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HOW FARMERS CAN REDUCE THE EFFECTS OF DROUGHT ON FOOD PRODUCTION IN THE LOWLANDS

By R. Michael Bourke, Senior Horticulturist, Highlands Agricultural Experiment Station, Aiyura, Eastern Highlands Province.

Most of Papua New Guinea receives plenty of rain for growing food crops, although some areas are not so wet. Even in areas with high rainfalls, there are years when the rainfall is low and this can damage food crops. When the rainfall is very low for several months, this is called a drought. In 1972 many peoples' gardens were affected or even ruined. A lot of people were hungry in that year.

In this article I want to point out some things farmers in the lowlands can do to stop drought having such a bad effect on their food crops. If peoples' gardens are ruined, they will have to spend their money buying rice or food from other areas, or the Government will have to help them. But if they do certain things every year, such as planting a little of certain crops, droughts will not have such an effect on them when they do occur. Most of the ideas in this article are things that village people in different areas do already. Not all ideas are known by every gardener everywhere, so they are written down here.

There are differences between crops that can be used by farmers to reduce the effect of drought. There are also differences between varieties for each crop. Here we will mostly be talking about differences between crops rather than between varieties. This is because not much is known by scientists about differences in drought resistance between varieties of our food crops. Nevertheless differences between varieties for any one crop are important and farmers and didimen should take notice of how different varieties react to dry conditions. For example, if a certain variety of taro grows better than other varieties in a drought, farmers should remember this and plant a little more of that variety than usual every year.

When we talk about the differences between crops or varieties, it is not suggested that farmers should change over to growing another crop or variety completely, but that every year they should grow some of the crops or varieties that are not so affected by drought. Then when there is a drought, they can use food from these crops if their usual food crop is damaged by the dry conditions.

Farmers can think about planting some of the following types of crops to reduce the effect of droughts.

1. *Crops whose food can be stored in the plant*

The most important food crops, such as sweet potato, taro and bananas, have to be eaten fairly soon after they mature or they will go bad. Food of some other crops can be left in the ground or the plant for a long time after it matures without going bad.

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Such crops are useful to have planted because they can be eaten whenever drought or other problems like insects damage the main food crop.

Food of the following crops can be stored in the ground or on the plant:

Sago
Swamp taro *(Cyrtosperma)*
Cassava
Paragum taro *(Alocasia)*
Chinese taro *(Xanthosoma)*

The harvesting date for Chinese taro is more flexible than taro tru, but if it is left in the ground too long, the cormels begin to sprout. To find out the differences between the different kinds of taros, look at the articles on taros in *Liklik Buk*. Even if these crops are never needed as an emergency food, they can always be fed to the pigs who won't refuse them!

Young sago palms, East Sepik Province. Sago is a valuable food in times of drought. Photo by author.

2. *Drought resistant crops*

There are certain crops that are not so affected by very dry conditions. We call these drought resistant. Some of these are:

Cassava
ABB bananas
Pineapples

Cassava is a very tough crop and can grow even when there is not a lot of water in the soil. The ABB bananas are able to grow better than other types of bananas and other crops under dry conditions. Villagers in dry areas know this and plant a lot of these bananas. For example, in parts of the Markham Valley the main food is the Kalapua banana. In dry areas of the Gazelle Peninsula people plant many Yava bananas. Kalapua and Yava are both ABB bananas. To find out how to identify the ABB bananas from other types, see the article in *Harvest*, Volume 3, number 2, (Bourke 1976). An easy way to tell ABB bananas is that they have a lot of white wax on the stems and hardly any black marks.

3. *Wetland crops*

Crops that grow in wet places will not be so affected by drought if the water always stays there. Some of these crops are:

Sago
Swamp taro *(Cyrtosperma)*
Taro tru *(Colocasia)*
Rice *(Oryza sativa)*
Kangkong *(Ipomoea aquatica)*
Salat (water cress)

Sago, swamp taro and kangkong are the most useful of these for escaping the effects of drought because they grow in swampy areas. Swamp taro can be grown in water that is a bit salty. Most

Swamp taro - another very useful emergency food supply. This crop at Vudal is 5 years old and can be harvested as needed.
Photo by E. Pais.

varieties of taro tru and rice only grow in flowing water, although some varieties grown overseas do produce in water that is not flowing.

4. *Tree Crops*

Tree crops are useful for providing food in a drought because the roots usually go down a long way in the soil and they can get water for growing even if the top of the soil is dry. Compare the roots of a coconut with sweet potato! It usually takes a long time from flowering to fruit maturity for tree crops, so that fruit or nuts growing in good times might be ready for harvest in a drought. Of course, damage to growth in a drought affects the tree for up to several years, but by then short lived crops are providing food.

Some useful tree crops that give food are:

Coconuts
Breadfruit
Tulip *(Gnetum gnemon)*
Fruit and nut trees such as galip, talis, okari, aila, pandanus, guava, laulau and mango
Avocado

There are many more fruit and nut trees that are grown in Papua New Guinea. The disadvantage of most for drought foods is that they produce food only in certain seasons and this is usually a few months after a dry period.

5. *Crops that can be stored after harvesting*

In places that have a long dry season every year, the usual way people have food all year is to grow some crops that can be stored after harvesting. Some of these crops are:

Yams *(Dioscorea alata)*
Mami *(D. esculenta)*
Corn *(Zea mays)*
Rice *(Oryza sativa)*
Peanuts and other grain legumes

In many parts of Papua New Guinea that have a long dry season every year, people grow yams and mamis. These can be stored for many months. Usually the longer the time to maturity for yams and mamis, the shorter is the storage life. Yams store better than mamis. These are really good crops for areas that have a long dry season every year, but not so good where there is a drought only sometimes.

Grain crops like corn, rice and peanuts, are difficult to store in climates that are usually wet and hot, like most of the lowlands. Some people have suggested that growing more grain crops is one way of providing food for droughts, but I do not think this is very suitable for Papua New Guinea.

As well as growing some crops other than the usual main food, other things can be done to reduce the effect of drought. Some of these things are :

1. *Gathering wild crops*

Many people gather food from the bush when their gardens are destroyed by drought. Wild products like sago, limbum palm, ferns and wild buai are just some of the things that are collected. Young people in many areas are not learning so much about wild products as their parents and grandparents and some of this knowledge is being lost.

2. *Gardening in different areas*

Sometimes, but not very often, it is possible to have gardens in different areas so that when one area is having a drought, the other area is receiving enough rain. An example of this is the north and south coasts of New Britain where the seasons are the opposite.

Another similar thing that people do is to have trading relations with clans that are in different rainfall areas. When it is too dry in one area, people exchange or buy food from another area that is not having rainfall problems. This is done in many places in Papua New Guinea. An example is the Lelet Plateau of New Ireland and the nearby coastal area.

3. *Storage in mounds*

Another way of storing crops after they have been harvested is in mounds. Experiments have been done in the highlands and at Keravat on this. In the highlands sweet potato could be stored for 40 or 50 days but not longer than this. At Keravat it was found that sweet potato could be stored for one month, but not two or three months. The highland work is described in an article by T. Aldous in the 1975 Food Crops Conference Proceedings.

This method is not suitable for storing food in case a drought occurs because the food can only be stored for a short time.

4. *Irrigation*

When farmers bring water to their crops to help them grow, this is called irrigation. It is common in really dry places in other countries. Some farmers used to irrigate their taro in parts of the Gulf, Madang, Milne Bay and Morobe Provinces and on the Gazelle Peninsula, but this has been dying out in recent years.

Making irrigation channels to carry water is a lot of hard work and is more suitable to areas where the same ground is farmed every year. In some places it might be possible to irrigate gardens using pipes made from bamboo to bring water from a stream to gardens.

Building a mound to store sweet potato in a trial at Keravat. It was possible to store tubers for 1 month, but not 2 months. Storage in mounds is not a suitable way of reducing effects of drought in PNG. Photo by author.

The author examines a variety of cassava at Keravat. Cassava is drought tolerant and can be harvested as needed. Photo by E. Pais.

5. *Saving Planting Material*

In a bad drought it is not possible to plant new gardens, but it is important that the planting material be kept alive to plant the new gardens when the rain comes. This is especially important for taro because it takes so long to build up planting material and it is easily affected by drought.

Taro setts can be planted in swampy areas and often crops like sweet potato and bananas can be kept alive in damp places such as next to a creek. During the dry season on New Ireland it is common to see a lot of taro planted in swamps or springs. Of course there is no problem with yams and mamis - they can be easily stored for up to 6 months in dry places like garden houses.

6. *Planting After the Drought*

Often it is not during a drought that people are hungry, but after the rain has come and they are waiting for the new gardens to produce food. It is a good idea to plant some quick maturing crops as soon as the new gardens are planted.

Corn can be eaten 10 to 12 weeks after planting. Some of the "wan mun" sweet potato varieties (such as K9) have some tubers as early as 7 weeks after planting. Snake bean (yardlong bean), mung bean and cowpea start to bear in 9 to 10 weeks which is faster than winged bean or peanuts (13 to 14 weeks or longer).

CONCLUSIONS

The things that people can do to reduce the effect of drought depends on what is available locally. Farmers cannot plant sago and swamp taro if there are no swamps! Whether an area has a long dry season every year or no dry season, the best thing to do is still the same - and that is to plant some extra crops that have been mentioned in this article, such as sago, swamp taro, cassava, ABB bananas, yams, mamis and coconuts.

It is too late to do much when the drought comes. The time to think about making suggestions to the village people is now, so that if a drought comes, they have food.

In this article we have been talking about reducing the effect of droughts, but many of the ideas are useful in case crops are destroyed by insect or disease attack, flooding or strong winds.

FURTHER READING AND REFERENCES

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VUDAL GIRLS' FIELD WORK ON THE HOSKINS OIL PALM SCHEME

By Cecilie Benjamin, Rural Development Officer, Kimbe.

The Hoskins Oil Palm Scheme was selected as the venue for field work for the first intake of female students to Vudal Agricultural College. In the first weeks, the girls visited the oil palm sub-divisions of Buvussi and Gali, the oil palm research station at Dami, and other parts of the oil palm development.

For their field work, the girls paid visits to families on the oil palm blocks.

During their first visit they measured the size of subsistence gardens and recorded varieties of crops, insect and pest attack and farming systems. They also counted pigs, poultry and fruit trees.

Their second visit to the settlers' gardens was to gather varieties of taro, sweet potato and cassava.

The girls collected about 100 varieties of taro, 40 varieties of sweet potato and 6 varieties of cassava. These specimens were sent to the Lowlands Agricultural Experiment Station (LAES) at Keravat for inclusion in their variety collections.

The third visit was to distribute corn to the women who had assisted the girls with this programme and to personally thank them for their assistance. The corn, from LAES Keravat, was also grown on demonstration plots in each of the community centres where the girls worked.

The girls also had one day with the Maternal and Child Health sisters who visit the subdivisions once a month. All the students enjoyed this day very much.

WORK PROGRAMME

An introductory course was carried out for a week before the girls actually went into the field. This course consisted of a visit to the Oil Palm Sub-division of Buvussi and Galai where basic crop technology was observed, such as cover cropping, pollination, harvesting, pruning and benching. The structure of the sub-divisions was also explained to the girls by the Department of Primary Industry officers in charge.

The Oil Palm Research Station at Dami was also visited where oil palm breeding, seed production, and laboratory work are carried out. Visits also included the Dami Forestry Station, Mosa Nuclear estate and the Oil Palm Mill. Talks and discussions were given by various departmental representatives from Health, Welfare, D.D.C., PNG Development Bank and Business Development to give the girls an idea of departmental involvement with the Oil Palm Scheme.

One day was taken up by a visit to the Hoskins Hot Springs, Megapod breeding grounds and Mora Mora Wildlife Station where crocodile recordings are carried out.

The girls also visited the international wharf where oil is pumped along pipes from nearby oil storage tanks to waiting ships proceeding to Europe.

Mosa Oil Palm Mill. Oil is extracted here for shipment overseas.

Iaka and Margaret in a Chimbu settler's food garden on Buvussi Subdivision.

FIELD WORK

The girls moved out onto 4 of the 7 sub-divisions where they were to work. Six girls on Sarakolok, 6 girls on Buvussi - Galai, 5 girls on Kavaui, and 4 girls on Kapore sub-division. The girls were accommodated in IMQ's or settler's houses on the community centres. Each girl was to visit 15 oil palm blocks which supported 15 families. These families were of mixed origin, some people were from the Sepik, East New Britain, Chimbu, Morobe, Papua and West New Britain Provinces. Each girl paid 3 separate visits to each of these families. The first visit was to measure the subsistence garden size, record varieties of crops, insect and pest attack, farming systems, pigs, poultry and fruit tree statistics.

The second visit was undertaken to gather varieties of taro *(Colocasia)*, sweet potato and cassava.

The third visit was to distribute corn to the women who had assisted the girls with this programme and to personally thank them for their

assistance. The corn was supplied from LAES Keravat by Mr. R.M. Bourke. This variety was also grown on demonstration plots on each of the community centres where the girls worked. The corn was approximately 3 metres high and was far in excess of the corn performance in subsistence gardens of the sub-divisions. Altogether 306 settler's blocks were visited by the girls out of a total of 1566 occupied blocks on the scheme.

The girls in front of a settler's house at Kavui Community centre

RESULTS

The food garden results have since been used to confirm the reliability of results of a survey done 6 months earlier to determine pressure on the gardens in the back areas of the oil palm blocks. Statistical information has been compiled on fruit trees, pigs and poultry to determine future supplies and policies. The girls collected approximately 100 varieties of taro, 40 varieties of sweet potato, 6 varieties of cassava which were forwarded to LAES Keravat for inclusion in their variety collections.

Aselika and Loates on field work on Buvussi sub-division. Note the bananas on Aselika's head.

Serry Loamin holding some of the taro varieties collected.

GROWING FOOD AT INSTITUTIONS IN THE LOWLANDS

By R. Michael Bourke, formerly Agronomist, Lowlands Agricultural Experiment Station, Keravat.

Many institutions, such as boarding schools, are growing food crops to become self-sufficient for at least part of their food needs. This article is intended as a guide for such institutions and gives information on suitable crops, land use, crop rotations and fallows. The information comes from a paper presented at the 1976 Waigani Seminar. Copies of the paper, which provide further information, may be obtained from the author.

It costs schools and other institutions a lot of money each year to buy food, so many institutions are growing some of their food themselves. There are a number of things that make institutions different from other farmers and these affect the way they must farm their land. The most important of these is that the same staff and students do not work their farm for very many years compared with village farmers. Sometimes the teachers at schools do not know a lot about growing crops and raising livestock; and at teaching institutions there is a break in farming over the long vacation.

WHICH FOODS TO GROW?

The nutrition section of the Department of Public Health (DPH) has made recommendations for a ration scale for boarding schools and other institutions. The scale gives the daily requirements per person of five sorts of food The DPH recommendation and the approximate daily costs are given in *Table 1*.

Only a few institutions will be completely self-sufficient in food production, so the institutional farmer must firstly decide which sorts of foods to grow. At current prices self-sufficiency should be sought in fruits, vegetables, and high energy foods (coconuts and oil palm) firstly, then staples and finally protein foods. Large price changes might alter this. For example, a large rise in the price of tinned fish might make it more worthwhile to produce grain legumes before staples. (For more figures on this see the Waigani Seminar paper)

Fruits.

