Goat Production and Research in the Tropics

Proceedings of a workshop held at the University of Queensland, Brisbane, Australia, 6–8 February 1984

Editor: J.W. Copland
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ACIAR was established to help identify priority problems requiring agricultural research in developing countries and to support collaboration with Australian research institutions who have demonstrated capacity to assist in their resolution. Workshops are one of the primary avenues for identifying where ACIAR might most effectively implement this mandate.

The aims of the workshop Goat Production and Research in the Tropics were: firstly, to identify the major problems facing the goat industries in developing countries; secondly, to understand Australia's comparative advantage in goat research; and finally, to identify potential topics, operating institutions and scientists around which ACIAR might develop collaborative research proposals.

Data on goats are not as good as they are for other animals. In the mid-1960s FAO estimated that there were 380 million goats in the world. The figure may currently be close to 500 million. There were about 28 cattle and 28 sheep for every 10 goats.

The Far East contains about 25% of the world's goat population and Africa has about 30%. Hence, the countries represented at the workshop together comprised more than 50% of the world's goat population. The Far East region has the greatest animal pressure on grazing land: 0.3 ha/animal unit compared with 2.9 for the Near East and 4.7 in Africa. This suggests that research on management and nutrition should have high payoffs, especially in the Far East.

In Australia, goats are kept for milk, skin, cashmere, and mohair production and are managed on individual holdings. In South and Southeast Asia they are primarily kept for meat and milk purposes and have a particular significance for subsistence farmers and for landless households. They often make effective use of land and vegetation that is unfit for cropping and generally do so more efficiently than sheep and cattle. Hence, research on goats can have considerable equity as well as productivity implications in developing countries. However, goats often roam and browse on land that does not belong to owners or herders. This fact can condition the type of Australian research that will be relevant to goat herders or owners in developing countries, especially in fields such as nutrition and management. Because of the complex nature of goat rearing and management in developing countries, it would seem desirable not only to consider projects that have a biological focus but also those having a socioeconomic component to properly understand the constraints that operate on goat producers.

Conclusions reached at the workshop have been valuable in developing ACIAR's collaborative research activities with goat researchers in the developing world. ACIAR would like to thank Dr Barry Norton and his colleagues at the University of Queensland for making the arrangements for the conduct of the workshop. It is obvious that they set the stage for a most useful interaction amongst goat scientists. We would also like to thank Jack Mertin and Janet Lawrence for helping with the editing of the proceedings.

J.G. Ryan, Deputy Director
Australian Centre for International Agricultural Research
Priorities for Goat Research in the Tropics: Workshop Recommendations

J.W. Copland*

During the workshop it became clear that the research needs of different countries in the region varied in such factors as the relative economic importance of goats, land use and management practices, and the countries' traditional experiences with goats. Variation occurs within and between countries so the following summary is presented on a country-by-country basis as discussed on the final day.

In general, all participants agreed that production from goats and their utilisation was low in all countries represented at the workshop, due mainly to high mortality, slow growth, poor production, inefficient marketing systems and low availability of capital. It was considered that access to a resource group of technical and development research personnel would be of great value to the various countries of Southeast Asia and the Pacific. In some cases, technical surveys were needed to identify component research priorities but emphasis should be given to practically oriented research consisting of both technical and sociological inputs which would lead to a package of activities relevant to the village environment. Successful packages could be expected to attract increased development support. The background papers cover in detail many of the research needs while specific priorities for research and other attention were identified after discussion as follows:

**Indonesia**

Goats contribute an important proportion (38%) to the total ruminant population. Twenty percent of farmers keep goats for a range of purposes: meat, milk, hide production, manure, crop residue utilisation, family employment and such sociological factors as financial security and ceremonial uses.

The program of priorities for improvement consists of research on nutrition, breeding, disease control, management and marketing. Significant aspects are:

**Nutrition**

There is insufficient quantity, quality, distribution and availability of feedstuffs to meet nutritional requirements. Quantity is inadequate due to seasonal variations, cropping patterns and insufficient land for feed production. Plant and crop residues are of poor quality and the supply and distribution systems are unstable.

**Breeding**

Low inherent productivity is seen to be due to the lack of sound and continuous selection programs for goat products and a lack of knowledge of the best types of available animals to use.

**Disease**

In the areas where goats are important there is little knowledge of the distribution prevalence and incidence of disease, and a lack of expertise in methods of epidemiological investigation and control at both the village and regional levels.

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* Research Program Coordinator, ACIAR, G.P.O. Box 1571, Canberra A.C.T. 2601, Australia.
Management and Marketing

There is little understanding of marketing mechanisms, price information, trading and market structures. In addition, there is a need for information on aspects of land use, climate interactions, and of the farmers’ needs and perceptions in relation to their goat-raising enterprises. Also, the role and potential of goat production in the total farming system requires clarification.

Malaysia

The needs for goat research in Malaysia have their foundation in the special significance of goats in the rural and village communities, and their role in producing meat, milk and other products.

Goats serve as a source of supplementary income to farmers who generally keep them as a reservoir of ready cash. They serve an investment function and also confer on their owner social standing within the community. On a production basis, goats are kept primarily for meat which brings amongst the highest prices. Milk is generally unimportant for human nutrition but is clearly a prime factor of maternal ability in does.

Breed improvement is an important goal of government policy and efforts are aimed at gaining knowledge on the potential benefits of introduced types in relation to local goats, for increased size and fecundity.

There is a small knowledge base which would allow the adoption of relevant technological procedures and emphasis is placed on the need for the design of suitable production systems at the farmer level. Such systems would include the choice of breeds, efficient feeds and by-product utilisation, management practices, alleviation of reproductive problems and the identification of health and disease problems.

A research priority exists for investigations with a farming systems perspective for integrating goat raising with plantation crops which would involve the consideration of both production and economic aspects.

Philippines

The vast majority of goats are raised by small farmers or people who own no land. As these people are not able to develop the industry nor to stimulate improved production and living standards, government policy is directed to research priorities which emphasise: (a) improved breeding, nutrition, health, housing and management; (b) development and evaluation of technology packages at the farmer level; (c) integration of goat raising with use of crops and marginal lands; (d) improvement of processing goat products; and (e) studies of socioeconomic aspects of goat raising and marketing.

To service these general needs, six project areas have been identified. They are: breeding; herd management, nutrition and health; product utilisation and marketing; socioeconomic studies; on-farm trials; and goat farm modular system.

Thailand

The major area for goat production is southern Thailand, especially in the Muslim areas of the border regions. Priorities for research into goat production in the area involve: (a) identification of present productivity and management constraints at village level; (b) intensive breeding at a central site of improved goats; (c) evaluation of breeding and production programs at the village level; and (d) distribution of improved or crossbred animals to village producers.

Solomon Islands

It is planned to develop goat production in the Solomons. However, several problems related to research were evident: first, the lack of adequate skilled manpower in goat management and production techniques; second, the problem of internal parasites which will require a cost-effective control program. Studies will also be needed on the
economics of grazing goats in association with other agricultural activities, such as coconut production, and evaluation of the impact of goats on tropical environments such as atolls.

Fiji

Although most goat raising is done by small farmers, commercial farms for grazing goats exist. The principal product is meat and a successful breeding project has been carried out based on crossbreeding with Anglo-Nubians.

Priority problems requiring a research input range from low productivity due to nutritional problems to poor management and severe internal parasite infections.

Management packages are required for about five different typical situations. The main technical research problems are disease, especially internal parasites; early mortality; improved nutritional management; housing and yard designs for commercial farms and marketing and management systems.
The Problems of Goat Production in Malaysia
Mohd Khusahry Mohd Yusuff*

In the Malaysian economy, agriculture contributes 23% to the total foreign exchange earnings and provides employment to 40% of the total workforce. Within the agriculture sector rubber and palm oil predominate and account for 50% of the country’s gross income. In both commodities Malaysia’s share of world exports has exceeded 45 and 60% respectively. In contrast, livestock contributes only 11% of the gross value of agricultural output or about 3.5% of the Gross Domestic Product.

The levels of sufficiency for the various animal products are estimated at 51, 18 and 6% for beef, goat meat and mutton, milk and dairy products, respectively. As a remedial solution the country has to rely on imports to meet the growing demand for protein. In 1980, Malaysia’s import bill of livestock products amounted to MR 480 million (MR = Malaysian Ringgit; 2.2 MR = $1US at time of writing). Thus, there is a need to devise suitable systems of animal production which are more effective and efficient than those presently practiced, for increased production of animal protein is important.

In recent years, more attention and interest has focused on the development of the goat industry in Malaysia. This paper attempts to outline the current status of the goat industry in Malaysia, problems and constraints faced in goat production, current research findings and future prospects and strategies for continued development of the goat sector in Malaysia.

Status of the Industry

Economic Significance

The goat industry in Malaysia is characterised predominantly by small backyard type of operations. Goats are mainly kept for meat production although milk, mainly fresh, is sometimes consumed in estates and urban fringe areas. In 1980, its estimated contribution to the overall gross turnover of animal products was 0.4% amounting to MR 5.5 million. Its meat is preferred by about 12% of the population with a per capita consumption of about 3.4 kg. The present local production level is about 800 metric tonnes, approximately 5% of a total 16 425 metric tonnes, and overall supply of goat meat has in fact declined at a rate of 2.7% annually (Devendra 1983).

It is therefore not surprising that the supply of goat meat is always short of the market demand. From 1976 to 1981 self-sufficiency levels for goat meat and mutton have fluctuated with levels of 18% in 1976, 25% in 1978 and 18% in 1980. With the government’s projected demand for goat meat and mutton to increase from 5648 metric tonnes in 1980 to 11 107 metric tonnes in the year 2000, greater dependence on imports is envisaged if efforts to increase production are not intensified. Already the value of import for this commodity has doubled during the last 10 years from MR 5605 million in 1970 to MR 11 911 million in 1981. Inevitably this has led to greater hikes in prices of local goat meat, despite imported mutton being 20–30% cheaper than local meat. In 1972 the average price per kilogram of local goat meat was MR 4.55 while in 1982 the value was MR 9.40/kg. During the same period, the price of imported mutton has increased from MR 3.13 to MR 7.34.

Population

The population of goats in Malaysia is about 348 746 animals. Out of the total about 83.6% are found in Peninsular Malaysia, 5.9% in Sarawak and 5.5% in Sabah. As a percentage of total ruminants, goats are important next to cattle, accounting for 31.3% of the total ruminant population. Goats represent the major ruminant species kept in Sarawak and are second largest in number in Malaysian Peninsular.

In Peninsular Malaysia, concentration of goats is highest in the northwestern states (48%) with 30% of the population found in the southern states and the rest (22%) found in the east coast. Distribution in Peninsular Malaysia is shown in Fig. 1. Distribution patterns show high concentrations of goat populations in the poorer states of the country, which invariably means that goat keeping is traditionally in the hands of the
rural poor and small farmers, and thus associated with various cropping patterns. Thus goats form an integral part of the overall farming activity of a majority of the farmers and are kept as a source of supplementary income.

Fig. 1. Distribution of goats in the various states in Peninsular Malaysia, 1982; from Devendra 1983.

The livestock census records of the years 1948–80, as shown in Fig. 2, illustrate some alarming trends. During the 1950s and early 1960s there was a steady increase in population. Estimated annual growth rate up to 1970 was 2.3% (Devendra 1983). But from 1970 onwards a 0.9% decrease in growth rate was seen. Overall growth rate for 32 years was approximately 1.2%. The relationship between population growth and extraction rate is also illustrated in Fig. 2. Rate of extraction was highest during the 1950s but has since shown a steady decline. Possible reasons for the slow growth rate are: 1) increasing slaughter rate especially of females; 2) increased demand for meat; 3) inadequate breeding replacements; 4) lack of legislation against uncontrolled slaughter; 5) relatively high kid mortality (Devendra 1983).

Breed of Goats

The goat population comprises three types of animals: 1) the indigenous Kambing Kacang, 2) the local or crossbred goats of various grades, and 3) the exotic purebreds.

The indigenous Kacang has been described as a small and compact type of goat with relatively poor growth rates (40–50g/day) but renowned for its prolificacy and fecundity traits. Average mature weights vary from 20 to 25 kg. This breed is adapted to a wide range of management conditions and feeding regimes. It is usually black with patches of white in the middle of the body or underside of the belly. Several reports have indicated that colour variation exists in this breed ranging from black to white with predominant colour variations of either black and white or black and brown making up about 60–70% of the population (Nishida et al. 1975; Devendra 1983). The development of the breed hitherto has been left to chance, resulting in a large variation found in its performance.

The crossbred goats are of various grades and are genetically heterogeneous animals. Numerically these 'local' animals are more important than the Kacang. The heterogeneity of these animals is associated with the degree of exotic blood in the cross as a result of indiscriminate crossing and upgrading. Although not distinctly identifiable, these grades of animals are somewhat stabilised and their distinctiveness in terms of colour patterns and performance are more associated with being naturally selected to be adaptable to a particular region or niche rather than due to any conscious effort by relevant authorities. Growth rates of these groups of animals are better than the Kacang (70–80 g/day) with mature body weights ranging from 30 to 40 kg.

Various exotic purebreds have been introduced into Malaysia for purposes of crossbreeding and upgrading. These include the Anglo-Nubian, Saanen, British Alpine, Toggenburg and Jumnapari which were introduced as early as 1950 (Keeping 1951). Exotic purebreds are usually reared at government farms and institutes. Performance and adaptation of the breeds have been variable. Improved animals have been extensively distributed all over the country for breeding purposes. It is difficult to measure the impact of this dissemination of exotic animals as no proper follow-up and monitoring has been done at the various distribution points. Other important breeds that have
been imported and widely distributed include the Indonesian Etawah and feral goats of Australia.

The Goat Enterprise

As mentioned, goat rearing in Malaysia is primarily a small farmer enterprise. They are kept as a source of supplementary income and reared in a subsistence manner. In a survey conducted in 1979, it was found that goat meat production for home consumption is of minor importance to traditional goat farmers (Peters et al. 1979). Goats were kept principally for meeting short-term cash requirements. Goats are kept by all ethnic groups in the country. In West Malaysia, goats are kept by the low-income economic units which comprise smallholders, landless estate workers and landless non-estate workers. Several surveys have been conducted to determine the relationship between ownership and herd size and the interrelationships between systems and management and feed availability within these low-income economic units (Peters et al. 1979; Abdul Rahman 1980a).

In general, the number of animals kept is less than five although there are medium-size flocks. Average farm size is usually less than 1 ha. Often goats are integrated with other small-scale farming activities such as paddy, rubber, oil palm, coconut and orchards. Characteristically this means that goats are reared on a low-input system, do not demand extensive labor inputs of both time and intensity, and are kept in traditional style. Thus farmers are oblivious and insensitive to improved husbandry techniques and other technological advancement, with no incentives to increase herd size or improve scale of operations.

