Small-Scale Beef Cattle Production in East Java, Indonesia

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Abstract

Despite its small area and intensively cropped landscape, East Java accounts for 30% of Indonesia's beef cattle population. About two million households draw on family labour to raise cattle in backyard sheds and small enclosures, largely for cash income. The paper reports on a study in two contrasting sites – irrigated lowlands and rainfed uplands – to explore the constraints facing cattle producers in these environments and possible means to enhance their production systems and incomes. In particular, the paper focuses on the issue of feed supply and the local market that has emerged for agricultural by-products (rice straw, maize stover, and legume residues) and planted forage grasses. The research shows that intensive cattle production can provide a viable pathway out of poverty, even for resource-poor households.

Keywords

smallholders; beef cattle; crop by-products; integrated farming systems; rural livelihoods

Introduction

Indonesia's population of 238 million people qualifies it as the fourth most populous country in the world. Though it is an archipelagic country, with more than 13,600 islands, almost 60% of the population lives on the island of Java, which has a population density of just over 1,000 persons per sq. km, making it one of the most densely populated agricultural regions in the world. The rate of population growth has declined from 2.2% in 1980 to 1.5% in 2010, largely due to a successful family planning program. Nevertheless, the total workforce numbers 120 million, 44% of whom are employed in the agricultural sector. Hence agricultural and rural development remains central to improving the livelihoods of large numbers of poor rural households, even though agriculture's share of GDP has fallen to around 15% (BPS 2011).

In its landmark World Development Report on *Agriculture for Development*, the World Bank (2007) identified Indonesia as one of a cluster of "transforming economies" in which "… agriculture contributes less to growth, but poverty remains overwhelmingly rural…. Growth in agriculture and the rural nonfarm economy is needed to reduce rural poverty and narrow the urban-rural divide" (World Bank 2007: 30). The Report outlined three potential "pathways out of poverty" for large numbers of rural households: (1) moving from subsistence-oriented to market-oriented farming; (2) moving into non-farm rural employment or business; (3) migration out of the rural sector, including international migration (World Bank 2007). Clearly, many households in Indonesia are pursuing the second and third strategies. Davis et al. (2007) estimated that in 2000, farm-oriented households (subsistence- and market-oriented) accounted for 16% of rural households, labour-oriented households for 37%, migration-oriented households for 12%, and diversified households (combining two or more of these strategies) for 36%. Nevertheless, given the rapid growth of urban population and incomes, the potential for market-oriented farming – both crop and livestock production – to provide a pathway out of poverty for rural households remains significant, even for households with limited assets.

According to Delgado et al. (1999), the growth in demand for meat in developing economies such as Indonesia underpins a "livestock revolution", which they regard as one of the largest structural shifts to ever affect food markets in developing countries. How this revolution is handled is seen as crucial for food security, the livelihoods of the rural poor, and environmental sustainability. In 2009, the Indonesian Government promoted a national beef self-sufficiency program in response to the growing population and rising per capita demand for beef, the latter due to the rapid growth of the urban middle-class economy. The program seeks to increase the numbers and productivity of the domestic cattle herd. This will influence the continuing evolution of cattle production systems in Indonesia, with significant implications for small-scale producers.

It might be expected that the expansion of cattle production would primarily take place in the extensive farming systems of the "outer islands" of Indonesia rather than the intensively cropped island of Java, where three crops per year is the norm in the lowlands. It is generally understood that as cropping systems are intensified, commercialised, and mechanised, both

the need for draught animal power and the availability of grazing land decline, leading to a fall in numbers of large ruminants. Nevertheless, livestock income[1] in East Java is the highest of any province in Indonesia and increased at the rate of 3.7% during the period 2006-2010 (Statistics of Jawa Timur Province, 2011). East Java accounts for 32% of the national cattle herd as reported by the recent livestock census (Kementan-BPS, 2011). The Ongole Cross (PO), introduced long ago from India by the Dutch, is the dominant breed in East Java, accounting for 34%, and used for breeding and fattening operations. Other breeds are Madura (21%), Bali (3%), and a variety of crosses, primarily between Ongole and Simmental, Limousin, and Brahman, accounting for around 42% (Dinas Peternakan Jawa Timur, 2009). About 1.9 million farm-households are involved in mostly small-scale cattle farming (Ditjen Peternakan, 2010), giving direct support to rural livelihoods.

