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Front cover: Students at Marionville girls' high school in the Central Province digging their garden ready to plant peanuts. This issue contains a detailed description of the Department of Primary Industry's plans to increase food production in the Central Province, including backyard gardening.

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Department of Primary Industry
Port Moresby
Papua New Guinea

PIONEER DIDIMERI—MRS DESIE WIRUA

By Cecilie Benjamin, Rural Development Officer

Mrs Wirua instructing school children at Ewasse community school on the planting of pineapples.

Mrs Desie Wirua is one of the few women Rural Development Assistants who has ever worked for the Department of Primary Industry. Mrs Wirua was born before the second World War in Vunamami village on the Gazelle Peninsula of East New Britain. She received a formal education to Standard 3 at the Vunamami Methodist Mission near Kokopo before the Second World War. She has two adult children, John and Jenny, who have also worked at some stage for the Department of Primary Industry.

Mrs Wirua commenced her training at Taliligap Extension Centre in 1962. "Desie", as Mrs Wirua is known to everyone, has worked in extension at Keravat and Taliligap on pepper, cocoa and coconuts.

At Napapar, also in the East New Britain Province, Desie worked on pepper, cocoa, coconuts and chickens before being transferred down to the Hoskins Oil Palm Scheme when it was newly established in the late 1960s, and has remained involved with oil palm until her recent transfer back to the Gazelle and the Lowlands Agricultural Experiment Station, where she will work principally on food crops.

Desie attended the Rural Development Assistants' Extension Course in Tigak near Kavieng in September, 1973, as one of the first women to do so.

Desie has worked with a number of "didimeri" and "didiman" and has taught many an expatriate newcomer how to speak Pidgin, the first thing essential to working with people in the Islands Region. Desie's wide knowledge of plants, fruit trees, bush trees, subsistence food crops, bush craft and vegetable growing has made her a valued information source and communicator of Papua New Guinea methods of food production.

In the Hoskins Oil Palm Scheme, Desie taught many women settlers how and why oil palm flowers should be pollinated, the most essential requirement for successful oil palm production. She also taught the women how

to apply fertilizer to their palms. All in all, Desie has a natural way with agriculture, as was evident in the beautiful round cabbages, carrots, chinese cabbages, parsley, lettuce, egg plants and many other kinds of vegetables growing in the Buvussi demonstration garden on the community centre (Buvussi is the largest subdivision of the Oil Palm Scheme).

Many of the grafted citrus now standing at Nahavio (the Oil Palm Field Headquarters) and Babata Department of Primary Industry Station (Bialla Oil Palm Headquarters) were grafted and maintained by Desie, as well as thousands of other fruit trees such as avocados, five-corners, laulau, rambutans, citrus, guavas and many other kinds of fruit trees distributed all around West New Britain.

Desie's main work in Babata was to establish food gardens as well as future planting material for settlers' food gardens for the Bialla Oil Palm Scheme. These gardens were of chinese taro, sweet potato, taro and bananas etc. Desie also established fruit trees around the station, and was even supervising some road building operations in the area.

Desie's pioneering contribution to women working in agriculture in this country has been considerable. She helped to pave the way for the present situation where Papua New Guinea is training its own women for working in agriculture at Vudal Agricultural College, Popondetta Agricultural College and soon at Highlands Agricultural College.

Mrs Wirua supervising the placement of a culvert under the road at Babata.

GIANT SNAILS—ANOTHER WAY

The giant snail is firmly established and is unlikely to be eradicated. It will probably spread all over PNG in years to come, and wherever the conditions suit it.

Seeing that we are unlikely to beat the snails, why not join them? Probably one of the best ways to create scarcity of any object is to make it desirable, and if possible, valuable financially.

The giant snail makes good eating, providing that they are properly cooked.

So what do we do? Well, we gather enough snails for our purpose and put them in an escape-proof container which has ventilation. There they can remain for a few days to digest any food already eaten, and clean themselves. Keep them moist.

Prepare a salt solution and soak your snails overnight. Make sure the vessel is filled and has a lid, otherwise the snails will avoid the saltwater. Next morning the snails will be dead and will have produced much slime. Once again scrub them under a running tap.

Now boil your snails for about 15 minutes, then take them out and pull out the meat from the shell with a bent wire. The meat will have a small "dirt bag" at the inner end and this should be pinched off. Lightly rinse your snails again.

Place a little garlic butter in each shell. Place the snail meat back inside the shell and top up with garlic butter again. Put the snails into an oven and bake for about 15 minutes. Serve the snails. **M. Mitchell**

HIGH SCHOOL POULTRY PROJECT

By Harold C. Killins, De la Salle High School, Bereina, Central Province

A poultry project was started at De la Salle high school because the students exhibited keen interest. The traditional method of raising chickens is simply to leave them to find whatever food they can. Little or no feed is provided by the owners. This means that it costs practically nothing to raise the chickens but it also means that they grow very slowly. It is therefore a long time before they are large enough to be killed and eaten. We promised the villagers that with good feeding and quicker growth we would produce a tender palatable product in a profitable way under village conditions.

Our first step was to demonstrate methods that would be useful on the village level. It was intended to start more sophisticated commercial ventures later.

Choice of stock

Day-old chicks of three breeds and one cross were purchased from Brisbane. They were Rhode Island Red, Black Australorp, White Leghorn and Leghorn X Black Australorp.

Experience had shown that the strain of Rhode Island Red available was of more value for meat than for egg production. They are vigorous birds, well able to survive the harsh village conditions.

The Black Australorp stock has been bred for both egg production and meat yield. Here again there is outstanding vigour and good survival rate. However, more feed is required to produce a dozen eggs than is the case with chickens of lighter weights, because of the maintenance of the larger bird. Birds require

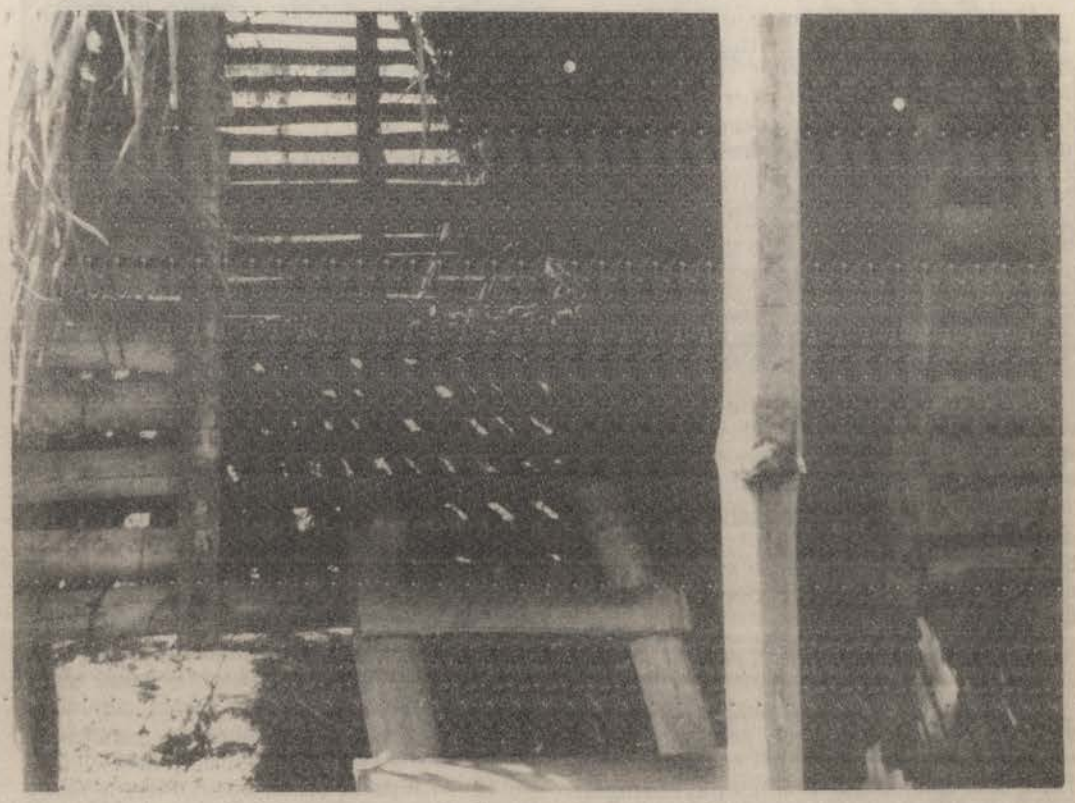


Plate 1.—Looking into a chicken house. Note the floor made from slatted bamboo.

Plate 2.—The chicken houses, with thatched kunai roof, surrounded by a fenced yard where the chickens can run, protected from dogs.

some feed just to stay alive before any can go toward egg production.

The Leghorn chicks purchased were weak and undersized when first received. This condition could have been due to one or all of the following causes: eggs that were too small were set, nutritional deficiency in parent stock, or a genetic factor. Leghorn pullets will probably perform as efficient egg producers in that a minimum of feed will be required to produce a dozen eggs. But as Leghorns are small, the meat yield from cockerels and yearling hens will be much less than from other breeds at the school. Meat quality is not quite as good as from larger breeds.

The cross between White Leghorn and Black Australorp is probably one of the best birds that can be supplied to village people. At time of writing we had cockerels and pullets of this breeding that were four months old. The cockerels averaged 1.4 kg each, and pullets 1.2 kg. Egg production from this breed is usually very good and efficient in terms of feed to egg ratio. However, the pure bred White Leghorn will be even more efficient in this regard.

Brooding

Brooding in this case was very simple. We used what is commonly known as the "cold brooder". This is nothing more than a cardboard box, with four doors or openings, each about 5 cm X 8 cm—one door on each side. A box 60 cm square and about 20 cm deep is satisfactory for 25 chicks. This brooder is required only at night in the warm climate of the lowlands. It is used for about a week.

The cold brooder is very satisfactory under our conditions where temperatures range between 21 °C and 32 °C. At lower temperatures the Department of Primary Industry recommends the construction of lamp brooders as described in the Rural Development Series handbook "Poultry".

As breeding stock is now established, we hope soon to make a start with brooding with mother hens. This programme is practicable in the village situation.

Housing

Day-old chicks were housed in buildings which were later used as growing pens, and then for housing layers. When day-old chicks were kept in the pens pictured (*Plate* 1) the slatted floors were covered with cardboard. Cardboard was also used on the walls as protection from cold winds. When the chicks were five weeks old the cardboard was removed.

The floors are made of bamboo slats with the rounded side up. These stay quite clean. The ends of the pens are also made with bamboo slats. A good amount of sunshine is admitted. The frames of the buildings are made of fairly straight poles of about 5 cm diameter. Nails are the only product purchased for the construction of these buildings. Roofs are thatched with kunai grass. The grass is about 20 cm thick; it offers a fair amount of insulation from the blazing sun (*Plate* 2).

Wire fences were also erected around the pens to protect the chickens from dogs, etc.

The pens are on posts about 1 metre above the ground. When they were being built, old tin plates were placed on the tops of the posts under the pens, to prevent snakes and rats from entering the pens.

Water and feed troughs are made from bamboo poles (*Plate* 3). These are a type the writer first saw at Popondetta Agricultural College. We find them very satisfactory. If too much wood is removed from the top opening, however, the chickens tend to waste a considerable amount of feed.

Feeding

The day-old chicks were started with one bag of commercial feed, and about three months later a second bag was used.

We feel that it is quite wrong to raise fowls in villages on prepared feed. All that is available is produced in Australia and transport costs make prices rather high. At De la Salle we have used cooked paddy rice, rice bran and cooked fish with reasonably good results. Feed supplied to young chicks up to 5 weeks of age, and to laying hens, contained 20 % protein. This was obtained by adding two parts (by weight) of cooked fish to three parts of rice bran, and mixing thoroughly.

We are growing a few soyabeans and plan to use these as a protein supplement. They must be cooked or heated in some way before feeding. Sweet potatoes are available in quite large quantities in this area, but they also must be cooked in order to get the best feeding

***Plate* 3.—Chickens feeding from troughs made from bamboo poles. These bamboo troughs are used for both feed and water.**

value. They have a fair value as an energy feed, but the protein level is only 4 % calculated on a dry weight basis.

Green feeds provide vitamin A and soluble minerals which are very important in the diet. When the chicks were small, dark green succulent grass was chopped and used with the feed. When the chickens were large enough to run on grass, they were of course able to obtain their own greens. We have used leucaena in a limited way, but it should not make up more than 5 % of the total diet, as it contains a substance which can have bad effects on the birds. The protein level of dried leucaena is between 26 % and 30 %.

Salt is supplied at a rate of about ½ % of diet (1 kg of salt thoroughly mixed into 200 kg of feed), and calcium as coral limestone in small pieces or pounded into powder.

Trace minerals come from the soil. When the chicks were small they were given a handful of soil each day. This was soil from a place were chickens had never been kept.

Results so far

Students have shown considerable interest in the project at the school. Twenty-two boys purchased cockerels from the school project to mate with village hens to improve egg and meat production at home.

Very few village people have as yet ventured into business on a large scale, although it is expected that commercial flocks will become commonplace in the future. Dressed poultry and eggs could be produced for the Port Moresby market. The new road to Bereina has made movement of all goods comparatively quick and cheap.

It is in the field of chicken nutrition that we believe most has been accomplished from our poultry project. Use of local energy feeds, balanced with protein supplements like cooked soyabeans and fish, gave fairly satisfactory results when fed at regular intervals. Fencing to protect the chickens from predators has certainly been demonstrated to be of value.

After five months, the value of the cockerels and pullets was three and a half times the cost of the day-old chicks, the feed and the pieces bought to build the chicken house.*

All changes in agricultural methods take place quite slowly. However, the methods demonstrated seem reasonably practicable. We feel that they can be taken up with advantage at the village level. Where changes have been made, a pattern is set for others to follow.