Most institutions do not grow much fruit apart from eating bananas and pineapples. A list of suggested fruit and nuts crops is given in Appendix 1. It does not take much work to look after fruit and nut trees and they make just as good decorative and shade trees as unproductive trees that are commonly grown around institutional buildings. Seed of most of the crops in Appendix 1 is available from LAES, Keravat, as it cannot be obtained locally.

Vegetables.

A list of suggested suitable vegetable species is given in Appendix 2. The species are given in an approximate order of usefulness (ease of cultivation and food value). Since many of the introduced

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vegetables, such as cabbage and cucumbers, have more pest and disease problems and are not as nutritious as traditional crops, emphasis should be placed on growing more traditional species. The list includes a number of shrubs and trees which are useful because of low labour requirements. There are other traditional vegetable crops, both wild and cultivated, that can be used. Ferns and tree ferns are an example.

Staples.

It is a good idea not to rely on just one staple but to have two or even three staples. This gives a change in a diet. Also if one crop is damaged or destroyed by insects, disease or drought, there is another one to fall back on. For example sweet potato could be ruined by weevil or drought but cassava would still yield a crop. Sweet potato is the staple crop most commonly grown by institutions. However, cassava and bananas give more food for the work needed to grow them. (See Appendix 3). This suggests that more use should be made of these two crops. Cassava can be stored in the ground and is therefore a more flexible crop than sweet potato. This is an advantage where there is a break in planting over the vacation or in dry periods. Its ability to tolerate poor soil fertility and drought is a further advantage. It can survive without much attention which is an advantage for institutions with long vacations. Except for rats, cassava is free of major pests and diseases in PNG . On the negative side, it is not a popular food and is poorer in protein than most other staples. It must be cooked properly to destroy poisons in tubers. Bananas are not very demanding of labour. They produce all year round and can help fill gaps between other crops. Triploid cultivars used for cooking should be grown.

Corn.

The way it is eaten in PNG gives about the same food value for the work needed to grow it as sweet potato. It can also be picked when it is dry and used to make cornflour. This can replace the imported wheatflour that is often used in institutions. See the 1977 edition of *Liklik Buk* on page 93 and 115 to find out how to do this.

If swamp taro (*Cyrtosperma chamissonis*) is planted in swampy areas, land can be used that would otherwise be wasted. Maturity date is very flexible with swamp taro. Sugar cane planted for snacks while working in the gardens may improve work efficiency and allow other popular foods such as peanuts and pineapples to reach the mess.

The data in Appendix 3 applies to institutional conditions which are different from the village situation. For example, taro gives a more favourable return relative to other staples under village conditions.

Protein crops.

Although it is more profitable to concentrate on other groups of

crops before protein crops, it is a good idea to grow some protein food both for diversity in the diet and because the legumes fit into rotations with other crops. Institutions can also have an educational role in promoting the use of protein crops as a means of improving subsistence farmers' diets. Unfortunately all suitable species are propagated by seed which reduces their usefulness in institutions. Seed viability is a problem in some legumes. Peanuts, cowpea and soybean are probably the most suitable species (See Appendix 4). Grain legumes need to be cooked thoroughly to get the most protein out of them.

LAND USE AND ROTATIONS

The following land uses should be considered for institutions:

1. Main gardens. These will be devoted to staples, vegetables, grain legumes and fallows. Reasonably large areas of flat or moderately sloping land are required if the ground is to be mechanically cultivated.

2. Blocks of perennial crops such as coconuts, bananas, oil palm, pineapples, fruit and nut trees, tulip and kagua. These can be planted in land not suitable for cultivation such as in gullies, or on steep hills.

3. Additional vegetable gardens, preferably near the mess. These can be fertilized with ash from cooking fires and compost made from mess scraps.

4. Fruit trees and other perennials around school buildings.

5. Wet areas that can be used for water tolerant plants such as kangkong, swamp taro and watercress.

6. Fences on which climbers such as yardlong bean, winged bean, choko, granadilla and yams can be trailed.

7. Areas from which wild products can be gathered, for example, sago, sago grubs, bush greens and fish.

Mixed cropping.

This is a widespread practice in village gardens and more use could be made of mixed cropping in institutional gardens. Weed control is often better in mixed stands; the combined yields of mixtures are sometimes greater than pure stands of the individual crops; there tends to be greater yield stability; and there may be less pest and disease problems.

Mechanization reduces the possibilities for mixed cropping, but it is still possible with the level of mechanization found. Generally traditional combinations should be followed as these have been proven over time. Some possible combinations are:

Corn with sweet potato or peanuts

Chinese taro *(Xanthosoma)* under coconuts or bananas

Pineapples under bananas, pawpaw, coconuts, pigeon pea or cassava

Corn and rice grown together.

Long term crops that are mix-cropped in village gardens but cannot be mixed with faster maturing crops where mechanization is used can nevertheless be used on hedges and boundaries. Examples are cassava, sugar cane, pitpit, aibika, diploid bananas and winged bean.

Crop rotations. This section applies mostly to main gardens (Land Use 1).

The long forest fallow traditionally used in the lowlands is a very good system giving high yields for work needed. Unfortunately mechanical cultivation is not possible with a long forest fallow.

Where no mechanical cultivation is used, the long forest or bush fallow can be used. But for most institutions, there is not enough labour and mechanical cultivation is needed. So either a grass, a creeping or planted shrub fallow must be used. Two possible rotational systems are suggested below:

System 1.

This is suitable for institutions with limited land resources and which are prepared to use fertilizer on food crops. It lends itself to mechanical soil cultivation and ridging. The rotations followed will depend upon the soil fertility. An example of such a rotation is as follows:

The available land is split into four blocks. Each year two of the blocks are cropped and two are under fallow. Three sweet potato crops and one crop of vegetables and grain legumes are grown every year. A plan is given in Appendix 5 and the operations for one block in Appendix 6. After the second fallow (stage 12), the cycle commences at stage 7 and continues. On poorer soils two, rather than three, sweet potato crops per four year cycle may be taken to maintain long term fertility.

System 2.

This allows more mechanization than using a long forest fallow but not as much as system 1. It does not require fertilizer to maintain yields, but more land is required. After land is opened up from forest it is alternatively cropped and fallowed, say every second year. Another area is cropped and fallowed in alternate years. After a number of crops, yields will have declined and another area is opened up and the process is repeated. The first area goes back to a fallow, perhaps under forest. To help the forest become established again, strips of forest should be left uncleared next to each block. These will provide seeds for the regrowth. When all available land has been used, the original area is opened up again for gardening. Mechanical cultivation cannot be used for the first year's gardens, but should be possible after that.

An example using six blocks is given in Appendices 7 and 8.

Areas required. The calculations for garden areas required are as follows:

For an institution of 250 persons seeking to grow enough sweet potato to provide 1 kg to each person every day of the week for 45 weeks a year, the amount of sweet potato needed per year is:

250 persons x 1 kg/person/day x 7 days/week x 45 weeks/year
= 78 750 kg/year.

If the crops yield 14 000 kg/ha, the area of sweet potato per year is:

78 750 kg/year ÷ 14 000 kg/ha
= 5.625 ha/year.

If two crops are taken from a block each year, each block would need to be 2.8125 ha in area. If land is cropped for 1 year in 6, as in system 2 above, then 2.8125 ha x 6 = 17 ha of land is required to maintain the system.

Role of animals.

In general it is considered that animals do not have a major role in institutional farming although a cattle project as a separate project is a possibility if land and money are available. However, land and capital requirements are very high and it is better to put resources into food crop farming because of the large internal food demand, and a cheap alternative protein source (tinned fish).

Pig and poultry units require large areas of cropping to keep them going or capital outlay to purchase food and are not generally suitable for most institutions. A small pig unit to use mess scraps and garden waste would be a useful project. A fattening project where pigs are brought in at the beginning of the year is more suitable than a breeding project unless mess scraps are produced all year. A typical mess could support about 10 pigs so the contribution to the diet would be small. Small goat or duck projects may be possible in many institutions.

Table 1. Cost of recommended daily food requirements per head per day

Type of food	Daily requirements	Approximate cost. Toea per kilogram	Cost per head per day (toea)
Starchy foods:			
Staple (root crops, sago or bananas)*	2.5 kg	6.5 (e.g. sweet potato)	16
(Rice)	(600 g)	35	(21)
(Wheatmeal)	(600 g)	17	(10)
High energy food	30 g	95 (e.g. dripping)	3
Protein food	150 g	55 (e.g. tinned fish)	8
Vegetables	100 g	17 (e.g. aibika, pumpkin tips)	2
Fruits	200 g	20 (e.g. pineapple, pawpaw)	4
		Total cost (using staples)	33

* Rice or wheatmeal can be substituted for staples.

Appendix 1. Some suggested suitable fruit and nut crops

Crop	Scientific Name	Notes
Pineapples	*Ananas comosus*	Grow well under shady conditions (labour requirements lower and yield not greatly reduced). Somewhat seasonal.
Eating bananas	*Musa* spp.	Use ABB or AAB triploid cultivars. Not seasonal.
Pawpaw	*Carica papaya*	Not seasonal.
Coconuts	*Cocos nucifera*	Very little maintenance if arable crops planted under them. Not seasonal.
Galip	*Cannarium indicum*	Edible nuts produced. Seasonal.
Talis (Java almond)	*Terminalia catappa*	Edible nuts produced. Seasonal.
Okari	*Terminalia okari*	Edible nuts produced. Seasonal.
Aila (Tahitian chestnut)	*Inocarpus edulis*	A leguminous nut tree. Seasonal.
Pandanus	*Pandanus* sp.	Two edible varieties: marita (seasonal) and karuka (not seasonal.
Pau	*Barringtonia* sp.	Seasonal.
Taun	*Pometia tomentosa*	Seasonal.
Guava	*Psidium guajava*	A popular fruit. Not seasonal.
Avocado	*Persea americana*	A rich food, not popular. Seasonal.
Pomelo, lemon lime	*Citrus* spp.	Not seasonal.
Orange, grapefruit mandarin	*Citrus* spp.	
Soursop	*Annona muricata*	A popular fruit. Not seasonal.
Five corner	*Averrhoa carambola*	Use sweet varieties. Not seasonal.
Rambutan	*Nephelium lappaceum*	Seasonal.
Langsat	*Lansium domesticum*	Bears heavily. A succulent fruit. Seasonal.
Mangosteen	*Garcinia mangostana*	Seasonal.
Lau lau (Malay apple)	*Eugenia malaccensis*	Seasonal.

Crop	Scientific Name	Notes
Giant lau lau	*Eugenia megacarpa*	Seasonal.
Mango	*Mangifera indica*	Prefers areas with definite dry season. Seasonal.
Bullocks heart	*Annona reticulata*	Popular in certain areas. Not seasonal.
Custard apple	*Annona squamosa*	Prefers areas with definite dry season. Seasonal.
Bukubuk	*Dysoxylum* sp.	Seasonal.
Breadfruit	*Artocarpus altilis*	Fruit, seeds and young leaves edible. Seasonal.
Jak fruit	*Artocarpus integrifolia*	Seasonal.
Granadilla	*Passiflora quadrangularis*	Not seasonal.

Appendix 2. Some suggested suitable vegetable crops.

Crop	Scientific Name	Notes
Aibika	*Abelmoschus manihot*	Insect pests can be serious.
Tulip	*Gnetum gnemon*	A tree. Young leaves and fruit edible.
Pumpkin	*Cucurbita maxima*	Both tips and fruit edible.
Choko	*Sechium edule*	Tips and fruit edible. A climber.
Karakap	*Solanum nigrum*	Self-sown.
Valangur	*Polyscias grandifolia*	Shrub. Young leaves edible.
Kangkong	*Ipomoea aquatica*	Grows in wet areas.
Chinese cabbage	*Brassica* sp.	
Taro	*Colocasia* and *Xanthosoma*	Leaves edible as well as corms/cormels.
Pitpit	*Saccharum edule*	
Kagua	*Ficus* sp.	A tree. Young leaves and fruit edible.
Russian comfrey	*Symphytum asperrimun*	
Cowpea and yardlong bean	*Vigna unguiculata*	Other leguminous bean can be used as green vegetables. Leaves also edible.
Sweet potato	*Ipomoea batatas*	Leaves edible as well as tubers.
Cassava	*Manihot esculenta*	Young leaves edible. Must be cooked for at least 15 minutes to destroy poison.
Aupa	*Amaranthus tricolour*	
Pepenge	*Amaranthus gracilis*	Self-sown.
Salat (water cress)	*Nasturtium indicum*	Grows in wet areas.
Basella (Ceylon spinach)	*Basella rubra*	Staking needed for best results.

Appendix 3. Comparison of various energy crops

Crop	Average yield Kg/ha (1) (2)	% edible portion	Energy value. Calories/ 100 g edible portion (3)	Labour requirements. Man-day/ha/ crop or year (2) (4)	Calories/ ha/crop or year ($\times 10^6$) (2)	Calories/ man-day ($\times 10^3$)
Cassava	22 000	80	146	180	25.7	143
Bananas (5)	10 000	46	94	75	4.3	58
Sweet Potato	14 000	80	117	280	13.1	47
Corn	2 300 (6)	100	270 (6)	140	6.2	44
Yams	12 000	80	105	350	12.6	36
Chinese Taro	8 000	80	104 (7)	220	6.7	30
Rice	2 000 (8)	65	360	220	4.7	21
Sago	6 000 (9)	100	362	1200 ? (10)	21.7	18
Taro tru	3 500	80	104	250	2.9	12

1. Average long term yield for PNG lowlands for institutional conditions. Presumes a high yielding variety and moderate soil fertility.
2. On a per crop basis except for bananas where it is per year.
3. World Health Organization figures.
4. Does not include clearing, soil cultivation (except for necessary ridging/mounding), peeling or hulling. Includes transportation to mess.
5. Triploid cultivars.
6. Fresh corn as eaten in PNG
7. Taken as the same for taro tru.
8. Winnowed paddy. Hulling required before consumption.
9. Waterfree starch.
10. An estimate for processing wild stands.

Appendix 4. Some suggested suitable high protein crops.

Crop	Scientific Name	Notes
Peanuts	*Arachis hypogaea*	Always popular.
Cowpea	*Vigna unguiculata*	High yielding if insects are not too serious. Yields poor in wet weather.
Soyabean	*Glycine max*	Seed storage is a problem.
Yardlong bean	*Vigna unguiculata*	Staking required.
Pigeon pea	*Cajanus cajan*	Grain yield often low because of insect attack.
Winged bean	*Psophocarpus tetragonolobus*	Labour requirements relatively high.
Mung bean	*Vigna radiata*	

Appendix 5. System 1. Plan of rotations

Year	Block 1	Block 2	Block 3	Block 4
1.	Sweet potato			
	Sweet potato			
2.	Vegetables and legumes	Sweet potato		
	Sweet potato*	Sweet potato		
3.	Fallow	Vegetables and legumes	Sweet potato	
		Sweet potato*	Sweet potato	
4.	Fallow	Fallow	Vegetables and legumes	Sweet potato
			Sweet potato*	Sweet potato
5.	Sweet potato	Fallow	Fallow	Vegetables and legumes
	Sweet potato*			Sweet potato*
6.	Vegetables and legumes	Sweet potato	Fallow	Fallow
	Sweet potato*	Sweet potato*		
7.	Fallow	Vegetables and legumes	Sweet potato	Fallow
		Sweet potato*	Sweet potato*	
8.	Fallow	Fallow	Vegetables and legumes	Sweet potato
			Sweet potato*	Sweet potato*

* Sweet potato crop fertilized

Appendix 6. System 1. Operations in Block 1

Year	Stage	Operations
1	1	Clear and burn forest or grass for gardens.
1	2	Sweet potato crop with corn, etc.
1	3	Sweet potato crop with corn, etc.
2	4	Cowpea, soyabean, pumpkin, aibika, aupa, etc.
2	5	Sweet potato (fertilized) with aibika, cassava, diploid bananas, sugar cane, etc.
3,4	6	Pigeon pea fallow.
5	7	Cut and burn fallow.
5	8	Sweet potato with corn, etc.
5	9	Sweet potato (fertilized) with corn, etc.
6	10	Cowpea, soyabean, pumpkin, aupa, etc.
6	11	Sweet potato (fertilized) with aibika, cassava, diploid bananas.
7,8	12	Pigeon pea fallow.

