

SUBSISTENCE FARMERS' ACCESS TO CATTLE VIA SHARING IN UPLAND FARMING SYSTEMS IN EAST JAVA, INDONESIA

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Summary

In the marginal upland areas of East Java, Indonesia, ruminants provide farming households with tradable assets in addition to manure and draught power. Households are interested in acquiring ruminants at an early stage of household development. This paper discusses farmers' access to cattle via sharing arrangements. In these arrangements owners lend animals to other farmers in return for a share of the offspring or the profits. Livestock owners only entrust cattle to households with prior experience in livestock keeping and sufficient labour. Details of the sharing contracts differ between villages.

Changes in cattle numbers and ownership over time are attributed to patterns of the development of village agriculture and the economic development of farming households. Feed shortages in the dry season bring about short-term changes; cattle numbers decline and the proportion of households rearing shared cattle increases. The institution of sharing plays a major role in replenishing herds after periods of severe drought.

(Key Words : Cattle, Sharing, Upland Areas, Java)

Introduction

Maintaining and improving the productivity of resources in upland areas has been a priority in Indonesia since the 1980s when the country became self-sufficient in rice production (Bashaasha et al., 1993). Keeping ruminants is part of the upland agricultural systems. Palte (1989) states that the systems of ruminant production in the upland areas in the south of Java have been developed in response to demographic pressures and the farmers' need to maintain soil fertility. As population growth in the area increased, so did the ruminant population, and ruminant husbandry had to change from grazing towards cut-and-carry feeding, in which the animals are penned throughout the year. This process started in the first decades of this century (Palte, 1989).

Farmers consider that rearing ruminants, particularly

cattle, is the best way to accumulate capital (Edmundson and Edmundson, 1983; Palte, 1989; Nibbering, 1991). Therefore farming households like to acquire cattle at an early stage of household development. However, most households lack capital to purchase cattle. In Java animal sharing agreements can enable resource-poor farmers to acquire the benefits of keeping animals (Sabrani and Knipscheer, 1982).

This paper evaluates the access of subsistence farming households to cattle via sharing and the division of benefits and responsibilities between owners and sharers in the limestone area of South Malang, a marginal upland area, in East Java.

Materials and Methods

The study area

The limestone area of South Malang in East Java is situated approximately between longitude 112° 08' to 112° 48' east and between latitudes 06° 00' to 08° 30' south. It covers about 68 240 ha of land (Anonymous, 1987). The area consists of hilly and mountainous terrain. The volcanic topsoil from many sloping areas has been washed away by surface runoff and deposited in the valleys. The climate in the area is mainly determined by

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the tropical monsoon, which divides the year into two main seasons, i.e. dry and rainy, with two short transitional periods in between. The rainy season usually starts in October or November and ends somewhere between April and July.

The villages of Putukrejo and Kedungsalam were selected as research sites mainly on the basis of differences in landform and soil characteristics. Putukrejo is situated in a rather flat area at the top of the mountain range, extending somewhat to the Brantas watershed. Its elevation ranges from 450 to 550 m a.s.l. Although also affected by erosion, not all the topsoil has been removed except on steep and very steep slopes. Sugarcane is grown on the flatter areas. Wet rice is cultivated on the valley bottoms. There is hardly any forest. The second village, Kedungsalam, is situated on the southern slope, extending from the highest part of the area from about 400 m a.s.l. in the north to the coast in the south. The village is located on gentle to mostly steep crests and ridges. More than half of the total area is covered by forest or waste land. Agroforestry systems dominate the agricultural land use. In both villages, the population is of Javanese origin.

The differences in land use have important implications for the livestock feed resource base. In Putukrejo a relatively large part of the feed consists of crop residues, in particular sugarcane residues. In Kedungsalam more tree leaves, especially *Gliricidia* sp. are included in the ration.

Cattle are by far the most important livestock in the limestone area, therefore this research concentrated on cattle. The cattle are of the grade-Ongole type.