*The cost of materials bought for the chicken house, including fence, were divided by five for this calculation, as they are expected to last for a long time.

EXCELLENT MARKET FOR CHILLIES

Birds-eye chillies are now being cultivated for sale in many part of Papua New Guinea.

The world market for birds-eye chillies is expanding and the prices are buoyant. The Department of Primary Industry is now paying 42 t per kilogram for dried birds-eye chillies in main ports of Lae and Port Moresby.

Last year, 1975-76, the Department purchased 200 tonnes of dried chillies from growers, and after sales to both local and overseas buyers it made a gross return of K 120 000.

From the size of the world market which is around 1 100 tonnes per year, one can see that PNG is starting to hold a significant share of this market, and by closely watching the quality of the commodity, the Department will be out to ensure that this share is maintained.

Western European countries make up the bulk of the market, although Australia and New Zealand do buy a small proportion of our chillies.

PNG's main rivals would be Nigeria and Tanzania, who are the traditional producers.

While the Southern Highlands and Milne Bay Provinces produce the bulk of the crop, chillies are also grown in other provinces. They are often planted together with other cash crops. Although chillies are not regarded as a major income-earning cash crop, due to the high requirement for labour, they could be a very important crop for the family to fall back on when prices for other crops are low.

Paul Sai'i

THE USE OF CARABAO AS A DRAFT ANIMAL IN THE PHILIPPINES

By Kup Manape, Rural Development Officer, Kindeng

Of all work farm animals the carabao is the main and the most important type of animal in a Filipino farmer's farmstead. Without these work animals the farm operations would be practically at a standstill. This is very true during the six months' dry season when the soil is very hard and is too hard to be worked by ordinary human labour. Also during the wet and flood periods it is impractical to use machinery on the flooded paddies. Most farmers involved in lowland rice culture use the carabao to do all the work although in some cases oxen and bullocks are trained to do the farm operations. The carabao is better suited to muddy conditions and can work effectively whether in rainy or muddy conditions. Although a few of the big-time farmers do use tractors, most still use animals. As I saw it the importance and the popularity of the animals is still going to be maintained for many more years to come, even though modern machinery and tools may be used or introduced. The carabao will still be the closest ally of the rice planter due to its initial cheap cost and cheap maintenance.

Most farmers own at least two to three carabaos for work. They can then change them around when one of the animals tires.

The carabao is the tamest livestock on the farm and is easy to breed by natural or artificial means. Breeding naturally is the most common and the oldest method. The carabao is a hard-working animal and can stand up to very difficult conditions.

The amount of rice produced in the Philippines to feed the large population can be credited both to the availability of expert technical knowledge and the use of work animals. Even though the country is advanced in many ways the importance of the work animals is still nationally recognized and cannot be questioned. In many cases the use of modern machinery would be impractical. This is based on the fact that most farmers own very small pieces of land and it would be a waste of money if they purchased expensive machinery. Also machinery is expensive to maintain and most simple farmers cannot afford the cost.

Carabao being used to cultivate a rice paddy.

Types of carabao

There are two types of carabaos that can be found. They are the dairy or milk type, and the draft or meat type.

In this report I will only discuss the latter category. As the name implies, this type of animal is used for both meat and work purposes. The animal is raised mainly for work purposes and meat is only a secondary purpose. The animal is sold for meat at an old age or if it is not fit for work. A young and good-looking animal may also be sold for meat purposes, if in the opinion of the farmer, it is not intelligent or intractable and is not going to turn into a good work animal.

The meat of an old animal, especially one that has gone through a lot of hard work, is very tough and is said to have a strong flavour. It is only eaten by people who are used to this kind of meat, and who prefer the characteristic strong flavour of the meat. With good cooking the meat is more palatable and tastier. Meat of the young animal is tender and tasty, and is not much different to beef.

Carabao = swamp buffalo. In the Philippines the word is used for any type of water buffalo.

Most young and good-looking animals are looked after and trained for work purposes. This type of animal serves the farmer for a long time.

Selection of work animals

Since the carabao and other work animals are very important and the whole farm operation is mainly dependent on the animals, the farmer must select and train his animals carefully so that he will get the maximum benefit out of his animal. The ability to select and train an animal is the result of many years of experience. It is more of a traditional culture that is handed down from father to son. To be able to select a good work animal, the farmer looks for and tries to develop certain characteristics in the animals. Briefly discussed are a few of the characteristics.

Firstly comes the size. The size of an animal intended for work is very important. For a working carabao to do its work effectively, it has to be well built. There should be plenty of weight and good strong legs so that it will be able to stabilize itself when pulling the plough or any other load. In ploughing a heavy animal can offset any resistance offered by the soil more readily than a light animal. The larger animal tends to pull steadily and balance itself well due to its bigger and stronger muscles. There is also the advantage that the animal could be sold for meat later and the larger animal would have more carcase.

Filipino farmer with carabao and plough. Note mouthpiece to prevent the animal from chewing the young plants.

Apart from weight it should have a good height. A well-built tall animal covers more distance quickly than a short fat one. A good work animal should measure about 500 to 550 kilograms and about 120 centimetres from the ground.

A good fast-moving animal is more desirable than a slower one; that is if it can keep its pace without tiring. An animal which may on the one hand be slow but does its work more surely and accomplishes more work is more valuable to the farmer than one that does not work properly. A fast-moving overgrown animal may tire easily and stop after a while.

Another thing is intelligence. An intelligent animal that follows the command of its master and responds quickly is a valuable asset.

The true ability of an animal lies in how much work it can accomplish in a day. A hard-working animal should plough a relatively large area of field in one day

Breeding

Most farmers breed their own animals. The carabao cows are important in this respect, as they can be used both for work and for breeding, and can later be sold for meat purposes at old age.

Carabaos start breeding at the age of two and a half to three years. Cows produce a calf every year or every one and a half years.

In most farms farmers generally keep only a few animals and any extra may be sold. During the rice planting season the price of work animals is high. As mentioned most simple farmers breed their own working animals but others may prefer to buy from selected breeders. It is usual to find a couple of males and a female or a couple of females and a male in any average farm.

Nursing

After a calf is born it stays with its mother for about a year, deriving most of its nourishment from her milk. At this period frequent handling of the young animal by its owners makes it into a gentle animal and makes it easier to handle later on. At about a year old it may be trained to lead or may be walked around so that it may get used to the command of its owners and go in whichever direction it may be required to lead. Great care is taken at this stage so as not to scare the animal or stampede it.

Weaning

The young carabao are weaned at the age of about a year old. Weaning is a gradual thing and it may take a fair amount of time to fully separate the young animal from its mother. In large farms weanlings may be herded together until about when they are two to two and a half years old. At this age males and females are separated to prevent unnecessary or poor breeding. Separation is done by use of strong ropes that are tied around the curved horns and tied to something firm. Weanlings are kept near the farmer's house and usually children take care of them so that they do not wander.

Training of young work animals

Training begins at a very young age. The earliest training comes in the form of practical farm or field experience. When the mother is used for work the calf walks behind or at the side, and at the same time getting used to the nearness of human beings.

The real training of young animals for work begins at the age of two to two and a half years. The animals are five to six years of age before they are fully trained. At the early age of about two years they are taught first to be driven. They are then trained to be ridden. A simple load on the back may teach the animal to get used to having a load on its back. Then the next step is to teach the animal to pull a light shaft and to pull a light harrow over a field. This may take quite some time and only when the animal is used to this equipment and at the same time relatively quiet, is it taught to pull a plough.

The frequent handling of the animal at a young age makes the animal gentle and easier to handle. Since most young animals grow up in close association with the farmer and household, it makes the task easier. This plus the natural ability of a Filipino farmer as an expert animal trainer results in the production of a good draft animal.

Farmer-animal relationship and management of work animals

The farmer-work animal relationship is a very close one. Work animals are well regarded and handled with utmost care. Usually young children or especially young boys look after the pasturing of animals. It is common to see a boy of about ten or even six riding on work animals to and back from the fields. In this way both young animals and young farm children get acquainted with each other. This prepares both for field tasks when they reach working age, about 5 to 6 for the animal and 14 to 16 years for the boy.

Braham-cross steer used for ploughing.

In average farms, work animals are taken out to work in the field early in the morning and as the sun gets hotter they are taken back to the house, scrubbed or washed down with cold water, given fresh water to drink and then allowed to rest under shade. Where there is a freshwater pool available, they may get a good swim and have a rest in the water. Either green feed or dried rice stalk in the form of hay is fed to the animals. During the afternoon when it is cool work begins again until about 5 or 6 pm in the afternoon.

During the rainy season when there is plenty of green feed available, ploughs and harrows are removed from the animal after a hard work period and it is let loose to wander around and feed with a long rope attached to the horns. During the cool afternoons they are taken back to work. When one tires a fresh one is brought in to take its place. Farm animals are never pushed beyond their limit as far as work is concerned.

After work they are well fed and watered before they rest. They are kept very close to the farmer's house for security and other reasons.

Work animal versus farm machinery

Briefly discussed are some of the advantages and disadvantages of the work animal compared to farm machinery.

Advantages

The initial price of a carabao or bullock is much lower than a farm tractor and most farmers can afford to buy one.

The value of the young work animal increases as it grows older and becomes more experienced whereas in the case of farm machinery it decreases as it is used for a few years.

The animal is able to plough muddy or wet fields which is mostly impossible to do with farm machines and also human labour.

It certainly does a lot more work and works much faster than ordinary human labour and is also a lot cheaper.

The animal is much cheaper to maintain than machinery.

Unlike farm machinery the farmer can easily replace a work animal when one breaks down or is too old, since he is able to breed the animal on the farm.

There is less chance of breakdown with farm animals and they also do not require spare parts as in farm machinery.

The animal can effectively work a small paddy without interfering with other people's fields, and it does not require much room to turn.

Disadvantages

A work animal is much slower and covers a smaller area in a day than farm machinery.

Unlike a machine you can't just add more fuel and keep going. The animal has to be rested when it tires.

It requires skill and experience to handle the animal, as well as machinery.

All in all the advantages outweigh the disadvantages.

Conclusions and recommendations

The use of carabao and other related animals for work purposes is part of the old cultural practices handed down from father to son in the Philippines. Work animals are so much involved in day to day activities that they are a common sight in any farmstead. The animals could be compared to our traditional pigs but here they serve a more useful purpose than pigs. In simple definition carabao and other related animals are "the simple farmer's tractor and poor man's source of meat and milk". The importance of work animals cannot be questioned and will remain for years to come.

Here in Papua New Guinea manpower has been the main source of work force for agriculture and it will be for many years to come. Papua New Guinea being a young and backward country most people cannot afford to use expensive machinery to substitute for manpower in farming. But there is a good possibility that animal power could be used for work. We do have a lot of cattle widely spread throughout the country and it does not require a great deal of technical knowhow to teach and maintain work animals. There are a few places that have tried using animals for work in PNG and the results have been satisfactory. The possibility of using animals for work should be considered carefully because it could have a very important effect on the future of this country agriculturally.

Machinery is expensive but most people could afford work animals. The equipment to be used with work animals could be easily made from locally available materials. There would be the advantage to the simple farmer that he would not have the complicated servicing that is necessary with agricultural machinery.

Therefore the use of work animals should be a possibility that we should try to look into and possibly introduce for the good of our young nation.

A FARM MANAGEMENT GAME FOR PNG

By Peter Thompson, Lecturer Farm Management, Popondetta Agricultural College

The rapid increase in rural development in PNG has put a greater demand on the farm management skills of farmers and extension officers. These skills are mainly —

1. Being able to make management decisions, and also to teach farmers how to make these decisions.
2. Helping farmers plan the physical and financial development of a farm based on the farmer's goals.
3. Making budgets so that farmers can apply for a loan from the Development Bank if necessary.

One method that can be used to teach these skills is to do case studies of a real farm. This involves visiting a farm, talking with the farmer and finding out what decisions he has made and observing the results of these decisions, preferably over a period of time.

