fish production

Island	Mangroves and shelf		Outer Slope 10 to 400m	
	Annual Fish Production	Production per ha	Annual Fish Production	Production per ha
Vanua Lava	127 660	76	11 650	0,50
Mota	?		?	
Mota Lava	25 010	42	31 770	4,83
Mere Lava	38 115	1 270	26 675	5,70
Santa Maria	77 375	29	?	?
Santo-Malo	179 035	40	3 365	0,05
Maewo	87 415	112	26 730	0,70
Ambae	93 290	402	29 015	1,90
Pentecost	67 030	39	19 500	0,60
Malakula	1 841 580	153	591 500	4,00
Ambrym	32 030	46	27 560	0,80
Epi-Paama-Lopévi	140 815	55	87 305	0,90
Tongoa-Tongariki	78 050	535	20 230	0,95
Emae-Makura-Mataso	32 760	16	?	?
Efaté	656 800	80	230 050	1,90
Erromango	154 130	115	11 390	0,20
Tanna	195 000	149	287 300	5,80
Aniwa	3 745	11,50	12 900	2,00
Futuna	?	?	5 510	1,10
Aneityum	133 380	52	24 750	0,70
VANUATU	3 963 220	84	1 457 200	1,40

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CONSUMPTION OF SEA PRODUCE AND ITS MARKETING

G. DAVID

1. Consumption of fish and shellfish among the female population

In 1983 the Ministry of Health ran a sample survey covering 522 pregnant or nursing women to find out their dietary habits (M. Hung, 1983). Because their eating habits differed very little from those of other adult women, the findings were deemed to be representative for the whole of the female population over 19 years of age throughout the islands.

1.1 Importance of the protein intake

The survey revealed that 42% of the women questioned had eaten no food with protein the day before the investigators visit. The percentage is lower in the urban area (10%) than in rural areas (47%), where, as shown in Table 6, a difference could be made between the shore areas and inland areas, in the latter of which the lack of protein intake affects 55% of the women questioned. At the heart of some islands, such as Tanna, this percentage exceeds 80%. There is therefore most definitely a protein deficiency in the diet, which is all the more serious in that it primarily affects pregnant or nursing women who, because of their condition, should follow a high-protein diet.

1.2 Significance of the consumption of fresh and tinned fish

Throughout the country 33% of the people questioned said they had eaten fresh produce from the sea the day before the investigators visit, and 15% had eaten tinned fish (Table 6).

Table 6 : the daily protein consumption among the female population of Vanuatu

	% of the population questioned having eaten during the day								
	No proteic food	proteic food	fish	shellfish	meat	tinned fish	tinned meat	eggs or milk	Total
Urban	10	90	20	0	72	29	13	6	100
Rural areas	47	53	26	8	26	23	3	1	100
Along shore	45	55	32	11	22	14	3	2	100
Inland	55	45	8	7	37	7	2	2	100
Overall	42	58	26	7	38	15	4	2	100

Table 7 : Constituents of the protein-rich rations

	Fish (%)	shellfish (%)	meat (%)	tinned fish (%)	tinned meat (%)	milk and eggs (%)	total amount of proteic foods
Urban areas	14	0	52	21	9	4	100
Rural areas	34	12	33	15	4	2	100
Inland	17	10	55	11	4	2	100
Along shore	38	12	27	17	4	2	100
Overall	27	8	42	16	5	2	100

In town the consumption of fresh fish and shellfish only concerns 20% of the women and is considerably lower than the consumption of tinned fish (tin fish), which represents 60% of the total amount of sea protein intake, or even that of the consumption of meat which accounts for 52% of the daily protein ration (Table 7).

Along the shore, the women consumers of fresh sea food represent 42% of the population included in the survey, as opposed to 14% inland. Among the former, fresh fish and shell fish account for 51% of the daily ration of protein, and in the latter, 27% (Table 7). On the other hand, be it in shoreline areas or inland, fresh produce makes up 70% of the overall high protein food consumed, while tinned fish comprises 30%.

2. Marketing of sea produce

2.1 Importance of marketing

According to the fishing census, in 1983 between 15 and 32% of the fishing production of the archipelago was sold, which corresponds to 400 to 750 tonnes worth between 105 and 193 million vatu (DAVID, 1985). Sales were particularly dynamic with respect to lobster, which accounted for approximately 85% of the revenue from the marketed produce in villages, and to fish, of wich 23 to 26% of the catch were sold (Table 8).