Data collection

The data collection was done within the framework of the INTERdisciplinary agricultural RESEARCH training (INRES) project; an on-the-job research training project in Farming Systems Analysis (FSA) executed by staff from Brawijaya University, Indonesia, and Wageningen Agricultural University and Leiden University, The Netherlands. INRES aims to develop scenarios for the development of farming systems in the limestone area (Stroosnijder et al., 1994).

In January 1991, 548 randomly selected farms (150 in Putukrejo and 398 in Kedungsalam) were surveyed to estimate the distribution of ruminants over the villages. The number of ruminants and ownership (owned or shared) were recorded per farm. Then, in March 1992, the same parameters were recorded again as part of an INRES household survey on 206 and 350 farms randomly selected respectively in Putukrejo and Kedungsalam. In addition, the respondents were asked to rank the following

reasons for keeping cattle: production of progeny, manure, weight gain, draught purposes and as a form of savings.

From January to March 1991, interviews were conducted with 35 farmers (12 in Putukrejo and 23 in Kedungsalam), to investigate various aspects related to ruminants, such as when and why the respondents decided to start keeping ruminants and how they acquired the animals. Case studies were done on the history of 12 of the 35 households, to collect detailed information on the decision making e.g. with regard to keeping livestock. Similarly, eight owners of large herds of cattle (> 100 animals) – five in Putukrejo and three in Kedungsalam – as well as village officials, were interviewed to obtain additional information on factors affecting the access of individual farmers to ruminants, especially cattle.

Results

Ownership and prevalence of ruminants

Cattle are the most preferred ruminant because they give a higher income than goats and sheep. In Putukrejo and Kedungsalam goats were kept by only 19 and 30% of the households, respectively, and sheep by 20 and 9.5% of the households, respectively. Around 80% of these households kept small ruminants as owned animals only. The reason that in Kedungsalam more households keep goats is that this village has larger *gliricidia* resources than Putukrejo and the leaves of this tree are regarded as good feed for goats. In Kedungsalam, sheep are less popular, because farmers believe that to obtain satisfactory weight gain the sheep must be herded, and this is considered tedious. However, some farmers do not herd their sheep and accept a poorer performance.

Figure 1 shows the changes in cattle distribution and ownership in the two villages Putukrejo and Kedungsalam between January 1991 and March 1992. In January 1991 the proportion of farms keeping cattle in the two villages was very similar (61-62%). In March 1992, however, the proportion was significantly ($p < 0.05$) smaller in Putukrejo (52%) than in Kedungsalam (60%). Three types of livestock farms can be distinguished i.e. farms keeping their own animals only, those keeping owned and shared animals, or those keeping shared animals only. Between January 1991 to March 1992, the proportion of farms keeping owned cattle decreased by 40% in Putukrejo and 12% in Kedungsalam and the proportion of farms keeping shared cattle increased by 53% in Putukrejo and 39% in Kedungsalam. Between January 1991 to March 1992, the estimated total number of cattle in each village decreased by about 10 per cent. The proportion of shared cattle increased from 37 to 56% in Putukrejo, and from 22 to