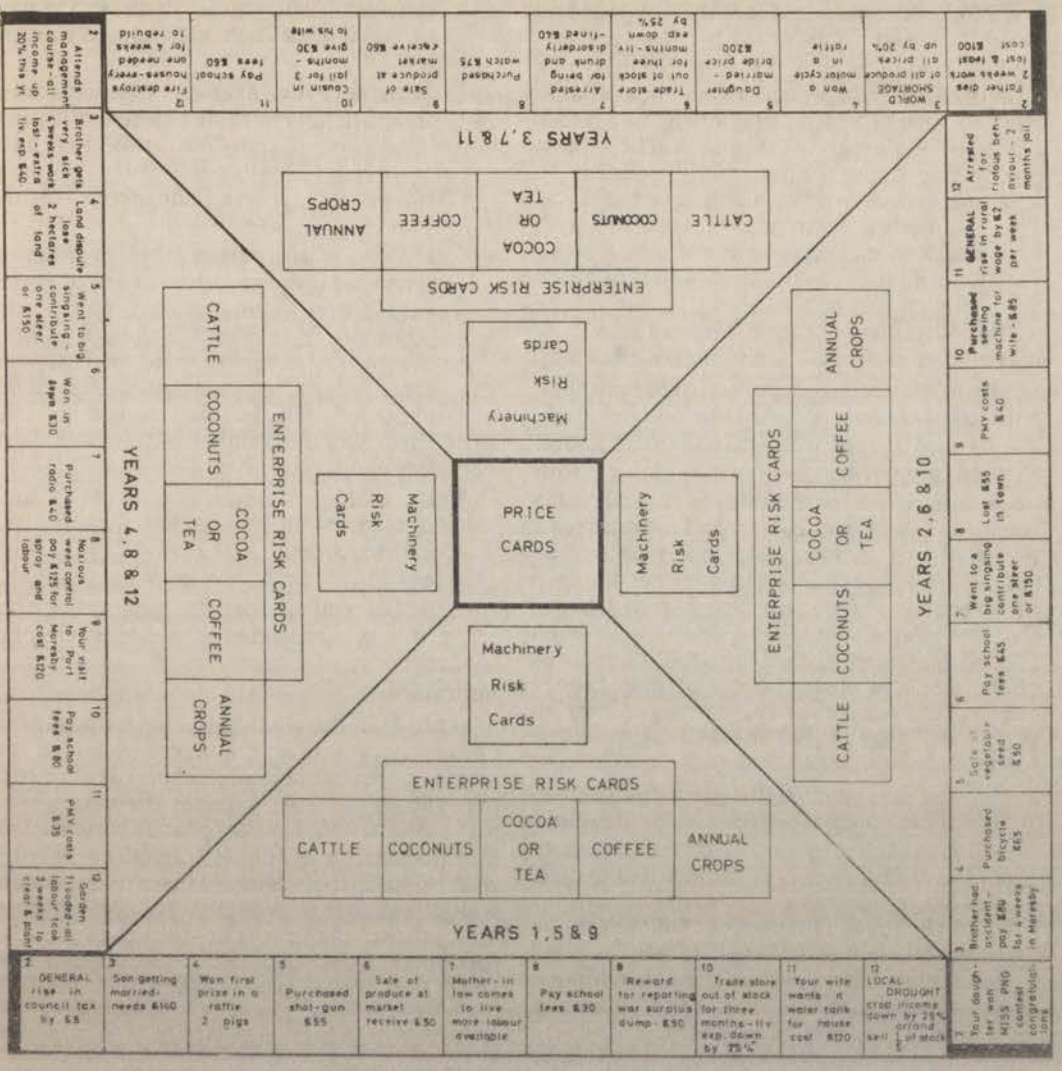
Case studies are very useful for teaching certain aspects of planning, such as the collection and organization of information, but are not always as good as they should be because the *students themselves are not involved in the decision making*. They are only observing the mistakes or successes of someone else. They do however usually find out *why* a certain result occurred.

Another method is to get the students involved in a farm management game. This is a model of a farm business which is used to give an idea of the outcome of management decisions made by the people involved in the game.

A farm management game for PNG

In 1973 lecturers at the Popondetta Agricultural College produced the first version of a farm management game that was applicable to PNG.* Since then the game has been revised—based on experience, and on suggestions from students and staff at Highlands Agricultural College, Popondetta Agricultural College and Vudal Agricultural College Field Station. It is now an established part of the farm management courses at these colleges. It has also been successfully played by groups of field officers from the

Popondetta Agricultural College students play the game in the classroom.



The board for the farm management game.

Department of Primary Industry as part of their in-service training.

From the outset the aim was to make the game as realistic as possible without making it so difficult to play that the teaching value would be reduced.

The "managers" start by inspecting an actual area of relatively undeveloped land, about 30 ha in size. This is their farm, of which they must plan the development for the next 10 years. They are told that they have a labour force of nine people consisting of the owner (themselves), his wife and four children, his brother and his wife, and his uncle. They can estimate the amount of work these people can do in the form of man days. Each "manager" also has K500 cash to start with.

A "manager" can consist of an individual or a management group of up to four people. Because each manager has the same resources to start with, later success or failure will depend on the types of enterprises chosen and the decisions made.

The managers are given a choice of enterprises suitable for their land. On the coast these are cattle, coconuts, cocoa, Robusta coffee, chillies, and annual crops such as sweet potato and peanuts. In the

highlands coconuts are replaced by tea, and Robusta coffee by Arabica.

The managers then have to decide which enterprise or enterprises they will put on their land, and make a physical plan and budget for a period ranging up to 10 years. To help them do this they are given a map of the area and a series of budget forms which they can follow. The last budget form will tell the manager how much money will be needed to put his yearly farm plan into practice, and if he needs a loan how much he will need. If he does need to borrow money the form will also show how much he can afford to pay back each year.

When the managers are satisfied with their plan and budget they are then able to test it out by playing the farm management game.

The game consists of a board with four sides, each side representing one year. Play begins at year 1 and each manager receives a set of record sheets, yield tables and K500 cash (play money). Players who need a loan (from their budgets) will receive that amount also in cash. It has been found that even though managers must keep accurate records of income and costs the use of play money adds to the realism of the game and cash in hand can always be checked against the records.

Playing one year of the game involves—

1. The game controller, who is the bank manager, trade store owner, produce buyer and supply firm, throws the dice. This represents the seasonal conditions of the year. The number will determine the crop yields and calving rate for every manager for that year. Each manager can easily find his actual production by looking up the yield tables.
2. The game controller takes the top "price card". This will determine the prices all managers pay or receive for produce and stock during that year.
3. Each manager then throws the dice—this number will land them in one of the "general risk" squares for that year (around the board). If the "risk" involves cash this will be paid or received in play money and also be entered into the records. Although some of these "general risks" are not entirely realistic, they certainly add enjoyment and interest to the game.
4. Each manager also take a "risk card" for each enterprise or machine they have, and this will tell them what happened to those crops, cattle or machines during that year. The results of these are paid or received in cash and entered into the records.
5. Managers then transfer any costs from their budgets to their records, allowing for changes due to the "risks" that have occurred. These costs must be paid *before* they receive their income for the year.
6. Income is calculated from production (yield tables) and prices received (price cards), and living expenses paid to the "trade store" (simply a box with a slot in the top). These are paid in cash and recorded by the managers. The living expenses can be determined by the controller and could be 10 % or 20 % of the income received that year.
7. If managers are due for a loan repayment this must be made in cash and recorded.
8. Managers work out their cash in hand at the end of the year and check that their records agree with their cash (play money).

Summary

As in real life, what happens in the game is not always what the managers budgeted for, and if so they must change their plans as they play the game. This requires the manager to make decisions based on past experience and all information available (including possible risks). This is the essence of farm management which cannot be taught by conventional methods of teaching. The managers are also fortunate in that they will get an idea of how good their decisions are when they play the next year.

Acknowledgements

I wish to express my thanks to the following—

John Cooper and Tony Hilsden (PAC), who helped design and improve the game.

George Whitlam (Regional Economist), who provided the original suggestion for the design of the budget forms.

Bob McKillop and George Yeates (DPI headquarters), who suggested improvements to the budget forms and the game.

Roland Freund and Ian Cooper (Vudal Field Station), who suggested improvements to produce the final draft of the budget forms and game.

The students of PAC, HAC and Vudal Field Station, who have played the game and provided us with the experience to improve it.

* In 1971-72 Martin Hallet, teacher at Goroka High School, developed a simple FMG based on annual crops, which is very useful for teaching the principles of gross margins.

USE OF HERBICIDES UNDER MIXED COCONUT AND COCOA STANDS IN NEW IRELAND

By J.S. Ballard*

One of the problems in mixed coconut and cocoa stands is the growth of weeds, especially in areas which get a lot of sun. In some areas the ground may be completely covered with weeds.

Each month before the nuts are collected, it is worthwhile cutting the ground cover to make it easier to find the fallen nuts. Tall grass and weeds make it hard for the harvester to find nuts, so that the total number of nuts collected is less than it should be and uncollected nuts germinate where they have fallen.

Short grass also aids the collection of cocoa pods after they have been cut from the tree.

This paper describes a test using herbicides to kill weeds.

The purpose of the test was to see if weeding costs could be reduced using herbicides and to make collection of all fallen coconuts and cut cocoa pods easier. Better growth of the cocoa trees and coconut palms was also expected.

Methods and materials

The weeds found in the area used for this test were as follows:

Main weeds—

Thurston grass *(Paspalum conjugatum)*
Centrosema pubescens
Pueraria phaseoloides

Other weeds—

Kunai *(Imperata* species)
Crowsfoot grass *(Eleusine indica)*
Carpet grass *(Axonopus compressus)*
Paspalum paniculatum
Leucaena seedlings with stems up to 12 mm across
Lantana camara
Broomstick *(Sida rhombifolia)*
Mimosa pudica
Unidentified ferns
Various glossy-leaved creepers at ground level
Yams *(Dioscorea* species) growing up some cocoa trees

Spraying mixtures

First of all a blanket spraying was done.

The term blanket spraying means that all the ground areas have spray put on them. The aim is to kill off all unwanted plants in the area; any regrowth is spot sprayed to keep the area free from these plants.

About six months later, spraying was done to weeds that had grown up again.

Six months after this, another spraying was done.

Several different chemicals were used each time spraying was done, so as to kill a range of weeds. The following chemicals were used during the programme.

Gramoxone
Sodium chlorate
Ansar 529
Amoxone 50
Butoxone 80
Dowpon
Wetting agents Lissapol and Agral

Various formulations were tried. The effectiveness of Gramoxone alone was compared with a "cocktail spray" containing several chemicals. The formulations tried are given in the Appendix. The most effective and economical formulations are given in the Recommendations.

The first spraying was carried out 14 to 28 days after weeds in the area had been cut. The area contained mature coconuts underplanted with mature cocoa. Some parts of the area had no coconut palms or cocoa trees on them for one reason or another. Comparisons could therefore be made between light shade, medium shade and dark shade conditions.

No damage or sickness was noticed in the coconut palms and cocoa trees as a result of

*Mr Ballard, NDA, MRAC, MATA, is at present Manager, Suma Plantation, New Ireland Province.

Cost of chemical control of weeds under coconut and cocoa stands may in some cases be less than the cost of cutting weeds by hands.

spraying herbicides. However, care should be taken so that the chemicals do not get sprayed on to any green parts of the plants, especially the cocoa trees.

Results

Effects of different chemicals

First spraying—Gramoxone alone. Gramoxone is a contact herbicide that gives rapid kill of green plant tissue. In strong sunlight, the kill is quick but not very lasting. However, in dark shade the kill is not as quick, but it is better.

Because Gramoxone kills weeds quickly it can be sprayed an hour before it rains and the rain will not wash it off before it has killed the weeds.

Where Gramoxone was sprayed, all plants died back within 3 days. After 6 weeks, leucaena, lantana and other woody plants had grown again. Kunai recovered quickly and flourished. Centrosema recovered and spread quickly, especially where there was light shade.

Average control from Gramoxone was 62 % at 6 weeks and 38 % at 8 weeks after the first spraying.

It was noticeable that the weeds grew again much more quickly after Gramoxone spray than after the "cocktail spray" (see below). This is because Thurston grass *(Paspalum conjugatum)* is not killed properly with Gramoxone and it was the dominant grass.

First spraying—cocktail spray. Sodium chlorate and Ansar 529, which were included in this spray, are both contact herbicides having slight movement with the plant. Both are general herbicides but Ansar 529 is very good for controlling Thurston grass *(P. conjugatum)* which was present in large amounts.

Amoxone 50 was also included. This chemical is moved within the plant and kills many broad-leaved plants and some

germinating grass seedlings. However, it is risky to spray Amoxone 50, which contains 2,4-D, where young cocoa is growing because it can kill the cocoa.

It has also been reported that MSMA (in Ansar 529) has caused temporary zinc deficiency symptoms in young cocoa.

Where the "cocktail" was sprayed, all green leaf was killed within 3 days. At 6 weeks, leucaena and lantana had grown again and kunai had reappeared. Mimosa was killed under shade, but not in open areas. Centrosema was growing again in open areas and so were grasses, although not as strongly as in the open areas where Gramoxone only had been sprayed.

Because the chemicals in the "cocktail" are slower to kill than Gramoxone, they can be more easily washed off the leaves by rain. The makers of Ansar state that MSMA will not work as well if it rains within 4 hours of applying. The makers of Amoxone 50 say that kill may be less if rain falls within 6 hours of application. It was noted in the trial that when it rained soon after applying the "cocktail" the kill was less than when it did not rain.

The average control at 6 weeks after the first spraying with the cocktail was 83 % and at 8 weeks 64 %.

Spot spraying. Some weeds in the trial were not controlled by the first spraying and needed spot spraying. These weeds were leucaena and kunai, which were treated with Butoxone 80 and Dowpon respectively.

Second spraying. The second spraying was done about 6 months after the first spraying. Because of the weed height, it was necessary to cut some of the area before spraying.

Plant growth over the ground at the time of the second spraying was between 20 and 100 %. As a comparison, 91 % of the area previously sprayed with Gramoxone was covered with weeds, whereas only 57 % of the area sprayed previously with the "cocktail" was covered with weeds.

Although there was still more pueraria, centrosema and Thurston grass than other weeds they were still not growing as strongly as before except in large open patches where there was no shade. *Euphorbia geniculata* began to appear.

Average control at 6 weeks after the second spraying with Gramoxone was 85 % and 68 % at 8 weeks, and with the "cocktail", was 67 % and 56 %.

Third spraying. For the third spraying, Ansar was not available, so a mixture of Gramoxone and Amoxone 50 was used instead of the "cocktail".

This round was done about 6 months after the second spraying, but it was more of a spot spray than before, although ground covered ranged from 5 to 100 %.

Average control at 6 weeks after the third spraying,for Gramoxone only, was 67 % and at 8 weeks 57 %.:

After the third spraying was finished, the main weeds remaining were as follows:

Imperata species) Patches of weeds
Euphorbia geniculata) in light shade and
Leucaena) open areas.

Paspalum conjugatum)
Centrosema pubescens) In shady areas.
Pueraria phaseoloides)
Peperomia pellucida)

Other weeds becoming more noticeable were:

Dioscorea species
Ipomoea species
Eleusine indica
Paspalum paniculatum

with *Sida rhombifolia, Lantana camara, Mimosa pudica, Chloris barbata* and *Axonopus compressus* also found occasionally.