In this paper we examine the nature and potential of small-scale cattle production in East Java, with particular emphasis on the relation between crop and cattle production.[2] We show that the increased demand for beef has induced an increased demand for feed, hence for the by-products of the intensive cropping system that is a feature of East Java. It is this close integration of crop and livestock production that has permitted the growth of beef cattle numbers in such a densely populated and intensively farmed region. However, access to land and crop resources differs between households and between regions (especially between lowland and upland regions). Hence cattle producers have had to devise ways to match their demand for feed with the available supply of rice straw and other crop by-products in the region. This has led to the emergence of a market supply chain linking crop producers and cattle producers in the lowlands and to cooperative arrangements for importing feed into the less productive uplands.

Background

More than 90% of beef cattle production in Indonesia is derived from smallholder cattle operations, often with only 2-3 cattle per household. There is a diversity of small-scale cattle systems in East Java. While in some cases the land, labour, livestock, and feed sources are all

[1] In 2008 livestock regional gross domestic product for East Java was estimated at IDR 8.2 quintillion in constant 2000 prices, i.e., over AUD 800 million (Badan Pusat Statistik, 2010). 1 AUD = 9,566 IDR on 2 February 2012.

[2] The paper draws in part on data reported in two earlier papers, Hanifah et al. (2010) and Mahendri et al. (2010).

combined within a single household, in others the ownership and management of these production inputs are dispersed among various actors, as for example when a landless household rears cattle in its backyard, maybe on a share basis, and obtains or purchases feed from common and private land. Many farmers in East Java keep cattle for draught power, manure, and as a form of savings to be sold when cash is needed. Others in more intensive systems focus on producing and selling calves. In general, however, cattle production is an example of market-oriented farming, with cash income the primary motivation. In other areas such as Bali and Lombok, it has also been found that cattle are raised as an important source of cash income (Patrick et al., 2010). Moreover, small-scale cattle production is generally subject to a low degree of risk and creates employment for various family members, particularly women and children.

There are also now some small- to medium-scale fattening operations (10-20 cattle) and a small number of commercial feedlots (up to 3,000 cattle) which take in feeder cattle to be fattened. There seems to be a greater willingness to focus on cattle fattening as a business, particularly in the main centres of beef cattle production in the north (Lamongan, Tuban, Bojonegoro), north-east (Pasuruan, Probolinggo, Blitar and Malang), and in the west (Magetan and Ngawi). However, the vast majority of cattle operations in East Java are small-scale, family-run, cow-calf enterprises, relying as far as possible on locally available feeds.

Small-scale cattle production is well integrated with intensive crop production such that crop residues and by-products are a major source of cattle feed, while cattle still provide draught power and manure for cropping. Especially in the lowlands, cattle management is very intensive, with cattle permanently housed in backyard barns utilising a cut-and-carry feeding system. The most commonly used feeds are agricultural by-products such as rice straw, maize, mungbean and peanut stover, and sugarcane tops and leaves. These feeds are obtained from the producer's own farm and/or other farms, whether directly or by purchase. Smallholders also cut the native grasses that are available in the village surroundings and introduced grasses that are grown on their marginal lands. Other feeds such as rice bran, molasses, *tofu* waste, and cassava are also fed to the cattle, but mostly in fattening operations.

To help achieve the target of beef self-sufficiency by 2014, the Provincial Government of East Java has launched the "Sapi Berlian" program with the aim of producing 5 million calves

within five years. This program is an acceleration of a previous program that aimed for artificial insemination (AI) of one million cows. The program is based on a projected growth of 2.7% in beef production, requiring extraordinary actions to be realised (Kadir, 2009). Whether realistic or not, it means there is strong government support for this livelihood strategy.

Methods

A research project was initiated in East Java in 2010 to explore ways of increasing calf production and cattle growth rates utilising locally available feeds (ACIAR Project LPS/2008/038). As part of this project, 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), referred to here as the lowland site, and one upland village (Srigonco in Malang District), referred to here as the upland site (Fig. 1). Probolinggo and Pasuruan encompass fertile irrigated plains about 25-150 masl, while Malang is a rainfed agricultural area about 550 masl with a seasonally dry climate.

Respondents in the 2010 survey were 194 cattle producers owning Ongole cows – 78 in the lowland site and 116 in the upland site. Respondents were interviewed using a structured questionnaire that included questions about household composition, land ownership and use, crop production, and livestock production, including specific questions on sources of feed and the sale of stock. In addition, a brief questionnaire survey was undertaken of 30 cattle traders from both sites and of 40 feed traders, mainly in the lowland site. Monthly recording of feed availability from farmers' land was also conducted throughout 2011.

