

The Role and Breeds, Management Systems, Productivity and Development Strategies of Goats in Indonesia: A Review

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Abstract

Small ruminants like sheep and goats are important for a larger part of the Indonesian rural population. The major breeds of goats found in Indonesia are the Kacang and Etawah goats. The biological and economic function of goats have long been recognised. Besides producing animal products, they also provide manure to maintain soil fertility. Goats are kept as an important component of farming activities, particularly by smallholders.

The existing goat husbandry is normally the result of hundreds of years of tradition. Different systems of goat production have evolved in response to factors such as climate, need of the owner, economic environment, and level of technology available. The general aim in the management of goat production units is to increase the productivity. The biological productivity of goats is determined by the fundamental processes of reproduction, growth and development and death. Key production traits which should be considered for improving goats' productivity are adaptability and productivity conditions, reproductive rate, growth rate and carcass value.

The objectives of this paper are to review the role and breeds of goats, current management systems and productivity for goats with particular reference to Indonesia, and to discuss the development strategies that may have specific applications in the Indonesian situation.

Keywords: goats, breeds, management, Indonesia

1 The Role and Breeds of Goats in Indonesia

Goats in Asia account for 62,86 percent of the total world population (FAO, 2003). Indonesia has about 13 million goats (Table 1), of which 54 percent are raised on the island of Java (DIRJEN PETERNAKAN, 2003). Table 1 shows the distribution of goats in Indonesia. Goats' population in Indonesia represents the largest population of small ruminants in South East Asian countries (DEVENDRA and MCLEROY, 1982; UTOYO, 1995), and there are many farming families involved in the production of small ruminants (WAHYUNI and SUPARYANTO, 1991; PRIYANTO *et al.*, 1991; DEVENDRA,

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1993). This suggests that goats fit well within the farming systems in the rural sector. Most importantly, goats can provide ready cash as liquid assets to meet unexpected household needs of the farmer, present insurance against crop failure, and a method of investing labour input (ATMADILAGA, 1991; DJAJANEGARA and SETIADI, 1991). The contribution of rearing goats to the total farming income is substantial, and was about 17.1, 26 and 14,8 percent for the three categories of lowland, rubber plantation and upland areas respectively (Table 2). The important implication of these figures is that goats provide a vehicle to improve the income of poor and destitute farmers (SABRANI and KNIPSCHER, 1982; SABRANI and SIREGAR, 1981; ADJISOEDARMO, 1991).

Table 1: Distribution of goats in Indonesia from 1996 until 2000

<i>Provinces</i>	<i>Number of goats (head) in year</i>				
	<i>Year 1996</i>	<i>Year 1997</i>	<i>Year 1998</i>	<i>Year 1999</i>	<i>Year 2000</i>
DKI Jakarta	7,888	6,767	8,349	6,415	5,773
West Java	2,098,635	1,935,346	1,698,631	1,666,500	1,710,496
Central Java	2,988,780	3,053,791	2,899,335	2,812,151	2,780,649
Yogyakarta	277,241	277,583	263,265	263,397	263,402
East Java	2,549,413	2,618,502	2,232,229	2,264,992	2,345,236
Other provinces	8,016,748	9,324,349	6,458,640	5,687,918	5,960,178
Total	13,840,070	14,162,547	13,560,449	12,701,373	13,065,734

Table 2: Contribution of goats to total farm income at different locations and farm size

<i>Location and Farm size</i>	<i>Small ruminants income to total income (%)</i>
Cirebon (lowland)	
0 - 0.15 ha	21.6
0.15 - 0.30 ha	13.4
over 0.30 ha	13.5
Average	17.1
Garut (upland)	
0 - 0.15 ha	22.6
0.15 - 0.30 ha	22.2
over 0.30 ha	10.3
Average	13.8
Ciburay (rubber plantation)	26,0

The Kacang is an Indonesian native small goat. To improve local breeds the government imported Etawah goats from Jamnapari and north India (MERKENS and SJARIF, 1979).

