



**PAPUA NEW GUINEA
COUNTRY REPORT**

**STATE OF THE
ANIMAL GENETIC RESOURCES**

NOVEMBER, 2004

**MINISTRY OF AGRICULTURE AND LIVESTOCK
P.O. BOX 2033
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FOREWORD

As the Minister responsible for Agriculture and Livestock it gives me great pleasure in presenting the Papua New Guinea's Country Report on Animal Genetic Resources for the preparation of the First Report on the State of the World's Animal Genetic Resources for food and agriculture. I wish to take this opportunity to thank the Food and Agriculture Organization of the United Nations for inviting Papua New Guinea to participate and contribute in the preparation of the report.

I understand that the ultimate aim of this exercise is to develop national capacities and international cooperation to achieve the sustainable intensification of livestock production systems. The Government of Papua New Guinea is in the process of further developing its livestock industry, particularly the subsistence and semi-commercial systems that contributes significantly to household food security and the socio-economic development of the rural communities, consisting of almost eighty per cent of the population.

To this end, the Government is seeking the support and technical cooperation of FAO and other international agencies to achieve its goals. On behalf of the Government of Papua New I endorse this Country Report and look forward to my country's continued participation and cooperation in the promotion of sustainable management of our livestock genetic resources for the benefit of posterity.

Finally, I wish to thank all those individuals and organizations that have contributed towards the preparation of this Country Report.


HON. MATHEW N. SIUNE, MBE, MP
MINISTER FOR AGRICULTURE AND LIVESTOCK

EXECUTIVE SUMMARY

In Papua New Guinea, despite a general recognition of roles and values of indigenous breeds there were no formal or informal programmes undertaken in the past to conserve them for future use and development. The only exception being two herds of Javanese Zebu cattle maintained at two government farms from 1974 and systematically evaluated, until they were dispersed in 1980.

Currently, PNG has no formal conservation strategies or action plans for AnGR, due mainly to lack of financial resources, technical capacity and trained human resources. This is perceived as the responsibility of the public sector.

Within the foreseeable future there is no threat to any of the indigenous breed, apart from Javanese Zebu, which is because of its smaller body size not attractive to commercial cattle producers and as a result the breed is declining rapidly, and the current number is not certain.

Geographical isolation, strict quarantine protocols, the country is free of major endemic diseases, relatively stable political, environmental, social and economic status provide considerable protection to the conservation of the indigenous breeds, despite the lack of any formal or informal conservation strategies or plans.

In the highlands of Papua New Guinea the native pigs have cultural significance and are mainly kept as a measure of social prestige, wealth and as an exchange medium in social events.

There is an urgent need to develop and implement a conservation programme to save the endangered Javanese Zebu breed and collect adequate information on and characterization of all other indigenous breeds in the country.

The National Agricultural Research Institute (NARI) of Papua New Guinea, a public entity, is mandated to carry out this task. NARI has proposed to undertake this programme in collaboration with other stakeholders, including the private sector and the farmers.

Adequate financial resources, technical capacity and trained human resources are considered as priorities in enhancing the capacity to develop and implement the conservation programme.

Some in-country expertise and facilities are available but needs strengthening for which cross-country assistance is required.

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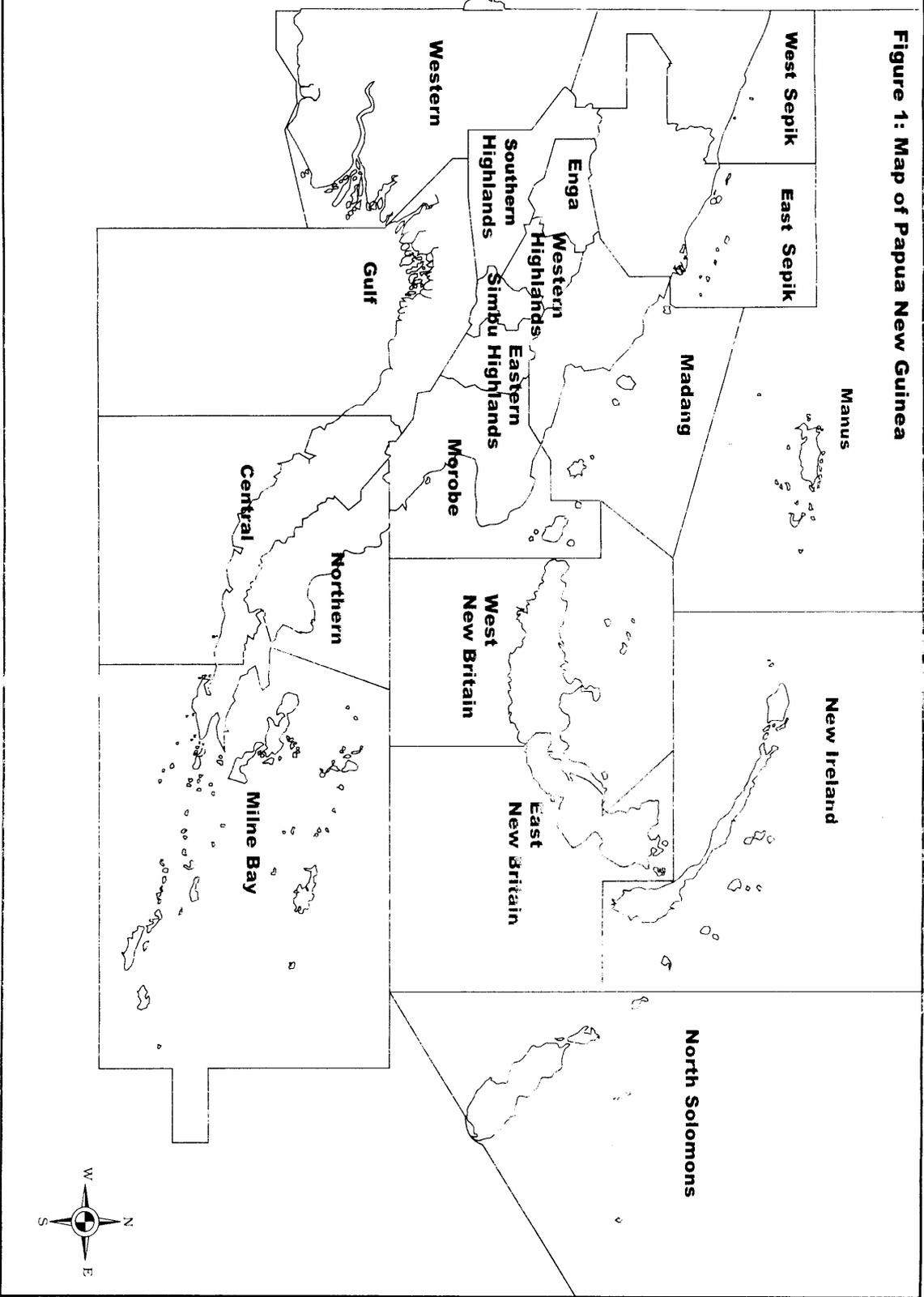
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Figure 1: Map of Papua New Guinea



Section 1

INTRODUCTION

1.1 The Country and Agricultural Sector

1.1.1 Location and Land Area

Papua New Guinea (PNG) lies north of Australia between longitudes 140° and 160° east and 1° and 12° south. It consists of a mainland and a collection of islands of varying sizes. The mainland is the eastern part of the island of New Guinea and the western part is the Indonesian Province of Irian Jaya (formally Dutch New Guinea). Of the total land area of 474,000 km², 85% is on the mainland and the remainder on some 600 islands. The larger islands are Manus, New Britain, New Ireland, and Bougainville.

1.1.2 Climate and Geographical Features

The centre of the main island of Papua New Guinea consists of a series of mountain ranges with populous upland valleys. It has thickly forested mountains in the centre, lowlands along the coast and swampy alluvial plains in the southwest. Being in the tropics, the climate in coastal areas of the islands is generally hot and humid, with temperature ranging from 25 to 35°C. The valleys of the central highlands are warm in the daytime but cooler in the nights. At the higher altitudes frost occurs during certain times of the year.

The humid rainfall varies from 1000mm in certain parts in the south to over 4000mm in some wetter areas of the country. About 80 % of the country receives over 2000mm of rain. Rainfall is the characteristic that differentiates the seasons. There are distinct wet and dry seasons, the timing and duration of which varies from one area to the other.

The general vegetation of the country varies with elevation and rainfall and most of the area is under tropical forest.

1.1.3 Agro-ecological Zones

The country is divided into four (4) agro-ecological zones, namely, wet lowlands, dry lowlands, highlands, and high-altitude highlands based on rainfall and altitude.

But for political and administrative purposes the country is divided into 19 provinces and 4 regions (Figure 1):

1. *Southern region* consisting of Central, Oro, Milne Bay, Gulf and Western provinces.
2. *Northern region* consisting of Morobe, Madang, East Sepik and Sandaun provinces.
3. *Highlands region* consisting of Eastern Highlands, Western Highlands, Southern Highlands, Simbu and Enga provinces.
4. *Islands region* consisting of East New Britain, West New Britain, New Ireland, Manus and North Solomons provinces.

1.1.4 Agricultural Sector

Like in other developing countries agriculture dominates the economy of Papua New Guinea, where 80% of people live in rural villages, and account for 25% of the GDP.

The Agriculture sector is the mainstay of the country's economy, and will continue to be for a very long time and provides employment over 25% of the workforce in the formal sector. The export earnings from the agriculture sector in 2000 were US\$290 million; which was 17% of the total export earnings

1.1.5 Livestock Sector

About 50% of the agricultural output comes from production of food items, of which livestock contributes about 13%, primarily from pigs and poultry, with an estimated annual output value of US\$60 million. All meat and egg production so valued is consumed locally and about 60% of that never enters the commercial trade but is consumed within the family or local community.

Despite an abundance of natural resources suitable for livestock production and an enviable low disease risk status, livestock production has not increased in the recent past. On the other hand, meat consumption is increasing steadily and is predicted to increase at 5% per annum commensurate with the growth of the population and continued increasing affluence and the current cost of imported livestock products exceeds US\$50 million. The estimated per capita consumption of meat is 21 Kg, which has not changed since 1990.

1.2 The State of Food Security

PNG is one of eighty-three countries defined by the FAO as low-income food-deficit countries. This is based on low cash incomes and the nation being a net importer of basic foodstuffs. But it is uncertain if this general definition is strictly applicable in PNG context. Although there are short-term and long-term food supply problems in parts of the nation, there are more widespread problems with access to food of adequate quality, especially high protein and energy dense foods, including oils and fats.

Short-term threats to food security in rural PNG are caused by frost, excessive soil moisture and flooding, drought, large variation in planting rates, and other local events such as clan fights and human disease epidemics, while long-term threats to food security arise from low cash income and land degradation.

Although droughts cause food shortages in PNG, only severe droughts lead to major shortages and these are uncommon. Short-term droughts associated with frost cause food shortages in the high altitude areas.

In a small number of locations with high population density and very small islands, the major risk factor for long-term food security is land degradation.

1.3 Population and Socio-economic Environment

The total population of PNG at the last census in 2000 is 5,130 million and the annual growth rate is 3.1%.

Local food production has increased significantly. In the early 90's imported food items, particularly cereals and sheep meat (cheaper cuts) increased considerably but this has stabilised in recent years. This may be due to the fact that imported food has become expensive, as the value of the local currency has depreciated by almost 75% and per capita income has not increased proportionally.

The depreciation of the local currency was inadequate to offset the fall in prices of major export crops, a major source of income for the people in the rural sector, which reduced the purchasing power of the rural people and increased their reliance on locally produced food.

There is a general increase in rural poverty in recent years, which further exacerbated by lack of maintenance of rural infrastructure such as roads, bridges, airstrips, hospitals, and schools that in turn had encouraged urban migration. This has created major social and economic problems in the urban centres and put undue strain on social amenities in these centres - housing, health services, transport, etc.

1.4 Role of Livestock

Although the demand for animal products is increasing at 5% per annum but the local production has not increased appreciably in the recent past and in some cases decreased. The shortfall in local supply is met with importation of meat. All the dairy products are imported. 80% of the beef and 100% of the sheep meat (cheaper cuts) are imported. 70% of the imported beef is used by the two canneries in the country.

Increase in commercial poultry and pig production has occurred in the recent past and the country is virtually self-sufficient in these products. Government used tariffs, import quotas and ban on imports to foster the development of these two industries. The tariffs on other meats have fluctuated from year to year. Zero tariff on sheep meat encourages importation of this meat for the consumption of those in the lower income bracket.

