Integrating

Village Rabbits in

Papua New Guinean

Agriculture

Training course, September 1996

For women from the Oro, Western and Sandaun Provinces.

Trainers:-

Dr David Askin- NZ Baptist Mission

Dr Ian Grant, Agriculture Department, UniTech

Mr and Mrs David and Anna Kulombao

Mr Kolopa Paita

Mr Simon Joseph,

Mr Gombong

Contents:

Integrating Village rabbits in Papua New Guinean Agriculture

Dr David Askin,

PO Box 1135, Lae.

Introduction

Most Papua New Guineans are surprised to learn that there are two kinds of rabbits- wild and domestic or village rabbits. Almost everyone knows something about the wild rabbit problem in Australia. Very few know anything about the farming of domestic rabbits. Given the problems with wild rabbits in Australia most people here in Papua New Guinea are surprised to learn that domestic rabbits are farmed in 186 countries.

There have been many misunderstandings. Many Papua New Guineans have believed that any kind of rabbit would kill and destroy the native bush of Papua New Guinea. Even the wild rabbit of Europe, Australia and NZ does not ever live in the kind of bush found in Papua New Guinea. Few know that domestic rabbits were released in the mainland of Australia with the aim of forming hunting populations. They failed to establish on mainland Australia and only then were wild rabbits caught in Europe and brought to Australia. These wild rabbits have devastated much of the central and south of Australia- but they do not survive in the far north.

Few realise that domestic rabbits have been farmed in Irian Jaya for about 40 years. None are wild. The rabbits farmed in Papua New Guinea came from disease free stock in Australia, imported by Dr Ian Grant of the Agriculture Department, University of Technology in Lae.

A chapter of the book is devoted to the differences between domestic and wild rabbits.

Throughout the book the work of keeping rabbits is emphasised. Rabbit farming is not for everyone. It is hard work. As I write this the three rabbits that David Kulombao and I have with us need our time to go and feed them before writing can start. Rabbits need lots of fresh leaves every day. These three rabbits will get more kaukau (sweet potato) leaves and weeds at lunch time. They will get more tonight. Tomorrow also! Don't start with rabbits until you have carefully thought about the care they need.

Rabbits need daily care-

Don't start keeping rabbits unless you are willing to look after them.

Every day!

For those who enjoy their gardens, who have enjoyed working with other animal species, then read on. The integration of rabbits in your garden will repay your efforts. If chicken rearing in the Papua New Guinea way of buying 7 bags of feed and 50 day old chicks was too hard, then forget rabbits! There is much more work in rabbit farming than in that style of chicken farming.

This book differs from other books on rabbit farming. It is written for a specific place- Papua New Guinea- and is written with the integration of the rabbit into

traditional gardens in mind. Garden systems can be made more sustainable and rabbit farming is one way of improving soil and land management. The author first started working with reforestation, domestic rabbits and garden systems in the highlands of Irian Jaya in 1989. To the Lani people of Irian Jaya and particularly of the Baptist Churches of the North Baliem valley- my thanks and the dedication of this book. Kinaonak o. Wa Wa Wa.

The book is also written with the different climatic zones of Papua New Guinea in mind. Cool highlands offer different opportunities and challenges to the hot and dry lowlands of Port Moresby and both these environments are very different from the hot and wet of the North Coast and island provinces.

Finally different options are given. We realise that some people will feed their rabbits entirely on weeds and forages. Lani people in Irian Jaya have done that for 40 years. Others here in Papua New Guinea will make use of by-products of local industries such as sugar (molasses), coconut oil (copra meal) and palm oil (oil palm expella). Advice is given on the use of these products and other items that lead to small and larger businesses.

Why keep rabbits

Rabbits are farmed around the world

There are about 600 million farmed rabbits in the world. These are spread throughout the countries of Asia, Africa, Europe, North and South America, Australia and New Zealand. In nations similar to Papua New Guinea villagers find that rabbit farming can be an important source of meat, manure and money. Close to PNG rabbits are farmed in Irian Jaya, East Timur (Indonesia), Philippines, Malaysia and the Northern Territory. A survey paper presented to the 6th World Rabbit Congress in France (Colin M.; Lebas F., 1996) showed that rabbit farming is conducted in 186 world countries. People in small island nations such as Fiji, Tonga, Malta, Bahamas, Barbados, Cape Verde Islands, New Caledonia are farming rabbits.

Rabbits are farmed in 186 countries. There are 600 million farmed world-wide.

Village people need protein

Everyone needs protein to grow strong and healthy bodies and minds. Protein comes from meat, milk and legume seeds like beans, peanuts and soybeans. Each day, each family member needs to be eating protein. Legume leaves and seeds and pods are good sources of protein. Rabbit meat is lean, low in cholesterol and very high in protein.

The need for sustainability

For some in Papua New Guinea money from mining or forestry operations pay royalties that allow the purchase of tinned fish and rice. However one day those payments will stop. Now is the time to establish more sustainable and environmentally friendly use of the land. Soil erosion, fire and forest destruction cannot continue at the present rate if future generations are to have a healthy life. A truly Christian attitude calls for the care and management of a good world that God made. There is a need to manage the land in a sustainable manner,

growing vegetables, meat, cash crops and timber in the gardens. Domestic rabbits through their eating legume forage can stimulate better soil and land management and the provision of both food and work in the villages of this beautiful land.

Likewise chickens and ducks can be grown in the village without expensive feeds. However these home grown products will take a lot more time than the broiler chickens grown totally on pellets.

Why not chickens?

Chickens cost up to K14 and and many village people earn less than K4 per day as a casual worker.

Why choose to keep rabbits and not chickens? Chickens need expensive imported feeds. Rabbits grow well on feeds that we can grow in our gardens. Many weeds are good food for rabbits. Rabbits will always grow faster if they are fed some concentrate feeds like chicken pellets or copra meal based rations.

Fresh and tinned meat is very expensive in Papua New Guinea. If a farmer wants to rear chickens she will buy day old chicks and plenty of sacks of food from the didiman store. Transport costs may lift the price of one kilogram (kg) of food to over K1, and the price of the chicken to K14 or more. This helps to explain why many villagers have to work for more than one day to earn the money to buy a chicken to eat. Some villagers are working for more than one week to buy a chicken.

Rabbits and the Melanesian way.

With domestic rabbits, villagers breed their own, eat some and give some to their friends and relations. When wantoks (relatives) come rabbits are ready to kill rather than having to go to the store for expensive chickens or other products. Surely this fits in with the Melanesian way!

Rabbits are small enough to allow a family to kill one and eat it without needing a fridge to store extra meat. A 2 kg rabbit will be about 3-5 months old depending on growth rate. Some are reaching 2 kg at 10-11 weeks in the highlands when fed well.

A female rabbit should give us at least 16 live weaners each year. Some people are recording around 30 kits per year per doe. They are pregnant for about 31 days whereas guinea pigs are pregnant for 60-74 days. Rabbits can be pregnant 4 times in one year, with litters averaging 5 rabbits, but numbers in a litter vary from one to ten rabbits. Young does often have smaller litters.

All that is the good news. But wait. All this meat does not come free. We have to work, collecting forage and feeding our rabbits two or three times each day. Cages also need maintenance. Don’t start looking after rabbits if you and your family have not thought seriously about the work involved each day. Better still, start by talking to someone else who already has rabbits. Help them with the rabbits for a week. Then you will know what is involved.

Will rabbits harm gardens or bush?

For many years Papua New Guinean villagers have been taught that rabbits would eat their gardens and damage their bush. There are some important things to consider when thinking about rabbits.

Although raising rabbits is something new for Papua New Guinea, in many countries of the world rabbit production provides an important source of animal protein. These countries are not having their gardens or bush eaten by domestic rabbits that have escaped from cages and gone wild. Instead every year there about 20 to 30 million kilos of rabbit meat produced.

The village meat or domestic rabbit is very different to the wild rabbit of Australia or New Zealand. For instance the wild rabbit chooses to feed at night when predators are less likely to catch and kill them. The village meat rabbit feeds during the day.

The map below shows that the feral rabbit has been unable to spread into the northern areas of Australia. Grasslands there are similar to those found in Irian Jaya and PNG.

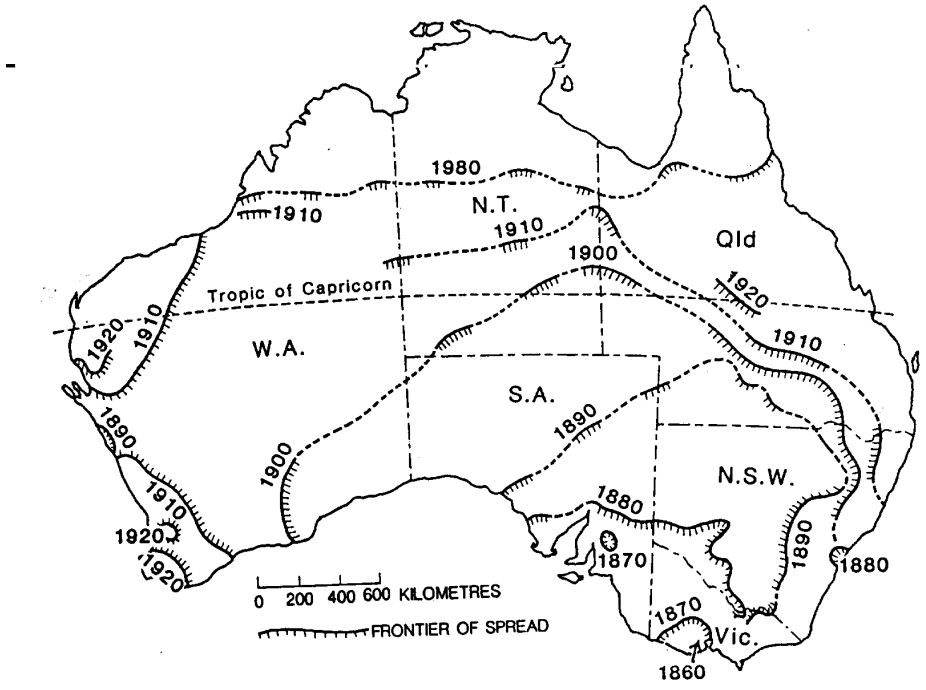


Figure 1. The spread of the wild rabbit showing that rabbits do not live in the tropical grasslands of northern Australia.

It is not the heat of northern Australia that stops the wild rabbits. Rather it is the very poor quality of the tropical grasses. Heavy rainstorms also flood burrows and there are many predators.

Domestic rabbits like those in PNG cannot survive in the wild of Australia or New Zealand. They can survive on isolated islands where there are no predators. In Papua New Guinea we have many predators. These include dogs, rats, pigs,

cats, hawks, snakes and hungry people. So a domestic rabbit will live for some time outside a cage, but only until a hungry predator catches and kills it.

Some people believe that the domestic rabbit could revert back to a wild type and form burrows here in PNG. This has not happened elsewhere. Furthermore an animal in a burrow is easily caught! Grass fires would quickly remove cover from the ground and show everyone, including hawks and village boys where the burrow entrances were.