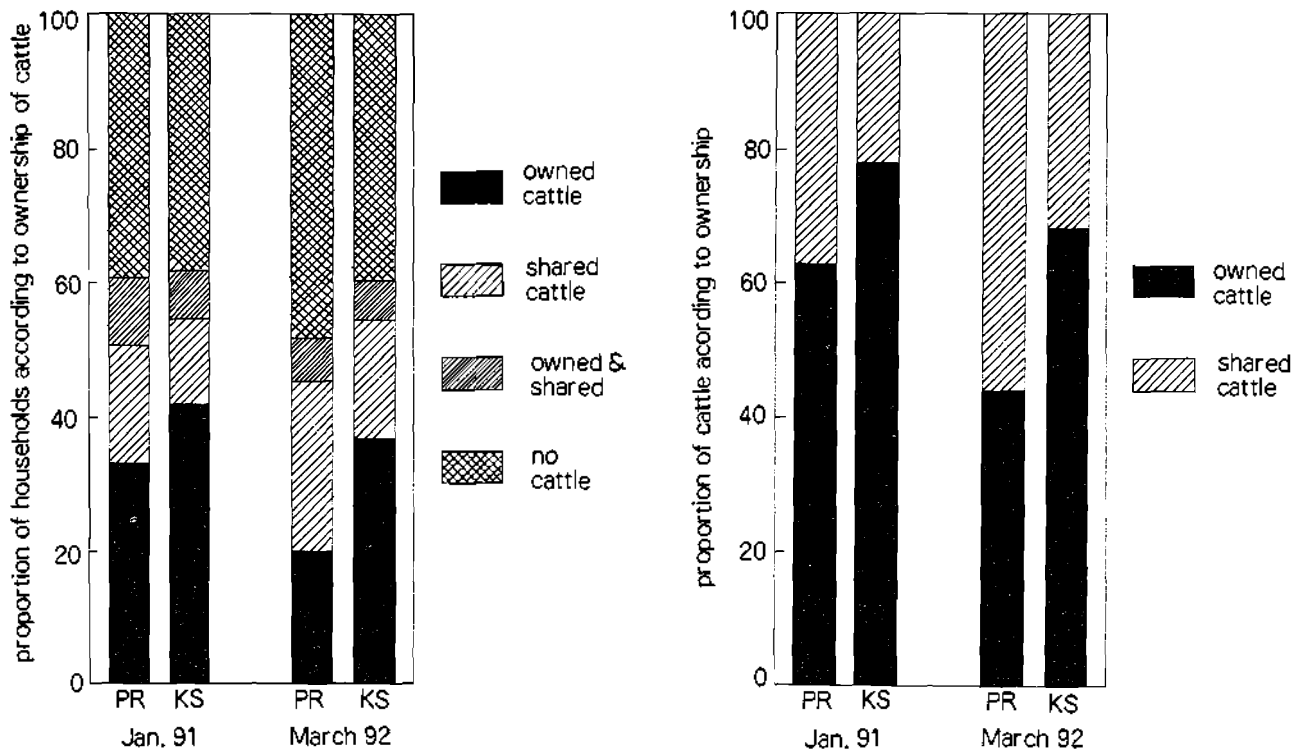


Figure 1. Proportion of households keeping cattle according to ownership and proportion of cattle according to ownership in Putukrejo (PK) and Kedungsalam (KS) in January 1991 and March 1992.

32% in Kedungsalam.

Herd size per cattle farm was the same in the two villages in January 1991, i.e. 1.9 animals. However, in March 1992 it was higher in Putukrejo (2.0 animals) than in Kedungsalam (1.8 animals).

Aim of keeping cattle

Table 1 gives the farmers' ranking of the reasons for keeping cattle. Most farmers opt for the production of progeny and manure as their first objective in rearing cattle, followed by providing draught power and savings.

TABLE 1. PROPORTION OF RESPONDENTS IN THE RANKING PRIORITY OF REARING CATTLE

Aim of keeping cattle	Rank assigned by farmers (%)					No priority (%)
	1	2	3	4	5	
Putukrejo (n = 150)						
Progeny	22	44	22	6	0	6
Manure	67	33	0	0	0	0
Weight gain	0	0	11	33	56	0
Draught	6	11	61	17	0	5
Savings	6	11	6	39	38	0
Kedungsalam (n = 398)						
Progeny	52	37	6	0	0	6
Manure	25	34	21	16	1	3
Weight gain	0	3	9	9	28	51
Draught	6	6	18	16	9	45
Savings	17	21	38	17	0	7

Farmers referred to their cattle as a saving (*tabungan* in Javanese) that gives security. Animals as savings have a higher priority in Kedungsalam than in Putukrejo. Liveweight gain is ranked lowest.

About half of the respondents in Kedungsalam did not rank the option of using animals for draught. This was influenced by several factors, including land quality (soil is often too shallow or stony to be ploughed) and the size of plots (these may be small and can be prepared within a few days, using the hoe). This village has a *sayan* custom of reciprocal help i.e. the members of the community help each other, without payment, to prepare land, build houses and in other activities. Under this custom, those who receive help for land preparation will provide a meal for the helpers. If the helper also brings draught cattle, the farmer who receives the help will provide feed for the animals.