Section 2

THE STATE OF ANIMAL PRODUCTION SYSTEMS

2.1 Primary Animal Production Systems

Three major livestock production systems are found in Papua New Guinea, namely,

- Commercial
- Semi-commercial
- Subsistence

2.1.1 Commercial Production System

This system includes poultry (chicken), pigs, and beef cattle. Under this system, meat and eggs are produced for the formal market.

A modern and vertically integrated commercial poultry production system is operated by three commercial entities supplying broilers and eggs to the formal market. These companies also employ out growers. Under this out growers scheme the farmers erect simple poultry houses for broilers. The company sells day old chickens and feed to the growers with the promise to buy back fully grown chicken for processing and marketing. Upon processing, the grower receives the net proceeds from the price to the processor less the cost of feed, chicken, and services.

These companies import parent stock and breed them locally. The companies also supply day old chicken to be grown by villagers for fresh meat in the local market. Production from this source is estimated to match the commercial production of frozen chicken, each estimated 18,000 tonnes annually, giving a total of 36,000. Both these sectors use imported feed or raw materials and compound locally.

The commercial pig meat industry too is based around a small number of large scale piggeries located on the outskirts of the major cities. Production is based on commercial feed formulation and strains of imported pigs. This industry too has a high dependence on imported feed. Owned and operated by companies which have their own processing facilities and marketing outlets

Beef cattle production in Papua New Guinea are organised on commercial lines but has two (2) sub-systems, namely large holder cattle ranches and smallholder cattle farms. There are 28 large holder cattle ranches in Papua New Guinea grazing either unimproved or semi-improved or improved pasture, with little or no supplementary feeding, except on one ranch, the largest in Papua New Guinea, which also practices feedlot to fatten the steers. This ranch is a subsidiary of the only Sugar manufacturing company in the country and uses the by-products for the feedlot.

The other sub-system consists of smallholder beef cattle farms that are smaller in size. The average herd size is about 30 – 50 heads. The total cattle numbers on ranches and the smallholder farms are 65,000 and 20,000 respectively.

2.1.2 Semi-commercial Production System

This production system, although not widespread in Papua New Guinea, is often located on the outskirts of provincial capitals and semi-urban localities. Here, the

farmers keep their livestock as part of the farming system but organised on commercial lines and dispose most of the products at the local market, depending on the demand and the price. The farms are individually owned or, in some cases, by a clan or sub-clan. The major species are pigs, goats, and sheep and in very few cases beef cattle. Use some kind of external inputs mostly feed and breeding stock, particularly in the case of pigs and poultry.

2.1.3 Subsistence Production System

This is by far the most common type where animals are kept primarily for household consumption but anything excess is either disposed for cash or exchanged for other livestock or crop produce. This is common in villages. The animal species are native chicken, pigs, sheep, goats, ducks, and rabbits. Individual households usually own the farms. Usually these animals graze or scavenge unattended and housed at night. It is estimated that there are about 1.8 million village pigs, 1.5 million native chicken, 20,000 goats and 10,000 sheep.

The pigs are of major cultural significance in most tribal groups, but particularly in the highlands provinces where they are used in exchanges as well as feasting. Under this system it is common for the farmers to have more than one species. These farmers use no external inputs and the livestock forms part of the smallholder farming system.

2.2 Major Animal Products

The major animal products in Papua New Guinea are meat and eggs. Under subsistence system, farmers use manure to fertilize the crop gardens. Other products hides of cattle, which are exported and some farmers use the wool from the sheep to make quilts, pillows and rugs, which is not widespread. Some buffaloes are used for cartage in coconut, cocoa and oil palm plantations. Under the subsistence system animals are used as capital accumulation and in the highland region pigs provide social status and prestige and used in exchange of gifts, payment of compensation, etc and thus have important social significance.

Cattle, poultry including ducks, pigs, sheep, goats and rabbits are used for meat production, chicken and ducks for eggs and buffaloes for draught purposes. The entire livestock products are consumed locally and almost 60% of them never enter the formal market. It is unlikely this situation will change in the near future. Locally adapted species are equally important and introduced breeds and strains depending on the nature of the production system. Under the commercial intensive production system imported breeds will continue to be used, whereas the locally adapted breeds will continue to be used as the production base for the subsistence production system. The recently introduced rabbits are reared by villagers under either subsistence or semi-commercial systems.

2.3 Changes in the Use and Management of Animals

The major significant changes that have occurred in the last ten years is that the country has achieved self-sufficiency in poultry and pig meat, which contributed to food security, particularly in the urban areas. Contributions to rural economy derived from small-scale commercial production poultry and pig production in the rural and

peri-urban areas. However, contribution to national economy is relatively small as the entire feed and veterinary inputs are imported.

The main reason for the changes that have occurred is the government policy of import ban of these products in the 1980s, which was replaced by high tariff on imports since 1992.

Over the last 10 years, there have been no significant changes in the types and diversity of products produced, only exception being introduction of rabbits into the country from Australia, which is becoming popular in rural areas.

2.4 Limiting Factors

In the case of beef cattle the national herd has shrunk from 153,000 in 1976 to around 85,000 in recent years proportionally reducing beef production by more than 50%. The reduction in cattle numbers and beef production is generally attributed to:

- Poor management and poor skills in animal and pasture management on both large holder and smallholder properties;
- The withdrawal of government support, particularly extension support to smallholders who lacked experience in cattle production;
- Owner disputes because of uncertainty of land tenure;
- Poor financing arrangements with loan repayment period too short;
- Problems associated with transport of animals to abattoir
- Increasing law and order problems, which made it difficult to secure grazing animals; and
- Better returns from alternative enterprises.

Major limiting factors in the case of sheep and goats are shortage of breeding stock, lack of management skills, poor extension support services and heavy losses of lambs and kids due to killing by dogs and pigs, which are kept together in the villages.

In the case of village pigs and native chickens production is low due to low productivity of these animals due mainly low genetic potential of these species, inadequate attention given in terms of feeding and management and poor extension services.

Improved extension, veterinary and advisory services to smallholders, easy access to credit facility, and research and development support to improve the management of the local breeds through better feeding practices using local feed resources and other husbandry practices will enhance the production and productivity of these species.

A detailed description on each animal species is presented in the proceeding section.

Section 3

ANIMAL GENETIC RESOURCES

3.1 CATTLE AND BUFFALO

3.1.1 Introduction

There are no cattle native to PNG and the earliest known introductions were in the 19th century from South East Asia and South Australia. The South East Asian cattle, known locally as Javanese Zebu, has been entered in the World Watch List as being endangered (see data supplied to DAD-IS by Alan Quartermain in 1995). Cattle imported from Australia were the British breeds including Hereford, Shorthorn, Aberdeen Angus, Redpoll, Jersey and possibly other breeds as well. Commercial beef production began in early 1950s with the establishment of a research centre and four breeding stations. In the early 1960s the establishment of large-scale cattle ranches led to the importation of Brahman and Brahman-cross cattle including Droughtmaster and Santa Gertrudis from Australia and a consignment of Brahman stud cattle from the USA. Government also provided funding for and encouraged smallholder cattle development. Cattle population in the country peaked in 1976 at about 153,000 but has since declined to about 80,000 with an estimated 63,000 on ranches and 17,000 on smallholder farms with an annual beef production output of 2,300 and 600 tonnes respectively (Quartermain, 2001).

No recent accurate estimates of cattle numbers are available; the last livestock census was conducted in 1961-62. The rapid fall in numbers since the mid 1970s reflects the collapse of the smallholder schemes, the run down of the plantations and the inclusion of cocoa, coffee and, more recently oil palm on coconut plantations. Most of the cattle are Brahman crosses used primarily for beef production but there are very small populations of Jersey and Friesian cattle kept in a few areas for dairy production. There are also horses present in the country that are used primarily for cattle work and to a lesser extent for recreation (see Quartermain 2002a).

3.1.2 Production systems

There are four production primary production systems:

3.1.2.1 Ranches

They are found in Morobe, Madang, Oro, Central and Eastern Highlands provinces where large areas of natural grasslands can be found. The ranches range in size from 1500 ha to 5000 ha. Brahman-cross cattle are the main animals used. The Javanese Zebu, a well adapted breed but smaller in size than Brahman-cross cattle, are not favoured by expatriate ranch owners and therefore not used under the ranch system of production. Horses are still used widely for cattle work in this system. Some ranches are privately owned but many are company owned. The ranches are relatively self-sustaining but rely on some external inputs such as fencing materials and frozen semen from overseas and veterinary care. The reliance on inputs from outside may influence the conservation, management and utilisation of cattle genetic resources. There appears to be no major risk factors in this production system.

3.1.2.2 Smallholdings

Few smallholder cattle enterprises existed before the 1960s. In the 1970s the smallholder programme was encouraged and promoted by funding from the World Bank, which funded over 1000 projects. Farm size ranged from 10 to 1000 ha but most holdings for cattle grazing were from 30 to 100 ha. Despite a lot of effort and funding in training smallholder farmers in cattle keeping, the system did not prosper. Existing smallholders keep a small number of animals, mainly Brahman crosses, supplied by the ranches, but a few of them keep over 1000 head. Some horses are used for work in this system. Most smallholder farms are privately or family owned, but some are owned by co-operatives, associations or clan groups. Most of the farms can be classed as small-scale commercial units. A few farms also keep exotic pigs and hybrid broiler and layer chickens and possibly some ducks as well in addition to cattle. Most are self-sustaining, but new projects or expansion of existing projects rely on fencing materials and at times breeding stock from local sources, and veterinary care. Nutritional stress and cash flow problems often lead to sale of breeding cows, which lowers output and reduces cattle numbers.

3.1.2.3 Plantations

Coconut plantations were established in the late 19th century on the coastal plains of the New Guinea Islands, with limited areas also being planted on the coasts of the mainland. Cattle (and other livestock) were introduced, initially to provide a local meat supply and as draught animals. During the 1939-1945 war cattle numbers fell and many of the plantations were neglected or abandoned. More recently the value of cattle under coconuts as a means of controlling grass and shrub growth has been recognised and, where plantations have been rehabilitated, cattle have generally been re-introduced. However, use of cocoa as an intercrop where soils permit has been found to be more profitable and cattle are now confined to the poorer soil areas. On most plantations the main emphasis is placed on crop rather than cattle production. Most cattle under this system are Brahman crosses but there may be small numbers of Javanese Zebu cattle and swamp buffalo as well. Some plantations also keep exotic and/or crossbred pigs and hybrid broiler and layer chickens. Horses are used in many plantations for cattle work. Many plantations are self-sustaining with minimal use of barbed wire fence but some use frozen semen or purchase breeding stock from other local sources. There are no major risk factors affecting cattle production under this system.

3.1.2.4 Institutions

Missions, schools, research stations and other institutions keep only small numbers of cattle; nevertheless these institutions represent an important part of the cattle industry. Many of these were established early in the last century and some of them play an important role in research, teaching, demonstration and multiplication. The institutions were often responsible for introducing animals of non-traditional types to rural areas and this has in some cases resulted in smallholder acceptance of cattle. Where cattle play an important part in the training activities or financing of institutions, management levels are generally good and cattle performance may be higher than on large-scale ranches. Most of the cattle kept are Brahman crosses. Many of the institutions keep other species as well, particularly pigs and poultry and may be a few buffalos for draught and dairy cattle. There is limited use of horses for cattle work under this system. Most are self-sustaining. Replacement stock is

purchased from nearby local sources. In the few small dairy herds currently operating frozen semen is imported from overseas. There are no major risk factors influencing this system.

3.1.3 Important animal products

The most important product is beef but small quantities of meat and bone meal is also produced. Some cattle hides are exported to parts of South East Asia for further treatment and processing into leather goods. Use of cattle for draught is uncommon although there is potential for this in certain areas. Buffalos are kept mainly for draught purposes but their meat is also consumed when the opportunity presents itself. At present all the beef produced in the country is consumed locally. However, recently there have been exports of live cattle and there may be opportunities in the future to export certain cuts of beef. These may improve the management and utilisation of cattle genetic resources in the country.

3.1.4 Major trends in use and management of animals

Beef production has been static for the last 10 years with annual production at around 3000 tonnes. There have been some recent increases in production mainly from the large-scale ranches attributed to a higher turnoff rate and higher carcass weights. However, there is unlikely to be any major changes in the industry in the short- to medium term that will result in any significant increases in production. Significant increases in production could occur if a major effort is made into reviving the smallholder sector since much of the potential land for grazing is traditionally owned. However, transportation of animals to central slaughter facilities is a serious problem. There has been little change in the types and diversity of beef products in the last 10 years due maybe to an unchanging and unsophisticated market demand. There have been a number of recent policy initiatives taken by the government through the Ministry of Agriculture and Livestock to increase beef production as part of the food security and import replacement programme but these are still at the policy stage and have yet to be translated into action.