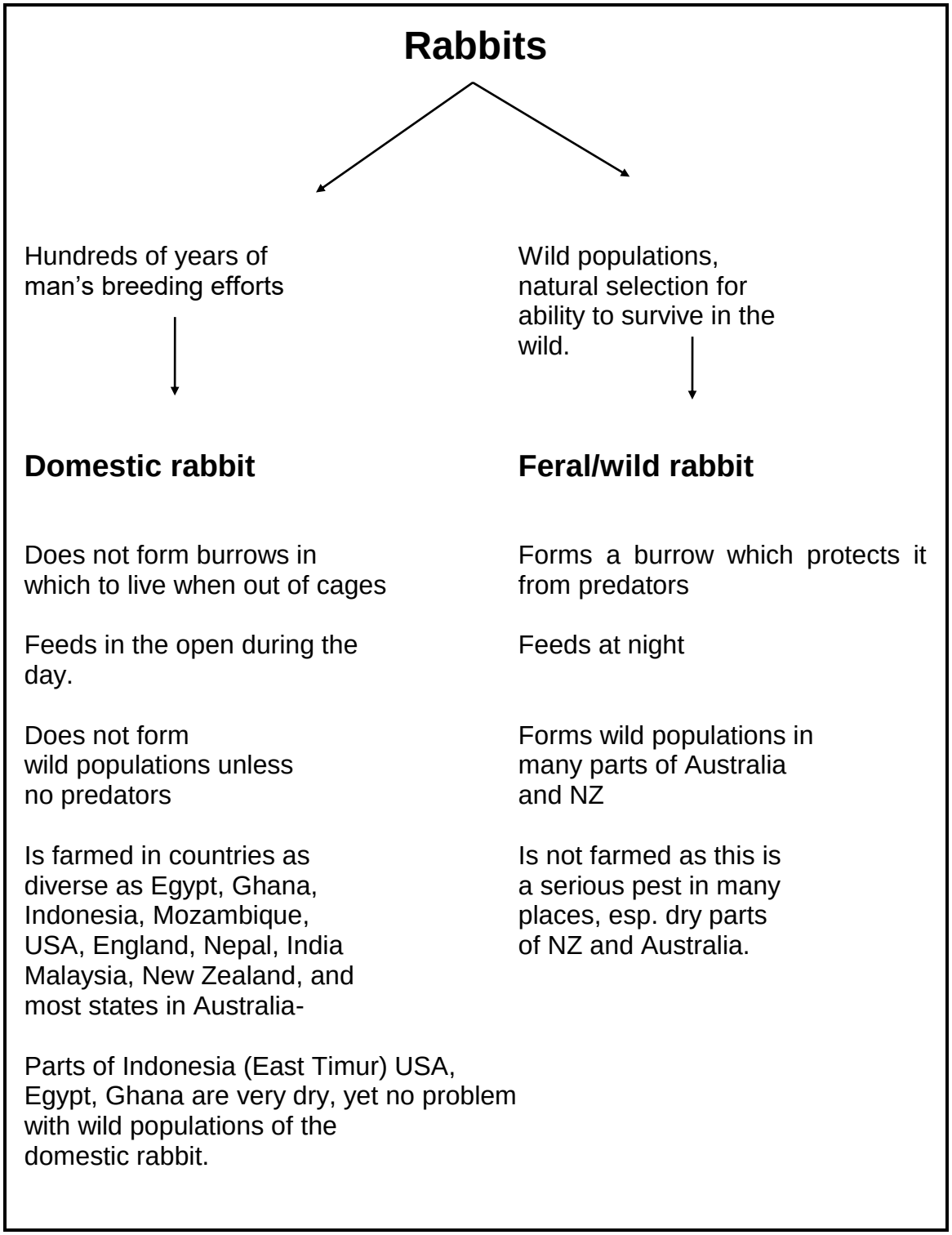
This kind of rabbit has been farmed by villagers across the border in Irian Jaya for about 40 years. No wild populations have ever established. Over there they also have many predators that would kill the rabbits. Rabbits commonly get out of their cages and can be seen hopping about under the cages. These are normally caught and put back into the cage. Those less fortunate end in someone elses pot and providing food for dogs, hawks etc.

All those interested in farming domestic rabbits must remember that the rabbits depends on the farmer for its food and care. If the farmer fails to provide this care, the animal suffers needlessly and dies.

Queensland is the only state of Australia where it is illegal for householders to keep domestic rabbits. The ban in Queensland is still in place even though the authorities admit that the domestic rabbit does not pose a threat to the environment. The keeping of domestic rabbits in Queensland is banned because of the fear that people will grow to like rabbits and therefore oppose the use of poisons or shooting of the wild rabbits. In the Northern Territory anyone may farm rabbits. There are no restrictions in New Zealand either.

Domestic rabbits have not lost all ability to dig burrows. These tunnels become escape mechanisms but Stodart and Myers in a three year study in Australia noted that cage reared domestic rabbits did not form burrows in which to live and hide from predators.

The figure below helps to summarise important differences between the wild and domestic rabbit.



How to get started with rabbits.

These steps should be considered when considering farming rabbits. Don't get too enthusiastic until you have considered these issues carefully.

? Talk with someone who is keeping rabbits well. It is easy to tell who knows how to look after rabbits. For <u>every</u> adult rabbit there will be about 5 young rabbits. Some babies, some half or nearly full grown.

? If possible work with that person for a week or two to see how much work is involved. If you want something for nothing, don't keep rabbits!

? Read about rabbits in PNG.

? Talk with your family. Keeping rabbits is likely to involve you all. The Bible teaches us that we are to care for and feed our animals. It is not a Christian way of managing animals to have starving, dirty animals in cages. Our rabbits should be contented, clean and well fed.

? Join or form a rabbit club- Help others with their rabbits. This will help everyone learn and bucks can be shared to stop in-breeding.

? Plant the beans (legumes) that rabbits need to grow well.

? Build a rabbit house with at least 4 cages.

? Get your rabbits, start with two does and one buck.

Important words of caution.

The section following details some of the common mistakes that have been seen by Dr Grant, Mrs Jill Hauschildt, myself and others over the last three years of evaluation and research here in Papua New Guinea.

⇒ <u>Full cages, but no young rabbits.</u>

This is perhaps the biggest problem for those starting out with rabbits. It cannot be stressed enough!

Be sensible- only keep as many rabbits as you can care for and feed well. Kill and eat rabbits as they get to 2 kg.

Consider the following. A family has bought two does and their first litters are growing. All the cages are full and there are lots of rabbits to feed. They haven't realised how many green leaves two does, one buck and ten young animals eat. They must not be greedy thinking of how many rabbits they could have if they waited and bred some more of these new, growing does. <u>Those young, 2kg liveweight animals need to be eaten or sold</u>. This after all is the reason why the rabbits are being farmed.

One family was reluctant to kill their young rabbits and soon found that rabbit brothers and sisters had mated. They were sorry to have to then kill pregnant does. The alternative is to make more cages. Don't rush into building more cages, especially if forages are the only food source. It is much better to do well with two does and eat their young rather than have six does and a couple

of bucks sitting in cages looking hungry! Remember that once rabbits reach about 3 kg they are almost at their mature liveweight. Many Papua New Guineans are used to pigs which keep growing for some years. This is not the case with rabbits.

⇒ **Food**

Rabbits need lots of care. They need feeding twice a day with lots of good green forages from our gardens and many weeds also. If we fail to look after them every day they may die, and will certainly not give us lots of healthy young.

⇒ **Theft**.

Sadly one of the biggest problems encountered in Irian Jaya was theft. This is hard to overcome, and is likely to be a big problem for rabbit farmers in PNG. Rabbits are available to be stolen all year round whereas broiler chickens are only ready to eat for a few weeks before they are all sold. Locks should be put on cage doors and cages should be close to where people sleep. A fence around the rabbit cages can also help and even a watch dog could be used so long as it is used to being near the rabbits. Normally dogs worry the rabbits and will kill them if they get close enough.

Sadly one of the biggest problems encountered in Irian Jaya was theft.

⇒ **Cage Maintenance**

Holes in a cage floor caused one man in the highlands to lose 15 rabbits in one night. Holes and broken wires need to be repaired, floors replaced and doors kept in good condition. Another family lost two litters of young when rain made young babies wet and cold. The roof had not been repaired. There is no sense in being unwilling to pay K8 for a good wire mesh floor when holes in a cheap floor could mean the loss of K60 worth of young animals.

⇒ **Stockmanship**

This refers to a man or woman, regardless of age who enjoys looking after animals. Someone who likes to see their animals happy, contented and growing well. People who have failed with pigs or chickens or sheep are very likely to fail with rabbits also. Rabbits that are picked up and handled nicely will be easy to mate and pregnancy test. Does will also allow the owner to check the babies in the nest and correct any problems. Rabbit farming is not for everyone.

Rabbit farming is not for everyone!

Although these issues are dealt with later they have been put here to help people gain an understanding of some of the most important issues. With any new animal it is easy to think it will be free meat every day. This is not ever the case. Think carefully before investing your money and time in rabbits.

Rabbit breeds in Papua New Guinea

The rabbits came from totally disease free stock in Australia. The project was started by Dr Ian Grant of Australia who obtained fourteen breeding animals in June 1993. Dr Grant is a Veterinarian at the University of Technology in Lae. There are currently two breeds.

Canberra half lops are very good in the lowlands. They have large floppy ears that droop. When mature they weigh about 2.5-3 kg.

The second breed (New Zealand White) is larger and is better in the highlands. Their ears stand up tall and are shorter than Canberra Half Lops. Mature does are about 3.5-4 kg.

Crosses between these two breeds have been very good, both in the lowlands and highlands.

Housing rabbits

(Refer the separate pamphlet for notes and diagrams on housing)

Successful rabbit raising requires a good house. It must

- protect from predators- especially dogs, rats, snakes, cats,
- keep out rain and
- give shade from sun,
- make theft difficult,
- be strong enough to last and not get holes in the floor or sides,
- make use of standard sizes of wire (eg rolls of mesh 90 cm wide),
- allow good light and wind (ventilation),
- be easily cleaned and allow manure to fall to the ground.

Coastal people should choose a site under the shade of a large tree.

Close to home is best as this makes it harder for thieves to come and steal the rabbits. It is good to be able to check on the rabbits two or three times a day.

Rabbit hutches can be made of local materials, but it is essential that you use strong wire mesh (1cm square holes) for the floor of all breeding cages. Light chicken wire breaks easily and manure collects in cages with this wire. Young rabbits will not fall onto the ground and die if good quality cocoa mesh is used (welded not woven).

Cages should be high enough off the ground to keep dogs away and allow the manure to fall freely and also to make for convenient cleaning under the cages. Each cage should be about 45cm high (half the width of a roll of netting) to allow for good ventilation. As the rolls of netting are 90 cm wide we split a length to make sides. Doe cages need to be 90 cm at the front wide and 70 cm front to back. These measurements make good use of wire rolls.

Cages can be made with a roll top roof or with doors on the front. If we use doors the doors can be made so that two large doors cover four cages and can be locked with just one padlock. See the diagram. Hinges can be made using nails, leather, bicycle chain, or even rubber.

Doors that open down are often easier than doors that are hinged at the top. Sometimes nesting boxes, records, are kept on top of the cage and a top opening door creates problems in this case.

If copra meal or other pellets are used then feeders can be put in the front of the cage if the door is only 70 cm wide.

Bamboo is a good material for rabbit cages, but make sure the rabbits can't eat the soft side of the split bamboo.

Wire

Fine chicken wire only lasts for a couple of months when used between cages as walls. Does try to reach each other and will make holes in this kind of wire. On the outside of cages and for doors this fine wire has sometimes worked well.

It seems there are different quality standards and some imported wire is not strong enough.

Larger mesh chicken wire 2.5cm holes with 0.9mm gauge wire is good. There may be concerns about rats being able to squeeze through the holes and kill very young kits. For larger kits this 2.5cm wire will work well.

Rabbits chew wood.

Any wood that is exposed to rabbits teeth will be chewed. For some cage corners it is possible to use a wire corner tied back to bush timber. Aim to have all wire netting on the inside of cages and the only timber available for chewing are the pieces mentioned below.

Rabbits need salt and timber to chew.

Holes drilled into a piece of wood can be filled with salt and then this wood can be hung in the cage. Alternatively the wood can be soaked in a strong brine of 50% table salt and 50% salt from a salt block. Rabbits will eat the salt and enjoy chewing the wood. Remember to replace the wood as it is chewed.

Salt is particularly important for those animals being fed forages only.

Rabbits integrated with the Melanesian village garden.

Gardens are changing as people change.

In many parts of Papua New Guinea people are experiencing problems with low soil fertility. Often men and women have to walk a long way to their garden. In the past there was always plenty of 'big bush' to cut down and burn for a new garden. Old gardens which used to be left for 15 or more years are now being gardened again in less than 5 years. Near towns and cities old gardens sometimes rest for less than 1 year. Soils are therefore not as fertile and more land is needed to give the same amount of food. With more land in gardens as yields decline then it follows that the fallow or rest period will also decline.

