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Water Quality of Wells in Some South Pacific Islands

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By

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## WATER QUALITY OF WELLS IN SOME SOUTH PACIFIC ISLANDS

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### Introduction

Many islands in the South Pacific Region lie in an area of high annual rainfall but despite this many of them have difficulties in obtaining potable water - relatively free from pollution of various types, for drinking. This is particularly so :-

- (i) in times of drought
- (ii) where there is no significant hills and hence no river drainage e.g. Niue (coral island), Tuvalu (coral atoll)
- (iii) where streams contain substances greater than the maximum permissible level set out by W.H.O. international standards for drinking water (1971) e.g. Savo Island in the Solomon Islands.

Since pure drinking water is an important natural source, all cities, towns and villages need to have their water supplies tested regularly for chemical and bacteriological quality. At the time this is impossible as most of the islands are separated from a chemical laboratory by large distances and many of the required water parameters must be analysed within a few hours after being sampled.

The present study, which will be continuing for some time, aims to monitor drinking water quality in countries of the University of the South Pacific region (Cook Islands, Fiji, Kiribati, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu) using portable chemical and bacteriological water testing equipment.

### Physical and Chemical Analyses

Water samples were collected at the well head either by pumps (e.g. bore holes and drilled wells in Tongatapu and Niue) or drawing water out by hand e.g. Savo Island.

pH, fluoride, chloride and nitrate were measured by direct measurement after calibration with standards on an Orion Model 407A/F specific ion meter using Orion pH and specific ion electrodes.

Total and fecal coliform counts were performed using a single-step Millipore bacteria testing field kit with a portable MF-Millipore petri dish incubator. Results are expressed as MPN/100 ml.

Phosphorus and nitrogen were analysed by standard spectrophotometric methods (APHA. 1971).

Sodium and calcium were determined by Atomic Absorption Spectrophotometry.

### Savo Island (Solomons)

<sup>2</sup> Savo Island is a semi-active volcanic island with an area of 31 km<sup>2</sup> and a population of approximately 3,000. Since the springs and streams on this island contain high sulphur levels and the valleys are dry except during storms, the main water supplies for the 80 villages are open unprotected wells on the beach. In early 1982, Cyclone Bernie destroyed many of these wells and filled in many others with sand. Since then, many new wells have been constructed. 58 wells were tested in June 1982 and the results are shown in Table 1 and the well locations on Map 1.

The presence of coliform bacteria in most of the wells tested and high levels of chloride in some shows that the waters are contaminated, probably from the surroundings of the wells and from seawater as a result of the last cyclone.

### Tuvalu

Vaitupu, the largest island of Tuvalu has a land area of 600 ha and a population of approximately 1,200. The people on Vaitupu obtain potable water from rainwater catchment from roofs and in times of low rainfall from four wells on the northern end of the island (Well Nos. 10, 11, 12, 13 on Table 2 and Map 2). These wells are lined and covered and are provided with handpumps. A number of other unprotected wells sited around the island are mostly brackish and are used only for washing and laundry purposes.

Samples were taken from each well over a period of four days. During this time each well (except No. 14) was in constant use by families living nearby. No significant change in the composition of the water was observed, even though the analyses were done when a drought of two weeks duration was broken by rainfall of 35 mm. The results of analyses appear in Table 2. All known wells on the island are marked on the map.

Most of the wells on Vaitupu are contaminated to a greater or lesser extent by seawater and are therefore only suitable as a source of washing water. Wells close to the more inhabited area at the southern end of the island have also high levels of coliform contamination. However, the wells at the northern end of the island, No. 10, 11, 12 and 13 are a source of acceptable quality drinking water and development work on further wells in this area by the SPC will now proceed.

### Niue

<sup>2</sup> Niue, an isolated, uplifted coral island has a land area of 260 km<sup>2</sup> and a population of approximately 4,600. As there is no surface water, the people obtain their drinking water from a number of rainwater catchments from roofs and from eighteen bores. Previously, the groundwater was found to be hard with high iron concentrations and often significant nitrate levels (Downes, 1981). Presently groundwater is protected from contamination by the Health Department enforcing a set of regulations which relate to the siting of dwellings and farms and burial grounds in the vicinity of bores.

Table 3 shows the results of samples taken from 18 bores and four rainwater catchments and Map 3 shows the bore locations. The presence of coliforms in the High School tank was due to the presence of a dead animal finding its way into the tank.