Major constraints affecting beef productivity and efficiency are:

- Low quality nutrition
- Low herd fertility - 50-60%
- Low calf survival percentage – only 50-60% of calves born are reared to maturity
- Low average growth rates of weaner cattle leading to long time to reach slaughter weights
- Inbreeding
- Lack of recording and use of performance indicators

Improvement in nutrition including making more use of local agro-industrial by-products in supplementary or feedlot finishing, introduction of new genetic material, recording of herd performance indicators and use of this information by the industry would help overcome some of these problems.

3.1.5 State of knowledge of genetic resources

Some good information is available on the status and importance of cattle and buffalo to food and agriculture production. Of particular relevance is the report of Holmes (1980) and the data supplied by Alan Quartermain to DAD-IS in 1995 on the Javanese

Zebu cattle. A report on the Conservation of Domestic Animal Genetic Resources in PNG was put together by Quartermain (2002b), which is annexed to this document. There have been no regular surveys conducted on cattle and buffalo genetic resources; the last general livestock census was conducted way back in 1961/62.

Information on reproduction, calving rates, calf survival, pre-weaning growth, weaning weight, post-weaning growth, slaughter and carcass weights are maintained for beef cattle. There is only limited data of this kind on buffalos. Information on breeding structure and organization of breed groups is maintained to a certain extent on the large-scale ranches where expertise is available to do this. There is no national livestock information system capable of monitoring breed status. Previous information provided to DAD-IS has come from the Ministry of Agriculture and Livestock and various other interested/concerned individuals. There is some good comparative data available on the production of straight-bred Brahman, Brahman cross and Javanese Zebu cattle and buffalo. These data have been obtained mainly on research stations. There have been no molecular studies done on cattle and buffalo. The main references to cattle and buffalo are contained in the report on Conservation of Animal Genetic Resources in PNG (Quartermain 2002b).

3.2 PIGS

3.2.1 Introduction

There are two types of pig present in the country. The native pigs (Papuan Pig) came with people from South East Asia into PNG about 5000 years ago, making them the first domestic animals to be introduced into the country. There is an estimated 1.4 to 1.8 million of these pigs in the country with an annual production of 27,000 tonnes valued at K62 million. This production does not reach the urban markets. The requirement of this sector is more to improve productivity rather than profitability. They are believed derived from a domesticated hybrid of the Southeast Asian *Sus scrofa vittatus* and the Sulawesi pig, *Sus celebensis*. The phenotypic descriptions and husbandry of these pigs can be found in Malynicz (1970) and Quartermain (1977). They are a unique genotype with a good population size and a considerable degree of genetic isolation due to geography and slow commercialisation of village production. Compared to modern commercial pigs, it is small and slow growing with a smaller litter size but good mothering ability. Its unique genetic features, whether identified or not, are not in immediate danger of loss but steps should be taken now to initiate further genetic studies and plan to conserve the genotype.

The other pigs present in the country are the imported European commercial pigs including Large White, Landrace, Berkshire, Tamworth, Saddleback and Large Black. A modern commercial industry, based on these imported breeds and feeds, has developed in more recent times to meet urban demand for pork. This sector is small compared to the traditional sector with estimated pig numbers of about 24,000 and annual production of about 1,000 tonnes and does not compete against the traditional sector for resources. Total local meat production from all species is estimated at 45,000 tonnes with pig meat accounting for 62% of this production and about 27% of all meat including imports.

The consumption of pig meat in the traditional sector is erratic and uneven, being governed more by location and frequency of pig kills than by normal commercial market forces. There are indications that the traditional place of the pig in rural

society may be changing amongst those owners now earning significant cash incomes from crops like coffee. More village pigs are being sold to urban areas, more are being exchanged for cash rather than to meet traditional obligations and in some areas people have stopped eating and even keeping pigs because of religious beliefs.

3.2.2 The state of production systems

The industry is comprised of 5 characteristic groups as summarised in Table 1.

Table 1. Pig industry structure and characteristics

Holding Type	Herd size	Number of herds	Number of pigs	Trends	Breeds
Smallholder traditional	1-20	360,000	1,800,000	Static Maybe increasing with human population	Native (see Quartermain, 1996)
Smallholder penned household	1-3	1000	2000	Growing slowly	Native
Smallholder commercial	10-100	50 (including prisons and high schools)	2000	Growing slowly	Modern commercial
Middle size commercial	100-500	4 (3 institutional)	1500	Static	Modern commercial
Large scale commercial	>500	7	20,000 (2,500 sows)	Static	Modern commercial

Source: Quartermain and Kohun (2002)

3.2.2.1 Smallholder traditional

This is by far the dominant sector in which pigs are largely run free range scavenging but generally confined at night and fed food wastes, food crop surpluses, sweet potato and/or coconut. This production is a continuum of a 5,000-year tradition. The structure is differentiated by location. The highland provinces with 45% of the total rural households have 78% of households owning pigs. Four provinces have over 80% and Enga has 89%. Pigs/person ratios average 1.2 in the central highlands, dropping to 0.6 in the highland fringes. Utilisation is largely geared to ceremonial feasting. Lowland and island provinces have pig ownership ranging from 18 to 58% of rural households with pigs/person ratios averaging 0.3 for the inland lowlands and some coastal areas and 0.1 for most coastal areas and islands. Utilisation here tends to be more opportunistic with increasing live pig sales for cash needs. Nationally some 50% of pig owners have indicated some intent to sell pigs. In general, traditional smallholders have very little involvement in formal marketing. Their requirements may be to improve productivity rather than profitability. Some farmers may also keep other livestock, especially village chickens.

3.2.2.2 Smallholder penned household

This group is small but slowly growing in many areas. In most respects they are similar to the smallholder traditional group. Owners keep traditional pigs but choose to confine them in permanent pens due to local government regulation or population pressures on land use. These households would also keep other livestock including village poultry and sometimes hybrid broilers as well.

3.2.2.3 Smallholder commercial, Middle size commercial and Large scale commercial

For these three groups the data in the table are only approximate because smallholder commercial piggeries go in and out of business and the large-scale units change sow numbers to accommodate demand. The modern commercial pigs are now mainly Large White and Landrace but some remnants of earlier Berkshire, Tamworth and Saddleback breeds remain.

3.2.2.3 Important animal products

The most important animal product is pig meat. Pork is competitive with equivalent meats but volume is restricted by the size of the market able to afford high quality chilled meat cuts. Canned meat is popular for rural sales or distribution because of lack of refrigeration. Imported pork is entirely in canned form and this is estimated at about 700-800 t per year. The proportion of local commercial carcasses that are processed into bacon, ham and smallgoods is significant and could be as much as 50%.

3.2.2.4 Major trends in use and management of animals

In the smallholder traditional sector in the highlands, pig meat and slaughter of pigs have social and cultural significance. However, this is changing with more pigs are now being sold for cash rather than kept to meet traditional obligations. Increasingly traditional smallholders are selling meat in the local markets, either fresh or cooked/smoked. Some such smoked meat comes from the hunting of feral pigs that make up an unknown but considered a significant addition to the total pig population. This trend will increase as demands for cash increase and will lead to confinement and intensive keeping of pigs for both urban and non-urban markets. This will have implications for time, labour and resource utilisation.

Local commercial production is static for the last 10 years and is protected by a 25% tariff on CIF value for fresh pork and 35% for canned pork. The commercial industry grew under the protection of an import ban imposed in 1983 that has now been replaced by the tariffs, which will be progressively reduced with time under WTO agreement. The country is self-sufficient in pig meat but this a reflection of the import ban introduced in 1983 rather than any comparative advantage in production.

Major limiting factors and constraints pig productivity and efficiency are:

- Slow growth rate and low survival rate in village pig herds

- Poor disease and parasite control in village and smallholder commercial herds
- High cost of imported cereals and other feed ingredients used in commercial production

Improvement in housing, management and control of internal parasites at the smallholder subsistence level would improve survival and growth of animals. Use of cheaper feeds based on locally available feed resources would reduce the cost of commercial pig production and make pork and other products more affordable by consumers. Research is required to develop optimal systems to address the problem of feeding pigs which are deprived of natural foraging, but are not in a commercial market oriented system, for both food security and traditional use nationally. Research required would include the assessment of the suitability and availability of local feedstuffs, assessment of time and labour input, and combining available feedstuffs into appropriate diets.

3.2.3 State of knowledge of pig genetic resources

A listing of past research and publications on pig husbandry in PNG up to 1979 is given in a bibliography by Cooper et al. (1981) and has been updated recently by Hide (2001). A recent status report on pig production in PNG by Quartermain and Kohun (2002) outlines the priorities for research and development investments in the industry. Obviously, more is known about the production potential, feeding and health and management of the European breeds and production data are available with commercial producers. More information is required on the native pig, but some information is provided by Quartermain (2002 b). There is very limited data on comparison between European and native pigs under different management and feeding systems including tolerance to parasites and high fibre diets.

3.3 POULTRY

3.3.1 Introduction

The native chicken was the only domesticated poultry species in the country up until the end of the 19th century. It was thought to have come with the Austronesian settlers into New Guinea between 2000-3000 years ago. The distribution was largely north coast and island with a spread along the southwest Papuan coast and up the Sepik River. There would appear to have been little demand for a domesticated bird in the highlands since the native avifauna was rich and hunting was easy. Ethnographers have generally paid scant attention to chicken husbandry and have been dismissive of its importance. The colonial era introductions of poultry are not documented up to the initiation of efforts to improve village poultry production in 1964. Since 1964 there have been ongoing attempts to improve poultry meat and egg production in rural areas by the distribution of birds of introduced breeds, mainly Australorps and Muscovy ducks, and some husbandry improvement suggestions (see Quartermain 2000a). Australorps were chosen to replace village chickens for improved meat and egg production. Quartermain (2000a) has summarised the available information on these efforts. At various times there have been introductions of other poultry species including geese, turkeys, guinea fowl, Japanese quail and pigeons, and of several breeds of *Anas* species ducks (Pekin, Campbell, Rouen, Indian Runner). Pigeons remain as feral birds and there are small flocks of quail, and Campbell, Rouen, and Indian Runner ducks

3.3.2 Production systems

There are four production systems in the country

3.3.2.1 Smallholder household production

Data from the 1990 census suggest that a higher proportion of households keep poultry in the coastal provinces, in particular Milne Bay, Gulf, Madang, East Sepik, New Ireland, and East and West New Britain, compared with limited poultry keeping in the highlands provinces. This would likely be a consequence of history and tradition as mentioned above. The type of poultry being kept would mainly be village chicken, but there would also be some Australorp chickens and Muscovy ducks as well as commercial hybrid chickens, mainly broilers. Quartermain (2000 a) has comprehensively reviewed the PNG literature on village poultry. Village poultry are bred mainly for subsistence consumption but are also sold for cash in many areas. There are an estimated 1.5 million village free-range poultry producing an estimated 5760 tonnes of meat per year (AIDAB 1989). Egg production from this sub-sector is estimated at 6 million. Some of these farmers may also own pigs, cattle and sheep and goats as well.

3.3.2.2 Commercial production

A modern commercial poultry industry based on hybrid broilers and processed feeds has grown up since the early 1980s. It has been protected by high tariff since 1992. It is based on smallholder contract growers selling chickens back to the parent company for processing and marketing. The industry supplies both fresh and frozen chickens through the country. Meat production from this industry is estimated to be about 20,000 tonnes per year. One of these companies also has a crocodile farm as part of its operation, while another has beef and dairy cattle.

3.3.2.3 Supply of day-old broilers

There is an increasing demand for day-old chickens to be grown by villagers for fresh meat. The Niugini Tablebirds Company distributes over 150,000 day old chicks every week to growers all over the country. These are raised by villagers and sold as live chickens at local markets at prices ranging from PNG Kina 15 to 25 depending on location. Production from this sector is estimated at about 6,000 tonnes per year.

3.3.2.4 Egg industry

The egg industry is growing though less rapidly. In 1993 there were five commercial companies producing 38.5 million eggs annually (ANZDEC 1994). The annual subsistence production in 1993 was estimated by ANZDEC to be only 4 million eggs. At an average price of PNG Kina 0.30 per egg, the value of commercial and subsistence egg industry would be PNG Kina 11.55 and 1.2 million respectively. At present it is estimated that there are about 200,000 laying hens producing about 54 million eggs per year. There are now more Papua New Guineans selling and/or eating eggs than there were 10-15 years ago as indicated by the amount of eggs, particularly boiled eggs, sold in locally-owned fast food shops and local and roadside markets. Some institutions and missions produce eggs commercially but on a small scale, and there are very few smallholder farmers involved in commercial egg production.