A number of factors contribute to increasing pressure on land close to town. People do not want to live a long way from airstrips, health centres, trade stores and schools. These facilities never shift and so people also want to stay in one place. More permanent homes also mean greater stability and a greater need to care for the land close to home.

Few people, long fallow.

There are two main kinds of old garden in Papua New Guinea. The first is in an area of big bush where the land will lie fallow for many years. It is likely to be in high rainfall. As the garden is abandoned bush trees start to grow alongside the last of the pawpaw and bananas. Soon the ground is covered and larger trees grow. Grasses are shaded and die. A new forest is growing. This is the traditional kind of garden in areas of very low population pressure. The low population- about 1person per ha is needed to allow this kind of garden system to remain sustainable over generations. ??? figures from Weishart. needed.

To give some idea of the problems of burning and loss of soil fertility, calculations have shown that in a large, mature forest there are about 4,500 kg of Nitrogen present in each ha. However the garden manages to accumulate only about 20-30 kg of Nitrogen. So the fire has burnt much old and valuable timber but also a very large amount of the nitrogen especially has been lost in the flames and smoke. It will take many years to recover.

Many people, short fallows

The second type of garden is much more common, especially in areas where there are many people. This may or may not be in an area with a long dry season. This garden is also abandoned but frequent fires ensure that the grass weeds and small trees are regularly burnt. The fire kills most of the young trees but fire resistant grasses continue to dominate. Indeed these grasses (kunai) need frequent fire to allow them to dominate. They would die out if shaded by large trees. After some months when the grasses are tall farmers will come and burn the grass and a new garden is dug in the ash. If heavy rain falls soon after the fire, much of the fertility left in the ash will be lost in the run-off water. Some Papua New Guineans in the highlands live on naturally fertile soils and so this loss of fertility is not so important. However for others their soils are not naturally fertile. Any loss of fertility in the fire or in run-off must be reduced.

As the grasses are not killed by fire, women will work hard at pulling out the shoots of the kunai as it grows amongst the kaukau (sweet potato).

Old gardens full of kunai grass do not increase in fertility very quickly.

Fire and soil fertility

There are many reasons why people burn. Sometimes burning does very good work and saves a lot of labour. However one place where all burning should be banned is close to home and near a rabbit farm. Leaves contain nutrients that are needed in the soil, and as they rot they form humus. It is humus that holds soil nutrients. Without humus rain will more quickly wash away the soil fertility. This is especially true for nitrogen and sulphur. All leaves can be collected and put under the rabbit cage where the urine will soak into them. Regularly put these leaves and manure back into the garden.

Improving soil fertility- using trees - protecting the forest.

Learning from Melanesian systems

We need to use all possible ways of keeping gardens fertile. Old gardens need to be full of legumes like bean plants and legume trees which can increase soil fertility. Because trees grow quickly and get very large they are able to accumulate much more fertility than does a green manure crop of say beans or lupins. How do we do this? In Irian Jaya a traditional technique was expanded and only slightly changed.

<u>Using Casuarina (diwai yar) as a fertility building tree:-</u>

In a garden and reforestation project in the Highlands of Irian Jaya, Casuarina (*Casuarina oligodon*) trees were planted with the kaukau. In each kaukau bed measuring about 4m x 20 m about 40 trees would be planted. This is the same as 1 tree in every 2 square metres. The traditional system was to plant either no trees or fewer trees and some people planted the trees when the garden was being abandoned. However the trees need to be planted at about the same time as the kaukau. Why?

If fertility building trees like yar are planted as the garden is abandoned it is likely that the trees will die. They will be dug up by pigs or the weeds will quickly grow on top of the young trees.

When trees are planted in the new garden the trees are weeded and cared for as the kaukau is weeded. Some people will be concerned about the trees competing with the garden plants. If the trees are growing too quickly it is easy to break off side branches and therefore make sure plenty of light gets to the crop. When the garden is abandoned the pruned seedling tree is ready to grow strong and big. This system works in with the desire to shift to a new garden. It leaves behind a small forest of trees growing instead of a wasteland of kunai grass.

Trees put down deep roots and bring up fertility which is stored in their leaves. If these leaves are fed to rabbits, or composted directly then gardens will benefit from this fertility. Casuarina leaves do not make good food for rabbits but in later sections trees for rabbits are mentioned.

Trees- a valuable crop

Most people recognise the value of plants like pawpaw and kaukau as valuable crops. Few think of trees as crops. However in other countries trees are thought of as being another kind of crop. The time to harvest is just longer. In New Zealand people crop pine (*Pinus radiata)* and harvest it about 30 years after planting. In Indonesia large plantations of (*Acacia mangium*) have been planted. They are harvested in about 10 years. This is the same kind of tree that is being planted next to the Lae-Madang highway near Madang.

In Irian Jaya and in parts of Chimbu and other provinces in Papua New Guinea people use the Casuarina in their gardens close to home for many things:-

1. firstly they live in cold places where firewood is very valuable
2. trees can be used for building poles, for houses for chicken sheds, rabbit cages, fences etc.
3. forest tree seedlings can be left to grow into large valuable trees. If straight, young trees are taken from the bush whenever poles are needed, then the quality of the forest will suffer. Older trees with good straight poles will be hard to find. Slowly, people will notice that the bush is getting further and further from their homes. They must walk further to get poles for their building projects.

Near Garasa in Morobe province some people plant Huon pine (Auricaria __??), a valuable timber tree with their new gardens. This is very good. It is a native of that area.

Some other people are using small, mobile sawmills and they know the value of the timber that is being harvested. They realise the need to plant seedlings whenever they cut down a large forest tree. They need to come back to the areas where large trees were cut and choose the best of the growing young trees. Some will need to be cut out to allow just a few to grow tall and straight.

Trees a bride price crop.

All parents are full of joy at the birth of a healthy child. For many there will be the thought of paying bride price in years to come. Why not plant 100 trees to provide part of the bride price payments in 20 or so years? Some options are listed below. Do not forget to go and talk with the local forestry advisers as they will give advice on what are the best tree species for each area. Some of the trees are only going to provide timber, others will also provide some food for rabbits or both.

Teak is an introduced tree common to the lowlands of Papua New Guinea. It grows in both warm/wet and warm/dry areas. It produces very valuable timber and some old people I have talked with have planted this as bride price timber. Indeed the new house needed for the married couple was made out of teak planted by the old father. Marvellous.

How can the planting of trees be integrated into the life of the garden and the small animals being farmed? Plant teak or other valuable tree seedlings into a kaukau garden so that the seedlings will be weeded as the kaukau is weeded. Also plant forage peanut close to the small drainage ditches and at the base of the sweet potato mounds. Later when the trees are growing well there will be other legume forage providing food in the garden. You can experiment with plants like snake bean, winged bean, cowpea and velvet bean- they could be planted under the growing trees and use the trees as stakes. Trees that must grow straight and tall may end up being bent over by the twining legume plants.

Live fences.

There are many reasons why a fence is helpful. It may provide shelter, privacy, protection from noise, dust and may also help to keep animals from the garden.

Willow makes a good live fence but is not good food for rabbits (leaves are low in protein). Willow trees are shallow rooted and these roots compete with garden plants for soil fertility.

If willow sticks are planted at about 10-15 cm intervals then the growing branches can be woven into a very strong live fence that will keep pigs and dogs out. It may also make it hard for a thief to come into the yard where houses, chickens and rabbits are kept.

In the highlands tanget is sometimes used as a live fence. It must be planted close together to form a strong fence.

Simple nurseries work!

The Casuarinas which are very common in the highlands do not need to be established in plastic bags. Most people in Papua New Guinea know that these seedlings grow on sandy river banks. Seedlings can be taken from these areas, and planted directly into a new garden. However take care to dig the seedling out with some soil attached so the roots do not dry out. It may help to cut off some of the side branches so that the tree doesn't dry out and die after it is transplanted to the garden. Trees should have trunks about the size of a pencil. If they are smaller then they are more likely to die.

Feeding rabbits.

Introduction

Rabbits have big appetites. They need lots and lots of greens- close to 1 kg of fresh forage for each doe, each day. The most common cause of slow growth rates, difficult breeding, low conception rates, abortion, fetal resorption, still-births and small litters is underfeeding. Does that are rearing many young need lots of carbohydrate feed.

Rabbits eat lots of green leaves. Are you prepared to give them plenty each day?

Carbohydrates (starch) are a major source of energy and are important for growing, reproduction and milk production. Foods that are high in starch and that are readily available in Papua New Guinea are kaukau tubers, cassava, bananas, copra meal and chicken pellets. In the highlands of Irian Jaya rabbits have been successfully reared without any root crops but their growth rates will not be as good as when some starch crops are fed.

During lactation (milking) it is particularly important to feed does as much as they can eat, giving plenty of fresh sweet potato leaves, bean and clover leaves and where possible as much concentrate feed as the females will eat. Legume leaves have high levels of useful soluble carbohydrates as well as a good balance of fibre. When these instructions are followed the doe will not lose too much weight and will rapidly regain that lost weight prior to being mated again.

Mouldy sweet potato will poison rabbits.

Plant fibre sources are important for maximum growth rate and to prevent hair-chewing. Rabbits fed low-fibre, high energy diets have reduced gains and more pronounced fur-chewing. This in not normally a problem in Papua New Guinea as most animals get plenty of green forages.

Forages

Green leaves of a wide range of plants should be given fresh in the morning and again in the late afternoon. There should always be some green material left in the cage when fresh forage is brought. This means they are getting plenty of food. Left-overs should be thrown under the cages for collection with the manure once each week. For village people living a long way from a town, forages will be the main food for the rabbits.

Refer to sections below for detail regarding plants for particular climatic zones in PNG.

Concentrates/pellets

For most villagers pellets are expensive and hard to get. Normally rabbits will grow well on forages, however pellets can be used and rabbits will grow faster. Normally we would feed a doe 50g of broiler finisher pellets/day and increase that to 150 g/d when she is pregnant or feeding young. A small plastic cup holds about 100 g of chicken pellets.

Do not feed layer pellets as these have too much calcium for rabbits. The calcium is specially added to make strong egg shells. Use broiler finisher pellets.

For those close to cities where transport costs are low, it is profitable to feed rabbits on pellets. This can become a business like chickens. However with chickens work is easy and after about 8 weeks a rest period is possible. With rabbits, there is work every morning and every evening.

In time it is very likely that special rabbit pellets will be available here that make use of local feeds that are by-products of other industries. Most likely are copra meal and palm oil meal (oil palm expella) as they are not able to be fed in large quantities to chickens or pigs because of their high fat content.

Short term growth rate studies have shown that rabbits grow well on a mixture of copra meal (with added minerals and vitamins, especially vitamin E) and some molasses. They always grow better and are happier if they also get some forage every day.

Until more is known about Vitamin E requirements when feeding copra meal or chicken pellets, use pig premix at the rate of 1 tablespoon mixed in about 16 cups of pellets or copra meal (150 g of premix to 50 kg feed).

When feeding concentrates remember that clean water must be available all the time. It is sad to see a young litter of rabbits die because the doe did not get enough food and water to produce plenty of milk. This is about the same as taking money from a wallet and throwing it into a river...

Metal feeders, made locally are available from the Sustainable Garden and Village Rabbit Project, Agriculture Dept., UniTech. These reduce wastage of expensive concentrate feeds.

In the section on rabbits as a business, some example budgets are presented which may help you to decide whether it is profitable to feed pellets.

Vitamins

Rabbits fed on copra meal need added vitamin E. Specific recomendations are being researched.

Where rabbits have access to a good range of green forages they will not need vitamin supplementation.

Salt requirements

Where forages only are fed it is wise to provide rabbits with salt. One way of providing salt is to soak wood in a strong solution of salt and water and hang this in the cage for the animals to chew. Drift wood off a beach may be a good source of salty wood. Where possible a mixture of 50:50 ordinary table salt and salt from a salt block for cattle is good.

