A comparison of feeding management practices of beef cattle smallholders in lowland and upland sites in East Java [1]

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ABSTRACT: Improved utilization of crop by-products is seen as essential on increasing productivity of smallholder cattle production in East Java. We report on a study to describe and compare feeding management practices in lowland and upland sites in East Java. A total of 184 farmers were interviewed in March-May, 2010, focusing on farm-household characteristics, cropping patterns, cattle numbers and uses, and feeding practices, especially with regard to rice straw. The lowland and upland cattle production systems varied in some important ways, reflecting the different agro-ecological and socio-economic characteristics of the two study sites. In the more intensively managed lowland site, farmers had more cattle and tended to specialize in calf production, whereas the upland farmers produced calves, young cattle, and adult cattle for sale. Use of cattle for draught power was less common than in the past, especially in the upland site. The high importance of rice straw as a source of feed was evident in both sites. Most of this feed was obtained from other farms, whether directly or by purchase. The greater scarcity of this resource in the upland site means that farmers travelled longer distances and incurred a higher total cost to obtain their supply. Rice straw was dried for 3-4 days and stored in the lofts of cattle sheds. Planted grasses and legumes were also fed to cattle, but there appears to be potential to increase their production and utilization, especially shrub legumes.

Key words: mixed farming systems, crop by-products, planted forages, feed supply

INTRODUCTION

Increasing the population of beef cattle has become a high priority for the Government of Indonesia, which aims to achieve self-sufficiency in beef by 2014. Whatever the merits of this policy goal, without additional feed resources becoming available to smallholder cattle producers, it is very difficult to see the program being successful. Indonesia has considerable potential agricultural by-products as a source of animal feed. Much of this abundance of biomass derived from agriculture and other industries is still neglected. Many potential feedstuffs are considered to be a problem in farming and agro-industries and are simply thrown away or burned (Diwyanto and Priyanti, 2007). Syamsu *et al*. (2003) stated that rice straw accounts for 85% of agricultural by-products used in animal production in Indonesia, followed by maize stover (6%) and groundnut hay (3%). Rice straw could yield 48 million tons per year from around 12 million ha of harvested area on irrigated rice fields across the regions (Haryanto, 2009).

East Java has the highest beef cattle population of any province in Indonesia, with 3.4 million head in 2009, contributing 21% of national beef production (Ditjennak, 2009). The number of cattle farm-household in East Java was 1.9 million according to the 2003 Agricultural Census (Ditjennak, 2009). This was the highest of any province and accounted for almost 42% of the total number of cattle farm-households in Indonesia. Households predominantly manage 1-2 head by an intensive cut-and-carry system. Many of these cattle are raised by landless households in which the main income sources are from agricultural wage work and raising cattle based on low quality feeds, such as native grasses, rice straw, and other crop residues. East Java also accounted for 2 million ha of wetland rice fields (BPS, 2009), estimated to produce around 8 million tons of rice straw. Diwyanto and Priyanti (2007)

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reported that a one-hectare of rice-field can produce sufficient rice straw to feed two cattle throughout the year. Greater utilization of this rice straw would increase the feed resources available for cattle production such that East Java could potentially carry around 4 million head.

There are few opportunities in East Java for significant increases in the production of feed given the intensity of land use for food crops. Improving the productivity and profitability of smallholder cattle farming will require greater and more efficient utilization of currently underutilized feed resources, particularly rice straw and other crop by-products. This study aimed to compare the feeding management practices of smallholder producers at two sites in East Java – lowland and upland – in order to assess the potential for improving beef cattle production based on the availability of local feed resources. Lowland and upland sites have different agro-ecosystems, as well as different socio-economic constraints and opportunities, affecting the potential to improve feeding practices and animal productivity. The study is part of a long-term interdisciplinary research project funded by the Australian Centre for International Agricultural Research (ACIAR) – "Improving the reproductive performance of cows and the performance of fattening cattle in low-input systems of Indonesia and Northern Australia" (LPS/2008/038).

MATERIALS AND METHODS

A survey was conducted from March to May, 2010, in four villages in East Java – three adjoining lowland villages (Klampok in Probolinggo District and Dandanggendis and Sumberanyar in Pasuruan District) and one upland village (Srigonco in Malang District). Probolinggo and Pasuruan are 25-150m asl, while Malang is 550m asl. Respondents in the study were 184 farmers rearing Ongole Cross (PO) cows as collaborators in the ACIAR project, 79 farmers in the lowland site and 108 farmers in the upland site. Respondents were interviewed using a structured questionnaire, which included items related to household and farm characteristics, cattle numbers, the acquisition, use and management of rice straw, and the use of legumes.