3.3.3 Most important animal products

Meat is the most important product with eggs being only of minor importance at the present time. Feathers are sometimes utilised for traditional decorations and ceremonial costumes.

3.3.4 Major trends in use and management of animals

Poultry meat is generally cheaper than other meats so the industry is likely to grow. The biggest growth may come from the smallholder live bird sub-sector if stock feed price remain reasonable. The commercial fresh and frozen chicken meat sub-sector may also grow due to export demands from neighbouring Pacific Island countries.

There are no major constraints limiting commercial production other than the cost of imported cereals and other ingredients. For the smallholders raising commercial hybrid chickens for the live bird market, access to feed and day old chickens and lack of extension and advisory service in many areas are major constraints to production. For smallholders keeping village poultry, low hatchability and survival rate of young chickens are major constraints. Strategies developed to address these problems should include research into local hatching of eggs and use of cheaper locally available feed resources.

3.3.5 State of knowledge of poultry genetic resources

The commercial production industry relies upon commercial hybrid chickens and there are no genetic resource implications. Australorp chickens and Muscovy ducks are still present in reasonable numbers in small to medium sized flocks and adequate information is available on them. However, little is known about the village chicken genetic resource and Quartermain (2002 b) suggested the following be done:

- A survey is required to characterise the bird according to the requirements of the FAO database.
- This chicken should be included in studies to determine type of bird and husbandry practices for household production in comparison with the Australorp and brown hybrid layer (Shaver 579) alternatives.
- DNA marker studies could be done as proposed for the pig to determine genetic affinities, differentiation and purity. It is highly likely that early colonial era introductions have mixed with the original native chickens to some degree.

3.4 SHEEP AND GOAT GENETIC RESOURCES

3.4.1 Introduction

Tropical sheep from Southeast Asia were also introduced by colonial administrations and post-colonial settlers. Later attempts to farm temperate sheep in the highland areas were initially successful, eg: Romney Marsh sheep in the highlands (at Aiyura and Nondugl), but high mortality and low fertility proved insurmountable problems. Major efforts to establish Corriedale and Perendale sheep at government sheep station at Menifo in the highlands from 1975 opened up a new era of expansion of small-scale sheep ownership.

Many of the tropical sheep introduced were lost during the Second World War. However, a flock was gathered at government livestock at Erap from 1971 and became known as Priangan, although they do not resemble the Indonesian Priangan sheep but resembles the Javanese Thin-tailed Sheep. PNG Priangan sheep were subsequently used to cross with the temperate Corriedale and Perendale sheep at Menifo to produce what is now known as the Highlands Halfbred. The Highlands Halfbred now dominates most highland flocks, while lowland flocks are mainly Priangan. The estimated number of sheep in the country is 15,000. Productivity of Highlands Halfbred and the Priangan sheep is well documented (Benjamin et al. 1996; Holmes and Absalom 1985; Kohun 1988; Owen and Awui 2000; Quartermain and Kohun 1985).

A variety of dairy goats were introduced during the early colonial period but this was never very successful. Subsequently the Australian administration adopted a policy of not encouraging goats and no further introductions were made for some 60 years. The surviving goats remained in the hands of village farmers in favourable areas and were kept only for meat. Consequently, they came to resemble the feral goat populations of Australia and New Zealand, which had similar origins. Flocks were accumulated at the PNG University of Technology in 1975 and subsequently on DAL stations at Erap and Benabena. Recently there were small introductions of goats derived from Australian and New Zealand feral populations to reinforce the highland flocks. In spite of this it is thought that at least the more isolated goats constitute a unique PNG genotype developed by selection over the past century. There may be some 20,000 goats altogether and their performance too is well documented (Benjamin et al. 1992, Holmes and Mott 1989, Quartermain 1982, Quartermain and Kohun 1985).

3.4.2` Production systems

3.4.2.1 Subsistence production

There is no commercial sheep and goat industry. These animals are in the hands of smallholder farmers and institutions. Recent estimates indicate that there are about 15,000 sheep and 20,000 goats in the country producing 54 and 72 tonnes of meat per year. Despite a number of distribution programmes for sheep with government support for the sheep industry, the number of sheep is less than goats while government support for goat industry has always been lacking due to perceived environmental problems. Sheep farming is widely promoted, but production is static due to health, breeding and nutritional problems. Sheep were widely promoted in order to develop a commercial sheep industry to replace sheep meat imports. However this did not eventuate, as annual import of sheep meat (mostly in cheaper cuts) has increased from 4, 000 tonnes in the late 1980's to almost 40, 000 tonnes in recent years. Without government policy support, the smallholder goat production is a steadily growing industry. Farmers have successfully adopted goats and its numbers have reported to be steadily increasing. Despite that, animal numbers are still small due to high kid mortality and low productivity due to inbreeding and poor feeding and management.

3.4.3 Most important animal products

The most important product is meat estimated at 54 and 72 tonnes respectively for sheep and goats as indicated above. Goat milk is used by some households particularly in the highlands and fleece from the Highlands Halfbred sheep is used by women in some areas of the highlands to make hats, carpets and floor rugs, etc.

3.4.4 Major trends in use and management of animals

Sheep numbers is static and may decline if not supported. A number of sheep projects in the highlands have failed either because of health or feeding and nutrition problems. Besides, breeding objectives have not been clearly defined to breed and select for suitable genotypes in highlands and lowlands of the country. Priangan sheep, which are suitable for the lowlands with high reproductive rate, are doing well, however numbers of pure breed Priangan is estimated to be around 1, 400. Action is also required to conserve these sheep. Goat numbers have steadily increased over the years without any government or institutional support.

Research is required to improve the production of sheep and goats nationally but especially in the highlands for improved diets and income through breeding, improved nutrition and better health. Research strategies for health could include obtaining information on health problems (internal parasites and foot rot) and providing integrated control measures while breeding could include defining breeding objectives, evaluation and selection of existing genotypes and introduction, selection or crossing of new genotypes.

3.4.5 State of knowledge of sheep and goat genetic resources

Currently the sheep and goat numbers are unreliable and the socio-economics of keeping sheep and goats by smallholder farmers in not well known. A number of surveys are in progress or planned and data obtained will help fill some of the information gap. However, adequate information is available on the production characteristics of these species kept by some of the institutions but only limited information the smallholder management system and this aspect needs to be addressed.

3.5 RABBIT

3.5.1 Introduction

Domestic rabbits of two breeds, New Zealand White and Canberra Half-lop, were introduced into PNG in 1993, which have been multiplied and distributed to farmers. There are an estimated 1800 farmers in over 50 sites throughout the country engaged in rabbit production. These farmers producing about 122 tonnes of meat per year keep an estimated 15,000 rabbits. The meat is either consumed within the village or traded for other items. The species shows promise as a source of cheap protein and is being encouraged in remote areas where there is protein deficiency in the diets of the people.

Studies on growth and reproduction using a series of locally available energy feeds and forage were conducted. A number of problems associated with reproduction and kit mortality have been identified under village management and are being addressed. Due to small numbers and the narrow gene pool at the start, there are likely to be genetic resource implications.

Section 4

THE STATE F POLICY DEVELOPMENT AND INSTITUTIONAL ARRANGEMENTS FOR ANIMAL GENETIC RESOURCES

4.1 Institutional Arrangements

As indicated in the previous section PNG does not have any formal national programme to cater for AnGR activities.

The major institutions which are likely to be involved are the:

1. Department of National Planning & Rural Development
2. Department of Agriculture and Livestock
3. Department of Environment and Conservation
4. National Agricultural Research Institute
5. National Agriculture Quarantine Inspection Authority
6. University of Technology of PNG
7. Commercial Producers.
8. Smallholder farmers.

At present there is no mechanism exist for all interested parties in policy development for AnGR. The Department of Environment and Conservation has policies and mechanism to manage the conservation of wild fauna. Recently, the National Agricultural Research Institute has taken some initiatives to formalize AnGR activities in consultation with other stakeholders.

4.2 Priority Areas in Capacity Building

The priority areas for capacity building in the management of AnGR are statistical sampling and survey techniques; breed evaluations and characterizations and molecular genetics.

4.3 Legislative Implications

There is legislation governing sanitary aspects of AnGR including quarantine legislation, which is implemented by the National Agriculture Quarantine Inspection Authority (NAQIA). The legislation prevents indiscriminate importation of animal genetic materials and imposes strict quarantine protocols in the movement of both indigenous and exotic genetic resources.

The current legislation and policies concerning food production standards do not affect the use, development and conservation of AnGR. Legislation and policies relating to the use and release of Genetically Modified Organisms (GMOs) and intellectual property rights are currently being developed.

At present the country does not have any formal bilateral or multilateral arrangements with other governments or entities on AnGR.

The NARI is involved in AnGR research and training; University of Technology in education and research; and Department of Agriculture and Livestock in policy development.

Although current educational programmes available within the country can provide some basic characterization, utilization and conservation of AnGR, for specialised training students have to go overseas.

The country is now in the process of developing strategies for enhancing its information and communication systems to support and promote the better management of the AnGR.

Section 5

PROPOSED STRATEGIES AND ACTION PLAN

5.1 Strategies

National Agricultural Research Institute strategies proposed by Quartermain (2002 b) (See attachment 1) for each of the five categories of animal mentioned above are as follows:

5.1.1 Native Pigs

- More needs to be known about the genetic affinities, differentiation and purity. This can be done through analysis of genetic markers such as micro-satellite loci, which are preferred because of high polymorphism and relative ease of assay.
- The reasons for superior fitness over modern commercial pigs in village situations need definition. Reasons could include ability to deal with dietary fibre and bulky feeds and parasite resistance.
- A research herd of representative animals should be established for further study. Ideally such a herd should have a minimum of eight boars and 48 sows. A smaller herd could be envisaged if boars could be regularly sourced from the general population.

5.1.2 Native Chickens

- A survey is required to characterise the bird according to the requirements of the FAO database.
- This chicken should be included in studies to determine type of bird and husbandry practices for household production in comparison with the Australorp and brown hybrid layer (Shaver 579) alternatives.
- DNA marker studies could be done as proposed for the pig to determine genetic affinities, differentiation and purity. It is highly likely that early colonial era introductions have mixed with the original native chickens to some degree.

5.1.3 Javanese Zebu Cattle

- A survey is required to determine the current status of the breed in its assumed Sepik Plains range.
- If it is indeed endangered by the FAO definition, then a conservation programme is required. Ideally a herd of adequate size should be assembled, say 40-60 cows, with bulls regularly sampled from the Sepik population.
- In the meantime, and if urgency is required, cryopreservation of semen or embryos would be feasible.

5.1.4 Priangan Sheep

- A survey is required to determine the current status of the breed.
- The flocks at Erap (DAL), Labu (NARI), the University of Technology and Launakalana (Livestock Development Corporation) should be managed to maintain breed purity as far as this can be determined, with selection for productivity under

minimal management systems, and with exchange of rams. Note that the Menifo and Tambul (NARI) flocks should have Highlands Halfbred animals.

- Agreement needs to be reached on the preferred characteristics and production parameters for both breeds.

5.1.5 PNG Goat

- A survey is required to determine the current ownership and utilisation of these goats with emphasis on known areas of concentration in Morobe, Eastern Highlands and Simbu.
- The flocks at Erap, Benabena, Labu and Unitech should be managed with agreement concerning breeding objectives and selection criteria. There should be a regular exchange of breeding males.

5.2 An Action Plan for PNG

In the absence of a national action plan, the following plan, proposed by the National Agricultural Research Institute, is adopted. This action plan includes elements from the proposed strategies given above and also gives recommendations concerning the animals and resources at various locations in the country.

5.2.1 Pigs

- A project will be proposed for external funding or collaboration with an Australian University for a genetic marker study on the native pigs.
- Efforts towards further characterisation of this pig should include assessment of its digestive capacity and parasite resistance. The former can be done in collaboration with the University of Technology while the latter can be included as a component of a village livestock survey.

5.2.2 Chickens

- A survey, or series of surveys, will be included in proposals for the livestock research programme. Samples may be collected during such a survey for genetic marker studies in collaboration with an Australian University.
- The native village population will be sampled for inclusion in genotype x management studies to be proposed for the Australorp and Shaver 579.
- The Labu Research station Australorp flock has been increased to commercial viability and the birds are available for further studies.

5.2.3 Javanese Zebu Cattle

- NARI must give some urgency to a survey of the current situation of the breed in the Sepik. Any subsequent recommendations will depend upon the results.

