Corn and Cattle Integration to Support NTB's One Million Cattle Program in Lombok Island

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ABSTRACT

Nusa Tenggara Barat (NTB) has launched competitive program called PIJAR (ab. Cattle, Corn and Seaweed). Corn development program will not only improve its main production but also its by-products such as leaves, stems, cobs and husks. On the other hand, its by-products are limitedly used for livestock feeding while farmers have difficulty in getting feeds during dry season. Several studies on corn and cattle integration have been conducted, especially outside NTB, but no one has provided data on their contribution to livestock productivity and farmer income with group systems. The research findings in year 1 were, (1) The daily weight gain of fattening cattle with fresh rice straw mixed ration fed 12.5 kg with bran 2.5 kg/head/day for 49 days was an average of 0.37 kg per head per day, (2) The production of fresh corn straw, harvested at the age of about 80 days was 47,67 kg per ha or in dried form 9,53 kg or 20% of fresh straw weight, (3) With harvested area of 76,447 ha, the production of fresh corn straw in NTB could reach 3,643,999 tons and 1,267,656 tons in Lombok island, (4) With fresh corn straw of 13 kg and additional feed of 2.5 kg per head per day each hectare of corn planted land can accommodate about 10 cattle, and (5) Farmers have not implemented a model of optimal integration of corn and cattle farming. The results of the second year research were: (1) farmer group-livestock management was not optimal yet, livestock farming was still conducted traditionally, (2) livestock breeders were relatively more responsive to technological innovation, (3) feed technology had crucial role in development group, (4) giving of silage as much as 22 kg per day to the weighted average cow 167 kg could produce daily weight gain 0,42 kg; (5) cattle with an average body weight of 191.5 kg produce wet dirt 11.43 kg per day and become dried manure 2.61 kg per day. The research concludes that corn crops in NTB have the potential to accommodate around 700,000 heads of cattle and in Lombok around 267,156 heads. In addition, group system can further improve productivity and hence farmers' income.

Keywords: Integrated farming, Corn and cattle, Straws based feed ration, Farmers' income.

INTRODUCTION

The main problem in the development of cattle on Lombok Island is the fluctuate availability of feed, abundant during the rainy season and shortages during dry season. Farmers keep livestock traditionally, relying on forage fodder, especially field grass, with cut and carry systems. The intensification of food crop agriculture has decreased field grass resources, making it harder to find grasses. On the other hand, agricultural wastes, such as rice straws, corns, soybeans, peanuts, and green beans have not been widely used as animal feed. This condition causes the breeders on Lombok Island to be only able to maintain on a small scale, 2 to 3 cattle per farmer, and hence the contribution of cattle to household income is relatively small. Therefore, integrated farming between food crops and cattle needs to be developed in the area of Lombok Island. Integrating farming of food crops and cattle is expected to overcome the availability of fluctuated feed, lack of feed in the dry season and excess feed in the rainy season.

The idea of combining the use of agricultural wastes as animal feed and livestock dirt as manure in a farming unit is known as crop-livestock integrated system. Integration of crops with livestock is basically for the efficient use of internal resources in farming so as to increase the productivity of farming and at the same time to generate the farmers' income. Agricultural waste which is usually disposed or burned can be used for animal feed, and vice versa. Livestock manure which is usually disposed can be used for natural fertilizing, resulting in efficient use of inputs (low external input).

West Nusa Tenggara (NTB) has launched a flagship program since 2009 known as PIJAR (ab. Sa**PI**=Cattle, **JA**gung=Corn and **R**umput laut=Seaweed). The cattle breeding program of NTB is called *Bumi Sejuta Sapi* (BSS) that means one million cattle land. Meanwhile, the BSS program and the corn development program are still running independently, whereas there is an opportunity for being integrated so that it can be more efficient, profitable and sustainable. During this time cattle ranchers only use the tops of corn green leaves as cattle feed, while the bottom stalks, dry husk, and corncob have not been utilized. Farmers also have not significantly used manure, yet prefer to use inorganic fertilizers. According to Bamualim and Tiesnamurti (2009), the use of manure can save about 25 per cents of the cost of inorganic fertilizers.

West Nusa Tenggara (NTB) has historically been known as a cattle warehouse, especially Bali cattle. In 1970s, NTB exported cattle outward, mainly to Hong Kong. At that time it was still easy to find the beef cattle weighing over 300 kg, while at present it is very rare to find one above 300 kg. Sularsasa (1992) said that Bali cattle with body weight of 350-400 kg were rarely found lately due to the continuous body weight decrement. The results of cattle weight trends of NTB inter islands transaction during 1980-1988 showed a significant decrease of 2.13 kg/head /year with trend line $Y = 334.7 \pm 2.4 X$ (Kasip et al., 1989), while delivery until 1992 recorded a drastic reduction of 2.90 kg/head/year (Dwipa and Sarwono, 1993).