RESULTS AND DISCUSSION

Characteristics of Farm Households

There were no obvious differences between lowland and upland sites in the characteristics of farm-households (Table 1). On average, farmers were in their 40s, had small families (4-5 members), limited education (not completing elementary school), but with around 20 years of experience in agriculture and cattle production.

Table 1. Characteristics of farm-households

	Lowland site (n=76)			Upland site (n=108)		
Characteristic	Mean	Min	Max	Mean	Min	Max
Number of family members	4.2	1	8	5.1	2	10
Husband's age, yrs	44.6	24	75	47.6	27	80
Wife's age, yrs	39.8	22	67	42.5	21	80
Husband's education, yrs	3.9	0	12	5.3	0	12
Wife's education, yrs	3.6	1	9	5.4	2	12
Farming experience, yrs	19.1	0	60	23.6	2	60
Cattle experience, yrs	17.3	0	50	19.4	1	60

Table 2. Main occupation of respondents

	Lowland site		Upland site	
Occupation	No.	%	No.	%
Farmer	51	67.1	106	98.2
Farm/non-farm labour	21	27.6	1	0.9
Seller/entrepreneur	2	2.6	1	0.9
Private company staff	2	2.6	0	0.00
Total	76	100.0	108	100.0

While most respondents in both sites indicated that farming was their major occupation, over a quarter of lowland farmers (28%) relied mainly on farm or non-farm wage work for their livelihood because the land they managed was not sufficient to support them (Table 2). Hence own-account crop and livestock activities were necessarily a secondary source of income.

Farm Size and Land Use

Lowland farmers owned about 0.4 ha, evenly divided between paddy fields and dry land fields, whereas upland farmers averaged 0.7 ha, most of which (94%) was dry land (Table 3). Some farmers had larger holdings, up to 4 ha. A small number of farmers (4% in the lowland site and 6% in the upland site) rented crop land to meet their subsistence requirements, averaging 0.25 ha and 0.85 ha, respectively.

Table 3. Farm size by land type (ha)

	Lowland site				Upland site			
Land type	Mean	%	Min	Max	Mean	%	Min	Max
Paddy field	0.18	47.4	0.02	1.58	0.04	6.2	0.00	2.50
Dry land field	0.20	52.6	0.02	2.00	0.61	93.8	0.02	4.00
Total	0.38	100.0	-	-	0.65	100.0	-	-

Table 4. Cropping systems in paddy fields in 2009

	Lowland site		Upland site	
Cropping system	No. of households	Percentage	No. of households	Percentage
Rice-Rice-Rice	4	5.3	0	0.0
Rice-Rice-Maize	5	6.6	0	0.0
Rice-Maize-Maize	29	38.2	1	0.9
Rice-Rice-Fallow	0	0.0	2	1.9
Rice-Fallow	2	2.6	1	0.9
Maize-Maize	2	2.6	1	0.9
Rice-Maize-Soybean	11	14.5	0	0.0
Rice-Maize-Peanut	1	1.3	2	1.9
Rice-Maize-Tobacco	1	1.3	0	0.0
No access to paddy field	21	27.6	101	93.5
Total	76	100.0	108	100.0

Table 5. Cropping systems in dry land fields in 2009

	Lowland site		Upland site	
Cropping system	No. of households	Percentage	No. of households	Percentage
Rice	0	0	6	5.6
Rice-Maize-Maize	14	18.4	63	58.3
Rice-Maize-Soybean	9	11.8	8	7.4
Rice-Peanut	0	0.0	3	2.8
Maize-Maize	10	13.2	1	0.9
Maize-Soybean	11	14.5	1	0.9
Maize-Cassava	2	2.6	14	13.0
Maize-Soybean-Peanut	2	2.6	0	0.0
Maize-Peanut	3	4.0	4	3.7
Maize-Maize-Peanut-Cassava	1	1.3	0	0.0
Sugarcane/Tobacco/Timber	3	4.0	4	3.7
No access to dryland field	21	27.6	4	3.7
Total	76	100.0	108	100.0

Paddy fields in the lowland site were mostly used to produce three crops per year (Table 4). The main wet season crop was rice (70% of households) but this was frequently followed by one or two crops of maize (65%), with some soybean production as well. Surprisingly, 28% of households in the lowland site had no access to a paddy field, presumably those who depended mainly on wage work.

In the dry land fields, there were twelve cropping systems as shown in Table 5. The dominant cropping pattern, especially in the upland site, was rice-maize-maize. Hence maize stover has to be considered a major source of feed in the upland site. Mariyono *et al*. (2005) stated that feeding maize stover to PO cows gives a relatively smaller loss in live-weight 60 days after birth, with a positive effect on reproduction.