Water

In the highlands we have fed rabbits on white clover, kaukau leaves and other leafy plants without giving any water. Rabbits bred and produced well. These green leafy forages will have about 900 mls of water for every kg of fresh forage.

However if we are going to feed rabbits any dry foods, like chicken pellets then rabbits will need water. A bamboo watering trough or tin fish cans may be used. It is important to keep the water clean and this is hard if the container is wired into the cage.

Imported waterers are available from the Sustainable Garden and Village Rabbit Project, Agriculture Dept., UniTech. These cost about K5 each and ensure that all animals have access to clean, fresh water.

Legumes as food for rabbits

Legumes are important in the garden because they take nitrogen from the air and put it into the soil via root nodules. Because legumes are rich in protein they also help animals to grow well.

Often in sweet potato gardens the inter-mound area is a waste area. Legumes can be planted here and in ditches and on the side of garden beds. They will provide food for rabbits as well as helping to hold the top soil in the garden. This will slow down erosion of valuable topsoil.

There are a range of twining bean like plants that are good food for rabbits. These include Dolichos lab lab, Velvet bean, snake bean, lima bean, common bean, and cowpea. These beans are good because we can eat the seeds and leaves, and still have some left over for the rabbits to eat.

These climbing beans can be planted in old gardens at the same time as the last of the kaukau, taro, yam, cassava is dug. At the base of old aibika plants we can plant climbing beans. The beans will climb the old aibika stems. Beans produce a lot of green material of high value as rabbit food, pod and seeds for people and the plants will increase soil fertility. When a new garden is ready to be planted, the beans can be cut with a bush knife and all green material dug into the soil. This will increase the yields of crops when compared with leaving the soil in a weed fallow.

Cowpea is a quick growing bean forage that produces lots of good quality green leaves. People can also enjoy the leaves and beans.

Dolichos lablab is widely used throughout Asia as both a food plant and a green manure plant. In Papua New Guinea it is grown up to 2100 m asl and it can last for more than one year, growing very large if there is a tree to climb. Half ripe

pods can be picked and cooked whole in boiling water. The seeds are then delicious.

Velvet bean is a new crop to many people in Papua New Guinea. It grows strongly for about 4 months but unlike Dolichos, it dies after seeding. It needs a stake to grow up, and is a very good green manure crop. If you wish to eat the dry seeds, they must first be boiled and the water thrown away. The seed coat must also be thrown away, and then the cooked seeds can be put in soups and stews.

Other pasture legumes include Centrosema pubescens, Kudzu and Stylosanthes. You may like to try these for feed for our rabbits. Those that are very hairy like kudzu may not be very palatable for our rabbits.

When our corn is about 50cm high we can plant climbing beans at the base of each corn plant. After corn harvest the beans can climb up the corn and we will have food for rabbits as well as looking after our soil. When the beans are maturing some plants can be dug into the soil for a new crop of taro or kaukau. Other beans can be kept for seed.

Tree leaves should not normally form more than 20% of the diet of our rabbits. Trees worth trying are *Gliricidia sepium* (Marmar), Erythrina and these also can become a good live fence. Even hibiscus can be used and rabbits enjoy some of this in their diet.

Finally rabbits are best fed a range of green forages.

Feeding rabbits and gardens in warm wet places.

In the lowlands perennial peanut (*Arachis pintoi*) is being evaluated as a replacement forage for white clover. This looks like peanut but does not produce seeds like normal peanuts. It can be planted under crops like taro or cassava. It may also be planted at the base of your kaukau mounds where it will reduce soil erosion.

Lamtoro (*Leucaena leucocephala)* is a widely grown legume tree, giving good sized poles after about 2-3 years. It is slow growing in the first year and has some toxins in the leaves that can slow rabbit growth. Up to 5-10% of the leaves in the rabbits diet can come from Lamtoro. Researchers in the Agriculture Department of the University of Technology are identifying kinds of Lamtoro that are best for rabbits. In the future we hope to evaluate a range of quickstick (pink flowered, Gliricidia sepium)

In the lowlands trees like, Balbal (*Erythrina indica)*, and lamtoro can be used. Sesbania species and rosewood are also good. Rabbits should not get more than about 10 percent of their daily food from tree branches. Rabbits enjoy hibiscus leaves and flowers. Cuttings from hibiscus hedges are now being fed to rabbits and instead of being burnt they are being turned into meat for people and manure for gardens.

Feeding rabbits and gardens in the highlands.

Temperate species of pasture legumes will provide the best forage for rabbits. The very best forage for rabbits is white clover (*Trifolium repens*). This grows well in the highlands and may give growth rates close to those achieved with pellets- about 20 g/day/kit from weaning up to about 2 kg liveweight. It does not grow in the lowlands. Kenyan white clover (*T. semipilosum*) is similar but with a purplish flower. With white and kenyan clover don't buy seed. It is likely to be old and not germinate. Instead plant runners (stolons).

Greenleaf and silverleaf desmodium are both common in the highlands and may be fed to rabbits.

A range of lupin species are good for building soil fertility and should be tried as food for rabbits. *Lupinus heterophyllum* with its mauve flowers on the Daulo pass is common and may be fed to rabbits. The leaves are bitter and rabbits may only eat a small quantity of this. In the future sweet varieties of lupins may be available either from UniTech or from DAL. Species such as *Lupinus mutabilis, albus* and *angustifolius* all have sweet and bitter forms. It is easy to tell which are sweet- just bite the leaves!

Lupins are a good source of nitrogen in fallow gardens where the rest period is only for a few months or year or so.

Put seed of the lupins in a cup and pour boiling water over them. Leave for a minute and then pour more cold water on the seeds to quickly bring them back to room temperature. Leave overnight and sow the seed in old gardens where the pigs have finished rooting for sweet potato tubers. Sow plenty of seed as this will help to cover the ground and smother at least some of the weeds.

Other plants include many kinds of weeds and herbs like comfrey.

Grasses

Some grasses like cocksfoot (*Dactylis glomerata*) and tall fescue (*Festuca arundinacea*) have performed well in the highlands and provide good food for rabbits. Temperate grasses are better nutritionally than tropical grasses. These grasses can be planted on the edge of terraces and provide soil erosion control. Be careful with tropical grasses. Some tropical grasses will produce lots of seed and become weeds. Cocksfoot and tall fescue have been used in Irian Jaya and they do not seed and so have not become weeds.

Where these improved grasses are available and grow well- do not use vetiver grass. Vetiver grass has potential as a soil erosion control species, especially in warm areas but has very limited palatability for animals. The emphasis in the kind of garden being promoted here is mult-purpose- providing soil erosion control and also food for animals like rabbits, ducks, geese, sheep and goats.

Feeding rabbits and gardens in hot dry parts of PNG.

Many African people enjoy rabbit meat and these rabbits are grown in hot dry countries like Ghana, Egypt, Algeria and Morocco. Closer to PNG rabbits are farmed in Timur which is a hot and dry area also. So there is plenty of potential for rabbit farming in the hot dry zones of Papua New Guinea. There will need to be some special techniques employed for success. Breed just prior to the rainy season so that most young are growing when gardens are producing lots of green leaves.

Rely on trees like Moringa oleifera, lamtoro, hibiscus, for some of the forage needs of the rabbits. Sesbania grandiflora is very common in Port Moresby with its large white flowers and long rounded pods. Try it. In coming years the University of Technology hopes to have a line of Gliricidia sepium available that is more palatable for rabbits. Plant lots of hibiscus. Use banana and cassava leaves.

Plant velvet bean (*Mucuna pruriens*), *Dolichos lablab*, winged bean, cowpea and pasture legumes for forages. Siratro is often found on roadsides with its twining stems, trifoliate leaves and dark red, almost black flowers. Rosewood leaves are liked by rabbits and it will be worth trying bouganvillea trimmings. Pigeon Pea is

a small shrub that gives good pods and seeds for us as well as plenty of leaves for our rabbits. The forage is not high quality.

Make use of all kinds of leafy weeds, but not harsh grass weeds.

The role of rabbit manure in Sustainable Gardening

Manure and urine is very valuable. A sheet of roofing iron under the wire floors to collect urine and manure in buckets is a wise investment. Rabbits are creatures of habit. An old bucket can be put under the spot where a doe drops its manure.

Most people rake and burn leaves and grass around their yards and in the village. These leaves should be stacked under the rabbit cages. Do not waste good organic material by burning it. Every two or three weeks take all of this wet material to a compost heap or spread it directly around those plants that need lots of fertility.

Burning leaves is banned. Heap dead leaves under cages and allow manure and urine to collect. Then spread this near the base of green leafy vegetables.

Green leafy plants like Aibika, choko, pumpkin, cucumber, cabbage, chinese cabbage, cauliflower will all grow better with manure. Spread it around the base of fruits like pawpaw, banana. Do not put the manure close to the base of a plant as it may help to cause stem rots.

Animal manure is best used when it is wet as it still contains plenty of nitrogen. Plants need nitrogen to grow well. Old, dry manure has lost much of its nitrogen.

If you spread the mixture of leaves, manure and urine around the garden it is good to cover this with some soil to prevent the nitrogen being lost as ammonia gas.

Too much manure given to young kaukau can reduce tuber yields while increasing leaf production.

Managing rabbits

Rabbits should be handled a lot, especially as young. If they are used to being handled they will accept your management when they are mature. Does that bite and are aggressive should be killed. However does can become aggressive when pregnant. Take care with the way you put your hand into the cages. One technique that works well is to show the rabbit one hand while the other hand is quickly and firmly placed over her head and shoulders. With your free hand you can now clean out the cage and put in more feed.

Rabbits need lots of handling. This way they will be quiet and easy to manage.

If does or bucks persist in being aggressive, then it is best to eat that doe and work with better mannered animals. Stockmanship mentioned earlier is important. Each animals has its own temperament. Some will be unhappy unless you first place some fresh forage in the cage. While they are busy eating is a good time to check young rabbits, or clean the cage.

Handling rabbits

The best way to learn how to hold a rabbit is to start with a small rabbit. We don't like being carried by our ears. Neither do rabbits. Don't carry rabbits by their ears. The proper way to hold a rabbit is shown in Fig.

Shifting rabbits a long way.

If we need to carry a rabbit a long way then put it in a wire carry cage with newspaper beneath rabbits. They produce lots of urine which can be a problem on a PMV or plane! A bilum can be used, especially if there is plenty of dry grass included. Cardboard boxes can also be used, but remember that animals need fresh air and a good litter of newspaper and dry grass. Do not put too many animals in one cage. Remember rabbits have sharp teeth and rabbits will make holes in a bilum. If A box is good also.

Breeding

Rabbits can be bred at about 2.5 kg liveweight, but for breeds where the mature liveweight is closer to 3.5 kg then wait until the rabbit is older.

The female should be taken to the bucks cage. Leave them alone- a successful mating will have taken place when the buck has mounted the doe, and the buck ejaculates and falls off the doe. Sometimes he will squeal. You can check that the mating was successful by looking for semen in the vagina.

If possible breed two or three does at about the same time. This way, when the time for kindling comes, if one of the does has too many young, some animals can be fostered to another doe.

It is important to keep accurate records so you will know when the does are due to kindle.

Mating difficulties

First-time does are sometimes unwilling to stand for the buck. They sit on the floor of the cage with their hind-quarters firmly grounded! They may need to be

held so that the buck can mate- place a hand under their stomach and gently lift them. Remember that her tail may need to be lifted out of the way of the buck as he mounts her. Once a doe has carried a litter, she is normally willing to stand for the buck.

Overnight it may help to switch the doe and bucks so that they sleep in thei others cage. Then try mating again in the morning.

Pregnancy test?

The ability to pregnancy test is best learned on the job- it is important if you want to get at least four litters per year.

