DRINKING WATER QUALITY IN A NUMBER OF SOUTH PACIFIC ISLAND COUNTRIES

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Drinking Water Quality in a Number of South Pacific Island Countries

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INTRODUCTION

Most South Pacific island nations lie in regions of high annual rainfall but despite this many of them have growing problems finding adequate sources of drinking water. This is particularly so on raised coral islands such as Niue and Tongatapu and coral atolls such as the islands of Kiribati and Tuvalu where there are no significant hills and hence no river drainage. Fresh water supplies on such islands come only from rainwater collection from roof catchments and from boreholes.

It cannot be assumed that such water supplies are regularly tested for chemical and bacteriological quality as most of the islands are separated by large distances from possible testing laboratories and many of the required water parameters must be analysed for within a short time of the water being sampled. Portable water testing equipment has not generally been available. A summary of much of the knowledge of Pacific Island water resources can be found in Dale (1981).

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 Island, Fiji, Kiribati, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu) using portable chemical and bacteriological water testing equipment.

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The work has been funded by Australian aid grants to the Institute and South Pacific Commission (SPC) grants for specific projects. Work is being concentrated on water sources where aid agencies such as SPC and regional governments have projects to improve the water supply.

ANALYTICAL METHODS

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/100ml.

Tuvalu

Vaitupu is the largest island of Tuvalu with a total land area of 600Ha and a population of 1200. The island has a secondary school at Motufoua and the Government is developing a agricultural station with emphasis on small animal production as well as investigating the feasibility of establishing a demonstration biogas/integrated farming project. 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 No.s 10, 11, 12, 13 on Table 1 and Map 1). A number of other wells sited around the island are mostly brackish and are used only for washing and laundry purposes. A preliminary survey by SPC personnel (Dunn, 1978) investigated possible further development of the high quality groundwater and the present study is an outcome of an SPC project to implement this development. A regular and adequate supply of fresh water is also required for the pilot biogas digester project.

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 35mm. The results of analyses appear in Table 1. Well numbers correspond to the numbers on Map 1. All known wells on the island are marked on the map.

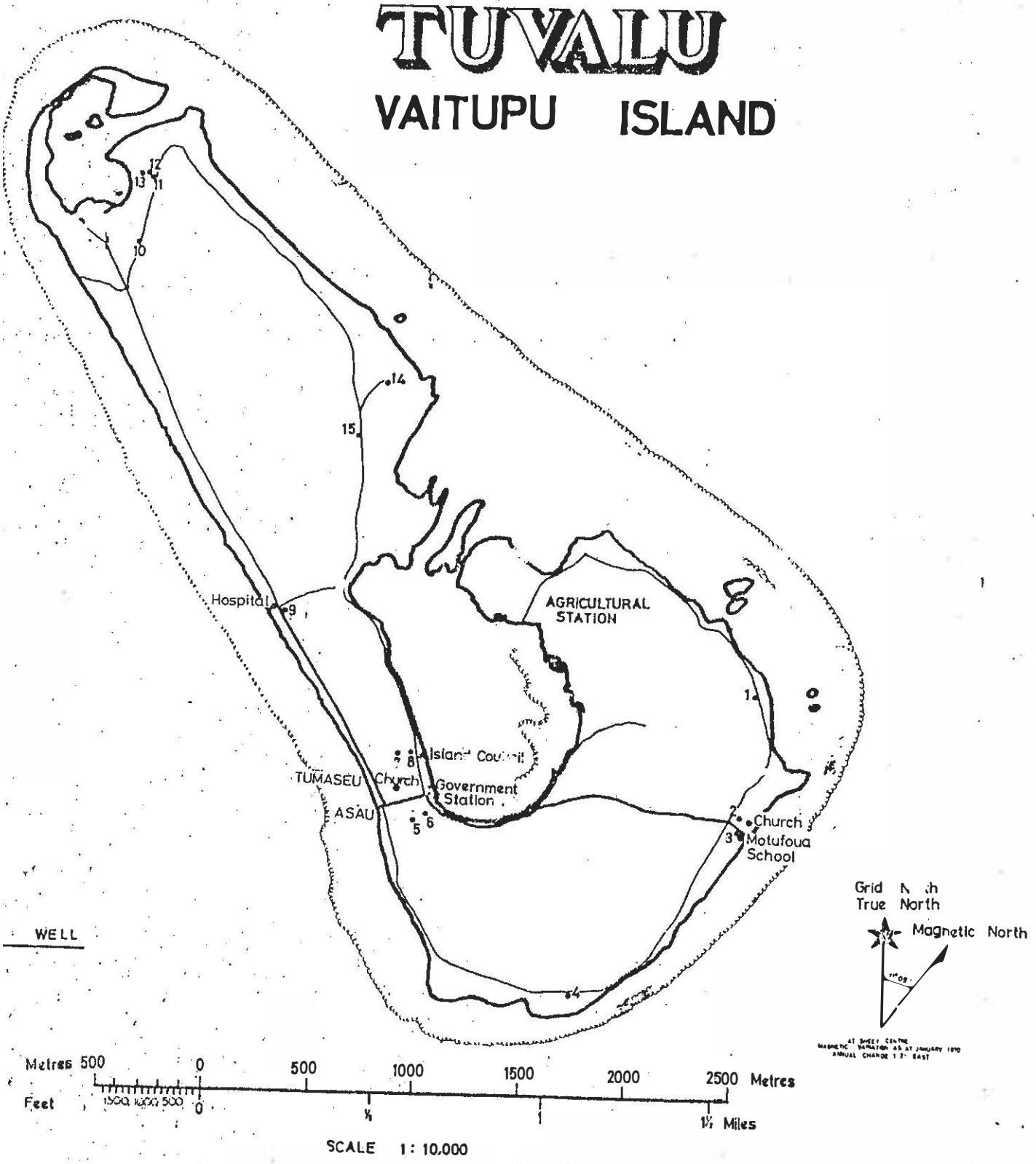
Most of the wells on Vaitupu are contaminated to a greater or lesser extent by seawater and are therefore only suitable as a source of washing water. Wells close to the more inhabited area at the southern end of the island have also high levels of coliform contamination. However, the wells at the northern 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.