The Cashmere, Angora and Saanen goats have also been introduced in the past, but only the Etawah goat has adapted to the conditions of the Indonesian farming systems (EDEY, 1983; DJAJANEGARA and SETIADI, 1991). The Marica goat is a local variation of the Kambing Kacang which is found in Sulawesi. The Gembrong goat is intermediate in size between the Kacang goat and the Etawah goat and is found exclusively on the eastern side of Bali. Costa goats are found in Banten. Angora or Montgomery goats were imported and brought to the experimental stations in Bogor, Bandung and Padang Mangatas. Holandsche-Edelgeit were even brought to Java and Sumba (DIRJEN PETERNAKAN, 1991; UTOYO, 1995; YULISTIANI *et al.*, 1998; SETIADI *et al.*, 1998).

2 Management Systems

The existing husbandry management systems in tropical countries such as Indonesia are normally the results of hundreds of years of tradition. In the humid Tropics, goats are usually kept in small family flocks under semi-intensive management. On the outer island of Indonesia, they are commonly grazed or tethered and housed at night, or they are left free to scavenge around the village by day and housed at night. During the crop-growing season, these animals may be kept under the control of children or of village herdsmen.

Integration with the cropping system has been practised in varying degrees in many parts of Indonesia. The nature and extent of the integration depends upon the type of crops being grown. Increasing attention is now being given to integrating small ruminants with rubber, coconut and palm oil trees to utilise the roughage that normally grows under trees. The advantages of this system are: increasing fertility of the land because of the input of faeces and urine, control of weeds by animals, reduced costs for fertilisers as well as the increase in crop yields with greater total income.

2.1 Housing or Kandangs

Housing of animals has been traditionally part of goat production systems in the humid tropics. Besides security reasons, housing is also provided for management reasons such as the control of animals to prevent damage to crops, ease of feeding and collection of excreta.

There are several types of animal house to be found within the Indonesian archipelago. In areas where flooding occurs or where there are predators, farmers build animal houses quite high above the ground. These types of houses are found on the islands of Sumatra and Kalimantan. In other areas, farmers may keep their goats under or inside their houses. The farmer's house may be built one to two metres above ground level with the animals directly underneath or the animal barn may be adjacent to the kitchen, utilising one of its walls. This is, however, contrary to the Department of Health regulations. Animal houses may also be on ground level.

The stilted housing type is more commonly used, since in the humid tropics rainfall is heavy and temperatures are high. This type of housing protects the animals from the wet and facilitates easy cleaning and collecting of the faeces and urine for fertiliser. The floor usually consists of slats of bamboo or wood, which allow faeces and urine to

fall through and provides greater air movement around the animal. The resulting air movement in stilted houses also reduces the effects of high temperatures on animals. Most animal houses in Indonesia have open sides for better ventilation to remove both sensitive heat and humidity (from the animals and its excreta). The roof provides shade from direct sunlight and from rain. The roof should provide effective shelter from heavy rain and high solar radiation. The roof materials can be made of coconut or palm leaves grass or alang-alang (*Imperata cylindrica*), tiles or zinc.

SODIQ *et al.* (1998b) found that nearly 80 percent of smallholders keep goats and sheep together in one pen. This has distinct disadvantages. Firstly, different categories of animals need different qualities and quantities of feed. For example, weaners as well as females in late pregnancy and during lactation need better feed. Of course it is not possible to feed different classes of stock differently, if there is only one pen. Male goats may disturb others. For example, young females may be mated too early, or unsuitable mating may occur. Parturient females should be separated from the rest of the flock, so that they can quickly establish the exclusive maternal-offspring bond.

2.2 Mating

Farmers prefer keeping female to male animals since each female can rear new offspring whereas one male can mate with a large number of females. Because of this, farmers rarely keep adult male animals. If there is an adult male, it is often kept in a separate pen.

Although well-fed kids can be mated at around seven months (CHANIAGO, 1994), probably under most village conditions where growth rates are slow, they should not be mated under 12 months of age. In fact many are not mated until 18 months to two years of age.