Appendix 7. The plan of rotations used for System 2

BLOCK	1	2	3	4	5	6
Years cropped	1,3,5	2,4,6	7,9,11	8,10,12	13,15,17	14,16,18
Years under short fallow	2,4	3,5	8,10	9,11	14,16	15,17
Years under long fallow	6-18	7-18; 1	1-6; 12-18	1-7; 13-18	1-12; 18	1-13

Appendix 8. System 2. Operations in Block 1

Year	Stage	Operations
1	1	Clear and burn forest fallow.
1	2	Sweet potato crop with corn, etc.
1	3	Sweet potato-crop with aibika, cassava, diploid bananas, sugar cane, etc.
2	4	Pigeon pea fallow.
3	5	Cut and burn fallow.
3	6	Sweet potato with corn, etc.
3	7	Sweet potato with aibika, cassava, diploid bananas, sugar cane, etc.
4	8	Pigeon pea fallow.
5	9	Cut and burn fallow.
5	10	Sweet potato with corn, etc.
5	11	Sweet potato with aibika, cassava, diploid bananas, sugar cane, etc.
6-18	12	Long forest fallow.

1. An old mango tree gives shade at a high school. Fruit trees provide food and shade, reduce grass cutting and are just as attractive as unproductive trees. But the fruit trees selected must be ones that bear well in that area and are liked for eating (See Appendix 1).

2. Valangur forms a hedge around a Tolai farmer's house. This is a popular leaf vegetable on the Gazelle Peninsula. Traditional vegetables are usually easier to grow, have fewer pest and disease problems.

3. High school girls mound for a sweet potato garden. Sweet potato is the staple food generally grown by institutions. However cassava and triploid bananas give more food for the work needed to grow them. (See Appendix 3).

4. Pineapples, Chinese taro and bananas growing under coconuts. Mixed cropping is a very good system that is widely practised by villagers but not by institutions. Compared with mono-cropping, mixed cropping often gives higher and more stable total yields, and less weed, pest and disease problems.

5. A pigeon pea (Cajanus cajan) fallow. Pigeon pea is a legume shrub. Some system of crop rotations and fallows is required for soil fertility maintenance. Two possible rotational systems using a planted pigeon pea fallow are suggested.

MANUS PROVINCE

By Nicholas Darku, formerly Provincial Rural Development Officer in Manus.

Mr Nicholas Darku comes from Kieta in the North Solomons Province. He did his early Primary schooling in Tubiana, Kieta and Buin, then went to Hutjena High School. In 1968 he went to Malabunga High School in the East New Britain Province where he completed his high schooling.

He attended Vudal Agricultural College in 1969 and graduated in 1971.

His first posting was to Rabaul District in 1972. He worked mainly on Crop Extension and Land Settlement Schemes.

Early in 1973 he was transferred to Taliligap Extension Centre as the Officer-in Charge, and later that same year he had another posting to Kieta in the North Solomons as the Officer-in-Charge of that district.

He attended a Middle Management Course at Internal Training Institute in Sydney in February 1974 and returned in June. When he returned he was transferred to Buin.

He worked in Buin as the Officer-in-Charge until he was posted to Manus Province as the Provincial Rural Development Officer in 1975. He then became Senior Agricultural Officer in Arawa, North Solomons Province.

Nicholas Darku

GEOGRAPHY

TERRAIN

The Manus Province is situated two degrees south of the equator, and comprises the Admiralty, Hermit, Ninigo, Anchorite and Pelleluhun island groups. Manus is the largest in the group, and is 96 km long and 32 km wide. The bulk of the population lives on Manus Island.

The terrain varies considerably with some very rugged mountains in the inland areas extending from Kari to Kali Bay down to Peli-Bowai on the south coast. The highest peak rises to a height of 718 metres.

The country is very broken with steep ridges and many streams which makes road construction expensive and difficult.

The coastline on Manus Island is covered with areas of fine sandy beaches. Most offshore islands are low-lying atolls, including Western island group. The islands of Rambutyo, Baluan and Lou have steep mountains rising to some 305 metres and above.

Manus Coast

VEGETATION

Most of the mainland is covered with rainforest. In some areas the forest extends to the shores. The coast is a mixture of mangrove swamps and old established plantations.

The highlands of Central Manus are heavily timbered which makes future logging prospects bright. The old garden areas are covered by secondary growth. The coconut plantations and village settlements occupy the coral sandy soils along the coastline and immediate inland areas.

On the coastline edible sago palms are found plus several species of native fruit trees. Extensive sago growing is found on river banks along the river courses.

Most offshore islands are under coconuts and fruit trees which play major roles in food supply.

CLIMATE

There is one Meteorological Station at Momote Airport.

The temperature ranges from 26.7° to 29.4°C.

The average rainfall is 2 500 mm. It does not vary greatly.

There is no distinct wet and dry period, however two prevailing winds occur each year. During these times the sea around Manus is very rough and travelling by boats and canoes becomes hazardous.

LAND

The total land is estimated at 2 070 square kilometres. Of this approximately 1 036 square kilometres is classified as arable land with varying limitations. There are no suitable areas for mixed farming or grazing. Approximately 3 500 hectares is under cash cropping and some grazing. Approximately 200 square kilometres is classified as marginal land.

SOIL TYPES

The soil types range from light sandy to heavy red clay types. Alluvial clay loam soils are found along river courses and are generally fertile soils.

Volcanic soils are only found on Lou and Baluan islands off the south coast of Manus mainland. The islands of Luf and Maron are also volcanic.

ROADS

The Province does not have a well-developed road network. It has an estimated 48 kilometres of all-weather road to the eastern tip of the island running from Mokerang Village, Momote and PNG Defense Force Patrol Boat Base Lombrum on Los Negros Island to Provincial Headquarters at Lorengau. From Lorengau towards Bunai is accessible for 57.9 km to a four-wheel drive vehicle in dry periods.

This road has opened the central Manus villages for further agricultural development, mainly rubber, cattle and pigs. Manus Transport Company commenced a bus service to Lundret Village and back three times per week. This service will be further extended when the road is improved.

Another major road construction has been started. This road will start at Sou on the north coast and will join up Kari village inland and will further connect the Manus highway at Buyang Village.

The Kali Bay to Malai Bay road has now been completed. In a year or two the Manus highway will connect the west coast to east coast with several feeder roads going to villages.

AIRSTRIPS

Momote is the only major airport in the Province. This airport has been upgraded to cater for international flights.

A small-craft airfield is on Lou island. On Western Islands three private airfields are based.

WHARVES

There are two overseas wharves at Lorengau and Lombrum Naval Base. Two coastal vessel wharves are at Lorengau.

COMMUNICATIONS

Telephone

Communication with outside provinces is still a problem. Local communication is good only within the Lorengau township and Lombrum Defense Force Patrol Boat Base. Outlying islands can be contacted by radio.

There is no subscriber trunk dialling system at Lorengau and it is not expected for a long time to come. The township of Lorengau is very well served by local telephone network which is still manual and operates for 24 hours per day.

Radio

The N.B.C. has a local radio station "Manus Belong Chauka". This is the only way to communicate within the provinces. The government departments have used the station for extension work.

The station opens up at 5 o'clock in the afternoon and closes at 10 p.m.

Transport

There is only one Bus Service run by Manus Transport Service. The bus service operates between Lorengau and Momote and Lorengau-Lundred. Rates are Lorengau-Lombrum 70 toea per trip and Lorengau-Lundred 45 toea per trip. Only 3 P.M.V.s are currently operating in Manus.

Many people in Manus travel by boat

PEOPLE

POPULATION

The estimated population is about 25 500 plus. The estimated manpower available is around 16 000. The absentees are estimated to be around 2 500, approximately 10%. The annual birth rate for the province is 4%, slightly higher than the country's birth rate which is 3%. The 4% annual birth rate means that 1 000 babies are born per year. This is obtainable from records at the Lorengau Hospital.

The potential farmers are estimated at 60% or 15 300.

CULTURE AND CUSTOMS

There are at least 11 languages spoken in the province. However, at least three languages are spoken by the majority. They are TITAN, KURTI, and KELE. The outlying islands have their own languages as do most of the villages inland.

Some of the social customs have adverse effects on development. Most of the Manus people are bound to obey their traditional customs at times. Traditional beliefs are very distinct right through the province.

The three main religious groups are Catholics, Evangelical Churches and Seventh Day Adventist.

There are not any major active cult movements. However, there are two minor cult movements. The most significant movement is the Paliau Movement on Baluan Island. This is a mixture of cult and economic movement.

Another minor cult movement is on Rambutyo Island called Muli Movement at Liuliu Village.

Sorcery is practised throughout the province, but not actively. With the introduction of law and order elders who practise sorcery are reluctant to put it into use. If they are found using sorcery the person concerned is liable to be punished by law.

LAW AND ORDER

Law and order is very well observed in the province. No tribal fighting has occurred.

Land disputes are sporadic. Land disputes occur in some coastal areas and disputes over fishing grounds exist. This is not so with growing of crops.

I think the situation with fishing grounds could become worse as the population increases and more coastal people derive cash from fish sales.

Fishermen of M'Buke Island

BEHAVIOURAL PATTERNS

There is a gradual behaviour change within the subsistence farming community towards cash income. The power of cash has changed people's attitudes not to sit and expect a free hand-out but to work in order to earn cash income.

There is a general tendency by groups to acquire more expatriate-owned plantations.

The people's general motivation is to achive goals such as taking part in business ventures in town, running their own business groups, etc. However, in many cases the limiting factor is the general know-how on the running of the enterprise. Many of the educated Manusians are outside the province either working for government or the private section.

Thus lack of technical know-how is holding up possible changes in the province.

EDUCATION

There are 47 community schools, 2 high schools, 3 vocational centres, 1 skulanka and 1 multi-racial school in Manus Province.

The community school enrolment in 1976 was 2 885.

Vocational centre enrolment in 1976 was 104.

High school enrolment in 1976 was 735.

Skulanka enrolment in 1976 was 35.

The total 1977 intake for community schools was 585.

Total high school intake for 1977 was 240.

The total number of 3 759 students in 54 schools in the province in 1976, represents 15% of the total population.

The effects of education on agricultural development is insignificant. Most of the school leavers have a tendency to seek employment in industries other than agriculture.

The village people have looked on education as a means of cash income through their children working in highly paid jobs. It is evident that the majority of Manus people working outside the province send a fair amount of cash to their parents. Sometimes elders have put stress on education as the only means for Manus people to obtain money.

A considerable number of school leavers stay home. It is frustrating for young people to stay home without any employment. However, in a number of areas school leavers have formed themselves into what are called "Leavers' Clubs". Two such clubs are now groups which have started agricultural developments with DPI assistance.

A piggery project at Sohonoriu has been established with technical assistance from Department of Primary Industry and financial assistance from Manus Provincial Area Authority.

On Baluan Island the groups are engaged on a fishing project as well as other things. The Leavers' Clubs get assistance from all government departments where it is applicable.

HEALTH

The level of nutrition is generally low throughout the province. The main staple food is sago which is low in protein and high in starch. However, this is compensated for by high consumption of fish (which has high protein value) on coastal villages. This does not apply to inland villages.

There are two hospitals in the province. The Manus General Hospital at Lorengau and Papua New Guinea Defence Force Hospital at Lombrum.

The province is well served by several aid posts run by the Public Health Department and council.

There is no "food action" group in the province, however, I anticipate the formation of a Provincial Nutritional Committee in the future.

The Department of Public Health conducts health education in Lorengau and in village areas. The birth rate in Manus is high at 4%. However, hospital officials predict this percentage to drop through family planning classes that are being conducted at Lorengau.

AGRICULTURAL DEVELOPMENT PROGRAMME

SUBSISTENCE AND NUTRITION

Local awareness of the problem of malnutrition is being increased. At the 1975 Food Crops Conference in Lae it was reported that 34% of children attending Maternal Child Health clinics in Manus suffer from malnutrition.

Extension and nutrition patrols are being carried out in an endeavour to discover the extent of the problem. High protein vegetable seeds have been purchased for resale to villages and a seed multiplication plot at Tamat has been established. It is intended to set up vegetable demonstration plots at Kali Bay and Kari village, and to improve village poultry. In 1981 three evaluation patrols will be launched into all affected areas to determine the effects of the programme.

CATTLE

There is little development of cattle in Manus. There are three native projects with a capacity of 10 heads each. There are a few privately owned plantations and mission projects with an estimated 90 head. In the future two forty ha projects, fenced and planted to improved pasture, are planned.

One project will be established, stocked and maintained each year for the next two years, and two farmers at a time will attend a basic animal husbandry training course.

FISHERIES

There is a great potential for fish in the province but the lack of adequate storage and ice facilities, and the long distances people would have to travel to sell their catches, and disputes over fishing grounds are problems.

It is intended to increase fish production by improving present facilities and to investigate further possibilities. Trials will be carried out on smoking fish for sale in the inland areas, as an alternative to freezing. Fisheries staff will attend courses at Kavieng Fishery College.

Fishing nets

PIGS

Two intensive piggeries at Manus and Papitalai provincial high schools have been very successful. It is further planned to conduct patrols to educate farmers on better pig husbandry methods, to hold four one-week pig management courses at Tamat for at least ten farmers at a time, and to recommend one field staff member for an advanced pig management course at Lae. Six additional piggeries on an intensive or semi-intensive system will be established in 1979. Production of pigs at Tamat Agricultural Station will be increased to ten breeders. In 1981 we shall look for a prospective pig farmer to establish a project near town to produce porkers for sale. In the same year a hundred weaners from Tamat will be distributed to new farmers.

RUBBER

There are three rubber factories established at Kari, Derimbat and Rossum. Farmers will be encouraged to increase rubber production from 0.1 tonnes in 1974/75 to 4 tonnes in 1978, by bringing each smallholder's block into production. Individual blocks will be increased by ½ ha each bringing provincial total hectarage to 120 ha. A marketing system for rubber will be organized in Manus and old processing plants will be replaced. It is planned to send 4 rubber farmers to practical rubber management training courses at Gavien and field staff members to Malaysia for advanced rubber management and technical training. Plantings will be increased, regular tapping encouraged, and tapping methods improved.

Manus Agricultural Agricultural Centre at Tamat. Assistant Simon Loh inspecting 10 month-old rubber trees

VEGETABLES

The idea is to get people to grow enough green and high protein vegetables for their own consumption. Any excess can be sold at the market for additional family income.

Suitable soils are limited in some areas and there are transportation problems for people wishing to sell their produce.

In 1977/78 the main extension activity will be trials and demonstrations and introduction of suitable varieties. The market system for local production will be improved and the necessary stocks bought. In 1979 a nursery at Pelikawa Base Camp is planned.

