SUSTAINABILITY CONCERNS OF SMALL RUMINANT PRODUCTION SYSTEMS IN DIFFERENT AGRO-ECOLOGICAL ZONES IN YOGYAKARTA-INDONESIA

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ABSTRACT

Sustainability has become an agenda item in livestock development programmes as they do not succeed in meeting their objectives and because of the impacts of animal production on the environment. This study report on the sustainability development of small ruminants in different agro-ecozones. The issues explored in this study consisted of socio-economic issue, ecological issues, and small ruminants performance issues. These issues were based on the relative of importance of each issue in Yogyakarta-Indonesia. Indicators of socio-economic issues were: farmers' income (SI_1), opportunity cost of family labour (SI_2), benefit in saving (S_3), and benefit in security (SI_4). The SI of small ruminant performance were consisted of litter size (SI_5), lambing/kidding intervals (SI_6), survival until weaning (SI_7), daily gain of pre-weaning (SI_8), and weaning age (SI_9). The ecological issue were consisted of level of gases in the air and water. It was NH_3 (SI_{10}), NO_2 (SI_{11}), and H_2S (SI_{12}) levels found on the air around small ruminant houses, and Faecal coliform (SI_{13}), total coliform (SI_{14}) and nitrate (SI_{15}) levels found on the water resources around small ruminant houses. The actual value of this study had compared with the acceptable limit of their parameters assessed by the local government in order to study the contribution to the sustainability development. Small ruminant in all three zones fail to contribute to the more sustainable development of small ruminant, in terms of economic issues, expect for the benefit security (SI_4) issue. The greater contribution of different agro-ecozones to the sustainable development of small ruminants was performed in the ecological SI point of views. Most of the ecological SI succeeds in contributing of sustainable development, except for the ecological SI which related to the groundwater quality. The study on sustainable development of small ruminants in three agro-ecozones showed that each zone had less contribution to the sustainable development in term of economic issue, such as farmers income and hired labour, while for the ecological aspects, all of the three agro-ecozone had succeed in contributing sustainable development of small ruminants, although sustainable indicator which related to the ground water quality seem to be failed.

Keywords: Sustainability, Small Ruminants, Indonesia

INTRODUCTION

Small ruminants in Central Java-Indonesia are found in all three agro-ecozones: lowland, middle zones and upland areas. Each zone has different cropping patterns, land use management and production potentials, and consequently feed resources. Changes

in resource endowment, land use, economic conditions, population pressures and marketing opportunities, will trigger changes in the livestock production system. The technical, economic, ecological and social implications arising from this transformation are important for the sustainability prospects of the new farming systems and for the adoption of interventions.

Sustainability has, in recent times, become a significant concern for society together with other world-wide issues such as global climate change and development of the global economy (Gibon *et al.*, 1999), it has become an agenda item in livestock development programmes as they do not succeed in meeting their objectives and because of the impacts of animal production on the environment (Udo and Cornelissen, 1998). The concept of sustainability is a dynamic concept in the sense that what is sustainable in one area may not be in another, and what was considered sustainable at one time may no longer be sustainable today or in the future because conditions or attitudes have changed (Lefroy *et al.*, 2000). From a physical point of view, a sustainable livestock farming system should improve, or at least maintain, the natural resources without running out of or devaluing them or generating outputs that, one way or another, reduce farming activities by, for example, giving rise to unacceptable levels of pollution (Nardone *et al.*, 2004). Animal agriculture, if not properly managed, can also have detrimental effects on human well-being and the environment, i.e. inefficient conversion of potentially human-edible foods, environmental degradation, adverse effects on human health (Bradford, 1999). Schiere *et al.* (2002) stated that in general, animals are often considered to be cause for unsustainability in both high and low external inputs agricultural systems.

Integrating sheep and goats into a farming operation can contribute to the economic and environmental sustainability of the whole farm. By studying the sustainability prospect, it can be seen what kind of production system could be sustainable in the future, and further what component of production system should be improved to achieve the sustainable production systems. This study report on the sustainability development of small ruminants in Yogyakarta, Indonesia.