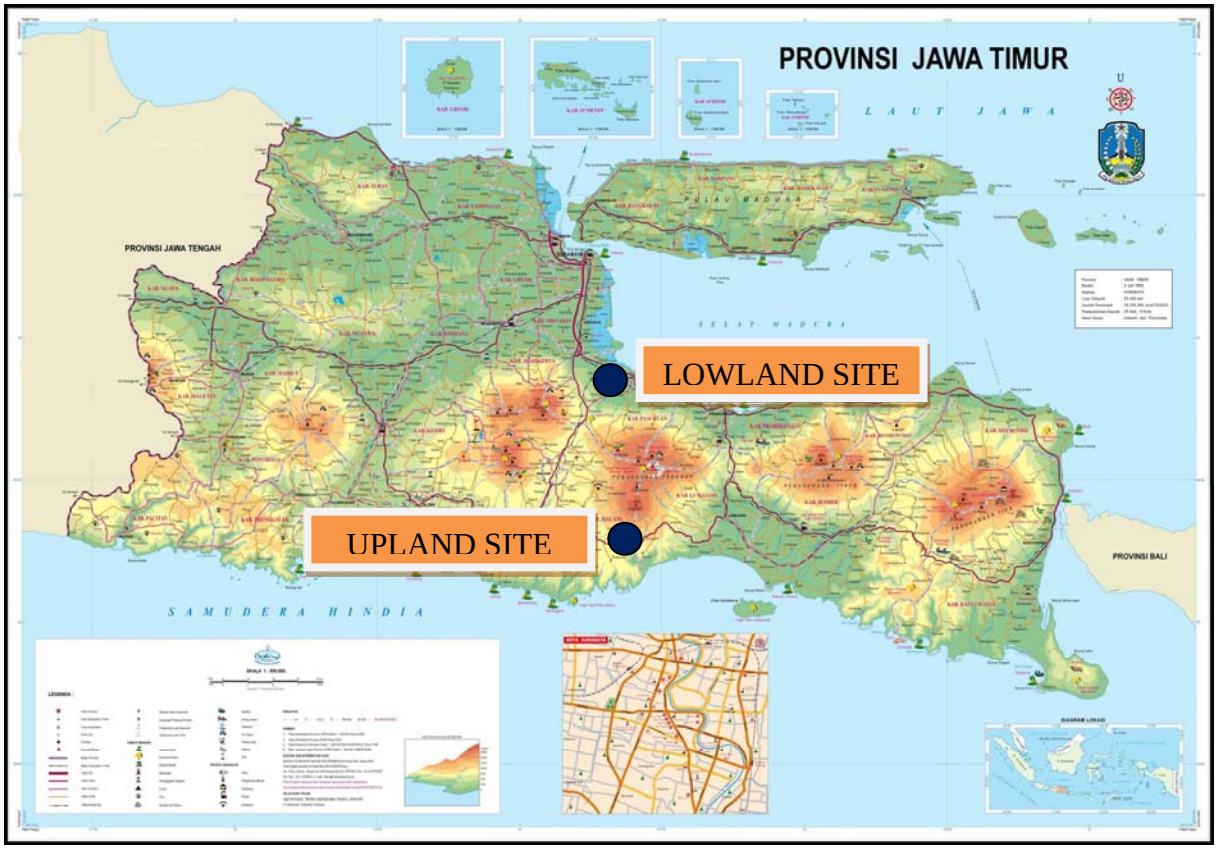
Results

Farmers' Characteristics

On average, farmers were aged in their mid- to late-forties (husband) or around 40 (wife), had 4-5 years of elementary schooling, had about 20 years of farming and cattle experience, and belonged to households of 4-5 members. There were no obvious differences between lowland and upland sites in these characteristics, including experience with livestock. However, in the lowland site about 28% of respondents listed farm and/or non-farm wage work as their main

occupation, indicating limited access to land for farming and greater off-farm employment opportunities, whereas in the upland site almost all were “own-account” farmers.

Fig. 1. Research sites in East Java



Small farm size is a feature of farming in Java. Fukui (2009) reports that Javanese villages are characterized by small landholdings caused by land fragmentation due to population increase and the system of equal inheritance among children. The small holdings do not enable households to earn sufficient income from rice farming, hence they practise mixed farming of rice and non-rice crops as well as fish and livestock production. Lowland farmers in the survey owned about 0.4 ha, evenly divided between paddy fields and dryland fields, whereas upland farmers averaged 0.7 ha, most of which (94%) was dryland (Table 1). 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. Most households were both crop and cattle producers.