5.2.4 Sheep

- A survey, or series of surveys, will be included in proposals for the livestock research programme.
- There is a need to define preferred characteristics and production parameters for both the Priangan and Highlands Halfbred breeds.

- The Labu flock will be maintained for the present as a Priangan flock and is available for further research.
- NARI should negotiate with the management of the 200 sheep flock at Erap in order to initiate a new breeding programme for the Priangan.
- The first priority for the highlands flocks is to ensure adequate and preferably compatible recording systems at both sites. A breeding programme should be agreed upon with common objectives and selection criteria for institutional and private flocks.

5.2.5 Goats

- A survey should take first priority for NARI action and should proceed, regardless of whether or not external funding is secured.
- NARI, Unitech and DAL should negotiate and reach agreement on common breeding objectives and selection criteria for the flocks under their control.
- The Labu flock should be maintained for nutritional research but negotiations should be undertaken to combine these 50 animals with the 70 at Erap to constitute an effective breeding unit.

5.2.6 Ducks

- The lines of ducks, including the Muscovy line, at Labu should be maintained as at present pending further consideration of the type or types of duck likely to be preferred and able to be managed by smallholder farm families. Once this definition has been made, fresh breeding stock could be sought in New Zealand.

5.2.7 Rabbits

- The rabbitry at Labu should be maintained, with adequate recording, for research, distribution and revenue raising purposes.

5.3. Concluding Remarks

More work is required in this area, especially to develop broad policies, legislation and other support mechanisms to govern the sustainable utilisation and conservation of the current farm animal genetic resources. There is need for better information to make the public more aware of this issue and to accept ownership of it, with organizations such as the Ministry of Agriculture and Livestock, Department of Environment and Conservation and other relevant groups, NGOs, livestock associations, farmer groups etc, taking a leading role in this work. It is proposed that a national co-ordinating committee be established with some funding support and mandate to develop basic legislation and guidelines for utilisation of animal genetic resources, administer the strategies and action plan suggested in this report and develop long-term plans for public awareness and ownership, research and information needs, human resource training, sustainable utilisation and conservation, linkages with regional and international groups for collaboration and funding support, and other important aspects of animal genetic resources in the country.

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Annex 1:

CONSERVATION OF DOMESTIC ANIMAL GENETIC RESOURCES IN PAPUA NEW GUINEA

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1 Introduction

This document is concerned only with domestic animal resources in Papua New Guinea (PNG). It outlines the prehistory or history of animal introductions, gives an assessment of the present situation, in so far as that is known, and discusses options for research and the conservation and utilisation of those resources considered to be unique. It gives proposed strategies for research and development and concludes with an action plan for the National Agricultural Research Institute (NARI).

2 Pre-Colonial Introductions

The only three domesticated animal species present in PNG prior to European colonisation were the pig, dog and chicken.

2.1 Pigs

Papuan Native pigs are an interbreeding population of domestic and feral pigs occupying the mainland and believed derived from a domesticated hybrid of the Southeast Asian *Sus scrofa vittatus* and the Sulawesi pig, *Sus celebensis*. This pig was well established in the inland highlands by 6000 years ago and has remained relatively isolated. The total population of village pigs is estimated to be at least 1.6 million of which over 1.0 million could be genetically isolated Papuan Native. In a study of coat colour polymorphism, Lauvergne et al. (1982)¹ suggest that the high incidence of archaic phenotypes indicates little genetic influence of modern introductions.

Descriptions of the pig and its husbandry can be found in Malynicz (1970) and Quatermain (1977). Existing data from villages and comparative studies under commercial conditions have been located, assessed and summarised (Quatermain 1996 and Appendix 5 this bulletin).

The Papuan Native pig is a unique genotype with a good population size and a considerable degree of genetic isolation due to geography and slow commercialisation of village production. Compared to modern commercial pigs, it is small and slow growing with a smaller litter size but good mothering ability. Its unique genetic features, whether identified or not, are not in immediate danger of loss but steps should be taken now to initiate further genetic studies and plan to conserve the genotype.

2.2 Dogs

The earliest evidence for dogs in New Guinea suggests an introduction from the south about 2000 years ago (Flannery 1990). Feral populations of the New Guinea Singing dog, so called because it does not bark but howls, are found today in sub-alpine grasslands in isolated areas (Brisbin et al. 1994). Most domestic dogs in PNG derive from more recent introductions and there is concern about the conservation of the native dog and the lack of information on non-captive populations. Research should be encouraged but does not fall within the NARI

¹ References are given in Appendix 1.

mandate.

2.3 Chickens

Austronesian settlers probably brought the domesticated chicken to New Guinea 2000 - 3000 years ago. In PNG the distribution was largely north coast and island with a spread along the southwest Papuan coast and up the Sepik River. There would appear to have been little demand for a domesticated bird in the highlands since the native avifauna was rich and hunting was easy. Ethnographers have generally paid scant attention to chicken husbandry and have been dismissive of its importance. Productivity was probably extremely low (Quartermain 2000) but data are scarce.

3 Post-Colonial Introductions

3.1 Cattle

Cattle have been introduced systematically by colonial administrations and ranchers, initially from Southeast Asia and later solely from Australia. Specialised beef and dairy breeds were tried but few dairy cattle remain today. The beef industry with currently some 90,000 head has come to be dominated by the Brahman or breeds such as Droughtmaster and Santa Gertrudis with Brahman ancestry. It would be difficult to argue for any uniqueness today amongst commercial beef cattle, with one exception.

The exception is the Javanese Zebu. These descendants of early Southeast Asian introductions were gathered into two government herds (Erap and Urimo) from 1974 and systematically evaluated. In 1980 there were some 2,000 animals but shortly thereafter the herds were dispersed and the current status is uncertain. These cattle possess unique features that would be difficult to replace, given current quarantine restrictions on importation of cattle from Asia. There are only three published papers with production data from experimental results (Gwaiseuk and Holmes 1985, Holmes 1979, Holmes et al. 1992)(See Appendix 4 this bulletin).

3.2 Buffalo

Southeast Asian Swamp buffalo were introduced from 1891 for draft and later the population was re-inforced with animals of similar origins from Australia and evaluated for beef production. There may be some 2000 animals today but their status is uncertain, except for those small number trained for draft under the Department of Agriculture and Livestock (DAL) programme. It is unlikely that these animals are unique genetically but there is some recent evidence of possible breed differentiation in Asia and the Australian-PNG population may be distinct. Few production data have been published (Holmes et al. 1977, Schottler et al. 1977).

3.3 Sheep

Tropical sheep from Southeast Asia were also introduced by colonial administrations and post-colonial settlers. Later attempts to farm temperate sheep in the highland areas were initially successful, eg: Romney Marsh sheep at Aiyura and Nondugl, but high mortality and low fertility proved insurmountable problems. Major efforts to establish Corriedale and Perendale sheep at Menifo (DAL) from 1975 opened up a new era of expansion of small-scale sheep ownership. The tropical sheep that could be located following the losses caused by the second world war were gathered into a large flock at Erap (DAL) from 1971 and became known as Priangan, although they do not resemble the Indonesian Priangan and appear more closely related to the Javanese Thin-tailed sheep.

PNG Priangan sheep were subsequently used to cross with the temperate Corriedale and Perendale sheep at Menifo to produce what is now known as the Highlands Halfbred. The Highlands Halfbred now dominates most highland flocks, while lowland flocks are mainly Priangan. There may be some 15,000 sheep in total. Productivity of the Menifo sheep and of the Priangan is quite well documented (Benjamin et al. 1996, Holmes and Absalom 1985, Kohun 1988, Owen and Awui 2000, Quartermain and Kohun 1985).

3.4 Goats

A variety of goats were introduced during the early colonial period, mainly for dairy production but this was never very successful. Subsequently the Australian administration adopted a policy, whether official or not, of not encouraging goats and no further introductions were made for some 60 years.

The surviving goats remained in the hands of village farmers in favourable areas and were kept only for meat. Consequently they came to resemble the feral goat populations of Australia and New Zealand, which had similar origins. Flocks were accumulated at the PNG University of Technology (Unitech) in 1975 and subsequently on DAL stations at Erap and Benabena. Recently there were small introductions of goats derived from Australian and New Zealand feral populations to reinforce the highland flocks. In spite of this it is thought that at least the more isolated goats constitute a unique PNG genotype developed by selection over the past century. There may be some 20,000 goats altogether and their performance is quite well documented (Benjamin et al. 1992, Holmes and Mott 1989, Quartermain 1982, Quartermain and Kohun 1985).

3.5 Equines

Horses were introduced systematically during the colonial era for both work and recreation purposes. They are still used on cattle ranches and for recreation but there is no published information on numbers or breed affinities. Donkeys were used for draft purposes, particularly in the Markham Valley prior to the Second World War (M. Woodward pers. comm.), but none remain today.

3.6 Pigs

Research into pig production and the development of commercial production became dependant upon breeds of European origin: Large White, Landrace, Berkshire, Tamworth, Saddleback and Large Black. The current commercial industry is dominated by the white breeds (Large White and Landrace), although there are still pigs owing genetic affinities to the other breeds. The Large Black and British Saddleback breeds are the subjects of breed rescue programmes in the United Kingdom (UK) but these breeds, together with the other minor breeds (Berkshire and Tamworth), are not irreplaceable from a PNG point of view.

3.7 Poultry

The colonial era introductions of poultry are not documented up to the initiation of efforts to improve village poultry production in 1964. Australorp and Rhode Island Red chickens were evaluated and the former was chosen as the preferred breed. Consequently there are now few traces of the Rhode Island Red genotype. Muscovy ducks were added to the programme in 1974. Quartermain (2000) has summarised the available information on these efforts. At various times there have been introductions of other poultry species including geese, turkeys, guinea fowl, Japanese quail and pigeons, and of several breeds of *Anas* species ducks (Pekin, Campbell, Rouen, Indian Runner). Pigeons remain as feral birds and there are small flocks of quail, and Campbell, Rouen, and Indian Runner ducks.

Australorp chickens and Muscovy ducks are still present in reasonable numbers in small to medium sized flocks.

The commercial production industry relies upon commercial hybrid chickens and there are no genetic resource implications.

3.8 Rabbits and Guinea Pigs

Domestic rabbits of two breeds, New Zealand White and Canberra Half-lop, were introduced into PNG in 1993 and are still under evaluation. There are currently some 1000 farmers with 15000 animals.

Guinea Pigs were introduced from time to time as pets and have been considered and trialed for village meat production without success.

4 International Documentation

FAO-UN has developed a Global Databank for Farm Animal Genetic Resources. This databank has been used to produce the World Watch List for Domestic Animal Diversity, which is currently in its third edition (Scherf 2000). These together form the key components of the Global Early Warning System for Animal Genetic Resources by providing an inventory of domestic breeds at risk and basic descriptive information on them. Based on survey data, the list classifies breeds as Extinct, Critical, and Endangered or Not at Risk. By the definitions used, no PNG populations can be regarded as critical but the Javanese Zebu of PNG is listed as Endangered, suggesting the need for an urgent and active conservation programme. The relevant entry is attached (Appendix 2). As mentioned earlier, the Large Black and British Saddleback pigs are listed as Endangered in the UK list.

The other entries for PNG in the database (www.fao.org/dad-is/) are those for the New Guinea Native pig and the Priangan sheep. Data sheets have also been prepared for the PNG goat and the Native chicken but have not been entered into the FAO data-base (see Appendix 3).

The Commonwealth Agricultural Bureau International is compiling data on Swamp Buffalo breeds. The data sheet for the PNG population (Appendix 3) was completed in consultation with the compiler (Dr P.N. Bhat of New Delhi) and using information from Holmes (1980) and Holmes et al. (1977).

5 Problems in the Conservation of Animal Genetic Resources

There are several problems peculiar to the conservation of animal genetic resources in PNG. These are as follows:-

- Lack of information on population sizes or even lack of adequate description. The former applies to all species except perhaps cattle and rabbits while the latter applies particularly to native chickens.
- Lack of information on genetic diversity or differentiation and the degree of penetration of genes from recent introductions into native populations. This applies particularly to breeds of interest including the Papuan Native pig, Native chickens, Javanese Zebu cattle and Priangan sheep.
- Genetic sampling for characterisation. Because most traits of interest in domestic animal species are quantitative traits controlled by many genes with individually small effects, adequate sampling of populations is critical to avoid bias. It would be wise to attempt a sample size close to 100 in any major survey.
- Avoidance of inbreeding. Animal populations are subject to inbreeding with likely adverse effects on fitness and performance if the breeding population size is too small. Small populations are also subject to genetic drift caused by fluctuations in gene frequencies as a consequence of biased sampling. Also because of uneven sex ratios in breeding populations,

the number of breeding males is critical. Hence any population maintained for conservation and study should contain at least eight males and a corresponding larger number of females. This minimum size can be achieved by exchange of males among a number of smaller populations.

