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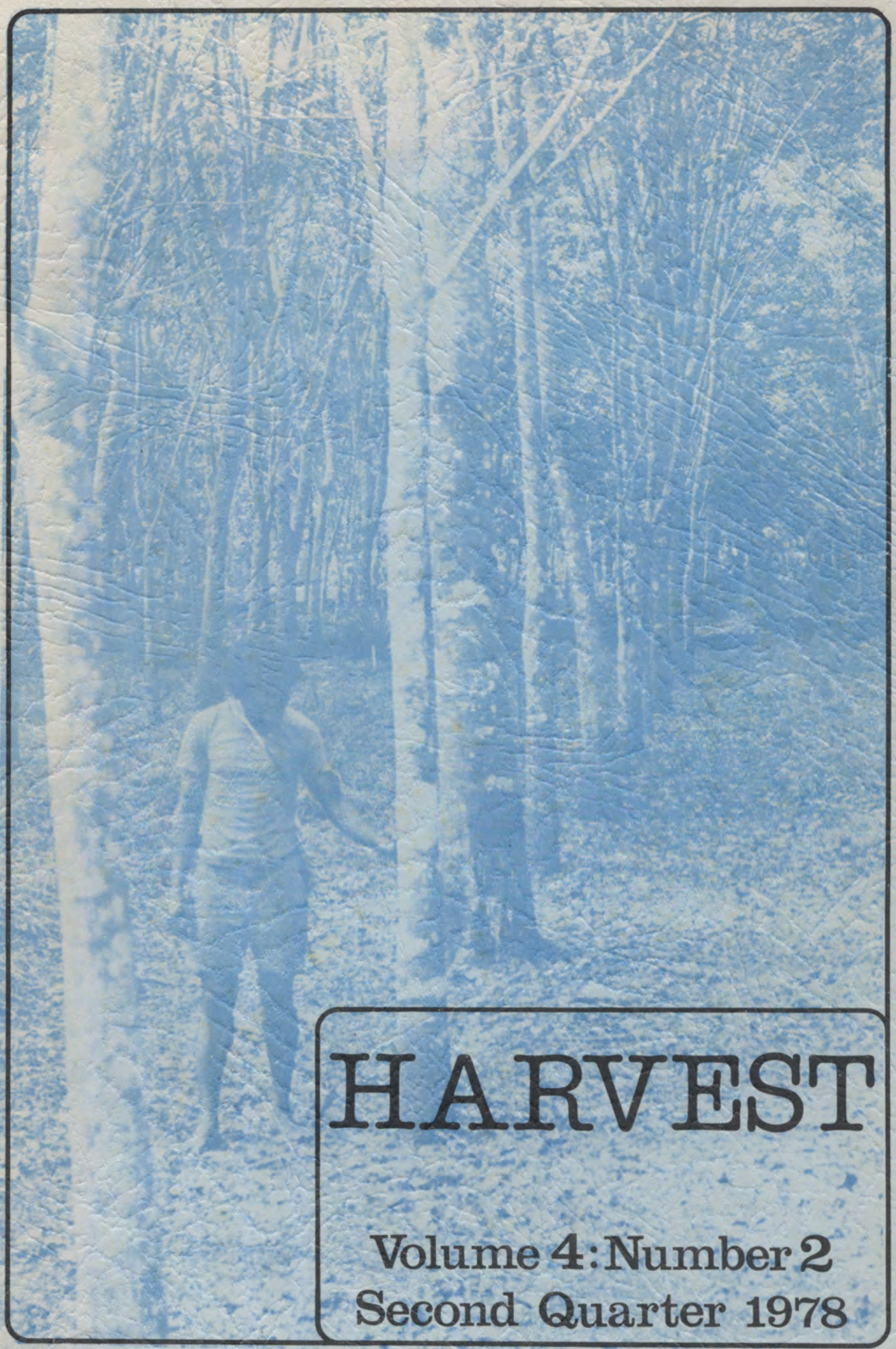

HARVEST

Volume 4: Number 2
Second Quarter 1978

ERRATA

- Soya beans in the PNG Lowlands by J.H. Sumbak p. 60 should be included in the Contents.
- "Marham" on line 14 p. 53 should read "Markham"
- "Clorthal-dimethyl" on line 17 p. 65 should read "Chlorthal-dimethyl"
- "ane" on line 9 p. 78 should read "and"
- line 1 p. 86 should be omitted
- "individua" on line 2 p. 116 should read "individual"

HARVEST

Vol. 4, No. 2. Second Quarter 1978

CONTENTS

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Editorial

We regret the late appearance of this volume of Harvest, but we have had many production difficulties over the past year. In order to overcome some of our difficulties, we have made certain changes in format which will facilitate production. We would welcome comments and suggestions from readers.

ADVICE ON WEEDICIDES

By D.W. Kidd - Senior Lecturer Crops,
Highlands Agricultural College

Mr D.W. Kidd, a senior lecturer at the Highlands Agricultural College sent the following reply to a request for information on weedicides. The advice given would be useful for all people using chemicals to kill weeds.

Paraquat or Gramoxone (ICI) should cope with most weeds. This chemical burns all plant tissues above the ground.

Perennial weeds need a "systemic"* chemical to kill the root system. For broad-leafed perennial plants, try 2,4-D, and for perennial grasses try Dalapon.

Atrazine is a very effective "pre-emergent" weedicide for use in maize and sorghum. (I have got spectacular results in Mt. Hagen and it is recommended for the Markham Valley also). Accurate application is the secret of success. The effects wear off after a few months, but then the crop should shade out the weeds.

Chemicals are not the total answer to your problem. If weeds are a problem perhaps you should examine methods of mechanical control.

Check the spacings of your crop plants. Most weeds prefer sunlight, therefore if you can get your crop to cover the ground efficiently and quickly your weed problems will be almost nil.

When Using Insecticides

1. Always add some detergent to the water, Lixapol, Nonidet or Agral, to increase the spread of the chemical.
2. Treat all agricultural chemicals as "Poison".
3. Bury old containers to prevent people using them as containers for food.

*Systemic weedicides are absorbed by the plant, and move through the plant system to all parts of the plant, killing stem and roots as well as the leaves.

4. Check that operators wash their hands after using agricultural chemicals.

5. Mix chemicals and water in 45 gallon or 200 litre batches where possible to minimise mistakes and reduce the need for detailed supervision.

6. A knapsack sprayer capable of taking the Polijet weedicide nozzle should be used.

7. I suggest you read further or discuss with experienced users the various methods of weed control, i.e.

dirty seedbeds

split applications

soil sterilization of seedbeds.

Soil sterilization of seedbeds can be done by "cooking" the soil for seedboxes in an old 200 litre drum split lengthways. Cook over a wood fire with the drum supported on the bricks until a sweet potato tuber placed just under the surface is ready to eat. This kills all weeds and insects and will give things like tomatoes a good start before transplanting.

Finally for positive identification of plant species use the forms "Botanical Specimen for Identification" obtainable from Division of Botany in Lae. To ensure your samples arrive in a condition that will enable recognition, follow these instructions:

Method of preparing specimens for identification

(a) Select a specimen with leaves, flowers, and fruit if humanly possible.

(b) Allow to wilt for an hour or two.

(c) Carefully arrange and flatten leaves over a piece of absorbent paper. "Post Courier" or "Wantok" are suitable but not imported newspapers. Cover plant with absorbent paper. Press gently between flat surfaces and use a brick as weight.

(d) Change the paper daily until nearly dry to prevent mould developing.

(e) If you squeeze too hard too quickly the plant cells are ruptured and the specimen will go black and be unrecognisable.

PLANNED SMALLHOLDER RUBBER DEVELOPMENT 1975—81

By G.L. Rady, Project Officer,
Village Rubber Development

The smallholder rubber industry, while being very small, is of growing importance in Papua New Guinea. Rubber has proved to be a good basis for the implementation of the Government's Improvement Programme and consequently will be given increased emphasis. Over the next five years, the industry should see a period of rapid expansion and significant technological change. The recently formed Rubber Development Section of the Department of Primary Industry, has been made responsible for supervising this programme and its progress.

Village development will continue to be the most important area of the industry's expansion. The total number of smallholders is expected to increase by a third from about 3 000 to over 4 000. Of this increase 70% are likely to be in villages and the remaining 30% should be fairly evenly divided between the new Gavien Land Settlement Scheme and re-developed Land Settlement Schemes at Cape Rodney, Murua and Bailebo. By 1980-81 we believe village smallholders will comprise about 80% of the total and that almost 50% of all smallholders will live in the Western Province.

When analysing future plans a similar trend can be seen, however with a few noteworthy differences. The total area planted is expected to double, from a little over 3 300 ha to in excess of 6 700 ha. Seventy per cent of these new plantings could be on village holdings with the balance on land settlement schemes. It should be noted that the Gavien Land Settlement Scheme, while representing only 3.5% of the total smallholders, is expected to plant about 25% of the total new plantings. By 1980-81, 75% of all smallholder rubber will be planted on village holdings and over 40% of all plantings will be in the Western Province. It is interesting to note that village holdings on average are only two-thirds the size of their scheme counterparts.

Production is expected to increase by almost three times from a little over 300 tonnes per annum to about 900 tonnes. Production from the Cape Rodney Land Settlement Scheme alone, by 1980-81, will amount to almost 40% of the total smallholder production. Western Province production is likely to increase over eight times and by 1980-81 represent some 30% of total smallholder production. It is of interest to note, that while scheme plantings will only account for about 25% of the total area planted, they will produce nearly 50% of the total production. This is mainly due to higher

productivity, that is, scheme holders are producing on average about 850 kg/ha as against a little over 300 kg/ha for village holdings.

The industry is currently in the process of a gradual change from polyclonal seedling planting material to budded material. Owing to shortages of budwood material and expertise, this programme has not progressed quite as well as we would have liked. However, with the commencement in late 1975 of eight "man years" of United Nations Development Programme, in the form of two experienced budgrafters, the programme is expected to go ahead rapidly. We are now confidently predicting that within two years 90% of new plantings will be budded material.

To begin with we will be using solely a mixture of PR107 and GT1 clones. Green budstick production nurseries initially will be established exclusively on selected Department of Primary Industry Stations. For the foreseeable future, common or illegitimate seedling rootstock material of polyclonal origin will be used only on those DPI Stations where it is possible to organize a central nursery for a scheme or group of villages.

In all other circumstances, interested groups of smallholders or individuals will establish their own polyclonal seedling nurseries (similar to present situation). These people will then undergo budgrafting training at the local DPI Station, and when their seedlings are of buddable size they will obtain green budsticks from DPI to bud their own nurseries.

DPI is currently carrying out a survey to determine the most suitable clone for each individual rubber-growing area. It is hoped that by 1980-81 we will have more specific clonal recommendations for each rubber-growing area.

The major area of change in the smallholder industry is planned for the marketing sector. There are two main changes proposed, both have the common aim of maintaining the industry's long term competitiveness in the international rubber market. Firstly, the Rubber Development Section is initiating studies into the feasibility of reprocessing all smallholder rubber through a central factory. This factory could produce special compounds for use by small-scale rubber goods industries to substitute some imports. The obvious possible implication for smallholders would be a change from the traditional production of RSS to some form of "initial concentration rubber", that is, cup-lump, polybag lump or "michelin" sheet. Secondly, work should commence, in 1980-81 at Gavien, on the first factory to produce Technically Specified Rubber (TSR)* from smallholder rubber.

There are numerous other aspects of the smallholder industry which will be receiving increased emphasis and hence should show response.

*Rubber graded by chemical analysis rather than visual appraisal.

Increased participation by women, particularly in tapping and budgrafting, will be given special attention, as, in the past, they have been both ignored by extension services and traditionally disadvantaged in Papua New Guinea society.

Inter-row cropping will be encouraged as a normal feature of rubber development in an attempt to create more interest and provide a source of cash income during the period prior to tapping.

Poor transportation has proved a serious problem for village smallholder development in the past, and would probably be one of the major reasons for the relatively low productivity of village rubber holdings. Through the New Zealand Aid Programme, attempts are being made to improve this situation by providing more reliable water transport. This may allow us to introduce a scheme of purchasing at the village rather than at main centres and hence improve smallholder productivity.

Where possible we are planning to encourage grower-owned organizations to market rubber and supply necessary inputs. Through a number of small-scale industries it is hoped to produce more of the industry's tapping and processing equipment needs within the country and hence reduce costs to smallholders.

Of course, this relatively ambitious programme of expansion and change will require considerable government support. The Government's rubber research programme is being reviewed in an attempt to direct it more to the needs and problems of the smallholder. A training programme, under the United Nations Development Programme, with a strong practical bias, is upgrading staff and smallholder skills while helping us to keep up to date with the latest technical knowledge. The National Rubber Planning Group, a government departmental body made up of field and headquarters representatives, has been established to review smallholder development programmes annually and recommend policy. As mentioned before, the recently established Rubber Development Section will be overseeing the programme and analysing its progress.

What of the smallholder industry after 1980-81 ? Of course there are many unknown factors which make projections very much a case of guess work but, assuming minimal monetary and expertise constraints, the following could be the situation ten years from now. The area under the control of smallholders may have doubled mainly as a result of the subdividing of smaller plantations and the expansion of the Gavien Scheme. It is possible that at least one land settlement scheme based on a central estate surrounded by smallholder plantings could be in the planning stages. Production should have doubled principally because of Gavien coming into production. About 40% of smallholder rubber production will be exported in the form of TSR while the remaining 60% will be absorbed by a central factory producing special compounds required by small businesses manufacturing rubber goods. All Papua New Guinea rubber, of both smallholder and plantation origin, will probably be marketed through the Papua New Guinea Rubber Marketing and Development Board. While at smallholder level productivity will be rising through better marketing, the greater need for money, and better-yielding material, hence ensuring a potentially viable future.

To conclude, it should be added that while the short term future is of expansion and modernization, this has come none too soon and is by no means assured of complete success.

This paper is adapted from a paper presented at the Association of Natural Rubber Producing Countries Seminar on Progress and Development of Rubber Smallholders, held at Haadyai, Thailand, in October, 1976.

PNG SMALLHOLDER RUBBER DEVELOPMENT PLAN 75-76 TO 80-81

	Current Situation 75 - 76					Projected Situation 80 - 81		
Province	Number Of Growers	Immature Plantings (Ha)	Mature Plantings (Ha)	Total Planted Areas (Ha)	Production 75-76 (Tonnes)	Number Of Growers	Total Planted Area (Ha)	Production 80-81 (Tonnes)
Western	1 600	1 615	130	1 745	30	2 000	2 870	250
Gulf	90	115	50	165	50	100	290	65
East Sepik	55	27	8	35	4	350	1 300	10
Manus	130	98	2	100	1	150	360	15
Northern	450	190	160	350	65	450	400	150
Central	700	670	280	950	160	850	1 100	400
West Sepik	0	0	0	0	0	200	300	0
PNG Total	3 060	2 730	635	3 365	310	4 150	6 740	890
Village Development	2 560	2 155	430	2 585	135	3 320	4 910	480
Scheme Development	500	575	205	780	175	830	1 830	410

SUGARCANE IN PAPUA NEW GUINEA

By J.H. Sumbak, Agronomist-in-charge,
Agriculture Research Centre, Bubia.

Plans to establish commercial sugar production in Papua New Guinea have been backed up by many years of field trials with sugar-cane. These trials have been carried out in the Markham Valley, by agronomists at the Bubia Agriculture Research Centre. The programme was directed by Mr Malcolm Hunter from 1965 to 1971, when he left Papua New Guinea. Subsequent work has been directed by Mr. J.H. Sumbak, Agronomist-in-charge at Bubia, who here reviews the programme and results to date, and assesses their practical implications for commercial sugar-cane growing, with particular reference to the Markham Valley.

