UNESCO/UNFPA Fiji ISLAND REPORTS No. 3 (Canberra, ANU [illegible], [illegible])

3.1 A DESCRIPTIVE NOTE ON THE SOILS OF TAVEUNI

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TABLE 1.1: PHYSICO-CHEMICAL CHARACTERISTICS OF SOILS

(values to nearest integer)

	HUMIC ANDOSOLS ON LAPILLI AND BASALTIC FLOWS				VITRIC ANDOSOLS ON LAPILLI			HUMIC FERRALSOLS ON BASALTIC FLOWS			FERRALLIC CAMBISOLS ON BASALTIC FLOWS		
Sample No.	51	52	53	54	91	92	93	141	142	143	591	592	593
Depth in cms	0-10	30-40	65-75	100-110	0-10	50-60	80-90	0-12	40-50	80-90	0-10	10-25	40-50
Horizons	A1	A3	(B)	(B)	A1	(B)	(B) C	A1	(B)	(B) C	A1	A (B)	(B)
Clay %	49	18	15	17	20	17	18	42	37	17	39	53	44
Fine loam %	21	25	21	25	18	22	26	25	36	35	41	31	32
Coarse loam %	3	18	30	23	17	21	21	4	7	17	2	2	4
Fine sand %	1	9	19	7	15	17	9	4	6	8	3	7	13
Coarse sand %	-	4	6	4	7	9	6	4	9	12	3	4	6
Organic carbon	159	96	54	39	96	26	-	117	29	-	62	23	14
Nitrogen %	15	10	5	3	10	2	-	9	2	-	5	2	1
C/N	11	10	12	15	10	13	-	13	17	-	13	12	12
pH (water) %	6	6	7	-	6	7	7	4	5	5	6	6	6
Exchangeable complex													
Ca++ in me/100 g	15.4	12.4	7.0	6.5	23.2	12.1	14.0	4.6	1.0	1.0	11.5	4.4	3.8
Mg++ " "	15.4	[illegible]	3.0	3.2	4.2	3.1	4.7	2.4	0.2	0.2	8.1	8.0	6.6
K+ " "	0.3	[illegible]	0.0	0.0	0.5	0.3	0.2	0.5	0.0	0.0	0.2	0.1	0.0
Na+ " "	0.8	0.3	0.2	0.1	0.3	0.4	0.5	0.5	0.6	0.7	0.4	0.3	0.3
C.E.C. " "	67.9	53.0	42.9	45.3	52.0	39.5	49.0	30.0	11.1	11.1	32.3	26.0	26.4
Base Saturation	47.0	33.5	23.8	21.9	54.4	40.2	39.5	27.0	16.0	17.0	62.4	48.8	40.6
Tri-acid Total Analysis													
Loss of ignition %	44.1	25.3	17.1	16.2	23.2	10.9	14.6	39.6	26.9	26.7	21.4	17.2	15.9
Insoluble %	11.8	18.1	14.4	17.4	20.2	18.4	5.9	2.4	1.3	0.2	7.2	0.6	0.2
SiO_2 %	12.9	18.1	22.3	20.4	20.7	26.2	29.3	3.7	4.8	1.9	25.0	30.0	31.5
Al_2O_3 %	15.0	17.2	19.0	20.8	14.8	19.0	24.0	28.8	36.3	41.5	21.8	27.0	28.5
Fe_2O_3 %	9.3	10.8	11.5	13.0	9.8	11.5	14.3	18.0	23.8	23.5	17.8	19.8	19.3
TiO_2 %	1.7	1.9	2.0	2.6	1.5	2.0	2.5	3.8	4.5	4.6	3.4	3.6	3.4
MnO_2 %	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.1	0.1	0.5	0.5	0.4
Ca^{++} in me/100 g	68.5	109.0	141.0	89.9	171.0	171.0	85.6	12.8	6.1	5.0	33.9	15.0	12.5
Mg^{++} " "	54.6	132.0	163.0	156.0	156.0	169.0	175.0	26.3	35.7	21.8	47.1	19.3	16.9
K^+ " "	1.3	1.3	1.1	1.1	.9	2.1	1.1	1.3	0.9	0.4	2.8	2.6	2.3
Na^+ " "	12.3	20.3	26.6	15.5	30.3	37.4	15.8	3.9	3.2	3.6	8.1	6.8	5.5
P_2O_5 %	7.1	8.1	5.3	-	5.4	3.6	-	5.1	3.1	-	4.9	3.5	3.6
P_2O_5 Assimilable OLSEN	0.4	0.3	0.2	-	0.2	0.3	-	0.2	0.1	-	0.1	0.0	0.1