MATERIALS AND METHODS

The sustainability indicators (SI) were assessed based on the overall results of the previous study on the performance, air and water qualities and socio-economic study of small ruminants in different agro-ecozones, in Yogyakarta – Indonesia (Budisatria, 2006). The issues explored in this study consisted of socio-economic issue, ecological issues, and small ruminants performance issues. Societal issue however does not take into account in this study, because it was related to the animal welfare, and that data are not readily available. However, animal welfare closely related to the housing systems and condition, herd management, i.e. lightness, spacing, grazing season (Haas *et al.*, 2000). It is assumed that if animal welfare such that criteria can be fulfilled by the farmers, then reward for the farmer could be better performance of animal. Therefore, in this study, societal issues were approached by using performance indicators.

Sustainability indicators of socio-economic issues were: farmers' income (SI_1), opportunity cost of family labour (SI_2), benefit in saving (S_3), and benefit in security (SI_4). These SI_1 and SI_2 then were compared to the regional minimum wage of Yogyakarta Province of unskilled adult labour, it was Rp 321,750/month. For SI_3 and SI_4, the calculation were done according to the interest rate of credit in the presence of the formal bank and the opportunity cost of insurance that have to paid in the presence

of formal insurance institution. The SI of small ruminant performance were consisted of lambing/kidding intervals (SI_5), litter size (SI_6), survival until weaning (SI_7), Daily gain of pre-weaning (SI_8), and weaning age (SI_9). These SI were compared to the potential growth rate of small ruminant, according to Gatenby et al. (1988). The ecological issue were consisted of level of gases in the air and water. It was NH_3 (SI_{10}), NO_2 (SI_{11}), and H_2S (SI_{12}) levels found on the air around small ruminant houses. The SI of water quality consisted of Faecal coliform (SI_{13}), total coliform (SI_{14}), and Nitrate (SI_{15}) levels contained in the groundwater resources of the farmers. The actual value of this study had compared with the acceptable limit of their parameters assessed by the local government in order to study the contribution to the sustainability development.

To asses the contribution of SI to sustainable development (assessment of sustainable development phase), the equation explained by de Boer and Cornelissen, (2002) were used. The following assumptions were used. Let SI_i (i = 1,...,n) be sustainability indicator i and AZ_j (j= 1,...,m) be agro-ecozones j. T_i be the target value of SI_i and A_{ij} be the actual value of the SI_i for AZ_j. The deviation of the actual value from the target value is considered as:

$$\mathbf{D_{ij} = (T_i - A_{ij})} \qquad [1]$$

When SI was expressed in different units of measure, D_{ij} is calculated as:

$$\mathbf{D_{ij} = \pm (T_i - A_{ij})/ T_i = \pm (1 - A_{ij}/ T_i).} \qquad [2]$$

The overall contribution (C) of the SI to sustainable development is calculated as:

$$\mathbf{C_j = \sum_{i=1}^{n} w_i D_{ij} / \sum_{i=1}^{n} w_i} \qquad [3]$$

RESULTS AND DISCUSSION

The overall contribution of SI (deviation of actual and target values) to the sustainable development graphically presented in Figure 1, while Table 1 presents the actual value, target value and the deviation of economical, environmental and societal SI in different agro-ecozones to the sustainable development of small ruminant. A deviation above the baseline indicated that contribution of SI to sustainable development of small ruminants succeeds, while deviation below the baseline indicates that SI fails to contribute to the sustainable development. If the deviation same with the baseline (for example, SI_5 of middle and uplands areas in this figure), the contribution was also considered succeed.

Figure 1 and Table 1 indicates that in the overall, contribution of either economic indicator, performance indicators or ecological indicators in each agro-ecozones to the sustainable development of small ruminant less succeed. It was supported by the overall C value was negative in all of three agro-ecozones. The overall value of C was -1.97; -0.73 and -1.74 for lowlands, middle zone and upland areas, respectively (Table 1).