The pattern of goat keeping varies according to location, and thus the system of management adopted is more a function of the social acceptance of the community to goats, available land, human resources and financial status of owners as well as feed availability. This means that the system of management adopted is not a result of any economic consideration but rather, in most cases, a consequence of the environment. Several reports have been written on the various systems of management (Abdul Rahman 1980a; Rajendran and Mohma 1983). In general, the most predominant and popular system is the extensive system of management, as this requires minimum labour input and animals are usually allowed to graze on any surrounding land that is available. The intensive system of management, although uncommon, is related to the degree of industrial and economic development that has occurred within the region. In such a situation the intensive system of management is the norm, because idle land available for grazing is in short supply. Tethering is popular among those farmers keeping one or two goats, although it is more tedious and labour-intensive.

Improved grasses are seldom grown for goat keeping. This in part is due to the competitiveness of land utilisation, as income from crops is normally higher and thus it is uneconomical to plant grass for feeding goats. It has been estimated that the natural feed resources available to goat farmers do not seriously restrict goat production (Peters et al. 1979). The type of feed resources utilised by goats is the mixed natural vegetation on roadside verges, public grounds, undergrowth of plantations, crop by-products and leaves of various bushes.

Housing among goat farmers is also a function of herd size and system of management. This is because the initial investment for constructing a shed comes close to the monthly income of rural households (Peters et al. 1979). However, cost of sheds can also be minimal as evidenced in practices where goats are kept under owners’ houses or in cases where owner and goats only meet at time of sale.

Designs for housing of goats have been adequately described (Abdul Rahman 1980b; Devendra 1983). In general, two main designs are predominant, viz. the ground-level type and the stilted type. No special reason can be given for this difference in housing design, except for the fact that this is more related to the farmers’ architectural fancy and their level of income. However, ground-level designs are more predominant in the northern states of Malaysia with the stilted design found more in other parts of the country. Housing of goats by farmers normally does not take into consideration such factors as separation units for kids, sexes, pregnant does, health reasons, etc. Thus, in most cases, houses assume the size of large pens with no distinct separation and with crude feeding troughs.

Goats owned by these small farmers are usually of mixed origin with traces of past introduced exotic inheritances expressed in varying degrees both in their physical appearance and their performance. These usually compact, small-sized animals show high reproductive rates, short kidding intervals and high incidences of multiple births. This in part is due to natural selection which will usually favour smaller-sized animals, with the ability to reproduce at a faster rate to ensure species survival in the face of continuous adjustments to changing availability of feed resources.

Production Problems

The Malaysian agricultural sector is predominantly tree-crop oriented for cash and export purposes. Traditional livestock farming on a large scale is an uneconomic activity compared to other agricultural
activities. Therefore, because of the comparatively poor financial returns from livestock farming in the Malaysian environment, which is characterised by high cost of initial inputs and long pay-back periods, livestock development programs have always been implemented as an integral part of other agricultural activities. Ruminant industry development has largely centred around cattle with little or no emphasis given to goats or sheep, and more than 80% of the budget for livestock development is allocated to cattle. Thus, the development of the goat industry has been left much to chance and has minimal collective thrust from the relevant agencies.

With this in mind, the problems of the goat industry can be divided into the following categories:

Production Units

Almost 95% of goats reared in the country are in the hands of the small farmers. However, the majority of farmers lack the managerial skill to operate a livestock enterprise efficiently. They are ignorant of the efficient methods of goat keeping, in particular goat breeding, feeding, management, and disease problems, and in general, economics of goat production as a whole.

Plots of land in most cases are small and uneconomic for profitable goat farming. Such a situation is more related to the social aspects of land inheritance prevalent especially among Malay farmers. Ancestral inheritance practiced over generations has led to individual farmers possessing fragmented pieces of land which in most cases are not large enough to support any agricultural activity economically. Tracts of land located by Government as grazing reserves are in most cases useless for their intended purposes. They are often badly sited and remote from the animals that they are intended to serve. Thus, they seldom carry any pasture of value and they are practically never maintained. Their value seems to be more as holding areas for stock during the rice-growing seasons when grazing in paddy fields is not possible.

The animals kept by the farmers, besides being small in number, present other problems. Due to traditional methods of rearing, a large proportion are of poor quality and unproductive. This is partly due to the unavailability of good quality stock for distribution by the relevant extension and development agencies. Further, such practices as slaughtering the largest males in the flock for festivities or sale, in the long run, lead to a degeneration in quality of the stock that is kept. Effects of inbreeding should not be precluded as causal reasons for the prevalent unproductiveness. Farmers seldom change their bucks for mating purposes. Even if they do, such as in the event of deaths of bucks, in most cases bucks bought from nearby locations are related, since farming communities within a particular location allow their animals to graze and intermix freely, leading to higher genetic relationships between flocks.

As a result of the above, efforts to increase flock size are usually thwarted by high kid mortality rates. This is a consequence of several interrelated factors such as poor milking and mothering abilities of the does, mismanagement, poor housing facilities and increased occurrences of health and disease problems. A survey done in 1979 reported the close ratio of female to young stock found in several goat farms in Peninsular Malaysia (Peters et al. 1979).

Labour presents a problem in most agricultural activities. The situation is not dissimilar in goat farming communities. Considering the state of the industry at the moment it is hardly surprising to see useful labour moving over to the urban sectors looking for better quality jobs and financial returns. Traditional goat farming among the rural sector therefore, in most cases, tends to be in the hands of older people who do not have the motivation to change. Old age and other interrelated factors often force farmers to close off their 'businesses', since none are left capable enough to continue.

Given the above considerations, it can be readily seen that efforts to increase levels of goat production will be faced with several constraints. This is because 1) utilisation of improved breeds to increase productivity of local stock cannot be effectively carried out if systems of breeding in an organised manner cannot be conducted; 2) due to the small size of farm plots, systematic animal production can rarely be practiced since profit-loss incentives hold no merit. Thus, practices like planting of improved pasture, improved systems of management and health measures are rarely adopted; 3) subsequently, since the enterprise will always remain a small, subsistence activity, it will mean that unless the farmer takes some very drastic step to change his lifestyle, which he seldom even thinks about or has the financial ability to do, his approach to goat farming will continue to remain small and stagnant.

Supportive Mechanisms

Aspects to be included under this heading include the mechanism to provide stock, credit, infrastructure, technology and production inputs. Much needs to be done before actual patterning of the various aspects of goat production can be worked out in detail. Perhaps the single item that deserves most elaboration is the dissemination of technology to target farmers. General pertinent factors have been reviewed and identified. These include lack of interagency cooperation and
linkages, lack of communication between research workers and extension workers, lack of effective extension services and a general lack of trained personnel to provide effective services to the farmers (Mohd Eusof 1983). While it may be construed that technology may not be available for the various aspects of the industry, effective linkage and sound feedback mechanisms will help in identifying and resolving some of the major problems affecting production.

Marketing Infrastructure

This is perhaps the most neglected aspect of the industry. The marketing structure for goat production is primarily for the sale of slaughter stock, in which sales are usually transacted on the hoof. The marketing of breeding or store stock is of minor importance, and no organised goat market infrastructure exists in Malaysia. Sales are made on an irregular basis, by the individual farmers, directly to the village butcher for slaughter and sale of meat from premises that are frequently unhygienic. The only advantage of the system is that the producer invariably receives cash, the full value of his stock at the time of sale, but obviously since the number of buyers is limited, monopoly exists and the farmer seldom gets competitive prices for his stock.

Production Research

In general terms, research on goats, and for all livestock species for that matter, must be organised to fulfill the following broad guidelines: 1) to develop and introduce technology which will reduce the constraints preventing high goat productivity; 2) to assemble and disseminate information on matters concerning goat production to appropriate extension and development agencies. This must be viewed and aimed towards resolving two clear-cut strategies: to increase goat production to meet increasing demands and to raise the standard of living of goat farmers.

Goat research in Malaysia can be divided into the following categories:

Breed Improvement

The principal breeding goal for goat improvement is for increased meat production. Emphasis should, therefore, be attached to important meat production traits, such as early growth rate, prolificacy, maternal ability, meatiness and to a certain degree carcass quality.

Breeding research must have properly defined objectives, breeding plans and definitive breeds, and the whole program must be coordinated and synchronised to provide a continuous update for extension and development agencies.

Breeding studies should not only be geared towards provision of data on productivity performances of various breed improvement programs, but more importantly be able to provide animals so that implementation agencies can be called upon to disseminate the recommended 'breeds' or strains for subsequent development work, such as the introduction of improved breeds and the subsequent performance of animals at the village level.

There is a need to characterise the predominant breeds of goats available in the country. Agreement from all participating breeders of the various agencies on this matter is important. This is because although the Kacang goat is the breed indigenous to Malaysia, its numerical importance is gradually diminishing. Observations have shown that the Kacang as earlier defined can seldom be found in areas where goat development and improvement agencies have penetrated. Mating and distribution of goats from various disorganised 'improvement' programs in the past have contributed to this situation, to the extent that the indigenous Kacang goats are now normally found in the very outskirts of towns and villages, out of the reach of development agencies. The implication of such a situation is twofold: while it is necessary to work on purebreds for true crossbreeding work, if efforts are not made to save this breed from further 'contamination,' research results may prove difficult to implement. Secondly, considering the large pool of localised crossbred animals existing within the country, efforts should be made to clearly identify the various predominant strains so that a program for development can also be initiated on these somewhat localised and stabilised populations.

Goat breeding research conducted in Malaysia up to now has been summarised in Tables 1–3. From these tables and review of other pertinent research, several short-term conclusions can be arrived at:

1. designated growth traits such as birth, weaning and yearling weights of the local Kacang goats can be improved by the introduction of exotic breeds of either the Anglo-Nubian, Saanen, Jamnapari or Etawah origins. While this may be so, the magnitude of variation reported does not identify any breed as the 'best' improver breed although there are tendencies to indicate that the Anglo-Nubian may be the most suitable. However, it should be mentioned here that more information should be gathered before any recommendations can be made. One of the areas which previously has not been reported in detail is the extent of hybrid vigour in the \( F_1 \) generation and its a subsequent performance in the \( F_2 \) and following generations. The average performance of stabilised flocks of a particular cross is an important evaluation
Table 1. Summary of body weights for various breeds of goats.

<table>
<thead>
<tr>
<th>Breed or breed-cross</th>
<th>Birth</th>
<th>3 mo</th>
<th>6 mo</th>
<th>9 mo</th>
<th>12 mo</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-Nubian</td>
<td>2.66</td>
<td>8.18</td>
<td>11.77</td>
<td>12.7</td>
<td>15.93</td>
<td></td>
</tr>
<tr>
<td>British Alpine</td>
<td>2.68</td>
<td>5.97</td>
<td>11.69</td>
<td>14.57</td>
<td>16.47</td>
<td></td>
</tr>
<tr>
<td>Saanen</td>
<td>2.62</td>
<td>10.09</td>
<td>12.94</td>
<td>18.36</td>
<td>20.73</td>
<td></td>
</tr>
<tr>
<td>Feral</td>
<td>2.39</td>
<td>8.02</td>
<td>10.49</td>
<td>13.57</td>
<td>16.31</td>
<td>Mohd</td>
</tr>
<tr>
<td>Saanen × KK</td>
<td>2.03</td>
<td>9.83</td>
<td>13.76</td>
<td>16.94</td>
<td>19.03</td>
<td>Khusahry 1983</td>
</tr>
<tr>
<td>Anglo-Nubian × KK</td>
<td>2.09</td>
<td>6.52</td>
<td>10.36</td>
<td>13.01</td>
<td>16.49</td>
<td></td>
</tr>
<tr>
<td>Kacang</td>
<td>1.56</td>
<td>5.89</td>
<td>7.64</td>
<td>9.08</td>
<td>10.59</td>
<td></td>
</tr>
<tr>
<td>Jamnapari × K</td>
<td>2.80</td>
<td>13.80</td>
<td>24.10</td>
<td>40.00</td>
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<td></td>
</tr>
<tr>
<td>Anglo-Nubian × K</td>
<td>2.5</td>
<td>13.20</td>
<td>20.00</td>
<td>35.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kacang</td>
<td>1.3</td>
<td></td>
<td>0.09</td>
<td>0.14</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Etawah × K</td>
<td>2.8</td>
<td></td>
<td>0.17</td>
<td>0.12</td>
<td>0.07</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Average daily milk yields from various breeds of goats (Mohd Khusahry 1983).

<table>
<thead>
<tr>
<th>Breed</th>
<th>Av. daily yield (kg)</th>
<th>Estimated 180-day yield</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mo 1</td>
<td>Mo 2</td>
</tr>
<tr>
<td>Exotic purebreds*</td>
<td>0.77</td>
<td>0.57</td>
</tr>
<tr>
<td>Feral</td>
<td>0.69</td>
<td>0.25</td>
</tr>
<tr>
<td>Kacang</td>
<td>0.26</td>
<td>0.21</td>
</tr>
<tr>
<td>Local crosses</td>
<td>0.19</td>
<td>0.18</td>
</tr>
</tbody>
</table>

* Saanen, Anglo-Nubian and British Alpine.

Table 3. Milk yield and lactation lengths of Kacang and Kacang Crossbred goats (Devendra 1983).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Kacang</th>
<th>½ Anglo-Nubian × Kacang crossbreds</th>
<th>¾ Anglo-Nubian × Kacang crossbreds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (kg)</td>
<td>89.5</td>
<td>295.5</td>
<td>236.8</td>
</tr>
<tr>
<td>Lactation length (days)</td>
<td>126</td>
<td>235</td>
<td>207</td>
</tr>
<tr>
<td>Yield/day (kg)</td>
<td>0.7</td>
<td>1.3</td>
<td>1.1</td>
</tr>
</tbody>
</table>

criterion to determine its suitability. It should be mentioned that no reports are in existence about the performance of these various grades of animals at the village level. Most data are from government stations or farms. The small numbers of animals kept is reflected in the general lack of reports on genetic parameters or important economic traits. However, repeatability of milk yield and birth weights of goats has been reported (Anuwar bin Mahmud and Devendra 1966, 1970).

2. There does not seem to be a great depressing effect on the reproductive performance of the resulting crossbreds with the introduction of these large purebreds. Although litter size is smaller than that of the Kacang goats, the magnitude of this difference is not large enough to matter.

3. Milk production is the least investigated trait in goats. Very limited reports are available on the Kacang, the exotics, or their crossbreds. In general, Kacang goats have low milk production and their lactations lack persistency, as about 65% of the flock dry off by the fifth month of lactation (Mohd Khusahry 1978). Average monthly yields obtained range from 0.28 kg in the first month to 0.12 kg in the sixth month. The performance of the purebred exotics so far has not shown their true potential, compared with overseas reports. Interrelationship between adaptation and milk production may be a reason for the poor production.