Table 1. Farm size by land type (ha)

Land type	Lowland site				Upland site			
	Mean	%	Min	Max	Mean	%	Min	Max
Paddy field	0.18	47.4	0.02	1.58	0.04	6.2	0.00	2.50
Dryland 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	-	-

Cropping Systems

Paddy fields in the lowland site mostly produced three crops per year (Table 2). The main wet season crop was rice (72% of households) but this was frequently followed by one or two crops of maize (69%), with some soybean production as well. Surprisingly, 46% of households in the lowland site had no access to a paddy field. This underscores the point that cattle producers do not necessarily have direct access to the crop residues they need to maintain their herds. Many of these households also had off-farm wage work, which can be more remunerative than rice production.

Table 2. Cropping systems in paddy fields

Cropping system	Lowland site		Upland site	
	No. of households	Percentage	No. of households	Percentage
Rice-rice-rice	1	2.4	0	0.0
Rice-rice-maize	1	2.4	0	0.0
Rice-maize-maize	28	66.7	2	1.7
Rice-rice-fallow	1	2.4	1	0.9
Rice-fallow	0	0.0	2	1.7
Maize-maize	1	2.4	1	0.9
Rice-maize-mung	7	16.7	0	0.0
Rice-maize-peanut	1	2.4	2	0.9
Maize-maize-fallow	2	4.8	0	0.0
No paddy field	36	46.2	108	93.1
Total	78	100.0	116	100.0

In the dryland fields, there were eleven cropping systems as shown in Table 3. The dominant cropping pattern in the lowland site was maize-maize and maize-mungbean while in the upland site it was maize-cassava and rice-maize-cassava. Hence, maize stover has to be considered a major source of feed in addition to rice straw.

Table 3. Cropping systems in dryland fields

Cropping system	Lowland site		Upland site	
	No. of households	Percentage	No. of households	Percentage
Rice-cassava	0	0	5	4.6
Maize-maize	13	29.5	0	0.0
Rice-maize-cassava	4	9.1	46	42.2
Maize-mungbean	12	27.3	0	0.0
Maize-cassava	1	2.3	36	33.0
Rice-maize-mungbean	9	20.5	0	0.0
Maize-mungbean-peanut	1	2.3	0	0.0
Maize-peanut	3	6.8	9	8.3
Maize-maize-peanut-cassava	1	2.3	0	0.0
Rice-peanut-fallow	0	0.0	3	2.8
Sugarcane/Tobacco/Timber	0	0.0	10	9.2
No access to dryland field	34	43.6	7	6.0
Total	78	100.0	116	100.0

Cattle Production

On average, lowland farmers managed 3.8 cattle while upland farmers managed 2.9 cattle (Table 4). 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 4, with minor differences between sites, except that lowland farmers averaged 60% more calves. A significant number 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 pens within the village.

Table 4. Number of cattle owned by age class

Age of cattle	Lowland site (n=76)			Upland site (n=108)		
	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 (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 INR 26,000 per day (including human labour). This once again underscores that generating cash income is now the primary function of raising cattle.

The main outputs of the cattle production activity are shown in Table 5. 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 5. Outputs of cattle production activity

Output	Lowland site		Upland site	
	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

It is notable that almost half the respondents in the upland site did not sell any cattle in the previous year, whereas only a quarter of those in the more intensive lowland site were in this category. There was a clear difference between the lowland and upland sites in the age profile of cattle sold (Table 6). Just over half of the producers in the lowland site, or 70% of those who sold cattle in the previous year, sold only calves, whereas in the upland site, most producers sold young cattle (30% of those who sold) and adults (40% of those who sold).

Table 6. Age of cattle sold by farmers in 2009

Age of cattle	% of farmers	
	Lowland site (n=76)	Upland site (n=108)
Calves	51.3	11.1
Young cattle (1-2 years)	2.6	15.7
Adults (> 2 years)	5.3	21.3
Calves, young cattle, adults	5.3	0.9
Calves, adults	7.9	0.9
Calves, young cattle	1.3	0.0
Young cattle, adults	0.0	2.8
Total selling cattle	73.7	52.8
No cattle sold	26.3	47.2
Total	100.0	100.0

Correspondingly, in the lowland site the number of cattle sold averaged 1.08 head per respondent, and in the upland site, 0.62 head per respondent. For those who sold cattle, the averages were 1.46 and 1.18 head/respondent, respectively. The different pattern is reflected in the numbers of cattle sold (Table 7). Calves accounted for 74% of cattle sold in the lowland site, with males and females in equal numbers, but only 25% in the upland site, with a predominance of females.

