Integration of sheep and corn in rural agriculture in Indonesia

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Abstract. The aim of the study was to determine the integration of sheep and corn in rural agriculture in Indonesia. The research was conducted in Serang District, Banten Province in 2021. The research respondents were sheep farmers as well as corn farmers. The number of research respondents as many as 58 people. Methods of collecting data were desk study, survey, and Focus Group Discussion (FGD). Data were analyzed by quantitative descriptive and economical analysis. The results showed that the integration of sheep and corn was stated to be quite good, but it needed institutional support from farmers and the government to facilitate the development of integration of sheep and corn. The development of integration of sheep and corn is focused on meeting the needs of aqiqah and qurbani. Through this integration system, the farmer's profit is Rp. 3,415,000/sheep. The conclusion of the study is that the sheep and corn integration system is feasible for development.

1 Introduction

The livestock sub-sector is one of the priorities contained in the 2020-2024 at the National Mid-Term Development Plan, with the main program providing quality and affordable food of animal origin. On the other hand, the food crops and plantation sub-sectors have the potential as a provider of biomass that can be used as feed raw material for sheep. During the last decade there has been a fairly high conversion of agricultural land into settlements or industries, but on the other hand, plantations, especially corn, have experienced a significant increase of 19.6% or 5.53 million hectares. The corn harvested area until 2018 has reached 68.57% of the total area of secondary crops or around 22,346 hectares. Meanwhile, the sheep population in Banten is 1.8% of the national sheep population and has the potential to become a center for sheep development. The population of sheep in Serang District, Province of Banten is 136,898 heads. Sheep have many regular cycles and are taken into consideration by government policies to develop sheep and facilitate sheep business for farmers [1].

Sheep are livestock that are easily cared for by every small breeder in the countryside and produce faster and are able to utilize local feed available throughout the year, sheep breed

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very quickly, because the calving distance is short, and the number of litter size is often more than one, so relatively quick to make money. Usually farmers always experience obstacles in their maintenance, namely the provision of feed, limited land, where there is no land or special area for the development of sheep farming. Limited land causes limited carrying capacity or the capacity of an area in providing fodder for sheep that will be developed by farmers. The corn-sheep integration system can be a solution in increasing the sheep population with relatively low maintenance costs, and easy to market. Small farmers in Asia cannot be separated from their lives with animal husbandry and this is precisely what makes agricultural businesses sustainable [2, 3].

However, the introduction of feed processing technology made from plantation by-products has not been adopted massively and sustainably, so it is very necessary to do so to meet the needs of sheep feed. In line with the introduction of the concept, the technology introduction model that is built can be done by visualization or demonstration of the innovation that will be developed in the form of a pilot unit with an integrated agribusiness perspective, including a field laboratory. The introduction of the integration of sheep corn can be developed in a participatory manner through the empowerment of farmer communities and institutions by using the media of field laboratories and field schools to realize feed independence. The application of corn-sheep integration is certainly not the same for all farmers with various limitations, this integration can only be applied by farmers if it is relevant to the needs of farmers.

The application of integration by farmers will increase according to the market for the products produced. The oil palm-sheep integration system has also been widely reported both in Indonesia and in Malaysia, especially research on the use of palm oil industry by-products as a source of ruminant feed [4-5]. Integrated agricultural business institutions, in the form of integration between actors, farmers, traders, processors and quality raw material products, excellent post-harvest handling and food safety guarantees [6]. Some of the innovations introduced to farmers include superior seeds, silage feed, utilization of agricultural by-products and food processing, utilization of feed processing machines, handling of sheep's health. Livestock health is part of the three pillars of the livestock business, namely breeding, feeding, and management [7].

In the current global economic conditions, agricultural products that are marketed are not only primary products, but also finished products or semi-finished products [8]. To be able to increase the selling value of higher agricultural products, a business network is needed using innovative technology, according to the ability of farmers, so that the products produced can be accessed by product users. The application of technological innovations required by farmers requires in-depth knowledge and skills of environmental interactions (farmers, local food sources, land, socio-cultural, and economic). The implication is that the application of location-specific technological innovations, accelerating the adoption of corn-sheep integration requires a well-targeted strategy while prioritizing the main benefits for farmers with stakeholder support through the related institutional system.