With the NTB- BSS program, it is expected that cattle can grow in terms of both quantity and quality (productivity). Based on data of beef cattle, dairy cow, and buffalo (PSPK, 2011), the population of cattle in NTB recorded 685,810 heads, ranks sixth after East Java, Central Java, South Sulawesi, NTT and Lampung (BPS, 2011). In the 2014 beef self-sufficiency program known as PSDS, NTB is nationally established as one of the provinces of beef cattle and source of livestock.

According to Devendra (1993) in Diwyanto (2001), there are eight advantages of applying crop-livestock systems, namely (1) diversifying the use of production resources, (2) reducing the occurrence of risks, (3) efficient use of labor, (4) efficient use of production components, (5) reducing the dependence of chemical energy and biological energy as well as other external inputs, (6) more sustainable and non-polluting ecological systems that protect the environment, (7) increase output, and (8) developing stable farm households. Rangnekar *et al*. (1995) states that in India mixed farming is done by most farmers and cattle having complementary and supplementary roles in agricultural production. Livestock is an important means of addressing risks and biomass recycling. Thus, livestock can integrate well with various plant systems. Devendra (1993) in Bruchem and Zemmelink (1995), suggest that in small-scale integrated farming in Southeast Asia, ruminant livestock is more important than others because it is able to utilize crude fiber from plant residues. Animal feed from this material, although of low quality, is often as main feed especially in the dry season.

Some research results in Indonesia on crop and livestock integration can be reported as follows. Teguh Prasetyo *et al*. (2001) reported the results of his research in Grobogan District, that for rice cropping pattern-rice-corn, rice straw production in planting season 1 was 6,050 kg per ha, on planting season two was 5,280 kg per ha, and corn straw of

300 kg per ha. Merkens (1925) reported the results of his research on the production of manure and grasses fed to livestock, from 2 Bali cattle for 20 days yielded 236 kg of manure and spent 600 kg of grass, from 2 Hisar cattle produces manure 251 kg and spent grass 600 kg. Based on the results of the study it can be estimated that the production of manure for Bali cattle is 2,153.5 kg per head per year or 5.9 kg per head per day, while Hisar can produce 2,290.4 kg per head per year or 6.3 kg per head per day, and buffaloes produce 4,275 kg per head per year or 11.7 kg per head per day.

The potential of corn waste in the form of corn straw consisting of leaves, stems, leaf-shoots and epidermis is estimated to be about 2 tons dry weight/ha (Luthan, 2006 in Saptati and Diwyanto, 2007). The chemical composition of some by-products of corn crops that can be utilized for animal feed is presented in Table 1.

Table 1. Chemical Composition of Corn Waste

No	Kinds of waste	Nutritional Content (%)				
		Dry matter	Crude protein	Crude fat	Crude fiber	TDN
1.	Corncob	87,54	10,91	2,44	13,78	62,62
2.	Fresh straw	21,68	9,66	2,21	26,30	60,24
3.	Corn cobbler	76,61	5,62	1,58	25,25	53,07
4.	Corn clay	42,56	3,40	2,55	23,32	66,41

Source: Gunawan *et al*. (2006) in Saptati and Diwyanto (2007)

According to Sunanto and Nasrullah (2012), the yield of corn biomass in the form of follow-up has a weight of 7,400 grams, consisting of 21.38 g leaves, 23.55 g stems, 3.1 g flowers, 22.05 g cobs, and 103.63g cobblers. Subsequently it was reported that the fermented yields of corn wastes were as follows (Table 2).

Table 2. Changes in nutritional content of fermentation treatment in corn waste in Bantaeng District 2012

No	Treatment	Content					BetaN
		Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Ash (%)	Water (%)	
1.	Probion + urea	11.62[b]	1.66 [a]	21.99[b]	20.46	11.40[b]	32.87
2.	Probion+Molases+bran	10.39[d]	1.33 [b]	23.60[a]	20.45	11.51[b]	32.72
3.	Molases+soft bran	12.88[a]	1.82 [a]	20.26[c]	23.21	12.44[a]	29.39
4.	Fermented straws	11.82[b]	1.47 [b]	19.57[d]	30.65	11.35[b]	25.14
5.	Urea	11.33[c]	1.15 [c]	21.75[b]	18.94	11.58[b]	35.25
6.	Control	9.53[e]	1.66 [a]	19.53[d]	21.98	10.70[c]	36.60
	Average	11.26	1.51	21.12	22.62	11.50	32.00

Note: *) The numbers followed by the same letter in the same column are not significantly different in the Duncan Distance Test at 5% level.
**) Analysis of SAS programming version 9.00.
Source: Proximate Analysis Lab. BPTP Sulsel, 2012