Table 7. Numbers of cattle sold by age and sex

Type of cattle	Lowland site		Upland site	
	No. of cattle	% of those sold	No. of cattle	% of those sold
Calves				
Male	30	36.6	5	7.5
Female	31	37.8	12	17.9
Total	61	74.4	17	25.4
Young cattle (1-2 years)				
Male	3	3.7	15	22.4
Female	5	6.1	8	11.9
Total	8	9.8	23	34.3
Adults (> 2 years)				
Male	4	4.9	13	19.4
Female	9	11.0	14	20.9
Total	13	15.9	27	40.3
Total cattle sold	82	100.0	67	100.0

For 95% of those who sold cattle in the lowland site, and 75% in the upland site, the reason was to generate household income to meet current farm-household needs, such as repaying consumption credit and buying production inputs (seed, fertilizer), or intermittent needs, such as school fees, health costs, and motorcycles. That is, cattle production was a regular source of cash income for the household. In a small number of cases the sale of cattle was to acquire an asset (land, house) or pay for a major event.

Cattle were almost all sold in the village to local traders rather than being transported to a marketplace by the producer. In most cases these traders were based in the same village, though some were from elsewhere in the sub-district. Almost all of these traders could be classified as "village collectors". In the upland site, 10% of respondents sold cattle to other farmers in the village, presumably so they could build up their own herds.

The gross cash income from cattle exceeded the income from crops in both sites (Table 8). This is particularly remarkable in the lowland site where there is effectively no land available for grazing. The cash income from cattle production was about 45% higher in the lowland site compared with the upland site. However, as expected, the cash income from cropping in the irrigated lowland site was several times that in the rainfed upland site. So, for the upland farmers, cattle represented 84% of farm cash income, compared with 61% for the lowland farmers.

Table 8. Gross cash income from cattle and crops compared (IDR)

Income category	Lowland site	Upland site
Crop cash income	2,195,000	572,000
Cattle cash income	3,427,000	2,993,000
Farm cash income	5,622,000	3,565,000
Cattle as % of farm cash income	61.0	84.0

Integrating Crop and Cattle Production

As highlighted in the Introduction, it the close integration of crop and livestock production that has permitted the growth of beef cattle numbers in this densely populated and intensively farmed region. However, this integration is not necessarily attainable within each farm. In this section we explore the spatial and seasonal constraints to the integration of crop residues and

cattle production in the two research sites, and the institutional means that have evolved to alleviate these constraints.

(a) Availability of Crop Residues

Cattle producers utilised a variety of on-farm feed resources, comprising natural vegetation (including grasses), crop by-products (especially rice straw and maize stover), and others. The monthly recording of on-farm feed sources in 2011 provided a spatial and seasonal profile of feed availability within the farming system. Table 9 shows that, in both lowland and upland sites, rice straw and maize stover were the most common crop by-products fed to cattle from farmers' own paddy fields. For farmers' dryland fields, maize stover was the most common feed source in both sites, along with cassava and rice straw in the upland site (Table 10).

Table 11 shows the seasonal availability of the different crop by-products by location. Rice straw from paddy fields was available from January to July or August in both sites. Rice straw from dryland fields was available during a narrower window within that range (March-June). Maize stover from paddy fields was available from April to August and again from November to December in the lowland site, reflecting the cropping pattern in that environment. In the upland site, maize stover from paddy fields (of which there were very few) was available from June to October, and from dryland fields (by far the majority) from April to May. Cassava was mostly grown in the upland site and was available from July to October. Thus there were peaks and troughs in the availability of feed that were evened out by storage and/or purchases from elsewhere, as discussed below.

Table 9. Feed availability from farmers' paddy fields

Type of feed	Lowland site		Upland site	
	% of all households	% of households with paddy fields	% of all households	% of households with paddy fields
Rice straw	16.8	40.0	4.0	50.0
Maize stover	21.0	50.0	2.9	35.7
Peanut straw	0.5	1.3	1.1	14.3
Mungbean straw	3.7	8.8	0.0	0.0
Total	42.0	100.0	8.0	100.0