2.3 Feeding System

The range of feeding systems in Indonesian animal husbandry encountered in villages, varies depending upon which crops are planted, area, tradition and many other factors. The feeding systems include hand-feeding or cut-and-carry systems, herding, tethering, free-range grazing and combinations of these systems.

2.3.1 Hand-feeding (cut-and-carry) Systems

Animals are usually kept inside all the time except may be for mating, bathing or for treatment. This system of management is generally found in villages with high population densities and intensive cultivation systems. Animals raised under this system generally perform better and are in better body condition than tethered or scavenging animals. This is because with this system it is usually possible to provide the livestock with better quantity and quality of feed and they do not have to spend time and energy walking around looking for feed. However, the quantity and quality of feed offered depends entirely upon the farmers' capability and knowledge of good quality foodstuffs. Also, during times when the farmer is busy with food crops, the quality and quantity of feed harvested probably declines. The farmer using this system can more easily watch

the health of animals.

Animals in pens are fed once, twice or three times daily. Fodder is cut from the harvested paddies, arable land, and bank of rivers or sides of irrigation canals, from roadsides or from certain other areas and carried by farmers to the animals' pens. Hand feeding is practised where grazing areas are limited, but fodder is available for cutting. In Indonesia, it is recommended to cut leaves of ipil-ipil (*Leucaena leucephala*), jack fruit (*Artocarpus integrifera*), cassava (*Manihot esculenta*), sesbania, glyricidia and calliandra to feed goats.

2.3.2 Herded Systems

In Indonesia, this management system is more generally used with sheep than with goats because sheep have a stronger flocking instinct. The number of animals in a flock varies widely depending on the area, but usually it is limited to 10 to 40 animals. This system can be seen in paddy field areas during the dry season when the fields have not yet been planted, because there is no irrigation water available. When the rainy season comes, farmers start to cultivate the paddy fields and their livestock can only be grazed on roads.

The animals are grazed under the control of children or herdsman, mainly on communal grazing areas or non-productive land such as fallow rice or other crop land, road sides, river banks or sides of irrigation canals. Herding may be practised all year round or for only part of the year.

2.3.3 Tethered Grazing

The animal is tethered by a rope attached to a pole or peg which enables a small circular area to be grazed with a minimum of labour. It is common on scattered crop lands, on road sides in Sumatra and Kalimantan.

With this system, the access of animals to grasses or leaves can be very limited in term of quality and quantity, so it is necessary to move the animals as frequently as possible, at least once and preferably several times a day. However, pressure of work often prevents the farmers from moving their animals sufficiently often to ensure good nutrition. With this system of raising livestock, the farmers are able to use their time more efficiently for other work. While their livestock are tethered, the farmers can carry out work including their most important work on paddy fields.

2.4 Disease Control

One of the factors affecting livestock production in Indonesia is animal health, rendering programmes for control of livestock disease very important as such diseases can cause large economics losses (DIRJEN PETERNAKAN, 2003). There is little information available about the relative and economic importance of different diseases in Indonesia although a number of reviews have been written. It has been reported that parasitic disease is by far the most prominent (GINTING *et al.*, 1994).

Small ruminant farmers in Indonesia often treat their sick animals with natural herbs that grow in the surrounding areas. This knowledge is generally obtained from the elders

in the village and neighbours who have had previous experience. There are a number of remedies that are often used by farmers to treat diseases in animals. For instance, a mixture of sulphur and used engine oil is considered a cure against scabies, ground areca palm (pinang) fruit is given to adults goats to reduce the burden of intestinal parasites. Recently, a survey showed that a number of traditional medicines are generally used by farmers in East Java (KOMARUDIN, 1990). There is a need for more information to justify traditional treatment in order to provide farmers with inexpensive methods to treat their sick goats. This might reduce the high mortality rate encountered in goats in the villages and also limit the need to import expensive pharmaceutical drugs which smallholders cannot afford to buy.

2.5 Recording

Records are necessary for efficient management but must be kept simple because goats are only the sideline of farming enterprises and smallholders have neither sufficient time nor skill to maintain a complex recording system. Some system of marking has to be adopted and there are many different kinds, which are not necessarily expensive.