With regard to weight gain, table 1 shows that in each village, half the respondents accorded little priority to this in their cattle keeping. The farmers have no intention of fattening cattle as is done in other villages by farmers of Madurese origin. Farmers in Putukrejo and Kedungsalam consider this to be too risky, because if the animal dies they lose the money and extra time spent on feed inputs. Nevertheless, they are concerned about the weight of their cattle because it determines the selling price.

Requirements for becoming a cattle sharer

From the owner's point of view, sharing out of animals means selecting between prospective sharers, because a considerable financial risk is involved. If the animal dies while in the hands of a sharer, the owner receives no compensation from the sharer. Owners only give their animals for sharing if they are confident that these animals will be taken care of properly. Owners evaluate applicant sharers as follows: (1) the household concerned should have some prior experience with keeping animals and (2) should be able to collect fodder continuously; (3) the applicant should not be a commuter or person who works and stays outside the village for several months a year, and (4) should not be single; and (5) if the applicant has children, these should preferably be grown up or at least belong to the work force, which according to local standards includes persons from 10 years onwards.

It is not always easy for owners to evaluate applicants or monitor the performance of sharers. Therefore, the first choice is relatives living in the same village. The second choice is close neighbours, friends or labourers working on the cattle owner's farm, and the last choice is farmers with a favourable reference from a person known by the

owner. Cattle owners who entrust animals to others generally claim that landless farmers tend to be better carers than those who farm land for crops, because they can concentrate on the management and feeding of animals. The landless are also thought to be more motivated because they rely more on animals than do households with land. The landless farmers expect that by keeping a shared cow they may themselves own valuable capital in the form of a calf at some time in the future.

Importance of sharing animals

As noted above, households who cannot purchase cattle have to start with shared animals. If all goes well, they will eventually have animals of their own and sell progeny to obtain the funds needed to improve the house, or to rent or purchase extra land. The cash earned from selling cattle is also used to finance wedding parties. The history of several households included in the 12 case studies clearly indicates the importance of this role of livestock and the institution of sharing. However, one of the households included in the case studies, which had progressed from a situation with shared animals only to a situation with a number of own animals, sold the animals it owned but retained them on the farm as shared animals. The benefits from the animals obtained from that moment onwards had to be shared with the new owner, but this disadvantage was compensated by the release of funds for purchase of land. In another case, a similar transaction took place and the money released that way was used to cover the initial expenses of renting land and planting sugarcane. The direct result of such a transaction is that a farmer who earlier reared only own animals, becomes a rearer of shared animals. Thus, whereas at the earlier stages of economic development of the household progress is associated with replacing shared animals by owned animals, at later stages of development the reverse could be true.

Obligations and rights of cattle owners and sharers

The initiative for a sharing contract can be taken by the owner as well as by the candidate sharer. Because of the socio-economic position of the latter, however, the initiative most often comes from the owner. There is no written sharing contract. Nevertheless, the conditions of sharing are well defined. The rearer of shared animals is responsible for the daily management of animals. He must inform the owner when the animal is in calf, about to calve or ill. The sharer can use the manure and can use the animal for draught power on his own land. With prior agreement from the owner, the sharer may also use the

animal (s) to plough the land or others, or rent the animal (s) to other farmers for ploughing. The period of time that the shared animal and, if female, her offspring will be on the sharer's farm is not stipulated in advance. In principle, both the sharer and the owner have the right to terminate the sharing contract at any time. The time when offspring should be sold is negotiable. If the sharer dies, the sharing contract is automatically terminated.

There are two types of contract: one regulating the sharing of profits, the other regulating the sharing of offspring. Though there are exceptions (see below), sharing profit normally applies to male animals, whereas sharing offspring applies to females.