It has been reported that studies utilising the Kacang goats as base female stock in crossbreeding with exotic sires at the F1 level will need milk supplementation in order to ensure that maximum expression of genetic potential of the crossbreed is to be seen (Mohd Khusahry et al. 1981). With milk supplementation,
phenotypic correlation between dam’s milk and pre-weaning gain is negligible (−0.02).

4. Goats of pure exotic origins, imported into this country from temperate regions, should be intensively managed to buffer them from expected environmental heat stress. A study conducted to observe changes in three parameters namely, body temperature, pulse rate and respiration rate to high environmental temperatures showed drastic three-fold increases in respiration rates after exposure to about 6 hours of no shade (Table 4). Further, depressed performance of purebred farm-born animals was observed when compared to performance of imported animals (Table 5).

Feed

Feed availability in organised goat production may be one of the most important single limiting factors affecting total productivity. Due to land limitations it may not be possible to plant grasses of the improved type to enhance goat production. However, this problem can be alleviated by utilising available agricultural by-products from various processes of the agricultural industry estimated to be about 5 million metric tonnes annually. Analyses of chemical and nutrient contents of available by-products have been adequately summarised (Devendra 1979). Work has also been initiated to determine feeding levels of some of the more important by-products (Devendra 1983). Subsequent to this, continuing research has been conducted to determine the practical application of some of these by-products at the village levels. Among these, the by-products from the palm oil industry have received much attention. Indications are that these by-products such as palm kernel cake, palm oil sludge and palm pressed fibre can be of good feeding value whether fed singly (Abdul Rahman and Mohd Khusahry 1984) or in combination (Mohd Jafar 1984; Kamal Hizat et al. 1984) or as a component of a concentrate diet (Abdul Rahman and Mohd Khusahry, 1983) in rations for goats. Other by-products that have been tested successfully include coconut cake, rice straw, cocoa pods, cassava chips, rice bran and fish meal (Abdul Rahman and Mohd Khusahry 1983; Mohd Jafar 1983; Abdul Rahman 1984; Kamal Hizat et al. 1984).

Besides agricultural by-products, tree leaf feeding can be an important source of feed for small farmers. Leucaena leucocephala has been proven to be an excellent source of feed for cattle. Work on feeding of Leucaena to goats has been conducted to determine its nutritive value to goats (Devendra 1983) and the practicality of its usage at the village level (Izaham and Hassan 1983).

Table 4. Means for body temperatures, pulse rates and respiration rates — by breed (Mohd Khusahry 1979).

<table>
<thead>
<tr>
<th>Breed</th>
<th>Parameter observed</th>
<th>Shade</th>
<th>No Shade</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Time of recording</td>
<td>Time of recording</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Morning</td>
<td>Afternoon</td>
</tr>
<tr>
<td>Anglo-Nubian</td>
<td>Body temp. °C</td>
<td>38.0</td>
<td>39.7</td>
</tr>
<tr>
<td></td>
<td>Pulse rate/min</td>
<td>73.7</td>
<td>97.3</td>
</tr>
<tr>
<td>British Alpine</td>
<td>Body temp. °C</td>
<td>21.6</td>
<td>40.2</td>
</tr>
<tr>
<td></td>
<td>Pulse rate/min</td>
<td>38.2</td>
<td>39.6</td>
</tr>
<tr>
<td></td>
<td>Resp. rate/min</td>
<td>69.2</td>
<td>95.8</td>
</tr>
<tr>
<td>Saanen</td>
<td>Body temp. °C</td>
<td>42.1</td>
<td>46.9</td>
</tr>
<tr>
<td></td>
<td>Pulse rate/min</td>
<td>38.2</td>
<td>39.7</td>
</tr>
<tr>
<td></td>
<td>Resp. rate/min</td>
<td>65.7</td>
<td>89.1</td>
</tr>
</tbody>
</table>

Table 5. Comparative body weights of imported and farm bred exotic breeds (kg).

<table>
<thead>
<tr>
<th>Breed</th>
<th>Imported</th>
<th>Farm bred</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 mo.</td>
<td>18 mo.</td>
</tr>
<tr>
<td>Anglo-Nubian</td>
<td>26.79</td>
<td>29.6</td>
</tr>
<tr>
<td>British Alpine</td>
<td>28.64</td>
<td>30.31</td>
</tr>
<tr>
<td>Saanen</td>
<td>32.35</td>
<td>35.90</td>
</tr>
<tr>
<td>Feral</td>
<td>34.18</td>
<td>36.22</td>
</tr>
</tbody>
</table>

On the subject of fodder and improved pasture feed for goats, little or no work has been done to increase its usage at the village level. However, adequate characterisation and evaluation of the most promising species has been done (Wong et al. 1982). More recently, work has been done to evaluate several species at various specific areas for dairy cattle production (Izaham and Hassan 1983).

In general, although increased improved feed resources given to goats may help to enhance productivity, this should be viewed in line with the available
local feed resources at a particular village location. This means efforts should be made to identify various prevalent feed resources available in a particular region suitable for goat feeding and to combine these particular feeds in the most efficient manner such as to stimulate their increased utilisation. In this manner, results obtained from trials can have direct practical application for farmers’ consumption.

Management

Systems of management practised by farmers for goat rearing are many and varied. These have ranged from the nomadic to the intensive type. The practicality of a system for a particular location as practised by farmers varies with factors that have been mentioned earlier, although little emphasis is given to economic considerations. In general, for organised goat farming, the most appropriate system for a location must take into consideration time and labour availability, existing feed resources, the type of animals used and the overall economics of such a system. Experiences with studies on local animals of poor growth rate have shown that it is uneconomical to intensively rear these animals even with concentrate supplementation (Mohd Khusahry 1983a). In a separate study at village farm locations goats intensively reared gave better performance than those semi-intensively reared. However, this is further influenced both by the quantity and quality of local feeds available at each location. Single feed supplementation with either palm kernel cake, coconut cake or cattle pellets provided no significant improvement to gains (Abdul Rahman and Mohd Khusahry 1984). From the results of a survey conducted from 151 various goat farms, almost 50% of farmers rear their animals semi-intensively. From their observations, they also noted that highest herd productivity was found in the intensive system, where herd size average was about 6–15 animals and mortality due to diseases the lowest (Peters et al. 1979). Therefore, from the above limited studies it should be clear that under farm conditions no one system is the most suitable for all locations.

Reproduction

Reproduction appears to be the least of all the problems in goat production. This may be because of the high reproductive rate reported in literature or because no organised breeding was ever initiated at village level. Reported results are normally from experimental farms and environmental factors such as nutrition, disease etc. may not be deciding factors in influencing reproduction. Research presently conducted at government farms tries to determine among other things the status of fertility, causes of reproductive failures both from the male and the female aspects and to adopt techniques of artificial insemination suitable for use under Malaysian conditions. In brief, two studies have been done to evaluate semen characteristics of various goat breeds (Koh 1975; Kamal Hizat 1984). Studies on use of different diluents for goat semen showed that it can be stored by using a 2.9% sodium citrate solution (Koh and Ong 1976) or trilidyl at 5°C (Kamal Hizat 1984).

Health

In the context of goat production in Malaysia three major causes of death have been identified: kid mortality, mismanagement and disease. On the subject of kid mortality, pre-weaning mortalities appear to have the highest incidence. Predominant cause for pre-weaning deaths appears to be coccidiosis (Mohna 1976). On the other hand low kid weights at birth can reduce their survivability (Mohna and Geneshdeva 1976). Other underlying causes of mortality include general debility, pneumonia, septicaemia, helminthosis, enterotoxaemia and melioidosis (Rajendran and Mohna 1983). Deaths due to massive staphylococcal infections of the foot and resultant septicaemia due to tapeworm infestations (Moniezia spp.) under field conditions have also been reported (Rajendran and Mohna 1983).

Strategy for Development and Research

Prescribed Objectives

Research outlook, in the long run, should be in line with increasing productivity from goats as well as providing increased additional income for the rural sector. It should also be consistent with the national agricultural policy in which several steps to improve the small farm subsector are outlined. Among them are the development of more land schemes and speeding up of in situ development. As part of the in situ development program, land consolidation and organised farming will be promoted. As Malaysia is traditionally crop-oriented, it is envisaged that future strategy for goat development should be formulated to coexist simultaneously within the cropping system.

Target Farming Clientele

Two subsectors are recognised:

1. Small farm subsector From a socioeconomic point of view, failure to develop or improve this subsector will hinder poverty eradication as a considerable proportion of the population who earn their
livelihood in this subsector are below the poverty line. Moreover, goat keeping by this subsector even in small numbers will help to increase overall population of goats to meet sufficiency level targets, considering a large number of farmers fall in this category.

2. Land schemes and estates subsector Research and development programs for increasing productivity should be directed at this subsector (especially for the land schemes) since land, labour and to a certain extent financial resources are not limiting factors subservient to goat development.

Methodology for Improvement

1. Small farm subsector Several alternatives are available for goat development. The first alternative is to run goats as an integral part of the overall farming system. Since land is a constraint within this subsector, maximising productive potential from a given piece of land appears to hold merit for the small farmers since they almost always are multiproduct oriented. Such diversity will ensure that they will not be as vulnerable in the event of fluctuations in prices should they depend on one single commodity. Several reports have been written on the role of goats in various crop-based farming systems. Its potential in single cropped rainfed rice areas (Wong et al. 1979), in coconut-based systems (Sharif et al. 1979), in orchard-based systems (Ooi et al. 1979) have been speculated. While this may be so, research is needed to determine the overall economic significance and suitability of goats under such a system.

Another alternative is cooperative farming. Organised farming through existing cooperatives can go a long way towards solving some of the problems, especially concerning land, faced by goat farmers. With the organisation of production units into an aggregation of farmers under a cooperative, the absorption of modern goat farming methods and to a certain degree organised processing and marketing of farm products can be practised. Organisation in such a manner, if the system is right, will help in improving methods of goat keeping and the overall livelihood of the farmer.

Communal grazing grounds can be put to good use. Several examples have been found in Malaysia where this system was seen to work. However, the most important point is the location of the grazing area. With proper guidance from relevant authorities, farmers can be better arranged and organised in their outlook to goat keeping. Sheds built by individual participating farmers can be located around the fringes of the reserved land.

Utilisation of bris and tin tailing soils could expand the area under pasture. At present there are about 155 000 ha of bris soils and 122 000 ha of tin tailing soils (Kho et al. 1979). Generally, agricultural activities on these soils are low. Therefore, competition for land for alternative purposes is not great. Research has shown that six promising grasses can be grown on bris with dry matter yields ranging from 5.3 to 17.1 t/ha (Wong et al. 1983, in press). Research should be conducted to determine the feasibility of utilisation of these soils for goat farming.

2. The land schemes and estate subsector Integration under tree crops has great potential to increase goat production within the country. With large plantings of cocoa, coconuts, oil palm and rubber available there is a need to look into the possibility of integrating goats under these plantation crops. Out of these four perennial crops oil palm and rubber hold the greatest promise for enhancing overall goat productivity. Early studies have shown that goats can be integrated under oil palm and rubber successfully (Abdul Wahid 1981; Tan et al. 1981) but more detailed studies need to be done to determine their overall and total feasibility. It is estimated that 25 to 35% of the country’s requirements for goat meat and mutton projected for 1990 can be met if intensive integration is conducted under these two major crops (Mahyuddin and Hutagalung 1978). Further, the overall livestock policy stresses that future strategy for increasing productivity of goats and sheep is via integration, especially under these two crops.

Several studies have been done to estimate feed availability under these crops. Under oil palm between 18-24 months of age, estimated dry matter availability ranged from 6 to 10 ha (Chen and Othman 1983). Dry matter availability, however, was inversely related to the age of the palm. Studies have also been conducted to determine suitability of various ruminants under these crops. Most are of the opinion that ruminants, in general, can be reared without supplementation. Performance improved when supplementation with agricultural by-products was introduced (Jalaludin 1978; Wan Mohamed 1978; Abdullah and Basery 1982). However, evidence is still lacking on detailed studies on feed types, nutrition, reproduction and overall management of ruminants in this manner.

Studies on the feasibility aspects, although not definitive as yet, may shed some light on the possible operations that can be realised for increasing goat productivity. These suggested operations seem more practical under rubber and especially oil palm holdings. The latter is more appropriate because by-products from its processing industry such as palm kernel cake, palm pressed fibre and palm oil sludge are reliable sources of feed whether fed singly or in combination.
Table 6. Conceptual outlook for goat development.

<table>
<thead>
<tr>
<th>Nature of farm</th>
<th>Input type</th>
<th>Breeding structure</th>
<th>Production system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>High</td>
<td>Elite herd</td>
<td>Monocrop</td>
</tr>
<tr>
<td>Land scheme and estate sub-</td>
<td>Medium</td>
<td>Intermediate herd</td>
<td>Integration under tree crops with specialised operations</td>
</tr>
<tr>
<td>sector</td>
<td></td>
<td></td>
<td>Farming system</td>
</tr>
<tr>
<td>Small farm sub-sector</td>
<td>Low</td>
<td>Commercial herd</td>
<td>Farming cooperatives</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Communal grazing grounds</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Farming cooperatives</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Bris and tailing soils</td>
</tr>
</tbody>
</table>

The rationale in establishing fattening operations under both oil palm and rubber stems from the fact that both palm oil mill effluent and effluent from rubber factories can be used as sources of fertiliser (Tan and Pillai 1975; Kanapathy et al. 1981). Already both are used in varying degrees for fertilisation of original crops. Thus, should the need arise, improved pasture can be grown to feed goats kept for this specific function.

It cannot be overemphasised that while these facets of improving goat productivity under tree crops show great potential, nevertheless, intensive research efforts are necessary before speculation becomes reality. Besides evolving alternative ways for goat keeping, the next single problem that needs to be resolved is breed improvement. Subsequent to that, the genetic improvement strategy for goats could be further enhanced should a systematic approach of improvement through a three-tier system be adopted. While location of the nucleus or elite herd should be placed on a government-controlled farm for easy collection, evaluation and dissemination of optimum genotypes, it is suggested that intermediate farms be chosen at strategic locations all over the country within the confines of the land schemes and estate subsector. In this way supply of improved animals to various interested goat farmers, notably from the small farm subsector, can be easily catered for. Close scrutiny of animal outflow from the elite herd to the lower structured herds and inflow from the other direction will ensure that enough good quality animals are available for selection and subsequent breeding. The conceptual strategy for goat development as discussed is summarised in Table 6.

**Monitoring and Coordination**

To ensure the successful implementation of a program of the magnitude mentioned, careful and stringent coordination and monitoring is of paramount importance. Careful consideration should be given to record keeping, and computerisation facilities should be made available. Close cooperation and coordination between various agencies is essential for successfully implementing such a project.

**Marketing**

The final link in the chain is to ensure that products so produced will be accorded healthy competitive prices. This is essential to ensure continuous incentive and motivation and to keep the industry dynamic and organised.