Breeding records that should be kept are: date of mating, date of birth, number offspring born (dead and alive) and if possible birth weight, survival to and weight at weaning. At present, few farmers keep records but they should be encouraged to do so. This has become feasible with almost complete literacy in young farmers.

Records can be kept for many purposes (PEACOCK, 1996). SODIQ *et al.* (1997) designed the model of breeding records, especially for students in practical work in rural areas, and the model has also been designed by the Division of Livestock Service (1996) used at the "Animal Breeding Centre".

3 Productivity of Goats in Indonesia

The keys traits and the production factors that affect efficient meat goat production (MCGOWAN and NURSE, 2000; DEVENDRA and MCLEROY, 1982; GATENBY, 1995):

- (1) Adaptability;
- (2) Reproduction performance;
- (3) Growth rate and productivity, and
- (4) Carcass characteristic.

3.1 Adaptability

As a humid tropical country, Indonesia has special problems associated with animal production. Animal production is the result of the interactions of genotypes and environmental factors such as climate, nutrition, disease and management practices. The effect of an environmental change on the production processes is a consequence of the neuro-endocrine and behavioural responses to the change. Table 3 shows the growth rate of Peranakan Etawah goats in different environments at different altitudes (WINUGROHO *et al.*, 1994). Table 4 shows the litter size and reproduction rate of Peranakan Etawah goats in different agro-climate (medium dry period with rainfall 2,000-3,000 mm; and short dry period with rainfall more than 3,000 mm) (YUSRAN *et al.*, 1991).

Table 3: Growth rate of goats in different environments

<i>Altitude</i> (m above sea level)	<i>Air temperature</i> (° C)	<i>Growth rate</i> (g/day)
700	6.6 - 31	94
300	20 - 33.5	70

Table 4: Litter size and reproduction rate with different rainfall

<i>Characteristics</i>	<i>Location</i>	
	<i>Medium dry period</i>	<i>Short dry period</i>
Litter size (kid)	1.74	1.48
Reproduction rate (kid/2 year)	4.7	3.3

3.2 Reproduction Performance

The reproductive rate of both individual goats and the flock as a whole is an important determinant of the overall success of the flock (PEACOCK, 1996). Some measurements used to assess individual reproductive performance: parturition interval, litter size, preweaning mortality rate, postweaning mortality rate. Some researchers have investigated the reproduction performance of goats in Indonesia, their results presented in Table 5 and 6 for Kacang and Peranakan Etawah goats, respectively.

SUTAMA (1994) investigated the puberty and early reproductive performance of Peranakan Etawah goats (Table 7). It was concluded that Peranakan Etawah goats reached puberty at about 56 percent of mature liveweight. Abortion and high proportion returned to oestrous of goats at their first breeding period are potential sources of reproductive inefficiency of young Peranakan Etawah goats. SANDHI (1992) reported that the type of birth for single, twin and triplet with Peranakan Etawah goats were 37,18; 53,85; and 8,97 percent, respectively. Kidding interval at single, twin and triplet birth type were 393, 347 and 315 days, respectively.

SODIQ *et al.* (2003) investigated some factors affecting the reproduction characteristics of Kacang and Peranakan Etawah goats under smallholders. Their results show that the type of birth was significantly affected by parity. Survival rate, kidding interval, doe reproduction and productivity were significantly affected by parity, type of birth and litter weight at weaning. Table 8 and 9 show the average doe reproduction of Kacang and Peranakan Etawah goats at different parity and types of birth respectively.

