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CROP PRODUCTION OF PAPUA NEW GUINEA

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Agriculture is the main component of the economy of Papua New Guinea (PNG). Although modernized systems in agriculture have been practiced throughout the country, a great part of the agriculture is still primitive, being characterized by the ignorance of modern techniques and resultant low productivity of land and labour. According to FAO yearbook and census, it is shown that between 1970 and 1987 the total population of PNG increased from about 2,422,000 to about 3,682,000, an increase of 52%, and that the rate of the economically active population tend to decrease continuously from 84.3% in 1970 to 69.9% in 1986 as total population increased. Areas of arable land and land under permanent crops between 1971 and 1986 increased from about 348,000 ha. to about 385,000 ha., an increase of 10%, but those of permanent pastures and forests decreased about 15% and 1%, respectively (FAO). 1971 census also shows that 79% of the total population of the country lived in village areas, with 63% of the working population mainly engaged in subsistence agriculture. Subsistence agriculture is also important on a value production basis. The Bureau of Statistic estimated it at 16% of the gross domestic production in 1975–1976. Agriculture, hunting. forestry, and fishing was about 97% of this nonmarket component.

In 1986, index numbers of total production and index numbers of production per capita of crops were 114.5 and 96.0, and of cereals were 91.2 and 76.5, respectively, which are shown as relative level of the aggregate volume of agricultural production for each in comparison with the base period 1979–1981. Both of the index numbers of cereals indicate the decrease of cereals production as the years went. Rice is the major component of the cereals production, but rice is not a traditional crop in PNG, hence it has been imported. FAO yearbook recorded rice imports of 95,000 tons a year and production of only 1,000 tons in 1987. For people engaged with work, other than food production such as wage earner, rice is a concentrated staple that can be stored under adverse condition and is quickly prepared, as contrasted with root crops which have a high water content and a short storage life. Over the past 30 years consumption has increased at an annual average rate of 8%, and this rate is nearly equal to the latest increasing rate of urban population. It is estimated that the urbanization will be promoted in the future, and that people take approximately 20% of the total carbohydrate requirements by rice. Therefore, in areas where climatic conditions are favourable for rice growing, development of new paddy fields will be needed. On our survey of the Markham valley in 1983 and 1989, it was pointed out that the potential for success in the area is considered much higher, if paddy fields having adequate irrigation equipments can be established by large investments.

As shown in Table 1, in recent years, crops which have had a considerable increase in its prodution are oil palm and sugar cane, and with an adverse production are pulses. Plantations

Table 1. Changes of the production of major crops in Papua New Guinea.

	Harvested areas×1000 ha			Yield Kg/ha			Production×1000 MT		
	'69–71	'79–81	'87	'69–71	'79–81	'87	'69–71	'79–81	'87
Rice	–	–	–	3572	2805	3000	2	1	1
Maize	–	1	1	888	2025	1300	–	1	1
Sorghum	1	1	1	1546	1962	1500	1	2	2
Root crops	135	159	171	6755	6920	6979	910	1102	1195
Pulses	35	3	4	500	500	512	18	2	2
Sugar cane	–	–	3	58644	40000	70303	–	10	232
Coffee	22	40	40	1172	1288	1305	26	52	52
Cocoa beans	55	78	92	496	387	371	27	30	34
Tea	1	4	4	536	2203	2250	1	8	9
Coconut							741	835	900
Copra							135	145	150
Palm kernels							10	19763	58400
Palm oil							16	47409	139000
Vegetables							203	248	283
Fruits							868	1054	1120
Bananas							758	916	967

of oil palm began in the 1960's. Areas under oil palm have increased rapidly from 2,672 ha. in 1978 to 6,806 ha. in 1979. Production of palm kernels and palm oil has increased from 10,000 tons and 16,000 tons during 1969–1971, to 19,763,000 tons and 47,409,000 tons during in 1979–1981, respectively, and these increasing trends remain constant up to date. Commercial plantations of sugar cane increased in the 1980's, and in 1987 the production was 232,000 tons. The production of root crops, bananas, coffee, cacao, tea, coconut, copra, vegetables, and fruits are stable over the past 20 years.

Traditional staple foods in PNG are sweet potato, taros, yams, bananas, and sago. Many new food crops such as cassava, maize, peanut, potato, tomato, cabbage, pumpkin, papaya, pineapple, etc., have been accepted into subsistence agriculture in relatively recent times. These are supplemented by coconuts, pulses, sugar canes, pigmeat, fish, etc..