**Conclusion**

Agricultural development within Malaysia must run according to the government's prescribed objectives. The agricultural sector at present and in the decade to come will continually be dependent on Malaysia's natural resources and tree crop earnings as this has been well established and firmly occupies a predominant position in international and world export markets.

While this may be so, in the continued effort to reduce dependence on imports for meat requirements, efforts must be made to intensify livestock production within the country. In this context, possibilities for increased goat production for meeting target productivity levels must assume new significance. Bearing in mind the competitiveness of land utilisation, the problem must be approached from the concept of evolving stratified levels of production units, those that are commercially viable as opposed to the smallholder type of production.

Research is needed to formulate a system that embraces both levels of production, the technological inputs that are required, the management technique, etc., to ensure successful running of such a scheme. And such success can only be achieved through a coordinated effort of research and implementation.

**References**


Goats in Philippine agriculture have generated considerable interest as a potentially profitable component of one-commodity and multi-commodity farming systems. The government, through the Bureau of Animal Husbandry, has investigated small ruminant development as a source of meat and milk, a livelihood activity, and a possible export potential and dollar earner. The goat, a small ruminant with a high reproductive rate and many uses, finds its place best in the present farming systems of the smallholder (1–3 ha) economy in the Philippines.

The goat development program of the country serves to complement the beef and carabao program of the government by reducing further the reduction of the cattle and carabao breeder bases, which are dually important in the production of draft animal power and as a source of meat and milk.

With the increased interest and enthusiasm in goats among the different farming levels of the country, the commodity may yet be the suitable livestock program for the majority of Filipinos, primarily the smallholder, the landless, and the seasonal/marginal farmers.

Status of Goat Production

The Bureau of Animal Husbandry (BAI)/Bureau of Agricultural Economics (BAECON) livestock survey 1981, shows that the Philippines has a total goat population of 1.696 million or 0.339 million animal units (1 goat = 1 A.U.), which is about 6.7% of the 5.043 million animal units of ruminants (1 cattle = 1 A.U.; 1 carabao = 1 A.U.). An estimated 99% of the goat population is in the hands of smallholders with an average flock size of 3–5 head. In a livestock production survey in the province of Zamboanga del Sur, which has 4% of the total goat population of the country, the results show that 14% of the province’s farmers (lowland and upland) own goats. These statistics indicate a potential to expand the goat program.

Goat population in the different regions ranges from 2% to 18.4% of the total number. The percentage of population for the three main islands is as follows:

- Luzon 34.2%
- Visayas 33.4%
- Mindanao 32.4%

These show a distribution suitable for a nationwide development program for goats.

Breeds

Except for some upgrades and purebreds, the majority of the goat population in the country is of the Philippine native breed. The local goats were probably introduced from mainland Asia. Chinese traders and Arab traders could have introduced some exotic breeds 600 years ago. Devendra and Burns (1970) drew attention to the similarity between the China goat and the ‘Kambing Kacang’ or native goats of Malaya, Indonesia, and the Philippines. Similarly Spanish and American colonisers could have brought in a number of different exotic breeds in the 19th century. From 1906 to 1983, the country made a series of imports from Malta, Spain, Mexico, India, USA, Australia, and New Zealand. Predominant in these breeds were Nubian, Saanen, Toggenberg, Alpine, Jamnapari and Black Indian.

The effect of earlier importations in the upgrading of the local stock cannot be clearly evaluated.

There are considerable variations within the native goat population that indicate a possible upgrading at various levels by the introduced exotic breeds.

The average mature body weight of the Philippine native goat ranges from 15–30 kg (Valdez 1983; PCARR 1977; PADAP 1978). Colour markings vary from white, black, red, brown, or a combination of these colours.

Farmers raise the animal mainly for meat and rarely for milk. Milk production has been recorded with an average of 0.30 litres/day for a 120-day period (Gerona and Posas 1982). Weight gain performance of the native goat on pure grazing indigenous grasses averaged 10.33 g/day while on improved grasses/pasture the average is 6–9 g/day (Posas and Gerona 1981; Gerona and Posas 1982). These indicate that goats show a better weight gain on indigenous pasture than on improved pasture, which could be attributable to the variety of pasture species in the indigenous pasture. Grazing with supplementation of molasses plus urea and concentrate at different treatments showed an increase in weight gain ranging from 24.95 g to 53

* Philippine ASEAN Goat and Sheep Center, Bureau of Animal Industry, Philippines.
g/day (Gerona and Posas 1982). Native goats on improved pasture supplemented with 50% corn bran and 50% growing ration with 18% crude protein (CP) showed an average daily weight gain of 49.3 g/day (Bautista and Vaughan 1981). The findings compared to performances of upgrades and crossbreds indicate a need to genetically improve the native stock in terms of meat and milk yield. A comparison of meat and milk production of the native goat with crossbred and purebred goats is shown in Tables 1 and 2, respectively. Comparative growth and reproductive rates of the native with some breeds at Bagalupa Stock Farm, Zamboanga del Sur, Philippines, are shown in Tables 3 and 4.

Table 1. Growth response of native goats under different feeding systems.

<table>
<thead>
<tr>
<th>Feed Description</th>
<th>Average daily gain (g)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% improved grasses + 30% concentrate (19% CP) based on 5% BW DM intake</td>
<td>53</td>
<td>Tan 1981</td>
</tr>
<tr>
<td>Grazing indigenous grasses</td>
<td>10.33</td>
<td>Gerona and Posas 1982</td>
</tr>
<tr>
<td>Grazing (indigenous grasses) + pure molasses (ad lib)</td>
<td>24.95</td>
<td>Gerona and Posas 1982</td>
</tr>
<tr>
<td>Grazing (indigenous grasses) + 20:1 molasses: urea (ad lib)</td>
<td>37.98</td>
<td>Gerona and Posas 1982</td>
</tr>
<tr>
<td>Grazing (indigenous grasses) + 10:1 molasses: urea (ad lib)</td>
<td>40.81</td>
<td>Gerona and Posas 1982</td>
</tr>
<tr>
<td>Grazing (improved grasses) at stocking rates of 20, 40 and 60 head/ha</td>
<td>9.0</td>
<td>Posas and Gerona 1981</td>
</tr>
<tr>
<td>Grazing (improved grasses) at stocking rates of 20, 40 and 60 head/ha</td>
<td>6.0</td>
<td>Posas and Gerona 1981</td>
</tr>
</tbody>
</table>

Table 2. Milk yield (kg) of does (2% milking for 120 days), VISCA, 1982.

<table>
<thead>
<tr>
<th>Breed</th>
<th>No. of Animals</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>High yielder</td>
<td>2</td>
<td>47</td>
</tr>
<tr>
<td>Breed average</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Saanen</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Toggenburg</td>
<td>3</td>
<td>38</td>
</tr>
<tr>
<td>Alpine</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td>Herd average</td>
<td>12</td>
<td>35</td>
</tr>
<tr>
<td>Native</td>
<td>1</td>
<td>9</td>
</tr>
</tbody>
</table>

Economic Significance

The goat is considered a vital livelihood component among the smallholder and the landless/marginal farmers in the Philippines. Economic and social benefits are also attached to the animal. A survey in Zamboanga del Sur, Philippines, suggested that there are a number of benefits that motivate small-scale farmers to own and rear goats. Foremost is its purpose to provide food and financial assistance in the form of a saleable asset. Unpaid family labour in raising the animals and the practice of sharing the offspring serves to strengthen the total farm enterprise. Goat ownership is also vested with social status.

It has been shown that profitability of goats in upland agriculture was similar to that obtained from cropping enterprises with the usual farm practices (Hitchcock 1983). A budgetary analysis is demonstrated in the following comparison of returns and labour inputs for three cropping systems and a goat enterprise in Zamboanga del Sur, Philippines:

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Net receipts Pesos/ha</th>
<th>Working days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Corn-corncorn</td>
<td>254</td>
<td>23</td>
</tr>
<tr>
<td>Upland Rice-mungbean</td>
<td>492</td>
<td>44</td>
</tr>
<tr>
<td>Upland Rice-soybean</td>
<td>815</td>
<td>43</td>
</tr>
<tr>
<td>Goat enterprise</td>
<td>644</td>
<td>40</td>
</tr>
</tbody>
</table>

The above figures are net receipts, i.e. gross receipts minus cash costs including labour cost.

These figures are being further evaluated under the Goat Key Farmer Cooperator concept of PADAP-ZDSDP with the objective of reducing the initial capital outlay and the training of farmers and farm technicians. More important in terms of economic significance at the farmer level is the integration of the goat as a component in the different farming systems primarily in smallholders' crop-based, freshwater-aquaculture-based, tree farming, and complementary livestock farming systems. The integration of goats into the different farm systems would maximise the utilisation of farm products and by-products, which would otherwise go to waste.

The significance of the goat can be further evolved with the landless/marginal farmers who could utilise roadside and marginal/idle lands effectively.

Management System

The traditional tethering practice is still predominant in the different parts of the country. Some raisers just leave the goat to graze freely on indigenous pasture
Table 3. Growth rates of some breeds of goats at Bagalupa Stock Farm. (Bautista and Vaughan, 1981).

<table>
<thead>
<tr>
<th>Breed Age</th>
<th>No.</th>
<th>Period when measured</th>
<th>Initial wt (± S.D.) kg</th>
<th>Final wt (± S.D.) kg</th>
<th>Growth rate (g/day) (± S.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anglo-Nubian kids</td>
<td>4</td>
<td>June-August 1981</td>
<td>7.5 ± 0.4</td>
<td>11.3 ± 0.9</td>
<td>63.3 ± 12.8</td>
</tr>
<tr>
<td>2. Anglo-Nubian goatlings</td>
<td>7</td>
<td>June-August 1981</td>
<td>13.0 ± 4.2</td>
<td>17.6 ± 0.5</td>
<td>79.3 ± 19.8</td>
</tr>
<tr>
<td>3. Anglo-Nubian × native kids</td>
<td>2</td>
<td>June-August 1981</td>
<td>3.8 ± 0.4</td>
<td>5.5 ± 1.4</td>
<td>58.3 ± 35.4</td>
</tr>
<tr>
<td>4. Anglo-Nubian × native goatlings</td>
<td>8</td>
<td>June-August 1981</td>
<td>9.6 ± 3.4</td>
<td>12.6 ± 2.8</td>
<td>84.8 ± 17.1</td>
</tr>
<tr>
<td>5. Anglo-Nubian × native young does</td>
<td>9</td>
<td>May-August 1981</td>
<td>22.9 ± 3.5</td>
<td>27.3 ± 4.2</td>
<td>48.8 ± 17.1</td>
</tr>
<tr>
<td>6. 1/4 Anglo-Nubian × 1/4 Saanen × 1/2 native goatlings</td>
<td>3</td>
<td>July-August 1981</td>
<td>11.8 ± 2.8</td>
<td>13.2 ± 2.9</td>
<td>44.4 ± 9.6</td>
</tr>
<tr>
<td>7. Native young does</td>
<td>42</td>
<td>May-August 1981</td>
<td>18.1 ± 3.7</td>
<td>22.4 ± 5.1</td>
<td>49.3 ± 30.3</td>
</tr>
</tbody>
</table>

Table 4. Interkidding interval of some breeds of goats at Bagalupa Stock Farm (Bautista and Vaughan, 1981).

<table>
<thead>
<tr>
<th>Breed</th>
<th>No.</th>
<th>Interkidding interval (± S.D.) in days</th>
<th>No. of kids/ kidding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-Nubian</td>
<td>6</td>
<td>231 ± 28</td>
<td>1.33</td>
</tr>
<tr>
<td>Saanen</td>
<td>3</td>
<td>275 ± 31</td>
<td>1.0</td>
</tr>
<tr>
<td>Native</td>
<td>18</td>
<td>292 ± 69</td>
<td>1.19</td>
</tr>
</tbody>
</table>

Marketing

Marketing of goats is done by traders and middlemen but a number of transactions find their way into the livestock auction markets of which there are now almost 100 in different parts of the country. Consumption centres are still the urban areas. The price of goats for slaughter depends on size, appearance, and condition of the animal. Farm gate prices (BAECON 1981) ranged from 3.51 pesos (US$0.25) to 7.45 (US$0.53) with an average of 5.31 (US$0.38)/kg liveweight. In Metro-Manila, the price is 6.63 (US$0.47)/kg liveweight. The prevailing market price is 16.00 (US$1.14)/kg carcass.

Aside from the seasonal demand for goats, i.e. fiestas, Islamic religious rites, parties, etc., goat meat (chevon) is gaining general acceptance as a regular menu in restaurants and specialised eateries that serve delicacies of goat meat and entrails.

Recorded goat slaughter in 1982 was 89,653 head. It is assumed that a greater number is slaughtered in the different households.

Breeder goat prices, crossbreds from selected native breeds to purebreds range from P150.00 (US$10.71) to as high as P4000.00 (US$285.71).

Milk production at present is confined to commercial, semi-commercial, and government farms with a few of the smallholders engaged in dairying. Milk is either consumed as fresh milk or is processed into milk products by commercial establishments. The average market price of fresh pasteurised goat's milk is P8.75 (US$0.63) per litre (Valdez 1983).

Limitations to Goat Production

Sociological Constraints

Cultural constraints and traditional beliefs, i.e. the goat contributes to land desertification, destroys plants, compacts the soil, etc., need enlightenment. The sociological and cultural implications of goat development should also be examined so that there shall be no dislocation of either cultural, traditional or sociological development.

Nutrition and Feeding

There is limited information on the nutritional requirements of native, upgrade, and purebred goats in the country. Similarly, there is a lack of information on the feeding materials, feeding behaviour, and grazing habits of goats.

Genetics and Breeding

The Upgrading/Genetic Improvement Program using exotic breeds should be carefully evaluated for reproductive efficiency and the degree of upgrading into the local genetic bloodline. Importation of purebreds is limited by quarantine restrictions due to exotic diseases.
Marketing

Goat production thrust must be coupled with a marketing program. Lack of market infrastructures, market information, market facilities and product processing establishments serves to stall efforts on production.

Management and Husbandry

There is inadequate data on the most profitable economies of scale from the smallholder to the highly commercial operation. Similarly, different management levels of production from grazing to pure confinement need further evaluation.

Research

Research studies are limited, particularly in the applied field. The lack of a unified and active national goat research program is considered to be a restraining factor.

Health

Health problems have become a major impediment to goat production. Mortality rates in confined and semi-confined rearing reached a high level of 40% (PADAP 1981). Mortality rate is similarly high in smallholder goat production. Identified predominant diseases are internal/external parasitism, pneumonia, blood parasitism, and haemorrhagic septicemia.

Production Economics and Smallholder Credit

Technologies generated on goat production must be translated into the economics of the small-scale farmer considering his farming system and financial capabilities. Unless this is researched, it serves to slow down the adoption of generated technology by the smallholder. Credit facilities are also lacking for the commodity.