Although sugar-cane grows well in almost every part of Papua New Guinea and it would be possible to make sugar from the cane at the village level, in most places the climate is not suitable for sugar to be stored in concentrations high enough to make commercial sugar production economic. The climate is too favourable for continuous growth, and therefore sugar is not stored.

Sucrose (sugar) is made in the leaves of the plant and moved to storage cells in the stalk. If conditions are warm and wet, the plant uses up the sugar for its growth. A period of less favourable conditions (either cool weather or shortage of water) will slow growth and allow sucrose to be stored.

The aim then is to get maximum growth at the beginning, and then eventually to have a period of very little growth.

A seasonal stress is needed to cause the plant to slow down its growth and store sugar.

In PNG the only areas with a great enough stress are those with a definite dry season. This is why places in the Markham and Ramu Valleys and in the Central Province were chosen for sugar-cane trials.

Experiments commenced in the Markham Valley in 1965 and by 1970 it was obvious that sugar-cane could be grown successfully. Many varieties of cane were tested, and the most suitable variety was found to be Pindar.

Problems of pests and diseases were not serious on the small areas of cane which were planted at that time. However, if large areas of of sugar-cane are planted it is possible that pests and diseases might build up over the years and become a problem.

A large, commercial-sized block of 16 ha was planted in 1971 to study this. This crop was harvested in 1972. The crop was then allowed to ratoon, that is, new canes were encouraged and allowed to grow again, and the ratoon crop was harvested in 1973. A further 12 ha were planted in 1972 and this was harvested in 1973.

Through this period there was no evidence of pest or disease build-up in either the first crops or the ratoon crops.

The following summarizes the work of the Department of Primary Industry to date. Recommendations are given for growing sugar-cane under Marham Valley conditions.

VARIETY TRIALS

A large number of varieties of sugar-cane were tried out, to find out which were most suitable.

The prime considerations in the Markham Valley were resistance to downy mildew (an air-borne fungal disease), and resistance to Fiji disease (a viral disease carried by insects).

Other important factors include pests, ratooning ability, size of the crop and sugar levels.

When some of the crop falls over, known as lodging, this makes harvesting difficult. This factor was looked at.

Flowering in sugar-cane is undesirable because it uses up energy which otherwise could have gone into sugar storage. Flowering time and intensity were also considered.

Different parts of the Markham Valley were tried out in 1965. These included Narakapor, Munum, Pyramid Hill and Sangan. The four Queensland varieties Pindar, Trojan, Q50 and Q57 were planted at each place.

Generally growth was satisfactory. The Pyramid Hill block yielded 100 tonnes/ha of cane after 12 months growth, with a fibre content of 12% and estimated commercial cane sugar (ccs) of 12%.

A first ratoon crop at Munum yielded over 63 tonnes/ha of millable and 38 to 50 tonnes/ha of immature and deteriorated cane.

Of these four varieties, Pindar appeared to be the best. It grew strongly, did not suffer much from downy mildew, and not many plants flowered before harvest time.

However, Pindar had two major drawbacks. It was not very resistant to Fiji disease, and it had a tendency to lodge badly, in places where good soil enabled the plants to grow tall. Pindar also had only moderate sugar levels.

In 1967, 14 more varieties were tried out. These varieties, all from the approved list for north Queensland, were: Eros, Cato, Ragnar, Q59, Q64, Q66, Q67, Q68, Q77, Q78, Q80, SJ4, HQ426 and Vidar.

In 1969, 13 more varieties were grown. They were: Q44, Q58, Q74, Q75, Q82, Q83, Q84, Q85, Cadmus, Comus, Damon, Luna and Sirus.

The variety Q44 was completely resistant to Fiji disease, and Damon was highly resistant. They were, however, deficient in other characteristics.

The best 16 of the above varieties (selected mainly on their resistance to disease) were planted at Pyramid Hill in October, 1970.

From the results of these trials, Pindar and Ragnar were selected as the best varieties for the Markham Valley.

Pindar was found to have fast early growth. This is useful because weeds are controlled early through shading. (It was shown that depending on variety,and also on weather, maximum growth rate is attained 120 to 160 days after planting).

Pindar was unfortunately relatively susceptible to Fiji disease, but it is not yet known whether this is important in the Markham Valley. It is still not known whether the leaf hoppers which spread Fiji disease are sufficiently active in the Markham Valley.

It is also susceptible to lodging, but none of the other varieties that did not have this problem was as good as Pindar in other ways.

The sugar levels in some other varieties are considerably better than Pindar, but again, they are not so good in other ways.

Ragnar was unfortunately not tested for resistance to Fiji Disease, but results from 14 trials overseas classify it as extremely resistant to this disease. For this reason, stocks of Ragnar are being grown, so that they can be used instead of Pindar, if Fiji disease becomes serious in the Markham Valley.

Some of the other good varieties chosen include Cato, Q84, SJ4, and Q78. Crops of these are being grown to supply planting material.

Recommended varieties are likely to change. New varieties are still being brought from Queensland, and varieties with higher yields may be found. If pests and diseases become a problem with one variety, another variety may have to be used.

PLANTING MATERIAL

Holding period. - Holding planting material for three days before planting seemed to give the fastest germination. (The best germination rate was 90 %). The buds still germinated if the material was held up to two weeks (76% germination), but if conditions were humid the setts started shooting before planting, and this made the shoots and roots vulnerable to damage.

Fungicide. - An organism (Ceratocystis paradoxa) may infect the bud and prevent germination in cool, dry weather and under such conditions it is essential to dip the planting material in a fungicide. The Department has found that under the hot, moist conditions in the Markham Valley dipping is not essential with commercial-sized plantings.

Planting pieces. - It was found that the best planting method was to cut off the tops of the stalks, and cut the remainder of the stalk into setts with three nodes each. These setts gave more even germination than uncut stalks, which germinated very unevenly.

Plant establishment. - In the experiment, 3-node setts of Pindar were planted in rows 145 cm apart with cane laid end to end in the rows. (The weight of planting material used was 5 000 to 7 000 kg/ha. The weight of planting material will naturally vary with the thickness of the cane. This will be different in different varieties).

Setts were covered with 5, 10, 15 and 20 cm of soil, and the number of shoots in a 7.6 m row counted over 12 months. There were big differences in the number of shoots at three months (111 for 5 cm, 83 for 20 cm) but by harvest time the variation was 45 for 5 cm and 41 for 15 cm. Lodging increased between 15 and 5 cm from a figure of 2.3% to 15%.

As moisture conservation is likely to be important at the time of planting it is recommended that setts be covered with 15 cm of soil.

Weed control. - On new land weeds would be unlikely to be a real problem. Where control is needed, hand-weeding, mechanical weeding or chemical control can be carried out. Mechanical methods would probably be the cheapest.

A number of chemicals, including atrazine and paraquat (Gramoxone) would be suitable. Sugar-cane tolerates paraquat fairly well. It gives an immediate kill of broadleaf and grass weeds.

Provided growth is satisfactory, the leaf canopy is usually complete after about three months, so weed growth is unlikely to be a problem after that.

FERTILIZER USE

A considerable amount of work on sugar-cane nutrition has been carried out in the Markham Valley. More work will be needed for specific soil types and areas.

Nitrogen

Nitrogen is almost certain to be necessary with sugar-cane, except perhaps after a leguminous crop.

However, too much nitrogen can cause problems, such as increased lodging. Lodging can lead to rat damage.

In the wetter areas of Munum, nitrogen increased dry matter production but the increase was in fact made up of deteriorated and immature cane, which spoils crop quality. A lot of the deterioration was due to rat damage. If rats had been controlled effectively, this deterioration could have been avoided, and there would have been a 30% increase in yield.

In view of this, it is recommended that on fertile, uncropped or lightly cropped soils only 65 kg/ha of nitrogen should be used. Higher rates can be used on poorer or lighter soils.

Urea can be sprinkled on to setts lying at the bottom of 20 cm deep furrows at rates of up to 212 kg N per ha without affecting germination or growth adversely.

Potassium

As levels of calcium and magnesium are high in most Markham Valley soils the possibility of antagonism with potassium was looked at. No yield increases were found. As sugar-cane removes large amounts of potassium it may be necessary to add potassium after cropping has been carried on for some time.

Trace elements

The alkaline soils of the Markham Valley can be expected to lead to deficiencies of zinc, copper and manganese. Tissue analyses of sugar-cane have indicated that these elements may be insufficient. Addition of trace elements to the soil gave greater mature stalk weights, sugar levels, crop yield and percentage moisture.

Further work on the need for trace elements will be needed if an industry develops.

COVER-CROPS AND ROTATIONS

As sugar-cane takes a lot of nutrient from the soil it will need to be rotated with other crops. Fertilizers would make up what the crops have taken out but it is likely that pests and diseases would build up with continuous sugar-cane crops.

A number of leguminous cover-crops have been looked at. *Dolichos lablab* proved to be the most promising. It unfortunately will not set seed in the Markham Valley but should serve as a suitable short-term rotation, provided seed can be obtained cheaply. Cowpea and possibly mung bean show promise.

CROPPING SEQUENCE

Times of planting and harvesting would be determined by the climate. With large-scale milling the longer the machinery is worked the more economical the operation is. Planting and harvesting schedules need to be worked out to give the longest possible harvesting period, provided that adequate sugar levels in the cane are achieved.

One suggested schedule for the Markham Valley was that planting be carried out in April to June. The crop would then be harvested in August to September of the following year, 14 to 15 months later.

The first ratoon would probably be ready to harvest between August and October the following year. Subsequent ratoon crops would then be harvested on an 11 to 12 month basis as the mill required.

While possibly adequate this system may not be the best. Planting in April to June would not achieve maximum early growth followed by sugar storage; conditions are generally dry in the Markham Valley from May onwards. What in fact would happen is that the crop would establish and then grow very slowly until the wet season, usually beginning in December. Vigorous growth would then occur. The lower and middle Markham also generally has a minor "wet" during July and August and this could in some years hinder harvest.

One crop which was planted in January, 1972, on an area with a high water table, was ready for harvest in October to November of the same year. The crop obviously benefited from the early planting and then grew vigorously until July to August. This suggests that early planting (possibly November to December) would allow maximum early growth and shorten the period to harvest.

<u>The following system is suggested based on "typical" weather conditions.</u>

At the top end of the Markham Valley and perhaps the Ramu Valley planting could normally be carried out in October to November. The wet north-west season commences early in this region, and good rainfall conditions occur until at least June or July. The crop should be ready for harvest in September to December. Early rains in October or November could impede harvest a little but should not be a major problem in normal years.

In the lower and middle parts of the Markham Valley, a late November to early January planting could be aimed at with harvesting in October to November of the following year. If the rains do not come early, planting could be delayed until March to April. In this case the growing season would be prolonged and harvesting could commence in June (depending on the season, the soil type etc.) and continue until September. This would give a milling season of June to December.

HARVESTING

Harvesting can be carried out by hand or mechanically. Hand-cutting would probably be preferable in Papua New Guinea as adequate labour is available.

Hand-cutting assessments were carried out in 1972 and 1973. In 1972 work was carried out on an incentive basis while in 1973 labourers worked on an hourly basis (8 hours/day).

The amount harvested varied with the tonnage and degree of lodging of the crop, and of course varied tremendously between individual workers.

Lodging was quite bad in some areas in 1972 and this adversely affected the harvesting rate.

In both cases the cane had been fired before harvest. The cane was simply cut and stacked every 4 or 5 metres and not carried to a truck.

Allowance for this should be made when looking at the cutting averages.

It would appear that, on an incentive basis (this would be the obvious way of tackling harvesting), labourers should be able to cut and cart at least five tonnes of cane a day.

Burning is beneficial in removing insects, snakes and rats as well as making harvesting easier. A drawback with burning is that is is critical that the burnt cane be cut and rapidly transported to the mill to avoid deterioration.

The amount of organization involved and fire risks are also drawbacks.

Green cane can be stored for a considerable time before any major loss in sugar occurs.

RATOONING

As ground preparation and planting are an expensive aspect of sugar production it is desirable to grow as many economical ratoon crops as possible.

After harvesting it is necessary to shave the stubble back to ground level to ensure that shoots emerge from underground and not from old stalks above ground level.

Provided hand harvesting is carried out properly (that is, canes are cut to ground level) mechanical shaving may not be necessary.

New shoots come up much more quickly from the old stools than from freshly planted cane, and early growth is faster.

Ratoon crops should be ready for harvest a maximum of 12 months after the crop is harvested. First ratoon crops have been quite successful in the Markham Valley but the one second ratoon observed grew very poorly. In this case the first two crops were unfertilized while the second ratoon only received a single application of nitrogen after the first ratoon was cut.

While there are records of 11 and 12 ratoons in some Central American countries we cannot rely on more than one with certainty at this stage.

LARGE AREA PLANTINGS

In order to see if major pest or disease build-up occurred on commercial-size plantings a 16 ha block was established between April and August, 1971.

The crop was harvested in August to September, 1972, and sample yields varied considerably. (23 to 86 tonnes/ha). Problems had occured with soil types and weeds. Better cultural techniques and more selectiveness in choice of planting areas would have improved yield considerably.

Some of the crop was badly lodged - this is tied up with the vigorous growth of Pindar, as well as planting depth and soil type. The very strong Markham winds are also obviously an influence.

Fiji disease was evident but its incidence was very low.

A number of species of stem borer were noted but build-up of numbers was not noted and it is doubtful whether they were of any real significance.

An outbreak of aphids occurred but this was put down to unusually dry conditions. With the onset of more normal weather the outbreak decreased.

The planting ratooned quite well despite the dry weather and it was harvested in August to September, 1973. The ratoon crop showed very little lodging and yields were from 25 to 58 tonnes/ha.

A further 12 ha were planted in January to May, 1972 and harvested in August to September, 1973. It was well overdue for cutting. Much of it was badly lodged and a lot had died. Yields varied from 50 to 58 tonnes/ha. Most of the area appeared to be ratooning quite well.

Again there was no evidence of pest or disease build-up in either plant crop or ratoon.

The second ratoon of the April to August, 1971, planting performed poorly and was eventually ploughed in.

TABLE 1.

Date	Sample	Amount cut/worker/day tonnes	Estimated yield tonnes/ha
1972	1	16.4	69.5
	2	11.7	56.7
	3	9.7	49.4
1973	1	7.1	54.7
	2	5.8	45.3

Note: Incentive workers (1972) worked an unrestricted time while hourly rate workers (1973) worked an 8-hour day.

SOYA BEANS IN THE PNG LOWLANDS

By J.H. Sumbak, Agronomist-in-charge,
Agriculture Research Centre, Bubia

The value of soya bean as a protein source both for humans and animal food is well known. The oil obtained from the seeds of soya bean also has many uses.

Soya bean has, however, not been grown much in Papua New Guinea because it is not a "traditional crop". Also, it is not very good to eat unless it is properly cooked.

Over the last few years people have become more aware that the traditional diet in many parts of PNG is not good enough for good nutrition. This has led to more interest in soya bean as a food for people, because of its high protein value.

The cost of imported stockfeed for the rapidly expanding pig and poultry industry is now very high, and this has also created an interest in growing soya beans for pig and poultry food.

A paper on how to grow soya beans on a small scale has been written for the Department of Primary Industry's Farming Notes series.

The following article describes research carried out at the Agriculture Research Centre, Bubia, between 1972 and 1975, to find the most suitable varieties and ways of growing soya beans for large-scale plantings in lowland areas of PNG.

Trials are continuing at Bubia and also at Aiyura in the highlands.

Staff at the Agriculture Research Centre, Bubia, carried out trials looking at varieties, plant populations and nutrients through 1972 to 1976 and are now in a position to make recommendations.

Most of the trial work was carried out in the Markham Valley ranging from Bubia near Lae to Umi some 160 km west. Some trial

work was also carried out near Madang.

