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Research Article
Intangible Costs Resulting from Inefficient Feeding and Water Usage in Smallholder Dairy Farm in Indonesia

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Abstract

Background and Objective: In terms of the environment, dairy cattle production uses input resources such as forage feed and water sources and if not used optimally will lead to inefficiencies that affect the productivity of the business. This study aimed to identify current condition of management of dairy cattle based on the business scale and calculate the efficiency of resources input utilization based on feed and water requirement and availability. **Methodology:** Respondents were dairy smallholder located in Sleman Regency, Yogyakarta-Indonesia. At least 100 respondents of dairy smallholder were selected as samples using purposive sampling method based on the number of cattle ownership low scale (1-2 head), moderate scale (3-4 head) and high scale ($\geq$5 head). Identification of the maintenance condition of dairy cows by the scale of business and eco-efficiency assessment were analyzed with quantitative and descriptive using tables. **Results:** The results showed that the bigger scale of business has inefficiency of the unutilized feed remains would increase the amount of cost by IDR 22,185.00 day^{-1} in the group pens (colony) and IDR 74,145.00 day^{-1} in individual pens. The use of water in dry season was more emphasized for watering forage plants instead for cattle raising. In order to reduce the cost of feed during dry season. **Conclusion:** Inefficiencies in the use of feed input and providing water sources by farmers in the colony pens and individual pens have an impact on the decrease in economic value. Therefore, it is necessary to conduct a more in-depth study on the calculation of feed inefficiency views of the environment and its effect on the production of which the provision of feed as seen from the N/C balance ratio. In addition, during dry season, it is necessary to provide forage through the silage-making technology. Further study is needed in accordance with the need for maintenance of cattle per day, especially for the needs of drinking water if the drinking delivery system was inefficient causing milk production to be low.

Key words: Inefficiency, colony pens, individual pens, feed and water, dairy smallholder

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Most dairy cattle farms in Indonesia are based on semi-intensive system with low scale ownership[1,2]. Smallholder dairy cattle production system are usually integrated with forage feed in highlands or small plots of pasture areas across the country[3,4]. Ditjennak[5] stated that 87.38% of the dairy cattle population are concentrated in Java, the rest are outside of Java and most of them are reared in the highlands. Limited feeding, facilities, milking machine, sanitation and environment hygiene are the main cause of low milk yield and quality in dairy smallholder farms[6,7]. New ideas are being explored to improve the efficiency and profitability of smallholder dairy farms while reducing potential adverse effects on the environment[8].

In order to support eco-friendly dairy cattle management, the inefficiency of resources usage needs to be reduced as this would affect external cost resulting from environmental damage. External costs are not accounted for in the market price of products or weighted on cattle output price, hence, invisible externality on market price are part of economic inefficiency.

The Marginal Cost (MC) curve shows the additional cost production or Marginal Private Cost (MPC) on dairy cattle business (Fig. 1). Private cost each farmer will be lower than Marginal Social Cost (MSC) if farmers do not use the waste properly. Private cost consists of water usage and feed waste, social cost consists of private cost and external cost for water usage and feeds waste. Supply curve that shows marginal cost or marginal private cost were production factor cost guaranteed by the producer on equivalent condition (P_1, q_1). Farmer maximized profit output produce in q_1 where marginal cost equal to cost. The difference in cattle output affects external cost, which can cause in Marginal External Cost (MEC) to change[9].

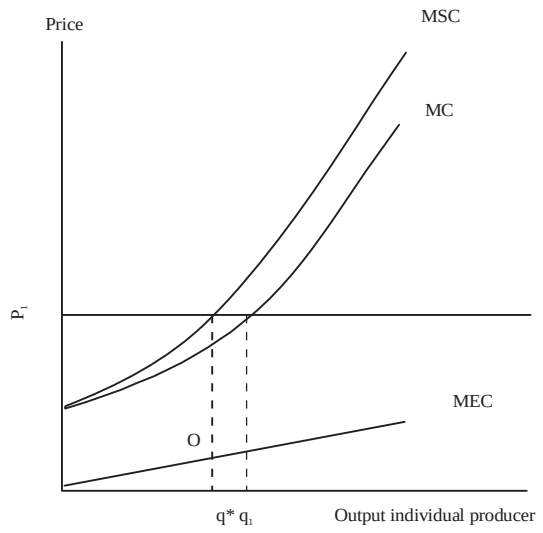

Fig. 1: Negative externality on each producer (individual farmers)[9]. Farmers maximize profit, which MC = P_1 = MR (Market rivalry factors) and equivalent point in (P_1, q_1). Output efficiency level occurs when P = MSC and equivalent point in (P_1, q*). More cattle causing an increase in an external environment marked by increasing slope to the right

Eco-efficiency scoring could decrease the wasted water and grass feeding so the productivity could increase. This study was conducted to evaluate the management system of dairy cattle according to business scale and the impact of feed and water resources on productivity and farm profitability. The objective of this study was to gather this information and to examine ways to decrease waste so could increase the business profit.