Table 8 : Village fishing production in 1983 and its marketing

	Total Production (tonnes)	Marketed Production		
		% total production	Weight (tonnes)	Value (million VT)
Fish	850 to 1200	23 - 26	190 to 300	15 to 24(1) 19 to 30(2)
Octopus	53 to 77	12 - 19	6 to 14	1 to 2

Looster	370 to 720	48 - 53	180 to 330	90 to 164
Sea shells	670 to 960	4 - 11	27 to 106	0.8 to 3.2
Total production	1900 to 3050	15 - 32	40 to 750	106 to 193(1) 120 to 200(2)

(1) The kilo price of fish estimated as VT.80
(2) The kilo price of fish estimated as VT100

The 1984 census findings only relate to fish catches. They show that 84% of the production was for self-consumption by the fishermen, 12% were sold and 3% were donated. In all 37.2 million vatu were spent by the archipelago's rural population to purchase fresh fish. Around 17% of this amount, i.e. 6.4 million vatu (1), went to the village associations supported by the Fisheries Department. 30.8 million returned to the fishermen themselves, againts approximately 308 tonnes of fresh fish sold at an average of 100 vatu per kilo. These sales correspond to 12% of the overall production which can therefore be estimated at 2,567 tonnes which is exactly twice as much as the 1983 estimates (Table 8). This difference, we feel, lies in the way the survey was carried out. In 1984 the catch was recorded on a daily basis, whereas in 1983 the fishermen were expected to reply to the question "how many fish did you catch last week?". Most probably they primarily gave the figures for the biggest catches, those readily saleable, which could explain the high level of sales, and omitted the smaller fish.

(1) The activities report from the Fisheries Department for 1984 states that the overall production within the village associations amounted to 96.3 tonnes of which 55%, being 53 tonnes, were solely and entirely consumed in rural areas. A value of 6.4 million vatu corresponds to an average price of VT.120 per kilo of fresh fish.

The 1983 production was grossly underestimated. On the basis of the 1984 figures, taking a marketing percentage of 12% for 1983, a new assessment was made (Table 9). The reassessment shows that the overall production is 70% higher than that shown in Table 8. The discrepancies are minor with respect to the marketed production. The first assessment is 30% below the second one.

Table 9 : Fishing production in 1983 and its marketing (Re-assessed).

	Total Production (3)		Marketed Production (4)		
	Number	Tons	% total production	Weight (tonnes)	Value (million VT)
Minimum	10,416,700	1,666	12	250	20(1) to 25(2)
Average	12,945,833	2,071	12	311	25(1) to 31(2)
Maximum	16,666,700	2,667	12	400	32(1) to 40(2)

(1) The kilo price of fish estimated as VT.80
(2) The kilo price of fish estimated as VT100
(3) 62.5% of the production consists of shallow-water fish; 22.5% of the deep-sea fish; and 15% freshwater fish. The mean weight of a fish has been estimated at 0.1 kg in shallow waters, 0.4 kg in deep waters and 0.05 kg in fresh water.
(4) The mean weight of 0.2 kg per fish was used for calculating the marketed tonnage.

2.2 Importance given to purchases of seafood in the household budget

According to the fishing census, in 1984 purchases of fresh fish amounted to only 2% of the household(1) budgets in rural areas, and took fourteenth place on the list of 113 products sold throughout the islands. The first five items alone monopolise 46% of the household budgets and these are rice (22%), tinned fish (8%), bread (6%), sugar (5%) and soap (5%). In 1984 every household allocated on an average 36,400 vatu to these products, i.e. 3,033 vatu per month. Table 10 reveals that the monthly amount allocated to fresh fish is 3.7 times less than the amount for tinned fish.

Table 10 : 1984 Household Budgets

	Budget Allocation per household %	Monthly Expenditure per household VT	Yearly Expenditure per household VT	Total Annual Expenditure million VT
Fresh fish	2.2	141.5	1,697	37.21
Tinned fish	8.0	527.0	6,327	138.76
Fresh meat	1.2	81.0	976	21.38
Tinned meat	3.4	226.0	2,709	59.41
Rice	21.7	1,423.0	17,076	374.47
Total	100.0	8,545.0	78,540	1,723.16

In town areas, the last survey on the subject of consumption was carried out in 1975 (T.G. McGEE *et al.*, 1980). This revealed that Melanesian families allocate on average 73% of their monthly budget to food expenditure, out of which rice took first priority with 32%, followed by sugar and fowl, 15.6% each, and tinned fish with 9%. Fresh meat, fresh fish and tinned meat only took up 2 to 2.5% of the monthly food expenditure.