RESEARCH METHOD

Research Methods Year 1. To answer the first goal, that is knowing the production of corn straw by doing tessellation upon 42 samples, each 21 footages in East Lombok and West Lombok districts, with an area of 4 m^2. Weighting of straw was done in two stages, namely immediately after wet tiling and after being dried. To answer the second objective of analyzing the carrying capacity of corn crops, analyses were based on the proportion of corn straw used as feed ration material, the production of corn straw yield, and

unit of corn plantation area or with STm/STt formula, where STm is the livestock unit for food and STt is the livestock unit for livestock. To answer the third objective, the utilization data of corn straw for cattle feed and livestock manure for corn crop fertilizer were collected using Focus Group Discussion (FGD). To answer the fourth goal, namely to know the effect of feed ration based on corn straw to daily weight gain of beef cattle, experimental method was employed with 20 fattening beef cattle belonging to breeder groups in Banyumulek, West Lombok. It took 60 day effective field trial. Prior to treatment, the beef cattle were given feed adaptation time for 5 days. Feed ration consisted of corn straw that was chopped and given additional 2 kg bran per head per day.

Research Methods Year 2. The second year research is the dissemination of research results of the first year, with more emphasis on the development of institutional management of livestock-farmer groups. Selected groups were trained in silage making, organic fertilizer, and bio-gas, and group management training. Machinery and equipment and materials used are provided. After the training, all farmers applied silage to their own animals. During the use of silage feed, cattle weighing were done to determine the daily weight gain. At the end of the study, an FGD was conducted to see the response of farmers to the innovation of feed technology in the form of silage.

RESULTS AND DISCUSSION

Production of corn straw based on tiled results of 42 samples, 21 samples in East Lombok and 21 samples in West Lombok district are presented in Table 3. The corn straws floored were those of early harvested around 75 to 85 days of age.

Table 3. Results of average corncob tiles per m^2 and per ha in Lombok

No	Component	Number per m^2	Number per ha
1	Number of clumps (clumps)	5,31	52.856
2	Number of stems (seeds)	9,81	98.155
3	Weight of stems and fruit (kg)	6,99	69.893
4	Weight of stalk without fruit (kg)	4,77	47.667
5	Weight of fruit (including dried husk) (kg)	2,17	21.678
6	Weight of dried husk (kg)	0,79	7.934
7	Weight of stems above the fruit (kg)	1,38	13.827
8	Weight of stems below the fruit (kg)	3,04	30.399
9	Weight of cob (kg)	1,36	13.583

The straw after being dried in the sun for about 4 days reduced its weight to about 20%. So from a fresh weight of 47,667 kg to 9,533 kg of sun dry weight. Thus if each cow is given a ration of fresh corn straw 13 kg mixed with 2.5 kg bran per day then per ha of corn crop field will be able to accommodate cattle as much as about 10 adult heads. Based on the results of fresh corn straw tiles (47,667 kg/ha/harvest), it can be calculated the production of fresh corn straw in NTB area as in Table 4.

Table 4. Production of fresh corn straw in NTB area

No	District/regency	Harvest area (ha)	Fresh straw production (kg)
1	Kota Mataram	12	572.004
2	Lombok Barat	3.597	171.458.199
3	Lombok Utara	3.458	164.832.486
4	Lombok Tengah	4.068	193.909.356
5	Lombok Timur	15.459	736.884.153
6	Lombok island	26.594	1.267.656.198
7	Sumbawa Barat	4.556	217.170.852
8	Sumbawa	25.041	1.193.629.347
9	Dompu	7.889	376.044.963
10	Bima	11.472	546.835.824
11	Kota Bima	42.661.965	42.661.965
12	Sumbawa island	49.853	2.376.342.951
13	Nusa Tenggara Barat	76.447	3.643.999.149

Note: corn straw is cut at around 80 days (young corn harvest)

Table 4 shows that all districts in NTB have a potential source of animal feed from corn straw. Sumbawa, East Lombok, Bima, and Dompu are considered as high potential districts.

Daily Weight Gain of Beef Cattle with Corn-Based Feed. At the beginning of the experiment, the average weight of beef cattle was 154.68 kg with a standard deviation of 15.19 kg. Ration used was a mixture of fresh corn straw 13 kg and 2.5 kg bran per head per day. Weighing the cows was done every Sunday morning before being fed. The results of weights of experimental cows are listed in Table 5 showing that the mean daily weight gain of all cattle during the 49 days experiment was only 0.37 kg. The UNH figures are below expectations, relatively small, the same as those traditionally maintained cows. The small amount of daily weight gain was more likely due to the experimental cattles that were still in adaptation. The beef cattle were from Sumbawa whose maintenance were extensively (released in grazing areas) so that it takes time for adaptation with intensive maintenance (continued to be grounded). During the experiment those cattle seemed to prefer bran.

