International Journal of Development and Sustainability
ISSN: 2168-8662 – www.isdsnet.com/ijds
Volume 3 Number 2 (2014): Pages 252-260
ISDS Article ID: IJDS13073102

Sustainability of cattle-crop plantations integrated production systems in Malaysia

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Abstract

Evaluation on the sustainability of cattle-crop plantations integrated production system (CCPIS) was conducted in Federal Land Development Authority (FELDA) plantation schemes in Malaysia. The study was carried out in state of Pahang and Negeri Sembilan for cattle-oil palm integrated production systems (COPIS) and Kedah for cattle-rubber integrated production system (CRIPS). The outcome of the study shows that settlers or farmers in FELDA plantation schemes have increase their family income and standard of living through adoption of integrated farming system in the plantation. Number of farmers participates in CCPIS increased up to 150% within 24 years period. Amoeba diagram was used for evaluation of sustainable resources management and determination of negative driving factors in CCPIS based on triple bottom line (TBL) reporting. The technique integrates economic, environmental, and social components in the system. The study showed that all states gave strong negative drives on social factors. Economic and environmental factors contributed minimal problems in CCPIS. Social factors were the main management problems encountered by settlers in CCPIS. TBL indicators managed to identify the main problems of CCPIS and these indicators can be used in rectification program in order to ensure the sustainability of the integrated production systems.

Keywords: Sustainability; Cattle; Oil palm plantation; Rubber plantation; Triple bottom line indicators

Cite this article as: Ismail, D. and Abdul Wahab, K.H. (2013), "Sustainability of cattle-crop plantations integrated production systems in Malaysia", *International Journal of Development and Sustainability*, Vol. 3 No. 2, pp. 252-260.

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1. Introduction

The grazing of animals on land used simultaneously for crop production is commonly known as integrated or 'zero-land' livestock-production system (Dahlan, 2009). The concept is to develop the livestock industry without having to depend on new land for pasture production. This system offers great potential in agriculture industry, yet this potential is being slowly realized. The systems have several advantages to crop production including improved fertility of the soil via the return of dung and urine, control of waste herbage or weed growth and reduced use of weedicides, easier management of the crop and distinct possibilities of increased crop yields per unit area (Jusoh and Mohd Noor, 2002). It is of cause recognized that the sale of animals and their products do add to the returns from the systems. In other words, this system provides more efficient resource utilization. In Malaysia, several livestock-production systems have been ventured and investigated, such as open-improved pasture land, intensive feedlotting systems and extensive system of smallholders (Dahlan et al., 1992; Dahlan, 2002). The results, which show the development of livestock through integration with plantation crops such as oil palm, rubber, acacia and coconut are very promising (Sanchez, 1995; Dahlan, 2005). The system demonstrates that the feeds such as the undergrowth or ground vegetation which forms part of the ecosystem of oil palm, rubber, acacia and coconut cultivation, which are the most critical factor in ruminant production, may be made available at the lowest cost than the other conventional, monoculture animal production system or other extensive animal production systems (Dahlan et al., 1995; Rosli, 2001). Further advantages to the animal production in tropical areas are that, the crops (canopy) will creates a better environment in the form of shade for the animal than open pasture land system. The shady environment will naturally reduce the heat stress problem of the animal in the tropic (Dahlan, 2002).

Livestock species suitability studies for integrated production systems with oil palm plantations such as ruminants (cattle, buffalo, deer, goat and sheep) has been carried out in Malaysia (Dahlan, 2009; Devendra et al., 2007). Most of the work to date has established that the integration of cattle with oil palm plantations in Malaysia has demonstrated a great potential and sustainable type of production system. Recently, under Malaysian Government's Economic Transformation Programme (ETP) (http://etp.pemandu.gov.my, 2011) have identified that "Rearing cattle in oil palm estates (Entry Point Projects, EPP no.5)" as one of the 131 EPPs that will generate big results fast. There is a need to develop a implementation plan for investors to get involved in this EPP no.5 which was postulated will generate national income of RM 150 million and create job opportunity for more than 3,600 people in rural and plantation areas by 2020.

More serious thought has to be given to the planning of agricultural development in Malaysia and other tropical countries. This would include systematic and efficient management of land resources for increasing agricultural productivity at farm levels. Potential areas for livestock (ruminant) development in the future will be integrated with crops commodities since Malaysia (MPOB, 2013) has 4.92 million hectares of oil palm plantation, 1.3 million hectares of rubber plantation and expending areas of agroforestry, utilization of agricultural by-products as animal feed and rearing animal for other activities such as recreation and agro-tourism. Sustainability of livestock-crops integrated production systems and other type of animal production systems depend on the balance between economic, community and ecological development. Three most

important aspects that we must stress on are people, planet and profit (3P) in any industry in order to transform into green business and to become sustainable in the long run. Measurement of sustainability of the production system should be done through understanding the interactions between components (major) in the system. System approach should be adopted in the study in order to understand the dynamic of the whole system scenario. Thus, the objectives of this paper are to evaluate the sustainability of integrated production system in relation to economic, community-sociological and ecological development.