Table 10. Feed availability from farmers' dryland fields

Type of feed	Lowland areas		Upland areas	
	% of all households	% of households with dryland fields	% of all households[3]	% of households with dryland fields
Rice straw	6.4	14.4	20.0	21.3
Maize stover	21.5	48.9	33.7	35.8
Cassava	2.9	6.7	32.2	34.3
Mungbean straw	10.8	24.4	0.0	0.0
Peanut straw	2.4	5.6	4.4	4.7
Sugarcane tops/leaves	0.0	0.0	3.7	3.9
Total	44.0	100.0	94.0	100.0

Table 11. Annual availability of different feed resources from crop by-products

Crop by-products	Lowland site	Upland site
Paddy fields		
Rice straw	January-July	January-August
Maize stover	April-August November-December	June-October
Peanut straw	October-November	July-October
Mungbean straw	September-December	
Dryland fields		
Rice straw	March-June	March-April
Maize stover	April-August	April-May
Cassava	September-October	July-October
Mungbean straw	September-December	
Peanut straw	June-August	May-June
Sugarcane tops/leaves		April-October

(b) Utilisation of Rice Straw

It was a working hypothesis of the ACIAR project for which this study was conducted that small-scale cattle producers could be helped to utilize the rice straw that was the main by-product of their cropping system as part of a low-input strategy to improve cattle productivity. Almost all farmers in both sites did in fact feed rice straw to their cattle; in the lowland site, farmers fed on average 22 kg/head/day of rice straw, compared with 14 kg/head/day in the upland site. During the wet season farmers fed fresh rice straw to their cattle but mostly

[3] Figures in this column need checking!

farmers in both sites dried the rice straw for 3-4 days before storing it in lofts over the animal pens. However, the sources of rice straw varied (Table 12). 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 (mainly from neighbours who did not need the straw for raising cattle). In the lowland site, 24% of farmers purchased straw from other farmers or agents. 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.

Table 12. Farmers' sources of rice straw

Source	Lowland site		Upland site	
	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 lowland site, farmers who collected rice straw within the village at harvest averaged 9 person-days for this activity. Farmers who bought rice straw in the lowland site paid on average IDR 119 per kg. 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 IDR 145,000 for one trip. The farmers did not pay for the rice straw, so the cost of renting the truck was the only cash outlay. The number of farmers in a group averaged around 5, with more men than women, and the trip typically required two days, so the total labour requirement was about 10 person-days. On average, about 3.2 tons of straw were collected in this way at one time, implying a cash cost of about IDR 45 per kg. If the labour is valued at IDR 25,000 per day,

the prevailing rural wage, the cost of the straw was about IDR 120 per kg, about the same as the cost of purchasing straw in the lowlands.

(c) Planted Forages

Farmers were not totally reliant on rice straw, other crop by-products, and natural vegetation. All farmers in both sites had dryland areas that could be used to plant forages. In general, forages were only planted along terraces or embankments, or in the backyard. Farmers did not pay much attention to the quality of the forage itself but were merely concerned to have 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 13). A lower proportion (only 13% in the lowland site and 66% in the upland site) planted forage legumes, mainly *Leucaena* in the lowlands and *Gliricidia* in the uplands. The greater area of dryland per household in the upland site permitted planting of more shrub legumes.

Table 13. 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	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%). 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.

(d) The Feed Supply Chain

As indicated above, many cattle producers could not obtain sufficient feed supplies from within their own farm resources. Due to the limited land area, unequal access to crop land, and increasing intensity of both crop and cattle production in East Java, there is an emerging market for buying and selling crop residues and forages, providing an additional source of livelihood for some rural households. This is a quite recent phenomenon and unique to the lowland site in East Java.

A preliminary survey of this "value chain" found that the actors include farmers as collectors, small- and medium-scale traders, wholesalers, and "site providers". Collectors bought and/or collected rice straw and other crop residues from cropland within their village and sold to nearby farmers. Small-scale traders bought and sold less than 500 kg per day while medium-scale traders handled 500-2,000 kg per day. Site providers made their land available to these traders to store and sell the feed, usually along the roadside, for a commission of around 10%. Wholesalers (or large-scale traders) handled larger volumes and directly supplied large operations such as feedlots. Medium-scale traders and wholesalers had more capacity to store and sell feed, so they sourced feed from further outside the village. Wholesalers mostly supplied commercial feedlots that could be in another sub-district or district, perhaps 50-60 km from the site where the feed was collected or purchased. The transportation mode differed between the different types of trader, ranging from a bicycle for collectors, to motorcycles, small trucks, and large trucks, with the rental fee for trucks ranging from IDR 40,000 to 150,000 per trip.