Cattle Production

On average, lowland farmers managed 3.8 cattle while upland farmers managed 2.9 cattle (Table 6). In both sites, the majority of farmers (82% and 77% respectively) managed 2-4 cattle, just over half of which were adults. At the time of interview, the breakdown of the herd was as shown in Table 6, with minor differences between sites, except that lowland farmers averaged 60% more calves. A minority of farmers (46% and 30% in lowland and upland sites, respectively) were involved in a cattle-sharing arrangement, accounting for 1-3 cattle per household. In the lowland site, cattle were mainly kept in stalls in the house yard. In the upland site, cattle were kept in small yards within the village.

Table 6. Number of cattle owned by age class

	Lowland site (n=76)			Upland site (n=108)		
Age of cattle	Mean	Min	Max	Mean	Min	Max
Adults (>2 yrs)	2.0	0	5	1.5	1	4
Young (1-2 yrs)	0.5	0	3	0.6	0	2
Calves	1.3	1	3	0.8	0	3
Total	3.8	-	-	2.9	-	-

Based on the respondents' recalled answer, the calving interval was somewhat longer in the upland site, which was 16 months, than in the lowland site (14 months). Likewise, calf mortality was reported to be higher in the upland site (8% compared with 1%). Unspecified diseases and deaths in utero were reported to be the main causes of calf mortality.

Few respondents used cattle for draught – 26% and 11% in the lowland and upland sites, respectively. Of those using cattle for draught, most used them in their own fields for only 6-8 days per crop season. In the lowland site, draught cattle were also rented out for Rp 26,000 per day (including human labour).

The main outputs of the cattle production activity are shown in Table 7. About 92% of lowland farmers produced calves, and 78% specialized in calf production, there being little capacity to grow (let alone fatten) animals in this intensive land-use system. In contrast, only 18% of upland farmers specialized in calf production, most (82%) rearing adult cattle. There were no specialized fattening operations in either site.

Table 7. Outputs of cattle production activity

	Lowland site		Upland site	
Output	No. of households	Percentage	No. of households	Percentage
Calves only	59	77.6	19	17.6
Calves and unfattened cattle	11	14.5	25	23.2
Calves, unfattened and "fattened" cattle	0	0.0	11	10.2
Unfattened cattle only	6	7.9	51	47.2
Unfattened and "fattened" cattle	0	0.0	2	1.9
"Fattened" cattle only	0	0.0	0	0.0
Total	76	100.0	108	100.0

Feeding Management

Almost all farmers in both sites fed rice straw to their cattle, but the sources of rice straw varied (Table 8). Only a minority of farmers (18% in the lowland site and 4% in the upland site) sourced their rice straw exclusively from their own fields. Most farmers in both sites (74% and 80%, respectively) collected the rice straw themselves, whether from their own or others' fields. In the upland site, 58% of farmers formed groups to collect rice straw, often in other sub-districts, requiring them to pool their resources to hire a truck for the purpose. Purchasing of straw from other farmers or agents occurred in the lowland site in 24% of cases. Most farmers in both sites (62% and 73% in lowland and upland sites, respectively) dried the rice straw for 3-4 days, before storing it in lofts over the animal pens.

Table 8. Sources of rice straw

	Lowland site		Upland site	
Source	No. of households	Percentage	No. of households	Percentage
Collected from own field	14	18.4	4	3.7
Collected from other fields	16	21.3	6	5.6
Collected by group from other fields	0	0.0	10	9.4
Collected from own and other fields	23	30.7	13	12.2
Collected from own or other fields, and group collection	3	4.0	52	48.6
Bought from other farmers	2	2.7	0	0.0
Bought from agent	3	4.0	0	0.0
Collected from other fields and bought from agent	13	17.3	0	0.0
All of the above	1	1.3	22	20.6
No rice straw fed	1	1.3	1	0.9
Total	76	100.0	108	100.0

In the upland site, where farmers collected rice straw in a group, the straw was transported to the village by renting a truck, costing an average of Rp 145,000 for one trip. The farmers never paid for the rice straw in cash, so the cost of renting the truck was the only cash outlay. The number of farmers in a group averaged of 5.4, with more men than women, and the trip typically required two days. On average, about 3.2 tons of straw were obtained in this way at one time, implying a cash cost of about Rp 45/kg. In the lowland site, farmers who collected rice straw within the village at harvest averaged 9 person-days. This is comparable to the 11 person-days required in the group collection process in the upland site. Farmers who bought rice straw in the lowland site paid on average Rp 119/kg. As farmers in the uplands combined both their own labour-time and the cost of hiring a truck, they incurred a higher total cost for rice straw, reflecting the greater scarcity of this feed resource locally.