- Quarantine restrictions on imports of breeding stock. Current regulations restrict the sourcing of imported breeding stock to Australia or New Zealand and for poultry currently to New Zealand only. This means that it is not possible to replace breeding material of Asian origin unless, as is the case with buffalo, the material is present in Australia. It also means that access to genetic resources adapted to the tropics is limited to what is currently in PNG or again available in Australia. Hence this reinforces the need to take seriously suggestions concerning the characterisation, conservation and utilisation of native pigs and chickens, Javanese Zebu cattle, Priangan sheep and PNG goats.

6 Proposed Strategies

Strategies are proposed for each of the five categories of animal mentioned above.

6.1 Native Pig

- More needs to be known about the genetic affinities, differentiation and purity. This can be done through analysis of genetic markers such as microsatellite loci, which are preferred because of high polymorphism and relative ease of assay.
- The reasons for superior fitness over modern commercial pigs in village situations need definition. Reasons could include ability to deal with dietary fibre and bulky feeds and parasite resistance.
- A research herd of representative animals should be established for further study. Ideally such a herd should have a minimum of eight boars and 48 sows. A smaller herd could be envisaged if boars could be regularly sourced from the general population.

6.2 Native Chickens

- A survey is required to characterise the bird according to the requirements of the FAO database.
- This chicken should be included in studies to determine type of bird and husbandry practices for household production in comparison with the Australorp and brown hybrid layer (Shaver 579) alternatives.
- DNA marker studies could be done as proposed for the pig to determine genetic affinities, differentiation and purity. It is highly likely that early colonial era introductions have mixed with the original native chickens to some degree.

6.3 Javanese Zebu Cattle

- A survey is required to determine the current status of the breed in its assumed Sepik Plains range.
- If it is indeed endangered by the FAO definition, then a conservation programme is required. Ideally a herd of adequate size should be assembled, say 40-60 cows, with bulls regularly sampled from the Sepik population.
- In the meantime, and if urgency is required, cryopreservation of semen or embryos would be feasible.

6.4 Priangan Sheep

- A survey is required to determine the current status of the breed.
- The flocks at Erap, Labu (NARI), Unitech and Launakalana (Livestock Development Corporation (LDC)) should be managed to maintain breed purity as far as this can be determined, with selection for productivity under minimal management systems, and with

exchange of rams. Note that the Menifo and Tambul (NARI) flocks should have Highlands Halfbred animals.

- Agreement needs to be reached on the preferred characteristics and production parameters for both breeds.

6.5 PNG Goat

- A survey is required to determine the current ownership and utilisation of these goats with emphasis on known areas of concentration in Morobe, Eastern Highlands and Simbu.
- The flocks at Erap, Benabena, Labu and Unitech should be managed with agreement concerning breeding objectives and selection criteria. There should be a regular exchange of breeding males.

7 An Action Plan for NARI

This action plan includes elements from the proposed strategies given above and also gives recommendations concerning the animals and resources at Labu, Erap, Benabena, Menifo and Tambul.

7.1 Pigs

- A project will be proposed for external funding or collaboration with an Australian University for a genetic marker study on the native pigs.
- Efforts towards further characterisation of this pig should include assessment of its digestive capacity and parasite resistance. The former can be done in collaboration with the University of Technology while the latter can be included as a component of a village livestock survey.
- The Labu piggery is too small for breed assessment work and a larger unit would not be justified at this time. The unit can continue as a revenue raising enterprise with adequate recording.

7.2 Chickens

- A survey, or series of surveys, will be included in proposals for the livestock research programme. Samples may be collected during such a survey for genetic marker studies in collaboration with an Australian University.
- The native village population will be sampled for inclusion in genotype x management studies to be proposed for the Australorp and Shaver 579.
- The Labu Australorp flock has been increased to commercial viability and the birds are available for further studies.

7.3 Javanese Zebu Cattle

- NARI must give some urgency to a survey of the current situation of the breed in the Sepik. Any subsequent recommendations will depend upon the results.

7.4 Sheep

- A survey, or series of surveys, will be included in proposals for the livestock research programme.
- There is a need to define preferred characteristics and production parameters for both the Priangan and Highlands Halfbred breeds.
- The Labu flock will be maintained for the present as a Priangan flock and is available for further research.

- NARI should negotiate with the management of the 200 sheep flock at Erap in order to initiate a new breeding programme for the Priangan.
- The first priority for the highlands flocks is to ensure adequate and preferably compatible recording systems at both sites. A breeding programme should be agreed upon with common objectives and selection criteria for institutional and private flocks.

7.5 Goats

- A survey should take first priority for NARI action and should proceed, regardless of whether or not external funding is secured.
- NARI, Unitech and DAL should negotiate and reach agreement on common breeding objectives and selection criteria for the flocks under their control.
- The Labu flock should be maintained for nutritional research but negotiations should be undertaken to combine these 50 animals with the 70 at Erap to constitute an effective breeding unit.

7.6 Ducks

The lines of ducks, including the Muscovy line, at Labu should be maintained as at present pending further consideration of the type or types of duck likely to be preferred and able to be managed by smallholder farm families. Once this definition has been made, fresh breeding stock could be sought in New Zealand.

7.7 Rabbits

The rabbitry at Labu should be maintained, with adequate recording, for research, distribution and revenue raising purposes.

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Appendix 2. World Watch List for Domestic Animal Diversity - Third Edition

Papua New Guinea

Javanese Zebu Cattle – Endangered

Locals Names or Synonyms:	Zebu
Population Data:	400-600 * 500 females * 1992
Population Trend:	Decreasing
Range of Uses:	Meat

The Javanese Zebu breed, established in the 19th century, is descended from cattle imported from Java, Sumatra and Thailand. Adult males weigh on average 540 kg and females 365 kg. The breed is highly prolific and hardy and is highly resistant to tick and screw worm infestation. The economic performance of this breed is comparable to that of the Droughtmaster (Brahman cross-breeds), although under prolonged drought periods the Javanese Zebu is superior. Its smaller body size has made it unpopular among cattle producers and as a result the breed is declining rapidly.

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Appendix 3. Data Sheets on PNG Livestock

3.1 Data Sheet on Papua New Guinea Goat

Country: Papua New Guinea
Species: Goat
Breed name: Papua New Guinea

Population data

Year of data collection: 1993
Total population size: 20,000 (not reliable)
Total number of females being bred: 9,000 (not reliable)
Percent females mated to males of own breed: 100%
Total number of males used for breeding: 1,000 (not reliable)
Number of males in AI: nil
Number of females is increasing

Data are estimates based on the reported number of owners from the 1990 population census, observed flock sizes and recorded production data. The goats belong to a heterogeneous population derived from an intermittent series of introductions, mainly from Australia, since the latter part of the 19th century. In general they are kept in very small flocks by villagers entirely for meat.

Performance data

Birth weight (male): 2.4 kg
Litter size average: 1.3
Mean age at first kidding (uncontrolled): 380 days
Mean kidding interval: 238 days
Male 16 week weight: 12 kg
Adult liveweight: Males 40 kg, Females 30 kg
Management type:
- Stationary
- Night housing
- Daytime free grazing

3.2 Data Sheet on Papua New Guinea Native Chicken

Country: Papua New Guinea
Species: Domestic chicken
Local name: PNG Native or Village Chicken
Tok Pisin name: Kakaruk

Stock can be classified as indigenous

Population data

Total population size: 1,500,000 (not reliable).

Estimate based on 1961-62 village survey of birds per person extrapolated to 2000 rural population estimate based on national census. This estimate confirmed by another estimate based on number of owners as revealed by the census, aggregated on a provincial or regional basis, and assumed flock sizes from RRA or PRAP.

Number of males used for breeding: 500,000 (estimate)

All females used to produce hatching eggs and all birds bred pure except for a limited amount of crossbreeding with introduced Australorps.

Description

Plumage and within feather patterns variable. Predominant pattern wild type and variants.

Other descriptors variable

- Age at maturity: females, 8 months
- Live body weight at maturity: males 1.8 kg, females 1.4 kg
- Average number of eggs per year: 70
- Average number of chicks hatched: 6
- Chick mortality: 50%

Purposes

- Meat
- Eggs
- Feathers for self-decoration

Management system

- Scavenging

Further comments

- Naturally broody
- Resistant to parasites
- Low productivity under low input systems
- High mortality from predation

3.3 Data Sheet on Swamp Buffalo

Country: Papua New Guinea
 Preferred breed name: Papua New Guinea Buffalo
 Species scientific name: *Bos bubalis bubalis*
 Species common name: Swamp buffalo
 Tok pisin name: Karambao

Products: Beef and Draught

History: See Holmes, Schottler and Leche (1977)

Environment: - Wet tropics. The main population is on the Sepik Plains (now mainly a feral population) - high humidity, high rainfall, poorly drained, phosphate deficient soils.
 - Draught animals in Madang and East New Britain Provinces kept on roadsides, fallow grasslands and native pastures (*Imperata*, *Saccharum* spp)

Population status: About 4000 total head; not under threat.

Description: - Colour 90 percent grey with white throat markings
 - 10 percent white becoming freckled with age
 - Coat up to 5 cm coarse hair at birth; mature animal hair sparse
 - Ears large and horizontal
 - Horns heavy, black and long (up to 80 cm); curve out and back
 - Less than one percent polled animals – polled bulls cryptorchid and sterile, polled cows fertile
 - Udder small, teats small and perpendicular
 - Tail short and thin

Husbandry: Extensively produced outdoors.

Geographical distribution: Related or similar animals are found in Indonesia, Philippines, other countries of South-east Asia and the Northern Territory of Australia.

Within Papua New Guinea:	East Sepik Province	3000 (feral)
	Morobe Province	150 (feral)
	Madang Province	400 (draught)
	East New Britain Province	150 (draught)

Health: Resistant to screw worm
 Roundworm (*Neoscaris vitellorum*) a problem in calves.

Performance: Growth rate - pre-weaning:	0.4-0.6 kg per day
- post-weaning:	0.2-0.4 kg per day
Mature body weight – male:	500-600 kg
- female:	350-500 kg
Typical slaughter age:	30-42 months
Typical slaughter weight:	400-500 kg
Carcass yield:	54-55 percent
Weight of weaned calf per year:	123 kg average
	108 kg poor
Age at first conception:	30-36 months
Calving interval:	13-15 months

No recorded multiple births.

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3.4 Data on Javanese Zebu (eng.) (Papua New Guinea) (www.fao.org/dad-is/)

General information

Species:	Cattle
Most common name (language abbreviation in brackets):	Javanese Zebu (eng.)
Other local names (language abbreviation in brackets):	Zebu
Taxonomic classifications:	Breed
Current domestication status:	domestic
Country:	Papua New Guinea
Main use: 1- food:	Meat
Risk status (1992):	Endangered

Summary Description

Note: This summary will be updated only during compilation of the next edition of the World Watch List for Domestic Animal Diversity.

The Javanese Zebu breed, established in the 19th century, is descended from cattle imported from Java, Sumatra and Thailand. Adult males weigh on average 540 kg and females 365 kg. The breed is highly prolific and hardy and is highly resistant to tick and screw worm infestation. The economic performance of this breed is comparable to that of the Droughtmaster (Brahman cross-breeds), although under prolonged drought periods the Javanese Zebu is superior. Its smaller body size has made it unpopular among cattle producers and as a result the breed is declining rapidly.

Population:

Year of data collection:	1992	1982
Risk status:	endangered	not at risk
Total population size:	400 - 600	> 2000
Population figures based on:	-	-
Reliability of population data:	Not reliable	-
Total number of breeding females:	500	
Population trend:	decreasing	decreasing
Number of males in AI service:	0	

Additional information on population data: Its smaller body size is making it unpopular among cattle producers and the breed is declining at a fast rate as a consequence.

Morphology

Adult live weight males (average, kg):	540
Adult live weight females (average, kg):	365
Specific visible traits:	Zebu
Number of horns (male):	2
Number of horns (female):	2

Origin of breed

Origin:	descended from cattle imported from Java, Sumatra and Thailand
Year of origin:	19th century

Special qualities of breed

Specific health characteristics: The Javanese Zebu is highly resistant to tick and screw worm infestation.

Special reproductive characteristics: The breed is highly prolific and hardy.

Other special qualities: The Javanese Zebu is a very hardy animal. The economic performance of this breed is comparable to the Droughmaster (Brahman cross-breeds). However, under prolonged drought periods the Javanese Zebu is superior.