Plant-livestock integration is able to utilize the potential of regional resources in order to maintain land fertility through the use of organic fertilizer from livestock manure so that a sustainable nitrogen cycle occurs for plants [9 -11]. Sheep function as a means of producing the basic ingredients of organic fertilizer which will be used to maintain the fertility of agricultural land in both the highlands and lowlands. Thus in one agricultural area can produce food crops as the main product, milk or meat as a result of livestock business, in addition to organic fertilizer. Banten Province is one of the areas that has the potential for the development of corn-sheep by utilizing corn plants as raw materials for making animal feed. Based on the problems mentioned above, it is necessary to innovate the integration of corn-sheep technology in the breeder group of Serang District, by developing farmer institutions.

The purpose of this paper is to determine the integration of corn-sheep through institutional support and increase the economic value of farmers, so this research needs to be done.

2 Materials and methods

The research was conducted in Anyer, Cikeusal, and Jawilan Subdistricts, Serang District, Banten Province in 2021. Research activities in collaboration with Regional Planning and Development Agency (BAPPEDA), government agencies, and other stakeholders in Serang District prioritized groups of sheep farmers selected by purposive sampling with the criteria of farmers who are currently seeking corn and sheep commodities. Survey activities are carried out through monitoring the existence of farmers and existing institutions, this in detail includes: (a) characteristics of farmer households and group profiles, (b) characteristics of food crops (maize) business, (c) characteristics of sheep farming business, (d)) corn business management and sheep rearing business. Descriptive analysis was used to describe the general condition of the sheep farmer group (characteristics of the breeder/group; group institutional system; the role of the group in livestock-farming business; adoption rate). Technological innovations that need to be studied for application are: (a) ancreased productivity of corn-sheep per unit time, (b) efficiency of labor use, (c) feasibility of corn and sheep business (d) added value of corn-sheep integration business, among others selling sheep seeds and fodder forage, as well as commercial sheep. Primary data was obtained from farmer groups, secondary data was obtained from the department and related stakeholders, primary data and secondary data were analyzed quantitatively and qualitatively and the economic value of farmers.

3 Results and discussion

3.1 Overview of research sites

Serang District is one of 8 (eight) regencies/cities in Banten Province, located at the western end of the northern part of the island of Java and is the main gateway connecting Sumatra Island with Java Island with a distance of ± 70 km from the city of Jakarta, the capital city of Indonesia. The administrative area is recorded at 1,467.35 Km2 which is divided into 28 (twenty eight) sub-districts and 320 villages. The research was conducted in Serang District in 3 sub-districts, namely in Anyer, Cikeusal, and Jawilan sub-districts. The research location map is shown in Figure 1.

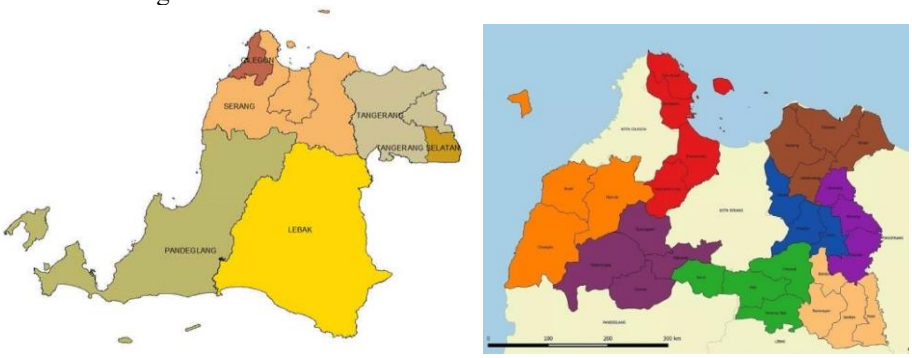

Fig. 1. Location map of Serang District, Banten Province.

3.2 Potential of corn-sheep integration area

Sheep farmers in Serang District develop livestock with an average of 8 sheep/breeder, while the sheep population in Serang District is 136,898 males and females of various ages with a total of 17,112 farmers. The number of farmers and livestock engaged in activities in 3 sub-districts is 9% each of the total farmers and livestock in Serang District. The market needs of sheep in Serang District are 151,610 heads/year, potential for aqiqah and qurban needs or 15,161 UT/year, as shown in Table 1.

Table 1. Sheep market potential in Serang District, Banten, 2021.