Training and Adoption Rate of Successful Packages

There are inadequate technology packages that could be cycled to the training and extension programs.

Lack of trained technicians and extension delivery systems also adversely affect the industry.

Present Research

Research into different aspects of the goat industry is being currently undertaken by the government and the private sector.

Research in the government sector is inclined towards smallholder producers. Current research activities are in the fields of reproduction and breeding, nutrition, management, artificial insemination, product and by-product utilisation, animal health, general husbandry in the different regions of the country, milk/meat production, the extension and training system, and other related aspects of goat development.

The commercial sector is more concerned with milk/meat production, breeds and breeding, animal health, and processing in intensive and extensive management.

There is a strong need to link research with extension work and smallholder enterprises.

Research Directions

Future research will work on the integration of the goat commodity as a component of the different smallholder farming systems.

Research on the dairying aspects of the goat in the rural setting must be expanded.

The potential of the goat in complementary livestock rearing systems whether it be in pasture or confinement, i.e. cattle-goat-sheep, goat-poultry, etc. must be explored.

Integration of goats into tree crops and plantation crops, i.e. coconut, orchard, etc. must likewise be considered.

Lastly, research activities must also include goat products and by-product utilisation and processing, i.e. meat preservation, cottage dairying, tanning, manure composting, etc.

Goat Programs

Commodity Loan or Dispersal

This is a regular program and it involves selection and screening of interested village farmers having feed resources, housing, and the labor needed for goat production. One to three female goats are loaned to the farmer after completion of training. The farmer is obligated to give two head of offspring to the government after which the original animal becomes his property. Pockets of 10-30 head of does usually go to a village (barangay).

Supporting the dispersal program is the Barangay Buck Loan Scheme (Upgrading Scheme) whereby a grade/purebred buck is loaned for 3-12 months. The barangay is obliged to pay 10% of the book value as rental and surety bond. In the PADAP scheme, the buck loan is for a period of 3 months, with a condition of renewal. A minimal fee is charged for maintaining the buck, and for the caretaker.

Village Goat Program

The Kambingang Barangay, a supervised credit program designed to promote goat production on a
small farmer level, was started in December 1979. Records of 1982 show a total credit amount of 15 million pesos with a high repayment rate.

The program is a package scheme through the rural banking system in the countryside with support services for animal health, pasture development, training, and other technical needs.

Kilusan Kabuhayan at Kaunlaran (KKK)

The potential of goats in human settlement development projects has led to the establishment of a National Goat Farm. This will serve the needs of human settlement areas and KKK project proponents in the provinces.

The Philippine ASEAN Goat and Sheep Center (PAGSC)

The Center was first proposed by the Philippine Bureau of Animal Industry in 1979, and the Center project commenced in May 1982. It is situated north of Pagadian City on the island of Mindanao in the Southern Philippines. The Center's activities include programs of production, research, training, extension, and marketing.

The project was considered at the Fourth Meeting of ASEAN-COFAF Coordinating Group on Livestock held in April, 1982.

The meeting considered the Philippines' proposal to establish an ASEAN Goat and Sheep Center and requested the Philippines to expand the proposal into an ASEAN Goat and Sheep Program with the ASEAN Goat and Sheep Center as a component of the program. The meeting also agreed that member countries submit their requirements to the Philippines to enable the Philippines to prepare a coordinated paper for presentation at the next meeting.

Singapore and Thailand responded and their requirements were incorporated in a proposal titled 'ASEAN Goat and Sheep Development Program', which was prepared by the Philippine Bureau of Animal Industry in January, 1983. This proposal included PAGSC as a component of the total program.

PAGSC Objectives

A. Long-Range Objectives are:

1. to advance the technology used in goat and sheep production;
2. to establish a training center for goat and sheep production;
3. to establish a stud for upgrading local stock;
4. to conduct educational programs on goat and sheep production technology and marketing.

B. Short-Term Objectives are:

1. to establish a viable goat industry and possibly sheep among ASEAN countries;
2. to increase the supply of chevon, mutton and milk, thus improving the nutrition of the people in the ASEAN countries.

In general, the objectives of the Center incorporate five functions, viz. research; training; extension; production; marketing and financing.

Current Projects

Goat and Sheep Production. The activities on goat and sheep production are directed to crossbreeding trials with consideration to meat and milk production, reproduction capacities, adaptation to local pasture and feeding conditions, disease resistance, and other factors necessary to develop a goat and sheep industry.

The production program also aims to establish a pool of breeding goats and sheep for both upgrading and conservation of indigenous germplasm.

Training

Training of marginal or subsistence farmers, key farmer cooperators, livestock technicians, commercial ranch-type operators, animal researchers, training and extension personnel from the Philippines and other ASEAN countries are all proposed at the Center. Training and observation tours are likewise included in the training program.

A total of nine training sessions, involving technicians and farmers have been jointly conducted at the Center.

Research

Research activity is divided into seven sub-projects, viz. nutrition/pasture; management and husbandry; disease; crossbreeding; conservation of genetic resources; economic analyses, marketing and credit research; monitoring and adoption rate of successful packages.

At present, the center is conducting the following nine trials:

Project 1: Pasture and browse museum, aimed to test the suitability of various forage species for production in the humid tropics; to evaluate the growth, seed availability, and degree of disease and insect resistance of forage species; to collect and preserve or provide cuttings or seed for further research or extension activities.

Project 2: Signal Grass/Centro goat grazing trial, in which productivity and response of Signal Grass/Centro is being tested.

Project 3: Pasture yield trial (Signal Grass/Centro and Hamil Grass/Kudzu/Centro at the Bagalupa Stock Farm), in which pasture yield is being measured at 5-weekly intervals throughout the year. This pasture cutting trial is designed to establish the number of goats that should be grazed for management purposes.

Project 4: Pasture yield comparison of leaf stem and flowerhead of: (1) Local Napier; (2) Sweeney

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Project 4: Pasture yield comparison of leaf stem and flowerhead of: (1) Local Napier; (2) Sweeney
Napier; (3) Splendida; (4) Hamil grass. The project aims to compare three high-yielding tall tussock grasses with oven-dry yield of the standard Hamil grass, following the introduction of an improved Napier grass and Setaria splendida from North Queensland in 1980. In the pasture museum both grasses appear to produce more leaf than Hamil grass or local Napier grass, which rapidly runs to flower.

Project 5: Goat and sheep internal parasite control, a trial to compare response and parasite infection in monthly and strategic drenching regimes.

Project 6: Cut-and-carry feeding trial, designed to measure annual productivity by weight response to various cut-and-carry feeding regimes.

Project 7: Andesite steep hillside pasture establishment. Observations of pasture establishment problems on unfertilised steep andesite, ridge and valley land forms.

Project 8: Establishment of Ipil-Ipil in poorer metamorphically derived and heavily leached old alluvial soils. Attempts to establish Ipil-Ipil at the Bagalupa Stock Farm using either transplanted seedlings, bare root or direct seeding have generally been unsuccessful. This project aims to determine rhizobial and nutrient requirement for establishment of Ipil-Ipil at the stock farm.

Project 9: Time of kidding and lambing trial, designed to determine optional kidding and lambing and/or double kidding or lambing times for a humid tropical region.

There are also some research activities on by-product utilisation. The partial results on the utilisation of goat manure for fish (Tilapia) show that it is comparable to inorganic fertiliser. Likewise yield trials on rice using goat manure and minimum inorganic fertiliser showed rice yield to be comparable with that obtained from applying pure inorganic fertiliser.

Further trials are being undertaken on the utilisation of goat manure for rice by deep placement and pure manuring as fertiliser. Similarly, goat manure application trials on different levels of Tilapia ponds are being undertaken.

Extension

The extension system of the Center shall be through the Key Barangay Livestock Resource Cooperative (KBLRC). The KBLRC shall be the working module of the Center to evolve a system of technology packages to reach most of the small-scale farmers in the least time at the least cost.

Marketing

Proposed marketing/finance studies are still being evaluated. Special subprojects are:

1. Integrated farming systems
   This activity aims to integrate goat/sheep raising in the present farming system, evaluating, (1) the livestock-crop system; (2) the livestock-aquaculture system; (3) the livestock-crop-aquaculture system.
2. Sloping agricultural land technology.
3. Food gardens.
4. Veterinary herbal gardens.
5. Barangay program modules.

Future Direction of PAGSC

1. Expand activities on testing goat and sheep purebreds and crosses in terms of meat and milk yield.
2. Intensify collection of indigenous goat breeds on the basis of colour, kidding rate, size, interkidding interval, meat/milk yield.
3. Procurement of additional sheep stocks and conducting trials on their viability at barangay level.
4. Packaging goat and sheep technology applicable to lowland and upland farming systems.
5. Link activities of the Center with other institutions in the country and among similar establishments in ASEAN member countries and international organisations/establishments.

Acknowledgements

Acknowledgement is due to the Project Management Committee, Bureau of Animal Industry, Manila, of the Philippine ASEAN Goat and Sheep Center for their support and approval of the paper.

Special thanks are extended to Mr Fabian Sweeney and Mr David Hitchcock for their worthy contributions and suggestions, and also to Mr Francis L. Bagundol and Ms Maxima Aranzo for the typing work.

Lastly, thanks are due to those who in one way or another made this manuscript possible.

References


Additional Reading


Goat Research and Development in Thailand
Siriwat Sarabol*

THAILAND is a predominantly agricultural country. Its total land area is 514,000 km² with about 40% under cultivation. The climate is tropical and monsoonal with three distinct seasons: a rainy season from May to mid-October, a cool dry season from mid-October to mid-February, and a warm season from mid-February to April. The average annual rainfall ranges from 1000 to 3000 mm. The population of Thailand is approximately 50 million.

The country is composed of four geographical parts: the mountainous north, the rolling northeast, the flat plain of the central and the isthmus of the south. It is divided according to administration into 73 provinces. Of the total population, 70% live in the rural areas where there are about 4.5 million farm households. The rural population is the backbone of the agrarian economy of the country. In 1980, agriculture contributed about 26% of gross domestic product (GDP), 58% of exports, and provided employment for 70% of country's labour force. The livestock subsector accounted for about 3% of total GDP, or 12% of agricultural GDP, and represented only about 1% of Thailand's total exports or 10% of agricultural exports.

Table 1. Number of goats and number of holdings, 1978.

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of goats (head)</th>
<th>Number of holdings (households)</th>
<th>Average per holding (head)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>4927</td>
<td>972</td>
<td>5.1</td>
</tr>
<tr>
<td>Northeast</td>
<td>1504</td>
<td>475</td>
<td>3.2</td>
</tr>
<tr>
<td>Central</td>
<td>4053</td>
<td>209</td>
<td>19.4</td>
</tr>
<tr>
<td>South</td>
<td>73,909</td>
<td>23,364</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Goat Population

Livestock production is an integral part of most of Thailand's smallholder-oriented agricultural sector. Buffalo, cattle, swine, goat, sheep, and poultry are kept by small-scale farmers. Goats have traditionally been raised by the Thai Muslims especially in the southern part and by the hill tribe people in the northern part of Thailand for several decades. Goat production is not commonly practiced in the typical smallholder farming system. The number of goats and number of holdings are presented in Table 1.

Characteristics of the Thai Indigenous Goat

Thailand's indigenous goat is a small-sized goat. Birth weight of kids is about 2 kg and bucks and does weigh 30–35 kg and 20–25 kg, respectively. Height measurements are 55–60 cm for bucks and 50–55 cm for does. They possess a straight bridge from eyes to nose on the head with small and erect ears. The colour pattern varies greatly, ranging from black to brown and white and sometimes there are several colours and shades or spots on the same animal. There appears to be no seasonal breeding for Thai native goats since kidding can occur at any time during the year. The average daily milk yield is about 300–700 g in the lactation period of 160–200 days. The rate of growth from birth to 2 months ranges from 70 to 20 g/day.

Village Management

Goat keeping has predominantly been practiced in the lower south of Thailand although goat raising is being dispersed throughout other parts of the country. There is an indication that goat rearing has traditionally existed in communities in which Islam is a dominant religion. About 95% of the goat population in the southern part of the country is being kept by the Thai Muslims with most of the holdings carrying 2–5 goats. They allow the goats to run freely and to shelter underneath the house, in rice grain storage bins and other non-utilised housing. The goats have to fend for themselves for feed, water and other activities such as mating, kidding, rearing kids, etc. Numerous goat keepers employ tethering systems by occasionally moving the goats to an area where a feed supply can be found. Herding is practiced by individuals who own more than 10 goats, for whom housing is built. The owner will drive out the goats in the morning to natural grasses in coconut plantations, oil palm plantations and other available feed sources and herd them back to the goat house in late afternoon. Some raisers save their time by training the herd buck to lead home all their goats.

* Department of Livestock Development, Bangkok, Thailand.
Information concerning diseases and parasites of goat in Thailand is very limited. Goats are susceptible to foot and mouth disease. Vaccinations against anthrax, haemorrhagic septicaemia and foot and mouth disease have been carried out by government agencies in order to eradicate these contagious diseases. Melioidosis was reported in a herd of Anglo-Nubian goats in southern Thailand. Screwworm (Calliphoridae) was found to be a problem in villages of hill tribes in the highlands of north Thailand, with few other diseases being evident.

Credits and Marketing

There is no information available on goat production credits. Village goat raising is supported by the government to some extent in the form of a buck loan program for the improvement of production. Goat husbandry in subsistence farming could provide additional protein and an important source of supplemental income. Sales occasionally occur when prospective buyers come to visit villages and ask to purchase goats. Marketing research on goats has not been conducted in Thailand although there are large numbers of Muslims who prefer goat meat. There is also some demand for goat meat from hotels and Muslim restaurants in Bangkok in order to supply Muslim tourists from the Middle East countries. Moreover, some Chinese restaurants serve a special recipe of goat meat for upper class people.

An unofficial survey on marketing was recently conducted in southern Thailand. A monthly demand for 1000 goats, both bucks and does, at a price of US$25–30 was reported. The goats were transported to the Bangkok market and some were illegally exported.

Research and Development

Goats have been raised in Thailand as backyard animals for years. It is possible that because of the small population and the view that it is an uneconomic animal compared to other kinds of animals, there has been little interest in goat research. Milch goats were introduced into Thailand in 1950 in order to study milk production of purebred goats and their crossbreds. Few studies have reported information on the growth, physiology, carcass and milk yield of goats from various sources.

Thai farmers are crop-oriented subsistence farmers with low levels of income and because of a lack of nutritional education, malnutrition, especially protein deficiency, continues to be a health problem. In 1977 the Department of Livestock Development and the Prince of Songkla University launched a program of buck loans in order to improve village goat production in southern Thailand. This effort is aimed at the smallholders to improve the supply of family needs for meat and milk. The Department of Livestock Development commenced collecting basic information about 3 years ago by establishing a small herd of indigenous goats at the Pattani Livestock Breeding Center in the south. The Department is going to introduce some Saanen goats from Australia in order to obtain information on the potential for improving goat meat and milk production.