The types of feed sold included maize stover (43%), rice straw (27%), grasses (native grasses and elephant grass, 20%), sugarcane tops and leaves (9%), and legume hay in a small amount (2%). The incidence of crop by-products reflected the harvest season at the time of the survey. A third of the traders interviewed reported that their feed supply was sold out every day. Of those whose feed was not sold out within the day, most sold their stock the next day at the same or a cheaper price (Table 14). There was no special treatment for this unsold feed; mostly it was left *in situ* (52% of those with carryover stock) or kept in the trader's houseyard (22%).

Table 14. Methods of dealing with unsold feed at the end of the day

Method	No. of traders	Percentage
Sell the next day at same price	10	25.0
Sell the next day at cheaper price	12	30.0
Reduce supply	1	2.5
Give free to farmers	2	5.0
Taken back by supplier	1	2.5
Sell next day at cheaper price and reduce supply	1	2.5
No unsold feed	13	32.5
Total	40	100.0

The use of a mixture of native grasses, crop residues, and fodder trees, with a reasonable proportion of green feed, was very common. Farmers had in their mind that green feed is better than dry feed. In addition, 78% of the traders sold fresh and green forages (Table 15). Traders sought to meet the farmers' demand regarding this requirement, and this was relayed back to the feed supplier. Elephant grass was cut at 40-45 days in order to provide good quality forage; some farmers were already knowledgeable about the optimal cutting age.[4]

Table 15. Traders' criteria when purchasing feed

Feed criterion	No. of traders	Percentage
Fresh and green forages	17	42.5
Good quality forages	3	7.5
Elephant grass to be cut at 40-45 days	2	5.0
No response	18	45.0
Total	40	100.0

Traders in this emerging feed market encountered some constraints (Table 16). During the wet season (December-April), there were abundant stocks of feed but fewer buyers. Farmers would cut and carry the abundant native grasses they could access freely within this period, reducing demand for the traders' stocks. On the other hand, during the dry season (August-September) there was peak demand but traders found difficulties in obtaining feed from suppliers. In short, the market for feed could address the demand for spatial redistribution of stocks between feed suppliers and cattle producers but not the demand for redistribution between seasons, which was constrained by the ecology of production. Some traders went

[4] Risdiono et al. (2006) reported that an average of 30-40 days cutting interval after planting is required to get an optimum yield of elephant grass during the wet season, and 50-60 days in the dry season.

further afield to different agro-ecological zones to find supplies in periods of peak demand, incurring higher costs and risks (Table 17). (This was, of course, the strategy of the farmers in the upland site who rented trucks to go and collect rice straw themselves.) In periods of peak supply and reduced demand, many traders ran down their stocks or temporarily stopped selling, implying that they had other sources of livelihood in those periods.

Table 16. Constraints encountered by traders of cattle feed

Constraints	No. of traders	Percentage
Wet season, excess stock, fewer buyers	7	17.5
Dry season, less supply	7	17.5
Competition from other traders	6	15.0
Small margin	5	12.5
Limited overall feed supply	3	7.5
Distance to obtain stock, high cost, long time	1	2.5
Combination of above	4	10.0
Not ascertained	7	17.5
Total	40	100.0

Table 17. Responses of feed traders to constraints

Solutions	No. of traders	Percentage
Wet season (peak supply)		
Reduce stocks	7	17.5
Temporarily stop selling	6	15.0
Better service to retain buyers	4	10.0
Lower prices	3	7.5
Sell to farmers outside the village	1	2.5
Dry season (peak demand)		
Look to other suppliers, more distant area	10	25.0
Lease trucks, hire labour	1	2.5
Not ascertained	8	20.0
Total	40	100.0

Conclusion

Smallholder cattle production is one activity in a complex, diversified, mixed farming system in East Java, in which both wetland and dryland 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 in the upland site 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. Likewise the production of manure was not as important. Rather, cattle production was a market-oriented activity, generating significant cash income for the household, often in excess of the income from cropping.

The high importance of rice straw and other crop by-products 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 meant that farmers travelled greater distances to obtain their supply, working cooperatively in small groups to do so. 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 appeared to be potential to increase their production and utilization, especially shrub legumes.

The unequal access to crop land, especially paddy fields, meant that many cattle producers in the lowland site could not produce sufficient feed from their own land, whereas other farmers had surplus supply. Hence the integration of crop and cattle production in this highly intensive farming system has required new institutional arrangements beyond the farm boundary. This has led to the emergence of an active trading network to link feed supply and demand within the region. Traders vary from small-scale, part-time collectors transporting feed on the back of a bicycle, to medium- and large-scale operators who use a truck and hired labour and scour the wider region for feed supplies in times of peak demand. The turnover of this stock of feed is rapid, mostly within one or two days, and cattle producers' feed preferences appear to be efficiently transmitted through the supply chain.