Results of these trials are summarized in this article and recommendations are given.

TRIAL RESULTS

Varieties

Some 112 experimental lines underwent preliminary assessment, together with 14 commercial varieties. The experimental lines were bred by the Department of Agriculture, University of Queensland, with the aim of producing types suited to low latitude (tropical) conditions. These lines are also being tested in Australia, Sri Lanka, Indonesia and Thailand.

Each of the 126 was tested at three places. Further trials were carried out with the most promising in 1975 and 1976.

The results of a trial in 1975 of the best ten commercial varieties are shown in *Table 1*. The results clearly show that Gilbert, Daintree and Ross, the varieties specifically selected for low latitude (north Queensland) conditions, gave satisfactory yields and acceptable heights for mechanical harvesting.

Nodulation in all cases was satisfactory.

Establishment was quite variable to variations in seed quality. Vegetative growth was good at Cleanwater and Leron Plains while at Umi growth was stunted. The latter is almost certainly due to a phosphorus deficiency as rock phosphate releases phosphorus only slowly and it appears to be of little immediate value with annual cropping.

Plant Population

Four varieties were used to compare various plant populations in 1975. Trials were planted at three sites.

Rows were sown 70cm apart, and within-row spacings of 4,8 and 16cm were used, to give maximum possible plant populations of 357 000, 178 000 and 89 000 plants/ha.

Results are summarized in *Table 2*.

Percentage establishment was quite variable, both with regard to variety and site. At Umi it was evident that in some instances more seed was sown than was intended.

Generally, Gilbert and Daintree showed better establishment than Semstar or Wills. Establishment increases as spacing within the row increased, no doubt due to decreased competition between plants. Within a variety higher populations gave higher yields generally, and increased plant height considerably.

Increased plant height correlates with increased height of pods from the ground, an important feature with mechanical harvesting. Results indicate clearly that increased populations increase yield as well as height.

Further trials — 1976

Two trials looking at 34 promising varieties and experimental lines were sown at Cleanwater late in January 1976. Two different spacings were used to see if it would be possible to get more height by decreasing between-row spacings. Between-row spacings of 75 and 50cm and within-row spacings of 4cm were used to give plant populations of 333 000 and 500 000 plants/ha. Results are summarized in *Table 3*.

Yields were lower than in 1975 averaging 2 200 kg/ha which is a little disappointing. This can largely be attributed to moisture stress at certain times. Gilbert and Daintree (two recommended varieties) yielded quite well and this was encouraging.

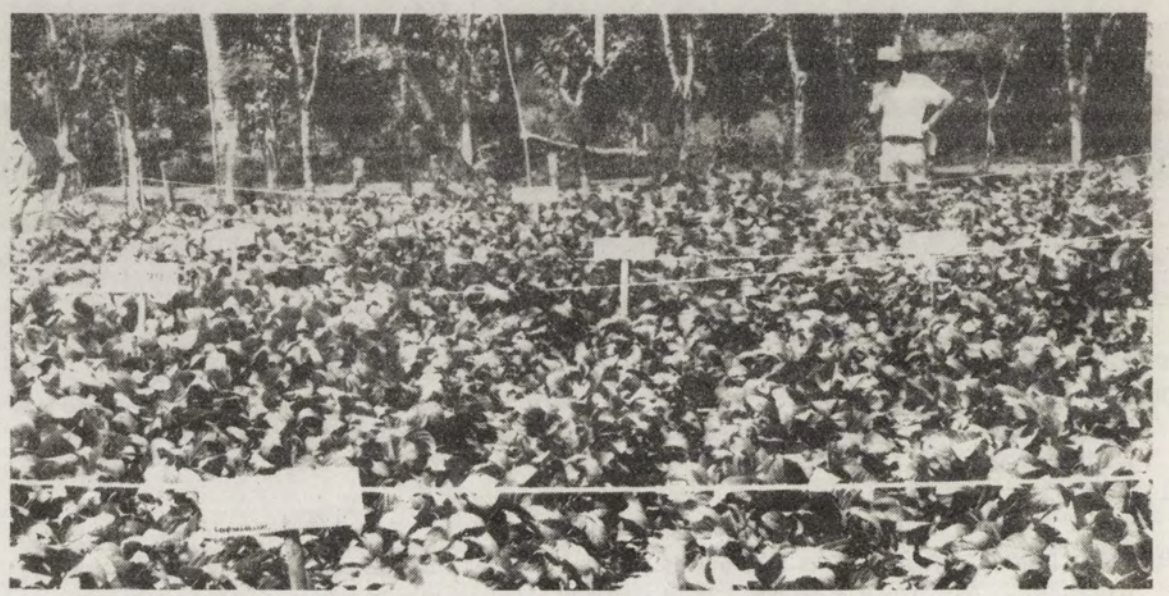
While yield did not differ significantly with the two plant populations plant height was increased considerably.

An observation plot looking at varieties and spacings at Leron Plains indicated that while closer between-row spacings will raise the height of short varieties, efficient mechanical harvesting would still not be possible.

Closer spacing with Daintree, a medium stature variety, increased height. Improved Pelican was tall and very impressive at all spacings.

It was disappointing that none of the newly developed lines outyielded Gilbert or Daintree and that most of the taller lines yielded significantly less and were in many cases susceptible to lodging.

There were considerable differences in time to maturity and this characteristic would be an asset in certain environments and situations in PNG. For instance, short season varieties would be desirable in the lower Markham while the reverse would probably hold for the upper Ramu.



An observation plot of soya bean varieties at Bubia

Pests and diseases

The green vegetable bug *(Nezara viridula)* was evident in considerable numbers in 1975 and appeared to be at least partially resistant to regular sprayings of DDT. In 1976 it was well controlled by spraying with Orthene (1 kg/ha) at regular intervals after flowering. Indications are that incidence will vary considerably from season to season. An entomologist is looking at the possibility of introducing parasites and predators of this insect from Hawaii. Insecticide trials are also in progress.

Some damage by a ladybird *(Hemosepilachna signatipennis)* occurred in 1975 but control was not considered warranted, although DDT deals with it quite effectively.

An unidentified disease occurred at Bubia in 1975. There was considerable variability between lines in susceptibility to this disease.

Bacterial pustule affected a number of lines in 1976 but Gilbert and Daintree are largely resistant to it.

RECOMMENDATIONS

Varieties

Gilbert, Daintree and Ross are recommended for the Markham and Ramu Valleys and other suitable lowland situations, on the basis of 1976 and previous results. Steps should be taken in advance to obtain seed as supplies may be limited.

Plant populations

Populations of 300 000 to 350 000 would be desirable. Spacings will depend largely on equipment available and the methods of weed control to be used.

If mechanical weed control is to be used, row spacings of 70cm with seedlings every 4 to 5cm within rows would be adequate.

If weeds are unlikely to be a problem or pre-emergence weedicides are to be used, closer row spacings should be used as these are likely to give better plant height. Rows 40cm apart or closer with the within-row spacings varied accordingly should be used.

The amount of seed needed will vary according to seed size and the population desired (*Table 4*).

Seed treatment

Soya bean seeds quickly lose viability in warm humid weather and seed should therefore not be stored under lowland conditions for more than three weeks. Seed should be stored under temperate conditions, for example in the highlands, or under air-conditioning. Preferably fresh seed should be obtained.

Soya bean requires a specific rhizobium and seed should be inoculated, especially if it is being sown on land that has never previously had soya beans growing in it. Agar inoculum can be obtained by writing to the Chief Plant Pathologist, Department of Primary Industry, P.O. Box 2417, Konedobu. Inoculum should be used within four weeks of receipt.

Experimental line of Gilbert variety

This picture shows the taller plant produced by closer within-row spacing (left). A taller plant is an advantage for mechanical harvesting

Seed should not be treated with fungicides as this may be detrimental to nodulation.

Land preparation and sowing

Soya beans do not require a particularly fine seed bed as they are quite large, but land should be as flat and uniform as possible to facilitate harvesting. Sowing depth should not exceed 5cm in heavier soils and 8cm in light sandy soils. Soils should not be compacted.

Sowing dates

As adequate moisture is essential during flowing and pod-filling, sowing times as below are suggested —

Erap area — early January
Sasiang, Leron, Mutsing — late January to early February
Kaiapit, Gusap, Dumpu — mid February to early March.

Fertilizer

Currently only the better to medium quality soils are recommended. Starter applications of nitrogen (20 to 30 kg/ha) may be beneficial on virgin soil or soil previously used for growing cereals. Phosphorus may also be needed in some situations. More research into nutrition in poorer soils is required.

Weeds

Chemical weed control has not been studied for soya beans in PNG, but north Queensland findings are reasonably applicable. Under furrow irrigation trifluralin (Treflan) at 1.4 l/ha on light soils and 2.8 l/ha on heavy soils is incorporated into the soil, preferably by harrowing and cross-harrowing immediately after spraying. Treflan controls most grasses and some broad-leaved weeds. Clorthal-dimethyl (Dacthal W75) or linuron (Linuron 50, Afalon) may also be used as post-planting pre-emergence sprays. There are no effective post-emergence sprays commercially available. Manufacturers' directions should be carefully followed and hormone sprays such as 2,4-D should not be used.

Pests and diseases

It appears likely that many crops will need to be sprayed for green vegetable bug (*Nezara viridula*) and perhaps other sucking insects. The 1975 tests indicated that DDT was relatively ineffective against green vegetable bug. Other insecticides are currently being tried out. Orthene (½ to 1 kg/ha) or endosulphan (½ to 1 kg/ha) can be used with first applications commencing about 14 days after flowering with follow-up applications as necessary. Endosulphan is more toxic than Orthene. If damage is severe *Hemosepilachna signatipennis*, a ladybird, can be controlled with DDT or carbaryl, but the damage is unlikely to be severe enough to warrant chemical control.

Generally to date diseases have not proved a problem, but some will undoubtedly occur. Some of these can be dealt with through the use of resistant or semi-resistant varieties. Bacterial pustule occurred at Cleanwater in 1976 but resistant varieties will control it.

FUTURE WORK

The more promising of the experimental lines will again be thoroughly tested against Gilbert, Daintree and Ross at several sites.

Table 1 — Average yields (kg/ha) and plant height (cm) in brackets at three sites.

Variety	Cleanwater	Leron	Umi
Gilbert	2 361 (42)	2 804 (41)	826 (20)
Daintree	2 287 (53)	2 715 (49)	802 (21)
Ross	2 614 (57)	2 419 (49)	1 096 (28)
Semstar	1 430 (69)	855 (71)	417 (28)
Bragg	832 (30)	1 142 (36)	742 (26)
Wills	1 597 (30)	2 274 (31)	673 (20)
Davis	1 465 (32)	1 405 (33)	615 (21)
Hampton	1 670 (29)	1 328 (32)	724 (22)
S2		1 273 (64)	483 (30)
Hood		547 (21)	399 (19)

Table 2 — Yields, % establishment and plant heights for three spacings

Site	Spacing*	Semstar			Gilbert or Daintree †			Wills		
		Yield	% estab.	Height	Yield	% estab.	Height	Yield	% Estab.	Height
Cleanwater	1	1 328	25	49	3 658	65	44	1 888	48	29
	2	1 181	41	49	3 125	76	35	1 064	50	28
	3	830	33	36	2 351	90	32	997	55	24
Leron	1	1 060	54	48	1 945	91	54	1 428	42	27
	2	655	77	38	1 794	92	40	1 499	55	26
	3	599	99	47	1 469	97	33	1 219	91	25
Umi	1	349	67	31	876	78	27	441	70	27
	2	335	86	31	726	92	20	502	86	23
	3	294	92	30	520	101	18	398	102	18

* 1, 2 and 3 represent within-row spacings of 4, 8 and 16cm respectively.

† Gilbert used at Cleanwater and Umi. Daintree at Leron.

Table 3 — Average yields and approximate heights* under two plant populations at Cleanwater.

Variety or line	Yield (500 000 pl/ha)	Yield (333 000 pl/ha)	Height
K39	3 639	2 643	M
P6	3 471	3 320	S/M
Gilbert	3 416	3 177	M
Daintree	3 379	3 477	M
71-39	3 374	2 857	S/M
K53	3 202	3 017	S/M
K8	2 747	2 222	M/T
X2S27	2 745	3 107	M
K152	2 729	2 974	M
X2S31	2 637	2 130	T
Ross	2 616	2 905	M
K70	2 539	2 460	M
P28	2 537		S
K195	2 502	2 749	M/T
P15	2 464	1 939	M
K157	2 457	1 894	M/T
71-20	2 426		M/T
K85	2 409	2 958	M/T
K12	2 377	2 621	S
K171	2 366	2 184	M
K197	2 324	1 957	T
X2S29	2 082	2 593	T
P47	2 027	1 444	M
X2B49	2 021	1 881	M
X2S21	1 898	1 118	T
K134	1 821	1 703	M
K77	1 791	1 265	M
49-9	1 789		T
X2L44	1 775	1 537	T
P36	1 297		S
K123		2 285	M/T
49-8		1 937	T
P33		1 135	S
P23		889	S

* S less than 30cm
S/M 30 to 40cm
M 40 to 50cm
M/T 50 to 60cm
T > 60cm

Table 4 — Seed required (kg/ha) for different planting densities. (It is assumed that 60% of the seed will establish).

Seeds/kg	200 000/ha	300 000/ha	400 000/ha
5 500	59	90	121
6 600	49	74	101
7 700	41	64	87
8 800*	37	56	76

* Gilbert, Daintree and Ross are relatively small-seeded types (8 600, 8 000 and 9 000 seeds/kg in the 1975 variety trials) so seeding rate would be about 50 to 60 kg/ha or perhaps less if good seed viability can be guaranteed.

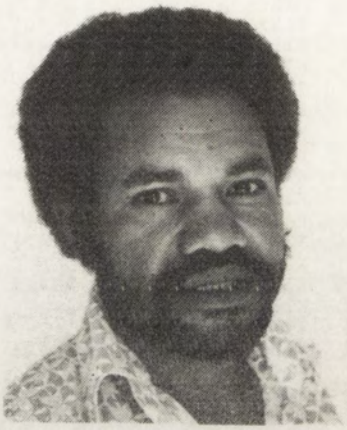
CHIMBU PROVINCE

By Alan Iorive, Provincial Rural Development Officer, and John Van Amstal

Alan Iorive was born in Kanosia, Kairuku District of the National Capital Province, in 1947.

He attended Primary School at St Pauls, Bomana, then to Marist Brothers College, Campbelltown, Australia, 1960-1962 for his secondary school.

He went to Popondetta Agricultural College 1963-1964.
His first posting was to the Lowland Livestock Station at Erap in the Morobe Province.



Alan Iorive

Then he went ot Kila Kila Quarantine Station and to Sogeri as a Livestock Inspector.

In 1972 he was transferred to Kerema and assumed the role of Provincial Livestock Officer until 1974. Then to Rabaul in 1974 as Provincial Livestock Officer for the East New Britain Province until June 1975. He was then transferred to Kundiawa where he became PRDO.

Mr Iorive is married with 3 children. His wife Hehure, used to work as a clerk with the Public Works Department in many of the places they have been.

There are two main seasons in the Chimbu Province: the north-west season and the south-west season. The north-west season lasts from December to March and brings high rainfall. The south-east season lasts from May to November, and brings mainly dry easterly winds.

Because of the rugged terrain of the province, the weather is very variable, and unpredictable.

The general trend is that rainfall gradually decreases from east to west.

The mean annual rainfall at Kundiawa is 1 753 mm, at Gumini it is 2 311 mm, at Kerowagi it is 2 337 mm and at Kegsugl it is 1 852 mm.

During the dry season only occasional showers occur.