Since information on goats is limited, more research needs to be done in the future for the development of goat production, especially in the south. The following fields of investigation are suggested for immediate attention and support:
1. Observations and studies on the pattern of village goat production in order to identify biological, cultural, and economic problems.
2. Studies on goat prices, consumption, and marketing.
3. Investigation and identification of forages and pasture suitable for village management practices.
4. Nutritional studies on locally available feed resources.
5. Investigations on reproductive efficiency including the relevance of A.I. and fertility studies as a means of improvement.
6. Study on the prevention and control of diseases and parasites of goats.
7. Experimentation with imported milch goats and their crossbred progeny to determine their genetic adaptability to local environments in the production of meat and milk.
Goat Development in Southern Thailand

Sujin Jinahyon*

Goats are of great importance in southern Thailand particularly in the Muslim areas of the border regions. For this reason an investigation into their potential as both a source of meat and milk was initiated by the Faculty of Natural Resources (FNR) in 1977. This preliminary and largely qualitative investigation has provided some information on the types of goats present, viz. a local Kambing Kajang type, and various crossbreds with Anglo-Nubian, Toggenburg, and Saanen infusions. As has been reported in Indonesia, Fiji, and Malaysia, the introduction of larger breeds of goats has increased the size (and meat production) of local goats, and it was concluded from this data that crossbreeding would substantially increase goat productivity in this region.

At this point it was decided to consult a wider spectrum of opinion as to how to proceed and a workshop on goats was held at the Prince of Songkla University (PSU) in June 1983 with participants from all over Thailand and from Australia (Goat Development Program 1983).

Various aspects of goat production were considered at this workshop including the nutrition, reproductive rate, genotype suitability, disease status, management at the village level, products (milk, meat, leather, organs) and the marketing and cultural restraints to increased production. As a result it was realised that there was a lack of quantitative data on most of these topics, which it is necessary to acquire before any management packages can be developed.

In order to achieve this, the following three point program was developed:

1. Baseline data accumulation at the village level in order to appreciate the position of goats in the different farming systems of southern Thailand and more particularly to assess productivity and the factors that control it.

2. A study of local goats under improved management conditions, i.e. good nutrition, disease control, and reproductive management. As such a study would be impossible under village conditions it was decided that this part of the program would be conducted with a representative flock of local goats on the PSU campus farm. This will enable a detailed study to be made of some of the biological limitations to production such as disease, nutrition, and reproductive activity. At the same time strategies will be developed for circumventing these obstacles.

3. Commence a crossbreeding scheme, since there is a demonstrated need in the villages for larger and more productive goats. This will be initiated on the campus farm using semen from two large exotic breeds with a potential for both meat and milk production. This will enable a quantitative evaluation to be made of any increase in the productivity of the crossbred progeny. Furthermore, after the baseline data have been completed, it will then be possible to introduce in an orderly manner 'improved' crossbred male goats (50% exotic genes) to selected villages and monitor the productivity of their progeny with those of local goats, under village conditions.

The information gathered in this integrated study will provide information on (a) the present levels of productivity of goats in various farming systems in southern Thailand, (b) the restraints to increased productivity, (c) the biological restraints to productivity under improved management conditions and (d) perhaps for the first time, an objective evaluation of the effectiveness of crossbreeding with 'exotic' goat breeds for increasing goat production at the village level. From this data, management packages relevant to the different goat populations (local vs. improved) in the different farming systems will be developed to assist villages to improve both the nutritional and financial status of goat production.

Implementation and Conduct of Program

A team of Thai scientists from different disciplinary areas (PSU) has been committed to this program together with technical and research advisers from the Thai-Australian PSU project resident in Hatyai. The physical facilities and feeds necessary to hold the experimental flock on campus are available from FNR and Thai-Australian PSU project funds. Local does will be purchased and introduced to the campus farm in October, 1984 and joined in March-April 1985. The

* Faculty of Natural Resources, Prince of Songkla University, Thailand.
details of the breeding program have been decided, and some research proposals for disease, nutrition, and reproduction studies are still being developed.

Since the program outlined above and in Appendix A is in various ways beyond the present capacity of FNR staff, there remains an urgent need for additional assistance, particularly at the technical and scientific level to complement the current program. The specific needs for aid are listed below, not necessarily in order of priority:

Baseline Data Collection

This program will be initiated in the near future, and has as its aims collection of biological data relating to animal production in the villages with particular reference to goats. This survey will be designed so that the results can be interpreted in relation to a survey presently undertaken to define broadly the existing farming systems in terms of socioeconomic restraints to production improvement. Assistance is required in the development of questionnaires and with a definition of the types of quantitative data needed to translate perceived limits to production into quantitative comparable data between farming systems. After the data collection stage, assistance will be needed to develop data storage and retrieval systems on the computers available at FNR (Sirius) and to interpret this data for publication.

Nutrition and Management

Little is known about the feeds offered to goats in southern Thailand, and an attempt will be made during the baseline survey to collect this information. There is an urgent need to evaluate the feeds offered to goats in housed systems, and to determine the extent to which feed quantity and quality are limiting production. The possibility of developing improved pastures and browse species for goats is also of interest to the program. Songkla is an area rich in agricultural by-products and their nutritional value for goats needs determination, if their economic value as a supplement is to be assessed.

Grazing management systems, such as under coconuts and oil palm, or in predominantly cropping areas needs further study and expert assistance is required to design and develop such systems in southern Thailand.

It is foreseen that there is immediately a need for expert assistance in the design of feeding and management studies to evaluate the range of potential feeds useful to goats in this area, and to define the nutritional requirements of goats in different physiological stages, in this environment. From these studies, recommendations to improve nutritional management should arise, and be applicable to the farming systems in which goats are kept.

Reproductive Management and Breeding

With the introduction of breeding does to the campus farm, there is an urgent need for advice on techniques and methods used to assess reproductive activity in both males and females so that the normal patterns can be defined for this environment. The breeding program requires the use of frozen semen and artificial techniques to avoid the infertility problems usually associated with the introduction of 'exotic' bucks into this environment.

FNR will fund a staff member skilled in reproductive techniques in cattle to train in Australia with Dr. Barrie Restall (N.S.W. Department of Agriculture, Wollongbar) to learn at first hand, and to develop further, techniques of artificial insemination with goats, semen storage techniques, methods of synchronising oestrus and stimulating ovulation in goats. These techniques will then be further developed and applied at FNR for use in the 1984 joining program. However, there is an urgent need for some basic equipment to support these techniques and the attendance of trained personnel at the first mating exercise. Apart from the technical training, it is believed that much will be learnt about the reproductive rate (potential and realised) of goats in southern Thailand and this information is essential if restraints to increased productivity are to be defined.

Animal Health

It is anticipated that some diseases may be limiting the productivity of goats in southern Thailand, but there is presently little information on types, incidence, or severity of diseases in goats. There is an urgent need for assistance to define the epidemiology of various diseases in goats in this area, develop relevant treatment for cure or prevention of the most important diseases. Expert assistance will be needed by FNR staff to develop the investigative techniques needed for identification of disease at the village level.

Staff Education

A major problem in developing this program is the lack of relevant literature on goat production in southern Thailand. Also, there is an urgent need for staff to attend international conferences, and visit other research institutes in Asia and Australia to discuss production problems and research.

In addition to the help required at the consultant's level from people working on similar problems in
Australia, there is undoubtedly an equal need for contact over longer periods by scientists at the immediate postdoctoral level who would be involved along with their Thai counterparts in the day-to-day implementation of this program. This aspect is just as important as the necessity of Thai-counterpart staff going to Australia to acquire particular techniques or to work on related problems.

From the above program it can be clearly seen that a long-term commitment to goat research has been made by the team at FNR, and that some resources are available for the implementation of the major parts of this program. However, there is also an urgent need for expert advice and financial assistance with various aspects of planning, implementation, and interpretation of this program. For this reason, it is proposed that specific assistance at the scientific and technical level be sought from ACIAR to provide information on the broader management aspects of goat production and aspects of reproductive biology, breeding and nutrition, which are as yet poorly understood by not only Thai scientists but also other scientists studying goat production in other tropical countries. It is also suggested that the dual aims of cultivating research into goat production in Thailand and of improving the income of the poor Thai farmer will be served through such a program.

Summary: Goat Development Program in the Southern Region of Thailand

Research Team: Staff of the Faculty of Natural Resources, Prince of Songkla University, and staff and advisers from the Thai-Australian Prince of Songkla University Project (ADAB funded).

Objectives

To make available to Thai villagers, information and technology that will improve the productivity of goats for meat, milk, and leather in the village system and thereby improve the living standards of poor Thai farmers.

Program

- Identification of present productivity and management restraints operating at the village level (1984-86).
- Introduction of local goats to the improved management system at University campus farm and evaluation of biological restraints to production in this environment (1984-91).
- Use campus flock to breed crossbred goats from introduced exotic goats using artificial insemination with frozen semen. Evaluation of performance of first cross (50%) and second cross (75%) on campus with local goats raised under the same system (1984-91).
- Introduction of first cross and second cross goats to selected villages and evaluation of these introductions with local contemporaries raised under 'traditional' and 'improved' village management systems (1987-93).
- Development and extension of relevant management packages for improved goat production in the villages (1987-93).

References

Goat Development Program in the Southern Region of Thailand 1983. Proceedings of Seminar held at the Prince of Songkla University, Hatyai, Thailand. Sponsored by the Faculty of Natural Resources and the Thai-Australian Prince of Songkla University Project.
IN Indonesian farming systems, goats are an important component especially among small farmers (De Boer et al. 1982). The animals are kept for multiple purposes, as a source of quick income to meet household cash needs, manure, hide production and also as a means to give employment to the farmer's family. The role of goats can be seen also from their contribution to the total meat consumption. Approximately 10% of total meat supply is from sheep and goats. Among the ASEAN countries, out of 7.9 million goats, 77.1% is found in Indonesia, and 79.7% of this population is in Java (Anon. 1979). Two major breeds are found in Indonesia, the Kacang and Ettawah. Crosses between the two breeds represent the largest group in the goat population. Today more foreign breeds have been introduced such as the Saanen.

Table 1. Human, sheep and goat population-density distribution.

<table>
<thead>
<tr>
<th>Regions/island</th>
<th>Area (km²)</th>
<th>Human population/km²</th>
<th>Goat population/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java</td>
<td>129654</td>
<td>716</td>
<td>47.1</td>
</tr>
<tr>
<td>Bali</td>
<td>5561</td>
<td>494</td>
<td>4.2</td>
</tr>
<tr>
<td>Sumatra</td>
<td>473606</td>
<td>59</td>
<td>1.6</td>
</tr>
<tr>
<td>Kalimantan</td>
<td>539460</td>
<td>13</td>
<td>0.1</td>
</tr>
<tr>
<td>Sulawesi</td>
<td>189196</td>
<td>60</td>
<td>1.6</td>
</tr>
<tr>
<td>West Nusa Tenggara</td>
<td>20177</td>
<td>141</td>
<td>4.9</td>
</tr>
<tr>
<td>East Nusa Tenggara</td>
<td>47876</td>
<td>62</td>
<td>4.7</td>
</tr>
<tr>
<td>Maluku</td>
<td>74505</td>
<td>19</td>
<td>1.1</td>
</tr>
<tr>
<td>Irian Jaya</td>
<td>421981</td>
<td>3</td>
<td>na</td>
</tr>
</tbody>
</table>

Source: Anon. (1982).

Table 1 shows the goat population distribution across provinces relative to the human population.

In terms of human population and goat population density, a strong correlation can be noted. This is because goat production structure is highly characterised by traditional small-scale farming activity, low level of investment and input use (Thomas et al. 1982). These phenomena are further explained in Tables 2 and 3. The average production per year per household based on macro data was only US$29.1, with the capital asset value US$74.7. From these data the ratio of capital/production per household was 2.6 or approximately 3% return on capital per year. In terms of rupiah (Rp) currency based on a household survey, income per household per year from goat enterprise was Rp 38 326 (US$39.51) while income per doe was Rp 18 835 (US$19.41) and income per hour of labour was Rp 50 (US$0.05). Compared with crop production, goat enterprises have very low labour productivity. This was Rp 298 for rice and Rp 254 for corn per hour of work (Anon. 1984). The low productivity of goats could be due to the labour intensive production system, low herd size, low kidding rate and low offtake rate (Table 4). The contribution of goats to the farmer's cash need was only 2% (Anon. 1984).

Table 2. Economic status of sheep and goats in 1982.

| Production: | (1) Total production (× 1000 tonne) | 59.0 |
|            | (2) Total value (million US$)      | 121.7|
|            | (3) No. of household (HH)          | 4 180 000 |
|            | (4) Average HH (US$)               | 29.1 |
| Ratio of capital to sheep and goats: | (5) Value of capital asset per HH (US$) | 74.7 |
|            | (6) Ratio of capital/product per HH/5 (US$) | 2.6 |

Source: Sabrani et al. (1983).

These productivity data may vary across the region due to large differences in management practices. The degree of grazing and zero grazing combinations under a certain agro-ecological environment could produce wide differences in productivity. The important point is that the present management systems offer an employment opportunity with a low opportunity cost value.

It is difficult to assess the productivity of goats in Indonesia under these varying management systems,
Table 3. Economic return per year to goat farmers in two Javanese villages based on a household survey.

<table>
<thead>
<tr>
<th>Location</th>
<th>Herd size (head)</th>
<th>Animal unit (AU) per farm</th>
<th>Off-take (AU)</th>
<th>Off-take (%)</th>
<th>Income to HH (Rp)</th>
<th>Income to HH (Rp)</th>
<th>Income to HH (Rp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cirebon</td>
<td>3.00</td>
<td>0.1195</td>
<td>0.0682</td>
<td>57</td>
<td>36547</td>
<td>21498</td>
<td>44</td>
</tr>
<tr>
<td>Bogor</td>
<td>5.67</td>
<td>0.1643</td>
<td>0.0805</td>
<td>49</td>
<td>40104</td>
<td>16171</td>
<td>56</td>
</tr>
</tbody>
</table>

Source: Sabrani et al. (1982).

Table 4. Productivity of Indonesian goats.