### Tonga

Tongatapu, the largest island in the Kingdom of Tonga has an area of 260 km<sup>2</sup> and a population of approximately 50,000. There are no large surface water supplies and almost all drinking water comes from the underground lens of fresh water. The wells range from 10 to 20 m in depth and may supply more than one village.

Twelve bores were chosen for testing in the present study on the advice of the medical officer. The results are shown on Table 4 and the bore locations on Map 4.

Sample Nos. 1, 2, 4 and 12 show high concentrations of chloride ions. This resulted from the chloride ions dispersing upwards through the saltwater - freshwater interfaces.

### Conclusion

Water intended for human consumption must be free not only from any substances which provide a hazard to health but should also be aesthetically attractive. It is strongly recommended that all drinking water be boiled yet the major population of some small remote areas in the South Pacific tend to assume that water poses no serious threat to their health.

### Acknowledgements

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### References

- Dale, W.R., 1981. 'Pacific Island Water Resources'. DSIR, New Zealand.
- Downes, C.J., 1981. 'Water quality in the Pacific Islands' in Pacific Island Water Resources, 93-110.
- Dunn, E.G., 1978. 'Report on a Visit to Tuvalu to Investigate the Possibility of Improving Water Supplies at Nukufetau and Vaitupu' SPC, Noumea, New Caledonia.
- Hazbun, J.A., 1982. 'Proposal for Rain Catchment. Water Supply System for Savò Island'. W.H.O., Solomons.
- Pfeiffer, D.I., 1981. 'Outline of the hydrogeology of the island of Tongatapu (Kingdom of Tonga - South Pacific)' in Advisory Services Report, U.N. Economic Commission for Asia and Far East.
- Standard Methods for the Examination of Water and Wastewater (APHA, 1971).
- Waterhouse, B.C., 1981 in Pacific Island Water Resources, 57-74.

TABLE 1

## WATER QUALITY (JUNE 1983) SAVO ISLAND

Village	Total Coliforms MPN/100 ml	Chloride mg/l	pH	Total Phosphorus µg/l	Total Nitrogen mg/l
Alialila	4	640	6.81	348	3.1
Valasigao	370	810	7.04	240	2.3
Bangabangara	>400	360	6.74	240	13.5
Majalika	20	140	6.61	108	3.1
Clinic Well	>400	380	7.20	246	3.4
Vatukomata	60	240	6.78	320	10.1
Bereniga	>400	1100	6.42	12	4.5
Volovolila		65	6.70	48	2.1
Qareka		100	6.52	130	7.5
Siata		49			
Kaogele		200			
Birasu No. 1		>300			
Birasu No. 2		>300			
Sogoka		1500	7.27	386	2.7
Bulai		>300			
Pogolagauka		57			
Sapeka		110			
Rebóbokola Str.		65	8.35	60	0.9
Kurikuri		86			
Bonala (old)		280			
Bonala (new)		300			
Kusini		270			
Mora		>300			
Parapara		>300			
Simbo		420			
Raja	1000	65	6.94	222	2.8
Tanavalea		100			
Sisiaka	250	43	6.73	246	2.1
Tanakidi		300			
Balola	800	430	6.70	376	2.7
Sesepi No. 1		61			
Sesepi No. 2	>6000	110	7.02	216	2.5
Paoga		350			
Kolika Str.	1000	62	7.68	48	2.3
Vurala Str.		33			
Lakevala		64			
Reko (old)	460	240	7.28	12	2.7
Reko (new)		72			
Fapaze		780			
Soviri No. 1		420			
Soviri No. 2		170			
Soviri No. 3		200			
Sirigama No. 1		160			
Sirigama No. 2		100			
Guelomata		460			
Tumunigabu No. 1		1000			
Tumunigabu No. 2		150			
Kudivatu		85			
Sagala		1100			
Longaka		160			
Mavulu		1600			
Kuila (new)		400			
Kuila (old)	0	1900	7.67	174	10.2
Tasimania No. 1		460			
Tasimania No. 2		>1000			
Tasimania No. 3		1000			
Kakalaka		300			
Sigasapa		80			