Thus the economic transformation that is underway in Indonesia – specifically the livestock revolution that has accelerated the demand for beef production – has created livelihood options for a range of households. Cattle producers include some diversified households in which the labour, livestock, and feed resources are combined in one production entity, as well as others for whom the ownership and management of these production inputs is dispersed among several actors. Thus even households with little or no cropland, nor even their own cattle, can benefit to a degree from the growth in the demand for beef by raising cattle on a share basis and collecting or buying feed. Likewise, the need to link feed supply and demand

beyond the farm boundary has created a new livelihood option for labour- and business-oriented households, at various scales.

The future trends in this complex system are difficult to map with any assurance. It is likely that some households in some regions will become more specialized cattle producers and that some will evolve from small-scale producers to small- and medium-scale fattening operations, as is happening already in some parts of East Java. However, a large proportion of East Java's and Indonesia's cattle production will continue to depend on millions of intensive, small-scale, backyard cattle breeders and the feed supplies produced as a by-product of the intensive, small-scale cropping systems in which they are embedded.

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References

BPS, 2010. *Statistik Indonesia*. Badan Pusat Statistik, Jakarta.

BPS, 2011. *Trends of the Selected Socio-economic Indicators of Indonesia*. Badan Pusat Statistik, Jakarta.

Davis, B., Winters, P., Carletto, G., Covarrubias, K., Quinones, E., Zezza, A., Stamoulis, K., Bonomi, G., and DiGiuseppe, S., 2007. *Rural Income Generating Activities: A Cross Country Comparison.* Background Paper for the World Development Report 2008.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., and Courbois, C., 1999. *Livestock to 2020: The Next Food Revolution.* Food, Agriculture, and the Environment Discussion Paper 28. International Food Policy Research Institute, Food and Agriculture Organization of the United Nations, and International Livestock Research Institute.

Dinas Peternakan Provinsi Jawa Timur, 2009. *Statistik Peternakan di Provinsi Jawa Timur*. Surabaya.

Fukui, S. 2009. Land tenancy market and determinants of the contract. In Iwamoto and S. Hartono (eds.) *Economic Structure and Social Institutions in Rural Java*. Gadjah Mada University Press, Yogyakarta.

Hanifah, V.W., A. Priyanti, I.G.A.P. Mahendri and R.A. Cramb, 2010. A comparison of feeding management practices of beef cattle smallholders in lowland and upland sites in East Java. Proceedings of 5th International Seminar on Tropical Animal Production: Community Empowerment and Tropical Animal Industry, October 19-22, 2010. Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta.

Kadir, T.N., 2009. Program Sapi Berlian Propinsi Jawa Timur. Makalah disampaikan dalam Seminar Tematik dalam rangka Hari Ulang Tahun. Indonesia Keluar dari Perangkap Impor Sapi Potong. Badan Penelitian dan Pengembangan Pertanian yang ke-35. Bogor, 12 Agustus 2009.

Kementan-BPS, 2011. Rilis Hasil Akhir PSPK 2011. Kementerian Pertanian, Badan Pusat Statistik, Jakarta.

Mahendri, I.G.A.P., Priyanti, A., Hanifah, V.W., and Cramb, R.A., 2010. Marketing practices of smallholder beef cattle producers in East Java. Proceedings of 5th International Seminar on Tropical Animal Production: Community Empowerment and Tropical Animal Industry. October 19-22, 2010. Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta.

Patrick, I.W., G.R. Marshall, G.R., Ambarawati, I.G.A.A., and Abdurrahman, M., 2011. *Social Capital and Cattle Marketing Chains in Bali and Lombok, Indonesia*. ACIAR Technical Report No. 74. Australian Centre for International Agricultural Research, Canberra.

Risdiono, B., Sajimin, N.D. Purwantai and I. Herdiawan, 2006. *Hijauan Pakan Ternak di Indonesia*. Badan Penelitian dan Pengembangan Pertanian, Departemen Pertanian, Jakarta.

Statistics of Jawa Timur Province, 2011. *Jawa Timur Province in Figures 2011*. Statistics of Jawa Timur Province, Surabaya.

World Bank 2007. *World Development Report 2008: Agriculture for Development*. Washington DC: The World Bank.