INTRODUCTION

The soils of Taveuni are all of recent origin, being derived from recent volcanic deposits. Twyford and Wright (1965) classed the whole as 'latosolic soils', and regarded them as an essentially homogeneous complex. However, they have been subjected to the weathering effects of humid tropical climate and pedological evolution is very rapid under these conditions. Detailed study of soils in the north and south of the island reveals that the soils of these two areas have evolved quite differently. In the north we encounter very mature soils (Ferralsols), rich in sesquioxides of alumina and iron; in the south, on the other hand, the soils are much more youthful (Andosols) and the mineral complex remains only weakly crystallized. It seems most probable that the different state of development of soils in the two regions is linked to the age of volcanic material from which they are formed.

THE ANDOSOLS

Like all Andosols (FAO, 1974), those of Taveuni are characterized by very weak profile differentiation, high porosity accompanying low bulk density, and a preponderance of allophanes among the clay minerals. Two types are encountered: Vitric Andosols rich in unaltered volcanic material, and sandy in texture; Humic Andosols which are more deeply weathered, rich in organic material and with humiferous horizons of average base saturation levels.

Vitric Andosols are developed in southern Taveuni on volcanic cones and their lower slopes. Soils on these slopes are shallow, contain large numbers of lapilli, and many blocks of vesicular lava. At the foot of the cones soils are deeper and of finer texture. These latter are rich in organic matter and nitrogen. The pH levels are weakly acid; the soils have a high exchange capacity and weak base saturation. Potassium levels are high. Total analysis by tri-acid method reveals the youth of the soils by high level of insoluble material and of alkaline and soil-alkali cations. Phosphorous reserves are important, and the assimilable fraction, extracted by OLSEN reaction, is high. These soils thus have very high fertility, and their agronomic potential is limited only by conditions of slope.

Humic Andosols, found only in the south of the island, are associated with areas of gentler slope. The effect of recent eruptions is weaker, and the soils are more finely textured, with a higher clay content. Three sub-types are distinguished: soils with a gravelly horizon at shallow depth (petric phase); soils with the surface littered by blocks of basalt (stony phase); deep soils (deep phase). It is very difficult to delimit the distribution of these three phases for mapping purposes, as they have no sharp boundaries. Chemical analysis of the Humic Andosols shows them to be rich in organic matter closely bound to the mineral elements. Nitrogen levels are high. The pH is weakly acid; exchange capacity is high and base saturation levels average. Elements such as calcium and magnesium are abundant, but exchangeable potassium is rather lean except in the humiferious horizons. Phosphorous is very abundant,