All farmers in both sites had dry land areas that could be used to plant forages. In general, forages are only planted along terraces or embankments, or in the backyard. Supriadi and Musofie (2005) reported that the availability of forages is highly dependent on the season. Suharjo *et al.* (1995), cited by Supriadi and Musofie (2005), stated that forage grasses in the dry season produce only one third of the wet season production. Farmers do not pay much attention to the quality of the forage itself but are merely concerned with whether there are some forages available to supplement other feed sources, primarily in the dry season.

Most farmers (54% in the lowland site and 81% in the upland site) planted forage grasses – primarily elephant and king grass (Table 9). A lower proportion (only 13% in the lowland site and 66% in the upland site) planted forage legumes, mainly *Gliricidia* in the uplands and *Leucaena* in the lowlands. The greater area of dry land per household in the upland site permitted planting of more shrub legumes.

Table 9. Types of forage planted

Forage	Lowland site		Upland site	
	No. of households	Percentage	No. of households	Percentage
Grasses				
Pennisetum purpureum (Elephant grass)	19	25.0	62	57.4
Pennisetum purpureophoides (King grass)	21	27.6	25	23.2
Others	1	1.3	1	0.9
None	35	46.1	20	18.5
Total	76	100.0	108	100.0
Legumes				
Gliricidia sepium (gamal)	0	0.0	45	41.7
Leucaena leucocephala	9	11.8	19	17.6
Sesbania sp.	1	1.3	0	0.0
Others	0	0.0	7	6.5
None	66	86.8	37	34.3
Total	76	100.0	108	100.0

The survey showed that feeding legumes to cattle was somewhat more common in the upland site (90%) than the lowland site (70%) (Table 10). Those not feeding legumes to their cattle claimed the cattle refused the legumes, they had no land to plant legumes, or they had no knowledge about their use as forage. There appears to be potential to increase the use of legumes, particularly in the upland site. However, Scaglia *et. al.* (2008) reported that differences in forage management have little observable effect on cow productivity because of year-to-year variability in environmental conditions. Therefore, it is likely to be difficult to convince farmers to increase legume production and utilization.

Table 10. Incidence of feeding legumes to cattle and reasons for not feeding legumes

Use of legumes	Lowland site		Upland site	
	No. of households	Percentage	No. of households	Percentage
Legumes fed to cattle	53	69.7	97	89.8
No legumes fed to cattle	21	27.6	11	10.2
Reasons for not feeding legumes:				
- no field for planting	6	7.9	1	0.9
- cattle refuse legumes	11	14.5	5	5.6
- no knowledge of feeding legumes	4	5.3	1	0.9
- other	1	1.3	1	0.9
Not ascertained	2	2.6	0	0.0
Total	76	100.0	108	100.0

There were differences between the two sites in terms of the quantity of rice straw and legumes fed to animals daily. In the lowland site, 99% of farmers fed rice straw to their cattle, averaging 22 kg/head/day. More farmers in the upland site (98%) fed rice straw to cattle, averaging around 14 kg/head/day. Elephant grass was fed by farmers in both sites, 60% of farmers in the lowland and 89% of farmers in the upland, averaging 21 kg/head/day and 16 kg/head/day, respectively. Farmers in the lowland did not feed King Grass and *Gliricidia* to their cattle. However, in the upland site, King Grass was fed only by 2% of farmers (averaging 9 kg/head/day) while *Gliricidia* was fed by 67% of farmers (averaging 8 kg/head/day). Farmers in the two sites also fed *Leucaena* to their cattle, averaging 8 kg/head/day by 21% of farmers in the lowland site and 6 kg/head/day by 46% of farmers in the upland site.

CONCLUSIONS

Smallholder cattle production is one activity in a diversified, mixed farming system in East Java, in which both wetland and dry land fields are used for a range of cropping systems. The lowland and upland cattle production activities varied in some important ways, reflecting the different agro-ecological and socio-economic characteristics of the two study sites. In the more intensively managed lowland site, farmers had more cattle and tended to specialize in calf production, whereas the upland farmers produced calves, young cattle, and adult cattle for sale. Use of cattle for draught power was less common than in the past, especially in the upland site. The high importance of rice straw as a source of feed was evident in both sites. Most of this feed was obtained from other farms, whether directly or by purchase. The greater scarcity of this resource in the upland site means that farmers travelled greater distances and incurred a higher total cost to obtain their supply. Rice straw was dried for 3-4 days and stored in lofts over feeding pens. Planted grasses and legumes were also fed to cattle, but there appears to be potential to increase their production and utilization, especially shrub legumes.

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