Management conditions

Mobility:	transhumant
Feeding of adults:	grazing
Housing period:	The animals were not housed

Performance

Birth weight male (kg):	32
Birth weight female (kg):	29
Age at first parturition/egg (min, month):	30
Age at first parturition/egg (max, month):	30
Parturition/clutch interval (min, day):	350
Parturition/clutch interval (max, day):	380
Daily gain (min, g):	530
Daily gain (max, g):	570

Management conditions under which performance was measured: Performance data were measured on farm pasture predominately *Imperata cylindrica*, annual rainfall 733-1360 mm.

Additional information: On improved pastures and under supplementary feeding it does not respond as much as Brahman crossbreeds. - weaning weights: 171 kg (males) and 160 kg (females);

In-situ conservation and ex-situ conservation

Cryo-conservation semen:	no
Cryo-conservation embryos:	no

Date of last modification

Date of last modification: 01.05.1995

Source of information

Informal contact : Dr Alan R. Quartermain

Note that certain terms are used for all species and have not been refined for particular species.

3.5 Database on New Guinea Native Pig (eng.) (Papua New Guinea) (www.fao.org/dad-is/)

General information

Species:	Pig
Most common name (language abbreviation in brackets):	New Guinea Native (eng.)
Other local names (language abbreviation in brackets):	Native Pig (eng.)
Taxonomic classifications:	Breed
Current domestication status:	Domestic
Country:	Papua New Guinea
Risk status (1991):	Not at risk

Population

Year of data collection:	1991
Total population size:	2000000 - 2500000
Population figures based on:	-
Reliability of population data:	-
Total number of breeding females:	1000000
Total number of males used for breeding:	800
Population trend:	stable
Percentage of females being bred pure (mated to males of own breed):	50
Number of males in AI service:	0
Additional information on population data:	The breeding system involves castrating most males (because the villagers believe that if castrated at an early age they grow faster and lay more adipose). This means that most females are mated by feral boars.

Morphology

Adult live weight males (average, kg):	50
Adult live weight females (average, kg):	37
Adult wither height males (average, cm):	60
Adult wither height females (average, cm):	60
Colour:	uni colour: black, grey, red, white, white, red or grey multi coloured: black spotted comment: born striped
Specific visible traits:	straight tail

Origin of breed: No data available

Special qualities of breed

Adaptability to specific environment: Performance is low but they survive well under poor nutritional and management conditions.

Management conditions:

Mobility: transhumant
Feeding of adults: fodder grazing
Comments on management conditions: The animals are kept under transhumant conditions with free ranging during the day and housing at night. They feed on grazing and fodder and root crops. The native breed is preferred to exotic breeds because it requires minimum management.

Performance

Birth weight male (kg):	0.5
Birth weight female (kg):	0.3
Litter size, born (avg, n):	5
In-situ conservation and ex-situ conservation	
Cryo-conservation semen:	no

Cryo-conservation embryos: no

Date of last modification

Date of last modification: 01.05.1995

Source of information

Informal contact : Dr Alan R. Quartermain

Note that certain terms are used for all species and have not been refined for particular species.

3.6 Database on Priangan (Papua New Guinea) (www.fao.org/dad-is/)

General information

Species:	Sheep
Most common name (language abbreviation in brackets):	Priangan
Other local names (language abbreviation in brackets):	Garut
Taxonomic classifications:	Breed
Current domestication status:	domestic
Country:	Papua New Guinea
Main location of breed within country:	mainly in Morobe Province
Risk status (1993):	not at risk

Population

Year of data collection:	1993
Total population size:	1400
Population figures based on:	-
Reliability of population data:	-
Population trend:	-
Additional information on population data:	It is estimated that there are a total of 1400 pure Priangan sheep in PNG with more than half in the Morobe Province. The Priangan is a distinctive type in PNG, but there may have been some genetic influences over the years by various other breeds.

Morphology

Adult live weight males (average, kg):	58
Adult live weight females (average, kg):	38
Colour:	multi coloured: very variable, mostly white but with brown or black patches comment: males often have a tuft of straight hair about 15 cm on the throat
Specific visible traits:	often earless, short tail (fat at base)
Number of horns (male):	2
Number of horns (female):	0
Hair or wool:	wool
Fibre type:	coarse/carpet

Origin of breed

Origin:	composite of Africander (probably Merino) and Javanese ThinTailed; The Priangan sheep were introduced to Papua New Guinea (PNG) well before the 1930's from Java, Indonesia.
Year of origin:	19th century

Special qualities of breed

Specific health characteristics:	It has been suggested that the Priangan is more resistant to worms as well as to the 'old world screw worm fly', but there is insufficient scientific evidence for these conclusions.
Special qualities of product:	The fleece varies from broad unattractive wool to a type more like hair or kemp than wool.

Performance

Litter size, born (avg, n): 1.7

In-situ conservation and ex-situ conservation

Cryo-conservation semen: no

Cryo-conservation embryos: no

Date of last modification

Date of last modification: 01.05.1995

Source of information

Informal contact : Dr Alan R. Quartermain

Note that certain terms are used for all species and have not been refined for particular species.

Appendix 4. The Javanese Zebu Cattle of Papua New Guinea

The Javanese Zebu (JZ) cattle of Papua New Guinea (PNG) recently featured in a publicity release by FAO as an example of a threatened domestic animal resource. No survey of the status of this breed has been carried out since 1979. The two government herds with these cattle were dispersed and many of the existing cattle are presumed feral. Anecdotal evidence suggests that there may be a reasonable number of animals of the type with smallholders in the Sepik Plains area. In 1980, Dr John Holmes (Holmes 1980) recorded 2000 animals total. A major salvage operation as was undertaken in the early 1970s to establish the government herds would probably be necessary to save the breed from extinction. Since there are only a limited amount of data in a small number of publications concerning these cattle, it is thought worthwhile to aggregate and summarise these data for ease of reference.

The FAO World Watch List for Domestic Animal Diversity (Scherf 2000) lists the breed type as endangered with a decreasing population trend. The total number of breeding females may be as low as 400 and there are no banked germplasm materials. Endangered is defined for breeds having between 100 and 1000 breeding females or 5-20 breeding males.

Cattle of Southeast Asian origin were variously introduced into the then New Guinea colony by the German Administration, planters and missionaries from the 1880s up until the change in administration as a result of the First World War (Holmes 1977 and Holmes et al. 1977). Cattle of a variety of types and origins became widespread throughout the colony or protectorate where coconut plantations were established. While there are various references to the introductions in records such as those of the New Guinea Kompagnie, it was rarely clear what kinds of animals came from where, most having been loaded on route. Indications are that most came from the Dutch colony of Batavia or Java and hence a distinct type of zebu cattle became widespread and known as the Javanese Zebu. Cattle were also introduced from Thailand. These cattle were ideally suited to the control of grass growth under coconuts.

The regions of the New Guinea north coast mainland and islands where most plantations were concentrated were also the areas occupied by the Japanese army during the Second World War. As a result of slaughter for food supply and intense fighting, the cattle herds were decimated and many cattle became feral. Post-war, a number of plantations and Catholic missions, particularly in the Sepik, Madang and New Ireland Provinces of what is now PNG, re-developed herds of JZ cattle. It is believed that few of these herds retain these animals in pure-breed form today.

From 1974, officers of the PNG government Department of Agriculture, Stock and Fisheries (now Department of Agriculture and Livestock) accumulated JZ cattle to establish herds on the government ranches of Erap and Urimo. Holmes et al. (1992) state that the department purchased one bull and 24 females of a range of ages from Catholic missions in the Lower Sepik, 33 heifers and four bulls from coconut plantations near Madang, and 25 heifers and two bulls from plantations in New Ireland. The available data were only begun to be collected after the formation of these government herds. A systematic description of the breed is given by Holmes (1980). There are only seven publications altogether, all authored or co-authored by Dr Holmes. Of these, only three papers contain experimental results with estimates of precision attached to production statistics. All data come from purebred or crossbred cattle on the two stations.

The former Beef Cattle Research Station at Erap in the Markham Valley of Morobe Province is situated at 100 m above sea level, has an average annual rainfall of 1250 mm and has a temperature range of 18°-35° C with little annual variation. The recently deposited alluvial silt and sandy loam soils support pastures of *Dichanthium annulatum*, *Imperata cylindrica* and *Cenchrus ciliaris*. The former Sepik Plains Livestock Station, now mainly reverted to traditional land ownership, has a considerably harsher environment. While the climate is similar to that of Erap, except for a higher annual rainfall averaging 1700 mm, the podsollic soils have multiple mineral deficiencies for cattle production, the major limitation being phosphorus as shown clearly by Holmes (1981a). The vegetation of these rolling grass plains is an association of *Imperata cylindrica*, *Themeda australis*, *Lochaemum barbatum* and sedges.

A general description of the cattle is given in Holmes (1980). The animals come in a variety of coat colours, the commonest being fawn with a black stripe along the spine. The coat is short, ears small (15 cm) and held horizontal, hump overhanging or pyramidal, horns variable in colour and direction but not twisted, and the udder small, neat and closely attached. Bulls weigh 500-580 kg while cows weigh 320-410 kg. The cattle are quiet but alert in the field. In yards they can become very excitable and nervous. They are good mothers and are very aggressive when the calves are young. They are the most resistant of all the PNG cattle to ticks (limited distribution in PNG) and screw worm. Comparative data on growth and reproduction are given below.

The most comprehensive set of comparative reproduction and calf growth data comes from assessment with continuous mating over five years of Brahman crossbred (BX) and JZ cattle and their reciprocal crosses at Erap (Holmes et al. 1992). The BX cows were typical lowland commercial cattle and there were 20 heifers (later reduced to 14 cows) in each mating group. Three bulls of each breed were used sequentially.

Tables 1 and 2 are reproduced directly from the Holmes et al (1992) paper and give the relevant data on cow weights and calving intervals by cow breed and on calf weights and pre-weaning growth rates by breed of dam and sire. Initial heifer mating time was determined by weight rather than age, based on earlier experience, and hence the JZ heifers were mated some 134 days earlier and 100 kg lighter than the BX heifers. Nevertheless, JZ cow weights never approached those of the BX and JZ cows were 62-73% of the weight of the BX. Calving intervals for the JZ were 19 days shorter.

Table 1. Least squares breed and parity means of weights and intervals during calving cycles in BX and JZ cows and calf pre-weaning weights

Trait	Breed	Parity				
		1	2	3	4	5
Cow Traits						
Weight (kg) at:						
Conception	BX	333	368	404	448	428
	JZ	217	262	276	279	292
Pre-calving	BX	424	455	471	487	486
	JZ	293	306	309	333	322
Minimum during lactation	BX	363	392	396	406	375
	JZ	241	270	274	284	253
Weaning of calf	BX	380	413	424	431	397
	JZ	277	294	273	312	278
Calving Interval (days)	BX	1078 *	389	357	365	370
	JZ	944 *	370	338	346	351
Calf Traits						
Birth Weight (kg)		31.3	31.9	31.3	28.4	27.4
Birth weight/Cow pre-calving weight (%)		8.7	9.0	8.8	8.0	6.6
Average Daily Gain (kg/day)		0.58	0.64	0.60	0.52	0.50
Weaning weight/Cow weight at weaning (%)		50	52	49	40	45

- Time between birth of cow and birth of first calf

Table 2. Least squares means for birth weight, birth weight as a proportion of cow pre-calving weight, average daily gain to weaning and adjusted weaning weight as a proportion of dam weight at weaning for BX – BX, JZ – JZ, BX – JZ and JZ – BX

<i>Trait</i>	Mean	Breed of Dam	Breed of Sire		
	(SE)		BX	JZ	Both
Birth Weight (kg)	30.1	BX	35.1	30.8	33.0
	(0.7)	JZ	29.3	25.0	27.2
		Both	32.2	27.9	
Calf birth wt/Cow pre-calving wt (%)	8.0	BX	7.8	6.7	7.3
	(0.3)	JZ	9.3	8.3	8.8
		Both	8.6	7.5	
Pre-weaning Average Daily Gain (kg)	0.57	BX	0.68	0.61	0.65
	(0.01)	JZ	0.53	0.46	0.50
		Both	0.61	0.54	
Calf weaning wt/Cow wt at weaning (%)	47	BX	47	43	45
	(1.0)	JZ	52	47	50
		Both	50	45	

Purebred BX calves were 10 kg heavier at birth than JZ calves and grew 48% faster to weaning at 7.5 months. Pre-weaning average daily gains were 0.68 kg and 0.46 kg respectively. The effect of the breed of sire in the reciprocal crosses was quite small.