COCOA

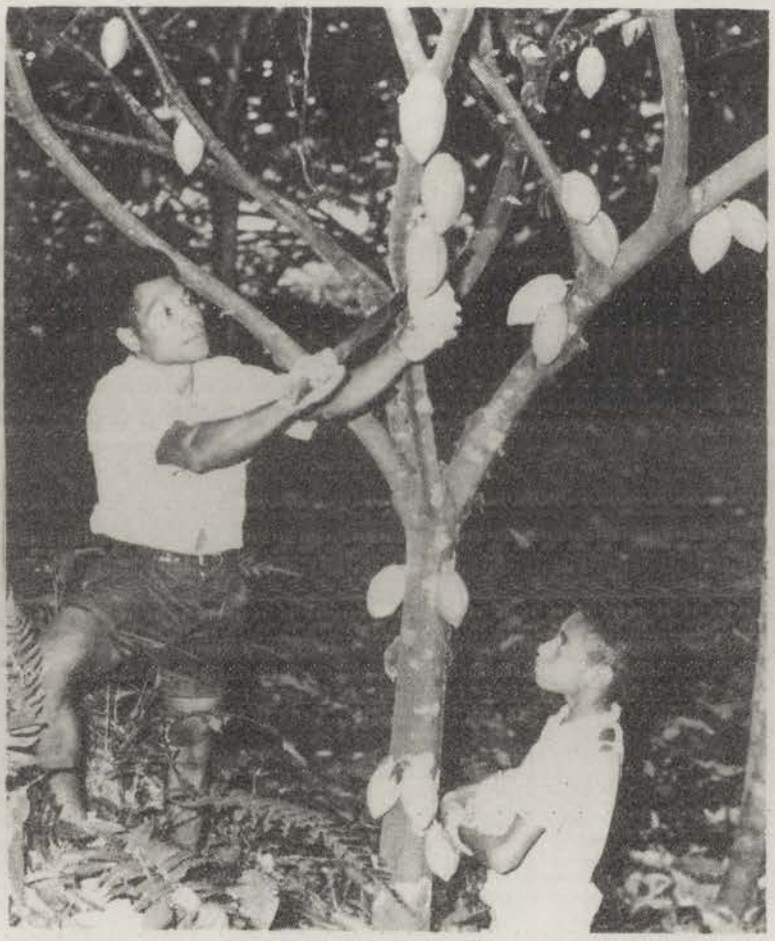
Transportation is a major problem in this area. In 1975/76 production was 3 tonnes. Fermentaries will be completed in 1977/78, and farmers will be encouraged to pick more pods and maintain their existing gardens. Plantings will be increased and two field staff members sent to Keravat Lowlands Agricultural Experimental Station

for a course on cocoa technology. Cocoa extension patrols in all areas will be conducted to educate farmers on pruning, harvesting/ processing and explain price fluctuation. Fertilizer trials will be conducted, an officer to work on cocoa inspection appointed, and negotiations conducted to establish a buyers' agency in Lorengau.

COCONUT

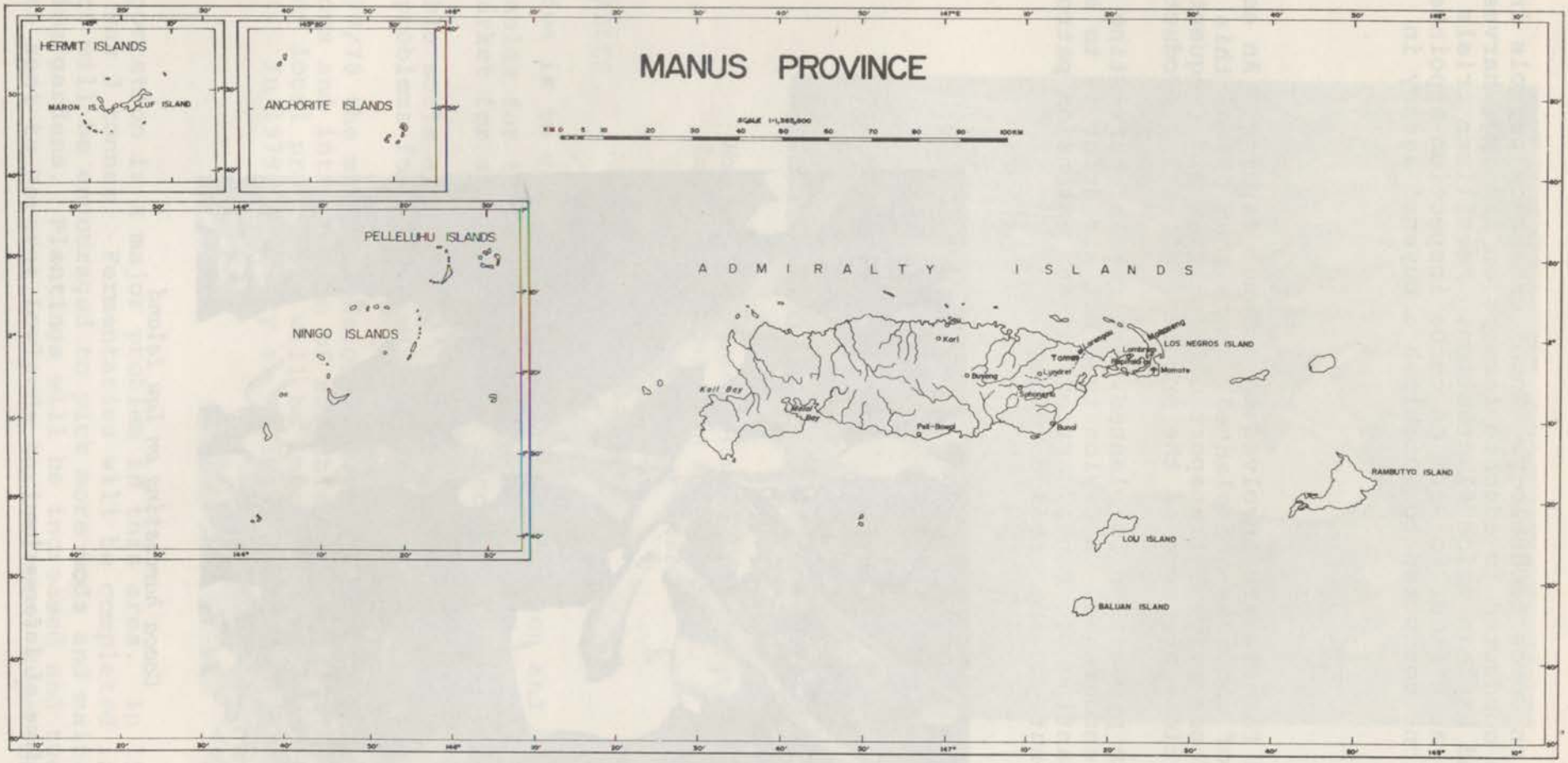
Eight hundred farmers are involved in coconut farming. An estimated 2 900 ha of coconuts are planted. More than 50% of this is producing. Copra prices, transport difficulties and frequent bad weather conditions are some of the problems affecting production.

An increase in production is planned, and regular harvesting of nuts will be encouraged. A Ceylon type hot air drier is to be built, a replanting programme carried out and extension patrols into all coconut growing areas conducted.



Cocoa harvesting on Lou Island

Photographs: Office of Information


MANUS PROVINCE
HERMIT ISLANDS
MARON IS.
LUF ISLAND
ANCHORITE ISLANDS
PELLELUHU ISLANDS
NINIGO ISLANDS
ADMIRALTY ISLANDS
Kari
Tong
Lyndrei
Bundi
Pak-Bowal
Momote
LOS NEGROS ISLAND
RAMBUTYO ISLAND
LOU ISLAND
BALUAN ISLAND

THE CLAM GARDENS OF MANUS

By J.L. Maclean

On two small islands off the north coast of Manus Island, Ponam and Pityilu, the villagers have an interesting method of storing their favourite seafood, the giant clam.

When a man has gathered from the reefs more clams than he needs for immediate use as food, the extra clams are put back into the sea, and kept in a convenient place until they are needed.

Often the area set aside for the clams is surrounded by a banis, a fence consisting of a ring of stones; this area then becomes an underwater garden.

Like plants, clams cannot move, and require little attention after they are put into the garden. Clams of all sizes are gathered for storage and they are often left for months and sometimes for more than a year.

They grow very slowly, so storing them is only a matter of convenience. People do not collect them when small, preferring to let them grow bigger before eating them.

Most living things grow rapidly at first but slow down as they get older. Clams grow in the same way, and giant clams 60 cm long grow only about 5 cm a year.

Pityilu islanders beside a banis. This banis is used for rubbish - but a similar design is used underwater for clam gardens.

Some scientists believe that giant clams may live for several hundred years. They never stop growing completely but their rate of growth is very slow in later life.

The method of reproduction of clams is the same as for other shellfish. Sperms and eggs are produced and are passed into the surrounding water. It is just a matter of chance whether an egg will come into contact with a sperm and be fertilized.

There are six species of clams in the world. All of them are found in Papua New Guinea waters. The largest species grows to 135 cm in length, and a pair of shells of this species would weigh over 230 kg.

The Manus clam gardens gardens are one of the simplest forms of aquaculture known. Aquaculture is the farming of animals that live in water. These islanders then are in some respects farmers of the sea.

A fascinating aspect of the clam gardens is the fact that the clams themselves are also farmers! Giant clams have two methods of obtaining food.

They can extract tiny organisms, called plankton, suspended in the sea-water, which they strain through an opening on one side of the clam and after the plankton has been filtered by the gills, the water passes out through the hole in the middle of the exposed colourful flesh.

A diver inspects a heap of empty shells next to his clam garden at Ponam Island

That beautifully coloured flesh (or mantle) displayed by an open clam contains a garden consisting of millions of tiny one-celled plants or algae, invisible to the naked eye. These organisms are literally farmed by the clam to produce extra food to meet its enormous appetite.

The clam's mantle provides a favourable "bed" in which these microscopic plants use sunlight to manufacture their food, just as land plants do. Special cells in the clam then digest the algae.

The farming of clams has been a traditional practice for many generations, and the present-day islanders do not know when their ancestors started doing it. It is a convenient way of storing food and will no doubt continue for many more generations.

Recently, however, the collecting of clams has assumed a new function. One islander wryly declared that he was gathering clams and putting them into his clam garden to prevent Taiwanese fishermen from taking them.

An underwater photograph of a clam garden among weeds on the inner side of Ponam Island. Note the hole in the centre of the clam mantle through which water passes out after food organisms have been extracted from it.

Taiwanese fishing boats have been known to make illegal voyages into Papua New Guinea waters especially to gather clam meat, which is highly prized by the Taiwanese people.

Giant clams are also farmed in other outer New Guinea islands and also in the Gilbert Islands in the South Pacific.

In Papua New Guinea the chief use of clams is for food. One giant clam provides a good meal for a big family. The meat (muscle) of a clam 71 cm long weighs about 7 kg.

In some other Pacific Islands, such as the Carolines, various tools are made from the shells. They have been used as money in the Solomon Islands.

Occasionally "pearls" are found inside clams. The largest one discovered weighed 6 kg. However, clam pearls have no lustre and are of little value.

Many stories have been told of divers who have drowned when they were caught between the shells of a giant clam. Actually very few deaths have occurred, because clams close their shells slowly, so that there is time to remove an arm or foot from between them. Nevertheless if a diver were intent on some other object, he might not notice the closing clam until too late.

If you know of anyone being trapped by a giant clam the staff at the Department of Primary Industry Fisheries Research Station, Kanudi, near Port Moresby, would be interested to hear about it.

Mr. Maclean was formerly a fisheries biologist at Kanudi Fisheries Research Station. He is now with the Fisheries Division of the Department of Primary Industry, Canberra, Australia. This article was first published in the Papua New Guinea *Post Courier* in May, 1975.

A crowded clam garden at Pityilu Island containing a variety of clam species.

SRI LANKA — A LABORATORY

In Sri Lanka for the past 2000 years farmers have worked the land to provide food for their families, sometimes even enough to store away for the bad year.

But times have changed. In the past 100 years most of the best land has gone to cash crop plantations producing valuable exports such as tea, rubber and coconut. Sri Lanka's population has grown too and so the land can no longer provide enough food to meet the people's needs.

One of the things that is being done to help feed the people in Sri Lanka is a research programme called "cropping systems research" or "multi-cropping". The agricultural scientists work alongside the farmers in the fields. The farmer becomes a partner in the research, he supplies the land and most of the labour, and he can say whether he feels an idea will be of no use to him, and make his own suggestions. Systems that work only in the laboratory are of no use to the farmer. The emphasis is on crops and the goal is to make the most of the farmer's total resources — land, animals, water and people. Sometimes this involves growing additional crops, either together or in sequence, sometimes increasing the yield of existing crops.

This approach has a practical value, and also has an important psychological effect on the farmer. Sri Lanka has a "wet zone" in the south where 6350 mm fall, and a "dry zone" in the north, which receives only 635 mm. The dry zone farmer has come to be seen as a "poor miserable human being living in misery". He therefore felt that he should get away from the land to be socially accepted. As Mr Medajama, an extension officer with the Ministry of Agriculture, says "The technology we preach and want them to adopt should be developed from within the resources available ... with what resources the farmer is capable of acquiring and using". So the researchers work alongside the farmers, who regain their self-respect and are encouraged to try new methods. An example of a new method is the dry planting of rice before the monsoon, instead of waiting until the rains have filled the ancient irrigation tanks to overflowing.

These tanks are the remnants of a remarkable irrigation system that once kept the northern part (dry zone) green and prosperous. Years of war and successive colonial administrations led to neglect and today many of the tanks need repair. By speeding up the paddy cultivation, and making better use of the rains, the water that collects in the tanks can be used for a 2nd, perhaps even a 3rd crop.

Careful records are kept of all the participating farmers' activities, and the researchers can then compare these results

with those of a number of farmers in the same area using the age old traditional methods.

On the research stations the scientists can experiment with different varieties and various combinations of crops to follow the rice harvest, such as chillies with soybean, black gram or groundnuts. Plant breeders, agronomists, physiologists, climatologists, soil scientists combine their efforts to form a complete team approach.

One of the factors that make Sri Lanka a good place to adopt a team approach, is that is a "living laboratory" from the scientists' point of view. Sri Lanka has uniquely varied soil and climate conditions. Scientists have classified the world's soils into 10 major types; nine of these occur in Sri Lanka. The rainfall varies greatly between the north and the south. Unlike most Asian countries, Sri Lanka experiences not one but two monsoons, the "Maha" from October to January, and the "Yala" from March to May. Finally, there is the land itself, with coastal plains at sea level contrasting with mountains that peak at 2 438 m. The wide variety of conditions found in Sri Lanka means that the results of the research may be applicable in other countries.

Shifting cultivation in Sri Lanka has been practised for thousands of years. It is called there "chena". Population pressures are making "chena" impractical. If there are too many people the fallow period becomes shorter. Under this traditional system mung bean, cowpea, black gram and sorghum are the common crops. A food grain improvement project aims at developing varieties of these crops that can be rotated with a rice crop. In these ways scientists and farmers work together in Sri Lanka to reduce the amount of food that must be imported and so improve the standard of living for everyone.

Adapted from an article by Bob Stanley in The IDRC Reports 2, 7 June 1978.

ENGA PROVINCE

By Gwaibo Banaga,

Formerly Provincial Rural Development Officer
in Enga Province.

Gwaibo was born in Kemaea near Kwikila in the National Captial District. He attended primary school at Daumagini, then he went to Kwikila High School.

Gwaibo then went to Vudal Agricultural College and graduated in 1969. His first posting was to Cape Rodney on Ramu Settlement Scheme. He was then appointed PRDO for the Gulf Province in 1972 until 1973 when he requested a field job to get more field experience. He was posted to Abau District as the DRDO in 1974 to June 1975. Gwaibo was appointed PRDO for the Enga Province after that.