Sheep market for necessities in Serang District	Amount (tail)
Aqiqah	119.280
Sacrifice	32.330
Total	151.610

Table 1 shows that the sheep market potential in Serang District is very large and according to information, most of the sheep are still filled with sheep originating from West Java (Garut and Sukabumi) by 70%, because the sheep population in Banten can only meet 30 percent. %. A large market opportunity needs to be used as the basis for sheep development in Serang District. The challenge of sheep development requires sources of seeds and feeders, feed, maintenance management, increased human resources for farmers, capital/investment and land support as well as supporting technological innovations with information obtained from the Animal Husbandry and Animal Health Service of Banten. The source of high-quality sheep is currently only supported by the Puslitbangnak in the form of superior composite sheep and the Department contributes to Garut sheep by applying Good Breeding Practice (GBP) to sheep, Indonesian Sheep and Goat Farmers Association (HPDKI) Dorper-breed sheep and local sheep as commercial sheep.

Population increase is needed with several requirements, including the capacity to accommodate, increase the scale of the farmer's business, socialize the addition of new farmers and handle marketing that supports small farmers by not abandoning the development of sheep farming companies. To optimize the capacity, technological innovations are needed that can be applied to the Serang District area. The technology for feed includes silage feed technology, hay feed, complete feed, and green concentrate. The feed traded in Banten is currently only complete feed with the quality set by the producer. The technique of maintaining plant feed sources needs to be improved with Integrated Crop Management (PTT) to increase productivity. The potential of sheep and harvested area of food crops is shown in Table 2.

Table 2. Potential of sheep and harvested area of corn, rice and peanut.

District	Sheep (tail)	Harvest Area (Ha)		
		Corn	Paddy	Peanuts
Anyer	5.689 (711)	163,66	8.219,90	87,10
Cikeusal	763 (95)	163,66	8.219,90	87,10
Jawilan	5.279 (660)	163,66	8.219,90	87,10

Table 2. Cont.

Serang	136.989 (17.112)	1.582,00	79.459,00	842,00
Banten	322.810 (40.351)	15.786,00***	303.732,00***	3.242,00***

Source: *BPS (2021); *** Director General of Food Crops (2020) (data reprocessed)

Table 2 shows that the harvested area of forage crops in Serang District includes corn covering an area of 1,582 ha which can accommodate 3,164 UT, and the harvested area of 79,459 ha of rice can accommodate 158,918 UT, and the harvested area of peanuts covering an area of 842 ha can accommodate 1,094 UT. The total predicted sheep capacity does not include natural grass 163,176 UT equivalent to 1,631,760 sheep. Improvements in maintenance management that need to be implemented by utilizing food plant by-products in the form of silage feed because it can last up to 6 months, livestock kept in cages to reduce grazing, handling of sheep parasites, marriage arrangements for three births in 2 years, increasing sheep business scale for farmers, management rearing of pre-weaned lambs (cempe) and fattening management. The maintenance management applied by farmers is still traditional, namely releasing, moving ties, grazing around 90%, in cages around 10%.

This traditional system is starting to face challenges from farmers and food crop farmers because it interferes with food crops including corn, rice and peanuts. Human Resources (HR) of farmers need to be improved through technical guidance, assistance, monitoring and dynamics of improvement through the application of Good Farming Practice (GFP). This task can be carried out by the Dinas, Balitbangtan and HPDKI until the farmers can implement it properly. Capital/investment support and land are needed to increase productivity through the application of PTT, GBP, GFP, human resources for farmers, supporting machines and technological innovations for corn-sheep integration. This source of capital/investment comes from Bappeda, Dinas and stake holders including HPDKI, Corporate Social Responsibility (CSR) from companies, banking and individual businesses, People's Business Credit (KUR) and livestock insurance.

3.3 Sheep farmer group profile

The Karya Tani group was formed in 2013 and experienced several changes in management due to the group's inactivity. In 2019, the group has a new board with 45 members, 20 (44.4%) of them are sheep farmers. Types of business carried out by group members in order of rice, horticulture, livestock and corn. The managed agricultural land is arable land (individual owner and PT) with 1/3 profit sharing or rent. The age group ranged from 17-65 years with an average of 46 years with an average education of junior high school, land ownership of 500 m2. Rice planting is done 1 (one) time every year (IP 1) in the rainy season, in the dry season the land is used for planting corn (1 time). Group meetings are held 1-2 times a month with the topic of information on fertilizers, botanical pesticides and technical trainings.