Table 5: Litter size, survival rate till weaning and kidding interval of Kacang goats

<i>Location</i>	<i>Litter size (head)</i>	<i>Survival rate till weaning (%)</i>	<i>Kidding interval (year)</i>	<i>Researchers</i>
Bogor (Experim. Station)	1.76	-	0.57	BPPP (1995)
Purworejo (Villages)	1.40	95.3	-	ASTUTI <i>et al.</i> (1984)
Temanggung (Villages)	1.73	92.3	-	
Bogor (Experim. Farm)	1.56	-	-	SUBANDRIYO <i>et al.</i> (1986)
Villages	-	-	0.59	DITJENNAK (1979)
Semarang (Villages)	1.92	-	0.64	SUMARTI (91)
Cilacap (Villages)	1.98	95	0.79	AMSAR <i>et al.</i> (1992)
Banyumas (Villages)	1.95	97	0.71	SODIQ <i>et al.</i> (1997)

Table 6: Litter size, survival rate till weaning and kidding interval of Peranakan Etawah goats

<i>Location</i>	<i>Litter size (head)</i>	<i>Survival rate till weaning (%)</i>	<i>Kidding interval (year)</i>	<i>Researchers</i>
Bogor (Villages)	1.7	88.4	0.95	BELL <i>et al.</i> (1982)
Cirebon (Villages)	1.5	83.4	1.25	
Kendal (Villages)	1.3	100	-	ASTUTI <i>et al.</i> (1984)
Purworejo (Villages)	1.5	95.3	-	
Temanggung (Villages)	1.7	94.1	-	
Bogor (Experimental Farm)	1.42	66.1	-	SUBANDRIYO <i>et al.</i> (1986)
Cirebon (Villages)	1.37	67.2	-	
Villages	-	-	0.63	DITJENNAK (1979)
Villages	-	-	0.82	Abdulgani (1980)
Villages	-	-	0.99	TRIWULANINGSIH (1989)
Bandung (Villages)	1.82	92.8	0.97	SANDHI (1992)
Bogor (Villages)	1.45	88.3	0.72	ANGGRAENI <i>et al.</i> (1995)
Banyumas (Villages)	1.65	93	0.96	SODIQ <i>et al.</i> (1998b)
Purworejo (Villages)	1.77	-	0.9	SETIADI <i>et al.</i> (1999)
Bogor (Experimental farm)	1.65	-	-	ADIATI <i>et al.</i> (1998)

Table 7: Reproductive performance of Peranakan Etawah goat at around puberty and first kidding

<i>Characteristics</i>	<i>Means ± S.E.</i>
Pubertal:	
Number of goats	60
Initial liveweight (kg)	16.2 ± 0.2
Pre-pubertal growth (g/d)	37.1 ± 1.8
Puberty:	
Liveweight	18.5 ± 0.4
Ovulation rate	0.9 ± 0.1
First Kidding:	
Liveweight of does (kg)	24.3 ± 0.7
Litter size	1.0 ± 0.0

Table 8: Average doe reproduction of Kacang and Peranakan Etawah goats at different parity

<i>Parity</i>	<i>Doe reproduction (head/doe/year)</i>	
	<i>Kacang goat</i>	<i>Peranakan Etawah goat</i>
1 st parity	1.9	1.28
2 nd parity	2.28	1.63
3 rd parity	2.95	1.94
4 th parity	3.84	2.47
5 th parity	3.32	2.12
6 th parity	2.66	-

Table 9: Average doe reproduction of Kacang and Peranakan Etawah goats with different type of birth

<i>Type of birth</i>	<i>Doe reproduction (head/doe/year)</i>	
	<i>Kacang goat</i>	<i>Peranakan Etawah goat</i>
Single	1.41	1.10
Twin	2.98	2.16
Triplet	4.58	3.51

3.3 Growth Rate till Weaning and Doe Productivity

Growth rate can be effectively divided into two periods: pre-weaning average daily gain and post-weaning average daily gain (EDEY, 1983). A high pre-weaning average daily gain not only reflects the genetic potential of the growing animals, but also the mothering ability of the doe (LUGINBUHL, 2000). Body weight at birth and at weight at weaning, and growth rate of goats in Indonesia have been investigated by some researchers, their results are summarized in Table 10 and 11 for Kacang and Peranakan Etawah goats respectively.