Gwaibo has been to Queensland, Australia, to do an Agricultural Extension Course. Other courses he did are, Piggery Course, Rubber Technology, Middle Management, Rural Development, Local Officers' Executive Course, Supervisory Course and various extension courses.

Gwaibo is married with three children, namely Vereto, Banaga, Vagi, plus one adopted one, Meabo. His wife Vickana stays at home and looks after the children.

PROVINCE DESCRIPTION

The rainfall averages 2 500 mm per year. From June to September it averages 100 to 150 mm per month, from October to May 225 mm per month, and from December to March up to 300 mm per month.

October to May is the wet season, and June to September the dry season.

The cloud cover is generally complete during early morning and late afternoon in the wet season. Morning fog is common. Sunshine is 4 to 6 hours in the wet and 7 to 9 hours in the dry.

Light frosts are common from July to September, above 2 450 m above sea level. Severe frosts in 1971 and 1972 destroyed subsistence gardens, and feeding of 60 000 people for 4 months was required.

The mountains rise from 600 m to 3 250 m above sea level.

The soils are shallow red or brown clay loam on the hillsides, with low fertility and deep black loams on the valley floors, with good fertility. There are some peat swampy soils.

The major rivers are the Lagaip and the Wabag Lai. The lesser rivers are the Marient Wage and the Kandep Lai, the Wale and the Tarua and Maramuni. All systems drain into the Sepik, Fly and Purari Rivers.

Swamps are extensive in the Lai and Marient basin, at Kandep, and the headwaters of the Lai around Sirunki.

There are some large areas of grassland at high altitudes. In other places there are dense rainforests with good milling timber, and grassland in rotation with subsistence use.

There is road access to all areas except the Maramuni and Wale Tarua areas. Maintenance of roads is a problem. The Mount Hagen to Wapenamanda and Wabag to Laiagam roads are being upgraded as an extension to the Highlands Highway.

There are seven airstrips - Category B type at Wapenamanda and Wale and Catergory C type at Laiagam, Progera, Kandep, Kompiam and Category D type at Maramuni. A new strip is under construction at Kaman. Three mission strips are located at Paiela, Lapolama and Yangis.

PEOPLE

The population is 174 000. There are 35 000-40 000 male taxpayers, mainly farmers. Population distribution in the districts are - 37% in Wabag district which covers 31% area of the province, 20% in Wapenamanda district which covers 9% of the province and 43% in Lagaip district which covers 60% of the province.

There is one main language group, Enga, and some dialectal distribution in the south-west tied in with Huli and Enga.

Malnutrition in children is common; protein levels in the diet are low. Food action groups and committees have been set up.

There are three high schools - Wapenamanda Lutheran Mission (up to Form IV), Wakumare (Wabag) Provincial High School (up to Form IV), and Laiagam (up to Form III). There are two Vocational Schools. There are 45 primary schools with a total enrolment of 8 800 students, 25% of which are girls.

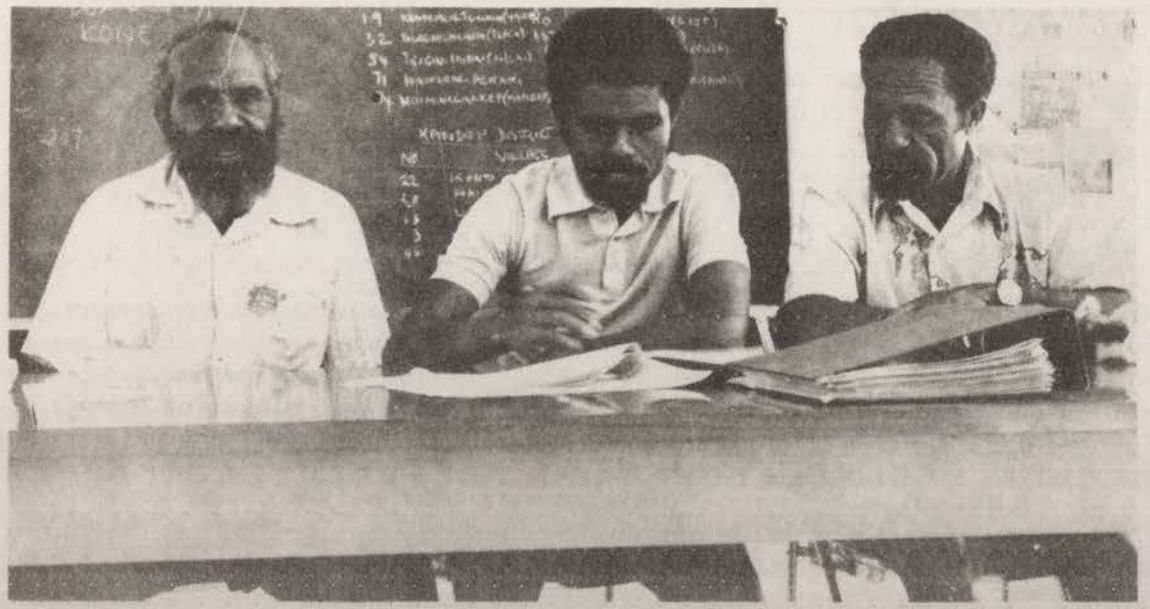
There is excellent co-operation between the schools and the Department of Primary Industry, with increased agriculture in schools. Wabag High school has a piggery, fish, poultry, vegetables and will soon be self-sufficient in food for boarders.

There are three main denominations, namely, Catholic, Lutheran, and SDA.* There are smaller ones - Baptist in Kompiam and Apostolic in Laiagam. The Catholic mission has a weaving centre, they buy wool from Yogos and Pompabus Vocational centre. The Lutheran mission has about 12 ha of coffee, grazes cattle, runs a piggery and a poultry project. SDA mission is involved in vegetable production. All missions co-operate satisfactorily, have lots of influence on the people, and are playing a major role in rural development.

*Seventh Day Adventist

The Yangpela Didiman organization is operating in Wapenamanda, and is particularly successful with standard 6 school leavers.

Communally owned projects are common, with vegetables and pigs the exception. Self-help groups include: Samu Pty Ltd, a newly formed potato company with good prospects; Aburin Business Group; a pyrethrum-producing company; and Sau Co-operative, which has coffee plantings and trade stores.



Gwaibo Banaga, former PRDO Enga province, in centre, with Kepa Pupi on left and Don Kapi on right.

ECONOMY

The main cash crops of the province are arabica coffee (about Kl.7 m), potatoes (about K53 000), and pyrethrum (about K80 000) in 1975/76.

Cattle is a growing industry, and sheep have recently been introduced. There are some commercial pig projects.

There are no plantations in the province.

Other industries include gold-mining at Porgera, timber-milling at Meriamanda, coffee factories at Wapenamanda and Wabag; and workshops at Wabag.

There are 20 land settlements blocks, growing mainly potatoes.

AGRICULTURAL DEVELOPMENT PROGRAMME

PROJECT MANAGEMENT

The Department of Primary Industry Headquarters is at Wabag with Extension centres at Wabag, Laiagam, Porgera, Wapenamanda and Kandep. Base camps are at Pumas, Serwiki, Maramuni, Pausa, Andatali, Yogos and Tsals.

In 1977-78 training courses will be held on cattle and buffalo. In 1979 a cardamom training programme will be initiated. In 1980 a Rural Development Officer will be trained to specialize in orchids.

By 1981 there should be enough officers and farmers to start pilot projects in cardamoms and buffaloes. Three buffalo ploughs will be made.

COFFEE

There are about 2 500 ha which produce 1 522 tonnes green beans.

New plantings are at Wabag 25 ha, Lagaip 25 ha and Wapenamanda 4 ha. The Wapenamanda programme has been hindered by pig damage and tribal fights (25 ha was destroyed in the Tsak). Growers are still reluctant to prune bearing (and income producing) bush.

In 1977-78 new plantings will include Wabag/Kompiam 20 ha, Laiagam 50 ha and Wapenamanda 7 ha. There will be 80 new nurseries established at Wabag and 50 at Laiagam (Paiela). These nurseries will mainly be on family unit basis. About 20 kg of Aiyura seed will be obtained for Wabag, 50 kg for Laiagam, and 10 kg for Wapenamanda. Growers will be encouraged to increase production by about 10% - from 1 500 tonnes to 1 700 tonnes green bean. Field officers will increase patrolling and intensify the campaign on pruning and quality control. A further 250 ha should be coming into production late 1978.

In 1979 it is hoped that plantings will have increased to 2 600 ha. Quality control will be intensified. Production in the Paiela area will increase.

In 1980, 2 500 ha will be in production giving over 3 000 tonnes. The Maramuni area should commence production.

In 1981 Department of Primary Industry involvement should decrease as growers become more self-sufficient and assistance and materials are supplied by Councils. A replanting programme of senile coffee will commence.

CATTLE

There are 288 projects with 1 412 head. Missions have 8 holdings with a total of 313 head. Department of Primary Industry owns 5 bulls. There is great potential in the Lagaip and Wapenamanda districts. In other areas land pressures, social obligations and tribal fighting affect the industry. Land development schemes have been proposed, but no definite plans have yet been made.

The Lai development is slower than expected. The site for the Kandep slaughter slab has been prepared. The yard, fence and pasture improvement programme was carried out. Tuberculosis and brucellosis testing was commenced. The Papua New Guinea Development Bank loans have decreased as people have ample money from coffee sales.

In 1978-79 outstanding cattle accounts will be cleared and the remainder of the 618 head of cattle will be delivered to projects. T.B. (tuberculosis) and C.A. (contagious abortion) testing will be completed at Wapenamanda, Laiagam and Kompiam. The Kandep Local Government Council will be pressured to complete their slaughter floor by December 1978.

In 1979 the Lai Lands projects will be further developed and with the present rate of progress continuing cattle population should reach 3 000 head.

In 1980 the Lai Lands project will be stocked with 500 head. Some of the smaller project owners could convert to sheep and others take up buffalo farming. Tuberculosis and contagious abortion testing will be recommended. A slaughter floor at Wabag will be built.

In 1981 cattle members should stabilize out at 3 000 head on smallholder projects and 1 000 head on the Lai Lands Scheme. A slaughter scale will be constructed at Laiagam and Wapenamanda. The possibility of establishing a central provincial abattoir at Sernuke will be investigated.

PYRETHRUM

Production has dropped to 210 tonnes and is continuing to fall. About 230 ha were replanted giving a total area of 500 ha. Price has averaged 37.5t/kg - the people are not satisfied with this return and many are turning to market gardening instead. A scheme at Pumus involving the Aburin business group has commenced.

In 1977-78 replanting will include 12 ha at Kandep, 100 ha at Wabag/Kompiam, 200 ha at Laiagam and 44 ha at Wapenamanda. About 50 ha of the new polycross variety will be planted in the Ambun Valley and 110 ha at Laiagam. A new buying point will be set up at Petendals (Kandep). People will be encouraged to replant on kaukau mounds.

In 1979 if the planting programme and the Pumus scheme are successful, production should reach 270 tonnes from about 600 ha. With the higher pyrethrum content there is a possibility of a price rise.

In 1980 the main emphasis will be on replacing old plantings with the new polycross material.

The possibility of draining and using the Sirunki swamp area will be investigated in 1981 - this could be subdivided and used for pyrethrum. Production could reach 300 tonnes.

CHILLIES

Production for 1975 was 3 tonnes. About 200 growers are involved. Still a comparatively new introduction, expansion is mainly in the lower altitude areas of Maramuni and Kompiam.
The crop is not very popular in Wabag and Wapenamanda due to high prices of coffee and vegetables. Plantings were not done at Pausa, Paweri and Awalibus - coffee was planted instead. The crop is encouraged in schools, by SDA people and in remote areas. Wet weather affects both production and transport of produce. People are becoming more accustomed to handling the crop and picking is done regularly. Coffee growers are being encouraged to plant chillies as a cash crop to provide income while coffee is still immature. Prices range from 42t/kg to 52t/kg.

In 1977-78 ten ha will be planted at Maramuni and 3 ha at Kompiam.

In 1979 trial plantings at Paiela will begin. Isolated areas such as Maramuni will have the most expansion. If prices remain high production should rise to 12 to 15 tonnes.

By 1980, about 15 ha throughout the province should be in full production and the Maramuni area should continue to expand.

In 1981, if the Paiela plantings are a success the people will be encouraged to expand. The replanting of 1978 gardens should commence.

POTATOES

Production in 1975 was about 600 tonnes worth about K53 000. The Samu Company at Laiagam bought about 570 tonnes from the Kandep area. Production has declined as individuals seem less interested. A Papua New Guinea Development Bank project was completed at Laiagam. A local business group at Pumas has mechanical cultivation in conjunction with pyrethrum planting. There is evidence of disease build-up - in particular bacterial wilt and early blight. A Department of Primary Industry field officer has been seconded to the Samu Company full time.

In 1977-78 potato trials will be set up at Kandep, Vogos and Wabag. A Papua New Guinea Development Bank supported project will be commended at Kandep. Twenty-five ha of land will be mechanically cultivated for potatoes at Laiagam. The Department of Business Development will investigate a possible potato powder or chip industry. About 20 tonnes of certified seed will be imported from Kuk at Mount Hagen. Seminars and an education programme will be commenced to sponsor quality control, avoidance of too early harvesting and shallow planting. Investigation will be done into the disease problem and crop sanitation encouraged.

By 1979 the certified seed gardens at Kuk should be ready to harvest. After the 2nd multiplication is completed adequate certified Sequoia seed should be available. The local Samu Company should be the sole provincial distributor.

In 1980 certified seed gardens will have been established at Kirunki, Kandep, Wabag and Wapenamanda. These should provide all province requirements. More people will be encouraged to obtain Papua New Guinea Development loans to buy fertilizer.

In 1981 with sufficient grower enthusiasm and freedom from pests and disease, production could reach 2 000 tonnes. All present varieties should have been replaced by Sequoia.

Planting sweet potato in the traditional way at Wapenamanda.

VEGETABLES

Production is estimated at 500 tonnes produced by 6 500 growers from about 80 ha. Seasonal variation and traditional customs affect continuity of production. Land pressure also restricts expansion.

Tribal fighting in the major producing area (Tsak) also inhibited development. A field day at Wapenamanda High School conducted by Kuk staff was well attended by officers and farmers. Development Bank loans were processed in the Wabag area.

In 1977-78 further efforts will be made to process 3 Bank loans at Wapenamanda. A major education programme will be initiated - starting with a vegetable seminar, by excursions and with the assistance of Hagen Agricultural College. Eight Community Schools will have small vegetable projects in the Wapenamanda and Wabag areas. Growers will be discouraged from producing large quantities of cabbage. A green house will be built in the Tsak to produce 1 000 vegetable seedlings a week. A hand-operated rotary hoe was purchased for demonstration purposes.

In 1979 the education programme combined with field days will be intensified and will be aimed at field staff and farmers. Full-time vegetable extension officers will be appointed to all centres. Growers will be encouraged to produce at a rate of 1 000 tonnes per annum.

In 1980 and 1981 - Department of Primary Industry's involvement in the programme will have increased by 30%. By making this a high priority activity and maintaining an intensive education campaign it is hoped to reach 2 000 tonnes of green vegetables, by the end of 1981.