MATERIALS AND METHODS

Sampling methods: This study was conducted in district of Pakem and Cangkringan, which is the center of the largest dairy cow population in Sleman Regency, Daerah Istimewa Yogyakarta Province. Samples were selected from 5 farmer groups of dairy small holders, namely, 3 groups in Pakem district and 2 groups in Cangkringan district. Selection of farmer groups was based on data obtained from dairy cooperatives Warga Mulya and UPP Kaliurang, especially farms that deposit milk in large quantities. The samples were further divided into 2 groups based on cow management system, whether in colony and individual pens. As much as 100 samples were stratified based on cattle ownership designated high, medium and low according to the number of animals (Table 1).

Data collection: The primary data were collected was using two techniques, namely: (1) Observation, data collection by

Table 1: Determination of the respondents based on maintenance system and business scale

Types of pens	Respondent
Colony	
Low scale (1-2 head)	26
Medium scale (3-4 head)	13
High scale (≥5 head)	8
Individual	
Low scale (1-2 head)	32
Medium scale (3-4 head)	12
High scale (≥5 head)	9
Total	100

directly observing the research object and (2) Interviews, namely the collection of data by requesting information from respondents. The secondary data were collected from using records available at the agencies or institutions involved in this study.

Other data collected include dairy cattle management based on business scale, farmer's demography characteristics, cattle characteristics, cattle feeding management, milking management, water resources management and waste disposal. The data obtained were summarized in tabular form.

Eco-efficiency scoring and water resources input related to water requirement and availability for routine cattle maintenance, such as washing, drinking, etc., were also recorded water resources and waste inefficiency occur because of unavailability requirements. Feed efficiency was estimated based on feed availability compared to given feed. Feed residues that were considered wasted especially grass or concentrates residues could cause business support inefficiency. Eco-efficiency data (water and feed) indicated the profit or loss from input resources in dairy smallholder. The next step was made strategies to remedy the water and feed input resources usage.

RESULTS AND DISCUSSION

Characteristic of respondent (Dairy farmers): Characteristic of respondent or dairy farmers included age, education, experience, the number of family members and the main occupation affecting the dairy cattle production system are shown in Table 2.

The results showed that the productive age of farmers was less than 60 years (Table 2). The average age of farmers in Yogyakarta was 49.49±11.31 year[10]. Even though most of the farmers of dairy cows housed in the group pens were away from the residence, the farmers were still able to run the business. The average formal education of farmers was primary school and supported by non-formal education through counseling and training on the management of dairy cattle, feed, artificial insemination, fertilizer processing, dairy processing and animal health (>50%). More than 50% of farmers had no schooling[10] at all. The average business experience was >20 years showed that dairy cattle business was a business handed down in accordance with the conditions sociological that cattle was a source of investment so that farmers cannot be separated from cattle. The average number of family members was 3-5 people. The daily routine

Table 2: Characteristics of respondent (dairy cattle farmer)