Taro is the characteristic staple food crop which is mainly grown on shifting farming in wet lowland areas. Yams are typically of better drained soils such as volcanic soils. Sweet potatoes are the main crop of the highland, and garden top-soils are usually broken up and then scooped up into planting mounds. Bananas become an important crop in areas with pronounced dry season.

The major export commercial crops–coffee, cacao, and coconut–are grown by all types of rural producers over most of the country where suitable environmental condition prevail. Other commercial crops are rubber, tea, oil palm, etc.. Rubber is mainly produced by largeholders, and is largely confined to the southern coastal regions. Tea is grown almost entirely in the highland where the climatic conditions are suitable for its growing. Oil palm is grown in West New Britain and northern province areas on large and small farms.

The total value of exported agricultural commodities of PNG in 1986 has been 338,972,000 U. S. $, although it has fluctuated largely in the past several years, mainly due to fluctuation of export prices in world markets. Coffee, cocoa and tea still remain in the leading positions among agricultural commodities, and their export earnings have occupied about 81% of the total agricultural export earnings on the same year (FAO).

We had carried out the ecological survey in the catchment basin of the Markham River in 1983 and 1989.

The climate in the Markham valley is lowland–dry–subhumid–type (MCALPINE & KEIG, 1983). Mean annual rainfall in this region lies between 1,000 and 1,500mm, and the rainy and dry season are greatly marked. A regular prolonged dry season extends from April to November, resulting in soil drought conditions for almost half the year. Forest is the natural and dominant vegetation of the region, although the indigenous village people, through burning, has converted large areas of forest into grassland. Therefore, grassland covers much of the dry hilly country along the rainshadow valley of the Markham River. It will be very difficult to regain the previous vegetation, mainly due to generally less favourable conditions of steep slopes and shallow stony soils. The vegetation of the plains extending on the Markham River basin is also grassland. A great number of animal farms operate on the region by largeholders. On the present survey, we could recognize a distinct improvement in facilities such as pastures and barns as compared with the previous survey.

Some Chemical Properties of the Soils

Four soil samples were collected from the grassland of the Markham River basin for analysis in this study (Fig. 1).

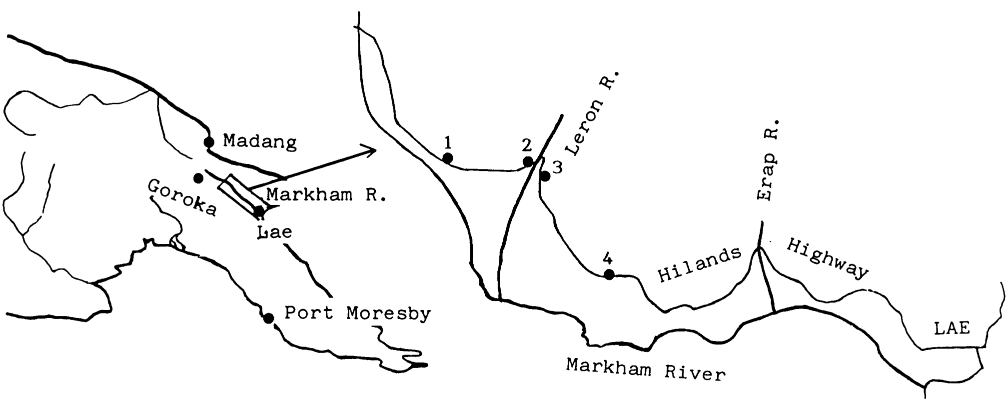

Fig. 1. Locations of sample sites in the Markham valley, PNG.

Because all soil samples were taken from the top horizon, the classification attempt of the soils was impossible. However, some chemical properties such as soil pH, exchangeable cation, cation exchangeable capacity (CEC), and humus were examined on the soils.

Analytical data were obtained according to the following methods: pH with a glass electrode pH meter in water (1:2.5); exchangeable bases by 10% sodium acetate buffer solution –pH 4– extraction followed by colorimetric determination of Ca, Mg, and K; CEC by measuring NH_4 retention repeating washing with 80% methanol solution –pH 7– and then replaced with N KCl, excess of NH_4 in remaining solution were subtracted from NH_4 in KCl by weighing

Table 2. The amounts of exchangeable cation, cation exchange capacities, base saturation degree, and base ratio of the soil samples.