TABLE 1. Well water quality (August, 1980). Vaitupu

Well (see map)	pH	Chloride mg/1	Fluoride mg/1	Nitrate mg/1	Calcium mg/1	Sodium mg/1	Total Coliform mpn	Fecal Coliform
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
	7.85	225	0.50	2.6	28.0	345	<100	0
15	7.75	300	0.17	2.5	15.5	70	<100	50

TUVALU

VAITUPU ISLAND



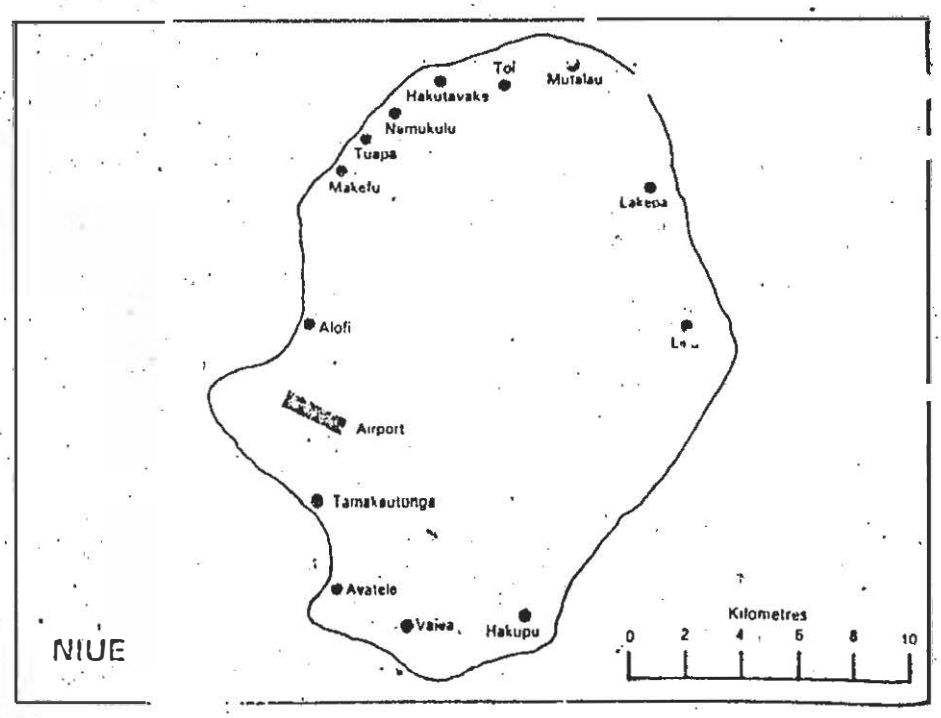
MAP 1

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

Niue

Niue is an isolated, uplifted coral island with an area of 260km^2 and a population of approximately 4600 (July, 1979). At present eighteen bores on the island and a number of roof catchments comprise the drinking water supply as the island has no permanent free flowing water. Previous work on the groundwater has shown that it is very hard, with high iron levels and often significant nitrate levels (Downes, 1981). Groundwater quality is now protected by the enforcing by the Health Department of a rigorous set of regulations which relate to siting of dwellings and farms and the burial of bodies in the vicinity of bores.