In Gramoxone-sprayed areas there was an increase of centrosema and pueraria in the lightly shaded areas. Although the legumes centrosema and pueraria are desirable because they fix nitrogen, grass is preferred under coconuts because nuts are easier to collect in grass. However, in open areas, a centrosema or pueraria cover-crop is useful in preventing other weeds, such as kunai, from growing.

Since the spraying, no serious problems have arisen through trying to control weeds, although a minor case of erosion was noticed.

Conclusions

Much better control occurred where the cocktail was applied. This is because the cocktail controls Thurston grass better than Gramoxone, and Thurston grass was the worst weed.

There has been a change in the kind of weeds growing in the area over the year, especially in areas where the same chemical was used throughout. There were some weeds that were not killed by the chemicals sprayed

because they are resistant to those chemicals. These weeds became the main weeds. Other herbicide mixtures must be used to control them.

Cost comparison

A cost comparison was made between costs of labour for cutting weeds monthly, and the six-monthly spraying programme with intermediate spot spraying.

The number of man-days for manual slashing, on the control plots, was 20 m-d per ha per year. The average labour for each slashing round was 1.7 m-d per ha.

The number of man-days for chemical control averaged 4.8 m-d per ha per year.

This was made up of—

2.6 m-d per ha for the first spraying;
1.5 m-d per ha for the second spraying;
2.1 m-d per ha for the third spraying.

The cost of chemicals had to be added to the cost of labour for the spraying rounds.

Although in the first year chemical weeding costs were greater than the cost of manual slashing, the author feels that chemical costs in following years would be much less because there are fewer weeds.

Since the test was carried out in 1972 and 1973, labour and chemical costs have increased - labour costs by 80 % and chemical costs by about 9 % only. This means that chemical control is far more competitive with manual control now that it was three years ago.

RECOMMENDATIONS

No two spray situations are the same. Before any spraying is done the general condition of the area should be considered and the following questions asked.

What is the amount of shade given by the crop? What is the amount of weeds? What kind of weeds? Are they growing strongly? Is the crop at a stage of growth when it could be damaged by the chemicals? What kind of chemical is need to kill the weeds?

There are many kinds of herbicides on the market that kill different kinds of weeds. Your local agricultural officer can advise you on the best kind to use.

The following chemical mixes were found to give satisfactory control of weeds in mixed coconut and cocoa stands. An average of about 208 l per ha was used through the whole trial.

First spraying. Use "cocktail" spray.

2.3 kg sodium chlorate
2 840 ml Ansar 529
570 ml Amoxone 50
140 ml Agral
200 l water

Second spraying. Six months after first spraying

850 to 1 140 ml Gramoxone
230 ml Agral
200 l water

Third spraying. Six months after second spraying.

850 ml Gramoxone
280 ml Amoxone 50
230 ml Agral
200 l water

Spot spraying. The following spot spray mixes were found to be effective.

Kunai *(Imperata* species). Spot spray 6 to 8 weeks after the general spray application. If necessary spray again 8 weeks later with the same mix.

2.7 kg Dowpon
60 ml Agral
200 l water

Leucaena seedlings. Slash seedlings first to 15 mm. Then allowto grow again up to 45 mm in height, then spot spray. If necessary spray again 12 weeks later with the same mix.

570 ml Butoxone 80
60 ml Agral
200 l water

The mixtures are made in 200 litre drums by adding the chemicals to 200 l of clean water (not salt water). Dirty water can cause some chemicals to lose their power to kill. Each chemical in turn should be well mixed with the water, especially mixtures containing Amoxone 50 (2,4-D), otherwise the action of all the chemicals is likely to be affected and the kill not good.

The mixtures are applied using knapsack sprayers. In our test we used Anchor brand knapsack sprayers that hold 18 l of liquid. 0.4-E Agri-Jet nozzles were used.

The spray operators should wet the leaves to a point just before the chemical runs off to the ground. Therefore, more chemical will be used where there are a lot of tall weeds.

Care should be taken, so that the chemicals do not get sprayed on to any green parts of the

coconut or cocoa trees, especially the cocoa trees.

If the weeds are tall, it is best to cut them 2 to 4 weeks before the first spraying.

The best results are obtained when the grass and weeds are sprayed when they are between 150 and 360 mm high. If higher than this, spraying costs will increase, because more spray will be needed.

Spraying can be done twice in the first year. This is usually enough.

In open areas, where the sunshine allows a lot of weeds to grow, it is best to spray about every 18 weeks. However, in areas of dark shade with a good stand of coconuts and cocoa, an interval of 29 weeks is reasonable during the first year.

After the first year, there will be fewer weeds, so that spot sprays only will be needed in the second year.

Acknowedgements

I am grateful to Mr W. J. Grose, Managing Partner of Poliamba Estates Pty Ltd, Kavieng, for instigating the spraying programme and giving permission to publish this paper, and to Mr J. S. Womersley, formerly Chief, Division of Botany, Department of Forests, Lae, of the positive identification of the plant species mentioned herein.

APPENDIX

Chemicals used:

Gramoxone (200 g paraquat ion per litre)
Sodium chlorate
Ansar 529 (399 g of monosodium methanearsonate per litre)
Amoxone 50 (2,4-D amine at 499 g per litre)
Butoxone 80 (2,4,5-T butyl ester 798 g a.i per litre)
Dowpon (85 % w/w dalapon as sodium salt)
Lissapol
Agral

Mixtures tried:

Gramoxone	Cocktail
First spraying	*First spraying*
1 136 ml Gramoxone	2 268 g sodium chlorate
284 ml Lissapol *or*	2 941 ml Ansar 529
142 to 227 ml Agral	568 ml Amoxone 50
200 l water	142 ml Agral
	200 l water
Second spraying	*Second spraying*
Same as above	2 268 g sodium chlorate
	1 136 ml Ansar 529
	568 ml Amoxone 50
	142 to 227 ml Agral
	200 l water
Third spraying	*Third spraying*
Same as above	852 ml Gramoxone
	284 ml Amoxone 50
	142 to 227 ml Agral
	200 l water

Spot spraying—

Leucaena: 568 ml Butoxone 80
57 ml Agral
200 l water

Kunai: 2 722 g Dowpon
57 ml Agral
200 l water

HANDBOOK ON WEED CONTROL

Weed Control in the South Pacific, edited by M. Lambert. Southern Pacific Commission, Noumea, Handbook No. 10, 1973: 119 pages.

This handbook, edited by South Pacific Commission agronomist Michel Lambert, is available for $A 1.00, post free, from—

SPC Publications Bureau
PO Box 306
Haymarket NSW 2000
Australia.

The handbook is written in relatively simple English, and is well illustrated. It will be very useful for Papua New Guinea application.

It describes all the most important herbicides which are available in the South Pacific countries. It goes on into calibration and application of herbicides. There is a big section on the use of herbicides in different crops, including pineapples, bananas, pastures, coffee, coconuts, cocoa, taro and so on.

There is a bibliography at the back which is very useful. An appendix with the chemical names of herbicides and the trade names which are used in the South Pacific is also useful.

H. Gallasch

SOUTHERN HIGHLANDS PROVINCE

By Paul E. Kahata, Provincial Rural Development Officer

Paul Kahata is from Lae in the Morobe Province. Since graduating from Vudal Agricultural College in 1968, he has worked for the Department of Primary Industry as an extension officer in the Morobe, Madang, East New Britain and Southern Highlands Provinces. After leaving Vudal he was in Lae and Mutsing, in the Morobe Province, then Dumpu, Saidor and Madang in the Madang Province, until 1971. In 1971 he attended an agricultural extension course at Queensland University, then spent four months touring around Queensland, looking at extension techniques used by the Department of Primary Industries in Queensland, and at beef production methods used in Queensland. After returning from Queensland he was posted to Rabaul for a year, and after a period in Port Moresby for study he went to the Southern Highlands Province, in 1974. He became PRDO in the same year.

Mr Kahata is married, with two children. His wife Lin is a school teacher in Mendi.

The climate of the province is typically rhighlands" with cool nights and warm days, but is generally wetter than other provinces. The average rainfall exceeds 3 300 mm, varying from 2 360 mm at Kaupena in the Ialibu subprovince to Pangia with nearly 5 080 mm.

Temperatures range between 21 °C and 0 °C, with the average high at about 18 °C.

The most conspicuous feature of the climate is the lack of seasonal contrast. The average number of rain days at all stations is about 230 per annum.

Much of the province is mountainous. The mountainous area would cover roughly 41.1 % of the total area of the province.

Plains occur over 8.3 % of the total area and are basically in the Ialibu-Kumbeme area to the south of Mt Giluwe, and in the Mendi-Tambul area to the west of Mt Giluwe, in the Tari Valley area south-west of Koroba, around the shores of Lake Kutubui and in isolated parts of river valleys.

The remainder is hills, slopes, ridges, terraces, etc.

Limestone base soils are widespread. Soils derived from sedimentary rock, volcanic derived soils, and small areas of alluvial flood plains and swamps occur in other areas.

Paul Kahata

The land with high potential for crops and grazing occurs mainly between 1 220 and 1 525 m in altitude, with a minor part between 1 000 and 1 000 m.

Areas above 2 300 m, and all the limestone areas, are generally unsuitable for all forms of agriculture.

There are three major road systems. These are the old Mount Hagen to Mendi road, and the new Mount Hagen to Mendi road, and the Highlands Highway, which connects the province through the major towns in the highlands to the port of Lae.

The three eastern subprovinces, Ialibu, Kagua and Pangia, can be reached by road, as well as Mendi, Poroma, Nipa and Margarima in the centre of the province.

Until recently air transport provided the only link within the province and with the rest of the country. Altogether there are 21 airstrips in the province.

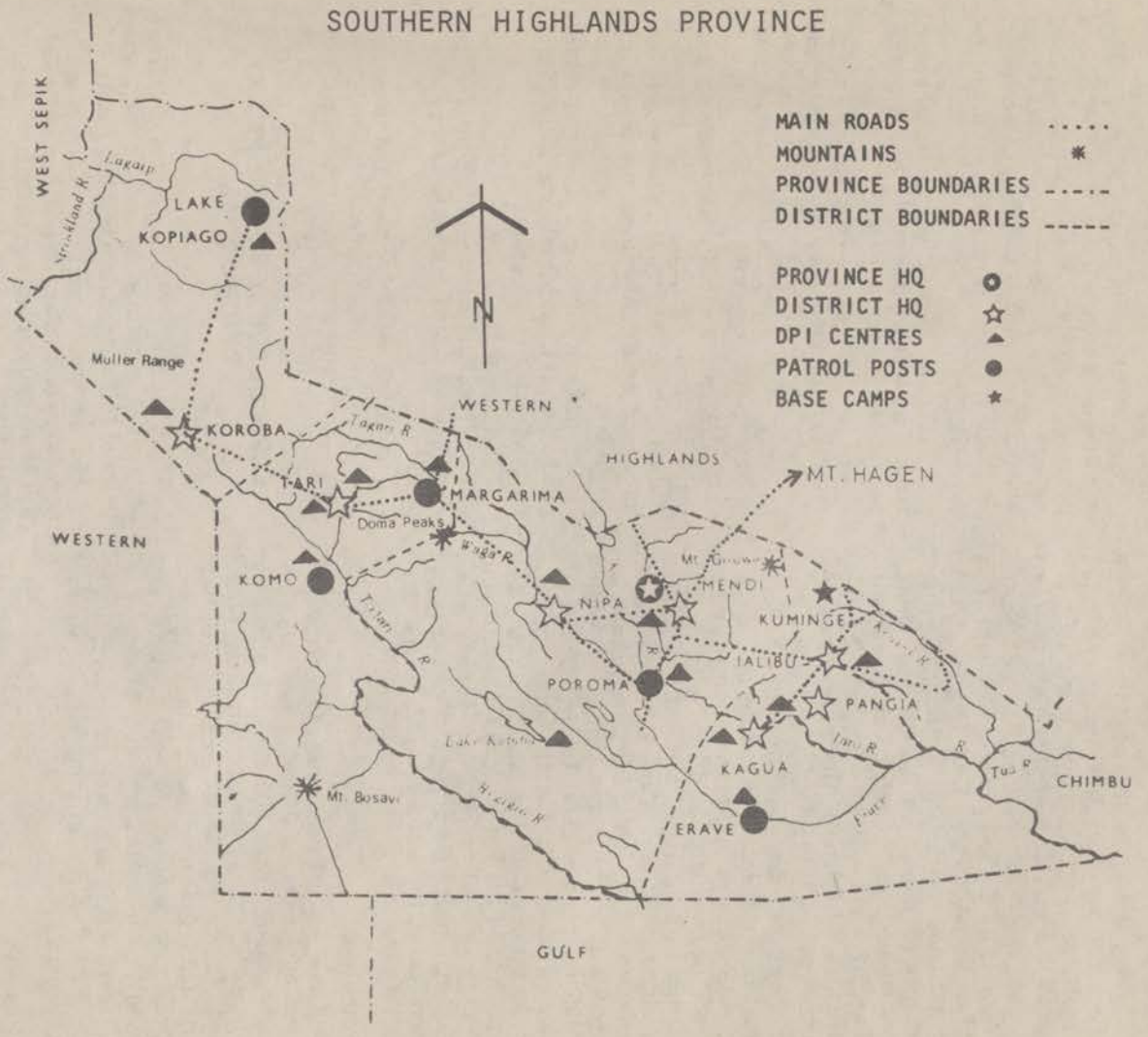
Telephone links major centres in the province with the rest of the country.

People

The total population at present is estimated at 220 000.

Because of the incidence of malaria below about 1 400 m, approximately 97 % of the population live above 1 400 m.