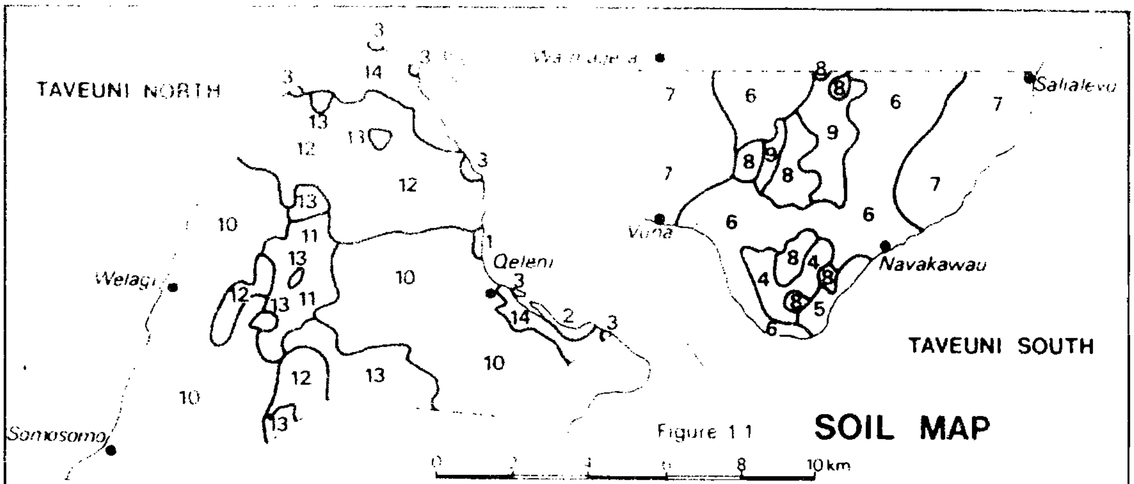

Figure 1.1 **SOIL MAP**

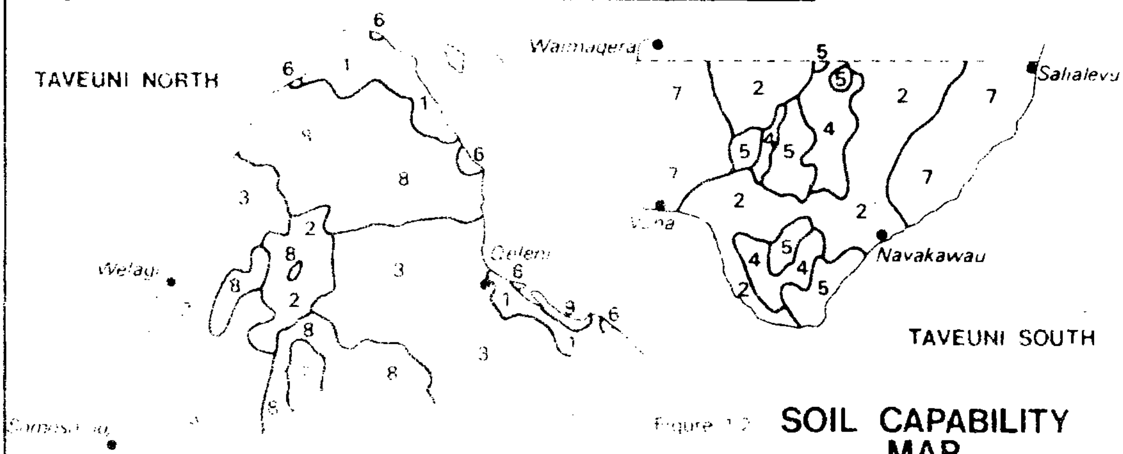

Figure 1.2 **SOIL CAPABILITY MAP**

(for description see Table 1.2)

SOIL MAP CODE	SOIL TYPES (F.A.O)
1	THIONIC FLUVISOLS
2	FLUVIC GLEYSOILS.
3	RENDZINAS.
4	VITRIC ANDOSOLS on lapilli
	HUMIC ANDOSOLS, medium textured, on basaltic flows :-
5	– gentle undulating and rolling to hilly, petric phase.
6	– gentle undulating and deep phase, and rolling to hilly and petric phase.
7	– gentle undulating, petric phase or stony phase.
8	VITRIC ANDOSOLS, steeply dissected, on lapilli.
9	VITRIC and HUMIC ANDOSOLS, deep phase on lapilli.
	HUMIC FERRALSOLS, fine to medium textured, on basaltic flows :-
10	– rolling to hilly, deep phase or petric phase.
11	– gentle undulating, deep phase or petric phase.
12	– gentle undulating or rolling to hilly, stony phase.
13	– steeply dissected, stony phase.
14	FERRALIC CAMBISOLS, fine textured, gentle undulating, on basaltic flows.

and the assimilable fraction of this element is high. These soils thus have very high mineral fertility, and their agronomic value is limited chiefly by slope and by soil texture.

THE FERRALSOLS AND ASSOCIATED SOILS

In the north of the island soils have developed a marked ferralitic character. Among the clay minerals, allophane has practically disappeared, and has been replaced by kaolinites and by sesquioxides of alumina and iron. Two main types are distinguished: Ferrallic Cambisols in which ferralitic characteristics are not yet strong, with a high level of halloysites and metahalloysites; Humic Ferralsols in which sesquioxides of alumina and iron predominate in the mineral fraction.

The Ferralic Cambisols are relatively shallow, the weathered horizon being seldom deeper than 60 cm. They are somewhat poorer in organic matter than the Andosols. Nitrogen levels are high; pH levels are weakly acid, exchange capacity is high and base saturation levels average. However, there is a slight potassium deficiency. Phosphorus levels are high, comparable with those of the Andosols, but the assimilable fraction is much lower than in the latter group of soils. Mineral fertility is thus only average, but the soils have good agronomic possibilities being found mainly in areas of gentle slope in the extreme north and northeast.