The principle of sharing profit is that when the shared animal is sold, the initial value, i.e. the value of the animal when it entered the sharer's farm, is deducted from the selling price and the difference is divided equally between the owner and the sharer. The rules are the same in Putukrejo as in Kedungsalam. Shared cattle are sold only when both the sharer and the owner agree to sell the animal. The reason for sale is often that either the owner or the sharer needs cash immediately. This may lead to frequent and sudden transactions. In one case for example, a young bull was sold 55 days after it arrived on the sharer's farm, because the sharer needed cash to cover medical expenses for his wife. Another reason for a sudden transaction can be that the animal is ill and expected to die. Such animals are sold for very low prices.

The sharing offspring contract applied to female animals is much more complicated than sharing profit contracts, because benefits can be in the form of property rights to progeny or cash. In this case there is also a difference between Putukrejo and Kedungsalam. In Kedungsalam, if the animal is one year old or younger when it arrives on the sharer's farm, the sharer is entitled to the first-born calf and the owner to the second calf. If the animal enters the sharer's farm at an age of more than one year, the first calf will go to the owner and the second to the sharer. In both cases property rights to the third and following calves are divided on a fifty-fifty basis between the cow's owner and the sharer. In Putukrejo, if the animal entering the sharer's farm is one year old or less, the owner will get one-third and the sharer two-thirds of the value of all offspring produced during the rearing period. If the animal is more than one year old when entering the sharer's farm, the value of all offspring will be divided on a fifty-fifty basis. Thus, if the animal is less than one year old at the beginning of the contract period, the owner in Putukrejo gets a smaller share in the progeny but receives the first return sooner. If the animal is more than one year old when it arrives on the sharer's farm, the

owner in Kedungsalam gets a bigger initial return, without the decrease in the overall return that occurs in Putukrejo. In both villages, it holds that if a cow is already in calf when it arrives on the sharer's farm, the first calf goes to the owner and the second to sharer. Thereafter the fifty-fifty sharing of progeny applies.

If one of the partners wants a shared calf entirely for himself or herself, the rules of "susuk-sinusuk" apply: the partner who wants to get the calf must pay half the value of the animal in cash to the other partner. Similarly, if one partner needs cash, the other partner must pay half of the value of the animal. The calf must be at least 8 months old for this. When a shared cow has had two calves and no transaction has yet taken place, the owner and the sharer of the cow are both entitled to 50% of the value of both calves. If one of the partners wants to have the bigger calf for himself he must pay half of the difference in value between the big and the small calves to the partner who will keep the smaller calf. This arrangement is only possible when the younger calf has reached the age of eight months and its value can be assessed.

Although the initial agreement for female cattle is usually of the sharing offspring type, this may be changed if the animal is found to be infertile or if either the owner or sharer needs immediate cash. In such cases, the principle of sharing profit may be applied. In the case of infertility, the owner may replace the animal with another cow or heifer. Cows are considered to be infertile if they do not become pregnant after being served five times or more.

The role of traders

Monetary values of animals are always decided upon with the assistance of a cattle trader. There are three categories of cattle traders in the area. Big cattle traders (*blantik gede*), usually belong to the village elite, have capital and means of transportation, and move from village to village. They purchase animals either directly from the farmers or from small local traders (*blantik cilik*). A third category are the *blantik nampar*, persons who are hired by the *blantik gede*. Their role is to bring animals to the market and sell them on behalf of the big cattle traders. In both Kedungsalam and Putukrejo, the assessment of the value of animals under sharing arrangements is done by the small local trader (*blantik cilik*). This assessment is made on behalf of both the owner and the sharer. The trader receives Rp. 1000 to Rp. 2000 (1 US\$ = 2100 Rp.) from the owner of the animal for this task.

In the case of male animals and sharing profit contracts the *blantik cilik* assesses the value of the animal

at the beginning and end of the rearing period. The price depends on physical characteristics such as colour, teeth, age, size and weight. Using these criteria the animal is valued according to the locally prevailing price. The value of mature cattle ranges from Rp. 400 000 to 800 000. The role of the trader is not only to arrive at "a good standard price" but also to avoid conflicts between owner and sharer arising from a different perception of the value of the animal. This assessment of the value of animals is an essential part of both the sharing profit and the sharing offspring agreements. The value of a calf is assessed when the animal is weaned at the age of about eight months.