Mountain ridges and peaks rise to between 3 000 and 4 510 m. There is little flat or undulating land. Most areas towards the north and towards Chuave are limestone country.

The main rivers are the Wahgi River and the Chimbu River. Other rivers of less importance are the Tua, the May and the Eravi Rivers.

Soils range from alpine peat and humus soils, found mainly in the Mount Wilhelm and Kegsugl areas, to humic brown clay soils in the Elimbari Area, humic brown and red latosols in the Wandi area, and meadow soils in the Mengendi area.

In most of the valleys and hilly uplands the forest vegetation has largely disappeared as a result of clearing for shifting cultivation and subsequent burning and also as a result of increases in population. The vegetation of the lower areas forms a mosaic of grassland, gardens, groves of planted trees, especially casuarina and gum trees, secondary forest and mixed vegetation of trees, shrubs and pit-pit along the streams.

A very dense and extensive road system has been developed, of which the Highlands Highway is the main feature. The Highway links the Chimbu Province with Goroka and Lae to the east and Mount Hagen and Mendi to the west. The stretch running through the Chimbu Province seems to run through very unstable land resulting in landslides that may make the road impassable after wet weather. Other roads are frequently impassable.

Subsistence agriculture on slopes

The Karamui area due to its isolated geography has no road link with the rest of the province. The area is serviced by regular air-services. A road is under construction to open up the area and is expected to go as far as Bomai in 1976-77.

There are ten airstrips, 6 government and 4 mission. Kerowagi, Gembogl, Gumini, Chuave, Karamui, Kup and Kilau Kantai can be contacted from Kundiawa by VHF radio via Goroka — reception is often unclear.

Kundiawa is linked to the rest of the country through the STD telephone system. The limited number of lines available sometimes makes it difficult to contact other places.

PEOPLE

It is estimated that the population is close to 200 000.

Apart from Pidgin, Kumon is the most commonly spoken language and is used over the greater part of the province. In the Nambyufa area most people speak Siasi. The Karamui area has developed its own main languages, Darabe and Tudawe.

There are five high schools, 74 primary schools, 2 vocational centres — one at Kundiawa and one at Gui, Kerowagi.

There are a number of self-help groups.

The Yangpela didiman movement is now fairly influential among the people and has clubs throughout the province. The club centre is now being built at Kup.

The Elambari Development Corporation aims to improve the economy of the Chuave District, and to establish a cement factory and business enterprises for local people. In this area there are also the Tarver group and a piggery established by John Kaupa, MP.

The Segowagi Youth Club is mainly interested in development of social activities in the Kundiawa area.

The Kamagu Development Corporation is involved with trucking, picture theatres and selling of fuel, and plans to set up a broiler chicken project, and later to expand with a cattle and pig project.

Land disputes occur from time to time and lead to fighting, particularly in the Kup area and to a certain extent in the Dom and Gumine areas. There are 47 recorded land disputes and it is suspected that there are also a number of unrecorded ones.

There are nine local government councils: Kerowagi, Mount Wilhelm, Sina-Sina, Kundiawa, Elimbari, Nambyufa, Kilau, Gumine and Karamui.

Some Councils have adopted plant hygiene rules but have not been able to police them. Some councils are in a poor financial position. In general the influence of the councils has waned somewhat since the establishment of the Area Authority.

The Area Authority has allocated Rural Improvement Programme funds in a number of agricultural development projects.

ECONOMY

Coffee and vegetables are the main crops. There is a small amount of pyrethrum, cardamom, chillie and tobacco.

There are four plantations, one is owned by the Chimbu Coffee Co-operative, one by Buka Stores,and two are for sale. An area of 242 ha has been surveyed for a cardamom plantation for the Chimbu Coffee Co-operative.

Cattle are very popular in the province. They are regarded as a symbol of wealth and are generally killed at singsings. However, there is not a great potential for development of the industry due to land shortage.

Tribal fights have held up many development programmes during the past year.

Kumul Bakery delivers bread throughout the province. Other light industries are motor repair shops and a coffee factory at Wandi.

The PNG Development Bank has opened an office in Kundiawa.

AGRICULTURAL DEVELOPMENT PROGRAMME

COFFEE

There are about 3 977 ha planted to coffee, with 41 312 growers. The total number of trees is approximately 108 617 000. Production last year was about 8 000 tonnes.

Most gardens are in poor condition. However, a new coffee improvement programme begun last year is going well in most districts, and is helping to reduce the number of gardens that are not attended to. Patrols emphasise maximum production, fencing to keep out pigs, proper processing facilities and drying. Coffee teams are established in each district and are co-ordinated by the Provincial Coffee Co-ordinator.

Tribal fights and staff shortage interfered with plans for expansion of production and plantings last year.

The Chimbu Coffee-Co-operative and Yomba Co. have now taken over coffee-buying in the remaining remote areas, as the Department is no longer involved in coffee-buying.

Plans for 1977-78 include establishment of nurseries to plant 30 ha by June 1978, and patrols every two months to encourage proper picking, processing, shade control and weeding. It is hoped that patrols will encourage farmers to prune 80 ha of coffee during the year. Two courses on servicing coffee pulpers will be held for coffee teams and farmers.

During the next four years patrols to encourage proper management and maximum production will be continued.

In 1979, 6.4 ha will be planted at Gumine, 12.8 at Karamui and Bomai, 4 ha at Kundiawa, 16 ha at Chuave and Sina Sina and 4 ha at Gembogl. Seeds of a new variety will be obtained from the Highlands Agricultural Experiment Station at Aiyura. A new spacing of 2.5 x 1.5 m will be used for new plantings. Extension officers will encourage pruning of 24 ha.

In 1980, 40 ha will be established, if farmers are interested. Twenty-four ha will be pruned.

In 1981 and 1982, 60 ha will be established each year, mainly in the Bomai area. Twenty-four ha will be pruned each year.

VEGETABLES SUBSISTENCE AND NUTRITION

This programme has two aims: to encourage people to plant high-protein food crops to alleviate the malnutrition problem, and to establish a new cash crop — vegetables for sale.

Forty-six per cent of the population of 200 000 are believed to be affected by malnutrition. A provincial nutrition committee was formed in 1975, with the PRDO as chairman. The committee meets every month although not enough interest is shown in the programme by some government departments. Two nutrition demonstration gardens have been established, and five will be established at schools or health centres in 1977-78.

In 1976 the planned programme to begin peanut and bean planting projects at schools was only partially successful, due to lack of interest in some cases.

Last year DPI began selling small packets of vegetable seeds, using Rural Improvement Programme or Council funds. This was very successful. The amount of seed distributed was 1 355 kg in one year.

Two seed production gardens have been established. These gardens produce seeds of mostly introduced vegetables, with some traditional pods as well.

The vegetables produced for sale come mainly from surplus subsistence gardens. Twelve vegetable projects were established last year.

There is no government vegetable market and vegetables are generally not exported outside the province. At present fresh food quotas available to the Chimbu Province are too low to warrant setting up a vegetable buying market.

Last year growers in the Upper Chimbu area were encouraged to grow onions and cauliflower for sale, although the planned target was not achieved because of shortage of seed and staff.

In 1977-78, 5 village vegetable projects will be established at Gumine, 10 at Gembogl, 2 at Karamui and 2 at Kundiawa. The seed production programme will include gardens at Kundiawa, Kerowagi, Kilau and Gembogl. Farmers will be assisted with marketing of vegetables. A storage shed will be built at Gembogl for potatoes, onions and other root crops.

DPI will endeavour to obtain closer co-operation between departments for the malnutrition programme. Legume seeds will be distributed to all areas from seed produced at the Kundiawa and Kerowagi gardens. Five more demonstration nutrition gardens will be established, and villagers will be advised on storage of legume seeds for eating during periods of shortage of food.

In the second half of 1978 more village vegetable projects will be established, and two storage sheds will be built at Gembogl and Kilau.

In following years the fight against the malnutrition problem will be continued, with more school projects, and publicity to create an awareness of the malnutrition problems and advice on ways to improve nutrition. Distribution of seed will be maintained.

In 1979 the department will assist in the marketing of vegetables. Advice will be given to farmers on improved cultural practices for both introduced and traditional foods.

In 1980 village greenhouses for production of vegetable seedlings will be set up where required. Rice pilot projects will also be set up.

Winged bean seeds from Kuk

Kundiawa vegetable seed nursery. Filipino Emmanuel Cena is in charge.

PYRETHRUM

There are now approximately only 18 ha of pyrethrum in production. Farmers have lost interest due to the static prices. Shortage of extension staff is also a contributory factor to the decline in production.

Some farmers who have shown interest have been introduced to the use of fertilizer to improve production. Three nurseries of improved seed have been established, but due to lack of interest no plants have been planted out yet from these nurseries.

If sufficient interest is shown, two nurseries will be established with improved seed in the Mondia and Pompomeri areas in the Gembogl district. In other areas 2 ha will be planted out from the existing nurseries if interest is shown. Farmers will be encouraged to increase production from the existing gardens.

A survey of farmer's attitudes will be conducted in mid-1978, to help determine the future of the industry.

If interest still exists, 8 ha will be planted from the nurseries. If enthusiasm warrants the effort, all present pyrethrum gardens, a total of 28 ha will be replanted with improvised plants from the new nurseries.

In following years, existing plantings will be maintained with no further expansion planned at this stage.

Politicians looking at pyrethrum with meri working in garden

Provincial Government Councillor Hasuve Kawage (left) with PRDO Alan Iorive (centre) and another leader inspecting a cattle yard

CATTLE

There are a total of 254 village cattle projects, with an average area of 8 to 24 ha, and a total of 2 493 head. The calving rate is now 60%. The turn-off last year was 20 at Gumine, 40 at Kundiawa and Sina Sina and 40 at Karamui. Cattle were killed for singsings only. The area of semi-improved pastures is now 24 ha.

Pig and cattle farmers have formed a Cattleman Association in order to set up their own pastoral supplies and other needs.

Management of projects is not as effective as it should be. People are still killing breeders for singsings.

In 1977-78 new fattening projects with at least 8 ha each will be established as follows: Gembogl 2, Gumine 6, Kundiawa and Sina Sina 12, Karimui 2, Chuave 3 and Kerowagi 10. Stocking on established projects will be completed. Improved pastures will be established on existing projects — Gembogl 1.6 ha, Karamui 0.8 ha, Gumine 20 ha, Chuave 12.8 ha and Kundiawa and Sina Sina 20 ha. Pasture trials will also be established, at Gembogl, Chuave, Karamui and Kerowagi.

Two training courses a month long on pasture improvement and management will be held at Baiyer River in the Western Highlands Province for 85 farmers.

The Kumgi abattoir will be completed in 1977 and is expected to slaughter 450 head per year.

In 1978 and 1979 slaughter slabs will be built at Gumine and Sina Sina.

With the establishment of the abattoir and slaughter slabs, DPI officers will attempt to regulate killing of cattle for singsings.

By mid 1979 new projects of 8 ha with 5 to 6 steers each will be established as follows: Gumine 4, Karamui 3, Kundiawa and Sina Sina 12 and Gembogl 2. In 1979 improved pasture will be established at Gumine (20 ha) and Karamui (4 ha). Courses at Baiyer River will be continued and field days to instruct farmers on simple management skills and pasture improvement will be held.

In 1980 12 new projects of 8 ha each will be established at Kundiawa and Sina Sina and stocked with 5 to 6 steers. Training courses and field days will be continued. The Cattleman Association will be encouraged to provide services to the farmer now provided by the government, including stock, veterinary materials, field and pasture seeds.

If land is available and interest continues, 12 more projects will be established at Kundiawa and Sina Sina and stocked with steers in 1981. The Department will find means of selling meat from abattoirs to butchers. Training for farmers will be continued to improve management skills.

FISHERIES

There are at present 15 carp ponds in the province. Although there is still interest shown in ponds the shortage of carp fingerlings supplies from Aiyura in the Eastern Highlands Province has slowed down further development of a number of ponds.

Due to the muddy nature and high rate of flash flooding, few rivers are suited to trout. The new trout hatchery at Kegsugl, financed by the Area Authority, will soon be completed. Twenty-five suitable rivers and creeks have been tested for distribution of trout from the hatchery which is expected to provide 45 000 fingerlings per year.

The first 10 000 trout fingerlings will be introduced to streams in the Gembogl area in 1977, and more rivers will be surveyed. A further 10 000 fingerlings will be introduced by December 1978. Assistance will be obtained from the Area Authority to build a fence around the trout hatchery to keep out pigs, and for purchasing feed for the hatchery. A DPI officer will train at Mendi for at least three months, to supervise the Kegsugl hatchery.

If carp fingerlings can be obtained, stocking of established ponds will be completed and new ponds will be built. New ponds will be at Gembogl (2) and Chuave (3), with 5 carp fingerlings per pond. Farmers with pig projects will be encouraged to establish carp ponds in conjunction with the pig project, to supply fish for pig feed.

In 1979 15 carp ponds will be established in the Kundiawa and Sina Sina areas if interest exists. Fingerlings will by then be supplied from viable existing ponds. Stocking of suitable rivers with trout fingerlings will be completed.

In 1980 the trout hatchery will supply fingerlings to other provinces. Extension officers will encourage people to eat trout at home and not sell it, in order to alleviate malnutrition problems.

PIGS

The province has 65 stocked projects (40 financed by Development Bank loans) with 339 pigs and 10 new Development Bank projects awaiting stock. The turn-off is 20 to 30 per year, mainly for singsings.

There are also an estimated 1 000 crossbred pigs and 100 000 native pigs in villages in the province. Village pigs are being improved by crossbreeding with DPI stud boars.

As mentioned earlier, pig farmers have joined with cattle farmers to form the Cattleman Association for their supplies and other needs.

As pigs are always a means of prestige, extension officers have difficulties in convincing farmers to sell their pigs in order to maintain even feeding.

Litter size averages 1.5. A distribution centre is being built at Kumgi financed by the Area Authority. This will be completed and stocked in 1977-78.

The ten new projects at Kundiawa and Sina Sina will be stocked by June 1977. New projects will be established at Gumine (5), Kundiawa and Sina Sina (28), Gembogl (6) and Chuave (1), and each will be stocked with 1 boar and 3 sows. Farmers will be assisted with purchasing weaners and fed. Management of existing projects will be improved and short courses will be held for farmers. DPI staff will assist Development Bank officers to promote loans for piggeries.

Twenty-four fattening projects will be established at Kundiawa.

In 1979, 24 projects will be established at Kundiawa and Sina Sina, and at Gumine, and will be stocked with 1 boar and 3 sows. Farmers will be assisted with purchasing of weaners and feed. Training to improve management ability will be continued. Farmers will be encouraged to grow their own feed to substitute for bought feed.

In 1980 more Development Bank projects will be established at Kundiawa and Sina Sina (12) and Gumine (4), ane each stocked with 1 boar and 3 sows. Marketing facilities will be arranged.

In 1981 4 Development Bank projects will be set up at Gumine and 12 self-financed projects at Kundiawa and Sina Sina. These will be stocked with 3 barrows and 1 sow. Two more stud boars to crossbreed with native pigs will be provided at Gumine.

In 1982 cross-bred boars will be supplied to the 16 new projects.

POULTRY

There are 16 broiler projects with about 493 birds. The turn-off is 100 birds per project annually.

There are also many village chickens. Improved stock are being introduced to village flocks to interbreed with village hens.

Management on present projects needs to be improved. Availability of feed is a problem, although the Kundiawa Vocational School and Kuman Holdings do provide some feed from time to time. Day-old chickens which have been ordered sometimes arrive on the wrong day, resulting in deaths. Egg and Breeder projects have still not been established in the province due to the lack of high management skills.

The Department will assist with the ordering of chickens and feed and ensure confirmation of delivery days with the suppliers of day-old chickens.