TABLE 2

## WELL WATER QUALITY (AUGUST, 1980). VAITUPU

Well (see map)	pH	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Calcium mg/l	Sodium mg/l	Total Coliform MPN	Fecal Coliform MPN
1	7.8	450	0.25	0.96	22.6	295	300	
2	8.3	760	0.34	0.82	25.4	480	>5000	
3	8.0	25	0.25	0.51	14.0	175	>5000	
4	7.45	1140	0.20	3.9	8.3	620	1000	
5	7.6	998	0.25	2.3	5.4	980	1300	
6	7.6	3400	0.32	2.45	47.0	43	>5000	
7		unused,	stagnant					
8	7.4	62	0.25	1.55	4.5	27	>5000	
9	7.6	185	0.23	1.1	3.5	86	300	30
10	7.75	10	0.15	2.8	17.0	4.0	<100	45
11	7.45	17	0.25	0.52	3.1	13.5	400	310
12	7.4	25	0.15	2.1	3.6	13.5	300	100
13	7.55	14	0.17	0.9	2.5	3.2	200	80
14	7.85	1225	0.50	2.6	28.0	345	<100	0
15	7.75	300	0.17	2.5	15.5	70	<100	50

WATER QUALITY (MARCH 1981). NIUE

TABLE 3

Sample No.	Location	pH	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Total Coliform MPN	Fecal Coliform MPN	
1	Airport DW	7.30	11.0	0.05	1.9	0	6	
2	Airport SP1	7.40	10.0	0.06	1.0	0	0	
3+	Tuila No. 1	7.05	12.0	0.06	2.0	0	0	
4+	Tuila No. 2	7.05	12.0	0.08	1.4	300	0	
5+	Tuila No. 3	7.15	12.0	0.09	1.65	500	4	
6+	Tuila No. 4	7.30	11.0	0.09	1.7	0	0	
7	Tamakautonga	7.40	9.0	0.08	1.7	0	0	
8	Avetele No. 1	7.55	12.5	0.05	1.8	0	0	
9	Vaiea	7.45	11.0	0.06	1.9	0	0	
10	Hakupu No. 2	7.50	15.0	0.05	1.6	0	0	
11	Liku No. 1	7.50	15.8	0.06	1.9	0	0	
12	Lakepa No. 1	7.25	16.5	0.07	1.3	100	0	
13	Mutalau No. 1	7.50	19.0	0.07	1.4	0	0	
14	Toi No. 1	7.40	23.5	0.08	1.6	0	0	
15	Toi No. 2	7.45	45	0.18	1.2	0	0	
16	Hakutavake No. 1	7.45	24	0.18	1.3	100	0	
17	Taupa No. 1	6.95	16	0.17	1.4	0	0	
18	Taupa No. 2	Pump not operational.						
19*	Village Restaurant	7.40	16	0.10	1.3	0	0	
20*	Burns Philp	7.70	0	0	0	0	0	
21*	High School	6.95	0	0	1.5	1800	52	
22*	Private	6.90	0	0	0	0	0	