Discussion

Cattle are an important asset for resource-poor farmers in the limestone area. By selling cattle, the farming households can earn a relatively large amount of cash which can be used to improve their possessions or to cover major expenses incurred in the household cycle. Sharing systems have a supportive role in gradually improving or maintaining the standard of living.

The current prerequisites for becoming a cattle sharer show that in principle a farm may have access to shared animals if the farmer has enough family labour to collect forage and has prior experience with rearing ruminants. The latter implies that young couples with no experience in rearing ruminants are excluded from the benefits of rearing cattle, unless they have funds to purchase animals themselves. One option open to such couples is to start with small ruminants. If the couple is able to build up the right social network and is accepted by the part of the community which controls the cattle resources, they may obtain a shared animal after their children are about ten years old and can help to collect forage.

The land characteristics and major activities of wealthy villagers influence land use systems and the farmers' access to cattle. Compared with Kedungsalam, farmers in Putukrejo have better chance of obtaining shared cattle from the wealthy villagers. This is because the wealthy villagers in Putukrejo, i.e. the sugarcane owners, also want to maximize benefit from their land under sugarcane. Apart from producing canes, the sugarcane area also produces sugarcane tops, ratoons and sugarcane leaves which can be used as cattle feed. Sharing out cattle to labourers and giving them priority to use the tops of canes they harvest, effectively gives the sugarcane farmer extra income from cattle and also binds labourers more closely to his farm. Sugarcane was introduced around the year 1978. From that moment on this process gradually developed. In Kedungsalam, it is difficult to obtain cattle

from wealthy villagers i.e. the kiln owners. This is because these members of the community prefer to invest their capital in limestone burning. The kiln owners believe that the demand for labour to burn limestone in the dry season may compete with the demand for labour to collect forage. To produce 5.5 t of lime from a kiln in Kedungsalam (the average production of lime per burning, taking about two weeks) requires 540 labour hours (Van Helden, 1991). However, data on labour hours needed to collect forage in Kedungsalam indicated that the labour requirements for feeding one animal are on average only 34 hours per fortnight (Ifar, S., personal communication).

Nevertheless, there are several ways for poor farmers in Kedungsalam to gain access to cattle e.g. by sharing animals owned by better-off relatives or friends living in the same village or elsewhere. Many start off by sharing small ruminants from better-off farmers. In addition, people who have left the village to get a better income in the city regularly send remittances to their families in the village. Whenever possible, these remittances are converted into cattle.

During the survey period both the proportion of farms with shared cattle and the proportion of shared cattle increased. This increase was more pronounced in Putukrejo than in Kedungsalam. This difference is related to the land use systems. The changes in cattle ownership were affected by the shortage of feed during the dry season of 1991. In that season, farmers in Putukrejo who had difficulty in finding forage had to purchase rice straw. In Kedungsalam, shortage of forage also occurred but the forest area in this village could, to some extent, buffer the need for forage. In Putukrejo, many farmers had to sell their animals to the better-off farmers, though they retained these animals on the farm as shared animals. The price of animals dropped by about 30 per cent in this period of forced sale. There is an indication that the money obtained through this procedure was used not only for rice straw to feed the cattle but also to purchase staple foods (Van Rheenen, personal communication). So, changes in ownership of cattle act as a buffer against periods of drought. Pronounced dry seasons like the one in 1991 have occurred erratically in 30% of the last 20 years (Widiyanto, personal communication).