By about 10 days after breeding, it is possible to tell if the doe is pregnant by carefully feeling her abdomen. The best way to learn this is to practice with non-pregnant animals, even bucks. Then try to compare with does that are 10-14 days pregnant. The rabbit's uterus is made up of two long tubes, or horns, that connect near the vaginal opening. One horn runs up through the rights side of the abdomen and the other in the left. You will be feeling one horn at a time, and feeling for marble sized lumps that are the growing babies. Hold the animal on a table with her head pressed between your right elbow and body. Use your left hand to keep her from backing away. Reach under her abdomen with the right hand and feel up into the abdomen, trying to isolate the organs between fingers and thumb. You need to reach up toward her backbone, not just the surface. The intestines will have very small lumps, which are the faecal pellets, but by day 10 of pregnancy the small rabbit babies are larger in size than anything inthe intestines. The technique gets easier with practise.

A quiet doe, even a few days prior to kindling can be felt and her babies will be very obvious. Be gentle.

Nesting boxes

Provide does with an enclosed space. A box that is about 30 cm wide by 30 cm high by 40 cm long is good. The opening should be 10cm from the bottom and approximately 15 cm square. This keeps the young from crawling or falling out of the box too early. When the young are large enough to jump out the box should be removed and cleaned and stored ready for use next time.

You should give the doe a nesting box 3 days before she is due to kindle. It is a real waste if you forget to put a box in and the doe has her young on the cold wire floor. A little dry grass helps in the bottom of the cage. She will probably add to that with fur from her belly.

Try to ensure that she is not frightened by loud noises or dogs or too many people. If frightened she may stomp her feet, and stomping in a nest box can kill the young.

Kindling

Good record keeping will ensure that a nesting box is put in the does cage well before the kits are due.

Some people do not use a nest box- they provide lots of fine, dry hay. Most people suggest that a nesting box is best.

Prior to kindling many does become somewhat aggressive. Bear with them. They will get over it!

Sometimes a doe will have her kits on the wire floor of the cage. They need to be put into the nest box straight away, with plenty of nice clean and dry fur. Have some fur ready from earlier litters. (Alternatively use some dry grass or even small pieces of newspaper).

Sometimes a doe will take all kinds of forage into her nest. If she has put any twiggy material into her nest- remove this. It could trap a kit under a little branch and mean that it starves. The first feed for the kits is critically important. Well fed kits are warm and full looking. If this is that case, just remove any placentas or dead kits, make sure thay are all together and covered with fur and leave them alone. Keep others away.

Right down the information before you forget!

If you have bred two does at about the same time then you can even up a large with a small litter.

It may be important to wash your hands before taking some of the kits from a ltter of say 8 and giving to a doe with a litter of 2 or 3. Mark the ears of the kits that have been moved with a waterproof marker. Mark them again in a week or two to ensure you keep track of who belongs to who.

If the kits are older when you need to foster them, then the doe may not accept the kits. Put the mother into a different cage to give the new kit(s) time to acquire the smell of the new litter. You may even have to separate the doe overnight, in which case she will be uncomfortable from the pressure of her milk, and will then be eager to feed the babies.

If a doe has only one kit, then it is quite reasonable to mate her again within 24 hours of her kindling. This is her most fertile time.

Caring for young rabbits and weaning.

This is where good stockmanship is important. Keep an eye on the young baby rabbits. Make sure they are in a group in the nest box. Make sure they are not wet and cold. Sometimes it seems the doe urinates in the nest box. Is the box in the side of the cage that the doe prefers to use as her toilet? If so - shift it!

If they are wet and cold, remove all wet fur, remove the wet cardboard liner or even put a clean, dry nest box in. Give them new dry fur or dry grass.

If a kit is out of the box and is too young to hop back in, you need to put it back.

The kits can be weaned when they are about 400-600 g. I prefer early weaning (4 weeks) to ensure that the doe is not put under too much stress from feeding kits for too long. It is good to leave the smallest kit with the doe for a few more days so that her milk supply is reduced slowly. By followig this practice the kits will not grow as fast as those able to feed from the doe for longer. However the doe is more important than each litter of her kits.

Other breeders prefer to wean at about 6-8 weeks. If kits are weaned at 8 weeks then it will be impossible to achieve 4 litters per year and also a rest period for the doe between weaning and next mating. Keep an eye on the does condition. If she is getting thin and bony, and her fur is dull then she should be fed extra and left before remating.

Keeping records

As rabbits breed fast and have a number of litters each year, every farmer can work towards breeeding better and better does and bucks. This will only be

possible performance is recorded. It helps greatly if each animal is tattooed at weaning.

We record the date a doe is bred, to which buck and then how many she has, number alive and so on. If possible we should weigh our animals regularly.

Some examples of recording sheets are given below.

Doe Breeding Sheet.

This doe:-

Ear No./Colour_____ Date of Birth _____Cage No._____

Mother_____ Father _____

Date Bred & Doe's live wt kg	Buck No.	BIRTHS Date	Total Born	Deaths	FOSTERED Added	FOSTERED Removed	WEANING Date	WEANING Tattoo no's	Commen

General Comments

Buck Breeding Sheet.

This buck:-

Ear No./Colour_____ Date of Birth _____Cage No._____

Mother_____ Father _____

Date Bred	Doe No.	BIRTHS Date	Total Born	Deaths	WEANING Date	No.	Litter wt g	Comments

General Comments

The following two cards can be used by you on each of your cages. These cards have been designed for those of you serious about improving your stock, and keeping careful records. Without a system you will soon lose track of how your animals are doing, and in particular

- relationships among the breeding stock- who is related to whom?
- which does or bucks are regularly outperforming the others.

Common Diseases of Rabbits

Most diseases of rabbits can be prevented by good management. Good nutrition is essential to maintaining health and giving good growth rates. Proper housing that is safe (free from holes in flooring and sharp wires or edges), has adequate ventilation, good lighting without overheating, and is protected from predators will prevent many problems for your rabbits. The cages need to be kept clean and dry. Uneaten greens and vegetables should be removed daily and replaced with fresh food. Clean water should be available at all times. Nest boxes should be disinfected between uses. Other animals should be kept away from your rabbits. You should handle and inspect your rabbits often. There is no other way to examine a rabbit's teeth or feet except to pick it up and look.

If a rabbit appears to have an illness which may spread to others, you have the choice of killing the rabbit or attempting to treat it. If you keep the rabbit, it should be isolated away from others. You should feed and handle this rabbit *after* all the others. Be sure to wash your hands well after caring for the sick rabbit. Disinfecting cages is very important to prevent disease from spreading. A good way is to scrub the cage with a brush, using soap and water with a little bleach added. Let this remain in contact with the cage for 20 minutes, and then rinse with plain water. Sun light is also helpful as a disinfectant, and if possible, let nest boxes, food and water containers, and floor boards dry in the sun after washing.

However, even with the best of care, rabbits will occasionally get sick or have problems. A good manager will look at his rabbits every day, and will spot signs of trouble early. This will prevent disease from spreading to other rabbits, and will give the affected rabbit the best chance of recovery. Taking the temperature of the rabbit may be a helpful diagnostic tool. Use a rectal thermometer, preferably. Shake the thermometer down and then lubricate the tip with Vaseline, margarine or whatever lubricant you have. Hold the rabbit on its back, and gently insert the thermometer into the anal opening to about 2 cm. Wait a couple of minutes and then read the temperature. Normal for rabbits is about 38.5-39.5 C.

This is a list of the most common problems that rabbits may encounter, although data in PNG is very limited at this point.

Noninfectious Conditions

Cannibalism

Many times, young does (first litters, especially) will kill and eat their young. This has been attributed in some cases to nervousness, lack of water, poor diet or lack of nest box for kindling. The young should be examined only by the person the doe is most accustomed to. Dogs and other predators should be kept away from the rabbitry when kindling time is near. Does that repeatedly kill their young should be disposed of.

Congenital Malformations

Common malformations of rabbits include crooked legs or spines, skull/facial deformities, and missing or misshapen gonads. All such animals should be butchered before breeding age is reached.

Dental Malocclusion

The teeth of rabbits grow continually (about 10 cm per year!). Normal length is maintained by constant grinding of the opposing teeth. Crooked incisors will grow out of the rabbit's mouth or up into the palate. The rabbit will be unable to eat properly and will eventually starve or die if the teeth grow into the brain. Occasionally the molars overgrow, causing severe tongue and cheek lesions. Malocclusion is caused by a genetic defect, and these animals should never be used as breeding stock. This can be a very difficult gene to eradicate once it is established in the breeding colony. Try to trace the defect to the affected parent (either buck or doe) which may carry the recessive gene, but exhibit normal teeth itself. Overgrown incisors can be kept trimmed every few weeks with side cutting pliers. This will allow the animal to eat well enough to reach butchering weight.

Dystocia

The gestation period of a rabbit rarely exceeds 33 days. If a pregnant doe is overdue and is straining and in distress, it may be that she is attempting to deliver a single, large kit, particularly if this is her first litter. If available, an injection of oxytocin (1-2 units, IM or SC) is generally effective, providing the position of the kit is normal. If the doe continues to strain throughout the day, she is probably unable to deliver the kit without veterinary intervention, and the most humane treatment would be to butcher her.

Heat Exhaustion

Hot, humid weather, along with poor ventilation, may lead to death, particularly of pregnant does. Affected rabbits lie on their sides and breathe rapidly. They should be cooled by immersing in tepid water. In coastal areas, rabbitries should be located under trees, or constructed with roofing material that is insulative against heat. Free access to water and salt should be provided. The appropriate breed of rabbit should be used in coastal areas. Kits in the nest box are particularly susceptible when there is excessive bedding and little ventilation. Extra fur may need to be removed from nest boxes, and open topped boxes can be used in hot areas.

Injuries

Accidental injuries can occur when rabbits are frightened, when their cages are not safe for them, or when they are handled improperly. Dogs and other predators can frighten the rabbits, especially at night, causing the rabbits to run and jump in panic around their cages. This can result in broken backs and legs. Holes in the cage can catch a leg or head, and sharp pieces of wire, metal, bamboo, nails, etc. can rip skin, injure eyes and damage feet. Rabbits need to be well supported while being held. (The ears should *never* be used to hold the rabbit.) If you think you may drop the rabbit, sit down, so at least the rabbit will not fall a great distance.

Poisoning

Poisoning may occur from ingestion of plants that have been sprayed with insecticides (outer cabbage leaves, for example) or herbicides, or from ingestion of spoiled vegetables, particularly kaukau. There are also some plants in PNG which are poisonous. The rabbit may be found dead, or may have convulsions or paralysis. Every attempt should be made to identify a source of poisoning, so as not to repeat the occurrence. It may be possible in some cases to treat a mild poisoning which supportive measures (holding the head up to eat, drink), but it is

probably best to butcher a rabbit that is showing incapacitating paralysis or convulsions.

Sore Hocks

If rabbits stamp their feet frequently on wire flooring, the bottoms of the hind feet may become tender. Open, bleeding sores may even develop. Rabbits with tender feet, will shift their weight from foot to foot, and can cause sores on the front feet as they try to keep weight off the back feet. For prevention, dogs and predators should be kept away from the rabbitry. The cage flooring must be kept clean and dry, with no sharp wires or edges that could injure the feet. It is often helpful to put a loose board into the cage so that the rabbit can have a place to sit that is off the wire. The board can be flipped over if it becomes soiled, and scraped off and washed as needed. If the lesions become infected, they should be cleaned and treated with an antibacterial powder. The rabbit may need a box or cardboard carton partially filled with clean, dry grass or saw dust to sit in while the feet heal. The grass must be kept clean and dry or the purpose is defeated. Large, heavy rabbits have more problems with sore hocks than others. Some rabbits have a genetic predisposition to this condition and if the problem persists despite good treatment and management, consider the option to butcher.

Wet Dewlap

Some rabbits have a heavy fold of skin underneath the chin. As the rabbit drinks, this skin may become wet and soggy, leading to an inflammation of the area. The hair may turn green and begin to fall out, with flies being attracted to the area. To prevent the occurrence of wet dewlaps, the water containers should have small openings and be placed so that the rabbit's dewlap doesn't hang into the dish when the rabbit drinks. The hair of the affected area must be clipped and an antiseptic powder applied.