Total Southern Highlands population density is 7 per km^2, with a maximum of 83 per km^2 in a small area around Koroba.


SOUTHERN HIGHLANDS PROVINCE
MAIN ROADS
MOUNTAINS
PROVINCE BOUNDARIES
DISTRICT BOUNDARIES
PROVINCE HQ
DISTRICT HQ
DPI CENTRES
PATROL POSTS
BASE CAMPS
N
WEST SEPIK
LAKE KOPIAGO
Muller Range
KOROBA
WESTERN
WESTERN HIGHLANDS
MT. HAGEN
TARI
MARGARIMA
Doma Peaks
KOMO
NIPA
MENDI
KUMINGE
IALIBU
POROMA
PANGIA
KAGUA
ERAVE
Mt. Bosavi
CHIMBU
GULF

The main language groups are the Huli (Tari area, part of Koroba and Margarima), Duna (Koroba and Lake Kopiago), and Imbongu (Ialibu and part of Pangia, Mendi, Nipa and Poroma).

Kagua and Pangia also have their own dialects.

There are 14 local government councils. Each member of the Area Authroity is usually a president or a nominated member of a council. The Area Authority meets quarterly.

Members of parliament are Andrew Wabiria (Koroba-Kopiago), Matiabe Yuwi (Tari-Komo), Ibne Kor (Nipa), Tombol Unganaibe (Poroma-Kutubu), Momei Pangial (Mendi), Yano Belo (Kagua, Minister for Housing and Supply), Turi Wari (Ialibu-Pangia) and Ron Neville (Southern Highlands Regional). All are also members of the Area Authority.

Leaders are mainly members of parliament, local government council presidents, area authority members and the traditional village leaders. Some notable leaders are Matiabe Yuwi, MP, Andrew Wabiria, MP, Turi Wari, MP, Undi Nandi, president of the Ialibu LGC and junior vice-president of the Area Authority, Andrew Andaija, president of the Tari LGC and senior vice-president of the Area Authority, Posu Ank, president of the Area Authority and president of the Lai Valley LGC, and Tubiri Wagep, president of the Mendi LGC, chairman of the Development Authority and member of the Land Board and the Area Authority.

Education

There are 104 community schools, with a total enrolment of 25 000. There are three high schools, with 900 students attending. There are four vocational centres. The Mendi and Erave vocational centres are both oriented towards basic building and machinery studies and the Pangia and Koroba centres are agriculture biased.

There is only one teachers' college, run by the Asia Pacific Christian Mission in Tari subprovince.

Missions

The three main missions in the province are Catholic, United and Lutheran. Many other missions also operate in the province.

Economic development

The agriculture potential of the province is far from clear. Present levels of cash cropping are low, and it is difficult to predict future development. The problem is simply that no cash crop capable of absorbing anywhere near the total land and labour available in the Southern Highlands Province has so far been identified.

Coffee is the main crop, with small holder plantings of about 600 000 trees. The various local government councils are promoting coffee plantings and an increase in smallholder plantings could be expected.

Cattle is also an expanding industry in the province.

Pyrethrum, previously an important cash crop, is now unimportant due to a low price paid to the grower.

Private enterprises run trade stores, sawmills, trucking and a garage in the province. Several Papua New Guinean owned trucking firms and building contractors operate in the province.

The Department of Primary Industry and the Southern Highlands Development Authority have put forward a proposal for an integrated area development project for the province.

The proposal involves coffee, tea, cattle, rural health and road development as well as a nutrition research programme.

Total cost of the project is estimated to be over K 10 million and it is hoped that foreign aid will be found to finance a large proportion of this.

The World Bank is considered to be the most likely source of finance. It has indicated that it may send a project appraisal team to PNG before the end of 1976.

AGRICULTURAL DEVELOPMENT PROGRAMME

Coffee

There are about 695 ha planted to coffee, and coffee plantings by smallholders are believed to be more than 600 000 trees.

The various local government councils now have coffee planting programmes which will boost coffee plantings in the province six times. There are 12 such developments, with areas of 16 to 40 ha. They are being funded by the economic branch of the Area Authority, and the Development Authority.

In smallholder plantings, expansion of approximately 30 % has been achieved in the past year.

Rural development assistant Peter Nemehi visiting a village cattle project.

Interest in coffee planting is good in most areas. Management and per capita plantings, however, are generally low.

The present Department of Primary Industry extension programme is to increase smallholder plantings by 230 ha to 923 ha.

This programme will continue over the next few years. Coffee pruning will be emphasized in the extension programme. Extension officers will aim to improve productivity by improving harvesting and processing methods, to improve parchment quality.

By 1980 we hope to reduce the need for government-run nurseries.

Local enterpreneurs show management problems in purchasing parchment coffee. The department will assist them to overcome these problems. We aim to ensure that all sound coffee produced is purchased, and to increase purchasing by private buyers.

By 1980 we anticipate that a significant proportion of production in the Pangia, Ialibu, Kagua, Erave and Mendi areas will be purchased by private buyers.

A research trial has been established at Pimaga, which is only at 800 m, and much warmer than the rest of the province, to compare the performance of Robusta and Arabica coffee.

Cattle

There are 386 smallholder cattle projects, with over 2 800 stock, and about 2 500 cattle on large properties or missions.

Interest in cattle is high and widespread in all parts of the province.

Present aims are to increase stock numbers to 3 176 and projects to 443, during 1976-77.

A 500 ha project will be started at Lavani. By 1979 this project will be 20 % stocked, and should have 250 head by 1981.

At present stock has to be purchased from outside the Southern Highlands for new projects. At times there have been delays in getting stock. However, the Sugu Bulmakau Company, set up by the Development Bank in the Sugu Valley, aims to eventually have 1 000 breeders, and when fully developed will be able to supply stock for new projects in the province.

A programme of pasture improvement at present underway aims to increase the area planted to improved pasture by at least 50 ha in 1976.

Health control is carried out, including supervision of slaughter floors at Kopiago, Koroba, Tari, Ialibu, Kagua and Pangia.

A new slaughter slab is to be built at Komo

There is a need for a road from Kopiago to

Koroba, so that Kopiago cattle can be slaughtered and marketed at Koroba. This is planned for 1978-79.

Chillies

This crop is very popular in the lower altitude areas. It has been proved to grow well in Erave, Prooma, Pimaga, Komo and Lake Kutubu areas.

Present Plantings are 195.4 ha. Present production is 27 tonnes.

Interest in chillies is growing, particularly in the Lake Kopiago and Erave areas. However, in Pimaga, the main production area, people are becoming involved in other rural improvement projects.

The Department of Primary Industry purchases chillies. Poor access to some areas around Lake Kutubu leads to partial harvesting. The department will endeavour to ensure that all production is marketed.

Aims for this crop include increased plantings from 195 to 272 ha by the end of 1976-77. Lai Valley and Kagua expect significant expansion in 1977-78. A replanting and pruning cycle is being promoted to maintain production. Improved drying methods will be encouraged to improve quality.

If old plantings are replaced and productivity kept up, and if overcoming transport problems enables complete harvesting, then this means a production potential of 136 tonnes per annum. This expansion will be carried out if there is a good market for chillies.

Fisheries

Trout are being introduced into the province's rivers. The introduction of trout is doing well. Demand for fingerlings outstrips supply. In 1975, 120 000 fingerlings of rainbow trout were raised from eggs imported from Australia, at the Komia establishment.

Interest in carp is low except for some institutions.

Rivers where trout have been introduced are being surveyed to check progress of the trout, and to check the effects of the trout on the river ecosystems. Rivers surveyed so far have shown trout doing well and breeding.

Extension officers will talk to people to gain acceptance of the need for protection of trout laying sites.

A trial of trapping local trout and incubating green eggs will be started at Komia this year. By 1978 developments at Komia will include a race and two small holding ponds. Two temporary traps for trout may be needed. By this time we should be able to decide whether trout eggs are still needed from Australia.

Piggeries

There are at present 114 pig projects with 581 stock.

Only piggeries with good management are able to survive economically due to the high cost of protein food.

Hence, expansion is not expected, unless food costs can be reduced. In the Koroba area, the number of piggeries is declining.

Trials were planned for last year on the use of soyabean for pig food. Lack of seed held up trials, but seed increase plots were established. Work on this programme, aimed at reducing the cost of protein food, will continue.

Sweet potato grazing trials are also being carried out.

A pig breeding centre has been established at Kagua.

However, the programme aims only to maintain stock at approximately present numbers, and to improve management at all viable piggeries. Owners of uneconomic piggeries will be encouraged to close down.

No major expansion of piggeries will be planned until protein food costs can be reduced.

Poultry

Again, there is a very low level of extension due to high good costs. No new projects are planned.

Subsistence

The main problems in this area are seasonal food shortage due to unplanned planting patterns, and child malmutrition. Much of the problem is due to commitment of able-bodied men to wage employment and other economic activities.

The Southern Highlands Province Nutritional Committee was formed recently to assist in policy planning aspects.

At Piwa research trials with subsistence crops are being carried out.

The Department of Primary Industry keeps a watch on food shortage and frost problems.

Extension officers are encouraging people

to plan their plantings to give continued food supply, and they are encouraging diversification of crops.

Extension officers are also encouraging use of soil fertility building practices.

Conservative attitudes to establish practices and patters are slowing progress in this area.

Vegetables

Extension in vegetable growing is undertaken throughout the eastern part of the province where access is good. Supply of vegetables to local markets has been achieved, but there is some irregularity of supply of particular vegetables.

Approximately 1 tonne of vegetables was bought last year by the Fresh Food Project.

Interest of farmers is variable. The future aims for this programme are to expand production of cabbages, carrots and potatoes, in Pangia, Ialibu, Kagua, Mendi and Nipa subprovinces. The Fresh Food Project will purchase all sound produce.

The cool store at Mendi will be completed in 1976-77, and one will be built at Ialibu.

The Oktedi market will be investigated to see if they can buy Southern Highlands vegetables.

Extension officers will continue to encourage expansion, and to emphasize improved cultivation methods and quality. If the Oktedi market develops, vegetable production in the western part of the province will be increased in about 1978. Vegetables will probably be shipped by air from Tari or Koroba.

Pyrethrum

This was previously an important cash crop. However, enthusiasm fell due to a low return paid to the grower. It is now not an important activity. Only the Margarima area produces a small amount (about 50 kg) for sale. However, in this area cattle is becoming the main activity.

Present plantings are approximately 7 ha.

The Margarima local government council has a project to plant 20 ha in 1976-77.

Any expansion of the industry beyond this depends on the results of the Margarima project.

Tea

There are two major tea plantations—the Peregai tea estate and the Catholic Mission estate.

A smallholder tea scheme at Wangiabugl in Ialibu subprovince caters for 12 smallholder tea growers.

Wildlife Officer Michael Aukugo (left) and village people at Was cassowary farm.

Both the two plantations and the smallholders sell their green tea to a factory in Mount Hagen.

There are 22 ha of smallholder tea. There are no plans as yet to increase the small tea growers, either their size or numbers.

Extension officers will concentrate on improving pruning, plucking and crop hygiene. In 1976-77 the programme will encourage farmers to own their own tools.

A permanent tea-buying shed will be built at Wangiabugl.

Other crops

Research is being carried out into several minor crops. These include tobacco, bixa, cardamon, pepper, fruit, soyabeans and orchids.

Tobacco

Trial plots have been established at Poroma and Nipa, in association with the local government council. Further developments will depend on the trial results.

Bixa

All bixa available will be purchased to assess production capacity. This is to enable an assessment of overseas markets. Japanese interests have shown some interest in the crop.

Farmers through Kagua subprovince and the Pimaga area will be encouraged to harvest, whereas up to now the Department of Primary Industry only purchased what the farmers wanted to bring in in the Erave area.

In 1975 all production was purchased, but not much was harvested.

Cardamon

Trials are being carried out with cardamon at Erave and Pimaga. The future of this crop will depend on the results of the trial.

Bees

Bees may be investigated in future if a bee expert is recruited for PNG. It is considered that this may be a very suitable industry for the province.

Wildlife

Investigations are being carried out into cassowary, butterfly and crocodile programmes.

A cassowary research centre at Kiburu was almost completed last year, although progress was delayed by land problems. Trial run sales of cassowary to local people were successful. Fourteen birds were sold at K75 to K80.

In 1876-77 sales of young birds from the Kiburu centre will begin. Twenty young birds will be sold to local growers, for them to raise to a marketable size.

By 1977 results of feeding trials at the research centre should be available, and extension workers will be able to pass on these techniques to growers. Sales of young cassowaries to growers will be increased to 50.

Feeding a young cassowary at Was cassowary farm.

The research centre will also start observations of breeding pairs.

Field investigations on wildlife by workers based at the research centre may be spread to other highlands provinces after 1978.

A wildlife management area is being established at Siwi-Utame. Another management area at Erave will be investigated this year, and if negotiations prove successful, will be established in 1977-78.

Butterfly business prospects are being investigated.

Last year the wild crocodile population in the Mt Bosavi area was investigated. A large population was discovered, indicating that this may be a suitable area for the establishment of crocodile farms.

CENTRAL PROVINCE

By Joachim Kupe, Provincial Rural Development Officer

Joachim Kupe comes from Kapau village in the Manus Province. After attending school at Bundralis in the Manus Province, and Mongop high school in the New Ireland Province, Mr Kupe went to Vudal Agricultural College in 1968. His first job after graduation was as a livestock officer at Kurakakaul, in East New Britain. He was then posted to Popondetta as provincial livestock officer for the Northern Province. He left Popondetta in June, 1973 to understudy the job of PRDO in Port Moresby. During 1974 he spent two months at Sussex University in England, at a seminar on food and nutrition, under a British Government Technical Assistance award. He was appointed PRDO for the Central Province in April, 1975. Mr Kupe's wife Ludwina formerly worked as a teacher. They have four children.