FISH

A further 50-60 000 trout fingerlings have been released in Enga rivers. Legislation to prevent fishing out of rivers is not now required as most fish have survived the danger period and more than enough fish are spawning. No rivers have been fished out. A full-time fisheries officer was not obtained as planned. There were difficulties in obtaining Mendi fingerlings at the right time and transporting them to rivers. The fish population in most rivers is very high and they are breeding prolifically, particularly in Kandep and the Lagaip headwaters. Both lakes Rau and Sirunki are stocked with trout and carp.

In 1977-78 a fisheries biologist will report on the feasibility of establishing a breeding pond at Wabag. Further efforts will be made to recruit a fisheries officer. A watch will be kept on the possibility of overfishing rivers and streams. People will be encouraged to feed fish to young children. Rivers at Paiala and Maramuni will be stocked, also at Kompiam and Wapenamanda.

In 1979 if the feasibility study is favourable then the fish pond at Wabag should be completed. All equipment will be funded by the Area Authority.

By 1980 the province should be self-sufficient - by providing fingerlings if needed and through good spawning in the rivers. If there is a surplus of fish, processing for fish meal could be introduced as well as smoking by 1981.

CARDAMOMS

Cardamom is a new crop and is still at the trial stage. There are 8 plots at Kompiam planted from 200 splits. It grows well and produces satisfactorily - we still do not know how it rates on world markets. The results will have to be good to compete with coffee and chillies.

In 1977-78 about a kg of dried capsules will be sent to Cardamom Traders, Lae. If funds are available an officer will be sent overseas to study the crop.

From 1979-81 the crop will be expanded at Kompiam and introduced to such areas as Maramuni and other isolated locations. The future depends on market reports.

POULTRY

Very little expansion has taken place due to the high level of management needed and the cost of feed. Most areas are too cold for successful chicken raising without introducing sophisticated techniques. There are problems in maintaining a constant supply of day-old chicks from the coast. WASO at Wapenamanda have a commercial unit supplying eggs. The Taluma Vocational Centre at Laiagam and the Wakumare High School have a small successful chick project. A poultry nutritionist sponsored by the Lutheran Mission is researching locally-produced feed. The Sau co-operative at Kompiam and Wapenamanda Council have poultry feed.

In 1977-78 assistance will be given to the Wakumare High School to enlarge its chicks project to be the breeding centre for the province. Close liaison will be maintained with the poultry advisor at Hagen and the Lutheran Mission nutritionist. The local more hardy type of bird will be checked on to see if they should be promoted, rather than introduced varieties. The brooders at Wabag and Wapenamanda will be improved. The Laiagam vocational centre will be encouraged to enlarge its chick project.

In 1979 if research work is successful Councils will be asked to take over brooders and supply of chickens. More emphasis will be placed on duck projects.

In 1980 and 1981, provided feeding and breeding problems are overcome, management training will be given to interested farmers. The province will never be self-sufficient in poultry meat unless these problems are overcome.

PIGS

There are 13 semi-intensive commercial projects with about 60 head. These are at Wakumare high school, Pompabus and Makulamanda (WASO). There are about 200 other small projects. Wakumare high school will continue with their breeding and distribution programme (25 to 30 head a year). Traditionally pigs are the people's wealth. Pig exchange (Moka Moka) which started in 1971 is still continuing. There is no Moka or commercial Piggeries at Laiagam. Most projects at higher altitudes free range on an excellent pasture of kikuyu-white clover mix.

In 1977-78 at least one pure-bred boar will be obtained for Wakumare High School. Other boars will be distributed to upgrade local stock. Seminars, excursions, field days and research will be carried out with the assistance of the pig adviser at Hagen.

In 1979 more boars will be obtained for distribution. Vocational school and Province-owned boars will be made available for mating with local pigs. More management training will be given to farmers.

By 1981 the vocational and high schools should have ample pigs for distribution. Perambulating and introduced boars should have had considerable effect on improving the local variety.

WASO Ltd is a national-owned company. It started in 1964 and deals in coffee, vegetables and other agricultural products. It also has a workshop and sells vehicles and is an airline agent.

SHEEP AND BUFFALO

There are 365 sheep in the province. The Department of Primary Industry station at Yogos has 36 ha fenced holding 103 head. The Local Government Council has 52 head, the Catholic Mission at Pompabus has 100 (Border Leicester cross in very good condition) and the Wabag vocational school has 100. Production was 244 kg at 50t/kg. A total of 25 wethers were sold for K35 each in 1975; the price will be increased to K40. The overall aim is to use sheep for meat and coarse wool production in areas of land shortage which is not suited to beef cattle. The research is being supported by New Zealand aid. In 1975 all fences and gates were completed on the government station. A paddock was prepared in the Tsak valley. Pasture improvement was carried out. One officer was sent to New Zealand for training. Dogs and worms are both being kept under control. The industry is still in the research stage therefore no village projects have been set up.

There are no buffalo in the province but an area at Kandep has been fenced in preparation.

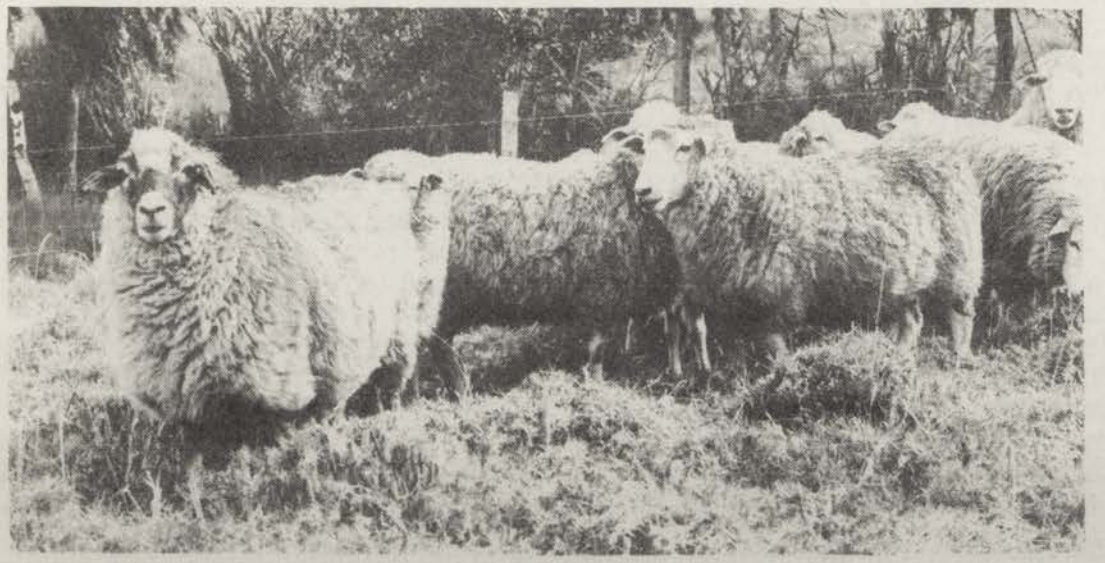
Urai Polona with sheep at Yogos.

During 1977-78 about 5 ha of Kenya white clover will be established for seed production. If approval is received then five pilot sheep projects will be set up - Wapenamanda 3, and Kandep and Laiagam one each.

Three or four buffalo will be introduced to Kandep to assist in cultivation of vegetable projects. A special plough will be made.

Development of the sheep programme depends on present research. If it is to go ahead then sheep numbers could have increased by 60% in 1980.

As buffaloes are accepted they will be distributed as village draught animals working mainly on production of vegetables.



Sheep in Enga Province.

ORCHIDS AND BEES

This is a new project and an officer to work full time on orchids has been posted to Laiagam. His duties include the preservation and collection of orchids from Paiala, Chimbu and Mendi. A high-altitude orchid station is at present being established at Laiagam, which will serve all Papua New Guinea with the purpose of conservation, botanical studies and tourism. So far ten collections of orchids valued at K4 000 have been made and sent via the University of Papua New Guinea for overseas export.

Bees are still very much in the research stage. There are 12 hives at Laiagam. The Area Authority has shown an interest in supporting this industry.

In 1977-78, an orchid house and botanic garden will be commenced at Laiagam. A field officer will be trained in general orchid husbandry. People will be encouraged to collect orchids in the low income areas such as Paiala and lower Lagaip. Orchid production will be increased to meet the overseas market.

Four bee hives will be established at Wabag on a trial basis.

In 1979 the Laiagam botanic garden and orchid house will be opened to tourists. An agricultural graduate majoring in Botany will be posted to Laiagam.

If bee trials are a success expansion will commence.

In 1980 the graduate at Laiagam and another Specialist will take charge of all orchid and bee work in the Province. It is expected that both industries will be well established by 1981.

SUBSISTENCE NUTRITION

Malnutrition is partly or wholly the cause of 60% of deaths in children 0 to 5 years old. Both government officers and village people are to varying degrees unaware that malnutrition is a real problem. Ignorance, beliefs and social and cultural factors hinder the awareness and consequently the education of village leaders and Local Government Councillors - this makes field staff working on the project reluctant to approach those people.
WASO is conducting wing bean trials to find a variety suitable to high altitudes. The Public Health Department has a full time provincial nutrition specialist who works mainly at the clinics. A nutrition committee including representatives from Department of Primary Industry, Public Health Department and Missions meet frequently - their main aim is to create awareness of the problem. Most schools have a special programme which covers propaganda and maintains nutrition gardens. Department of Primary Industry has an officer full-time on nutrition at Wapenamanda where variety trials are conducted in wing bean and soya bean.

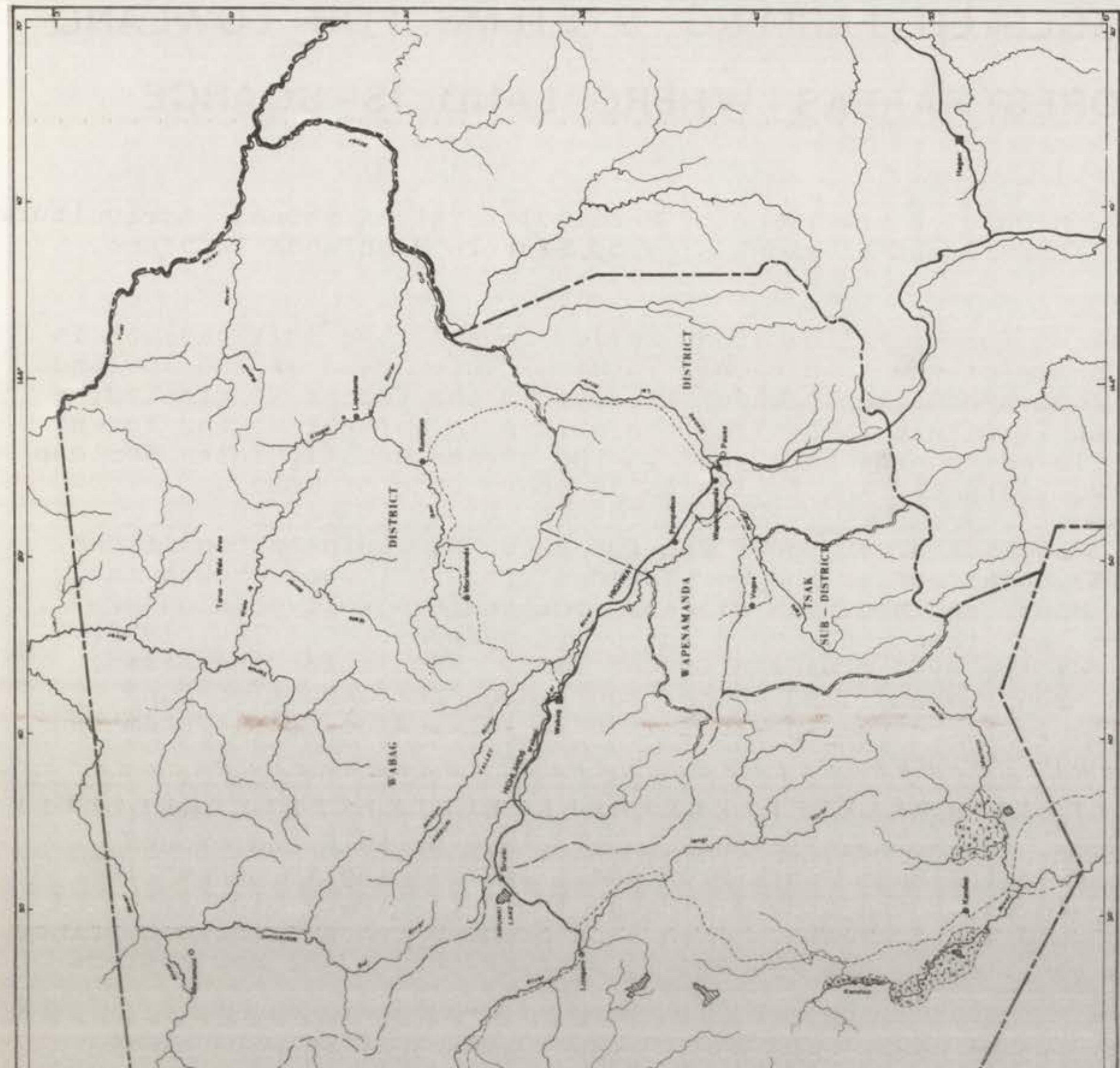
In 1977-78, Department of Primary Industry will introduce wing beans to the Paiala and other remote areas. A follow-up will be made on the idea of palm oil being mixed with kaukau especially for children, (high energy intake). More emphasis will be given to positive action from nutrition committee meetings. Present nutrition plots will be maintained and developed. People will be encouraged to regularly harvest and store high nutrition pandanas. More salted tilapia fish will be brought in from the Sepik.

For the period 1979-81 the programme will be intensified - Department of Primary Industry involvement will be increased by 50%.

SPECIAL PROJECTS

Mechanised Pyrethrum and allied projects.

Following the FAO/UNDP recommendations broadacre mechanically cultivate schemes growing both pyrethrum and vegetables as a means to developing large areas of the Highlands are being carried out. Department of Primary Industry commenced development through the Aburin Business Group at Laiagam, by cultivating some 300 ha at Sirunki and Pumas with possible later expansion to Lake Rau and Tsiasbai near Mount Hagen. This programme, apart from opening up large areas of unused land, and increasing potato production and pyrethrum exports, would ensure the more efficient operation of the Kagamuga Natural Products factory at Mount Hagen by bringing the present annual pyrethrum figure of 260 tonnes to 600 tonnes by 1979, thus helping to avoid the closure of this factory.


ENGA PROVINCE
WABAG DISTRICT
WAPENAMANDA DISTRICT
TSAK SUB - DISTRICT
LAGAIP DISTRICT
Kilometres
Provincial Boundaries
District Boundaries
Provincial Headquarters
Towns & Villages
Base Camps
Lakes
Swamp
Minor Roads
Sub District Boundaries
Wabag
Hagen

SUGGESTED FARMING SYSTEMS FOR LOWLAND FOREST AREAS WHERE LAND IS SCARCE

By R. Michael Bourke, Senior Horticulturist, Highlands Agricultural Experiment Station, Aiyura, Eastern Highlands Province.

The long forest fallow (bush fallow or shifting cultivation) is the basis of the traditional farming system used in the lowlands for food production. Under the system the forest is cleared, a garden is planted and after the garden is harvested, the forest is allowed to grow back again. The garden usually lasts for one or two years and the fallow is 10 years long or more.

The system is a very good one for Papua New Guinean conditions. Yields obtained for the work needed are high; weed growth is kept down; and pest and disease problems and soil erosion are often less than under more intensive systems. (Charles, 1976). However the system uses a lot of land. Population increases, cash cropping and land alienation reduce the amount of land available for gardening. If land is too scarce, the system can no longer be used.