Wool eating

Rabbits consume some wool as they groom themselves, but impaction results only if a habit of wool eating is formed. Rabbits may pull wool from the back of another rabbit or eat their own wool. It is often difficult to break this habit. The causes are not always known, but nutritional deficiencies may sometimes be responsible. Young rabbits may need to be isolated. A rabbit in heavy moult will benefit from daily grooming which will remove loose hair and encourage new growth more quickly. Wet the hands with water, and rub the fur of the rabbit in both directions. As the hands dry, they will become tacky, and will remove much dead hair as the rabbit is rubbed.

Parasitic Infections

It is possible for rabbits to pick up parasites from other species of animals, although this has not yet been documented in PNG. Some of the more common parasites that may occur in the future are as follows:

Coccidiosis

Coccidiosis is caused by a protozoan. Animals that recover from infection can become carriers. There are two forms, liver and intestinal, each caused by different strains of the organism.

Liver coccidiosis: An infection may be present with no apparent signs, or death may occur after a short course of illness. Young rabbits are the most susceptible. Signs include diarrhea, loss of appetite, and a rough hair coat.

Growing rabbits fail to make normal gains. After death, small, grayish-white nodules or cysts are found throughout the liver. Preventative measures include good hygiene in the rabbitry, with care that feed and water do not become contaminated with droppings. Cages should be kept dry, and accumulated droppings removed from under the cages regularly. Treatment consists of giving sulfaquinoxaline (0.05% in the feed and 0.04% in the drinking water) continually for two weeks. The drug should not be given within 10 days of butchering of food animals. Amprolium, sulfamerazine and sulfadimethoxide can also be used.

Intestinal coccidiosis: This form may occur in rabbits receiving the best of care, as well as in rabbits raised in unsanitary conditions. Inability to gain weight, loss of appetite, and "pot belly" are prominent signs. Diseased animals should be isolated, and if possible, the feces examined for coccidia. Sulfaquinoxaline treatment may be given.

Ear mite Infestation

Ear mites are the most common external parasite of rabbits. Head shaking and ear flapping, along with scratching at the ears with the hind feet are common signs. If not treated, the ear may lose its blood supply and actually slough or fall off the head. Thick, brown, crumbly crusts accumulate inside the ear. These should be removed with cotton soaked in dilute hydrogen peroxide. After cleaning, the ears should be treated with Mitox or a 0.25% suspension of lindane in mineral oil. About 6-8 drops of either medication should be put into the ear and massaged every third day for two weeks. Even plain mineral oil can be used if nothing else is available. The most effective treatment is Ivermectin injection which can be obtained from a veterinarian. (It is given 0.1-0.2 ml SC of a 1:100 dilution in sterile propylene glycol or sterile water.) The cage should be carefully cleaned and disinfected.

Larval Tapeworm Infection

Rabbits are the intermediate host for 3 forms of tapeworm of the dog and cat. Cysts may be found under the skin, in the organs or in the liver. There is no treatment except good management. Dogs and cats should not be allowed near the rabbits' feed, water or bedding where their feces could contaminate the rabbit's environment. Only cooked rabbit organs should be fed to dogs and cats.

Mange Mite Infestation

Rabbits infected with mange mites scratch themselves almost continually. There is loss of hair on the chin, nose, head, base of the ears and around the eyes. The condition is extremely contagious, and unless valuable breeding animals are involved, it might be best to butcher infected animals. Cages should be thoroughly cleaned and disinfected.

Diseases Caused by Infective Agents

Abscesses of the Jaw

There have been several cases in PNG rabbitries of a large swelling that develops on the lower jaw bone. The face swells out on one side. There may be slobbering and the eye may become affected as the abscess grows. This may be a form of avian TB, although the TB organism has not yet been isolated from an abscess. The abscess is filled with a thick, white pus. The infection gradually erodes the jaw bone, and the rabbit is best off being butchered before undue

suffering results, and before the abscess bursts, possible spreading infection to other rabbits.

Conjunctivitis

Mature bucks and young animals seem particularly susceptible. The affected rabbits rub their eyes with their front feet. The drainage from the eyes may vary in color or consistency. Any of the human ophthalmic antibiotic preparations may be used.

Diarrheas

Diarrhea can kill many rabbits, often just before or after weaning. The signs, which may come on quickly, include loss of appetite, bloated abdomen, lethargy, and a rough hair coat. The ears droop and the eyes may have a squinty appearance. The temperature may be below normal. Affected rabbits sit in a humped position and may grind their teeth. They may be constipated or have a profuse diarrhea. The faeces may consist of a clear, jelly like mucoid material, or they may be a patsy green to brown. Occasionally there is great thirst, but at other times the rabbits refuse to drink. Tetracycline may be helpful. Changing diets gradually at weaning time may prevent some diarrhea. Sometimes giving a dry, high fiber type of feed (such as straw, rice hulls, dry grass) at the *first sign* of loose droppings can be helpful. Weak pekoe tea may also be helpful if given along with the dry straw or grass.

Hutch burn

Hutch burn is caused by wet, dirty cage floors. Constant exposure to urine irritates the membranes of the genital area, which may then become secondarily infected by bacteria. Brownish crusts cover the area and a bleeding, pus like discharge may be present. The area should be washed and antibiotic ointment applied. Needless to say, the cage floors must be cleaned and kept dry.

Mastitis

Mastitis is often caused by streptococci or staphylococci infections which affect lactating does. The mammary glands become hot, reddened and swollen. Later, the glands may become blue or black. The doe may not eat, but will crave water. Her temperature may be 40.5 C or higher. If the infection is caught early enough, intramuscular injections of penicillin may be given to save the doe. (20,000 to 40,000 units per kg body weight per day.) If the doe shows signs of toxicity (paralysis), it is probably best to butcher her. Even if the doe recovers she may not be able to lactate normally if most of the glands were affected.

Pneumonia

Drafty, damp, unsanitary cages are predisposing conditions for pneumonia. Several types of bacteria can cause pneumonia, and the rabbit usually dies within a few days. Symptoms include loss of appetite, fever (40 C), difficult respiration, diarrhea and lethargy. Treatment may be given of either a course of penicillin or tetracycline.

Ringworm

Ringworm is a fungal infection that causes circular, red, raised lesions on the rabbit’s skin. They may occur anywhere, and often there is a thinning of the hair at the site. The lesions may be capped with a flaky white material. The drug of

choice is griseofulvin given at an oral rate of 25 mg per kg body weight daily for 14 days.

The prevention of rabbit diseases can be summed up briefly-

'good feeding and cleanliness'

Scabby nose

Similar to hutch burn, this infection causes a chapping and cracking of the skin on the nose and lips. Most cases are contracted from infected genitals. When secondary infections develop, large brown scales are produced on the nose and lips. Cases of hutch burn should be dealt with first, and those with scabby nose should be treated with an injection of penicillin (50,000 units), repeated on the third day.

Snuffles

Snuffles is an infection caused by the bacteria, *Pasturella*, which is highly contagious. The rabbit has either a thin or a pus like nasal discharge, with coughing and sneezing. The fur on the inside of the front legs will be matted and caked with dry exudate from the rabbits pawing at their noses. Snuffles generally occurs when the rabbit's resistance is low or at kindling time. The rabbit may recover or the infection may develop into pneumonia. Abscesses (from fight wounds) and genital infections may also be caused by *Pasturella.* Isolate infected animals. Penicillin injections (50,000 units per day) or Oxytetracycline (Terramycin) given in the drinking water may be helpful.

. Remember to remove old food begore putting fresh food in the cage. Make sure faecal matter cannot build up on the floor of the cage.

Injuries are normally infrequent and minor. Cage floors should not have holes for young to get their legs stuck in. Use small mesh for floors.

Nesting boxes should be cleaned out after each use. A small amount of light, dry grass can be burnt in each nesting box and then the box can be aired between uses. This will kill any mites and other disease organisms.

Diarrhoea in rabbits can be caused by a change in feeding or by spoiled food.

Calendar for raising rabbits. see world neighbours...

Killing rabbits and using the meat and skin.

Unlike chickens, rabbits have a number of useful products. In Papua New Guinea the meat, skin and fur are all valued. When a rabbit is to be eaten it is a waste to burn the fur in a fire.

Rabbit skins can be cured or tanned and used for hats, slippers, blankets, jackets, purses- anything you like to think of. This section covers different ways of curing skins and gives instructions on tanning, using both tree barks and chemicals like Chrome sulphate.

Killing the rabbit.

Introduction

It is good to read the section on skin tanning before killing the animal. Skins rot quickly and everything should be on hand prior to killing.

One of the best and easiest ways to ruin a potentially good skin is to leave it in the sun for about 20 minutes. In the heat of the tropical lowlands the bacteria will start working and fur will soon start to fall out of the skin. Final leather will not be strong if it has started to rot prior to your getting organised.

- Do not leave skins in the sun.
- Do be ready for the next stages of tanning before you kill the rabbit.
- A freezer is a great place to store skins you can't deal with, but get them in the freezer! Don't wait around...

Some of these chemicals are dangerous as are sharp knives. Remember to have a cupboard where kerosene, baking soda and other items are kept so that children and others cannot harm themselves. Safety first!

For those with access to a freezer (not just a refrigerator) it is probably best to put the green (fresh) skin into a plastic bag and freeze until there are enough skins to tan as a group.

Killing

This section is not for the squeamish. It gives detail to ensure that killing is painless. (Necks can be broken but this skill is not easily learned and may lead to unnecessary pain. If you want to try this, start with a young animal and hold the animal by the back legs. The other hand should hold the head of the rabbit and tilt the head back as far as it will go. With a short sharp push down on the head, the neck can be broken very quickly). The rabbit should go from contented to dead in a matter of a second. It should feel no pain. In your right hand hold a short, heavy stick. In your left hand hold the back legs of the rabbit. While the rabbit is upside down hit the rabbit on the back of the head with a firm hard whack. The first hit will stun and probably kill the animal. A second hit will further smash the skull and ensure that killing has been painless. Often blood will run freely from the nose. Cut the animals throat and allow blood to drain.

Alternatively the rabbit can be held on the ground and hit on the top of the head with a short piece of solid wood. There is less struggling than if the animal is held upside down. There is also less bruising of the neck and shoulders. The

trauma caused by smashing the skull will mean that the animal will twitch and jerk, even though dead. Follow this by cutting the throat to allow blood to drain.

If you are going to use a kerosene and baking soda skin cure, then it may be wise to wash the animal some days prior to killing. This will ensure a clean and dry skin prior to killing.

Skinning

You will need:

- sharp knife- blade no more than 10-15 cm is best.
- bowl/pot with lid and water to keep the meat clean and away from flies.
- clean plank or piece of plywood to act as a table, even if it is laid straight on the ground. It will be best if this is at least 40cm by 50cm.
- Scrubbing brush and water in a bucket to wash hands prior to skinning and also to clean the knife and board after use.

There are many ways of skinning animals but the aims are always the same:-

1. Cleanliness of the meat
2. Safety of the person skinning- don't cut towards yourself!
3. A rectangular, even shape to the skin.

? How to skin animals. drawings needed. Refer practical work you did on the training course.

Cooking the meat

Like all meats rabbit will benefit from being hung for a few hours prior to cooking. However it can be barbequed, mumu'd or boiled. Cook it like chicken or bandicoot. Some recipes are given at the end of this book.

Removing vellum- meat attached to the skin

The skin will now be ready for the next steps. It needs the muscle tissue (called vellum) to be removed. This is not easy as skin and muscle are hard to separate. It is easy to tear the skin while trying to remove the vellum.

Some people find it is easiest to remove the vellum as the animal is being skinned. This is fine, but it takes a lot of time. When removing vellum as the animal is skinned there is plenty of time for dirt to get onto the meat.

However the following steps will help in removal of vellum.