Table 10: Average body weight at birth and at weaning, and growth rate of Kacang goats at different locations

Location (condition)	Average body weight (kg)		Average daily gain (g)	Researchers
	At birth	At weaning		
Villages	2.4	-	53.2	ASTUTI <i>et al.</i> (1984)
Breeding centre	2.0	9.0	-	SETIADI and SITORUS (1984)
Village	1.7	9.7	-	NGADIYONO <i>et al.</i> (1984)
Breeding centre	-	6.9	-	SETIADI and SITORUS (1984)
Breeding centre	-	-	20.5	TRIWULANINGSIH (1989)
Experim. Farm	-	-	63.2	SITORUS <i>et al.</i> (1995)

Table 11: Average body weight at birth and at weaning, and growth rate of Peranakan Etawah goats at different locations

Location (condition)	Average body weight (kg)		Average daily gain (g)	Researchers
	At birth	At weaning		
Villages	2.5	-	65.4	ASTUTI <i>et al.</i> (1984)
Breeding centre	2.6	10.7	-	SETIADI and SITORUS (1984)
Village	-	-	-	NGADIYONO <i>et al.</i> (1984)
Breeding centre	-	8.6	-	SETIADI <i>et al.</i> (1987)
Villages	2.5	9.9	-	Setiadi (1989)
Breeding centre	2.9	8.9	-	TRIWULANINGSIH (1989)
Breeding centre	3.3	12.7	62.4	Sutama <i>et al.</i> (1995)
Experim. Farm	3.8	-	-	ADIATI <i>et al.</i> (1998)

Growth rate until weaning and doe productivity of Kacang and Peranakan Etawah goats were significantly affected by parity and type of birth (SODIQ *et al.*, 2003). Average growth rate until weaning and doe productivity of Kacang and Peranakan Etawah goats at different parity and type of birth are presented in Table 12 and 13, respectively.

Table 12: Average doe productivity of Kacang and Peranakan Etawah goats at different parity

Parity	Doe productivity (kg/doe/year)	
	Kacang goat	Peranakan Etawah goat
1 st parity	17.72	22.56
2 nd parity	22.00	29.68
3 rd parity	29.12	35.73
4 th parity	40.03	44.84
5 th parity	34.15	36.16
6 th parity	23.24	-

Table 13: Average doe productivity of Kacang and Peranakan Etawah goats at different litter size

Litter size	Doe productivity (kg/doe/year)	
	Kacang goat	Peranakan Etawah goat
Single	14.82	21.21
Twin	29.72	38.75
Triplet	45.01	57.35

3.4 Carcass Characteristics

Carcass characteristics of interest are carcass weight, dressing percentage, ratios of lean : fat : bone, and anatomical distribution of muscle. Generally, the dressing percentage of goats is around 40-50%. As an animal grows, it tends to increase the percentage of fat in the carcass, decrease the percentage of bone while the percentage of lean stays about the same (BOGGS and MERKEL, 1993; LUGINBUHL, 2000). UMIYASIH *et al.* (1993) and RISMANIAH *et al.* (1989) reported that dressing percentage of Kacang and Peranakan Etawah goats ranged from 45.4 - 48.6%, and depends on the age of animals. The average slaughter weight and carcass weight of Kacang and Peranakan Etawah goats are presented in Table 14 and 15, respectively. SODIQ *et al.* (1998b) reported that there were relations between body weight and carcass weight. The carcass weight of local goats in Banyumas' slaughterhouses ranged from 43 up to 48%.

SUDARMOYO (1983) studied the growth rate of tissues of Kacang goats based on an allometry equation (Huxley Allometrix) and revealed that there was no significant effect of sex on the growth of carcass tissues. Table 16 shows the relative growth of carcass tissue of Kacang goats.