	Colony pens						Individual pens					
	Low scale		Medium scale		High scale		Low scale		Medium scale		High scale	
Components	Person	%	Person	%	Person	%	Person	%	Person	%	Person	%
Age												
Productive	19	73.08	13	100.00	5	62.50	27	84.37	9	75.00	7	77.78
Non-productive	7	26.92	0	0.00	3	37.50	5	15.63	3	25.00	2	22.22
Education												
Formal education												
No schooling	5	19.23	0	0.00	1	12.50	3	9.37	1	8.33	1	11.11
Elementary school	15	57.69	9	69.23	5	62.50	21	65.62	8	66.67	4	44.45
Junior high school	3	11.54	1	7.69	0	0.00	2	6.25	2	16.67	2	22.22
Senior high school	3	11.54	3	23.08	2	25.00	6	18.76	1	8.33	2	22.22
Non-formal education												
*Counseling and training on the management	14	53.85	7	53.85	7	87.50	11	34.37	6	50.00	5	55.55
Experience raising dairy cattle (year)												
<10	12	46.15	1	7.69	1	12.50	3	9.37	2	16.67	1	11.11
10-20	4	15.38	5	38.46	1	12.50	9	28.12	5	41.67	2	22.22
>20	10	38.47	7	53.85	6	75.00	20	62.51	5	41.66	6	66.67
No. of family member (person)												
1-3	14	53.85	4	30.77	4	50.00	15	46.87	3	25.00	4	44.45
4-5	10	38.46	5	38.46	2	25.00	17	53.13	8	66.67	3	33.33
>5	2	7.69	4	30.77	2	25.00	0	0.00	1	8.33	2	22.22
Main occupation												
On-farm	23	88.46	11	84.61	8	100.00	30	93.75	9	75.00	9	100.00
Off-farm	1	3.85	1	7.69	0	0.00	0	0.00	1	8.33	0	0.00
Non-farm	2	7.69	0	0.00	0	0.00	2	6.25	2	16.67	0	0.00

*Non-formal education through counseling and training on the management of dairy cattle, feed, artificial insemination, fertilizer processing, dairy processing and animal health

Table 3: Production and reproduction characteristics of dairy cattle raised under colony and individual pens

	Colony pens			Individual pens		
Components	Low	Medium	High	Low	Medium	High
Milk production (L day^{-1})	9.56	10.95	13.19	10.58	12.33	14.67
Peak lactation (month)	2.83	3.08	3.00	2.74	2.83	2.78
Long lactation (month)	9.41	9.62	9.63	8.56	8.79	8.22
Weaning age (month)	3.81	3.73	3.13	3.31	3.50	3.06
Calving interval (month)	14.76	12.77	13.13	14.13	13.91	14.89
Age of first mating (month)	26.52	28.36	28.00	28.79	28.36	24.67
Age of culled cow (month)	68.00	84.00	88.00	78.24	82.80	88.00
Mating system	IB	IB	IB	IB	IB	IB
Service per conception (time)	2.77	2.38	1.88	2.75	2.22	3.56

IB: Artificial insemination

Table 4: Number of Animal Units (AU) owned by low, medium and large scale farmers and raised in colony and individual pens

	Cows						Calf					
	Lactation		Dry		Heifer		Male		Female		Total	
Respondent	Head	AU	Head	AU	Head	AU	Head	AU	Head	AU	Head	AU
Colony pens												
Low scale	1.00	1.00	1.22	1.22	1.27	0.63	1.00	0.25	0.46	0.36	4.95	3.46
Medium scale	1.00	1.00	2.10	2.10	1.50	0.75	1.83	0.46	1.80	0.45	8.23	4.76
High scale	2.00	2.00	4.00	4.00	1.86	0.93	1.00	0.25	2.37	0.59	11.23	7.77
Individual pens												
Low scale	1.25	1.25	1.19	1.19	1.00	0.50	1.12	0.28	0.17	0.29	4.73	3.51
Medium scale	1.50	1.50	1.92	1.92	1.67	0.83	1.28	0.32	1.60	0.40	7.97	4.97
High scale	2.20	2.20	4.55	4.55	1.50	0.75	1.60	0.40	2.40	0.60	12.25	8.50

AU: Animal unit

Table 5: Utilization and land area of owned by farmers

	Colony pens			Individual pens		
	Low	Medium	High	Low	Medium	High
Plant	Land area (m^2)					
Grass	3,167	1,285	3,500	1,937	1,840	4,430
Intercropping (G+AC)	1,418	5,333	9,500	3,500	1,900	2,500
Intercropping (G+SZ)	7,133	4,000	7,000	2,520	5,000	1,000
Intercropping (G+SZ+AC)	500	300	0	4,000	1,000	0
Total	12,218	10,918	20,000	11,957	9,740	7,930

G: Grass, SZ: *Salacca zalacca*, AC: *Albizia chinensis*

management of livestock was not only dominated by the head of the family but also the wife's role was also crucial. The majority of dairy cattle owners were farmers (on-farm), the rest had non-farm jobs, such as sand miners, construction workers and merchants.

The production and reproductive performance dairy cows are shown in Table 3. The average production of milk per cow with average lactation length of 8-10 months was more than 10 L day^{-1}. The problems almost in all dairy smallholder were that the farms were less efficient, with low-performing lactating cows that produced about 8-12 L day^{-1} cow^{-1}, which resulted in low farm income[11,12].