<table>
<thead>
<tr>
<th>Description</th>
<th>Kacang goat</th>
<th>Etawah</th>
<th>Specific farmer’s cross</th>
<th>Village cross</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter size (head)</td>
<td>1.76</td>
<td>1.42</td>
<td>2.00</td>
<td>1.92</td>
</tr>
<tr>
<td>Kid survival (%)</td>
<td>78</td>
<td>78</td>
<td>66</td>
<td>79</td>
</tr>
<tr>
<td>Kidding interval (day)</td>
<td>210</td>
<td>290</td>
<td>270</td>
<td>400</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>1.6</td>
<td>2.9</td>
<td>2.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Weight at weaning (kg)</td>
<td>8.7</td>
<td>13.1</td>
<td>11.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Mature weight (kg)</td>
<td>18</td>
<td>24</td>
<td>25</td>
<td>22</td>
</tr>
</tbody>
</table>


breeds or strains, cropping systems, socioeconomic conditions, and little research has been conducted. Outside Indonesia, few references can be obtained for comparison (e.g. Devendra and McLeroy 1982; Pharo 1982). Efforts have been initiated to compare the goat productivity on village farms, on the research station, and on specialised farms (Table 4). The length of the kidding interval was longest and body weight was lowest in the village as compared to those of on-station and specialised farms. Poor nutrition and uncontrolled breeding management at the village level have reduced growth, as well as productivity. There is the need for goat development today to provide goat meat; this is likely to substitute for beef, which is now declining. Development programs in provinces are mostly directed at improving goat production technology, credit and production sharing systems, and marketing, with the main objectives being to increase land input, improve income and reduce risk and seasonal variation. The programs are oriented to develop a goat production model under small-farm conditions in rural areas. For this reason the development of research policy for such small-scale farming units requires a deep understanding of the complexity of interactions among livestock, farmers, and the environment.

Constraints to Productivity

Although there seem to be good prospects for developing goat production that provide a means of raising the income of small farmers, some limitations were identified (Sabrani et al. 1982; Anon. 1984). The limitations, which are physical, biological and socioeconomic in nature, create figures of high mortality, low growth rate, low reproductive performance, low off-take rate, poor marketing systems, and low capital availability.

Diseases

Appendix 1 gives a list of some diseases of goats, which have been reported in Indonesia.

Although a number of diseases of goats in Indonesia are now well recognised, there is little information on the relative importance of these diseases on goat productivity in the country. In broad terms, the diseases of significance in reducing productivity can be divided into three main groups: first, those that cause acute disease and frequently death, e.g. acute helminthiasis and anthrax; second, those that cause a chronic, debilitating disease, e.g. chronic endoparasite infections; and third, those classified as reproductive diseases causing infertility, prenatal or neonatal deaths, etc. In addition there are diseases of high morbidity but low mortality, e.g. conjunctivitis, which may have some effect on productivity. There are also diseases that can be transmitted either directly or indirectly to humans (zoonotic diseases), which are of some public health importance, e.g. hydatidosis and rabies.
Those that have veterinary and economic impact are endoparasites, ectoparasites, pneumonia, orf (contagious ecthyma), pink eye, goat pox, and mortality at or around parturition.

Endoparasites can occur in up to 80% of a sample (Beriajaya 1983). The diseases consist of gastrointestinal worms and coccidia and are mainly due to grazing practices under wet tropical conditions.

Based on a 1979 survey, 28.2% of goats suffered from pneumonia (Iskandar et al. 1983). The agent, however, has not been identified but it is suspected to be a combination of bacteria and virus.

Statistics for small ruminant mortality in Central Java show that 50.6% of total mortality (13.4%) occurred at birth, 43.3% during the preweaning period and 6.1% after weaning. The high rate of mortality at birth in most field surveys is very often overlooked; this seems to be a critical aspect of production improvement.

**Nutrition**

Poor nutrition in the village goat can be seen as low growth rate and low body weight at birth, weaning, and at maturity. It seems that rice monoculture in large areas creates difficulties in providing a balanced feed source for goats who prefer a mixture of leaves and grasses. In addition to this limitation, there is the uncertain source of feed as shown by the high percentage of goat keepers who obtain feed from land that is not their own, and the seasonal variation in feed supply due to climatic conditions. These impose nutritional problems for stable goat development. The major physical factors affecting feed supply potential are precipitation (duration and intensity), elevation, slope, and soil type.

Appendix II presents data on the feed composition of goat diets in three villages. By cut and carry management, field grasses dominated feed composition in all locations in terms of percentage and frequency of feeding. The percentage of grass was relatively higher during the dry season, while herbs became lower. The same thing happened also with crop by-products. The fluctuations in feed composition from wet to dry seasons are a typical problem in nutrition in which nutritional levels decline in the dry season due to increased fibre and reduced protein. This limitation occurs in composition and in the quantity of feed, which also declines.

**Reproductive potential**

In a village environment, the reproduction rate of the goat is still about 1.14 kid per adult female per year (Kartadihardja 1979). However, on specialised farms a reproduction rate of 2 young animals per female is realised (Soedjana et al. 1983). Potential reproduction rates achieved at research stations and at well-managed village units (Setiadi and Sitorus 1983) reach 3 kids per doe per year. This difference may be due to the lack of selected males for breeding purposes and the uncontrolled breeding system. This is demonstrated by the length of the kidding network and the uneven distribution of male ownership within a certain area.

**Market**

As far as meat is concerned there are few marketing limitations. The demand for meat has shown an increasing trend due to the increase in income per capita and the increase in human population. However, the beef supply potential is declining as shown by the decline in cattle and buffalo populations. The most critical limitation in goat marketing is the marketing system itself. The system fails to transmit market information to the farmers and to stimulate production. The multi stages of the system create inefficiency at the farmer's level (Sabrani et al. 1982, 1983).

In terms of goat milk, the demand is limited to a particular ethnic group. Thus the problem is limited consumption and dairy goat production is unlikely to expand rapidly.

**Capital limitation**

Capital constraint in goat development is reflected by the relatively small flock per farm and low input. The goat enterprise utilises the non-cash input intensively, especially family labour. The goats utilise marginal land, crop residues, and grasses. The low economic return coupled with the capital constraint seem to be one of the major limitations in technology transfer because the improvement that can be made produces a very marginal impact.

To reduce these production limitations, a sharing production program (GADUHAN) offers an excellent opportunity to small farmers. In this program female animals are distributed and part of their offspring is used as pay-back. The program is used where credit and repay conditions are not feasible.

**Current Research**

The present goat research program is included in the Small Ruminant, Animal Disease and Farming System Research Program. Problem-oriented research is organised around five general areas that were identified as potential constraints to increasing small ruminant productivity. Within each problem area, several specific projects are being undertaken.

The Small Ruminant Program investigates four main areas of research (feed, genetic, economics, and
sociology) with the U.S. Small Ruminant Collaborative Research Support Program. The Animal Disease Program is supported by Australian Government assistance.

The Breeding Research Program is designed to assess: (1) the effects of environment on reproduction; (2) management of mating to reduce kidding interval; (3) the genetic basis of high prolificacy; (4) grading of Etawah and Kacang goats; (5) comparison of progeny.

The Nutrition Research Program involves: (1) feed evaluation; (2) supplementation studies; (3) determination of protein quality of crop by-products, grasses, and legumes.

The Socio-economic Research Program investigates: (1) socioeconomic analyses of marketing systems; (2) women's role in small ruminant production; (3) labor utilization analyses; (4) comparative budgeting analyses; (5) animal sharing analyses; (6) on-farm technology testing; (7) agro-economic profile analyses.

The Disease Research Program comprises: (1) studies on endoparasite epidemiology; (2) studies on scabies; (3) comparative study of orf (contagious ecthyma) and goat pox; (4) an abattoir survey; (5) studies on pink eye; (6) studies on small ruminant resistance to cyanide toxicity in cassava.

Research Prospects

There is a need to continue the present research programs to provide solutions to the many and varied farm problems. In addition to this, the use of research results in specific locations such as transmigration areas should be given high priority.

Investigation of land use, cropping pattern and goat production-interaction must be intensified in the future. The investigations are directed to the development of appropriate technologies, which may be able to strengthen the linkage among land, crop, and goats under small-farm environment. This strategy of research has to be developed since capital and small farms dominate the goat production problems.

Management variables that produce a positive impact on production and reproduction performance should be intensified. Examples are selective feeding, supplementation, feed storage, feed treatment, breeding practices, and housing.

Last but not least, the development of methodology for goat production analyses must receive reasonable attention. Lack of good research methodology can create bias in analyses.

References

Pharo, H.J., 1982. The role of the goat in small farmer development in Southern Asia. MSc Thesis, Department of Agriculture and Horticulture, University of Reading, U.K.
Appendix I. Some diseases of goats in Indonesia

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Agent</th>
<th>Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anthrax</td>
<td>Bacterial</td>
<td>Sporadic</td>
</tr>
<tr>
<td>2. Reproductive disease</td>
<td>Bacterial</td>
<td>Sporadic</td>
</tr>
<tr>
<td>3. Enterotoxaemia</td>
<td>Bacterial</td>
<td>Sometimes</td>
</tr>
<tr>
<td>4. Colibacillosis</td>
<td>Bacterial</td>
<td>Sometimes</td>
</tr>
<tr>
<td>5. Salmonellosis</td>
<td>Bacterial</td>
<td>Occasionally</td>
</tr>
<tr>
<td>6. Pneumonia</td>
<td>Bacterial, Viral</td>
<td>Common</td>
</tr>
<tr>
<td>7. Foot rot</td>
<td>Bacterial</td>
<td>Rare</td>
</tr>
<tr>
<td>8. Haemorrhagic septicaemia</td>
<td>Rickettsiae, bacterial</td>
<td>Sporadic</td>
</tr>
<tr>
<td>9. Pink eye</td>
<td>Viral</td>
<td>Sporadic</td>
</tr>
<tr>
<td>10. Foot and mouth disease</td>
<td>Viral</td>
<td>Rare</td>
</tr>
<tr>
<td>11. Pox</td>
<td>Viral</td>
<td>Sporadic</td>
</tr>
<tr>
<td>12. Orf</td>
<td>Viral</td>
<td>Rare</td>
</tr>
<tr>
<td>13. Papillomatosis</td>
<td>Viral</td>
<td>Rare</td>
</tr>
<tr>
<td>14. Rabies</td>
<td>Viral</td>
<td>Common</td>
</tr>
<tr>
<td>15. Helminthiasis</td>
<td>Parasitic</td>
<td>Common</td>
</tr>
<tr>
<td>16. Coccidiosis</td>
<td>Parasitic</td>
<td>Common</td>
</tr>
<tr>
<td>17. Ectoparasite infection</td>
<td>Parasitic</td>
<td>Fairly common</td>
</tr>
<tr>
<td>18. Blood parasite infection</td>
<td>Parasitic</td>
<td>Rare</td>
</tr>
</tbody>
</table>

Appendix II. Contribution of major crop by-products, shrubs and leaves to sheep and goat diets

<table>
<thead>
<tr>
<th>Common name</th>
<th>Botanical name</th>
<th>Garut Wet</th>
<th>Garut Dry</th>
<th>Ciburay Wet</th>
<th>Ciburay Dry</th>
<th>Cirebon Wet</th>
<th>Cirebon Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop by-products:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bean straw &amp; hulls</td>
<td>Glycine soja</td>
<td>14.0</td>
<td>5.9</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Cassava leaves</td>
<td>Manihot esculenta</td>
<td>6.8</td>
<td>10.8</td>
<td>72.7</td>
<td>45.9</td>
<td>12.8</td>
<td>12.8</td>
</tr>
<tr>
<td>Maize stover</td>
<td>Zea mays</td>
<td>16.9</td>
<td>2.9</td>
<td>2.7</td>
<td>5.2</td>
<td>12.8</td>
<td>12.8</td>
</tr>
<tr>
<td>Peanut straw</td>
<td>Arachis hypogaea</td>
<td>0.6</td>
<td>2.9</td>
<td>2.9</td>
<td>4.4</td>
<td>14.1</td>
<td>14.1</td>
</tr>
<tr>
<td>Potato stover</td>
<td>Solanum tuberosum</td>
<td>0.2</td>
<td>2.9</td>
<td>2.9</td>
<td>4.4</td>
<td>14.1</td>
<td>14.1</td>
</tr>
<tr>
<td>Rice straw</td>
<td>Oryza sativa</td>
<td>23.0</td>
<td>22.2</td>
<td>2.7</td>
<td>12.8</td>
<td>12.8</td>
<td>12.8</td>
</tr>
<tr>
<td>Sweet potato vines</td>
<td>Ipomoea batatas</td>
<td>4.5</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
</tr>
<tr>
<td>Water melon stover</td>
<td>Citrullis lanatus</td>
<td>2.2</td>
<td>9.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shrub and tree leaves:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avocado leaves</td>
<td>Persea americana</td>
<td>0.6</td>
<td>0.9</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Banana leaves</td>
<td>Musa paradisiaca</td>
<td>20.8</td>
<td>23.5</td>
<td>9.1</td>
<td>2.8</td>
<td>2.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Capoe leaves</td>
<td>Ceiba pentandra</td>
<td>20.8</td>
<td>23.5</td>
<td>9.1</td>
<td>2.8</td>
<td>2.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Erythrina</td>
<td>Erythrina sp.</td>
<td>2.5</td>
<td>3.2</td>
<td>2.9</td>
<td>10.0</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Hibiscus</td>
<td>Hibiscus tiliaceus</td>
<td>4.6</td>
<td>2.8</td>
<td>2.8</td>
<td>6.5</td>
<td>32.1</td>
<td>32.1</td>
</tr>
<tr>
<td>Hibiscus</td>
<td>Hibiscus rosa-sinensis</td>
<td>2.5</td>
<td>3.2</td>
<td>2.9</td>
<td>10.0</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Jack fruit leaves</td>
<td>Artocarpus heterophyllus</td>
<td>1.2</td>
<td>3.2</td>
<td>2.8</td>
<td>6.5</td>
<td>32.1</td>
<td>32.1</td>
</tr>
<tr>
<td>Leucaena</td>
<td>Leucaena leucocephala</td>
<td>0.9</td>
<td>1.4</td>
<td>1.8</td>
<td>2.7</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Mango leaves</td>
<td>Mangifera indica</td>
<td>0.3</td>
<td>5.9</td>
<td>5.9</td>
<td>7.6</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>Papaya leaves</td>
<td>Carica papaya</td>
<td>0.3</td>
<td>5.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seshania</td>
<td>Seshania grandidflora</td>
<td>0.3</td>
<td>2.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thorn apple leaves</td>
<td>Datura fastuosa</td>
<td>6.2</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Data are expressed as a percentage of total crop by-products, shrubs and tree leaves, on an as-fed basis.
b. Wet = wet season; Dry = dry season.
Source: van Eys et al. (1983).
Potential and Problems of Goat Production in Indonesia

I.C. Fletcher*

The broad distribution of ruminant animals in relation to human population and land area is presented in Table 1 to emphasise two general points. First, the goat is numerically an important domestic animal, and on this basis alone the potential and problems of goat production merit consideration. Second, the ratios of small ruminant and human populations to land area differ widely between Java and the rest of Indonesia. This suggests a large potential for increasing goat production through an expansion of numbers, though with enormous problems associated with human population shifts and the development of new land areas. These problems are being addressed through national transmigration schemes, and are not considered here. Emphasis is given rather to the potential and problems of goat production in relation to improving the productivity of existing populations, with the understanding that modest increases in numbers might also be achieved through improved utilisation of existing resources.