\* Rainwater tanks in Alofi

+ Tuila is situated immediately inland from Alofi

TABLE 4

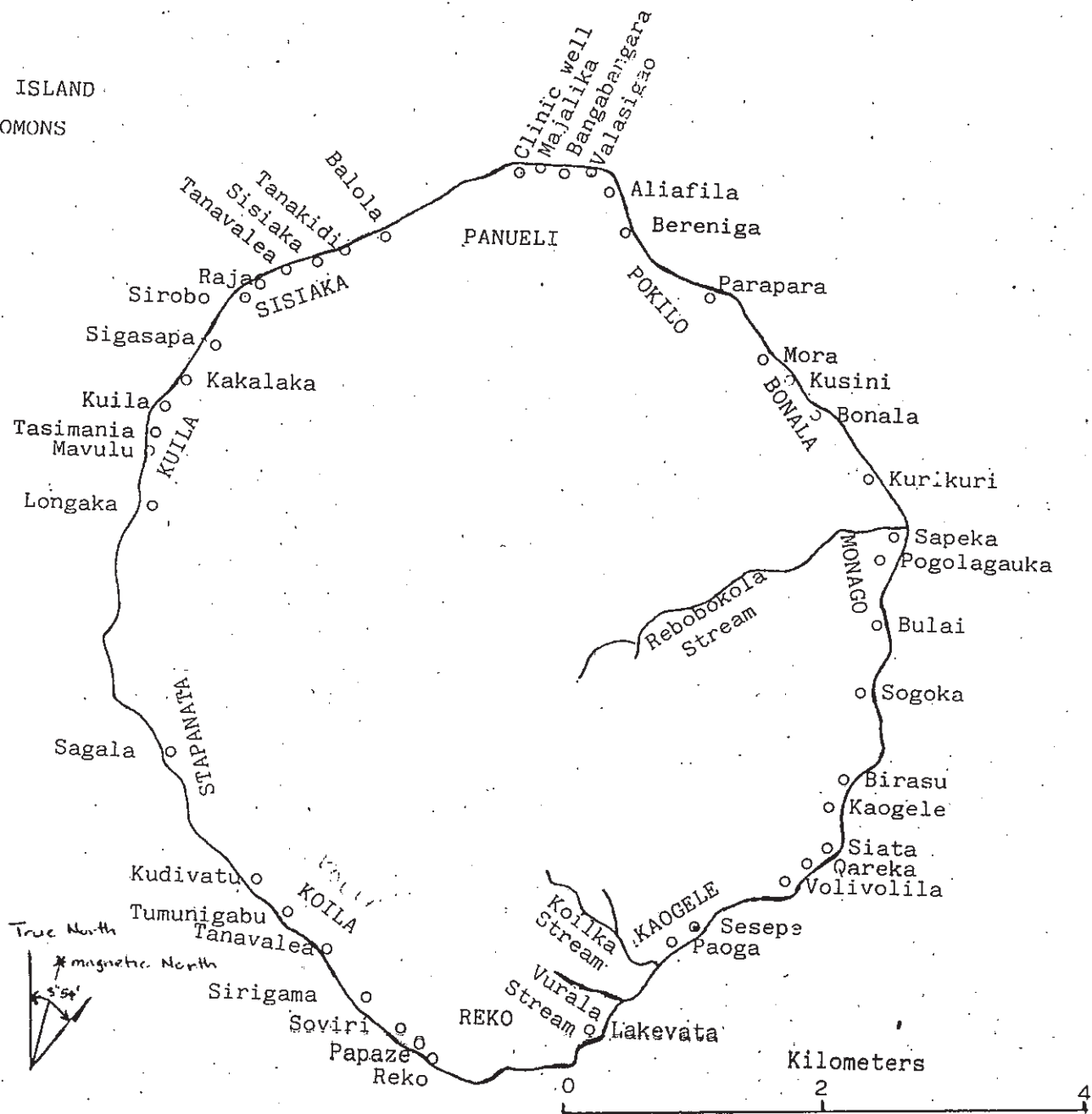
## WATER QUALITY (MARCH 1981). TONGATAPU

Sample No.	Location	pH	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Fecal Coliform
1	Fou'i	6.40	260	0.10	0	0
2	'Ahau	6.45	260	0.11	0	0
3	Ha'atafu	6.50	265	0.10	0	0
4*	Maui	6.65	52	0.08	0	0
5*	Coconut Board	6.65	52	0.08	0	0
6*	Joe's Place	6.65	53	0.09	0	0
7	Reservoir	6.40	71	0.09	0	0
8	Airport	6.65	18	0.08	0	0
9	Lavengatonga	6.50	57	0.08	0	36
10	Tokomololo	6.40	38	0.08	0	0
11	Fatumu	7.00	110	0.08	0	0
12	Haveluliku	6.90	480	0.08	0	160