A five-year programme to improve management skills will be started, using the media, training courses and extension effort. In 1977-78 a two-month course for farmers and three DPI officers will be held at 3-Mile, Lae.

New broiler projects will be established at Gumine (8), Gembogl (6), Kundiawa and Sina Sina (18) and Chuave (3). Projects will range from 100 to 500 birds each. Two egg-producing projects are planned at Kundiawa and DPI will provide supervision for these projects.

Farmers will be encouraged to grow their own feed.

Village chickens will be improved through introduction of improved breeders. One semi-intensive project will be established at Gembogl for demonstration purposes.

Chicken brooders for production of day-old chickens will be established at DPI stations at Chuave, Gumine, Gembogl and Karamui.

In 1979 semi-intensive broiler projects will be established at Gembogl (3), Gumine (3), Kundiawa and Sina Sina (10.) Farmers will be assisted with marketing outlets.

In 1980 and 1981 if previous projects are successful, four new egg-producing projects will be established in the Kundiawa and Sina Sina area.

CARDAMOM

Cardamoms are planted in the Karamui area only. There are now 200 family plots with a total of 20 ha under production. Three village driers have been built. Last year 680 kg were produced, worth K270.

Due to the nomadic lifestyle of the people, harvesting and general maintenance of the established gardens are not as encouraging as expected.

Ten new cardamom projects each with an area of 0.25 ha will be established by December 1977, and a further 12 ha will be planted during 1978. The area of existing projects will be increased to a minimum area of 2 ha each. Planting will be completed on the Karamui Council block of 46 ha. The aim is to double production of 1 tonne by December 1977.

Three one-month training courses on harvesting and drying techniques will be held in 1977.

Three new cardamom driers, each capable of holding five drums will be established.

In 1978 and 1979 new high-yielding varieties will be introduced. It is hoped that a cardamom expert will be available to carry out trials for selection of improved varieties.

In 1979 plantings will be expanded both at Karamui and Bomai. Twenty ha will be planted. A drier will be built for the council plantation; and council plantings will be increased by 25 ha where required.

In 1980 the council plantings will be increased to 100 ha, and more drying ovens will be built where required.

In 1981 the council plantings will be expanded by 25 ha and village gardens will be expanded by 25 ha if interest still exists.

TOBACCO

There are now 28 ha of tobacco, in the Chimbu Province. All tobacco leaf is sold at local markets. Assistance hoped for from the tobacco companies did not eventuate last year, and in fact prices fetched by tobacco in the markets are better than prices paid by the companies, so no expansion is planned, unless the tobacco companies provide extension and buying assistance.

CHILLIES

There are 50 growers, with only 1 ha planted. Production last year was 100 kg worth K24. Although there are no nurseries at present due to seed shortage, there has been no actual extension effort put into chillies because of staff shortage.

If staff is available two new nurseries will be established at Bomai and 2 ha of chilli gardens will be planted during 1977-78. Amount of production will be increased to 100 kg. Farmers will be instructed on proper harvesting and drying and demonstration or field days will be conducted every four months on drying facilities and processing.

In 1979 one nursery will be established at Karamui and one at Bomai. Buying centres will be established and the Department will assist further with buying of the crop.

Another 1 ha will be planted each year at both Karamui and Bomai in 1980 and 1981. Training for farmers will be continued.

MADANG PROVINCE

By Walai Benjamin,
Provincial Rural Development Officer

Walai Benjamin was born at Karkar in the Madang Province 29 years ago.

Walai Benjamin

He completed all his primary education in the Madang Province, then went to Tusbab high school in the same Province. Later in 1964 he went to Sogeri high school where he completed his fourth form in 1967.

He attended Vudal Agricultural College from 1968 to 1970 where he graduated with a Diploma in Tropical Agriculture.

After graduating he joined Coconut Products Limited and worked at the Garua and Numundo Plantations in Talasea as assistant plantation manager since he had been sponsored by the firm to attend Vudal. He stayed with the company for a period of 7 months.

He resigned and joined the Department of Primary Industry in September, 1971. Later he was posted to Finschhafen and then to Kabwum in the same province in 1972 as the officer-in-charge of the Kabwum district.

In July to September, 1973 he attended an Agricultural and Information and Communication Workshop at the East-West Centre, Hawaii. He has attended numerous other courses including middle management courses.

In October, 1973 he was transferred to Madang to understudy the Provincial Rural Development Officer position. He was acting PRDO from February, 1974 to December when he became substantive PRDO.

His special interest in agriculture is vegetable farming.

Walai is married with two children and his wife Barbara works with the Health Department as a maternal and child health nurse.

The land area is 29 150 km^2 with a narrow mainland coastline of 354 km. Inland the rugged central ranges rise 4 510 m dividing the coast from the extensive Ramu valley. The lower part of the Ramu River runs northwards towards the coast, through extensive swamp areas. The offshore islands are Manam, Karkar, Bagabag and Long Island.

Along the coast and inland on the rugged central ranges, rainforest predominates except where rainfall is less than 2 540 mm. The whole of the Ramu Valley is covered with grassland, giving way to rainforest near the coast.

The climate is a wet tropical type with a "wet" season from November to April and a "dry" season from May to October. The average annual rainfall ranges from 1 796 mm at Dumpu to 5 902 mm at Aiome, with a daily temperature range from 23^0C to 30^0C.

Out of the total 29 150 km^2 of land about 20% is suitable for cropping or mixed farming. Nearly 20 000 ha is cultivated annually as part of the bush fallow rotation for subsistence and about 16 300 ha is in use for smallholder cash-crops.

The soils are generally brown and red clays on mudstone, and alluvial deposits occur in coastal areas and river valleys. There are recent volcanic deposits on Manam, Karkar and Long Islands.

Major road links are Madang to Bosmun, Madang to Ramu joining the Highlands Highway from Lae, Madang to Ileg and Madang to Gogol.

Apart from Bagabag and Manam Islands, all the districts, patrol posts and mission stations have airfields.

Coastal vessels service the entire coastline and offshore islands. There is a wharf on a deep natural harbour at Madang for overseas ships.

Telephone services include the overseas telecommunication link, STD telephone services plus radio-telephone at government and mission stations. There is a local NBC radio station.

PEOPLE

The province population is 207 000. The majority are subsistence farmers. Manpower available is about 150 750 and there are about 137 995 potential farmers.

There are more than 51 language groups. The major languages like Gigaged and Amele, the former along the coast and the latter inland,

are spoken by most people in the province as a second language.

Naturally in the past there was a high degree of tribal isolation. But with the import of modern influences - communications, government, missions, and other agencies - there are fast changes and some innovators are taking advantage of these changes especially in rural enterprises.

Because there is no real land pressure problem apart from areas like Bundi, Simbai and Karkar Island, there are fewer land disputes than in most areas of Papua New Guinea.

With the long period of contact, since 1901, there are only a few old people who cannot speak and understand Pidgin and most villages have a radio. Through education changes are taking place from the younger generation upwards. There are 4 high schools, 1 teachers' college, 1 technical college, 5 vocational centres, 1 skulanka, 103 community schools and 1 multi-racial primary school. Currently 19 241 students are attending these schools and colleges. All schools take an interest in agriculture. Most mission schools endeavour to be self-sufficient in food.

The two main missions are the Catholic and Lutheran. These missions also own large plantations, rural health centres, aid posts, both community schools and high schools, and play some role in agricultural education and development. The two have bulk stores for wholesaling and retailing. The Lutheran Mission has a shipping service and a Lutheran Technical Service. Other missions in the province are Church of Christ, Seventh Day Adventist, Anglican, Jehovah's Witness and United Church.

The missions have had a lot of influence on the people in the past but their influence is lessening as more people are becoming educated.

Apart from a few areas, the level of nutrition is probably slightly higher than the Papua New Guinea average as there are no real land problems. Most people have enough garden space and usually have access to fishing on the coast or in rivers, and hunting grounds. Some large families may lack labour to produce enough food for all months particularly in severe dry seasons.

There are health centres in all major centres. There is a hospital and 19 rural health centres and 138 aid posts. The hospital has a college attached to it which offers three-year courses for health inspectors and health extension officers, and nursing aide training.

POLITICAL

Although the members of parliament are all involved with one or other kind of rural business, they have not become involved in planning for agriculture development in general.

The Area Authority is quite an active and effective body. DPI gets good support from the Area Authority on agricultural development plans.

There are 15 councils in the province - 14 rural and 1 urban - and 2 non-council areas. All the councils have agricultural committees but most of them have not yet become effective.

Tax rates vary from K15 to K1.50 depending on income in each ward.

Department of Primary Industry staff in all council areas always attend council meetings in their areas.

Fishing boats and Paul Katio

SELF-HELP AND PRESSURE GROUPS

The major self-help groups are: Bogia Co-operative Society, Madang Cocoa Society, Josephstaal Kofi Society, Karkar Kampani, Madang Provincial Cattlemen's Association made up of branch associations from districts, Jamlong Kampani (formed by pig farmers), Ali Fishermen's Association and the Bel Temanek Association.

The Karkar Kampani and the Bogia Co-operative Society are strong and well established. Most of the other rural associations are not as strong as most of them are new societies.

Women's clubs exist with interests in sports and social welfare.

ECONOMY

Rural economic farming consists of copra and cocoa in coastal areas, and in inland areas, coffee. Rice is becoming important. Fishing along the coast and on the offshore islands is being encouraged.

In general marketing facilities are good. However, some areas in the province such as the inland areas and islands like Long Island have problems in transporting produce to the main market outlets.

The Government is buying plantation land in areas of high land pressures like Madang district, Karkar Island, etc. The government is also trying to buy land around Bogia district to provide an opportunity for Manam Island people to resettle.

There are two land settlement schemes at Sanapa, Hupuai and Hatzfeldthaven.

There are savings and loan societies in the province and the head office is in Madang.

Amdex Mining was looking for nickel at Bundi and Carpentaria Exploration was also at Bundi looking for copper. Hyundai Company was surveying Saidor for the setting up of a cement factory.

Jant Company operates a chip mill. A large sawmill is run by Wewak Timbers and the missions have a couple of sawmills for their own requirements. The Gogol Timber Project is a national project.

Dylup Plantation produces coconut fibre mattresses. There are also industries for plastic manufacturing, contruction of concrete tanks and boats, and a tobacco factory.

There are three commercial banks in Madang. The Papua New Guinea Banking Corporation gives loans to individuals or groups and associations as personal or business loans for any feasible project.

There is a branch of the PNG Development Bank.

Large trading companies in the province are Burns Philp, New Guinea Company, Steamships and Namasu.

AGRICULTURAL DEVELOPMENT PROGRAMME

COCONUT

Smallholder growers have 9000 ha mature coconut and 6500 ha immature. There are 24597 growers and smallholder production is 4 749 tonnes.

The total copra produced from smallholders and plantations is 14 093 tonnes.

The Copra Marketing Board buys copra in Madang.

There is much more land available for expansion in the Saidor, Bogia and Madang districts. Neglect of maintenance and below maximum harvesting may be due to the low price.

harvesting may be due to the low price.

The area under coconuts was 15500 ha in 1976, with an increase of 300 ha planned for 1976-77. Another 292 ha is planned for 1977-78. Copra driers will be increased from 270 to 324 in 1977-78. About 25 new driers will be built each year in the next four years.

DPI extension staff will encourage maximum harvesting of existing trees and improved processing and maintenance of the existing copra driers. Producers will be trained to keep farm records - 200 in 1977-78, 150 in 1979, 300 in 1980, 400 in 1981 and 600 in 1982.

A rejuvenation programme has been started on six very old plantations. In the next four years the rejuvenation programme will include six old plantations per year.

More production is expected when new plantings come into production by 1980. By then a copra oil extracting factory in Madang will be warranted.

COCOA

There are 973 237 mature trees (1 129 ha) and 341 378 immature trees (461 ha) of smallholder plantings. There are 6727 growers. Smallholder production has increased from 455 tonnes to 511 tonnes out of the total province production of 2 157 tonnes of cocoa.

Most of the smallholder cocoa is either sold to the co-operative societies or to large estates, or sold direct to Rabaul Trading Company in Madang.

Madang, Bogia and Karkar group organizations have mechanical driers.

Interest in the crop is high in all areas where cocoa can be grown, but areas where road access does not allow wet beans to be transported to a central fermentary within 12 hours are not able to start cocoa-growing.

In 1976 - 77 the Department encouraged maximum use of existing plantings through better harvesting and processing through group organisations. Coastal coconut growers have been encouraged to interplant 1 580 ha with cocoa. Another 208 ha of new plantings is planned for 1977-78.

Dieback-resistant cuttings will gradually be introduced to cocoa growers. A clonal seed distribution centre for the province is also planned for 1977-78.

An increase of plantings of 100 to 150 ha annually is anticipated if marketing facilities and good prices are maintained.

Increased planting of up to 50 000 trees is anticipated for Saidor by 1980. A central fermentary for Saidor is planned for 1980.

Taro true

Mami

Aibika grown in the Madang province in a subsistence garden.

FISHERIES

There are ten commercial fishing groups and another four are to be established by the end of 1976-77.

Fishermen sell fish privately to business firms in town. The Bel Temanek Association which deals with buying and selling of fresh fish has run into financial problems. Steps are being taken to help the association to overcome its difficulties.

Sale of fish supervised by DPI was 4.5 tonnes per year. The province's annual catch is estimated to be approximately 10 tonnes.

Much effort has been made in fisheries extension to increase fishing activities in the province. Use of nets and handlining and improved preservation techniques - ice packing, smoking and salting - are being demonstrated. Shortly there will be ten ice hoppers in villages.

Fourteen more buying points will be established in 1977-78. About 8 village fishing groups and 2 commercial groups will be set up in 1977-78, with about 20 more village group and 5 more commercial groups over the next four years.

When the projects are well established on Bagabag, Karkar and Long Islands the catch could be well over 20 tonnes.

Carrying Fish to Freezer

CATTLE

There are 173 smallholder cattle projects with 5 300 head. Total cattle population in the province is 15 000. An estimated 182 000 ha of land is suitable for beef cattle. The annual slaughtering figure is at present 500 head.

Cattle are sold to Lae and Madang abattoirs.

Lack of quick monetary return, lack of support from village groups and overstocking problems are slowing down this activity, but overall interest still exists.

In 1977-78 the aim is to establish 98 new projects. These will be stocked with 1 499 head. All cattle projects are stocked with 16 head - one bull and 15 cows - to start with.

About 50 new projects will be established each year.

Improved pasture will be established on about 1 000 ha in 1977-78, and about 500 ha each year in following years.

In 1977-78 32 farmers will be sent to Urimo for training, and extension officers will train 87 more project owners at their own stations.

Two steers will be trained as draught animals at Bogia in 1977-78.

Local involvement will be encouraged this year.

Health services will be maintained by the Department.

COFFEE

There are approximately 20925 Robusta and Arabica coffee growers. The total area under coffee is 1762 ha (514 ha mature and 247 ha immature Robusta and 610 ha mature and 391 ha immature Arabica coffee).

Total annual production is 381 tonnes parchment (161 tonnes Robusta and 220 tonnes Arabica). Production may double if maximum harvesting of cherries is achieved.

More than half the growers find difficulty in marketing their coffee. DPI, Namasu and J. Perkins buy coffee.

Lack of seed supply and lack of interest from farmers restricted coffee expansion programmes.

In 1977-78 a total of 225 ha of coffee plantings is planned. Local government councils will be requested to provide 72 coffee pulpers in 1977-78 and 32 in 1979.

Planting of Arabica and Robusta will be about 80 ha each for each of the following years.

Local coffee dealers are being encouraged where possible to reduce the Department's involvement in coffee-buying. Most of the marketing responsibility should be taken over by local organizations by 1980.