In 2019, the group managed to sell 60 sheep on Eid al-Kurban with a minimum age of 1.5 years with a price range of Rp 2.000.000 – 8.000.000 / head (depending on the horns and body weight). The price difference on Eid al-Kurban with normal days is Rp 1.000.000/head. In 2020, the group managed to sell 80 sheep on Eid al-Kurban with the feeder sheep obtained from the Garut area. In addition, the need for parties/intentions is as much as 5-10 tails/person in certain months. The need for routine sheep is 20 heads/month which is intended for Akikah and others [12–14]. Apart from sheep, currently there is a demand for sheep urine as much as 500 liters/week at a price of Rp 5.000/liter from Jakarta consumers. To support the sheep

farming business, the Agricultural Extension Center (BPP) in 2020 has conducted counseling on silage making. And in the same year, the Banten Provincial Agriculture Service provided assistance with 1 ha of Odot grass.

The sheep farming business in the group: a) the types of sheep that are cultivated are local sheep (72.62%), Garut sheep (1.43%) Priaga sheep (5.55%) and Doba Dorper (0.40%), the type of sheep preferred by farmers is horned sheep; b) the reproductive characteristics of Garut Sheep at the location were 72.09% single calf, 26.74% twins and 1.16% triplets with <5% mortality; c) the scale of sheep rearing ranges from 1-4 heads/breeder; d) most of the rearing system is displayed for 5 hours/day from 12.00-17.00 WIB by providing additional feed in the cage as much as 4 kg/head/day; e) It is known that the interest in breeding sheep is still low but has started to be done; and f) types of sheep market from the largest to Eid al-Kurban > Aqiqah > Hajat.

Based on the survey results, it is known that as many as 67.44% of respondents (58 people) participate or are members of institutions or groups with the number of respondents who are active in institutions as many as 68.97% (40 people). The reasons for joining the agency were to exchange sales information (87.18%), to get assistance from the government (7.69%) and both (5.13%). Meetings with groups of corn and sheep farmers in a year conducted by institutions vary widely and are adapted to the needs and opportunities of local agricultural extension officers with an average of 26 times per year, the types of institutions participated in by respondents can be seen in Table 3.

Table 3. Types of institutions followed by respondents.

Number	Institution	Total Respondents (People)
1	Farmer group (a)	31
2	Livestock group (b)	2
3	Farmer and livestock group (c)	13
4	Farmer group with livestock group (a+b)	6
5	Farmer group with farmer and livestock group (a+c)	2
6	Farmer group with livestock group with farmer and animal farmer group (a+b+c)	1
7	Cooperation with farmer group (Co)	2
8	Cooperation with livestock group with farmer and animal farmer group with social (Co+b+c+social)	1
Total		58

Table 3 shows that there are 5 (five) institutions that are followed by respondents, namely farmer groups (53.45%), livestock groups (3.45%), farmer and livestock groups (12.96%), cooperative and social. However, some of the respondents joined in several of these institutions, including: a+b (10.34%), a+b (3.45%), a+b+c (1.72%) and co+a (3, 45%), and co+b+c+social (1.72%). In its activities, group assistance activities have been carried out from related agencies in the form of technical guidance on agriculture (66.67%), livestock and agriculture integration (27.27%), sheep management (3.03%) and sheep feed processing (3, 03%).

The results of the assistance were mostly felt by the respondents and as many as 83.33% of participants applied the knowledge of corn and livestock cultivation counseling, then information was obtained about the weaknesses/shortcomings of the livestock group including cohesiveness and the participation of other members was still lacking (40%),

guidance by officers still lacking (30%) and capital and infrastructure to support farming is not evenly distributed (30%). These weaknesses, farmers expect improvements by increasing training and submitting assistance to the government for capital for corn and sheep business facilities and infrastructure. Aspects of extension (animal husbandry), that the respondents consecutively want counseling on corn cultivation, livestock health, business management of sheep, sheep fodder formulations and livestock reproduction.

3.4 Inventory of sheep feed formula

The development of sheep (ruminants) is an important part that must be met both in quantity and quality to support its growth. Ruminant feed is divided into forage feed ingredients and concentrated feed ingredients, forage feed ingredients have high crude fiber content and are difficult to digest, while concentrated feed ingredients have low crude fiber content and are easy to digest. The availability of land greatly affects the composition and quality of feed given to livestock, especially in land-based livestock development where the use of forage feeds is up to 100%. The provision of sheep feed can come from the cultivation of corn plants, forage crops, general pastures, crop fields plantations, agricultural by-products and agro-industrial waste.