\* In the capital - Nuku'alofa



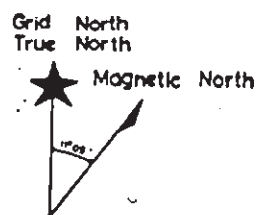
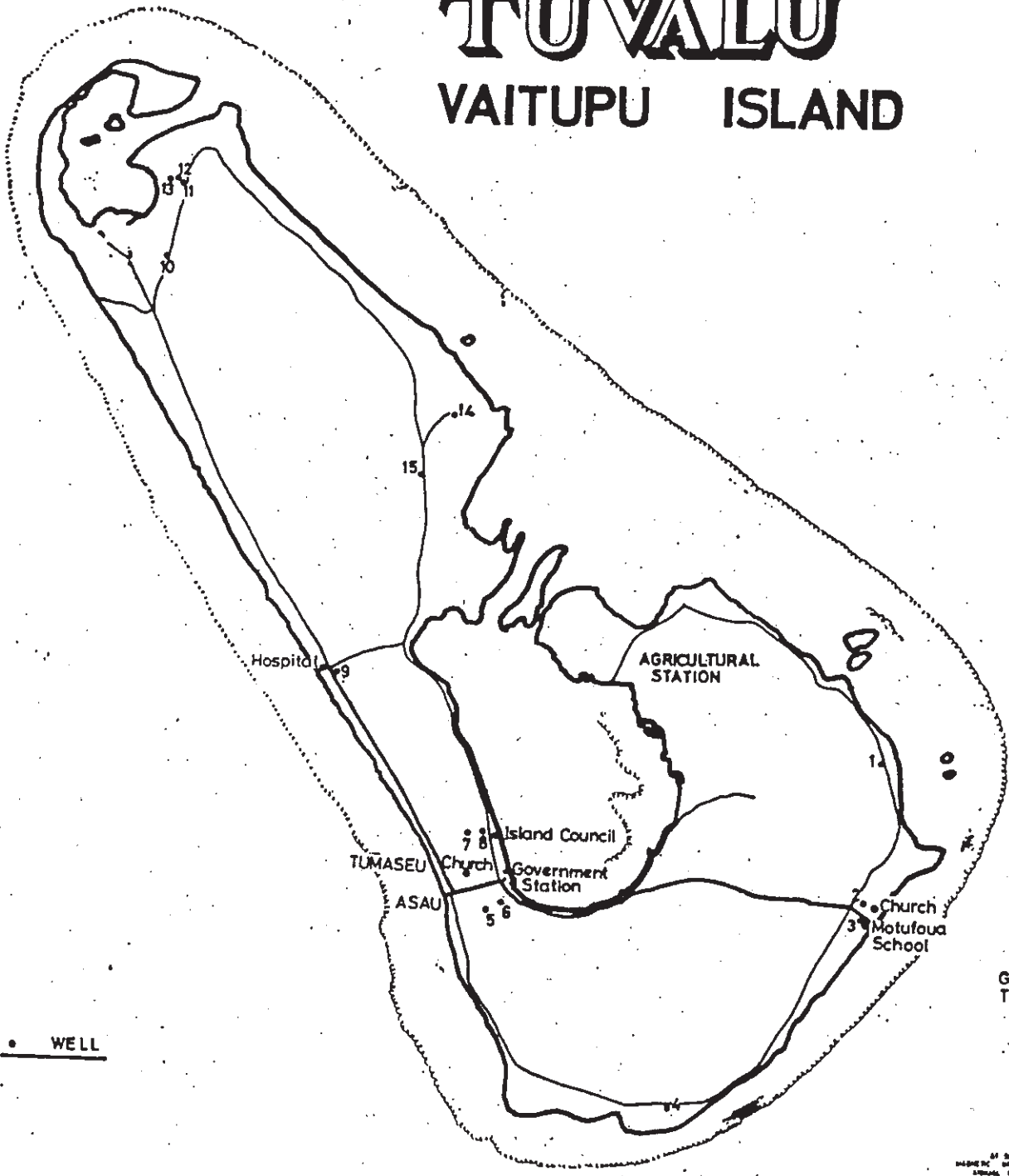
SAVO ISLAND  
SOLOMONS