- With a fresh or green skin, start from the tail. This should assist in reducing the number of holes that are made.
- Older animals have stronger skins and will tear less easily.
- Try rubbing about two desert spoons of salt into the flesh side of the skin, fold and leave for an hour or two. Make sure the skin is in the shade. After this time the vellum will be easier to remove.
- For tanning skins in solutions like wattle bark the first step can be a mix of tanning solution that actually tans the vellum for a couple of hours. Then the vellum can be removed more easily. See below.

Holes in the skin?

Stitch any holes with a needle and thread. Do this before tanning the skin.

The easiest way of curing a skin is with a mixture of kerosene and baking soda.

Kerosene and Baking Soda.

You will need:

- Kerosene- about 50-60 ml for each skin.
- Baking soda- one packet (weight___???) costs about K1.50 from a store and will be enough for two or three skins.
- A piece of flat timber- eg plywood about 40 cm x 60 cm.
- Approx 20 of 2.5 cm small nails
- Hammer
- Tinned fish can or similar to mix the kerosene and baking soda.
- A small flat stick to spread the mixture. An old fork that is only used for this work is good.

This is the easiest technique and gives consistently good results. It only cures the skin and so these skins cannot be washed. They will not be able to cope with sweat (hats) or rain.

Skins should be kept as clean as possible and should have no blood on them. If the animal was bled from nose and mouth then the skin should be free of all blood.

After removing vellum place the skin with fur down on the centre of the piece of plywood. Stretch it roughly into a rectangle shape.

Start tacking by puting a tack at the base of the tail and pull the skin firmly at the centre of the neck. Tack the neck. Now stretch eachh of the legs evenly and tack them. Follow up by stretching and tacking the sides and across the base and top of the skin.

Mix kerosene and three tablespoons of baking soda in a clean tinned fish can.

With a wet paste rub into the skin. Let it dry in a shady place. No sun. No rain either!! Repeat this process about 3 times over 4 days, nothing too exact here, use plenty, the chemicals are cheap. If there is lots of dry clean looking baking soda on the skin, don't be afraid to damp that with kerosene and then give the paste a good rub into the skin. Use a stick or an old fork.

After about 4 days the skin will be well cured. Take the nails out and trim the edge of the skin, to make it look neat. Cut with a sharp knife. Cut on the skin side so that you don't cut the fur.

It will feel like it is a sheet of cardboard, not soft and leather like. Refer Finishing the tanning below??? page

Curing skins with salt and battery acid.

Wattle and other tree barks

You will need:

- For each skin the equivalent of about 2mx5cm of bark from a young tree or the branch of an older tree
- Salt (40g/litre)
- Battery acid (0.5ml/litre)
- Detergent (approx 1 tspn/skin)
- Stainless steel or aluminium pot to boil the cut up bark in
- Plastic bucket to soak the skin(s) in
- A piece of flat timber for each skin- eg plywood about 40 cm x 60 cm.
- Approx 20 2.5 cm small nails for each skin
- Hammer

Introduction

Many trees contain tannin in the bark. By using tree barks as the base for skin tanning it is possible to produce a good quality tanned skin that doesn't cost too much. Wattle trees have plenty of tannin. However the tannins in bark can be removed by washing. After the tanning is completed, don't wash these skins too often.

This section tries to explain some of the principles of skin tanning so that best use can be made of what is available. Some of the ingredients may not be entirely necessary. Trees in different areas will contain different levels of tanning and will result in different leather properties. Each person will need to do some experimenting.

The tanning process- background information

There are two main ways of getting tannin from tree bark. A young tree of 4-6 years old will have soft, young bark with lots of tannin. Don't remove bark right around the trunk. This is called ring-barking and will kill the tree. Instead cut a strip up the side of the tree. The equivalent of two strips of bark about 2m by 5cm long is enough for one skin if wattle bark is used.

The second way is to climb an older tree and cut a branch from it. The young branch can have all its bark removed. Too much bark is not a problem.

The bark should be from young branches up to about 200 mm in diameter. Once they are older than that the bark becomes dry and old and has less tannin. Use fresh bark. Older bark on firewood can be used, but there will be less tannin in this and more bark will be needed.

Do not use steel pots or steel buckets as tannins will react with the steel. Use aluminium or better still, stainless steel.

Cut the bark into small pieces (5cm x 5cm) and put it into an old pot and boil with water for about 15 mins. Leave to soak and cool for about 5 hours or overnight. Throw away the bark, and pour the brown liquid into a large plastic bucket.

Tanning

Into a clean plastic bucket put about

- 2 litres of water and then add
- 100 g of salt, (stir until dissolved) then add

- 2ml of battery acid.
- add about a teaspoon of disinfectant- something like dettol is fine .
- add the rest of the tanning solution.

Dissolve the salt by stirring. The disinfectant is to stop the solution from frothing and going rotten.

Two or three skins are placed in the brew so that as much skin as possible is in contact with the solution.

Removing vellum- meat attached to skin.

Stir the skins often in the first couple of hours. Then remove the skins and now remove the partially tanned vellum. The vellum should be much easier to remove.

Tanning

Stir at least 10 times a day. The more stirring the better, as this will help to get the tannin into the skin.

No parts of the skin should stay folded together for too long.

Don't put rocks or heavy items on the skins to make them sink. This has the effect of stopping the tanning solution getting into the skin. Rather keep stirring the skins so that small pieces of skin are not out of the solution for too long.

Make sure there is enough liquid in the bucket for the number of skins. They should slosh around freely.

Skins are fully tanned when a piece of cut skin has the reddish brown colour going right through the skin. Check on a piece cut up near the neck as the skin is thickest there.

The brew smells 'off' and is starting to froth?

The skins should stay in the brew for about 3-4 days. However if the brew starts to froth and bubble even with disinfectant then a fresh brew of bark can be made. Wash the skins in fresh water and then put the skins into this fresh, cold brew.

<u>If Chrome sulphate is available</u> then you can remove the skin(s) from the solution and wash them. (The following is applicable even if the skins do not appear to be going 'off'. The chrome sulphate will make the skin washable.

Lay a skin on a piece of plywood with the wet fur down.

For each skin make a solution of

- Chrome sulphate 1 rounded tspn
- Salt 1 rounded tspn
- 50 ml of hot water.

Dissolve the salt and chrome then when cool paint this solution onto the skin.

If a second skin is available place this second skin on top of the other, so that the chrome is touching the skin (not fur) side of both skins. Where only one skin is being tanned, fold it in half.

After about 4-5hours repeat the process. Leave overnight. Check to see that the bluish colour of the chrome has penetrated the skins, by cutting a smalll piece off the neck. Next day wash the skins and either

1. hang on a line out of sun and rain. As the skin dries it can be stretched and softened.
2. Tack out on a board to dry in the shade.

Where you are experimenting with barks that are not from wattle trees you may find that this frothing starts more quickly. Be prepared to either move to the chrome tan if possible or make a second fresh brew of bark. You may like to try the following which aims to tan a skin without having the fur wet.

Wattle bark tanning with a dry skin.

Take a fresh skin, remove the vellum and lay this skin on a board. You may like to try rubbing salt into the fresh skin and leaving for two hours. Now the vellum may be easier to remove. Do not wash this skin.

For each skin make a mixture of

- 150 ml of wattle bark liquor
- 1 teaspoon of battery acid
- 30 g of salt (1 rounded desert spoon)
- 2 desert spoons of flour

Now use this mixture and paint this onto the skin. The flour is to stop the brew flowing off the skin. Keep the skin moist with this brew. You may like to do two skins at one time and put one skin on top of the other, skin side to skin side. About three to four times over 24 hours, open the two skins and remove the old tanning brew. Put some fresh mixture on the skins. The skins will be tanned in one or two days. Check for thorough tanning by cutting through the neck of the skin to see that the brown colour has penetrated the whole skin.

When tanned rub off all the ingredients and allow to dry in the shade. As the skin dries it can be stretched and worked on a clean post.

Refer to the section below on finishing the tanning and final softening. .

Chrome Sulphate tanning.

Introduction

The method given below works well with rabbit skins. It is simple and not very expensive. However it uses a chemical that may be hard to obtain. It has been the main chemical used by skin tanners world-wide for many years.

The main reason for including the method in this book is that it produces a product that can be washed. I hope to see a range of levels in rabbit farming develop in Papua New Guinea. Some people will develop into village artisans or craftspeople, with skills in skin tanning and the use of skins for all kinds of purposes. This will become their business in the village. Men and women can do this. Chrome tanning is included for them.

The recipe below works well for about 10 rabbit skins.

Storing fresh skins.

It is likely that you will want to tan a number of skins at one time. Skins must be cared for carefully after killing. If they sit in the sun even for an hour they will start to rot and the skin will always be poor quality. Even the fur from skins that have started to rot may be useable. Pull the fur out of the skin and sell as fur for bilums or hats.

If possible quickly freeze fresh skins- place them in a plastic bag first. Store in a freezer for up to 5 months.

Most people do not have a freezer close by. Prepare the skin tanning chemicals before the rabbits are killed, so that fresh, washed skins can be put straight into the first bucket.

Preparing the skins.

Soak frozen skins in water until thawed. Then wash skins making sure to remove all blood.

Remove the vellum (layer of meat closely attached to the skin) by first soaking the skins in a bucket of prepared wattle bark tanning solution as outlined in the sections above. You could also try using salt as discussed on page ?? above.

Tanning.

For ten skins, dissolve 150g Chrome tanning powder in 2 litres of hot water. This is the stock solution.

Dissolve 150 g of plain salt in enough water to cover the skins in a plastic bucket.

Now add about 500 mls of the stock solution to the bucket and then add the skins. Stir them frequently. Stirring is critical to ensure even tannage. You cannot stir too much. At the end of the first day add another 500 mls of the stock solution.

In the morning check to see if the skins are thoroughly tanned. Take one of the largest (oldest) skins, cut a piece of skin off the neck and check to see if the colour has penetrated the whole skin. If it has then the skins are tanned. Remove them, wash and hang to dry in the shade. Do not wring the skins when washing them. Some detergent can be used during washing. Now go to the section on finishing the tanning.

Assuming the skins were not thoroughly tanned add another 500 mls of stock solution and stir the skins.

This solution can be used again for the next group of skins. There is no need to throw away the chrome sulphate brew. Just keep adding more skins as the animals are killed and add fresh stock solution as required.

Testing for thorough tanning

A tanned skin will not shrink when put in hot (70deg C) water. Untanned skins shrink.

When using tanning chemicals that change the colour of the skin it is easy to check for thorough tanning. The colour of the tanning agent should have penetrated the full thickness of the skin. Test by cutting a small piece of the neck.

Tanning with synthetic tanning agents.

This section is for those wanting to become the local skin tanner- possibly buying skins from other farmers and producing good quality jackets, blankets, bilums etc. Quantities given are for approx. 10 skins.

Skinning.

Remove as much velum/meat from the skin as possible.

Soak

In 5 litres of water add 2.5 g of detergent

Soda ash- 0.5 g per litre

Soak for about 3-4 hours and then remove last of the vellum.

Pickle

Water, salt (40g per litre) and acid from batteries or sulphuric acid- adjust to pH 3.0. Be very careful with acid. Only add acid to water, never water to acid. Use safety glasses.

Tan

Water

Salt 40 g per litre

Neosyn RH 20 g per litre

Battery acid- 0.5 g per litre.

Stir the skins often over a two day period.

Check that tannage is complete by taking a piece of square skin in put in warm water. Slowly raise temperature. The piece of skin should not curl-up and shrink below 70 deg.

Wash

To remove salt. If salt is left in the skins then during humid/wet weather the skins will become damp.

Now go to the section on finishing the tanning.

Finishing the tanning

During tanning much of the natural skin oils have been removed to allow the tanning agents to penetrate. This is especially the case where the Chrome sulphate and tree bark techniques have been used.

Oils need to be put back into the skin to allow them to be soft and pliable.