In term of economic issues, small ruminant in the uplands areas contribute higher than others areas, while the less contribution to the sustainable development was in the lowlands area due to the value of overall SI of economic issues (C) is the lowest. There is a tendency that higher zone have a better contribution to sustainable development of small ruminant.

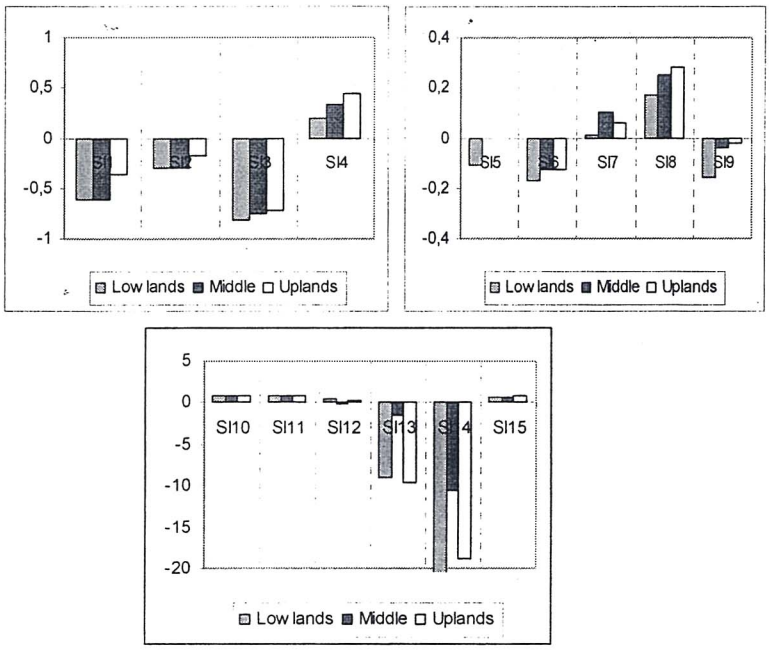

Figure 1. Graphical assessment of the contribution of sustainability indicator (SI) of three different agro-ecozones to sustainable development of small ruminants' production. (1A= economical SI; 1B= societal SI; and 1C = environmental SI)

From the economic issue point of view, it is realised that farmers would be hardly contribute to the sustainable development, because the main objectives they kept small ruminant were intangible benefit, not on the production oriented, small ruminant can be sold every time when urgent cash are needed. Ayalew et al. (2003), stated that it is not justified to base the economic evaluation of subsistence livestock production on the conventional recognized yield attributes, because the non-conventional utilities such as manure, asset, security, traction, employment generation, farm integration and socio-cultural relevance can be as important depending on the value systems of communities.

Improvement of economic performance is difficult to achieve because farmers have not kept small ruminants for business purpose.

However, small ruminants can also be considered as alternative employment for family labour to avoid the jobless in case of the absence of formal employment, especially for those farmers who lived in higher zones and far away from the city. It is in agreement with Jahnke, (1982) and Steinfeld, (1988) by Ayalew et al. (2003) that goats also play role on the provision of employment opportunities for otherwise low opportunity cost household labour.

Zones have higher contribution to the sustainable development of small ruminants in terms of performance SI compared to the economic SI. Some of the performance SI in the middle zone and upland areas were succeed in contributing sustainable development of small ruminants, such as litter size (SI_5), survival rate (S_7) and pre-weaning daily gain (SI_8). In the lowlands, however only succeed in the S_7 and SI_8, while others SI were failed to contribute to more sustainable development.

Table 1. The target and actual value of the overall SI of economical, environmental and societal issues in three different agro-ecozones.