Soil No.	pH	Exchangeable cation			CEC	Base satu. (%)	Ca/Mg	Mg/K	Humus (%)
		Ca	Mg	K					
		me/100g							
1	6.7	27.8	0.2	1.2	59.1	49.4	139.0	0.2	4.0
2	6.6	15.9	0.1	0.7	38.1	43.8	159.0	0.1	3.9
3	6.6	22.0	0.1	0.9	40.1	57.4	220.0	0.1	2.7
4	6.7	157.1	18.9	0.8	32.0	552.5	8.3	23.6	1.8

for CEC calculation; humus by 2.23% sodium pyrophosphate solution and 1% sodium hydroxide solution extraction followed by colorimetric determination of total carbon.

As shown in Table 2, the soil pH is mostly neutral on all samples examined. Among exchangeable bases, Ca level is notably high compared with other bases. Mg and K level in all samples are relatively low, except for Mg in soil 4. Soil 4 has a marked large amount of Ca and Mg, it can be distinguished from other soils as heterogenous soil. CEC level of all samples is relatively high varing from 32.0 to 59.1.

The desirable values in base saturation degree are 40−80 me/100g, which are the recommended standard values in Japan under humid temperate climate. From these values, it is estimated that values of soils 1−3 are also moderate under tropical conditions.

As to Ca/Mg ratio, soils 1−3 show very high values varing from 139 to 220. These results mainly from the high content of Ca and the very low content of Mg. Mg/K ratio is very low in soils 1−3 but high in soil 4: the former result from the low contents of Mg and the latter from the high content of Mg compared with K.

For farming in Markham valley, it is reasonably shown, on these data, that Mg and K fertilizer applications are needed to gain the adequate yield.

Mineral Composition of the Soils

Mineral composition of the soils were determined using X−ray diffractometer. The results are shown in Table 3. Quartz, plagioclase, orthoclase mica and clinoptilolite are predominant in all samples, but carbonate and clay minerals are more abundant in sample 4 than in the others. Furthermore illite is more distinct in samples 1−3, but paragonite is predominant in sample 4. Smectite−mica random mixed−layer mineral occurs as a trioctahedral form. The organic remains were observed from all samples.

All soil samples were collected mainly from alluvial fans in the Markham valley. Soil 1 was collected from the alluvial fan from Gorambampan Creek, of which the source materials have been supplied from the Leron formation and Mena beds composed mainly of siltstone, sandstone, conglomerate and graywacke. The mineral composition of the soil might be explained to be directly derived from such rocks, and the small quantity of clay minerals suggests that the weathering speed is not so high compared to the transportation of weathering products. Soils 2 and 3 are from the surface of the piedmond-slope deposits of the northwest side of the Leron river. The geological map by TINGEY & GRAINGER (1976) shows that the source mate-

Table 3. Mineral compositions of the soils from the Markham valley.

Sample No.	1	2	3	4
Quartz	○	○	○	○
Plagioclase	○	◎	○	○
Orthoclase	○	○	◎	◎
Carbonates	•	•	•	◎
Mica group	○	○	○	◎
Clinoptilorite	○	△	○	○
Smectite–mica mixed layer	△	•	△	◎
Kaolinite	•	•		△
Chlorite		•		△

rials might have been supplied by the Leron river. In that case, as the drainage basin is wide, the materials might have been drived from the Gowop limstone and gabbroic to dioritic intrusions, as well as from the formations mentioned above. In spite of quite different chemical features, the remaining and weathering products in soils 2 and 3 are almost the same as those in soil 1.

Soil 4 was collected from the humid lowlands between the fans from the Leron river and from the Rumu river. The rocks in both drainage basins are almost the same. Hence, the source rocks of soil 4 is thought to be the same as those of soils 2 and 3. However, the mineral composition, as well as the chemical composition, of the soils differ with each other. The abundance of clay minerals might be explained by the remaining unmoved weathering products in the humid lowlands. It can be thought that the source materials of soils 2 and 3 might be derived from the other drainage basin than the Leron river basin. The other possibility is that the sampling site of soil 4 might be under special environment, and that the carbonate minerals might have remained unchanged. More samples under systematic survey are needed to understand the enrichment of carbonate and to explain the abnormal chemical compositions.

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