The Humic Ferralsols are deep soils with a maturely evolved clay-mineral fraction; however, they often contain large quantities of gravel and almost unweathered blocks of basalt. They are rich in organic matter, but the carbon/nitrogen ratio is often high. In some localities they are quite highly acid. The exchange capacity is weak, and the base saturation levels high. Exchangeable cations are of average value in the humiferous horizon, but very weak in the mineral horizons. Phosphorus reserves are good, but the assimilable fraction of this element, as in the Cambisols, is low.

Two sub-types may be distinguished within the Humic Ferralsols. Rocky soils are developed in the steep and very steep areas at the northern end of the volcanic chain, and around isolated cones. Deeper soils, sometimes with patches of stone in the profiles, are encountered on the undulating terrain away from the main volcanic chain. Where they are not too rocky, or on steep and accidented slopes, these Humic Ferralsols have good agronomic qualities. However, it would seem likely that these soils are much more fragile, and less likely to retain their qualities under prolonged cultivation, than the Andosols.

CONCLUSION

It is therefore true that all the soils of Taveuni are 'very fertile', as Twyford and Wright (1965) remark, and as is commonly believed. They are probably the most fertile soils in the whole Fijian archipelago. However, there are quite important differences within the island, and these

TABLE 1.2: POTENTIAL USE OF TAVEUNI SOILS

[illegible]	SOIL TYPES	SOIL FERTILITY	CONSTRAINTS	AGRONOMIC POSSIBILITIES	CROP POSSIBILITIES
	17	good	Low level of assimilable phosphorus	Fallowing or fertilization necessary; mechanized cultivation possible	All food crops, tree crops, pastures
[illegible]	12/6	good	Some steep slopes	As above but phosphates not immediately required	As above
[illegible]	10/11/13	good	Slopes 15-30° greater in valleys	Manual cultivation only; fallowing essential	As above but no livestock
[illegible]	4/9	average	Steep slopes; good soil structure in humiferous horizon limited to soil type 4	Mechanized cultivation possible to shallow depth; fallowing essential	Food crops and coconuts
[illegible]	5/8	below average	Steep slopes; poor accessibility	-	Best left under natural vegetation
[illegible]	3	below average	Unfavourable physico-chemical characteristics	-	Coconuts or other tree crops possible
[illegible]	16/7	poor	Much rock on surface and in shallow depth	Large scale use requires major rock clearance.	Coconuts, other crops by manual cultivation between rocks; other crops with rock clearance; worst areas best left under natural cover.
8	14/15	poor	As above, also some steep areas	As above	As above
9	1/2	poor	Hydromorphic and saline areas	Drainage required	Without drainage best left under natural cover.

have agronomic significance. The data available are [illegible] at first sight, but are capable of interpretation. Taro yields [illegible] determined by the Project for five sites (Haynes, 1976), are generally higher in the north than in the south, and the highest yield obtained was from a steep site on the petric phase of the [illegible] Ferralsols. The lowest yield obtained was from a site [illegible] gently undulating land with Humic Andosols in the south. However, the former was a first crop, the latter from land used continuously for more than a decade. It [illegible] that the allophanes present in large quantity in the [illegible] effect of retaining nutritive elements and thus depriving the [illegible] sustenance, whereas nutrients are [illegible] released from the [illegible] soils in the north. It is probable, [illegible] that the fertility [illegible] will be more quickly exhausted [illegible] hypothesis [illegible] the generally lower yields [illegible] estates; estate [illegible] cropped for about a [illegible] nutrients to the [illegible]

Soil and land [illegible] characteristics of each [illegible] assessment is based on [illegible] the stoniness of the soil, [illegible] not [illegible] rainfall and cloud conditions, [illegible]

EDITOR'S NOTE

This note is [illegible] translated [illegible] Greater detail will appear in the ecological report of the Project, to be published in French and English by ORSTOM. [illegible] may obtain further detail [illegible] from [illegible] ORSTOM, B.P. A5, Noumea, New Caledonia.

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A descriptive note on the soils of Taveuni

1978

Auteurs Denis Bernard.

Source , Canberra : UNESCO, 1978, p. 13-19. (UNESCO/UNFPA.Fiji Island Reports ; 3).