Holmes (1981b) has reported average calving intervals and pre-weaning growth rates for both types of cattle at Erap and at Urimo. Intervals were 14 months for BX cows at Erap, 22 for BX at Urimo, 12 for JZ at Erap and 13 months for JZ at Urimo. These intervals are probably closer to what might be expected in a smallholder herd than the least-square means in Table 1. Corresponding pre-weaning growth rates were 0.72 and 0.35 kg per day for BX at the two sites and 0.50 and 0.52 kg for JZ. Weaner production per cow in kg per year were 162 and 61 for BX at the two sites and 122 for JZ at both sites. BX cows at Urimo lose 30 percent of their body weight during lactation (Holmes 1977) compared to 5 percent and 11 percent for JZ and BX heifers at Erap. The environmental effect of the conditions at Urimo on performance of the BX cows is clear.

Two reports of feeding experiments give data on the post-weaning growth of steers and on carcass characteristics. Holmes (1979) grazed steers of the two breeds at Erap on three feeds with three steers per group. The feeds were Nunbank buffel grass pasture and two cultivars of the tree legume *Leucaena*. The experiment ran for one year. Initial weights of the 14-17 month BX steers averaged 215 kg while the 12-18 month JZ steers averaged 177 kg. Since there were no differences in steer growth between the feeds, the following data (Table 3) are given as breed means.

Table 3. Growth and carcass characteristics of JZ and BX steers at Erap

<i>Breed</i>	Javanese Zebu	Brahman Cross
Average daily gain	0.3 kg	0.4 kg
Total live weight gain	105 kg	143 kg
Final weight	282 kg	358 kg
Carcass weight	170 kg	212 kg
Dressing percentage	60.3 %	59.2 %
Back-fat thickness	6.4 mm	3.8 mm

BX steers grew significantly faster than JZ steers with a greater total weight gain. However, the breeds had similar dressing percentages since the JZ steers had smaller but fatter carcasses.

In the second experiment, Gwaiseuk and Holmes (1985) fed steers for 18 weeks on treatments to evaluate the use of wheat millrun as a supplement to grazing of buffel grass pasture. Breed differences were not analysed as such and only data relevant to the breed comparison are given here. There were two 20-24 month JZ steers and two 16-24 month BX steers on each treatment. Relevant data from the grazing and four hours of millrun feeding as a supplement to grazing treatments are given in Table 4. JZ steers did not respond at all well to higher levels of millrun supplementation. The only significant breed difference was that for average daily gain on full grazing when the BX out performed the JZ steers.

Table 4. Growth and carcass characteristics of JZ and BX steers on grazing and limited millrun supplementation

Treatment	Grazing only	Millrun 4 hours	Grazing only	Millrun 4 hours
Breed	JZ	JZ	BX	BX
Growth rate per day	0.61 kg	0.97 kg	0.83 kg	1.07 kg
Final live weight	345 kg	386 kg	358 kg	391 kg
Carcass weight	192 kg	215 kg	194 kg	215 kg
Dressing percentage	55.6 %	57.4 %	54.2 %	54.9 %
Back-fat thickness	6 mm	9 mm	4 mm	8 mm

In summary it seems appropriate to quote the conclusion and recommendation of Holmes et al. (1992). They “conclude that crossbreeding BX and JZ to produce F1 cattle is unlikely to be advantageous in PNG unless greater advantages are shown than found here. The BX cattle at Erap have high fertility and good growth rates. JZ cattle are smaller and more fertile than BX, but this advantage is smaller under good conditions and their energetic efficiency is unlikely to be significantly greater. Under harsh, humid equatorial lowlands conditions JZ are superior and their contribution to beef production in Papua New Guinea probably lies in these areas.”

The JZ cattle of PNG should not be allowed to vanish through neglect or ignorance of their actual or potential contribution to beef production from the poor fertility lowland grasslands.

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Appendix 5. Characterisation of the Papuan Native Pig

A slightly shortened version of this paper was published in: Partnerships for Sustainable Livestock Production and Human Welfare. The 8th AAAP Animal Science Congress, Japanese Society of Zootechnical Science, Tokyo, Proceedings Vol. 2: 8-9. 1996.

1 Introduction

The Papuan Native pig is here defined as the population of domestic and feral pigs occupying the mainland of what is now Papua New Guinea and relatively free from the genetic influence of colonial era and later introductions. This pig is believed derived from a domesticated hybrid of the South-east Asian subspecies *Sus scrofa vittatus* and the Sulawesi native pig *Sus celebensis* (Groves, 1981). It is assumed that this hybridisation of two domesticated species took place in the Moluccas and the pig introduced into New Guinea island between 6,000 and 10,000 years ago. Pig husbandry was certainly well established in the inland highlands by the more recent date (Bulmer, 1975). The original introduction was presumably further hybridised or replaced by domestic *Sus scrofa vittatus* in coastal and island locations (eg the Admiralty Islands) and later by other *Sus scrofa* domesticates, the most recent being modern pigs of European origin. The most archaic pigs would be found in the inland highlands and this discussion concerns pigs from such areas. Further genetic and characterisation studies should be made as far as possible using pigs from geographically isolated areas.

The total population of village pigs in Papua New Guinea is estimated as at least 1.6 million based on extrapolation from a survey done in 1961-62 and collaborated by the number of rural households claiming ownership as enumerated in the 1990 national census. At least 1.0 million of these animals would be owned in the five highlands provinces. General descriptions of the traditional feeding and husbandry systems can be found in Malynicz (1970) and Quartermain (1977).

A general description of the pig itself can be found in Malynicz (1970). Use of the pigs ranges from the hunting of feral animals through to very intense husbandry using sweet potato as the primary feed. There is much variation according to geography and ethnic grouping. It is clear however that domestic and feral pigs constitute a single breeding population and gene pool. In the only published study of genetic polymorphism, Lauvergne et al (1982) have suggested that the high incidence of agouti, black and black spotted coat colour phenotypes, relative to white, red or piebald (white design) phenotypes indicates little genetic influence of exotic pigs, even in villages quite close to major towns, and a long period of isolation following the original introduction of pigs with few coat colour mutants.

2 Production Data

The existing literature and available unpublished data have been searched and assessed to give as much information as possible on the performance characteristics of these pigs. There are three broad types of data. Firstly there are data from pigs kept under traditional systems and these are quite variable. Secondly there are data from pigs kept under improved systems of management and thirdly there are limited data from comparisons between native pigs and exotic (European-derived commercial breeds) pigs under the same commercial management.

3 Body Size

Adult weights would appear to range up to a little over 100 kg. In villages pigs range from 40 to 90 kg (Rappaport, 1968; Malynicz, 1977) at 2-3 years with the only comparison between sexes showing females at 49.5 kg and males 87.6 kg (Malynicz, 1977). Rose and White

(1980) had well fed castrated 15 month males at 92.9 ± 13.6 kg while in the only comparison with exotics under commercial feeding, Malynicz (1975) had 16 mature sows at 104 kg and 14 equivalent Berkshires at 175 kg.

Birth weights in villages are given by Rose (pers. comm.) as 580 g but with 910 g recorded under good conditions. Eight week weaning weights given by Rose (pers. comm.) are 5 kg (3-7 kg) for village pigs and 7.45 kg for optimal conditions, the latter figure confirmed by Malynicz (1975).

4 Growth Rates

Growth data are, as expected, quite variable. Under village conditions, Rose (pers. comm.) suggests 50-80 g per day from weaning to maturity, consistent with the village data of Malynicz (1977). Under optimal conditions, Rose (pers. comm.) suggests 189-205 g but with a normal ceiling of 200 g which is three times the growth rate expected under traditional village husbandry. Rose (1981a) grew pigs from three months of age for 140 days on diets of *ad lib* sweet potato, foraging and 20 g per day of protein supplement. Start weights (16 pigs) averaged 7.6 ± 0.5 kg, final weights 35.3 ± 1.1 kg and growth rate 197.5 ± 5.6 g per day. This achievement is attributed to the earthworm component of the forage diet.

Malynicz (1992) using 1974-75 data compared 12 native pigs with 17 Berkshires on commercial diets. Native pigs took 281 ± 4.4 days to reach 66 kg liveweight compared with 178 ± 1.1 days for Berkshires. This growth was achieved on 279 ± 3.2 and 197 ± 0.8 kg of feed from six weeks of age, corresponding to approximate feed conversion ratios of 4.7 and 3.3 for natives and Berkshires respectively. Earlier 1973 data (Malynicz, 1977 unpublished) had similar growth rates and conversion ratios of 252 g per day versus 415 g and 4.7 versus 3.6 for natives and Berkshires respectively. Finally, Malynicz (1973b) grew a total of nine native and 10 exotic (Berkshire or Tamworth) pigs for 100 days from 56 days of age. Results averaged over two housing treatments showed growth rates of 211 ± 18.2 g versus 450 ± 26.5 g per day, food consumption of 1.62 ± 0.056 versus 1.01 ± 0.080 kg per day and 5.05 ± 0.28 versus 3.78 ± 0.26 food conversion efficiency for natives and exotics respectively.

5 Carcass

There are clear differences between native pigs and exotics in terms of carcass length and fatness. Malynicz (1992) gave carcass length and back fat depth (C measurement) of the carcasses of 66 kg pigs as 64.9 ± 0.10 cm and 3.8 ± 0.05 cm for his 12 native pigs and 75.2 ± 0.12 and 1.7 ± 0.02 for the 17 Berkshires. His earlier data (Malynicz, 1977 unpublished) gave similar figures of 64.8, 3.85, 74.7 and 1.73 cm for the four measurements.

In the experiment of Malynicz (1973b), the backfat depths of the two types of pig were almost the same, 1.46 ± 0.084 and 1.80 ± 0.105 cm, in spite of the carcass weight being twice as large in the exotics, 21.78 ± 1.32 and 43.14 ± 3.50 kg for natives and exotics respectively. Rose (1981b) states that his dissection data indicate a trend for village (native) pigs to be fatter and have lower bone weight than would be expected of exotic pigs of similar carcass weight. This gives a higher edible portion for the native pig since virtually all soft tissues are eaten. Of course, with inferior genetic ability for protein deposition and a smaller mature size it would be expected that native pigs would have a tendency for fat deposition on high energy diets.

6 Reproduction

Observation on village pigs suggests litter sizes of at best 4-6 (Rose, per. comm.; Quartermain, 1977) with 3-5 pigs weaned. Malynicz (1977) reports 3.67 ± 0.29 pigs born from one village and gives a range of 3.6 to 4.8 from others. These litters were reduced to 1.9 - 3.0 at weaning and Rappaport (1968) has reported two survivors per litter under very harsh conditions. Under commercial conditions in both the highlands and lowlands, Malynicz (1975) recorded an average of 6.2 born and 5.5 weaned per litter at 8 weeks. First parity sows gave 5.3 pigs per litter while third parity sows gave 7.9 pigs. It would seem that there is a ceiling litter size of about 8 pigs per litter under optimal conditions, but that neo-natal mortality is not unduly great due to good mothering ability and sow aggression to avoid disturbance.

In general with respect to other aspects of reproduction, Malynicz (1977) has reported mean farrowing intervals of around 200 days for both exotic (Berkshire, Tamworth, Large Black) and native pigs whereas in the field this may be extended to 16, 18 or even 24 months due to poor nutrition. Puberty is reported to occur between one and two years (Rose, pers. comm.) but this too is probably a function of nutrition and body weight which may have to reach about 35 kg before sexual maturity is attained.

7 Survival and Fitness

There is no clear evidence on superior fitness of native pigs under adverse village conditions but they do survive, grow and reproduce. There is no real disease challenge in Papua New Guinea except parasitism, and low productivity is generally ascribed to poor nutrition. However, a government policy of distribution of weaner pigs of exotic genotypes into certain villages to "improve" the pigs over the years from the mid 1940's to the mid 1970's can be judged a failure in spite of little follow-up investigation. Two reports (Malynicz, 1973a; Gibbs, 1981) have indicated very high mortalities of between 14 and 75 percent or more loss within six months of distribution and growth rates of between 16 and 140 g per day for survivors.

8 Conclusions

The Papuan Native pig is believed to be a unique genotype with a considerable degree of isolation due largely to geography and slow commercialisation of village production. In comparison with modern commercial pigs it is small and slow growing with a smaller litter size but good mothering ability. Numbers are yet large, well over one million animals, and any unique genetic features, whether identified or not, are in no immediate danger of loss. However it is definitely endangered in the longer term as village husbandry responds to the demands of commercialisation. Its archaic nature and large numbers make it a prime candidate for further study with immediate attention to polymorphisms, cytogenetics and molecular genetics.

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