For most farmers, the main aims of keeping cattle are to produce progeny and manure (table 1). The first aim can be justified by the fact that, whether rearing shared or own cows, the progeny provides the farmer with an additional tradable asset. Manure is considered essential to maintain soil fertility in the area. Farmers find that artificial fertilizer is most effective when combined with farmyard manure (FYM). This is in line with the

observations of Palte (1989) in the upland area in Central Java and Edmundson and Edmundson (1983) in other villages in the limestone area of South Malang, who found that manuring is necessary for crop farming in that area. The latter researchers found that farmers applied half a tonne of dry manure per hectare per year. This ensures good soil structure but does not improve the availability of soil nitrogen, potassium and phosphorus to a level at which high yield of crops can be obtained. In Putukrejo, Widiyanto (1993) found that the utilization of NPK inorganic fertilizers by maize and cassava is improved when these fertilizers are combined with air-dry FYM. The application of 10 t ha⁻¹ of air-dry FYM in combination with NPK fertilizers compared to the application of fertilizers only increased yields of fresh cassava roots and maize cobs by 24 and 50%, respectively. This rate of FYM application exceeds the manure-producing capacity of the present herd. The average number of cattle in Putukrejo and Kedungsalam is about two head per hectare of agricultural land. These animals would only produce 1.2 t ha⁻¹ of air-dry FYM annually. This implies that attempts to improve crop production by using more FYM in the area studied is limited by the herd size.

There is no real indication that shared animals are managed differently from owned animals. Data on amounts of feed offered suggest that the amount of digestible organic matter offered per kg metabolic weight was significantly higher in farms keeping their own cattle and in farms solely keeping shared cattle than in farms keeping shared and owned cattle (Ifar, S., personal communication). There were, however, no significant differences in weight gain of animals between these three types of farms.

The subject of sharing receives little attention in the literature. However, studies on the feasibility of new technologies should consider sociological factors involved in keeping livestock. There are two types of factors that play a part in livestock keeping, i.e. the sharers and the owners. Any intervention has to be accepted by both of them. In the economic analysis of livestock systems at farm level, the division of inputs and outputs between owner and shareholder should be considered when estimating economic benefits and returns to labour and capital.

It can be concluded that sharing practices result in a more optimal use of the resources labour, capital and feed at village level.

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Literature Cited

- Anonymous. 1987. Kabupaten Malang Dalam Angka. Kantor Statistik Kabupaten Malang. Malang, Indonesia.
- Bashaasha, B., W. Dogbe, A. Hartveld, Li Ou, G. Mes and F. Turkelboom. 1993. Constraints and development potentials of Yogyakarta critical uplands Indonesia. A summary of study. International Centre for Development Oriented Research in Agriculture (ICRA), Wageningen.
- Edmundson, W. C. and S. A. Edmundson. 1983. A decade of village development in East Java. *Bulletin of Indonesian Economic Studies*. XIX, no. 2:46-57.
- Nibbering, J. W. S. M. 1991. Hoeing in the hills. Stress and resilience in an upland farming system in Java. Ph. D. thesis. The Australian National University, Australia.
- Palte, J. G. L. 1989. Upland Farming on Java, Indonesia: A Socio-economic Study of Upland Agriculture and Subsistence Under Population Pressure. *Nederlandse Geografische Studies* no. 97. Utrecht.
- Sabrani, M. and H. C. Knipscheer. 1982. Small ruminants for small farmers. *Indonesian Agricultural Research and Development Journal* 4:86-90.
- Stroosnijder, L., S. Efde, T. Van Rheenen and L. Agustina. 1994. QFSA: a new method for farm level planning. In: *The Future of the Land*, Proceedings of the 75th anniversary conference of Wageningen Agricultural University (Eds. L. Fresco, L. Stroosnijder, J. Bouma and H. van Keulen). John Wiley and Sons, Chichester, pp. 299-332.
- Van Helden, F. W. 1991. Lime and livelihood in Kedungsalam. Mimeograph INRES project, Interdisciplinary Agricultural Research Institute, Brawijaya University, Malang.
- Widiyanto. 1993. Pengaruh pemberian pupuk kandang dan pupuk NPK terhadap pertumbuhan dan hasil tanaman jagung dan ubikayu secara tumpangsari pada lahan kering di Putukrejo Malang Selatan. Mimeograph INRES project, Interdisciplinary Agricultural Research Institute, Brawijaya University, Malang.