Table 1. Distribution of ruminants in Indonesia in relation to human population and land area (adapted from Juwarini and Petheram 1983). All units are \( \times 10 \).

<table>
<thead>
<tr>
<th></th>
<th>West Java</th>
<th>Rest of Java</th>
<th>Rest of Indonesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goats</td>
<td>1.0</td>
<td>4.0</td>
<td>3.1</td>
</tr>
<tr>
<td>Sheep</td>
<td>1.8</td>
<td>1.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Cattle</td>
<td>0.2</td>
<td>3.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Buffalo</td>
<td>0.5</td>
<td>0.5</td>
<td>1.5</td>
</tr>
<tr>
<td>People</td>
<td>28</td>
<td>58</td>
<td>64</td>
</tr>
<tr>
<td>Land area (ha)</td>
<td>4.4</td>
<td>8.6</td>
<td>177.5</td>
</tr>
</tbody>
</table>

There is relatively little published or accessible information about the productivity of goats in Indonesia. Small ruminant literature seems somewhat biased towards sheep, possibly because national administration has long been centred in West Java, which also happens to be the only province in which sheep outnumber goats (Table 1). In general, sheep and goat husbandries are not obviously different. It is common within a single village to find some farmers with sheep and others with goats, and reasons for keeping one species or the other appear to be a matter of personal preference rather than any perceived difference in management requirements, productivity or profitability. Indeed, the potential productivity of both species is probably about the same (Obst et al. 1980; Chaniago and Obst, unpublished data). Differences in forage utilisation might be expected, but limited evidence (Table 2) suggests that the types of forage offered to sheep and goats vary more between villages than between animal species. Reference is made in this paper to sheep or to small ruminants in general where specific information about goats was not available, but this does not imply that superficial similarities between sheep and goats extend to all aspects of management and production.

Table 2. The percentage composition of forage offered to housed sheep and goats in two Javanese villages (van Eys et al. 1983).

<table>
<thead>
<tr>
<th></th>
<th>Ciburay Sheep</th>
<th>Ciburay Goats</th>
<th>Cirebon Sheep</th>
<th>Cirebon Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasses and herbs</td>
<td>96</td>
<td>93</td>
<td>83</td>
<td>76</td>
</tr>
<tr>
<td>Shrubs and tree leaves</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Crop by-products</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>

Potential Benefits from Improved Production

Economic Well-being of the Rural Population

Over 80% of the total population of approximately 150 million people live outside of the major cities and are largely dependent on agricultural production (BPS 1981). Average farm size is small (commonly less than 0.5 ha in West Java), and many rural families are landless (Thomas and Rangkuti 1983; Basuno and Petheram 1984). Specialised small ruminant farms (Knipscheer et al. 1983) are relatively rare, and most

* Small Ruminant Program Adviser, Balai Penelitian Ternak, Bogor, Indonesia.
of the goat population is maintained by smallholders and landless farmers as a sideline enterprise to generate additional household income. Thus any improvement in goat productivity, besides increasing national production of the various commodities discussed below, will also have the important general consequence of improving the economic well-being of the large rural population.

**Meat**

Meat production from all domestic livestock (cattle, buffalo, sheep, goats, and poultry) currently provides an average per capita meat protein consumption of less than 2g/day (BPS 1981). By the year 2000, with predicted population growth, meat production must increase by about 60% to maintain even this level of intake, and by about 170% to achieve a proposed daily target of 2 g meat protein consumption/person. Because of their low capital cost, efficiency, and ease and cheapness of maintenance, goats have particular potential to contribute to this increasing requirement for meat production.

**Leather and Manure**

These by-products of goat production are included because they have real economic value, though they are a function of total animal numbers rather than of productivity per animal. Leather is utilised both locally and as an export commodity, and manure has particular importance in Indonesian agricultural systems. It may contribute as much as 25% of the gross income from small ruminant production (Basuno and Petheram 1984), and in some areas is considered to be the most important product from goat farming.

**Milk**

There is a high demand for cow milk and dairy products in urban areas that cannot be met by local production, and more than 80% of the present milk consumption is supplied by imported milk powder. The potential for goat milk production is almost totally unrealised. Local goat breeds are capable of producing up to 2 litres of milk per day (Chaniago and Obst. unpublished data), but there are few goat dairies, and some of these do not milk on a regular basis, but maintain unweaned kids with the does and remove them for hand milking only when there is a local demand for the milk.

Milk is generally not an important component of the diet of rural people. In a survey of the consumption of animal products by traditional village farmers (Suradi-sastra and Nolan 1983a), only 6% of respondents claimed to consume milk ‘often’, 21% ‘seldom’, and 73% ‘very seldom’ or ‘never’. This was apparently a consequence of the high cost or unavailability of purchased cow milk, and ignorance of or resistance to the potential utilisation of small ruminant milk.

It is difficult to understand why an existing potential for goat milk production should remain unrealised in a country with expensive milk imports and a low per capita animal protein consumption. Two approaches seem possible. First, milk could be accepted from goat farmers and mixed with cow milk in those areas that already have an established cow milk collection system. This would have little initial impact on total milk production, but would test the response of goat farmers to the opportunity of earning extra cash income from milk production and, if successful, could be extended to goat milk collection from hotter low altitude areas near the urban markets, which are better suited to goat than to dairy cow production. Second, and more difficult because it offers no income incentive, a research and education program could be established to promote the consumption of home-produced goat milk as a source of high quality protein, particularly for children, in goat-raising areas that are too remote from markets for cash sales.

**Fibre**

Indigenous goat breeds have no potential for commercial fibre production (Robinson 1977). However, common management systems involving continuous housing, and relatively low labour and production costs, could readily be adapted to the production of high quality fibre such as mohair or cashmere to provide increased and diversified income for goat farmers and additional national export income. The manufacture of cloth and garments, possibly of a ‘cottage industry’ type, might be included to make use of inexpensive labour and provide additional rural employment. (Hand weaving of traditional patterned cloths from imported cotton is already practiced in many parts of the country). Potential difficulties with the importation and acclimatisation of suitable animals, and in the development of production, manufacturing and marketing skills, make this a possibility for future rather than immediate consideration.

**Scope for Improved Production**

Average productivity of village goats is about one offspring weaned per breeding female per year (Kartadihardja 1979), and a growth rate of 20-40 g/day (Petheram unpublished data). The potential of these animals is about two offspring weaned per breeding female per year (Obst et al. 1980) and a growth rate of more than 100 g/day (Chaniago and Obst. unpublished data). There is thus a potential to approximately double meat production from the existing goat population. The potential for milk production is difficult to define,
but the average daily per capita consumption of 0.27 g milk protein (BPS 1981), largely from cow milk, could be provided from 4 million does with an average daily milk production of about 300 ml. As already stated, there is no potential for fibre production in indigenous goat breeds.

Potential Sources of Improved Production

Genetics

The introduction of exotic genotypes, although sometimes superficially seen to provide a quick and easy means of improving productivity, should not be considered at least until the present wide gap between actual and potential production of existing genotypes is reduced. An example of the doubtful benefit of exotic genotypes (Table 3) shows a comparison of the productivity of indigenous Kacang goats and Ettawah goats, now considered as an indigenous breed but originating predominantly from the earlier importation of Jamnapari-type goats from India. In this comparison the larger and faster-growing Ettawah goats actually produced less meat than the Kacang goats, particularly when results were expressed per unit of doe metabolic body weight to give consideration to differences in feed requirement associated with different body size. Studies with sheep similarly have shown that indigenous animals produce more meat per unit of feed intake than larger and faster growing exotic crossbreds (WARD, unpublished data).

On the other hand, because the goat population is virtually an unselected one with considerable within-bred variation in growth rate and body weight, genetic selection for increased production among indigenous genotypes under existing or improving management systems could be a useful component of any wide-ranging program for improving goat production. Any selection program should of course ensure that existing high potential levels of fertility and fecundity are maintained, and would need to include a system for distributing genetically superior animals into the general population.

Nutrition

There are a few situations where small areas of pasture grasses or legumes are grown to stabilise land terraces in erosion-prone watershed zones, or where they are stipulated as a condition of government credit schemes supplying small ruminants to smallholders. For the most part, however, feed for goats comes from a wide range of plant species associated with crop residues, tree leaves, and grasses and herbs ('weeds') growing on unproductive lands. The nutritive value of these plant species varies widely (Lowry et al. 1983), and their availability varies both between regions and between seasons within regions. Further, feeding systems vary along a continuum from grazing all year round to continuous housing and hand feeding (Thahar and Petheram 1983). Under these conditions it is obviously impossible to make any general statement about nutritional constraints on goat production, though observation and experimental responses to improved nutrition indicate that energy, protein and/or mineral insufficiencies limit production in at least some animals for some of the time.

Means of improving nutrition include storing forage for use in the dry season, chemical or biological treatment to improve low quality roughages, the provision of mineral supplements and/or high quality feed supplements, and improved utilisation of existing feedstuffs. The last-mentioned approach is particularly attractive in view of the constraints on improving production imposed by farmer attitudes, discussed below. Housed animals are generally fed ad lib, but on any available mixture of plant species that the animals are known to eat without apparent regard to species differences in nutritive value. Further, all animals are usually run together and offered the same mixed herbage except that breeding males, if present, may be penned separately and given preferential feeding. There appears to be scope for improved productivity from existing feedstuffs by selective harvesting of higher quality herbage, when possible, and by the selective use of higher quality herbage from within the harvested material for those animals that have the greatest nutrient demand for production at that time (e.g. young growing animals fed preferentially to non-lactating does, or does in late pregnancy or early lactation fed preferentially to non-working males).

Reproduction

There is no apparent seasonality in reproduction, nor any pattern of planned mating in relation to seasonal variation in feed availability or market prices. The average goat herd of 3–5 animals often does not
include a breeding male, and the general situation is probably similar to that described for sheep in which 10 of 22 village flocks did not maintain any rams of breeding age, and the others maintained rams on average for only 6 months of the year (Bell et al. 1983). Males, whether maintained or borrowed, are commonly used for hand mating rather than being run with females for a prolonged mating period, and mating is not always arranged at the appropriate time. For example, Bell et al. (1983) observed ewes being held for mating without necessarily being in oestrus, and supported this observation with records that 9% of 55 village ewes mated in this way were already pregnant, and only 26% of the non-pregnant ewes conceived to that mating.

There is preliminary evidence that goat reproduction can be increased by improved nutrition during late pregnancy and early lactation (Chaniago and Fletcher unpublished data), and there is scope for improving nutrition either in the ways already discussed or by controlling mating so that maximum nutritional requirements for reproduction coincide with periods of maximum herbage availability. Another and perhaps more immediate means of increasing reproduction could be the development and application of management systems that ensure adequate male/female contact at the appropriate times.

Health

Ill-health is an important problem of village goats (Basuno and Petheram 1984), and improved disease and parasite control is undoubtedly an important potential avenue for increasing the productivity of village animals. Discussion of the varying incidence of the wide range of bacterial, viral, parasitic, and metabolic diseases is beyond the scope of this paper.

Production Constraints

Research and Development

A case for increased research and development can be made for most types of agricultural production in most countries, and goat production in Indonesia is no exception. Potential productivity is reasonably well defined, but much remains to be known about how and to what extent this potential can reasonably be achieved through the various avenues already mentioned. It is not intended to suggest specific priorities for research between and within the general areas of genetics, nutrition, reproduction and health, but rather to discuss the particular importance of considering farmer access to and acceptance of research results in determining any such priorities.

Farmer Access to Research and Development

The educational level of smallholders and landless farmers, i.e. the majority of goat rearers, is generally low. For example, Basuno and Petheram (1984) found that 68% of ruminant rearers in a village near Bogor had never attended school, and only 1% had progressed beyond primary schooling. This situation will change as the farmers' children, now receiving education, become involved in agricultural production. Nevertheless, it is clear that scientific publication of the results of research and development will not be directly accessible to the goat farmer.

The established agricultural extension service has difficulty in covering the very large and widely dispersed rural population. Extension workers were the main source of information for only 5% of small ruminant farmers in two Javanese villages surveyed by Suradisastra and Nolan (1983b). Both of these villages were near agricultural extension centres, and the situation can only be worse in outlying areas. Limited personal experience, and observations such as those of Bell et al. (1983) already mentioned, suggest that even existing knowledge is not well extended, so it cannot be assumed that the farmer will have even indirect access to the result of research and development from central or regional research centres.

It is virtually impossible to duplicate the widely diverse conditions of smallholder goat production within research centres, and many research results therefore must be tested in village situations before they can be recommended for adoption. Because such results will be not only directly applicable but also immediately accessible to the farmer, high priority should be given to research and development programs carried out within the village.

Farmer Acceptance of Research and Development

It is clear from Table 4 that small ruminants are kept principally as a means of capital accumulation and storage for use at times of emergency cash need (for such things as medical costs, school fees, and family celebration or ceremonies), and only secondarily as a source of regular income. Farmers undoubtedly want additional income from small ruminants, but see the answer in increased numbers (Basuno and Petheram, 1984), which has very real constraints imposed by limited capital, labour, and in some cases forage availability, rather than increased productivity from existing animals.

A great many factors work against the ready acceptance of any results of research and development that may lead to increased productivity. The fact that small ruminant production is only a supplementary and not a major source of income, and even then regular
income is only of secondary importance, is not conducive to extra inputs of limited capital or labour. Animal products are sold as they become available or as money is needed, so there are no regular marketing periods that would allow a comparison of economic return before and after any change in technology. Further, real increases in productivity are not easily detected in the short term from very small herds with high inherent variation. There is a reluctance to make any cash inputs because of low income and a tradition of maintaining animals on 'free' communal forage, compounded by the time delay between expenditure and receipt and difficulties of judging cost effectiveness. Finally, there is a general disinclination to change, exemplified by a survey of small ruminant farmer attitudes (Suradisastra and Nolan 1983b) in which 85% of respondents agreed that 'success in farming is more dependent on God than on the efforts of man.'

Thus priority should be given to research and development, which has the potential to increase productivity through simple technology changes with little or preferably no cash cost. Radically new, complicated or expensive inputs, no matter how cost effective, are unlikely to improve productivity in the short term because of problems with farmer acceptance.

Summary

Goats in Indonesia have an immediate potential for increased meat production, a longer-term potential for increased milk production, and a possible future potential for fibre production. Increased meat production could come from improved nutrition, reproduction and health in existing genotypes. Increased milk production is a step further away in that utilisation must first be developed before any great emphasis is placed on productivity, and fibre production is even further away since it would require the introduction of exotic genotypes and development of new management techniques.

A major problem of increasing production through research and development is limited farmer access to and acceptance of new information. Priority should be given to research and development programs that extend directly into the villages, and that have the potential to increase productivity through simple technology changes with little or preferably no cash cost.

References