Central coffee-buying points and storage sheds are planned for Tangu, Gangalau and Usino by 1979.

A coffee mill for the province is being investigated.

SUBSISTENCE, NUTRITION AND FRESH FOOD SALES

A wide range of tropical fruits and vegetables is sold through the Madang market and to Jant Company operations.

The recurrent annual dry spell between June and September does have a fluctuating effect on the volume of subsistence produce going through the markets at Madang, Saidor, Bogia and Usino.

A population pressure problem is becoming evident on Karkar Island and attempts are being made to assist subsistence farmers to change from shifting cultivation to intensive gardening.

Seed collection and distribution centres for subsistence crops are being set up in all districts. The aim is to provide high-yielding and disease-resistant planting materials to villages through observation and selection from the demonstration plots.

New varieties of food crops are being introduced where applicable to these seed collection plots, and better culture methods, use of compost, etc. will be encouraged.

There is no serious malnutrition along the coast but it is a problem with some inland people.

People's attitude to change in this field is very conservative.

The introduction of new varieties of vegetables is continuing and seeds are being distributed.

A variety of vegetable seeds has been distributed. Approximately 100 kg of vegetable seeds, maize, sorghum, soya bean, peanut and sugar-cane were distributed to schools and the councils for further distribution to growers.

Councils are being encouraged to purchase more seeds for resale.

Fourteen district collection and distribution blocks are planned for 1977-78 and nutrition field days and health education programmes in conjunction with other departments are being planned.

The subsistence nutrition programme will continue over the next four years, with about five new demonstration blocks established each year, and seed distribution and education will be continued.

POULTRY

There are numerous village chickens. Of the two sizeable poultry farms near Madang, concentrating on egg production, only one is still operating. The other closed down when the owner left the country. A suitable person or group may start the farm going again. There are no commercial poultry projects owned by village people.

The Department of Primary Industry distributes day-old chickens to villages at the rate of 200 chickens per month. However, commercial hatcheries do not meet the demand from villages for chickens.

A feasibility survey for poultry projects between Madang and Bogia is planned for 1977-78.

An officer will be trained at Lae in 1977 and on return will be responsible for setting up eight broiler projects for 1977-78. Each project will be stocked with 1000 birds. Farmers will be encouraged to grow poultry feed.

Six new projects are envisaged each year, and established projects will be expanded to 2 000 birds.

In 1977-78 3 300 day-old chickens will be distributed to villages.

One layer project is planned for 1977-78, 5 for 1979, 3 for 1980, and 1 for 1981 and 2 for 1982.

Ducklings will be distributed from 1980, with 150 in 1980, 350 in 1981 and 400 in 1982.

Monica Imai from Yabob village hosing and cleaning piggery

Councillors standing in smallholder rice paddock at Erima. Rice belongs to Yogeri Moteriri (third from left)

PIGS

Dylup plantation is running an intensive piggery producing pork for sale.

Four pilot pig-fattening projects near Madang - "peri-urban pig projects" - using Dylup's feed and weaners, proved successful.

Five are now in operation financed by Development Bank loans, seven more are to be established by the end of 1978.

Weaners are raised to 60 kg average live weight. Current price for pork in Madang is K1.76 per kg dressed weight.

Results to date show one project earning a net profit of K7 compared to K380 on another for 20 pigs raised for a period of three months. Such contrasting results reflect management problems and the standard of selection for weaners.

More fattening projects will be set up if the market warrants it, at the rate of about five per year. In 1979 a feasibility survey for a fattening project at Bogia will be carried out.

Semi-commercial projects will be set up in Bogia and Saidor - 1 or 2 in 1978, and 3 each year for the next four years.

Village pigs will be improved by lending a station boar to 24 villages near Bogia in 1977-78, 8 in 1979, and 5 each year in 1980-82. Saidor will also be surveyed in 1977-78 to see whether a boar is needed there.

The Jamlong Kampani, which arranges sale of pigs from projects near Madang, will be assisted to become fully operational in 1977-78.

In 1980 the company will be assisted in negotiations for purchasing Madang Butchery.

RICE

There are 340 rice farmers. Production last year increased from 72 to 103 tonnes of paddy. A total area of 180 ha was planted.

More interest has been shown in this crop. There is a bright future ahead for the rice industry if village consumption can be encouraged and milling facilities in Madang can be efficiently maintained.

A new Satako rice mill has been installed in Madang and its daily milling capacity is 500 kg of white or brown rice.

Another Satako machine is planned for Bogia by 1977-78 if money becomes available.

Simple processing implements were produced by DPI staff and use of these is being demonstrated to villages to encourage people to process and eat their home-grown rice. It is planned to increase local consumption each year up to 25% in 1982.

Problems with supply of rice seeds for distribution and low seed viability are recurrent.

A programme to improve the quality of paddy will be carried out for the next five years.

In 1977-78 250 ha will be under rice cultivation. A feasibility study will be carried out into lowland rice farming with irrigation. If feasible rice farming with irrigation will be tried beginning in late 1978. The area planned for 1979 is 158 ha, for 1980 152 ha, 1981 205 ha and for 1982, 240 ha.

WILDLIFE

To protect and develop wildlife resources a full-time wildlife officer was appointed drawn from DPI staff.

Already some wildlife management areas have been set up. These are Bagiai on Karkar, Long Island, and Balek Wildlife Sanctuary. Wildlife management committees have been set up for these areas. Aiome, Simbai and Astrolabe Bay management areas are at their initial negotiations.

Two crocodile farms have already been set up at Josephstaal, stocked with 49 crocodiles.

Two large crocodile farms are planned, one at Bogia and the other at Usino with holding capacity of between 1 000 and 3000 crocodiles.

A provincial wildlife station for Madang is planned and two wildlife stations at Long Island and Aimoe, for 1977-78.

Between 40 and 55 cassowaries were sold to the highlands by the Ramu people.

Two cassowary farms are planned for 1977-78.

PEANUTS

Commercial peanut production in the province has declined because of poor marketing services.

The peanut seed distribution programme is still maintained.

Large-scale commercial production of peanuts is anticipated on the upper Ramu where mechanical cultivation is encouraged.

The takeover of Kaiani feed mill in the Morobe Province by Gillespie Brothers, one of the big livestock feed companies in Australia, will definitely provide a pressure for the production of more peanuts.

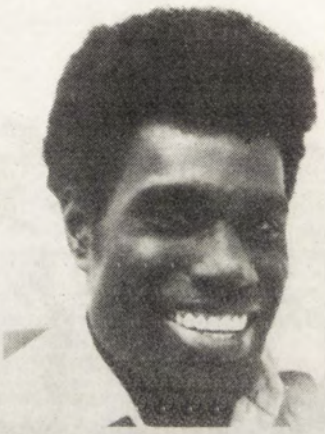
Progressive farmers will then be helped to buy tractors through Development Bank loans.

PRDO Walai Benjamin and other provincial leaders looking at Buffalo

NORTH SOLOMONS PROVINCE

By Jacob Momoi,
Provincial Rural Development Officer

Jacob Momoi was born at Buin in the North Solomons Province. He went to school at Turiboiru Catholic primary school then went to St. Joseph's high school at Rigu in 1963. After completion of high school he went to Vudal Agricultural College from 1969 to 1971. After graduating from Vudal he was posted to Boku in the North Solomons from 1972 to 1973 for about 18 months. He was appointed as associate Provincial Rural Development Officer for the North Solomons in June, 1974, was acting PRDO from October to November, and then appointed PRDO in December, 1974.



Jacob Momoi

Mr Momoi has attended a three-month livestock production course at Lae and a middle management course at the International Training Institute, Mosman, N.S.W., in 1973. In 1974 he went on a tour of Malaysia, India and the Philippines to study the extension services and farmer organizations in these three countries. His main interest is to develop the rural areas. He likes to spend a lot of time with the village people discussing their problems.

Mr Momoi's wife Pauline is a former MCH sister, but now stays at home looking after their 2½ year-old daughter.

Bougainville Island is approximately 209 km long and varies in width from 64 to 96 km. The small island of Buka lies to the north and is separated from Bougainville Island by the narrow waters of Buka Passage.

The province also includes many small islands and two isolated coral atolls: these are the Mortlock Islands 298 km to the north-east, and the Tasman Atoll 558 km to the north-east.

The dominant geographical features of Bougainville Island are the Emperor and Crown Prince Ranges which extend from north to south and rise to 2 500 m. Within the zone there are three volcanic areas: Mount Bagana which is an active volcano, Mount Balbi, 2 590 m high, a dormant crater and Mount Lololu which has a crater lake and fumaroles.

The interior is wild and broken, jungle-clad and inaccessible.

The climate of the province is similar to that of other tropical areas. Temperatures vary only slightly and remain in the vicinity of 27°C to 32°C. The average annual rainfall throughout the province is 3 632 mm per annum, with variation from 2 972 mm to 6 350 mm at Panguna.

There are extensive areas of volcanic soil particularly along the east coast of the main island. Buka Island is derived from raised coral atolls.

The vegetation is mainly tall rainforest. Coastal areas are covered mostly by pitpit with pandanus, and mangroves in more swampy areas.

Of the total area of 10 614 km^2, less than half, 4 142 km^2, is in use. Of this about half is used for expatriate-run plantations and other non-village uses.

Over the last ten years or so there has been considerable development of the road system in the province. The councils, the provincial government and the central government are continuing with the development of the road system. Access is satisfactory throughout all areas with the exception of more isolated areas such as the Eivo-Rotokas and Kongara areas.

Air services to the province are good. There are 17 airstrips for light aircraft in the province. All areas can be reached by light aircraft.

Outstations have access to radio communications. Radio Bougainville broadcasts for several hours a day.

The overseas wharves at Kieta and Loloho receive overseas ships regularly. The Loloho port has been developed with bulk loading facilities for copper concentrate from the Panguna mine. There are many smaller wharves that are serviced regularly by coastal vessels.

PEOPLE

The North Solomons has a population of approximately 90 000 village people, and 10 000 from other provinces or overseas. The total manpower available for agricultural activities is 35 000. The number of growers is estimated to be well over 14 000.

Pidgin and English languages are widely spoken. There are six local languages in Buin district, nine in Buka and four in Kieta districts.

Generally the standard of health is high due to numerous health centres, aid posts and hospitals run by government and missions.

There are 132 community schools, 5 high schools, 7 vocational centres and 1 technical college. Other schools such as the Bougainville Copper Limited's Mabiri Agricultural Training School play an important role.

All schools now teach agricultural subjects but very few school leavers come back to their homes to take part in development. It appears the younger people with good education are reluctant to return home and assist in development.

The three main churches, Catholic, United and Seventh Day Adventist have a certain degree of influence, socially, politically and economically.

There are a large number of small self-help groups. The following are some of the self-help groups in each district: Buin-Siwai Cattlemen's Association, Pikei-Boku Association, Taipira Natural Work Group; Kieta-Koiano Association; Buka-Hahalis Welfare Society, Nakarkau Association, Teop Women's Fellowship Association.

POLITICAL

Each village has its own leaders and with the formation of provincial government these men are responsible for the development of their own area. These leaders are not normally people with good education- they are persons respected for their common sense and actions to improve the community. There are also educated mature leaders among the village governments and businessmen.

The "Republic of North Solomons" Government was very active and effective. The supporters had strong feelings towards breaking away from the rest of Papua New Guinea. There is still a great deal of political awareness in the rural areas.

Since the re-establishment of provincial government, the top political body in the province is the Provincial Assembly. There are 19 elected members, and the Premier selects his six executive members from the members of the Provincial Assembly.

All capital works are now financed by the central government through the provincial government.

ECONOMY

There are no major land disputes.

People in this province tend to be cash-economy-minded, and goals are centred on the well-being of the community, possessing consumer goods, cars etc.

Copra and cocoa are the main crops.

The PNG Development Bank has financed large numbers of smallholder projects, in particular cattle and cocoa. The Development Bank finances six 1 400 layer poultry projects in the Kieta district.

There are no major secondary industries apart from small industries such as bakeries, soft drink manufacturers, a cement brick and pipe factory, and a boat building factory.

The most impressive industry is the mining operation for copper at Panguna. The mining production started in 1972 and it is expected that income from this industry will be about K400 000 000 in the first ten years.

The province has now established a headquarters for Savings and Loan Societies at Arawa and there are branches in all areas.

There is only one land rationalization scheme in the North Solomons and that is the Wainana Scheme in Buka district.

The Provincial Management team is very active. It has members of the public and government departments concerned with development, drawing up the provincial plan, evaluating the plans and setting priorities and then implementing the provincial programme.

AGRICULTURAL DEVELOPMENT PROGRAMME

COCOA

In 1975-76 total production increased from 11 582 to 12 519 tonnes of which 6 220 tonnes was produced by Papua New Guineans. Production per grower increased by 8%.

There is a total of 20 091 ha of which 72% are producing and 28% are immature. The province has a number of producers' marketing co-operatives, through which the bulk of cocoa is marketed. The Bougainville Marketing Co-operative has been buying and exporting cocoa overseas from these co-operatives. There are also other firms which export cocoa.

Growers are handling most of their own processing and marketing due to improvement of roads.

In 1977-78 an increase of plantings of 9% is planned (up to December, 1978). New planting will be encouraged at Torokina, Aita and Eivo. An increase in production of 9% is also planned.

The Department will continue its assistance to growers in all aspects of management, processing and marketing of cocoa.

Expansion of processing facilities is planned.

In 1979 a further increase in production of 7% is expected.

Over the next four years 1979 to 1982 an annual increase in plantings of 5% is planned.

A DPI Officer points out black pod rot on a cocoa pod. Cocoa is a major cash crop in the province.

COCONUTS

Production in 1975-76 was 21 601 tonnes of which 8 370 tonnes were produced by village growers, and 13 331 tonnes by plantations. The production in 1975-76 was 3% lower than in 1974-75, due to the low price for copra. People in the Buin area have lost interest due to low prices and leaf spot disease. The west coast people still have shipping difficulties in getting their copra to Buka or Kieta.

The Copra Marketing Board buys copra at Kieta and at Buka Passage.

There is a total 20 383 ha coconut palms of which 3 602 ha are not yet bearing and 16 781 are bearing.

A small increase of plantings of 2% is aimed at for 1977-78. Better seed nuts (from the Markham Valley) will be distributed to the growers. Smallholders will be encouraged to increase production by 10% during the period July, 1977 to June 1978, through better management and processing.

The Department will try to arrange improved shipping services to west coast people.

In the next four years this programme will be continued with a planned 2% increase in plantings each year. Farmers will also be educated in plantation management.

COFFEE

There are 75 ha coffee trees between 310 growers, in the Kieta district. Production last year was less than 1 tonne.

The number of trees is decreasing due to lack of maintenance. This is because other crops have high prices, and also because coffee in isolated areas has to be carried out of the area by people due to lack of roads. However, road access to these coffee-growing areas will be improved in the near future. People are encouraged to have central processing facilities.

In 1976-77 output increased by 10%. No increase in plantings is planned at present but the Department will continue to provide assistance to growers and encourage them to improve quality by putting up central processing facilities.

Headquarters statistician Peter Herrington demonstrates sample survey techniques to North Solomons staff.

The Department will continue to liaise with the Provincial Government and other organizations and departments to try to provide a road from Kieta to the Kongara coffee-growing area in 1977-78.

Similar assistance will be provided to growers in future years.

CATTLE

The total number of cattle in the province is 1 879 head. There are now 90 stocked properties of which 60 properties with 1 080 head are owned by smallholders.

An abattoir to slaughter cattle has been built between Kieta and Arawa. It aims to kill four beasts a week, increasing in 1977-78 to six beasts a week.

Cattle development is slow-moving due to shortage of staff and high cost transport, and lack of interest from the people.