Average lactation parent ownership of both group, individual and colony pens was still low in the range of 1-2 head (Table 4), so that the milk production if was used as the principal reception, cannot be expected to meet the needs of farmer's lives, so that the additional revenue was derived from the integration efforts of vegetables and fruits and non-farm. Farmers worked on intercropping plant in home gardens to combine the forage plants with fruits, especially *Salacca zalacca* fruit and plant *Albizia chinensis* which is worth selling in addition to utilizing idle land, reclamation of degraded lands as well as efforts to increase the added value for household income (Table 5).

Eco-efficiency of feed: Feeding activities were carried out twice a day, with concentrate supplementation of ±5 kg head^{-1} day^{-1} and forage were adjusted to achieve appropriate intakes. It could be one bundle per day or more of cut grass or other forages. The usual sorts of green feed given to cattle were *Pennisetum purpureum*, *Zea mays* waste, reed grass, browse and rice straw, while the concentrates supplied were pollard only or concentrate formulations obtained from the cooperative.

The source forage was derived from leased land that cultivated grass or native grass and harvested and during dry season the farmers usually purchase forage feed. Feed that available and sold in the market was a mixture of *Pennisetum purpureum* and *Zea mays* waste by weight per bundle for a medium-size of 27.7 kg was of IDR 20,000.00 bundle^{-1} and large size (40-40.5 kg) was IDR 25,000.00-30,000.00 bundle^{-1}.

This study was conducted in dry season when feed availability was limited and cattle were given limited amounts of feed. On the other hand, during the rainy season where the feed was relatively abundant and easy to obtain and the farmers did not need to buy, the possibility of feed residues was greater. Indonesia is known as a tropical country and the climate is fairly even all year rounds. The climate and weather of Indonesia were characterized by two tropical seasons, which vary with the equatorial air circulation (the Walker circulation) and the meridian air circulation (the Hardley circulation) so that weather usually has high temperatures and humidity[13,14]. The weather in Indonesia is characterized by high temperature ranging between 27.7-34.6°C, humidity[14-16] ranging between 55.8 and 86.8% and temperature humanity index value is 78-80. The productivity of dairy cows in a tropical environment, which are generally thought to result from the lower lack of management that is not in accordance with the demands of livestock to produce optimally[14].

Available feed were all fed to cattle on a low scale (Table 6) although, in dry season, corn stalk and *Gliricidae sepium* were also given. According to NRC[17], dairy cows needs 12 and 63% of crude protein and Total Digestible Nutrient (TDN) consecutively to produce 10-15 L of milk. Corn straw has 7% protein and TDN 52%[18] and does not meet the minimum requirement for milk production[19]. According to observation, the remaining grass was wasted even though most farmers uses it for making compost. This condition was caused by unavailable chopping machine (chopper). If the remaining grass were used to make compost, it could decrease economical and grass feeding inefficiency. A little knowledge of feed formulation and concentrates for dairy cows, unknown the benefit of feedstuffs, also low feed quality in dry season were the main problems for dairy smallholder[19,20]. Rochijan *et al.*[14] reported low intake of forages, the negative effect in the digestive process could be prevented if the concentrates had high structural carbohydrates. This condition could be used by farmers as a reference, especially when forages were hard to get and expensive when dry season.

Table 6: Use and residual forage in dairy cattle feed

	Availability of forage			
Raising management	Bundle (day^{-1})	kg day^{-1}	Rest (kg day^{-1})	Economic inefficiency (IDR day^{-1})
Colony pens				
Low scale	2.19	60.28	0.00	0.00
Medium scale	4.00	110.00	8.80	6,400.00
High scale	6.37	175.31	30.50	22,185.00
Individual pens				
Low scale	2.37	6531.00	0.00	0.00
Medium scale	5.33	146.57	30.05	21,855.00
High scale	6.22	171.05	101.95	74,145.00

Utilization of water: During this study time, dairy cattle farmers obtained water facility of municipal Water Maintenance Agency (WMA) from Boyong river and Turgo and Merapi mountain springs. Water usage and maintenance costs (including installation) were IDR 100,000.00-200,000.00 month^{-1} for the whole farmer groups that raised animals in the colony pens. The distribution of water from the water spring into the pens was by using PVC pipes and the water stored cisterns. In dairy farms water was used for drinking water, cleaning the cattle udders and cleaning the pens and the floors. Washing the cattle was carried out on a weekly basis considering the water availability were limited in dry season. Waste water from the milking process, washing of appliances, cleaning the pens and washing the cattle, was directly channeled into the pasture/forages around the pens. Suranindyah *et al.*[21] reported that water use was essential in the maintenance of dairy cattle, for example in the milking process (sanitation before and after milking). Hygienic milking procedures include cleaning the floor, water and feed trough, washing the cows, cleaning and drying udder after washing, discarding first milk flow and streaming floors with water after milking.