Joachim Kupe

The Central Province consists of the south coast of the mainland island, from Cape Possession to Orangerie Bay, a distance of 407 km. The northern border is the watershed of the Owen Stanley Range. The distance from the coast to the watershed of the ranges varies from 100 to 30 km.

The province is one-third coastal plain and two-thirds foothills and mountain range giving a total area of 34 457 km².

One of the important factors about the Central Province is that it contains Port Moresby, the administrative centre and the national capital of Papua New Guinea with an area of 225 km².

The Central Province has a high potential for agricultural development. The arable area is approximately 75 %; 25 % is being used in cash crops, subsistence agriculture and timber lumbering while 50 % is unused. The remaining 25 % is swamps, mangroves or mountains not suitable for farming.

The soil varies from the coastal plain and river beds of sandy to alluvial soil to clay in the inland and mountains, several of which are rocky.

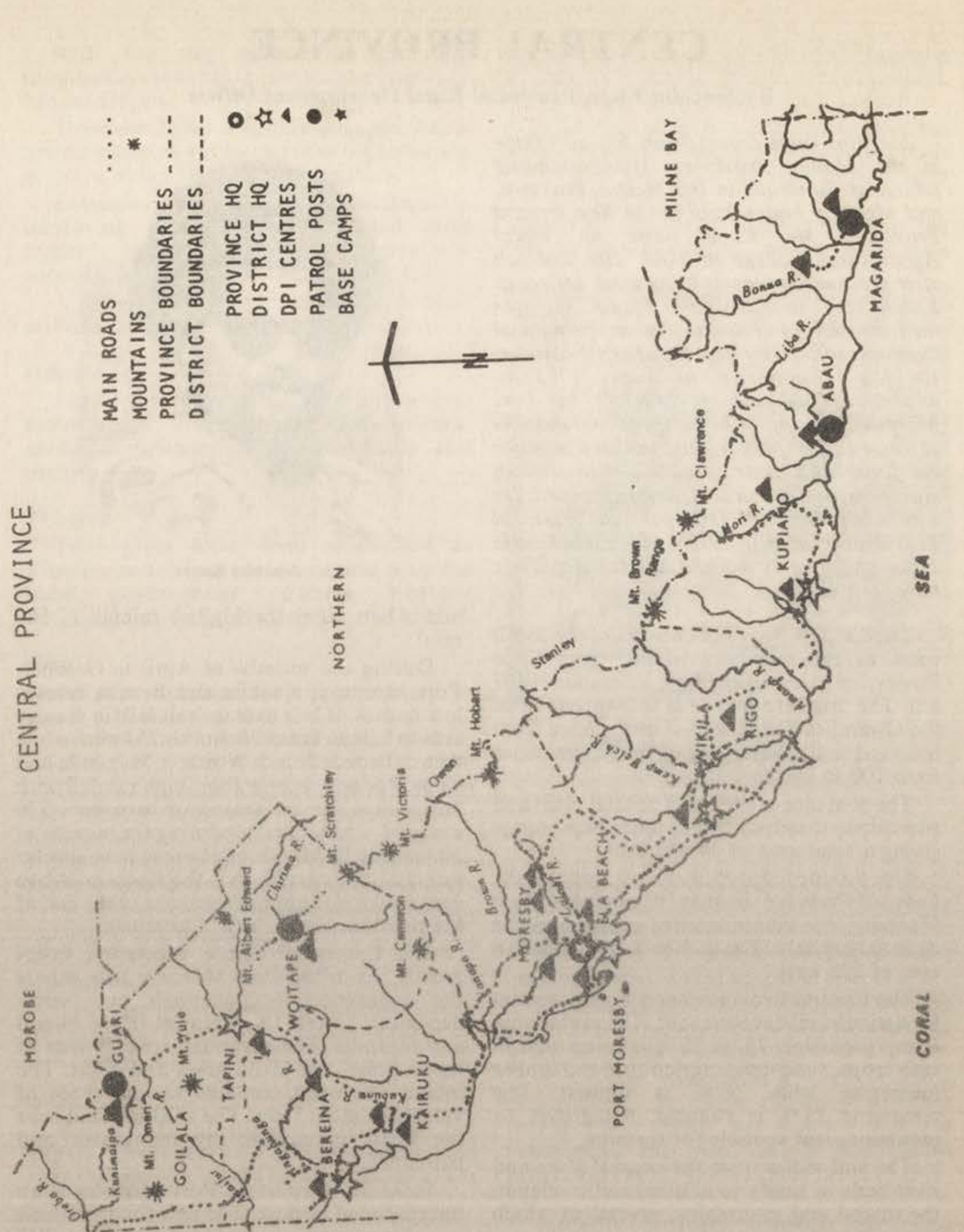
The province's annual rainfall is light compared with other nearby provinces such as the Gulf and Western Provinces. Within the province Port Moresby has the lowest rainfall (1 016 mm). The districts of Goilala and Abau have the highest rainfall (2 500 mm).

During the months of April to October, Port Moresby, Kwikila and Bereina receive low rainfall. Their average rainfall for the dry season ranges from 76 mm to 254 mm, while Abau, Tapini, Guari, Woitape, Magarida and Cape Rodney receive their high rainfall with an average for the season of between 1 270 mm and 1 524 mm. But during the months of November to March most areas have similar rainfall—the exception is the Kupiano-Abau area which has opposite seasons to the rest of the province, i.e. a "dry" Christmas.

The Central Province vegetation varies greatly, from the Port Moresby area, where the vegetation is savannah and semi-deciduous forest, to rainforest in the inland and foothills. The savannah area consists of kunai grass, kangaroo grass and pitpit. The inland rainforest contains various types of valuable timber trees. The swampy land near the coast is covered by mangroves and pandanus.

Jacksons Airport in Port Moresby is an international airport. The new runway which is under construction will be suitable for 747 Jumbo Jets. There is a total of 27 smaller airstrips in the province.

There are about 1 600 km of road in the province, half of which are able to stand heavy traffic. The two main highways are Port


CENTRAL PROVINCE
MAIN ROADS
MOUNTAINS
PROVINCE BOUNDARIES
DISTRICT BOUNDARIES
PROVINCE HQ
DISTRICT HQ
DPI CENTRES
PATROL POSTS
BASE CAMPS
N
NORTHERN
MILNE BAY
MOROBE
GULF
CORAL
SEA
GUARI
GOILALA
TAPINI
WOITAPE
BEREINA
KAIRUKU
PORT MORESBY
MORESBY
LA BEACH
KWIKILA
RIGO
KUPIANO
ABAU
MAGARIDA
Mt. Yule
Mt. Albert Edward
Mt. Scratchley
Mt. Victoria
Mt. Cameron
Mt. Hobart
Mt. Brown
Range
Mt. Clewrance
Stanley
Owen
Chirima R.
Brown R.
Kemp Welch R.
Bonua R.
Musa R.
Mori R.

Moresby to Bereina known as the Hiritano Highway and the Port Moresby to Rigo highway which is going to be connected with Kupiano. There are numerous feeder roads.

The Asian Development Bank is lending K 7 500 000 to PNG to extend and improve the Hiritano Highway. A road will be constructed to connect the Tapini to Guari road with the Hiritano Highway, via the Kubuna to Bakoiudu road. The improvements to the highway will allow a large increase in vegetable production in the Bereina and Goilala areas, for sale in Port Moresby.

With the improvements and extensions to the Hiritano Highway, the Asian Development Bank forsees an increase in sales from the Bereina area from about 8 000 tonnes in 1978 to 50 000 in 1997, and to 18 000 tonnes from the Goilala district in 1997.

Outstations along the coast not accessible by road are served by a fleet of small ships.

The province is very fortunate in having transceiver radios in all settlements, patrol posts and centres. A few of the district headquarters have telephone services.

People

The estimated 1976 population of the National Capital District consisted of 93 000 Papua New Guineans and 18 000 expatriates. The population of the remainder of the province is estimated at 130 000.

There are 34 main language groups in the province, with a large number of groups from other provinces.

The main religious groups are the Catholic, Anglican, Jehovah's Witness, Salvation Army and Seventh Day Adventist. Missions are involved in agricultural development, small-scale industry, road development, health and education.

The diet of the Central Province people varies from coastal to inland and mountain areas. The people of the coast mainly live on fish with banana, yam, cassava, sweet potato and taro, with other coastal crops. The coastal area around Port Moresby experiences food shortages during the dry season but a large number of people are employed and are able to buy food from stores.

In the highlands of the Goilala district shortage of food can occur due to singsings, crop diseases or frosts.

The Central Province has numerous aidposts and health centres. Port Moresby has a general hospital and a number of other hospitals are administered by the government and private organizations. the standard of health is generally good but there are incidences of malnutrition in both the urban and rural areas.

The people of the Central Province generally speaking have as their aims: to gain better education, to establish primary and secondary industries, and to improve the standard of living in their areas.

Land disputes are one of the major problems, as is common throughout Papua New Guinea.

The people of the Central Province are highly educated compared with the Papua New Guinea average.

There are 138 community schools, including 14 which teach the Australian curriculum, 11 high schools, 2 teachers' colleges, 1 technical college and 16 vocational centres.

In addition to these educational institutions, a wide variety of other types of education and training is covered in the Central Province, by national colleges and training centres. Situated in or near Port Moresby are the following: University of Papua New Guinea, Administrative College, Papuan Medical College, Dental College, Posts and Telegraphs Training Centre, Police College and Police Training Depot, Electricity Training College, National Broadcasting Commission Training College, China Navigation Company Seamen Training School, Army Recruit Training Depot, Corrective Institute Bomana and the Public Service Commission Training Centre.

There are numerous self-help groups functioning throughout the province.

Political

Political awareness is high in the province.

There are three active political groups, namely Papua Besena Movement, Numea Association and Negos.

The members of the National Parliament have all contributed to the Department of Primary Industry's efforts for agricultural development.

The members are: Regional, James Mopio; Goilala, Louis Mona; Kairuku-Hiri, Stanton Ronald Slaughter; Moresby Coastal, Gavera Rea; Moresby Inland, Sir Maori Kiki; Rigo-Abau, Reuben Taureka; National Capital

Irrigation farmer Edea Umia, from Kerekadi. Mr Umia is watering a crop of corn.

District, Josephine Abaijah.

The Central Provincial Government was established on 29 June, 1976.

There are 11 local government councils including the Port Moresby City Council.

The councils have all been engaged in some agricultural development projects in their areas.

Economy

The main cash crops are coconut, fish, vegetables, rice, rubber and cattle.

The Central Province is fortunate as far as the advisory services of the Department of Primary Industry are concerned.

Two-thirds of the agricultural potential of the province is not tapped due to such reasons as land disputes and lack of resources.

About 80 % of available labour are prepared to engage in some sort of work to earn cash while 20 % carry out subsistence agriculture.

Port Moresby is the main industrial and shopping centre with numerous tradestores and banks.

The Papua New Guinea Banking Corporation has agencies in all the districts of the province.

There are seven settlement schemes with rubber and other cash crops.

The Office of Business Development is encouraging community groups to establish Savings and Loans Societies in numerous parts of the province. However few of these are very successful.

AGRICULTURAL DEVELOPMENT PROGRAMME

Fresh foods

At present, fresh foods are the highest income-earning cash crop in the Central Province.

In general, people in rural areas grow their own food, but most of the food consumed in the National Capital District is purchased.

Using a per capita consumption figure of 475 kg of fresh food per annum, it has been estimated that the total consumption of fresh foods for the province would be 132 000 tonnes, with 50 000 tonnes consumed in the National Capital District.

It is interesting to note, from the following figures, that an estimate of the actual consumption in Port Moresby adds up to only 43 025, leaving a shortfall of 7 000 tonnes.

These figures suggest that some people in Port Moresby may be short of food.