In 1977-78 the aim is to increase the number of smallholder projects by 15 projects. Practical training will be provided for cattle project owners, to improve the management of pasture and stock. An effort will continue to promote more interest in large-scale cattle development of about 80 ha.

The Department provides disease testing under the National Disease Programme. It is expected that the North Solomons will be declared tuberculosis and brucellosis free, after completion of testing of all cattle.

In 1977-78 slaughter floors will be established at Buin and Buka. These slaughter floors will initially kill two beasts a week, increasing to three after they have been operating for two or three years.

In 1979 the number of cattle on Papua New Guinean owned projects will be increased to 1 500, on 70 smallholder and 3 large-scale projects.

Expansion will continue along these lines until 1981, when it is anticipated that the province will have 2 700 head of cattle on 120 smallholder projects and 10 large-scale projects.

RICE

There are at present only about 4 ha of rice planted, by a few schools and farmers. Most people have no interest in growing rice because it has a high labour cost.

DPI staff will continue to attend courses to learn about rice, and will assist those schools and farmers who are interested in growing rice.

SUBSISTENCE

The Department provides assistance to farmers and schools in improving their subsistence crops. Improved vegetable seeds and hybrid corn seed have been distributed.

DPI officers will help the Health Department to educate the villagers to eat more of the meat and vegetables they grow, instead of selling it. Villagers will be encouraged to grow more nutritious varieties of food. Two demonstration food gardens will be established in 1978 at Buka.

FRESH FOOD FOR SALE

At present K½ million of fruit and vegetables are imported into the province. There are seven contractors who supply Bougainville Copper Limited with fresh foods. In 1975-76 contractors supplied 1 684 326 kg or vegetables worth K300 000 to BCL.

Apart from these contractors, there are some commercial plots planted but fresh foods sold are mainly surplus from subsistence gardens.

In 1976-77 the Department and the North Solomons Fresh Food Committee reviewed pricing policy with the aim of encouraging the growers. A fresh foods specialist gives demonstrations and field training to staff and farmers.

Six pilot vegetable projects will be established in 1977-78 for demonstration purposes. An increase of production of 15% each year is planned.

A potato project is shortly to be set up in the Wokunai with the aim of replacing imported potato (approx. ½ million kg per annum) with locally grown ones.

Unfortunately the most suitable areas for growing fresh foods are isolated and therefore very difficult and expensive to transport goods from.

PIGS

Farmers have shown very little interest in advanced piggeries and there is not much change from traditional management. There are only a few pig projects which are being upgraded.

One 50-breeder project for rearing pigs is being investigated.

Bougainville Copper Limited is releasing about 300 pigs to village farmers. Generally village stock is improving due to the distribution of better breeds of pig by BCL vocational centres and some high schools.

The Department is encouraging villages to accept improved stock, and encouraging villagers to rotationally graze pigs on sweet potato, with protein supplements.

Ducks are being introduced, both to provide food in the villages and for a cash income.

POULTRY

There are six 1 000-bird layer projects in Kieta, 12 broiler projects of 100 to 200 birds and six 2000-bird broiler projects.

Most people have a great interest in broilers. For the first six months of 1977 we had projects that could take 62 000 birds, at 2 000 to 3 000 per week. We have had difficulties in obtaining birds from Lae and Ilimo.

Village stock is being upgraded by introducing roosters of good breed.

Projects of 100 to 200 birds for village consumption are being encouraged.

Small broiler projects will be established in all areas that can easily be supplied with feed. These projects are to be operated as cheaply as possible using local materials wherever possible. The birds will initially be sold alive at local markets.

Bougainville Copper Limited has completed a poultry abattoir at Kieta. The Department encourages large projects which can economically transport live birds to the abattoir for sale.

Broiler project. Some problems have arisen with deep litter (used here) so the Department intends to investigate use of cages.

LARGE LAYER PROJECTS

At present there are five large egg projects operating near Kieta. In 1975-76 the local projects produced 60 000 dozen eggs.

The aim is to establish 14 large projects of 1 000 layers so as to retain within the North Solomons the money now going to Australia for purchase of eggs, and at the same time provide income for local farmers.

Prospective farmers are now being encouraged to establish 200-bird projects to assess their capability, before requesting loans for large units. Because of many problems found in deep litter the Department is now investigating keeping birds in cages.

By 1979 central North Solomons should be self-sufficient in eggs. By this time the industry should be run as a co-operative, with very little intervention by DPI staff, apart from giving advice, such as in the case of sickness etc.

RUBBER

There are approximately 13 000 mature trees in Kieta and Buin districts which are not being maintained. The rubber trees are scattered which makes rubber processing difficult. Rubber tree owners have cocoa so they have little interest in rubber.

In 1976-77 the province obtained advice from a headquarters rubber technologist but there has been very little interest from the owners.

Growers in Buin will be encouraged to build two small processing factories, to process cup lump and produce crepe rubber.

However, the low price for rubber restricts its popularity compared with other crops like cocoa. People are not interested in expanding the size of their plots.

FISHERIES

The Department assists those people who are interested in fishing, although there is a lack of trained staff and of sea transport to get to the good fishing areas.

In 1974-1975 one Tongan fish trap and a smokehouse were built in Buka district. There are now four smokehouses.

In 1977-78 more fish traps and smokehouses will be built.

There are two ice-makers in the Kieta and Buka areas. Fishermen will be encouraged to use ice for sale of fresh fish.

Kerekeka Plastic Limited is now operating and fishermen will be able to use locally made fibre-glass ice boxes to keep the fish fresh for market.

A private contractor has started a business with a fishing boat in the Atolls. The boat, which is equipped with freezing and refrigerated storage equipment, travels around the Atolls and collects from six freezers and brings them to Kieta for sale.

COCOA INSECTS IN THE SANGARA SETTLEMENT AREA OF THE NORTHERN PROVINCE

By E.S.C. Smith and P.M. Room

During 1972 a trial was conducted to obtain information on the abundance of many of the important cocoa pests and their distribution in relation to other insect or environmental factors. The information gathered, when analysed by a computer, indicated which of the biological and environmental factors were the most important in determining the distribution and abundance of the pests, and enabled guidelines for future research work in controlling the pests to be proposed.

Over the past 15 to 20 years, cocoa trees growing in the Northern Province have been severely damaged by a variety of insects. At present, the *Pantorhytes* weevil and the podsucking bug *Helopeltis* are the most important pests, but many other insects can cause damage by feeding on the pods or leaves of the cocoa trees.

Most of the cocoa produced in the Northern Province is grown under *Leucaena* shade trees, but in some blocks, this shade has been removed to prevent outbreak of the cocoa armyworm *Tiracola plagiata* and other leaf-eating caterpillars. Some small areas of cocoa have been planted under rubber, coconuts or *Erythrina* sp. shade, and there are a few blocks of cocoa planted directly into thinned primary forest.

During 1972, a study was made of the abundance and distribution of many of the important cocoa insect pests, and other factors in the cocoa environment which might affect them. These other factors might be for example shade, cocoa flush, other insects etc.

This information, when analysed, showed which factors were probably important in affecting the distribution and abundance of the pests, and so gave a guide to future research work. For instance, if it was found that a certain insect pest was associated only with cocoa grown under one type of shade tree and no connection with other factors was found, then it would be reasonable to suggest that by stopping the use of the shade tree, the particular cocoa pest problem would not be as bad, or might not occur.

Before recommending the use of a different shade tree, however, the associations of all the other pest insects to the new shade tree would have to be examined in case the new conditions

especially suited a different insect pest, and so created a new problem.

The results of this study can of course only be applied directly to cocoa grown in the Sangara Soldier Settlement Area of the Northern Province and the particular pests found there.

SAMPLING METHODS

Sampling was carried out on one day every two weeks between December 1971 and January 1973. On each day, four trees were sampled in the morning from one block, and a further four trees from a different block were sampled during the afternoon. The blocks were selected from maps of the cocoa-growing area, and chosen so that the afternoon block was situated a long way from the morning block, thus giving representative samples covering the whole land settlement area.

Trees were selected at random within each block, and at each sample tree, the number of *Pantorhytes* larvae and the larval predator-parasite *Nephrotoma* found in trunk channels were recorded.

Environmental factors were also recorded at this time, and included weather conditions, type and amount of shade, the degree of damage by various insects and the condition of the cocoa canopy.

Trees were sampled either as "canopy samples", in which a white sheet 3 metres square was spread on the ground under the canopy space between four trees, or as "trunk samples" when a different sheet with a split in it was placed around the trunk of the tree.

A quick-acting insecticide (pyrethrum) was sprayed into the cocoa trees above the sheets, and all the selected pests, predators and parasites which fell onto the white sheets during the next 30 minutes were collected as shown in *Plate I*, and taken to the laboratory.

There the insects were sorted, identified and counted *(Plate II)*.

RESULTS

The pest insects collected from 200 trees and their abundance are shown in *Table 1*.

Pantorhytes weevil was by far the most abundant pest, occurring on 65% of all trees sampled, followed by *Helopeltis*, *Ectropis* and *Tiracola*. *Amblypelta* occurred in a large number of samples, but usually only in low numbers. The figures for these adult *Amblypelta* bugs were low since they fly from the tree as soon as spraying begins, and so are missed in the sampling.

The other pest species listed were less common.

The records for predators, parasites, condition of trees, environmental factors and shade tree species are shown in *Table 2*.

In addition to the insects mentioned above, a further nine predators of either *Pantorhytes* or *Helopeltis* and a further three parasites of *Pantorhytes* were recorded. These insects occurred in such low numbers that they were not included in the analysis.

All the data collected were analysed using a computer, which showed whether any of the factors recorded (either insect or environmental) were associated with any of the other factors.

If, for example, a certain pest was found on more than 95 out of 100 cocoa trees under a particular kind of shade tree, but under any other shade tree was found to a much lesser extent, then the computer would show that the pest was associated with the first shade tree species. This would mean that of any other 100 cocoa trees sampled under that shade tree, 95 would be expected to contain the pest insect. In this case the pest is "positively associated" with the shade tree, but if the pest was found in less than five out of the hundred cocoa trees under the shade tree species, it would be termed "negatively associated" with the shade tree.

The actual analyses were much more complicated than the simple description above. The levels of greater than 95% or less than 5% associations were set as limits in this study. The main positive (+) and negative (-) associations between factors are shown in *Table 3*. Columns having neither a + nor a- sign indicate nonsignificant associations between factors.

In addition, all four flush-eating insects were positively associated with one another. The analysis did not reveal any associations between months and only a few between quarters (three monthly records combined) and any of the insect or environmental factors. This suggests that the effects of changing seasons on the factors recorded are fairly slight compared with the effects acting between factors. The quarterly associations showed that the proportion of samples with sunshine, podsucker damage, *Tiracola* and *Achaea* increased during the first nine months of 1972, and then decreased in the final three-month period. Cocoa flush, present in a steady 38% of the samples in the first three quarterly periods, increased dramatically during the last quarter. This is probably associated with the breaking of an abnormally severe dry season drought lasting from July to October 1972.

DISCUSSION AND CONCLUSIONS

The aim of the project was to obtain information on the abundance of the main cocoa pests, and their distribution in relation to other insect and environmental factors. *Pantorhytes* was by far the most abundant pest sampled. This insect is the most damaging pest of cocoa trees since the larvae bore into trunks and branches of the trees, permanently weakening them and often killing them. Podsuckers and flush-eating caterpillars, however, rarely cause the death of bearing trees, but may very seriously lower crop production.

Table 3 shows two factors which are negatively associated with *Pantorhytes* — coconut shade and *Anoplolepis* (crazy ants). This means that where cocoa is either grown under coconut shade, or is

infested by crazy ants, *Pantorhytes* in damaging numbers are usually not present.

The positive association of *Pantorhytes* with *Nephrotoma* was to be expected since the crane fly is a parasite of *Pantorhytes* larvae.

The positive association of *Pantorhytes* with no shade was also expected, since another worker has previously reported that heaviest populations of *Pantorhytes* occur in cocoa grown without shade (Hassan: *Harvest* Vol. 1 No.3).

Leucaena shade is unsuitable for cocoa as is shown by the positive association with podsuckers *(Helopeltis)* and leaf-eating caterpillars.

No methods of growing completely pest-free cocoa are suggested by the results. They do indicate however several ways of growing cocoa in which *Pantorhytes* populations may be kept at a low level, and in which direction research into the pest problem could proceed. Such work could include -

1. Investigation into the use of coconuts as a shade tree for cocoa in the Northern Province. The results described here are strengthened by previous findings that:-

   (a) Populations of *Pantorhytes* under coconut shade stabilize at a level which does not result in economic damage to the trees.

   (b) In the New Guinea islands, where cocoa is grown under coconut shade, no caterpillar attack has occurred.

   (c) *Helopeltis* populations were consistently lower, and of little economic importance on cocoa grown under coconut shade when compared with cocoa grown under *Leucaena* or without shade.

2. Investigations into the use of crazy ants in controlling *Pantorhytes*-

   (a) Previous work has described how crazy ants drive *Pantorhytes* adults from an infested area, and prevent recolonization by the weevil while the ants are present.

   (b) Some planters in the Northern Province have successfully used this method of control for some time, but have encountered problems with maintaining ant populations.

3. Investigations into the biology of the predator-parasite *Nephrotoma* as a means of controlling *Pantorhytes* larvae.

Some work has begun in the Gazelle Peninsula on the first two of the above points.

The investigation also suggests that the insecticide knockdown method could be extremely useful to analyse pest situations in other crops. However care must be taken in crops previously unstudied not to project results gathered from small plots directly into large scale areas, as conditions may be completely different from these experienced in a large area of the same crops.

FURTHER READING

Room, P.M. and Smith, E.S.C. (1975). Relative abundance and distribution of insect pests, ants and other components of the cocoa ecosystem in Papua New Guinea *J. appl. Ecol., 12:* 31 - 46.

Plate I. - The entomology team collecting all insects knocked down from the cocoa trees by the pyrethrum insecticide.

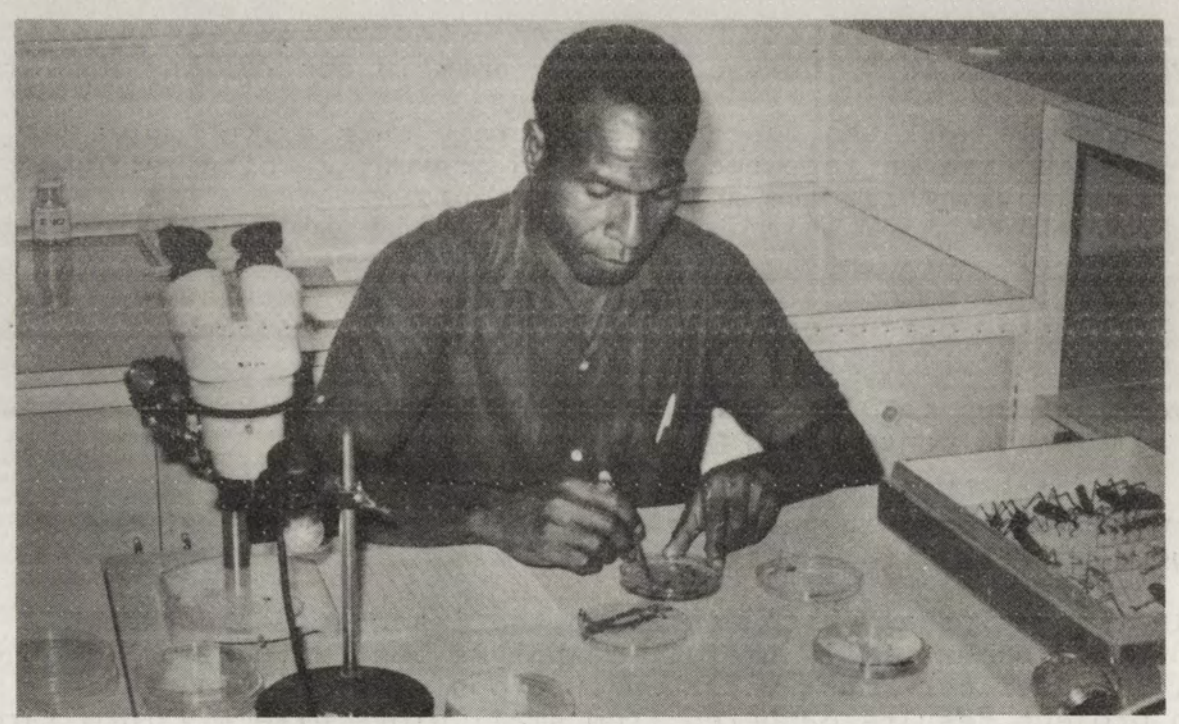


Plate II. - Sorting the collected insects in the laboratory.