The water cost in individual pens was appropriate with the basic rates of water in Sleman Regency at IDR 2,000.00 m^{-3} or IDR 200.00 L^{-1} of water.

Table 7 showed that the higher scale of business did not necessarily mean that water use for cattle raising was also higher but rather more water was used for watering forage plants rather than for the maintenance of cattle. The use of water in dry season was more emphasized for watering plants instead of for cattle raising in order to reduce the cost of feed during dry season. The more the number of cattle did not result in the increase in water demand for cattle. This was seen in high-scale group pens (11.23 head) water requirements for cattle raising was calculated to be 400 L month^{-1} with extensive land holdings of about 3,500 m^2.

Input resource utilization strategy: Although differences in resources input usage had an impact on inefficiencies or economic efficiency, a strategy to overcome the economic inefficiencies imposed by the scale of the farm can be similar. This was because of the problems that occurred were nearly as much as the utilization of the waste feed, water and sewage. Table 8 shows suggested measures of strategies for resources utilization for feed and water usage.

Table 7: Availability and use of water

Raising management	Cost of water (IDR year^{-1})	Availability of water (L month^{-1})	Water needs			
			No. of animals (AU)	Raising cattle (L month^{-1})	Forage land (m^2)	Irrigated forage land (L month^{-1})
Colony pens						
Low scale	171,900.00	859.50	4.95	442.44	3,167	417.06
Medium scale	180,000.00	900.00	8.23	191.54	1,285	708.46
High scale	423,750.00	2,118.75	11.23	400.00	3,500	1,718.75
Individual pens						
Low scale	213,300.00	1,066.50	4.73	104.68	1,937	961.82
Medium scale	355,050.00	1,775.25	7.97	346.25	1,840	1,429.00
High scale	803,550.00	4,017.75	12.25	758.33	4,430	3,259.42

Table 8: Strategy of resource utilization input

Input parameters	Step strategy
Feed remains	• The inefficiency of feed remains unused, remaining feed should be mixed with dirt (sludge) as an additive constituent of compost
	• The remaining feed was shredded (with grated tool) and then inserted or mixed at the time of the feeding concentrates
	• Feed given is a favorite of dairy cattle (not hump of grass) so it is not wasted
Water	• The inefficiency of liquid waste residual from cleaning pens and bathing cattle by establishing a wastewater treatment plant (WWTP) using the tub or pool terraced ponds and put a plant to reduce the concentration of contaminants in the liquid waste such as water hyacinth
	• Increase the amount of water reservoir (tendon) during dry season

CONCLUSION

Inefficiencies in the use of feed and providing water sources by farmers raising cattle in both the colony pens and individual pens had a negative impact on the farm income. Therefore, it is necessary to conduct a more in-depth study on calculating feed inefficiency in view of the environment and its effect on the production in which the provision of feed as seen from the N/C balance ratio. In addition, during dry season, it was necessary to provide forage through the silage-making technology. Further study needs to be conducted examine the effect of water requirement and usage in the routine management of dairy cows especially for the needs of drinking water and the water delivery system that may cause milk production to be affected.