Issues	SI	Target Value (T)	Lowlands A_i	Lowlands D_{ij}	Middle zone A_i	Middle zone D_{ij}	Uplands A_i	Uplands D_{ij}
			124572	-0.61	124335	-0.61	147020	-0.36
Economical	SI_1	321750						
	SI_2	1500	1038.1	-0.31	1036.1	-0.31	1225.2	-0.18
	SI_3	166417	32054	-0.81	41755	-0.75	46923	-0.72
	SI_4	133133	160199	+0.20	177073	+0.33	191693	+0.44
	C	=		*-0.38*		*-0.34*		*-0.21*
	SI_5	1.8	1.6	-0.11	1.8	0.00	1.8	0.00
Performance/ Animal welfare	SI_6	240	280.6	-0.17	270.8	-0.13	272.0	-0.13
	SI_7	85	85.5	+0.01	93.4	+0.10	89.8	+0.06
	SI_8	85	99.5	+0.17	106.1	+0.25	109.1	+0.28
	SI_9	*90*	104.4	-0.16	93.8	-0.04	91.8	-0.02
	C	=		*-0.05*		*0.04*		*0.04*
	SI_{10}	2	0.36	0.82	0.42	0.79	0.4	0.80
Environmental	SI_{11}	0.2	0.01	0.95	0.013	0.94	0.013	0.94
	SI_{12}	0.03	0.016	0.47	0.032	-0.07	0.022	0.27
	SI_{13}	80.0	1822.2	-8.91	920	-1.53	1579.1	-9.66
	SI_{14}	80.0	792.6	-21.78	202	-10.50	852.8	-18.74
	SI_{15}	10.0	3.32	0.67	3.5	0.65	0.86	0.91
	C	=		*-4.63*		*-1.62*		*-4.25*
	Overall contribution *(C)* =			*- 1.97*		*C = - 0.73*		*C = - 1.74*

In the lowlands, although the actual value of SI_5 was negative, it was nearly reached the target, namely 90% from the target value. The actual value of SI_9 in the middle zone and upland areas was negative, however it almost reached the target value, while the actual value of SI_6 far below than the target value. The actual value of SI_8 was much higher in all zones, it was almost 1.3 times compared to the target.

The greater contribution of different agro-ecozones to the sustainable development of small ruminants was performed in the ecological SI point of views. Most of the ecological SI succeeds in contributing of sustainable development, except for the ecological SI which related to the groundwater quality (faecal and total coliform). Contrast views were found on the SI_{13} and SI_{14} (groundwater qualities), the actual value much higher than target value, indicated that all agro-ecozones fail to contribute to the sustainable development. High actual value of these two ecological SI causing the overall contribution of agro-ecozones to the sustainable development was low, it was indicated by the low and negative values of C.

From ecological issue, each agro-ecozones have a positive contribution to the small ruminant sustainability development. The main issue concerning small ruminant production in the developing countries is land degradation, deforestation and over grazing, in this study however did not account for these issues, because small ruminants production systems in the field study had change from grazing into more intensive systems, such as cut and carry feeding, so degradation and over grazing is less relevant. Thus, the environment issue could be change from land degradation into air and water pollution. One thing that should be consider is that ecological issue should not be focused only on the impact of small ruminants to the environment, but its role in recovering the land fertility must be taken into account. El Aich and Waterhouse (1999) stated that small ruminants are the only alternative for population living in marginal areas which prevent these areas from human desertification.

The issue for small farmers in the developing countries such as Indonesia. seem to be not as important as those in the developed countries. Indicators of sustainability released are often not match with the farmer situation. In addition, the target value of the sustainability indicators which can be used as measurement can not always available. The economic, ecological and societal issues might be difficult to apply under small farmer's condition which has multi-purposes goals. Societal issues, however concern on animal welfare. It would be less important for farmers in the developing countries to realise that issue. This is considered more relevant in developed countries (de Boer and Cornelissen, 2002). Under small number of small ruminants kept by the farmers, low external input systems, ecological issues could be also less relevant (El Aich and Waterhouse, 1999). Environmental issue were more prominent under intensive systems, using high external input, large scale, mainly those in poultry, dairy and pig farms.

CONCLUSION

The study on sustainable development of small ruminants in three agro-ecozones showed that each zone had less contribution to the sustainable development in term of economic issue, such as farmers income and hired labour, while for the ecological aspects, all of the three agro-ecozone had succeed in contributing sustainable development of small ruminants, although sustainable indicator which related to the ground water quality seem to be failed.

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