This is now happening in some places, such as on some small islands, on the Gazelle Peninsula of New Britain and around Maprik in the East Sepik Province. It is going to happen in more places in the future because there is a very high rate of population increase. When land becomes too scarce to continue with the traditional system, it must be changed or new systems found.

This article makes some suggestions as to what changes can be made or new systems used. These ideas are for village farmers who are mainly producing for subsistence rather than for cash sales. Another article has been written for institutional farmers such as schools ("Growing Food at institutions in the lowlands," Bourke), and some of the ideas in that article should be useful for farmers growing a lot of food for sale and who are using machinery for cultivation. D.P.I. has been concerned with alternatives to the long forest fallow system since before the war. The ideas in this article come from seeing what village people who are short of land are doing; the Department's experiments; and what is done in places overseas that have a similar climate and are short of land, such as Eastern Nigeria.

Alternatives to shifting cultivation for highland areas and dryer lowland grassland areas are easier to find than for lowland forest areas. Highlands and lowland grassland areas are not considered here, although most of the ideas discussed here can be used in these two situations, including some that do not work in lowland forest areas.

SUGGESTED MODIFICATIONS AND ALTERNATIVES

It was once believed that a single, simple, and practical

alternative could be found to the long forest fallow farming system. We now know that this is not so. Such alternatives as a short term legume fallow, or a rotation of grazed pastures, or inorganic fertilizers are not as efficient as the long forest fallow; or they are impractical for subsistence farmers. Most of the suggested modifications and alternatives are already used in areas where land shortages occur.

Mixed cropping and crop rotations are traditional practices often used by farmers. These two practices are often superior to monoculture and should be retained if possible as systems are changed. Some of the advantages of mixed cropping can be:

better weed control
higher yields
more stable yields
fewer pests and disease problems
less soil erosion

1. *Use of higher yielding varieties.*

One of the first changes that can be made when land is short is to use more of the high yielding varieties. These give more food for the work needed to grow them and for the same fallow period. High yielding varieties can come from research stations, but they can also come from the gardeners themselves. People are often aware that some varieties of their crops yield better than others, but they keep lower yielding ones for other reasons, such as good taste. The cost of using more of the high yielding varieties is the loss of varieties valued for other reasons.

In some areas where land pressure is high, people have made the change to high yielding varieties. For example, in the Wosera area near Maprik the high yielding "Asagwa" mami *(Dioscorea esculenta)* is the main food grown in the gardens (see Plate 1). On Petats Island off Buka where land is also short, the people grow a lot of one high yielding sweet potato variety.

Plate 1. Dioscorea esculenta c.v. Asagwa.

2. *Shorter fallow period.*

Fallows can often be shortened without damaging the system. For example, there will be little difference between one year of cropping and 15 years of fallow, and a system based on one year of cropping and 10 years of fallow.

As the length of the fallow period is reduced, the amount of work needed to grow a certain amount of food increases. This is because the soil fertility is not increased so much under a shorter fallow; and more weeds, insects and diseases will remain in the soil. Yields per crop are lower under shorter fallows, but actual food production will increase because there are more crops taken from the land (see Plate 2).

If the fallow is too short for the trees to grow and set seed, grasses will replace the forest as the fallow vegetation. When this happens, people have to work much harder to make gardens and yields are lower. This is the situation that we want to avoid. Research in Africa has shown that most of the improvement in soil fertility occurs in the first 5 years of a fallow, but this period will be different for different types of soil.

The gardening period can be extended instead of shortening the fallow period. As the gardening period becomes longer, it becomes more difficult for the forest to grow again, so it should not be extended beyond two or three years if the gardener wants a forest fallow to follow the garden.

Plate 2. Taro and bananas in the Markham Valley.

There are certain things that gardeners can do to help the forest grow quickly again. When the forest is cleared, all trees should be cut low down. This will help the stump to grow quickly again when the garden is finished. The other thing is that rubbish should not be burnt on stumps when the garden is cleared as this might kill the stumps.

3. *Planting at closer spacing.*

Generally use of closer spacing results in greater yield per garden, but lower yield per plant. Most gardeners seem to prefer a larger yield per plant, and therefore they plant at slightly wider spacings. However if they are short of land, wider spacing is not a good idea.

As well as reducing the average yield per plant, closer spacing has another disadvantage. This is that the crop is more likely to be damaged if there is a drought. Spacing should not be too close or yield per garden will be reduced. Closer spacing will increase the yields of most crops but it makes little difference to sweet potato yields. It will not make much difference where intercropping is used, such as Chinese taro ("taro kong kong") grown under bananas, but it has the greatest effect when most of a garden is taken up by one crop such as taro or yams.

4. *Growing food crops with plantation crops.*

Food crops can be planted with young plantation crops such as coconuts, cocoa, coffee, oil palm and rubber. They can also be planted with young forestry plantations of trees such as kamarere, teak and pine. This system needs much less work than growing food gardens and young plantation crops in separate areas. Sometimes it might reduce the growth of the plantation crops a little, but this is a small disadvantage compared with the advantages. On the Gazelle Peninsula, Tolai people have worked out a new system where food crops such as cooking bananas and Chinese taro provide shade for young cocoa and *Leucaena*. As the food crops die or are cut down, they are replaced by the *Leucaena* and cocoa and sometimes coconuts. The ground is always covered by one or more crops and this keeps the weeds out. (Bourke, 1976). In many areas of Papua New Guinea new coconut plantations are always planted in with a food garden (see Plate 3).

With most of the plantation crops, it is not possible to grow food crops under them when they are mature. However this is possible with coconuts. A wide range of crops can be grown under mature coconuts. Some of these are certain bananas, Chinese taro, cassava, pineapples and ginger. (Gallasch, 1976).

In Papua New Guinea cocoa and coffee are usually planted under shade trees, but in other places overseas these crops are successfully planted under bananas. Sometimes other crops such as beans are also planted under the bananas and coffee.

Plate 3. Coconuts in a kau-kau garden.

5. *Change of staples.*

Another thing gardeners can do when they are short of land is to change from lower yielding traditional crops such as taro and diploid bananas to higher yielding ones such as sweet potato, triploid bananas,Chinese taro and cassava (see Plate 4).

This is a big change to make because the traditional crops are part of people's lives and often have great spiritual significance. Such changes may also result in a drop in the quality of people's diets. Yams and taro for example are richer in protein than sweet potato, bananas and cassava.

Plate 4. A variety of high yielding staples; Chinese taro, triploid bananas, and cassava.

6. *Greater use of perennial crops.*

Perennial crops are ones that remain in an area for many years. They are usually trees. Yields of perennial crops are usually less per year than short term crops such as sweet potato and yams. Their big advantage is that they stay in the same area and keep producing food for many years. Fairly high yields can be had for a small amount of work. This is because perennial crops like bananas, fruit trees or plantation crops are more similar to the natural forest than annual crops and they protect the soil better. If a farmer tried to grow annual crops in the same land for many years without fallows, yields would become very low and weeds would be a big problem.

People who are short of land can grow more perennial crops. The main perennial food crop is triploid bananas. Villagers around Rabaul who are very short of land now grow triploid bananas on any land that is not planted to coconuts and cocoa. Other perennial food crops are breadfruit, coconuts and fruit and nut trees.

Some people who are really short of land might find it better to grow plantation crops such as cocoa or coconuts for sale and to buy their food from the markets or stores. The problem with doing this is the prices of the plantation crops go up and down a lot, so sometimes they will not receive much money. Also if their crop is badly damaged by a disease like cocoa dieback or an insect like coconut leafhopper, they could be left with nothing to sell and no food. I think it is always better for people to grow at least some of their food needs.

7. *Use of natural fertilizers.*

There are a number of natural fertilizers that can be used by gardeners to increase the soil fertility. These are ash from fires, kitchen scraps, other plant waste and animal manure. If a lot of these fertilizers are applied to the soil, gardeners can use a short fallow or even no fallow.

The problem with this system is that most farmers only have a little of these natural fertilizers. So they can only be used on a small area, such as the gardens around a house. Gardeners with cattle, buffaloes or goats that graze in other areas might have enough manure to fertilize larger gardens. This would be possible perhaps in the Wosera area where buffaloes could graze the large areas of infertile grass lands and their manure be used on the fertile alluvial soils that are used for gardening.

Farmers who are buying in food for animals, such as poultry or pig feed, may have enough manure to fertilize larger areas of their gardens (Quartermain, 1976).

OTHER CHANGES AND ALTERNATIVES

There are a number of other possible changes and alternatives to the long forest fallow system. It is considered that these are not suitable for subsistence gardeners in Papua New Guinea low-land forest areas, except in a few cases. These are discussed below:

1. *Use of inorganic fertilizers.*

Inorganic fertilizers such as urea have given large yield increases with food crops like sweet potato, bananas and taro in our experiments at Keravat. It has also been found that reasonably high yields can be maintained where food crops are fertilized in a rotation.

Because inorganic fertilizers have to be bought for cash, they are generally only useful where the garden produce is sold for cash. The only situation where they might be used by subsistence gardeners is where the gardener is very keen to keep a traditional food, such as taro, and is prepared to buy inorganic fertilizer using money obtained from other sources. Another problem is that the correct fertilizers are not available in many areas.

2. *Rotation of food gardens and planted legume fallows.*

In temperate climate countries, planted legume fallows are sometimes an important part of farming systems. However in other countries with hot humid climates, they have been shown to be no more effective than natural forest fallows in maintaining yields (Newton, 1960). There are also problems with establishment, maintenance and incorporation of residues into the soil because of the work needed (Bourke, 1974).

A planted tree fallow, such as pigeon pea, should be useful where mechanical cultivation is used and possibly also in grassland areas.

3. *Rotation of food gardens and grazed pastures.*

This system is also a part of farming systems in certain temperate climate countries and tropical highlands areas.

Such a system requires large areas of land, machinery for cultivation, and a lot of capital to buy livestock and fencing unless the animals are tied up. It is beyond the resources of most subsistence farmers, although it may be practical for large institutional farmers such as an agricultural college. Systems based on a rotation with grazed pastures have not yet been proved possible in the wet lowlands of other countries with a climate similar to that of Papua New Guinea.

4. *Irrigated rice.*

In Asia and elsewhere in the humid lowland tropics, the farming systems are based on irrigated rice. Because of the special conditions that exist in irrigated rice fields, soil fertility can be maintained for hundreds of years without long fallows or fertilization. The water also assists weed control.

Despite the technical success of this system, it is not considered suitable for Papua New Guinean farmers at this stage. The economics of growing rice are not favourable in PNG ; a lot of work is needed to make the paddies; and the change from rain-fed root crop based systems to an irrigated grain crop based one is so great that it would take great pressure to make people want to adopt it.

DISCUSSION

As well as the changes and alternative farming systems discussed above, there are other things people can do when land pressure stops them using the traditional long forest fallow. These include population movements to other areas; use of land other than traditional land; and purchasing most of their food needs with money from cash employment.

Most people who can no longer use the long forest fallow system will probably find that a mixture of the methods discussed above suits them. People who are short of land might firstly reduce the fallow period and use higher yielding varieties and closer spacing; later they might plant their food gardens and plantation crops together; then they might change to higher yielding food crops; and finally they might decide to have some areas growing perennial banana gardens and other areas growing plantation cash crops, a poultry project using purchased feeds, and fairly small food gardens where the soil fertility is maintained with the manure from the poultry project. People must start making changes before the traditional systems break down completely. Once this happens change is more difficult.

The choices must be made by each family. What people will decide will depend on what resources and markets are available to them. Gardeners on a small island a long way from a town will choose different systems from those chosen by gardeners just outside a town.

This article has discussed possible changes and alternatives to the long forest fallow system. It is the agriculturalist's job to explain these to gardeners who are short of land and to help provide higher yielding varieties and technical advice to them when needed.

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This paper discusses the role of animals in food crop farming systems, using mostly African examples.

Ruthenberg, H. (1971). *Farming Systems in the Tropics*, Clarendon Press, Oxford.

This book describes different farming systems found in the tropics, including some based on shifting cultivation. There is a chapter on development of new systems from traditional ones.

MILNE BAY PROVINCE

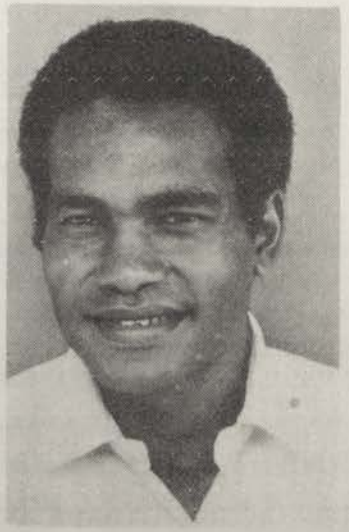
By Rodney W. Abaijah,

Provincial Rural Development Officer.

Rodney W. Abaijah was born at Bwagoaia station in the Misima District of the Milne Bay Province. He attended Bwagaoia Primary School before transferring to Kila Kila in the Central Province. He completed form one at Port Moresby High School and forms two, three and four at Sogeri Secondary School.
He attended Vudal Agricultural College in Rabaul from 1967 to 1969.

After graduating in 1969, he spent 12 months working on pig research at Goroka and Erap. In February, 1971, he attended UPNG preliminary year and 1st year Science. In February 1973, he became Rural Development Officer in Alotau, then was posted to Esa'ala District. In May-August 1974 he attended a Middle Management Course in Sydney. On his return to Alotau he was appointed Associate DRDO Milne Bay Province in November 1975.

Rodney is married with one child. His wife, formerly Mary Paulisbo of Misima, is a former Head Mistress of Nimoa Community School in the Misima district.



Rodney Abaijah

PROVINCE DESCRIPTION

The total area of the Milne Bay Province is 251,133 sq km but the land area totals only 20,246 sq km.

The Owen Stanley Range ends in the Milne Bay Province. It enters the Province at a height of 10 000 feet, and slopes away down to the coast. Nonetheless the mainland can be described as generally mountainous although only the mountains in the extreme south west of the Province reach some 1 524 m or more. This section of the Province, stretches across hundreds of miles of tropical ocean and contains hundreds of large and small islands, most of them well watered, green and fertile, and are pleasant, attractive regions in contrast to some of the high, gloomy and broken country of the mainland.

Tobua Island

The Island Groups of Milne Bay are:

Trobriand Group

These Islands are all of coral. Some rise abruptly from the shore to a height of about 91.4 m forming coral cliffs. Others are only just above the surface of the water.

Laughlan Group

Also known as *Budibudi*

This group comprises five islands and several islets and rocks, and lies 65 km to the east of Woodlark. The islands are coral and sand.

Woodlark Group

Woodlark Island or Murua, to give it its native name, was at one time the chief goldfield of Papua. The island comprises a succession of hills and valleys and is covered in parts by dense tropical growth.

D'Entrecasteaux Group

Fergusson Island has a linear extension of 61 km in a north-west and south-east direction, with an average width of 40 km. There are three groups of mountains, and several lakes, the largest of which is lake Rabu. The most impressive features on this island are the numbers of extinct volcanoes, hot springs, geysers, solfataras, fumaroles and magnificent deposits of sulphur and geyserite.

Normanby Island is about 72 km long and from 20 to 25 km at its greatest breadth. There is a range of mountains whose highest peak is 1 097 m.

Goodenough Island is separated from Fergusson by the Moresby Strait. A mountain range extending through almost the whole length of the island culminates in two rugged peaks of about 2 438 m in height. This range is flanked by an extensive plain.