Waste from food crops as a source of sheep feed, but in the community it is still very minimal even though if it is used properly, it can support the development of sheep and reduce production costs for purchasing feed. Sources of feed come from by-products of food crops such as corn (forage corn, corn husks, corn cob, corn tumpi), rice and peanuts and feed can be given in fresh or processed form. To find out what the benefits and costs are, during the economic life of the project (in the future), a detailed financial calculation is needed for one year [15]. The results of the survey in the field, that there is a farmer who has processed feed ingredients from food plant by-products into complete feed and silage, the feed is given to sheep as much as 1.5 kg/head/day (complete feed) and 1 kg/head /day (silage or grass feed) can produce an encouraging daily body weight gain (PBBH) in the fattening business of 0.44 kg/day for Garut Sheep aged 7-8 months which are kept for 3 months. Complete feed formulated by The breeder is trial and error or trial and error has not referred to nutritional needs and the nutritional content is not yet known, the formulation of sheep feed for farmers is shown in Table 4.

Table 4. Complete feed formulation for fattening by farmers.

Ingredients	Volumen (kg)	Price (Rp/kg)	Amount (Rp)
Corn cake	100	150	15.000
Rice bran	30	3.000	90.000
Molasses	6	6.000	36.000
Coffee skin	30	150	4.500
Tofu dregs	50	800	40.000
Oil palm	20	2.800	56.000
Soy sauce	15	6.000	90.000
Urea	0,5	8.000	4.000
Premix	1	25.000	25.000

Table 4. Cont.

Salt	0,5	2.000	1.000
Labor	1	80.000	80.000
Real price of feed	254	1.738	441.500
Price of finished feed		3.000	3.000
Feed profit (kg)	1	1.262	1.262
The selling price of the sacrificial lamb	80	100.000	8.000.000
The production of the sacrificial lamb	40	100.000	4.000.000
90 days feed production	135	3.000	405.000
Net profit /tail			3.595.000

Supporting the development of sheep in farmer groups, nutrition in feed is an important element in supporting the growth, reproduction and health of livestock. The feed given to sheep must be of good quality, and in accordance with the nutritional needs of livestock and the amount adjusted to the physiological status of livestock in terms of energy, protein, minerals and water, energy sources obtained from forage and grains and their by-products [16–18]. Sources of protein are obtained from fortifying feeds such as fish meal, soybean meal, coconut meal, peanut meal and legumes such as turi leaf, calliandra, gliricide and indigofera and as a mineral source, salt or mineral mix can be added. Water needs are provided ad libitum all the time, referring to the nutritional needs and complete feed based on local resources to support the development of sheep and increase the economic value of farmers. Silage feed formulations and prices by farmers are shown in Table 5.

Table 5. Silage feed formulation by farmer and price.

Ingredients	**Volumen (kg)**	**Price (Rp/kg)**	**Amount (Rp)**
Molasses	5,0	6.000	30.000
Rice bran	5,0	3.000	15.000
Em4	0,3	25.000	7.500
Elephant grass/muck/rice straw	100,0	600	60.000
Amount	110,3	1.020	112.500
Consumption/head/day	1,0	2.000	2.000
Consumption of complete feed/head/day	1,5	3.000	4.500
The price of buying a lamb to be sacrificed	40,0	100.000	4.000.000
Price of silage feed consumption 90 days/head	90,0	2.000	180.000
Price of complete feed consumption/head/day	135,0	3.000	405.000
The selling price of the sacrificial lamb	80,0	100.000	8.000.000
Net profit/tail			3.415.000

4 Conclusions

The results of research in Serang Banten District, the integration of corn and sheep in the farmer group shows the ability of farmers to increase the corn and sheep business is quite good, so it needs institutional support, central and local governments to spur farmers to make their business more commercial, so that the economic value of farmers increases. and the need for sheep for aqiqah and sacrifice is met, so that Serang District does not rely on or fulfill it from outside Banten Province. Components of livestock technology, veterinary and maize cultivation, as a source of sheep feed and the establishment of an institutional model for maize-sheep integration based on maize waste can increase the sheep population. The design of the institutional model that is made is expected to be further refined and developed into an institutional model of sheep development in Serang District in accordance with the potential of the region.

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