(1) The definition of household for the 1979 population census was given as being "all the persons living under the same roof or in neighbouring buildings and taking at least one communal meal together per day".

3. Restrictions on the consumption and marketing of sea produce

M. HUNG's investigations and those of the fishing census revealed that dietary habits suffer from a marine protein deficiency in those areas where populations are involved in little or no fishing activities, which is particularly the case inland, in towns and in some shore areas where there is no traditional fishing despite generally favourable conditions. The principal factors limiting the consumption of fish are the distance, be it physical or cultural, from production sites and urban lifestyle. The recent development of village fishing associations is definitely a key component in the gradual process of solving the protein deficiency problems experienced by some islanders. Given the present network of roads and the population distribution (Fig. 2), it appears unlikely that the village fishing associations will be able to fill in the near future all the demand for marin proteins among the islanders. Fresh fish is a particularly perishable product in such intertropical latitudes; moreover the need to provide customers with quality produce imposes serious restrictions on the distribution network. There are two solutions to the problem :

- either an increase in the number of fishing associations
- or an expansion of the marketing area covered by each.

The studies undertaken by BROUARD and GRANDPERRIN (1983 and 1984) showed that the first option would be difficult to put into practice as the resources along the reef slope are only limited and sensitive to any intensice exploitation because of the scarcity of nutritions salts in the marine environment exploitable by man(1). Expanding the scope of fresh fish network distribution around the islands can be effected in three different ways :

- by developing and improving the road network in order to reduce transport time from the offloading base for fish to the marketing points;
- by providing each association with a cold-storage installation to enable the catch to be kept for several days;
- by introducing and then extending methods of smoking and drying fish.

The first solution would be difficult to put into effect over the short and medium term as it requires substancial financial inputs, the implementation of which is the responsibility of the local government councils. The second is also very costly and requires systematic maintenance of the refrigeration plant and generator unit supplying the power for it. Smoking and drying appear to be the most suitable solutions. During a visit to Vanuatu H. VON PEL (1956), an FAO expert showed how smoked fish, cooked first for 30 minutes in sea water seasoned with coconut flesh, then shredded and stored in carefully sealed bottle, could keep for over six months without much alteration of the bacterial characteristics of its flesh, in spite of occasional brief exposures to air.

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(1) In this connection refer to article in previous pages : Fishing and Natural Environment