Seventeen bores and four rainwater tanks were tested in the present study. The results are shown in Table 2 and the bore locations on Map 2. Some bacterial contamination was noted and the high coliform count in the High School rainwater tank ascribed to the presence of a small dead animal in the tank. Further work to measure Fecal Coliform/Fecal Streptococci ratios and hence trace the source of bacterial contamination is now being planned.



MAP 2

Table 2. Water quality (March 1981). Niue

Sample No.	Location	pH	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Total Coliform	Fecal Coliform
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	Tuapa No. 1	6.95	16	0.17	1.4	0	0
18	Tuapa 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

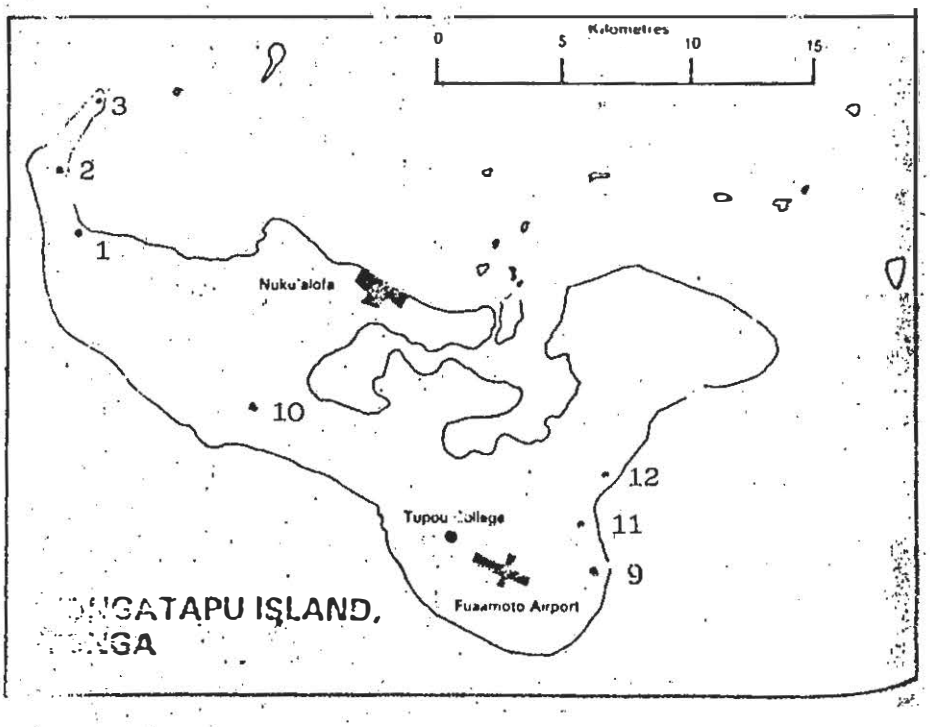
*Rainwater tanks in Alofi

†Tuila is situated immediately inland from Alofi

Tonga

The main island of the Kingdom of Tonga is Tongatapu. This is a flat uplifted coral atoll overlain with a layer of rich soil composed mainly of volcanic ash. It has an area of 260km^2 and a population of approximately 50,000 (1979). Almost all the drinking water supplies for the people of Tongatapu comes from the underground lens of fresh water. The wells range in depth from 10 to 20m and may supply more than one village, (Pfeiffer, 1971; Waterhouse, 1974, 1976). Previous water analysis results (Waterhouse, 1981; Downes, 1981) have shown a good quality water but with high calcium hardness as might be expected in the location.

Twelve heavily used bores were chosen for testing in the present study on the advice of the Medical Officer for Health. The results are shown in Table 3 and the bore locations on Map 3.



MAP 3

Table 3. 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

As can be seen from the results salt water intrusion is becoming a problem in a number of the bores (Nos. 1, 2, 3 and 12). Two of the bores also show signs of bacterial contamination. Since aquifers in coral formations such as in all the cases in this study are invariably unconfined contamination from surface pollution is always a problem. Further work in the outer islands of Tonga is now being planned.

ACKNOWLEDGMENTS

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