Table 14: Average slaughter weight and dressing percentage of Kacang goats at different sex and age

<i>Sex and Age</i>	<i>Slaughter weight (kg)</i>	<i>Dressing percentage (%)</i>
Male		
1-1,5 years	14.2	45.4
1,5-2 years	17.0	45.6
2-3 years	19.5	46.0
Female		
1-1,5 years	14.4	45.9
1.5-2 years	17.1	46.5
2-3 years	20.0	47.4

Table 15: Average slaughter weight and dressing percentage of female Peranakan Etawah goats at different age

<i>Age</i>	<i>Slaughter weight (kg)</i>	<i>Dressing percentage (%)</i>
1-1,5 years	21.3	48.2
1,5-2 years	24.6	48.6
2-3 years	28.0	45.6

4 Development Strategies

The strategy is a unified system with the smallholders farming system as the central unit of the industry. The mechanism of the strategy should reflect the importance of the smallholders system as a basis of the production system (DJAJANEGARA and SETIADI, 1991; ADJISOEDARMO, 1991). There are a number of important development strategies that are worthy of attention. This includes considering the genetic improvement (EDEY, 1983; BRADFORD, 1993; PEACOCK, 1996; TAWFIK, 2001), clear production objectives, developing the avenues of production that are consistent with sustainability, continuing research and validation of research results (DEVENDRA and McLEROY, 1982; DEVENDRA, 1993; ADJISOEDARMO, 1991; KOEMONO, 1991; SOEDJANA, 1993).

- (a) Genetic improvement. Three methods can be used for improving genetic potential for production: (1) import breeds selected for these traits, to replace the local breeds; (2) import improved breeds, crossed with the local breeds and use F_1 or later generations from the cross as the production stock; (3) select within a local breed or crossbred population based on local breeds.
- (b) Clear production objectives. It is important to decide on clear objectives of goat keeping (for meat ,milk or dual purposes). To improve quantity of the meat goat include: total meat yield per animal, total amount of lean meat in the carcass, growth rate, total number of animals available for slaughter. To improve quantity of the milk goat include: total yield, lactation length and number of lactations.

Table 16: Relative growth of carcass tissue (Y) fixed on carcass weight (X) based on $\log Y = \log a + b$

Y and Sex	a	b	r^2
Bone			
Male	0.57	0.64	0.75
Female	0.05	0.79	0.85
Muscle			
Male	-1.01	1.24	0.93
Female	-0.49	1.08	0.97
Fat			
Male	-1.47	0.99	0.14
Female	-2.54	1.34	0.25

- (c) Developing the avenues of production. The prevailing avenues of production need to be examined critically and exhaustively. Priority should be given to the development of the production system that integrate goats with mixed cropping, especially in smallholders' farm systems. It is essential in this task to use appropriate breed(s) and choose these in relation to production objectives, suitability for a given agro-ecological environment and the development of sustainable agriculture.
- (d) Continuing research. Continuing research is vital to sustain and stimulate increased production from goats. There should be a clear focus on breed characteristics, genetic potential, feed resources, feeding and nutrients, physiology, breeding and genetics, improvement management practices, prevention and control of disease, carcass quality and processing. Research priorities are essential in which there should be a balance between fundamental and applied research. Research needs to be identified with the real problems at the farm level and to include the poor and landless peasants who own goats.
- (e) On-farm validation of results. Most research activities within national programmes tend to be carried out on experimental stations and are usually intensive in approach, without wider appreciation of farming systems. This tendency needs to be corrected.

The following points could be taken into account concerning the improvement of management systems for smallholders in rural areas (CHANIAGO, 1994; ADJISOEDARMO, 1991; ANGGRAENI *et al.*, 1995; SODIQ, 2000, 2001; SODIQ *et al.*, 1998b):

- (a) Among improvements in management which are feasible, are subdivision of animal sheds to enable better management of the different classes of stock. Better management during mating and during the perinatal period are two areas where improvements could be carried out without extra costs to the farmer. A major problem is the unavailability of bucks at oestrous as well as inability of the farmer to detect the oestrus doe either due to ignorance or to lack of time. Sharing of

males by a group of farmers is one solution, and less expensive than provision of one male per flock. Extension efforts are needed to improve the farmers' skill in oestrous detection.