Table 5. The development of cattle weight for 49 days

Weighing	Average weight (kg)	Standard deviation (kg)	Daily weight gain (kg)
1	154,68	15,19	-
2	159,58	15,80	0,70
3	164,58	15,65	0,71
4	167,79	15,57	0,46
5	168,39	16,70	0,09
6	172,21	16,75	0,55
7	173,45	16,67	0,18
8	172,63	16,68	-0,12

Note: weight of the first weighing result (Date 19/10/2013) is the initial weight of the experiment

Daily Weight Gain with Silage Feed of Corn Straw Basis. The daily weight gain of bulls during the silage fed is shown as follows (Table 6).

Table 6. Daily weight gain of bulls fed with silage of corn straw

No	Initial weight (kg)	Final weight (kg)	Weight gain (kg)	Daily weight gain (kg/day/head)
1	110.5	132	21.5	0.72
2	195.5	205	9.5	0.32
3	86	93	7	0.23
4	200.5	214.5	14	0.47
5	190.5	203.5	13	0.43
6	220	230.5	10.5	0.35
Total	1003	1078.5	75.5	2.52
Average	167.17	179.75	12.58	0.42

Note: Initial weight obtained from weighing date. 28-09-2014; The final weight is obtained from the weighing date. 28-10-2014.

Table 6 shows that for one month, bulls with an average initial weight of 167.17 kg after feeding of silage straw maize increased weight by 12.58 kg or with daily weight gain 0.42 kg. Silage given an average of 22 kg per head per day, consisting of a mixture of 20 kg corn straw and 2 kg bran with the price of bran Rp 1,500/kg and corn straw Rp 250/kg then the cost of feed to be Rp 7,500 per head per day. With live cow price Rp 32,000 per kg, gross revenue of Rp 13,440 per day or Rp 403,200per month. Thus the income will be obtained after minus the cost of feed of Rp 5,940 (Rp 13,440 to Rp 7,500) per day or Rp 178,200 per month. With the fattening period of six months then the cattle fattening business will be able to provide income of about Rp 1,069,200 per head or about Rp 2,000,000 per head per year.

Livestock Production. The results of cattle manure on two groups of 6 heads are presented in Table 7 and Table 8 below.

Table 7. Cattle manure production of 6 head groups with weight of 1,155 kg

Weighing phase	Wet weight (kg)	Dry weight (kg)
1	68.5	20.5
2	62.5	16
3	59.5	15.5
4	60.5	17.5
5	53	16
Total	304	85.5
Average	60.8	17.1
Average per head	12.16	3.42

Table 8. Cattle manure production of 6 head group with body weight 1,143 kg

Weighing	Wet weight (kg)	Dry weight (kg)
1	76	12
2	73.5	12.5
3	73.5	13
4	87.5	22.5
5	71.5	11
Total	382	71
Average	76.4	14.2
Average per head	12.73	2.37

Weighing livestock manure was repeated 5 times a day. Each weighing result contained the sum production of a group of cows for 24 hours. The wet weight was the weight of the dirt accumulated over the 24 hours, while the dry weight is the weight of cow dung after 4 days of drying in very hot sunshine, in September and October 2014. Combined Table 7 and 8 can be culled The following: average weight of 191.5 kg of cattle yielding wet waste 11,43 kg per head per day and become dried manure 2,61 kg per head per day.

Management of Livestock Farming Groups. The management of livestock farming groups was not yet optimal. Daily livestock farming activities were still managed traditionally. The farmer groups were more likely function as cattle safeguards. Each of the group members managed their own cattle. Groups only helped with marketing, whether buying seeds or selling cattle, and conducted individually, not as group program. This condition was caused by a lack of information and ongoing mentoring. Based on observations during the study, the farmers were very responsive to the technological innovation that was believed to increase the production and income of livestock business.

CONCLUSIONS

The core conclusions derived from the results of this study are as follow:

1. Livestock farming groups in NTB, especially in Lombok have great potentials for the development of fattening cattle by considering the following: (a) the changing of original feeding system from cut and carry system to stock system (storage), (b) an increment of the initial business scale from 2 to 3 heads to 6 heads, (3) in addition to livestock housing and its equipment, each group needs to be furnished with feed warehouse and feed processing, organic fertilizer installation, bio-gas installation, and tool and machinery for feed processing.
2. Counseling and mentoring should be done continuously. In addition to technology transfer, the marketing support is not less important.
3. In the central corn areas, the development of cattle farmer groups by integrating crop and cattle breeding systems is very advantageous. The feeding silage based corn straws coupled with 2 kg corn bran per head per day can result in a daily weight gain for Bali cattle fattening an average of 0.47 kg and may reach 0.77 kg at most.

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