It is estimated that the following quantities of fresh foods are consumed by people in the National Capital District per annum—

	tonnes/ annum
Imported by Food Marketing Corporation from Lae and highlands	2 600
Imported from overseas	3 000
Produced by Central Province farmers for sale in National Capital District	22 000
Produced by National Capital District backyard gardeners	125
	27 725

Cereal products replacing traditional staples, mainly imported from overseas, are as follows—

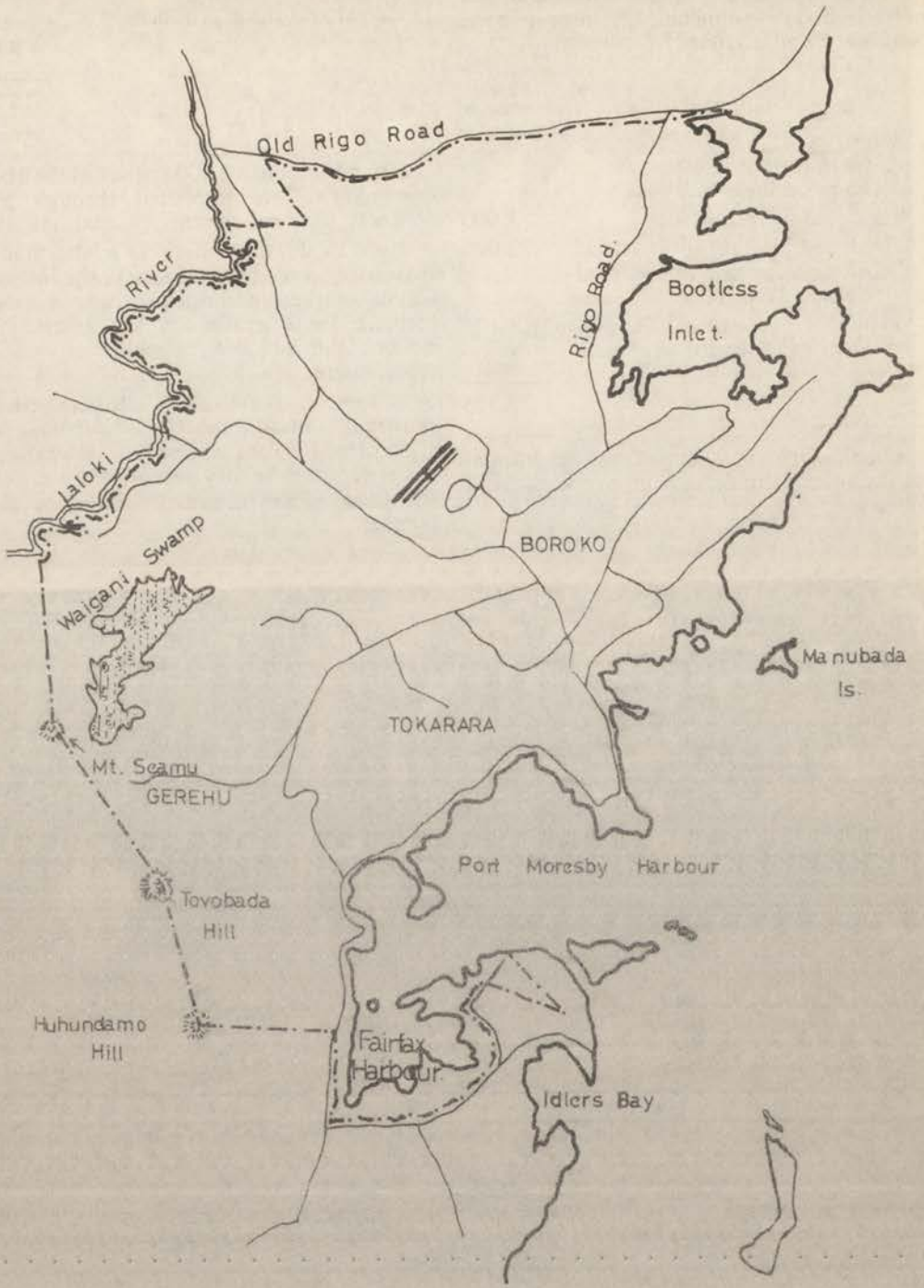
	tonnes/ annum
Flour	7 000
Cereal and flour products	300
Rice	8 000
	15 300

(An additional 10 000 tonnes of the above commodities are imported through Port Moresby for rural centres, plantations, etc.)

It is likely that there is a shortage of reasonably priced fresh foods in the National Capital markets, and this programme aims to increase local production to correct this before this before aiming at import replacement.

People in rural areas also experience shortfalls. Food shortage problems are aggravated by poor soil, the low rainfall, and the eight months' dry season. Farmers also sell food which should be eaten by their families.

Mr Umia's family weeding a garden.


NATIONAL CAPITAL DISTRICT
Old Rigo Road
River
Rigo Road
Bootless
Inlet
Laloki
Waigani Swamp
BOROKO
Manubada
Is.
TOKARARA
Mt. Scamu
GEREHU
Port Moresby Harbour
Tovobada
Hill
Huhundamo
Hill
Fairfax
Harbour
Idlers Bay

The overall aim of the programme is to encourage farmers with road access to Port Moresby to eventually provide the people of the National Capital District with sufficient reasonably priced fresh foods to replace imports from both outside Papua New Guinea and other areas such as Lae and the highlands.

Along with this aim it is important that the people in rural centres and villages also become self-sufficient and develop a farm output that will provide them with an adequate and nutritious diet.

The national government has provided an outlet for fresh foods with the establishment of a wholesale fresh food market in Port Moresby, and the Port Moresby City Council has built market facilities at Waigani, Gordon, Hohola, Morata, Boroko and Kilakila. There is also the large, almost traditional, market at Koki.

The government has also established a 50 ha vegetable farm at Moitaka.

A village farm-gate buying service which was started last year was discontinued as people were dissatisfied with prices and operational expenses were too high.

Planting material is sold to farmers when required.

A machinery service has been organized, so that farmers can hire tractors and implements to plough their ground. This is very important, as the amount of labour needed to dig hard ground using hand tools makes vegetable-growing unattractive compared with other activities such as paid employment or fishing.

The 1976-77 programme includes the following.

One thousand citrus trees will be distributed at Kuriva and Kapogere.

Farmers will be encouraged to plant a further 200 ha of vegetables along the Hiritano Highway.

Two small irrigation plots have already been established near Port Moresby, and four more will be introduced. Two or three field staff will be trained in irrigation techniques.

Pamphlets on gardening techniques will be designed in three languages and distributed.

Production of the more perishable food will be encouraged closer to Port Moresby.

There will be an intensive propoganda campaign to encourage people to produce sufficient food to satisfy both subsistence and cash crop needs.

In 1977-78 it is expected that production could increase by 10 000 tonnes. With population growth the deficiency of fresh foods will still be considerable. It is expected that a further 300 ha will be cultivated this year.

Field staff will receive more training on irrigation and in 1978-79 the Department will set up a group of irrigation extension technicians. A further 200 ha will be cultivated, including 10 to 20 irrigated farms.

If the above programme is successful and population growth remains at 8 % the amount of food imported will be reduced by 75 % by 1979-80.

As roads are developed to isolated areas such as Mt Koiari and Goilala, more farmers will become productive.

The Central Province should be self-sufficient in most fresh foods by late 1981. Rice and flour imports would be the exception but these could be halved as locally produced staples take their place.

Fresh foods—National Capital District

Last year the Department of Primary Industry investigated the practicability of increasing the level of backyard food production to make the urban dweller more self-sufficient. Two field officers were involved full-time on liaising with interested groups, leaders, housewives etc.

It is estimated that out of a total Papua New Guinean population in the National Capital District of 96 400 there is a potential for home food production among about 70 % of families, with an average area per producing household of about 122 m^2 (0.012 2 ha). The total potential home garden area is about 100 ha.

Seventy per cent represent 8 360 suburban holdings. Some 5 000 families are excluded as they are either on blocks without suitable garden land or are settlement families without land.

The possible yield per household garden is 100 kg per annum. The average number of people per household is eight.

There are also schools with an average potential garden area of 0.5 ha, where food can be produced for sale.

Along with the objective of self-sufficiency is the problem of overcoming the high rate of malnutrition among children caused

National Capital District rural development officer, Mrs Juana Hernandez, in front of a blackboard showing the crop - rotation schedule she designed for Port Moresby home gardeners. With Mrs Hernandez are (from left to right), Councillor Ara Geno, chairman of the Moale Youth Centre, PRDO Joachim Kupe, Councillor Francis Griffin, chairman of the Koki Market Trust and Councillor Mahiro Kivovia.

generally by their inability to obtain sufficient quantities of the right foods.

A 40 m^2 nursery has been established at the DPI office at Kilakila.

Demonstration plots have been established at Wariarata Scout Camp and Bavaroko community school, ranging in size from 200 m^2 to 500 m^2.

Vegetable seedlings are being distributed at 2 t each; 1 856 seedlings have been distributed this year. Packets of seeds are sold at 5 t to 15 t per packet. Two rotary hoes and 48 hand tools have been purchased for hiring out.

The Housing Commission and the Port Moresby City Council have set aside areas of land within the National Capital District city plan, and these areas will be developed as allotments for home vegetable growers.

The 1976-77 programme is as follows.

A small utility with driver and a trailer are to be obtained.

Radio programmes in English, Motu and Pidgin will be broadcast 15 minutes per week. A permanent provincial broadcast officer will be nominated from among the DPI staff, if a suitable person can be obtained.

Extension staff will increase contact with urban gardeners; we will attempt to contact 500 housewives through community groups and field days.

In conjunction with the Department of Health, 12 slide shows on nutrition will be held for urban gardeners, schools and community groups.

An exhibition at the Port Moresby Show in June will show examples of small vegetable plots and poultry houses suitable for suburban gardens.

Two pamphlets on poultry and one on gardening are planned.

The use of manure and compost will be encouraged on field days.

As well as carrying out the extension programme, the Department will liaise with other departments to solve land and water shortages.

The programme over the next four years will continue along the same lines. The amount of home garden land available for cultivation will be increased to 216 ha by 1980-81. The number of housewives reached by extension workers will be 750 in 1977-78, 1 130 in 1978-79, 1 690 in 1979-80 and 2 530 in 1980-81.

Urban dwellers will be encouraged to grow 1 500 chickens, increasing to 5 160 chickens

National Capital District housewife, Mrs Hau, with her family in the garden at her home in Gerehu. The Hau family moved into their home five months ago, and now have tomatoes, chinese cabbage, corn, pumpkin, cassava, bananas, beans and sweet potato growing.

by 1980-81.

Farm Machinery Hire Service

This service was established last year. At the time there were approximately 50 privately owned tractors and equipment in the Mekeo area, and more at Rigo, but their owners were reluctant to lease them, so the Department decided to provide a service.

Tractors and farm implements were bought by the government, and hired out to farmers and groups who have insufficient funds to buy their own machinery.

The rice-growers in the Mekeo area were the first to use this facility. In 12 months they paid K18 000 for hire of the machinery.

An important part of the aim of this programme is to encourage farmers to produce more fresh foods for the Port Moresby market. The cultivation of hard ground using hand tools, especially where labour was short, was discouraging to would-be vegetable growers, and was restricting production and providing only a low income for the farmers.

The Department now provides machinery for hire to these vegetable growers, plus technical advice.

Sufficient tractors and equipment were obtained to meet farmer demand along the Hiritano Highway and at Kupiano.

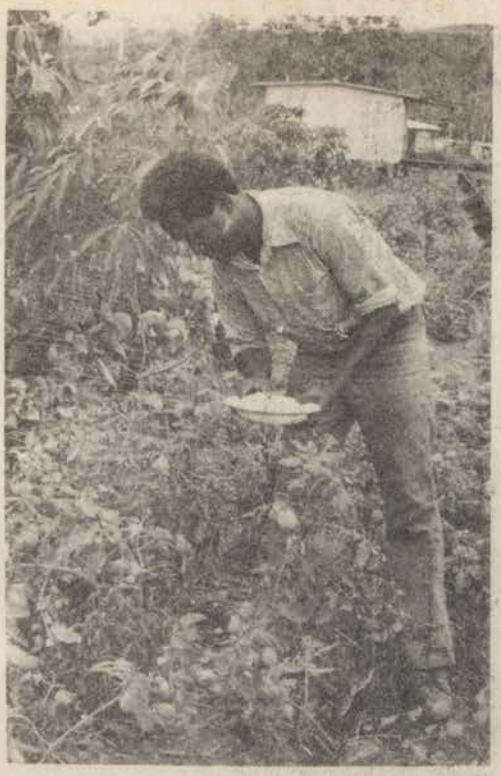
There are about 200 to 300 ha with potential for vegetable growing waiting for this machinery.

In 1976-77 the requirements for equipment will be further investigated, and the correct equipment, particularly rice harvesters, will be made available.

Ten farmers and DPI operators will be trained in a two to three week course at Bereina on the technicalities of operation of tractors and setting of farm equipment to achieve maximum efficiency.

Five or six farmers will be selected for a trial planting of Metro corn for fresh food and stock feed.

Trials on mechanized pasture development will be conducted in March, 1977, and if they are successful a field day will be held at Rigo



Rural development assistant Anthony Aisau picks a good harvest of tomatoes from Mrs Hau's garden.

to demonstrate the techniques.

Four new tractors and six trailers and two row-crop planters will be purchased, and a new rice harvester if required.

In 1977-78 the farm advisory service and operator training will be increased to cater for an additional 100 farmers on the Hiritano Highway. Further small irrigation units will be introduced, particularly in the Port Moresby area. Three more tractors and, if necessary, another rice harvester will be obtained.

In 1978-79 farmers using the service will be increased to 600. The service will be introduced in a small way in isolated areas such as Mt Koiari and Goilala, when roads are built into these areas.

Along the Hiritano Highway, and in other areas where the service will have been operating for three years, farmers will be encouraged to become self-sufficient in machinery, beginning in 1979-80. At the same time the equipment will be directed to new areas i.e. Goilala, Mt Koiari and Cape Rodney.

Fisheries

The Department of Primary Industry provides freezers and arranges a market for fish, and advises fishermen.

Last year portable freezers and ice boxes were positioned at Hula, Deboin, Hisiu, Poukama, Bereina, Kupiano, Abau and Kapakapa. Frozen fish was transported to the Food Marketing Corporation for sale in Port Moresby.

The freezer at Hula was later moved—it was successful for a time, then people stopped fishing, so it was moved to another spot.

Low prices are a cause of lack of interest in selling fish through the freezer, but freshly caught fish sell readily at high prices in town markets. People also stop fishing when they have sufficient money for their immediate needs.

In 1976-77 five more freezers will be installed. Staff at freezer locations provide advice about fishing, handling of fish and maintaining and running of the freezers.

School leavers will be trained to take an interest in fishing in suitable areas.

In 1977-79 village groups will be encouraged to take over the village freezers.

An investigation was being carried out last year into processing of tilapia. Extension staff are advising villagers on improved handling and processing of fish, with a view to having processed fish available when there is a shortage of fresh fish.

Last year 3 000 trout fingerlings were released at Gosipi near Woitape, and 3 000 in the Lowa River near Tapini. If this introduction proves successful more high altitude rivers will be seeded in 1978-79.

Rice

In 1975 there were 240 ha planted to rice, in the Mekeo area, and production was 528 tonnes. About 40 farmers were involved.

Although the area planted increased last year, there was no improvement in production per hectare. Production could be higher if thorough weeding were done. Another problem was that farmers were sowing non-viable, weedy and weevil-infested seed, and using poor varieties.

Some rice plots and other good potential land are under dispute.