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REFERENCES

1. Setiadi, D., 2006. Peningkatan kualitas manajemen sapi perah di Indonesia. Prosiding Lokakarya Nasional Sapi Perah, November 23, 2006, Bogor, pp: 56-58.
2. Kusmaningsih, Susilowati and K. Diwyanto, 2008. Prospek dan perkembangan sapi perah di Jawa Tengah menyongsong MDG's 2015 [Prospect of dairy cattle development towards MDS's 2015 in Central Java]. Prosiding Semiloka Nasional: Prospek Industri Sapi Perah Menuju Perdagangan Bebas 2020, April 21, 2008, Jakarta, pp: 404-412.
3. Devendra, C., 2001. Smallholder dairy production systems in developing countries: Characteristics, potential and opportunities for improvement-review. Asian-Australasian J. Anim. Sci., 14: 104-113.
4. Anggraeni, A., 2006. Productivity of holstein-friesian dairy cattle maintained under two system in Central Java, Indonesia. Ph.D. Thesis, University of Newcastle Upon Tyne, Departement of Agriculture, New Castle, UK.
5. Ditjennak, 2009. Statistik peternakan 2009. Direktorat Jenderal Peternakan, Departemen Pertanian RI, Jakarta.
6. Misgiyarta, S. Roswita, S.J. Munarso, Abubakar and S. Umiyati, 2005. Status tingkat residu antibiotik pada susu segar [The concentrations of antibiotic residues in fresh milk]. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner, September 12-13, 2005, Bogor, pp: 206-214.
7. Misgiyarta, A. Budiyanto and R. Sunarlim, 2008. Pengaruh lama waktu transportasi susu segar terhadap tingkat kontaminan mikrob (studi kasus di wilayah KUD Sarwamukti, Lembang, Jawa Barat) [The effect of transportation periode of fresh milk an microbial contamination level (Case study in the region KUD Sarwamukti, Lembang, West Java)]. Prosiding Seminar Nasional Teknologi Peternakan dan Veteriner, November 11-12, 2008, Bogor, pp: 264-270.
8. Rotz, C.A., D.L. Zartman and K.L. Crandall, 2005. Economic and environmental feasibility of a perennial cow dairy farm. J. Dairy Sci., 88: 3009-3019.

9. Pindyck, R.S. and D.L. Rubinfeld, 2013. Microeconomics. 8th Edn., Pearson Education Inc., New Jersey, USA., pp: 661-699.
10. Guntoro, B., B.P. Widyobroto, N. Umami, Indratiningsih, S. Nurtini, A. Pertiwiningrum and Rochijan, 2016. Marketing and institutional characteristics of dairy industry in Indonesia. Int. J. Environ. Agric. Res., 2: 106-114.
11. Yusdja, Y., 2005. Kebijakan ekonomi industri agribisnis sapi perah di Indonesia. Majalah Analisis Kebijakan Pertanian, 3: 256-267.
12. Widiati, R., T. Prasetyo, Y.Y. Suranindyah, S. Nurtini, Supriyadi and I. Harsantyo, 2010. The performance of credit program for smallholder's dairy cattle development in Indonesia. Proceedings of the 5th International Seminar on Tropical Animal Production (ISTAP) on Community Empowerment and Tropical Animal Industry, October 19-22, 2010, Yogyakarta, Indonesia, pp: 753-758.
13. Thayeb, T.M.H., 2015. Profile of Indonesia. Embassy of the Republic of Indonesia, November 24, 2015.
14. Rochijan, B.P. Widyobroto and Ismaya, 2016. Effect of High Rumen Undegraded Protein (HRUP) supplementation on estrous response and progesterone hormone profile in dairy cows raised under Indonesia tropical environmental conditions. Asian J. Anim. Sci., 10: 175-181.
15. BPS., 2010. [Statistics Indonesia 2010]. Badan Pusat Statistik (BPS), Jakarta, Indonesia, (In Indonesian).
16. Hernawan, A.E., 2014. Effect of banana peel application in ration on hematological level, nitrogen retention and body weight gain of heat exposed broiler chicken. Sci. Pap.: Ser. D: Anim. Sci., 42: 101-107.
17. NRC., 2001. Nutrient Requirements of Dairy Cattle. 7th Edn., National Academies Press, Washington, DC., USA., ISBN: 0309069971, Pages: 381.
18. Hartadi, H., S. Reksohadiprodjo and A.D. Tillman, 2005. [Tables of Feed Composition for Indonesia]. Gadjah Mada University Press, Yogyakarta, (In Indonesian).
19. Baba, S., A. Muktiani, A. Ako and M.I.A. Dagong, 2011. Variety and need of feed technology of small-scale dairy farmer in Enrekang regency. Media Peternakan, 34: 146-154.
20. Gomez, C., M. Fernandez, I. Salazar, I. Saldana and H. Heredia, 2007. Improvement of small dairy producers in the central coast of Peru. Trop. Anim. Health Prod., 39: 611-618.
21. Suranindyah, Y., E. Wahyuni, S. Bintara and G. Purbaya, 2015. The effect of improving sanitation prior to milking on milk quality of dairy cow in farmer group. Procedia Food Sci., 3: 150-155.