There are at least three ways of putting oil back into skins-

1. While the skins are slightly damp grate soap into an old pot (approx 1 tablespoon of grated soap/skin) and add enough water to allow slow heat to dissolve the soap. Soap is an emulsified fat and this can be brushed into the skin. As the water dries out the oil soaks in.
2. Neatsfoot oil or dubbin can be bought at a chemist shop and rubbed into the skin or

3. Emulsify 10g (about 1 tspn) of Remsynol 58 in 50 ml of hot water. Only make up enough for immediate use. Brush this into the flesh side of the skin. Check softness of the skin as it dries- if it is too hard then repeat the addition of the oil.

Final softening.

For the final softening any process which stretches and causes the fibres of the skin to move over each other helps. Animal skins are like felt. They have protein fibres crossing in all directions. Now that the skin is leather, the fibres have a protective coating of chrome salts or vegetable tanning compounds which prevent decay and allows these fibres to slide over each other. The oil which was brushed on lubricates the skin and helps prevent shrinkage when the water dries out.

Now is the time to work the skin to loosen up these fibres and to allow them to slide over each other. There are many methods for working skins.

First wash your hands if you want to end up with a really nice and clean piece of leather. Skins pick up dirt very quickly and hands often have grease and dirt on them.

Find a nice clean piece of wood or post top that is a little rough. Rub the skin over that, remembering to choose a clean piece of timber. Do not rub on the fur side. After lots of work, even just rubbing the skin in your hands, the skin will start to soften up. Rub the skin as though you are washing a pair of socks.

Finally brush the fur with a stiff brush.

Rabbits as a business

Some wise people suggest that rabbits should not be considered as a business. They argue that people will only look for money and forget the needs of their families for meat.

However all of those starting out with rabbits must evaluate the costs and likely returns. There is no point starting any enterprise without thinking carefully before hand.

Whether rabbits are kept for meat or for sale - keep the following in mind.

- If rabbits are kept for status, to prove that a person is a big man then he will want to have lots and lots of rabbits. This person does not understand rabbit farming.
- People who really understand rabbit farming will breed the animals they have and produce lots of young rabbits. These young rabbits will be fed well and sold or eaten when about 3 months old, or 2 kg liveweight.
- A rabbitry that has about 5 young rabbits for each adult indicates that the people running the rabbits know the secrets of rabbit farming. These are feeding, cleaning, breeding, killing and eating.

There are two critical factors which influence our rabbit business. Assuming we are looking after 4 does then the table below shows a budget in the second year when cage costs are low, and all does are mature. This table shows the amount of money we should be able to have as profit if we mate our animals from two to

four times a year. The other side of the table shows the effect of having good does that give from three right up to seven young per litter. We should aim for 4 matings a year for each doe and about 5 kits per litter on average. At UniTech with some pellets being fed the Canberra half lops have averaged more than 6 kits per litter.

The table below shows the kind of rabbit business that someone with almost no money can start. The main costs in the first year are listed, and the number of animals that are available at then end of the first year.

Table 1. Sample Budgets for Chicken Farming in PNG.

Profitability of keeping broiler chickens for sale in PNG Villages

Farmers decisions:-

Number of chickens:-	52
Chickens eaten?	3
Chickens given away	3
Average Sale Price	10
Total Feed costs/bag	35

Mortality %?	10
Therefore number dead	5.2
Animals able to be sold	40.8

Expenditure		**Kina**
Purchase cost of chickens		80
No of bags required?	8	
Total Feed costs		280
Kerosene costs?		15
Feeders- replacement		20
House maintenance		10
Total Costs		**405**

Income		**Kina**
Animals sold	40.8	
Income from birds sold		408
Income from manure		4
Total Income		**412**

Total Profit/Loss 7

Table 2. The effect of average sale price/chicken and total feed costs, including transport on overall profit or loss, for 52 chickens.

Feed Cost		Average Sale Price/Chicken			
		8	10	12	14
per 50 kg	30	-34.6	47	128.6	210.2
includes	35	-74.6	7	88.6	170.2
transport	40	-114.6	-33	48.6	130.2
	45	-154.6	-73	8.6	90.2
	50	-194.6	-113	-31.4	50.2

Table 3. Sample budgets for domestic rabbit farming. Two does and 5 kits per litter with 20% mortality. All young sold.

Profitability of domestic rabbit farming in PNG Villages

Farmer Decisions:-

No. of Does	2
No. of Bucks	1
Family eats:	0
Ave. sale price at 3 mths	10
(Total/bag cost of feed)	45

Production:-

Kits/litter	5
Mortality %	20
Litters/year	4
Kits/doe/yr (survived)	**16**

Expenditure		**Kina**
Cost per doe (kina)	10	
Cost per buck (kina)	10	
Animal health costs	0	
Total Animal costs		**30**
Wire for cage floors	28	
Other wire, nails, feed bucket	104	
Feeders and waterers	43	
Cages		**175**
Pellets used/kit (K)	1.45	
Kina spent in feed for all kits	46	
Purchased feed		**166**
Annual labour costs		**0**
Skin tanning costs k/skin	1	
Total skin tanning costs		**0**
Total Costs		**371**

Income		**Kina**
Surplus sold	32	
Income, live sales	320	
Total animals sold K/yr		**320**
Skin price	6	
Skin sales from those eaten		0
Manure (K6/breeding animal)		
=(gain in vegetable production)		18
Total other income		**18**
Total income		**338**

Total Profit/Loss Yr 1	**-33**

Total costs no pellets	**205**	**Profit in yr 1 with no pellets**	**133**
Year 2			
Incidental costs, cage repair	40		
Total Costs in Yr 2	**206**	**Total income in yr 2**	**338**
		Profit in Yr 2 (with Pellets)	**132**

Table 4. Sample budgets for domestic rabbit farming. Two does and 5 kits per litter with 20% mortality. Family eat 20 young rabbits and sell skins.

Profitability of domestic rabbit farming in PNG Villages

Farmer Decisions:-

No. of Does	2
No. of Bucks	1
Family eats:	20
Ave. sale price at 3 mths	10
(Total/bag cost of feed)	45

Production:-

Kits/litter	5
Mortality %	20
Litters/year	4
Kits/doe/yr (survived)	**16**

Expenditure		**Kina**
Cost per doe (kina)	10	
Cost per buck (kina)	10	
Animal health costs	0	
Total Animal costs		**30**
Wire for cage floors	28	
Other wire, nails, feed bucket	104	
Feeders and waterers	43	
Cages		**175**
Pellets used/kit (K)	1.45	
Kina spent in feed for all kits	46	
Purchased feed		**166**
Annual labour costs		**0**
Skin tanning costs k/skin	1	
Total skin tanning costs		**20**
Total Costs		**391**

Income		**Kina**
Surplus sold	12	
Income, live sales	120	
Total animals sold K/yr		**120**
Skin price	6	
Skin sales from those eaten		120
Manure (K6/breeding animal)		
=(gain in vegetable production)		18
Total other income		**138**
Total income		**258**

Total Profit/Loss Yr 1	**-133**

Total costs no pellets	**225**	**Profit in yr 1 with no pellets**	**33.1**
Year 2			
Incidental costs, cage repair	40		
Total Costs in Yr 2	**226**	**Total income in yr 2**	**258**
		Profit in Yr 2 (with Pellets)	**31.8**

Table 5 Sample budgets for domestic rabbit farming. Four does and 5 kits per litter with 20% mortality. Family eat a rabbit a week. Sell all skins.

Profitability of domestic rabbit farming in PNG Villages

Farmer Decisions:-

No. of Does	4
No. of Bucks	1
Family eats:	52
Ave. sale price at 3 mths	10
(Total/bag cost of feed)	45

Production:-

Kits/litter	5
Mortality %	20
Litters/year	4
Kits/doe/yr (survived)	**16**

Expenditure		**Kina**
Cost per doe (kina)	10	
Cost per buck (kina)	10	
Animal health costs	0	
Total Animal costs		**50**
Wire for cage floors	39	
Other wire, nails, feed bucket	187	
Feeders and waterers	63	
Cages		**289**
Pellets used/kit (K)	1.45	
Kina spent in feed for all kits	93	
Purchased feed		**323**
Annual labour costs		**0**

Income		**Kina**
Surplus sold	12	
Income, live sales	120	
Total animals sold K/yr		**120**
Skin price	6	
Skin sales from those eaten		312
Manure (K6/breeding		

		animal)	
Skin tanning costs k/skin	1	=(gain in vegetable production)	30
Total skin tanning costs	**52**	**Total other income**	**342**
Total Costs	**714**	**Total income**	**462**
		Total Profit/Loss Yr 1	**-252**
Total costs no pellets	**391**	**Profit in yr 1 with no pellets**	**71**
Year 2			
Incidental costs, cage repair	40		
Total Costs in Yr 2	**415**	**Total income in yr 2**	**462**
		Profit in Yr 2 (with Pellets)	**47.4**

A checklist when things go wrong.

Problem	Cause	Action
Kits die in first 24 hours.	No nest box	Kits need to be born into a warm litter with fur. Keep good records and put a nest box in 4 days prior to kindling date. (pg??)
		Some people in the highlands do not use nesting boxes- they provide lots of dry grass (fine, short grass is best, not rough, long kunai type grass) and rabbits make a nest in the corner of the cage.
	Kits not being fed	Keep an eye on young kits. Quiet does will not mind you checking on the kits. If they feel hot then they are being fed. It is possible to see an area of white milk in the abdomen of kits getting plenty of milk. Does normally feed once a day, and this mostly at night. Hungry kits are cold kits. They may need fostering - refer page ??
	Rats	Holes in cage?
		Wire mesh too large
	Dogs worrying the doe	Ensure the doe is contented and not anxious. Do not allow people near the kits in first 24 hours after kindling. The owner of the rabbits should check the nest.
	Mother has no milk.	She may not be getting enough good food.
		If the doe is on concentrates (copra meal) has she got plenty of clean water?
		If this happens twice cull (kill) her.
	Mother herself may bite and damage the kits.	May be a problem with does that have not had a litter before.
		Salt should be available, esp. for rabbits that get no pellets. Cull if happens twice.
		Keep dogs and strangers away especially in first 24 hours after kindling.
Kits die after they are a week or two old	Often from wet, urine soaked litter	Keep an eye on the litter. Replace wet/cold fur with small pieces of dry newspaper or dry fine grass clippings. It is a good idea to have a carton of dry grass ready for this.
		You may need to put dry cardboard under the kits.
	Starvation	Are you feeding the doe well? Milking does need lots of food (and water if fed concentrates/pellets).
Poor growth rate in kits	Poor quality feed Not enough feed.	Feed some kaukau or pellets. Feed plenty of bean leaves. Esp. remember that rabbits like to feed at night. Give them plenty in the late

		afternoon.
		Rabbits need variety in their diet. If does are on pellets they can get bored with this. Ensure variety by also providing plenty of greens and some fresh kaukau tuber. (page ???)
Diarrhoea	Dirty water	Give clean water
		Are the young kits able to get into the water and so urine and pekpek gets into the water?
	Dirty cages	Clean cages
	Diet	Try feeding some dry straw for a few days.
	Too much molasses	if more than 10 % molasses is fed this can cause diarrhea.
Doe refuses to mate	She is not ready for the buck	Check her vagina- a doe ready for mating has a reddish coloured vagina; she may also make some noises in her throat and may rub throat on feeders etc in the cage.
		You may need to hold her for the buck, esp. if this is her first mating. (page ???)
Does appear to be mated but do not get pregnant.	Infertile buck	Try someone elses buck who is known to be fertile..
	Mating only appears to be successful	After mating the buck should fall off to the side, may squeal. Pick up the doe and check her vagina. There should be some sign of semen in her vagina.
	During very hot times of the year in the lowlands it is possible that the buck is infertile for some time	Do most breeding during the cooler time of the year, allowing all animals a rest during the worst of the heat.
Doe attempts to bite people	Aggressive doe	Cull
	The owner may be scared	Place one hand in view of the rabbit, quickly place the other hand over the rabbits head and quieten the rabbit. (page ???)
	pregnancy	some does become a little aggressive while pregnant. Give lots of forage, handle as little as possible. Stroke the doe a lot when the kits are over one week old.