A plan to set up a rice trial and

demonstration plots at Cape Rodney was not achieved last year.

In 1976-77 a rice trial and demonstration plots for villagers will be planted at Cape Rodney.

Mekeo plantings will be increased to 500 ha and growers to 70.

The Department will plant 20 ha at Bereina using varieties IR8, IR9 and NG 6637 short stem which will be weeded before harvest to produce clean seed of pure variety.

Farmers will be encouraged, through their own organization, the Mekeo Rice Growers, to plant clean seed only of the best variety, and to clean-weed their plots.

Plans will be completed for the rice mill at Bereina, which will include facilities for sun-drying and ratproof storage.

Harvesting problems will be resolved, and a second harvester will be purchased if necessary.

In 1977-78, through development of new areas at Cape Rodney, the area planted will be increased to 600 ha. More encouragement will be given to small village farms. The new rice mill at Bereina will become fully functional, and a small mill will be established at Cape Rodney.

In 1978-79, if problems such as insects, disease and processing are manageable in small village plots, this aspect could be developed to 100 ha.

A Provincial Rice Growers' Association will be formed with the object of developing self-sufficiency in the industry—harvesting, processing, marketing etc.

In 1979-80 large-scale mechanized dry rice farming at Cape Rodney will be developed to 200 ha.

The total area for the province will increase to 1 000 ha. With improved management, production could reach 3 000 tonnes.

By 1980-81 the more successful farmers will be planting 50 to 60 ha, and will be completely independent in cultivation and planting machinery. Some could own harvesting machinery, and lease it to other farmers.

Subsistence

The Department provides encouragement and advice to subsistence gardeners, and maintains a constant watch on the food garden situation so as to anticipate possible food shortages and problems of malnutrition.

Extension officers aim at improving the methods of farming used where appropriate, to increase food production at the village level and improve the overall level of nutrition.

Planting material, particularly more nutritious vegetables, is made available for distribution to farmers.

School leavers will be encouraged to play a greater role in subsistence agriculture.

Cattle

There are 157 village cattle projects with 1 800 head. There are 22 large cattle stations with 3 734 head.

The abbatoir at Tiaba near Port Moresby kills 150 head of village cattle per annum, and 1 400 head of plantation cattle per annum. The slaughterhouse at Tapini kills 100 head per annum, half of which are mission-owned.

Cattle project development is progressing slowly—the level of interest is declining.

In village cattle projects the estimated calving survival rate is 40 %.

Village cattle project management is poor. The cattle training scheme is ineffective because young trainees leave projects to take up other employment.

Copper deficiency in the Karuama area of the Goilala district caused death of about 150 cows at calving last year.

With the exception of the Sogeri area the province is free of ticks.

In 1976-77 the level of assistance and advice will be improved by better positioning of experienced staff. Field staff will visit projects once every three months in all areas. They will maintain a high level of reporting to the Development Bank on management and loan repayments of 150 projects with bank loans.

Two projects at Marshall Lagoon will be stocked with 20 head, two at Kapogere with 20 head and 1 bull, one at Tapini with 5 bulls and 24 heifers, and 8 bulls will be distributed in the Mt Koiari area.

In future, only cattle project owners will be accepted for training courses. Twenty farmers will be trained per year.

Two "sick" paddocks of 1 ha each with improved pasture will be established at DPI stations in the five districts of the province.

Tick control will be maintained in the Sogeri area. Tests are at present being carried out in copper-deficient areas, and a copper deficiency correction programme will be

implemented when the test results are known.

In 1977-78 plans will be made for slaughterhouses for Kupiano and Bereina, and these will be completed in 1978-79.

With improved management, solution to the copper problem, and better allocation of advisory services the number of village cattle should reach 3 500 head in 1978-79.

Takeover of expatriate-owned stations by Papua New Guineans is expected to begin in about 1977-78, and it is possible that all Central Province cattle will be owned by Papua New Guineans by 1980-81. The total number of cattle in the province should be 8 000 to 10 000 head, provided managerial levels improve.

Rubber

Rubber is planted in 200 village plots and 500 block holdings. The total area of mature rubber is 445 ha, with 497 ha of immature trees. Production is 195 tonnes per annum.

There are also 30 plantations, totalling 9 500 ha, with an annual production of 4 800 tonnes.

On village blocks, people tap according to their need for money. At present the price is stable, and growers are satisfied with the price. Tapping is increasing in the Cape Rodney area and the factory is nearing its limit. Cape Rodney is also increasing plantings.

In 1976-77 up to 50 ha of bud-grafted rubber trees will be planted out from established nurseries at Cape Rodney and Bailebo.

New nurseries, with field potential of 30 ha, will be established in the Cape Rodney area. These nurseries will all be for budded material.

There are no plans for planting out trees from nurseries at Bakoiudu.

Three processing units will be established for Bakoiudu smallholders. A central factory will be planned for Kubuna if this if found to be necessary.

One-quarter of the farmers and half of the staff working on rubber will be trained on tapping and bud-grafting, by two Malaysian experts.

In 1977-78 a further 53 ha of budded material will be planted at Cape Rodney and Bailebo. In these areas it is anticipated that plantation production will decline due to old and uneconomical trees and labour shortages.

More nurseries with a potential for 28 ha will be established at Cape Rodney and Bailebo.

Cape Rodney could move into production of crepe rubber from cup lump and polybag collection.

In 1978-79 Cape Rodney will will probably begin to produce technically specified rubber, laboratory tested and rated on international standards, in place of RSS and crepe production.

In this area plantings will be increased by 25 ha, and nurseries with potential for 28 ha will be planted. This will be planted out the following year. Plantings will be increased by 28 ha each year.

At Kubuna, nurseries using polyclonal seed will be established. Ten hectares will be planted in 1980-81.

The bud-grafted rubber which will be used in the Cape Rodney and Bailebo areas is expected to produce at the rate of 1 500 kg per ha per annum, and seed rubber will produce 1 000 kg per ha per annum.

Prices are expected to remain stable during the next five years, although this depends on the price of artificial rubber.

By 1979-80 plantation production is expected to decline to 4 300 tonnes.

Coconuts

Last year the production of copra was 815 tonnes from village growers and 4 823 tonnes from plantations.

A large quantity of coconuts is sold through fresh food markets, particularly in Port Moresby.

Price fluctuation and the amount of labour needed discourage growers from producing copra.

In 1976-77 17 new copra driers will be constructed: 13 at Abau, 2 at Kairuku, 1 at Port Moresby and 1 at Rigo.

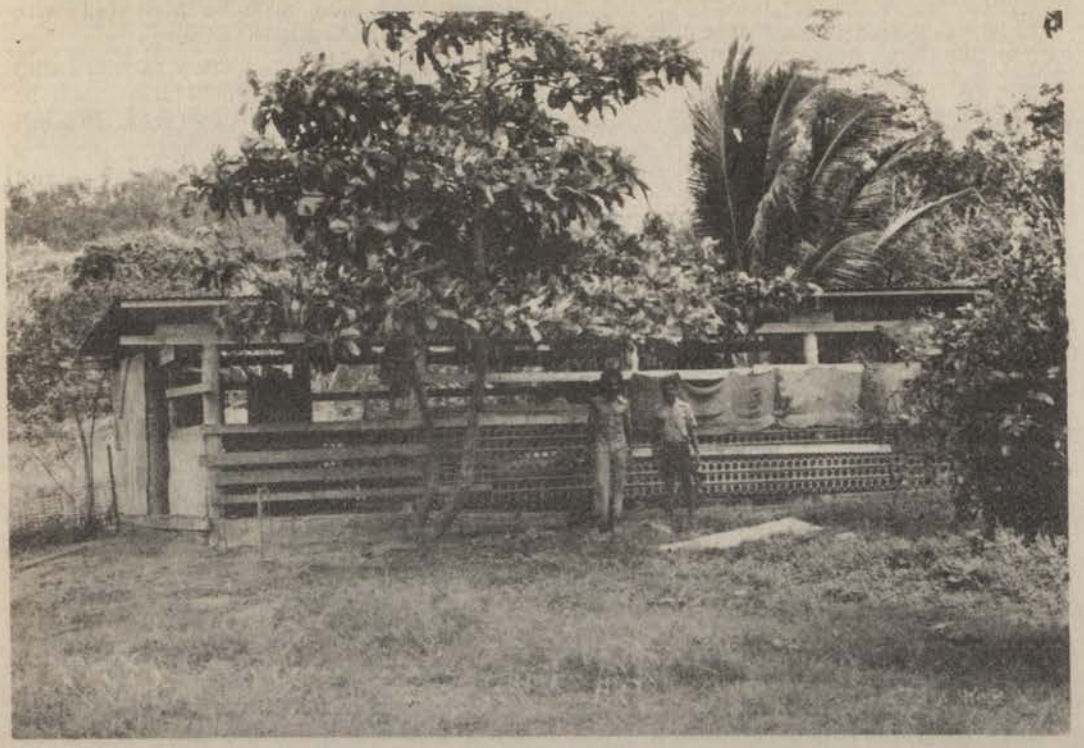
The area of coconuts in the Abau district will be increased by 62 ha.

Introduction of livestock under coconuts will be encouraged to reduce labour costs.

In future years, no increase of area is planned, but advisory services to farmers will be continued.

Coffee

In 1965 coffee rust was discovered in Sogeri and the Rigo Koiari. All coffee was



Pig house belonging to Mr Kedu Aruma, of Kerekadi.

destroyed in those areas and DPI staff have conducted regular 6-monthly inspections to ensure that no coffee is grown either deliberately or accidentally in the control areas. This prohibition will continue for these areas.

Last year 14.5 tonnes of Arabica coffee and 2.2 tonnes of Robusta coffee were produced. Main plantings are approximately 50 ha of Arabica in the Mt Koiari area.

Interest in coffee is low, although an increase of 10 ha was achieved last year. Price fluctuations have discouraged growers.

Management of coffee gardens could be improved. Growers neglect maintenance while the coffee flush is on, and for social obligations.

The 1976-77 programme is to rejuvenate all old trees, to improve maintenance on existing gardens and bring into production deserted gardens, and to encourage growers to increase their plantings to 500 trees per family. Fifty kilograms of Besuki coffee seed will be planted in nurseries in the Abau district. Statistical data will be collected.

Local government councils will obtain 30 coffee pulpers in 1976-77, and more pulpers will be bought in future years to achieve an adequate supply to villages.

A permanent coffee shed will be constructed at the DPI station at Efogi. As the Mt Koiari people are the most responsive, DPI field activities will be concentrated on that area. A continuing programme of Arabica nursery establishment will provide for expansion by 10 ha in 1976-77, 20 ha in 1978, 40 ha in 1979, 20 ha in 1980 and 10 ha in 1981.

Cocoa

There are about 7 ha of old low-yielding cocoa trees at Maipa in the Kairuku district. It is planned to increase this in 1977-78 to 12 ha using 12 000 clonal cuttings. This area will be served by a central fermentary costing K20 000, to be built in 1979-80.

It is doubtful if full potential will be realized until a road is put into the area.

Suitable areas for village cocoa plantings in the Abau district will be investigated in 1976-77. If necessary a DPI nursery of 3 ha of clonal cuttings will be planted for later

distribution.

Existing cocoa growers will be encouraged to improve their management techniques.

Wildlife

One demonstration crocodile farm with five crocodiles has been constructed at Bailebo in the Abau district.

There is growing interest in crocodile farming in the Abau district.

Feasibility studies will be carried out in areas where crocodile farms have been requested, including a study of availability of food, and projects will be established in 1976-77.

Extension officers involved in crocodile farming will be trained.

The Department of Primary Industry will purchase skins in the Abau district.

It is hoped that the industry will develop to a stage where by 1980 medium-sized community-owned farms each with 150 crocodiles will be established at Abau.

Pigs and poultry

There are 30 pig projects. Fifteen of these are moderately successful.

The Development Bank is reluctant to lend money for pig projects, as a number have failed.

In 1976-77 the Department will continue to encourage and improve the existing projects, and discourage the establishment of unsound piggeries.

The feasibility of setting up intensive pig-breeding projects in the Port Moresby district will be investigated. Other possible schemes for sound and viable piggeries will be investigated.

Pig farmers will be given necessary training similar to cattle farmers.

There are 15 newly started broiler poultry projects. A market has been achieved and the projects have satisfactorily passed the developmental stages.

Poultry farmers will be provided with training similar to cattle farmers.

Advice will be given to new farmers who want to keep poultry. Up to 20 farmers will be encouraged to join the supervised broiler-growing scheme in 1976-77.

Growing of peanuts, soyabeans, corn and sorghum for stock feed is being encouraged. By 1980, provided the fresh food programme is successful, farmers will be encouraged to develop 500 ha for the production of stock feed mainly along the Hiritano Highway.

Chillies, cardamoms, ginger, pueraria

Interplanting of chillies with rubber is being encouraged.

Further introduction of cardamoms in high altitude highland areas of the Central Province is planned for 1976-77.

Two hundred and fifty kilograms of ginger will be obtained for farmers in 1976-77.

One hundred kilograms of pueraria seed were produced for sale last year.

Sugar

The Department of Primary Industry has been conducting trials in sugar-growing for several years.

In 1964 overseas consultants confirmed that certain areas had suitable soil, climate and access for development of the industry. Following that, DPI representatives visited India and Australia to determine a development plan which would involve in particular the village farmer. Research work by the Department in the Markham Valley indicated that the varieties of Ragnar and Pundar were the most suitable. Several shipments of these were planted as one plot in the Kemp Welch area of the Central Province. This plot has now been successfully expanded to 20 ha. In 1976-77, bulking up in association with field research will continue in preparation for expansion of the project.

Implementation of the Kemp Welch sugar programme is dependent on adequate finance being available.

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