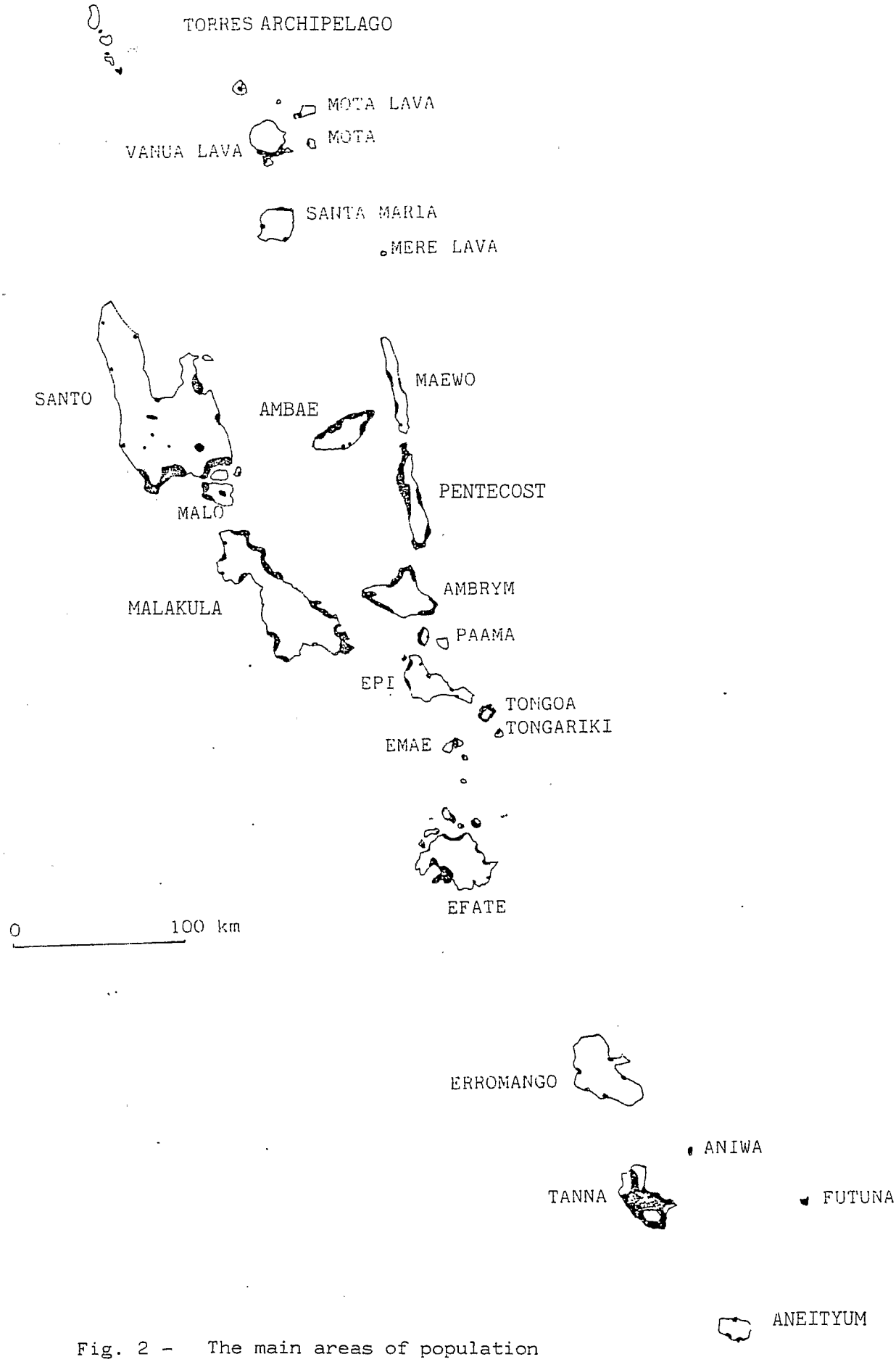

Fig. 2 - The main areas of population concentration throughout the archipelago (1979 census).

Left whole, smoked fish will keep perfectly for one or two weeks under similar climatic conditions to those found in Vanuatu, subject to it being protected from the elements. Beyond this period it only requires to repeat the smoking process in order to keep it longer. Because of its good storage and transport potential, smoked fish could easily be sold in any village store, however remote and removed from the coast. Smoked fish may be eaten cold or warmed up in a few minutes. It goes well with laplap, rice and soup.

Drying is a form of conservation which has raised a lot of interest over the last few years in many Oceanic countries such as Fidji and Papua New Guinea. New techniques have been developed for salting and drying fish. At a very low cost it is possible to keep the fish in perfect condition for six months. For instance in Papua New Guinea fillet of tilapia, salted and then smoked in the villages along the shore of the Sepik river is sold at half the price of "tin fis". From a nutritious point of view, smoked or dried fish is, for the same weight of fresh fish, much richer in proteins, mineral salts and vitamins than the fresh product (JARDIN and CROSNIER, 1975).

The Melanesian population of the urban areas remains a poor consumer of fresh fish, giving far greater preference to tinned foods. Granted these are somewhat cheaper than fresh fish. At the beginning of 1984, with 80 vatu a family could buy 450 grams of tuna in brine, 400 grams of bonito, and 275 grams of red snapper. Just about everything is edible in "tin fis", which is not the case of fresh fish in which the edible parts only form half the total weight according to nutritionist (JARDIN and CROSNIER, 1975). So at a cost 80 vatu, a tin of fish holds 66 grams of protein, bonito 40 grams and ned snapper 24 grams. In terms of calories there is an even more marked difference: 775 calories in "tin fis", 350 calories in bonito and 130 calories in the red snapper. Therefore tinned fish is a much more economical food than fresh fish and given that 50% of the working Melanesian population, in the private sector, was earning in 1983 less than 16,000 vatu per month, with 25% getting wages below 9,000 vatu (QUILLE, 1985), it is no wonder that "tin fis" so popular!

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