Louisiade Archipelago

The Louisiade Archipelago contains the numerous islands found in the extreme south-eastern corner of the District. Some of the main islands in this group are:-

Sudest or Tagula Island, approximately 80 km in length and 25 km at its greatest breadth, is formed by a succession of irregular hills and mountains. The highest point is Mount Rattlesnake, 914 m.

Rossel Island, approximately 33 km in length, possesses a most irregular and tortuous coastline.

Misima Island, has a linear extension of 64 km in an east-west direction, being irregular in width, varying from 10 to 11 km in the eastern portion and tapering suddenly from near the centre of the island to a narrow strip from 1 to 3 km wide in the western portion. The island is very mountainous with Mount Oiatau (1035 m) the highest peak.

Conflict Group

The Conflict Group is about 110 km east of Samarai and comprises over 20 small islands.

Samarai Group

This is a small group of islands off the south-eastern tip of the mainland of Papua New Guinea. South-east from the Samarai Group lie a number of lesser island groups.

Samarai is a very picturesque group of islands off the south-east tip of the mainland. In 1899 Samarai became the main centre for the gold rush and later the base for coconut plantation development.

Alotau in Milne Bay itself replaced Samarai as Provincial Headquarters in 1971; in 1975 the overseas wharf at Alotau was opened.

The natural vegetation of much of the province, including the higher parts of the D'Entrecasteaux and Woodlark Islands, is rainforest. The drier north coast, lowland areas of the D'Entrecasteaux Islands, much of the Louisiade Archipelago, the Trobriands and the northern part of Woodlark are covered with secondary regrowth forest or grassland resulting from clearing and burning for gardening and hunting.

There are three distinct rainfall patterns in the Province.

The islands are continuously wet and have an average annual rainfall of 3 810 mm.

The north coast area is a relatively dry zone. It has a marked dry season from May to December, the period when the south-easterly winds are dominant. Cape Vegel and the head of Goodenough Bay are the driest sections of the Province.

The south coast and the Milne Bay areas have an intermediate rainfall pattern with some seasonality. Samarai receives an annual rainfall of 2 682 mm with its driest periods from December to February, when the rainfall averages 160 mm per month.

The soils on the coastal plains are metamorphic, clay, sandstone and alluvial. The island groups consist of metamorphic, volcanic rocks surrounded by raised coral lime and alluvial on the lower plains.
Transport is one of the major problems facing development in the province. Contributing factors are the nature of the topography, the distribution of islands and so on, which make development and extension activities difficult.

PEOPLE

The population of the province in 1975 was 112 265 inhabiting the 20 254 km^2 of land mass, giving an average population density of 5.5 per km^2. The total available work force is only about 40%. The rate of increase in population over the 1966-71 period averaged 2.6%. This is more or less the same as the average annual increase of the country.

The number of people absent from their villages varies throughout the province, averaging about 15% of the population; 11% represent absentees from home villages but residents in other parts of the province. Reasons for absenteeism vary from district to district. One of the main reasons is for work in urban areas. Students absent at school account for over 50% of the figure in the Samarai and Misima areas. Absence of people from the villages causes some problems, especially in land matters.

There are 31 language groups in the province. The main ones are Kilivila (Losuia district), Bwaidoga, Dobu, Duau and Iduna (Esa'ala District), Daga (Rabaraba District), Tawara (Alotau District), Suau (Samarai District) and Misima.

The languages most used by Radio Milne Bay are Dobuan, Wedau and Police Motu (all linguae francae) and Misima, Suau and English.

There are 20 health centres, 18 run by Missions.

There are 129 primary schools, 4 high schools and 4 vocational centres. The missions play a major role in education, providing 92 of the community schools, 3 of the high schools and 3 of the vocational centres.

Missions also run coastal vessels and have properties in the province.

The level of literacy in the younger generation is high.

The Department of Primary Industry training centres at Bubuleta and Kuiaro give basic agricultural and fisheries training to 80 to 100 farmers and fishermen each year.

The Ahioma Centre near Alotau gives training in Community Education to both government welfare assistants and village leaders.

A trainee farmer at the Farmer Training Centre, Bubuleta, husking corn to allow them to dry quickly

SELF-HELP GROUPS

The Milne Bay Province is well known for its many different groups or organisations. These range from the Ialeba-Tavawa Association of Milne Bay to the Vivigain Rice Growers' Club.

Other groups are:-

Damuni Association (Alotau)
Samarai Island Union
Ahioma Association (Goodenough)
T.K. Association (Trobriands)
Northern Normanby Co-operative Association (Esa'ala)
Sineada Women's Association
Milne Bay Cattle Farmers Association
Milne Bay Association (Alotau)
Baniara Trading Company (Raba-raba)
Daga Rural Producers' Co-operative (Agaun)
Wedau Rural Producers' Co-operative
Pearl Farmers' Association (Samarai)
Louisiade Fisheries Co.
T.K. Development Corporation (Losuia)
Tofa (Agricultural) Association
Faiawa Cocoa Group (Goodenough)

Village Agricultural Committees are established and operating in most areas.

ECONOMY

Agricultural development has mainly been confined to a narrow coastal fringe on the mainland and to the scattered islands of the Province, although the highlands (Agaun Daga area) on the mainland are proving suitable for crops such as coffee and cardamoms.

The greater portion of land is unsuitable for commercial agriculture, although within these areas lies a large portion of subsistence gardening land.

A number of commercial fishing ventures have been established since 1973. Fish is marketed in Alotau and Port Moresby.

The known forest potential of the Milne Bay Province is assessed at 106 075 ha. In addition, 43 200 ha are believed to have economic potential but require more detailed assessment. Timber rights have been purchased for 58 000 ha and a further 20 800 ha are controlled by the government.

Manufacturing in the Province is negligible. It is dominated by sawmilling and joinery. Boat building and marine engineering (repairing) is perhaps the second most important activity followed by Mission-based small boat building. These manufacturing activities are scattered throughout the Province.

Labourers unloading copra at Samarai Wharf

A cultured pearl industry is undertaken by Con. Dennis George and Sons. They are making progress with establishing this industry in Bwanabwana Council area. Thirteen small farms have been established on Basilaki Island. Half pearls are being processed from six of these farms. Government participation is being investigated.

Cottage industries also have potential. The most flourishing is wood carving particularly in the Trobriands where the value output is estimated to be in excess of K500 000 per year. This trade was severely affected by the loss of the hotel at Losuia by fire and would have ceased but for day tourists and the development of two outlets in Port Moresby. Two guest houses have, however, been opened and the trade is showing signs of recovery to its former level.

Pottery has been developed as a minor industry in the Amphlett Islands, Esa'ala District. Prospects for the pottery are very limited as clay has to be obtained from Fergusson Island and transport of the fragile pots to markets from these isolated areas is a handicap.

SUBSISTENCE AND NUTRITION

This area has been neglected, particularly by the field officers. It has been reported, at the Food Crops Conference in Lae 1975, that 53 per cent of the children attending Maternal Child Health Clinics in Milne Bay Province are malnourished. An educational programme to create local awareness and eventual adoption of an improvement plan is the starting point. Plans for 1977/1978 include a survey of the food crops, analysis of their food value by the Chief Food Chemist in Port Moresby, a combined education and training programme with Health Education and Welfare on nutrition and the establishment of demonstration plots and seed nurseries and food gardens at Bubuleta. A Fresh Food Marketing Branch is planned for 1979.

CATTLE

The total number of small-holder cattle projects in the province is 174 with 5 500 head. Plantation and mission cattle number about 2000 head. There are two slaughter houses, one at Alotau (Gili) and one at Samarai (Mwamwaneune). Plans for the next three years are to stock village projects and establish new projects, to train farmers on general cattle and pasture management, to organize markets and to establish more slaughter floors and train field staff for meat inspection. A feasibility study on a canning factory and investigations into markets for meat outside the Province will be conducted.

Alotau market

FISHERIES

Commercial fisheries have been established in the Losuia and Samarai areas, in the Calvados Chain of the Louisiade Archipelago and in the Alotau area. The present annual rate of production is 240 tonnes, with 120 tonnes purchased from Samarai, and 120 tonnes from Losuia. Several locally-owned boats are now fishing commercially.

The Department of Primary Industry runs a freezer in Samarai and has a fleet of six vessels for collection of fish.

There are 12 portable deep freezer units operating in the Milne Bay Province. They are being used in areas where there is little or no other source of income to villagers. They are serviced by 22-foot launches equipped with ice boxes. These launches (dories) were built at the fisheries station at Kiuaro (near Samarai) by unpaid fisheries trainees under supervision. They have Yanmar 12 h.p. diesel engines, a crew of two, and a capacity for 200 kg fish. The freezer units are all powered by portable diesel generators, originating from a grant by the New Zealand Government. They have proved very reliable and robust.

The holding capacity of the freezer units is close to 500 kg, with a freezing capacity of 100 kg. Clearance of units is done every day; maintenance is done on week-ends. The fish is marketed in Samarai and Alotau; occasionally in Popondetta and Port Moresby.

The T.K. Development Corporation has a shore-based freezer, a fishing vessel with freezer, and two DPI dories assisting in the Losuia area. All their fish is marketed in Port Moresby. Louisiade Fisheries (formed by the Local Government Council and the Catholic Mission) operate on a similar system in the Calvados Chain, Sudest and Rossel Islands. They have installed a freezer in the M.V. "Pollyanna". The vessel "Tanya II" operates in the Suau to Oranjerie Bay area, most of the catch is sold in Brisbane, but some reef fish are sold in Alotau.

Crayfish appear in and around Losuia and Oranjerie Bay areas in November. The commercial potential could be investigated.

Future plans are to increase production and improve market outlets in Popondetta, Port Moresby and possibly the Highlands. Fishermen will be assisted with rural credit and training in freezer maintenance, and group-fishing on a self-help basis will be encouraged. If feasible foreign aid for a fish meal factory may be sought.

PIGS AND POULTRY

Projects financed by the Development Bank on intensive level pig and poultry production have not proved successful, largely due to management problems.

An expatriate producer turns off 500 chickens a month and a project near Alotau turns off 100 chickens a month. The only intensive piggeries are at Giligili, Hagita, and Cameron High Schools.

Plans are to maintain existing poultry farms and introduce new strains suitable for the village situation, to establish two new poultry projects and implement pig breeding programmes, and to expand training facilities at Bubuleta for pig and poultry farmers.

COFFEE

It is estimated that 400 ha of Arabica and 130 ha of Robusta are producing coffee. There are about 3000 Arabica coffee growers and 900 Robusta coffee growers in the province. Rabaraba district is the main producer.

It is planned to maximise production of coffee to 200 tonnes by December 1978. Existing coffee plantings will be renovated and the handing over of coffee purchasing to local growers will be encouraged. If feasible finance for a coffee factory will be applied for.

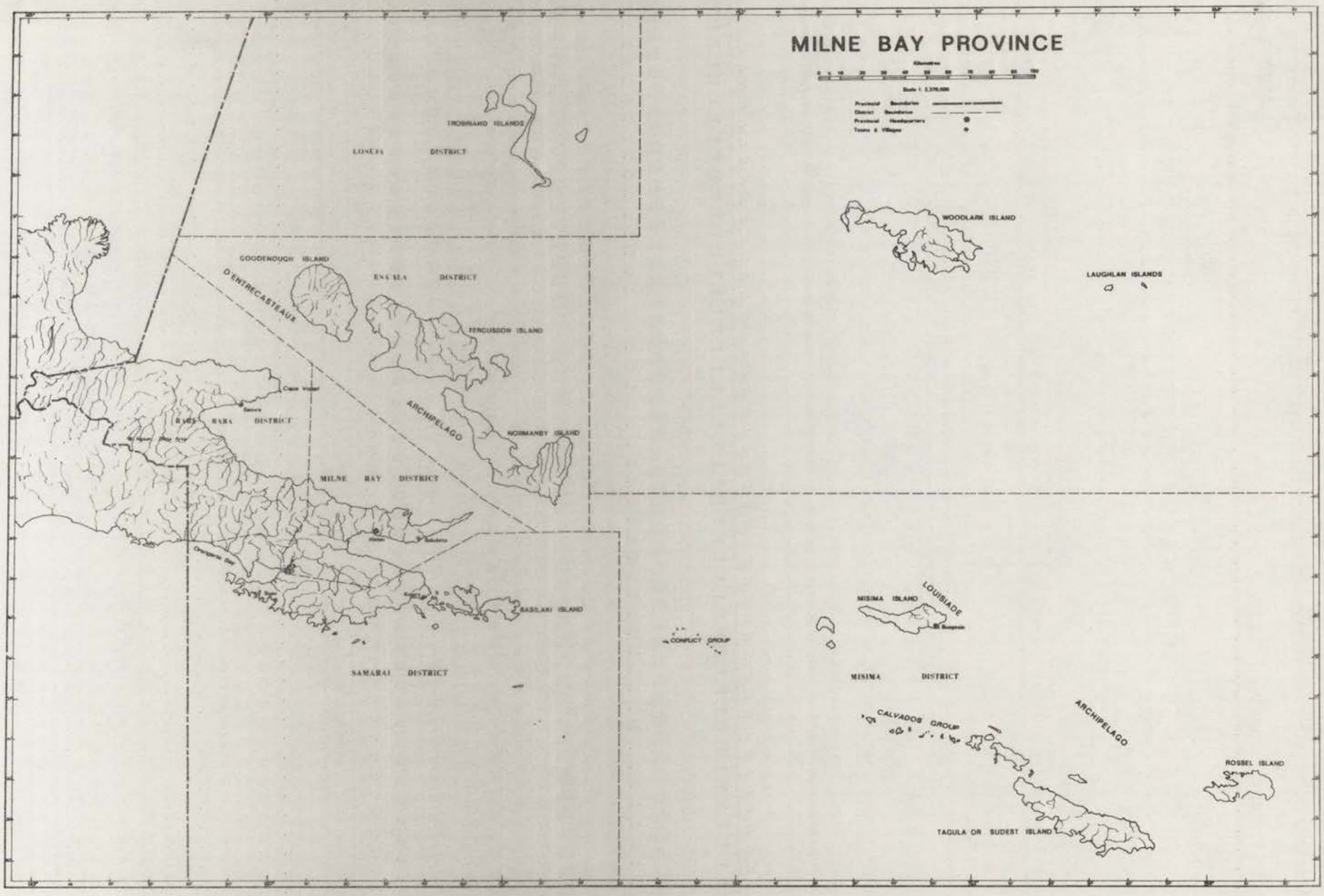
COCONUT

Coconut is grown in every area of the province. Estimated area planted is 20 000 ha and about 70% of this is bearing. There are 11 plantations and about 30 000 village planters. Production is estimated to be about 4000 tonnes from village plantings, and about 2000 tonnes from plantations.

It is planned to plant new coconuts, build hot air dryers and to train farmers on copra culture and processing methods at Bubuleta.

Gili-Gili Plantation, Alotau

Photographs: Office of Information


MILNE BAY PROVINCE
TROBRIAND ISLANDS
LOUISIADE DISTRICT
WOODLARK ISLAND
LAUGHLAN ISLANDS
GOODENOUGH ISLAND
ENGLISH DISTRICT
D'ENTRECASTEAUX
FERGUSSON ISLAND
ARCHIPELAGO
NORMANBY ISLAND
MILNE BAY DISTRICT
BASILAKI ISLAND
SAMARAI DISTRICT
CONFUCT GROUP
MISIMA ISLAND
LOUISIADE
MISIMA DISTRICT
CALVADOS GROUP
ARCHIPELAGO
ROSSEL ISLAND
TAGULA OR SUDEST ISLAND