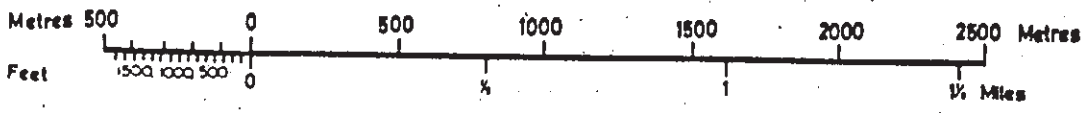
MAP I

# TUVALU

## VAITUPU ISLAND



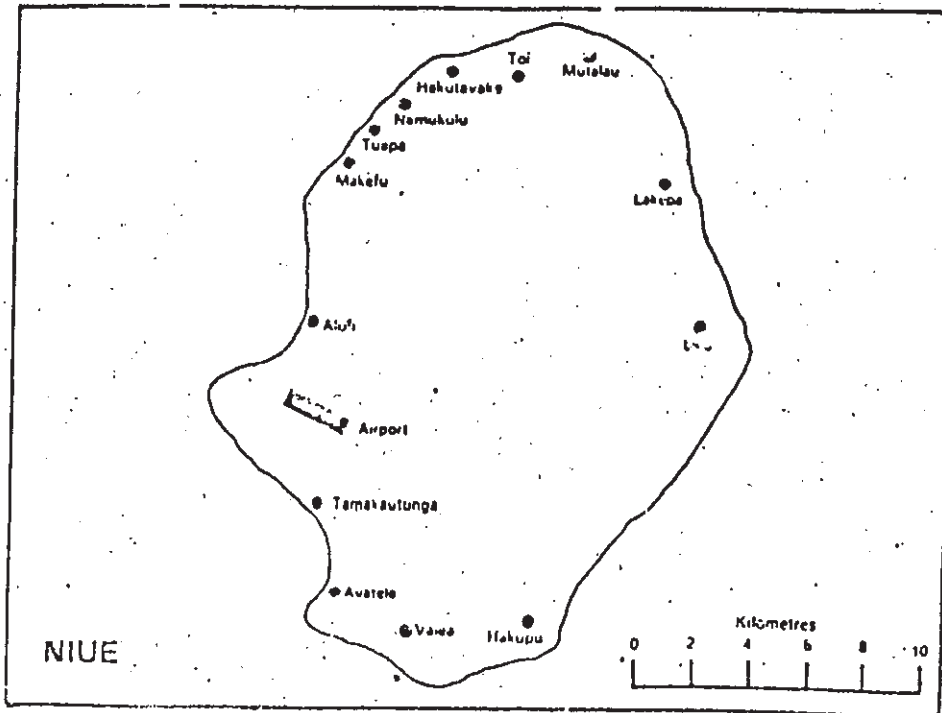
OF SHEET COVERING  
MAGNETIC DECLINATION AS OF JANUARY 1970  
ANNUAL CHANGE 1' EAST



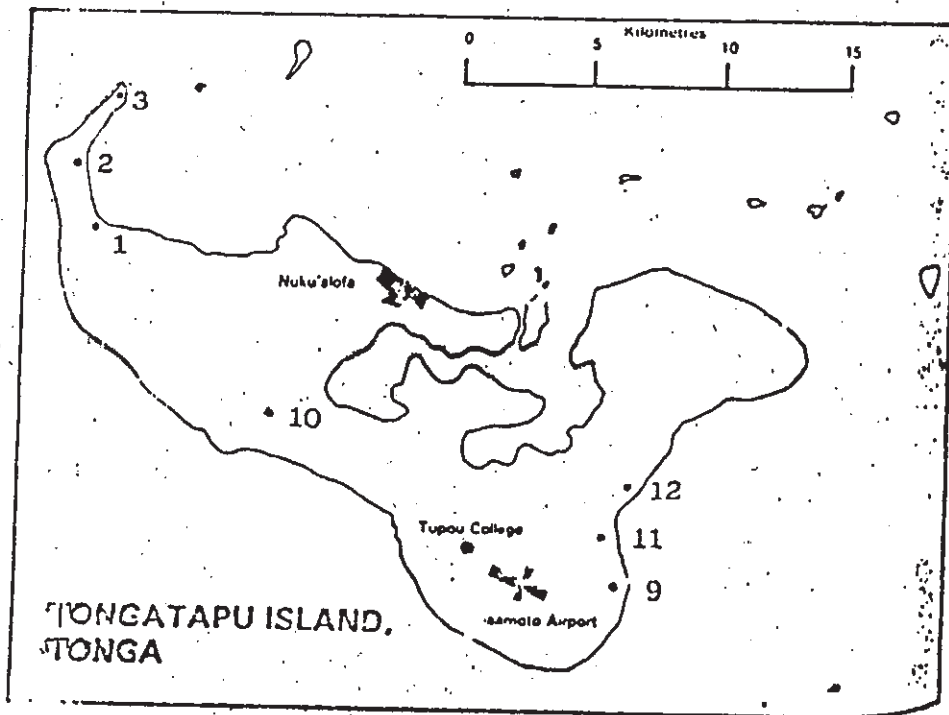
SCALE 1: 10,000

MAP 2

DRAWN BY : M. G. RAJ, S.N.R., U.S.P.



MAP 3



MAP 4