TABLE 1. - ABUNDANCE OF PEST INSECTS IN 200 COCOA TREE SAMPLES

Pest	Type of damage		Number of recordings	% occurrence	Total no. insects collected	Mean no. insects per recording
Pantorhytes szentivanyi (cocoa weevil)	Adult	Chews young growth	130	65	1 064	8.2
	Larva	Bores into trunk and branches.	88	44	262	3.0
Helopeltis clavifer (cocoa mirid)	Adult and nymph	Suck pods	88	44	512	5.8
Amblypelta theobroma (amblypelta)	Adult and nymph	Suck pods	62	31	119	1.9
Pseudodoniella laensis (red capsid)	Adult and nymph	Sucks pods	2	1	2	1.0
Tiracola plagiata (cocoa armyworm)	Larva	Flush defoliator	40	20	667	16.7
Ectropis sabulosa (cocoa looper)	Larva	Flush defoliator	60	30	454	7.6
Hyposidra talaca (cocoa looper)	Larva	Flush defoliator	30	15	163	5.4
Achaea janata (cocoa false looper)	Larva	Flush defoliator	17	9	46	2.7

Table 2 - FACTORS PRESENT DURING THE SAMPLING OF 200 COCOA TREES

Factor	No. of recordings	% occurrence
Pest predator		
Technomyrmex albipes (black ant)	114	57
Anoplolepis longipes (crazy ant)	80	40
Oecophylla smaragdina (kurukum)	28	14
Pristhesancus femoralis (assassin bug)	31	16
Euagorus sp. (assassin bug)	22	11
Pest parasite		
Nephrotoma spp. (crane fly)	43	22
Shade tree		
Leucaena leucocephala	136	68
No shade	52	26
Coconuts	19	10
Thinned forest	16	8
Cocoa conditions		
Good canopy	122	61
Flush present	89	45
Podsucker damage heavy	14	7
Environmental factors		
Top shade heavy	52	26
Sample taken with sun shining	124	62
Sample taken in morning	105	53
Canopy sample	100	50

Table 3 - THE MAIN POSITIVE (+) AND NEGATIVE (-) ASSOCIATIONS BETWEEN FACTORS.

	Pantorhytes adult	*Pantorhytes* larva	*Helopeltis*	*Amblypelta*	*Tinacola* *	*Ectropis**	*Achaea**	*Hyposidra**	*Technomyrmex*	*Anoplolepis*	*Oecophylla*	*Nephrotoma*
Leucaena			+	+	+	+	+	+			-	
No Shade		+	-		-		-	-	-			+
Coconut Shade	-	-										
Thinned bush shade			-			-				+		
Good canopy	-		+	+			-		-	+	-	
Cocoa flush	-	-	-		-							-
Technomyrmex	+				+					-		
Anoplolepis	-	-							-		-	-
Oecophylla			-							-		-
Nephrotoma	+	+			+		+			-	-	

* All four flush defoliators are positively associated with each other
Columns having neither a + nor a - sign indicate non-significant associations between factors

DEVELOPMENT OF THE PNG RUBBER INDUSTRY

By C.E.W. Arnold,
Head of the Rubber Development Section

Rubber *(Hevea brasiliensis)* was first planted commercially in Papua New Guinea during the first decade of this century, and as an industry was slow to develop - in 1939 production from the estates sector amounted to only 1 300 tonnes. The estates were somewhat neglected during World War II, but after the end of the war plantings resumed and expanded to a peak of 14 300 hectares in the early '60s, with production reaching 6 000 tonnes by 1969-70.

Rubber planting by Papua New Guineans commenced at village level about 1927 and at scheme level about 1960 and, like the estate sector, was quite slow to develop, contributing only 2.5% of total rubber exports by 1971. However, production since then has risen steadily to just over 300 tonnes (1975-76), being 6% of total PNG production. From 1965 to 1970 the estates sector area increased at a rate of less than 1% per annum whilst smallholdings increased annually by 10%. Since 1970 the estate sector has in fact declined in area, the major factor being the type and age of rubber planted combined with fluctuating world prices.

A further factor has been high PNG estate manufacturing costs, brought about at least in part by old equipment, processing costs and a decreasing estate production area.

Smallholdings on the other hand have increased rapidly in number and area, there being currently an estimated 3 000 smallholders with almost 3 500 hectares of combined immature and mature rubber.

During the period from 1964 to 1974 world natural rubber production rose by some 48% from 2.35 million tonnes to 3.47 million tonnes, this being mainly caused by a 78% increase in production by Malaysia. However, during this same period, PNG production rose by only 10% from 5 041 tonnes to 5 553 tonnes, representing only 0.16% of total world production in 1974.

THE ESTATE SECTOR

This sector, until about the start of the last decade, constituted the whole of the PNG natural rubber industry. Rubber estates total over 70 in number, and are found chiefly in the Central Province (Galley Reach, Sogeri plateau and Cape Rodney areas), Gulf Province and Northern Province (Kokoda). Terrain varies from mostly flat and gently undulating coastal delta to steep rising land of 300 to 500 metres above sea level.

Tapping on estates is an entirely different proposition from that which confronts the smallholder.

The estate must employ tappers in a labour force which is contracted for the relatively short period of two years, following which each man is repatriated to his home village. This is in striking contrast with the situation in most other rubber-producing countries, where skilled workers are encouraged to live permanently on estates in central villages and are provided with all basic amenities. There has been no attempt to introduce such a system in Papua New Guinea, and as a result good training, high tapping standards and a reasonably disciplined tapping force are most difficult to achieve and rarely seriously attempted. Unlike Malaysia where the *jebong* tapping knife is universally used, Papua New Guinea estate tappers are provided with the *gouge* knife, which invariaby produces a higher rate of tree and bark damage.

There are 79 estates in the country with an average of 174 hectares; of these, 62 are in Papua. The remaining 17 in New Guinea average only 16 hectares per holding. In the total estate sector, almost 40% of holdings have less than 40 hectares, 14% have more than 400 hectares, with a similar proportion in the "middle" range of from 160 to 400 hectares.

Only about 14% of the area planted is wholly high-yielding stock (budgrafted or polyclonal seedling), a further 18% planted mainly with "improved" material, and the remaining 68% is almost entirely non-clonal stock.

This places the majority of estates at a competitive disadvantage compared with other natural rubber-producing countries.

Very little new planting or replanting is taking place, and to date no positive steps have been taken to change from the traditional sheet and crepe production techniques in an endeavour to present PNG's estate crude rubber in a more modern, competitive and internationally acceptable form (e.g. technically specified block rubbers, etc.).

THE SMALLHOLDER SECTOR

Rubber planting by smallholders first commenced with the Native Plantation Ordinance (1918), which generated rubber plantings, notably in the Northern Province, from 1927 through to the second World War. Since then planting by Papua New Guineans at scheme and village level level has multiplied rapidly, notably in the Western Province which alone boasts some 52% of the current national total of about 3 000 smallholders. Since rubber was first produced by smallholders a decade ago, production has grown by one thousand per cent to over 300 tonnes in 1974-75, and a continuing production growth rate in this sector is confidently predicted, and should almost treble by 1980.

Planting has always been practised using conventional methods of forest clearing, planting and, later, tapping. Processing at village level is almost entirely through the medium of shared hand-operated equipment which results in a high proportion of good quality sheet-grade rubber (86% ribbed smoked sheet grades from all smallholdings in 1974).

Terrain varies from flat and undulating to occasionally hilly, and soil nutrient status is of a sufficiently high level to enable

smallholders to avoid the costly practice of fertilizer application. The PNG smallholdings are also remarkable in that there is an almost complete freedom from the normal major diseases suffered habitually by the rubber tree in all other major producing countries.

Smallholders, encouraged and assisted by the Government through its Department of Primary Industry, have planted wholly high-yielding polyclonal stock raised from imported (Malaysian) and locally produced seed, thus enabling the smallholder to derive a potentially greater return per unit of area than his estate counterpart. Plantings from 1976-77 will switch progressively over to the use of material budded in nurseries using the most modern techniques of propagation, and based upon carefully selected clones suited to the special conditions which commonly prevail in PNG smallholdings.

Such planting has taken place both at village level and upon formalized resettlement schemes. These schemes, principally in the Central, Gulf and East Sepik Provinces, generally cater for a centralized rubber process, with individual smallholder block latex collection by vehicle. Currently scheme plantings represent only about 23% of the total national smallholder area of almost 3 500 hectares; however, redevelopment plans currently being implemented to rejuvenate the less successful of these schemes should result in an increase of well over 1 000 hectares of budded rubber planting in these areas.

Excellent incomes can be earned by smallholders from holdings such as this at Cape Rodney.

Smallholders may obtain loans from the Papua New Guinea Development Bank, once the trees have matured to the point of being ready for tapping, to assist them in purchasing essential equipment and

building materials. Currently, for an average one-hectare holding, and upon the basis of a six-holding share-factory, an individua loan is set at about 350 Kina at 8% interest per annum.

Due to the relative isolation of the majority of (village) smallholders, particularly those in the Western Province, very little change in processing method is foreseen in the short term, as at present the simpler methods of processing fit well the geographical and communications constraints.

The success obtained so far with smallholder rubber plantings gives strong support for the view held in a number of other countries that *Hevea* -growing and cropping is almost ideally suited to the average way of life of most smallholders. It reinforces the PNG Government's development policy, which aims principally to promote development at village level, combined with low level technology and village-based management. Rubber for smallholders has proved an ideal vehicle for such development policies.

Green budding technique now used in Papua New Guinea.

MARKETING

PNG rubber marketing for the past 20 years has been performed by the Papua New Guinea Rubber Pool (PNGRP) based in Australia. The Pool uses a buying price in PNG based upon Singapore Rubber Exchange prices and Australia, under a trade agreement, takes the whole PNG output.

Both estate and smallholder sectors benefit from a price umbrella, which provides for a subsidy during times of low world market prices (this subsidy, averaged over the past four years, has been 2.4 toea per kilogram). Estates usually market output individually or through agents to the PNGRP, which then disposes of it to an Australian buyer. Smallholders, however, market through the Department of Primary Industry organization (and hence through the PNGRP), thus being spared the "middleman" problem so common in other natural rubber producing countries. This marketing facility for the smallholders, which amounts to another form of government subsidy, has meant that on average the PNG grower is receiving some 65 to 75% of PNGRP prices, compared with, for example, Nigerian rubber farmers who often receive as little as 25% of market prices.

FUTURE PROSPECTS

The measures being taken by the ANRPC member countries, led by the three major South-east Asian producers (Indonesia, Malaysia and Thailand), through stockpiling, replanting and restricted exploitation systems, should result in higher and more stable prices on world markets, with a steadily increasing demand for natural rubber, provided it is presented in a modern form acceptable to the buyer, i.e., technically specified.

The outlook for the PNG producer can be comparatively optimistic provided a solution is found to the currently most pressing problem- complete change-over from traditional conventional crude rubber process to speciality or block rubbers (BR).

Interrow cropping demonstrated at Gavien Rubber Scheme

The current marketing arrangement via the PNGRP may not continue to function, at least in its present form, in the longer term, and thus the country's crude rubber production would almost certainly be faced with competition on an international scale. It is quite reasonable to assume that the present RSS and crepe grades would be difficult to sell in competition with technically specified forms.

PNG estates will have to modernize to a large degree, and producing tree areas must be revitalized through high-yielding clonal replacement if manufacturing costs are to be significantly lowered.

However, recent industry investigations and resultant replanning has led to the now acknowledged need to endeavour to consume all "remote" (village) smallholder production within the country. Rubber produced from areas which will eventually support a block rubber factory (or reprocess plant) will continue to be exported; however other rubber, being produced in the more remote parts of the country (and thus less easily supervised), should be absorbed into a domestic masterbatch compounding and rubber goods industry thus obviating the need for modernization of presentation and packing as none of this rubber would need to be exported. This domestic industry is shortly to be appraised by both consultants and interested foreign investors.

It was noted in the introductory paragraph that PNG estate areas are declining in extent. This is due to a variety of factors, some of which were noted in that section. However, Papua New Guinea, like so many other developing countries, is experiencing to some degree politically rather than economically justified land rationalization policies. Thus in numerous areas there is pressure from local groups to acquire foreign-owned estate properties. In certain parts of the country, there is a genuine land shortage problem. However as virtually none of the areas in which rubber estates are to be found

Typical smallholder factory and equipment

could be classified as "areas of land shortage", acquisition by local groups will be principally upon "political" rather than "economic" grounds, resulting in declining production through an absence of incentive. Such a trend has been borne out by a number of other "Third World" countries over the past decade or so. It is thought that in a large number of cases, such previously foreign-owned properties will progressively decline in production to absolute zero output.

There is an urgent need here to very carefully investigate and assess all such properties with a view to retaining the more desirable and potentially viable of them for the overall benefit of the country in addition to the previous, customary land owners. Selected properties are seen as "national assets" to be preserved and (re)-developed and thus play an important role in the national economy. They would be categorized, and would probably fall into one of the three following groups-

Properties which should be developed as nucleus estates to support a BR factory, and with provision of land for peripheral smallholder block development.

Properties which the Government considers should be acquired from the existing owners, and which should be developed as "estates", but with local participation in the form of shares, rent or royalty payment.

Properties which, due to their proximity to existing resettlement schemes, should be replanted and subdivided into blocks for incorporation into the existing, adjacent smallholder scheme.

In the short-term then, the PNG estate sector is expected to rapidly decline in area to perhaps as little as 4 000 to 6 000 hectares. On the other hand, many properties with high potential hitherto run by foreign-owned interests could be revitalized and be retained within the national industry for the benefit of both local groups and the economy in general. The loss by the estate sector may be converted into a gain by the smallholder sector.

The present smallholder sector, on the other hand, is not faced with the same drastic change. Plantings will continue, and future material will all be of the higher-yielding budded type. Economies of scale, aimed at promoting contiguous village plantings supporting a viable shared processing unit, are of paramount importance. Area plantings must aim to reach a level whereby output might support a centralized reprocess to either speciality or block rubber. Formalized schemes must similarly achieve total planted areas which will permit the viable operation of central, block-rubber processing units.

It may be said that the PNG natural rubber industry is upon the threshold of a new era. Whether this new era proves to be beneficial to grower and country alike will depend upon the industry's ability to modernize and keep pace with international producer and market developments and trends.

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The PNG delegates during the opening ceremony at the fifth ANRPC Assembly, Jakarta, November, 1976.

Left to right: C.E.W. Arnold, M. Setae (Leader) and J. Aitsi (Department of Foreign Relations and Trade)

The PNG delegation at that ceremony, meeting from left to right, the Indonesian Minister for Trade, His Excellency Mr. Radius Prawiro; the ANRPC Secretary-General, Dr. Moeljono Partosoedarso, and the Assembly Chairman, Dr. Suhadi Mangkusuwando of Indonesia