- (b) Improvement of management during the perinatal period is another area which would not need extra cash input. This necessitates the subdivision of animal sheds to allow isolation of the dam and her offspring necessary for the establishment of a strong maternal-offspring bond. It means intervention by the farmer to help weak neonates to obtain that first crucial drink of colostrum which is necessary for survival. This intervention needs to be skilfully applied and may well require training of the farmer or the farmers' family by extension staff. It does not require great strength, but time, so it could be taught to the wife and older children in the family.
- (c) Pharmaceutical remedies for the various health problems are well known and effective. Unfortunately, however, they are also expensive, and outside the reach of the smallholder farmer. Farmers already know and use many traditional remedies which are extracted from local plants. There is urgent need for the evaluation of traditional medicines, which are affordable by the smallholder farmer.
- (d) Training and provision of extension personnel knowledgeable in farming systems' approach to whole farm management, with up-to-date knowledge of research findings in the different areas and ability to communicate with smallholder farmers, remains a high priority.

There are two main approaches in goat improvement strategies (PEACOCK, 1996): (1) The improvement of existing systems of goat production. The approach to improving existing systems of goat production should be one of a stepwise progress, in keeping with the owner's objectives. After identifying the owner's reasons for keeping goats and defining with the owner what would be an improvement, technical or economic improvements can be designed. (2) Stocking-restocking people who do not own goats. Supplying goats to people who do not currently own them is a very attractive way for a donor-assisted project to make an immediate and significant impact. There are two main approaches. Firstly, extending goat ownership within a community, often to the poorest members, by providing finance, normally in the form of credit for purchase of goats, either local or improved. Secondly, restocking farmers who have lost their goats, and thus their livelihood, during a drought, disease epidemic or warfare.

Concerning these strategies (ADJISOEDARMO, 1991) reported that an effort to improve on the number of owners and the production performance of existing goats has been undertaken from 1980 to 1990 under the Provincial Development Programme (PDP) supported by the Small Ruminant Credit Project. The target group were the rural poor with 145 villages covered. Based on that project it can be concluded that the small ruminant loan-in-kind project could be used as a means (1) of introducing an improved and appropriate technology, especially artificial insemination for goats, (2) increasing the farmer's income, (3) improving the production performance in rural areas, and (4) improving the farmer's group dynamics.

SABRANI and KNIPSCHER (1982) reported that the Indonesian government encountered the problem of stagnant livestock numbers with a number of so-called animal "dropping" schemes. These are animal distribution programmes where animals are provided on credit according to the traditional gadohan. Under this system female animals are distributed and part of their offspring are used as pay back. Such a sharing agreement is common in all villages of Java as in other parts of Indonesia. Animals are lent by owners to neighbours, relatives or friends in return for a share of the offspring. The gadohan system offers an excellent opportunity for animal distribution, especially if the credit and repay condition are carefully spelled out. SODIQ *et al.* (1997, 1998a); SETYANINGRUM *et al.* (1999) use the "gadohan system" in the project of implementation technology for increasing the income of goat smallholders in rural areas. Presently there are a growing number of goats' distribution schemes based on the sharing principles in Java.

5 Zusammenfassung

Die kleinen Wiederkäuer, Schafe und Ziegen, sind für den ländlichen Raum in Indonesien von großer Bedeutung. Die verbreiteten Ziegenrassen in Indonesien sind die „Kacang“- und die „Etawah“-Ziegen. Die ökonomische und biologische Bedeutung der Ziegen sind wohl bekannt. Neben den tierischen Produkten ist der Koteinsatz als Düngemittel von Bedeutung. Ziegen sind ein wichtiger Bestandteil der bäuerlichen Betriebe und sind das Ergebnis langer Tradition.

Verschiedene Haltungssysteme für Ziegen haben sich auf Grund des Klimas, der Betriebsbedürftigkeit und der wirtschaftlichen Lage entwickelt. Das Ziel der Ziegenhaltung ist die Verbesserung der Produktivität, die ausschlaggebend von der Reproduktion, Wachstum und Mortalität abhängig ist.

Das Ziel der vorliegenden Arbeit ist, die Arbeiten über die Rolle des Zuchtmaterials, des Management und der Produktivität sowie Maßnahmen zur Verbesserung der Ziegenhaltung in Indonesien, zusammenzustellen.

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