2. Methodology

Sustainable development approach will be used in this study (Bell and Morse, 2003; Jordan, 1998). The new approach for agriculture production systems evaluation was done through triple bottom line (TBL) - an integrated/sustainable development (Economical–Sociological–Ecological) approach. Method of resources evaluation used by Bie (1991) will be applied in this study. Cluster sampling on Federal Land Development Authority (FELDA) settlers were done in this study. National data on cattle rearing in FELDA plantations will be gathered from Target Area Concentration Project of Ministry of Agriculture and Agribusiness Malaysia. Eighty five (85) respondents were interviewed from 3 states; Pahang (FELDA Chini, Pahang; Latitude 3.39^{o} N, longitude 102.94^{o} E) and Negeri Sembilan (FELDA Palong, Negeri Sembilan; Latitude 2.70^{o} N, longitude 102.61^{o} E) for cattle-oil palm integrated production systems (COPIS) and Kedah (FELDA Bukit Tangga, Kedah; Latitude 6.49^{o} N, longitude 100.47^{o} E) for cattle-rubber integrated production system (CRIPS). Questionares were developed and applied to the cattle-crop plantations integrated production system (CCPIS) participants in the plantations. Identification of problems faced by the settlers were recorded and classified into the TBL aspects of sustainability; social, ecological and economic problems. Amoeba diagrams were used for evaluation of sustainable resources management and determination of negative driving factors in CCPIS based on TBL reporting (Brink et al., 1991). It is a technique which integrates economic-environmental-social thinking into core business activities. Amoeba graph will provide better picture on the related issues (Simon dan Stephen, 1999).

This study has identified 5 social, 5 economic and 6 ecological problems, which are common for CCPIS in Malaysia. All these problems will be used to measure sustainability of the CCPIS as negative driving factors. Economic aspects (negative driving factors) were - Lack of information on source of cattle for farming (E1); Problems in looking for credits or loan for farming (E2); Problems of cattle being stolen (E3); Problems of equipments and facilities being stolen (E4); Problems of missing cattle (E5). Social aspects (negative driving factors) were – Problems of plantations ownership (own by other people) (S1); Problems of cattle poisoning in the plantation due to fertilizer and rat poison applications in the plantations (S2); Problems of not using electric fencing in CCIPS (S3); Problems of cooperation among members in the group (S4); Lack of knowledge in cattle farming (not attending training programs) (S5). Ecological aspects (negative driving factors) were – Problems of cattle infected with diseases (foot and mouth disease and brucellosis) (P1); Problems of old plantations - Age of plantations > 20 years (P2); Problems of other cattle diseases (P3); Problem of long drought period (P4); Natural disasters, example monson flood (P5); Problems of plantation re-planting period (P6).

Herbage botanical composition and dry matter yield estimations were done according to Dahlan et al. (1993). Stocking rate estimation and carrying capacity of the plantations were done based on Local Kedah-Kelantan (KK) cattle (1 animal unit equivalent, AUE = 210kg) and crossbreds cattle (1.43 AUE = 300 kg). Cattle body weight measurements according to breedtype, sex and age group were done by using portable electronic weighing scale from randomly selected cattle herds in the plantations. Estimation of ecological carrying capacity (ECC) was done according to Dahlan (2005). Data were analysed and Amoeba charts were performed using Microsoft Excel 2010.

3. Results and discussion

3.1. Participation

Number of farmers participates in CCPIS increased up to 150 % for 24 years period (Figure 1). Studies in Pahang and Negeri Sembilan for COPIS and Kedah for CRIPS shows that settlers or farmers in Federal Land Development Authority (FELDA) plantation schemes have increase their family income and standard of living through adoption of integrated farming in the plantation. These factors influenced and encouraged more settlers to participate in the project.

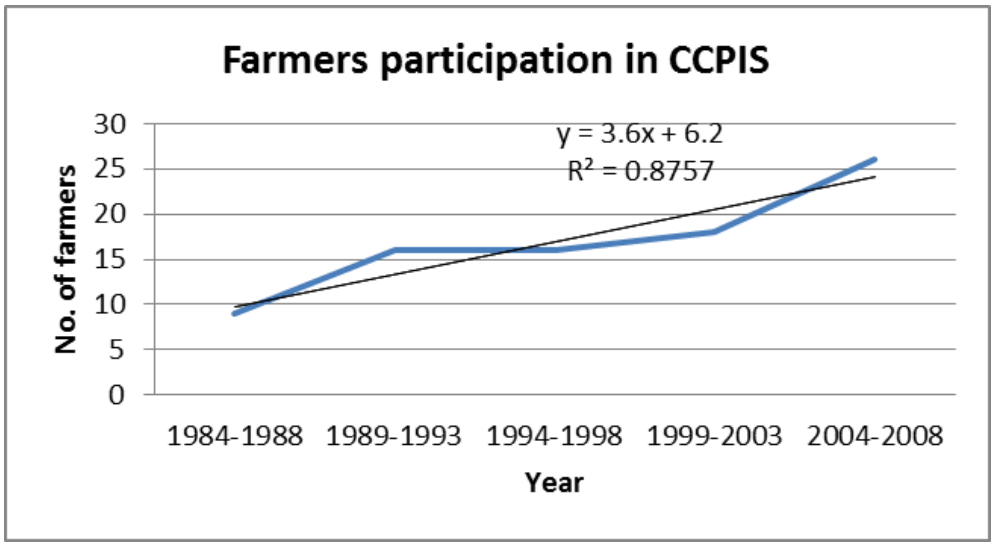
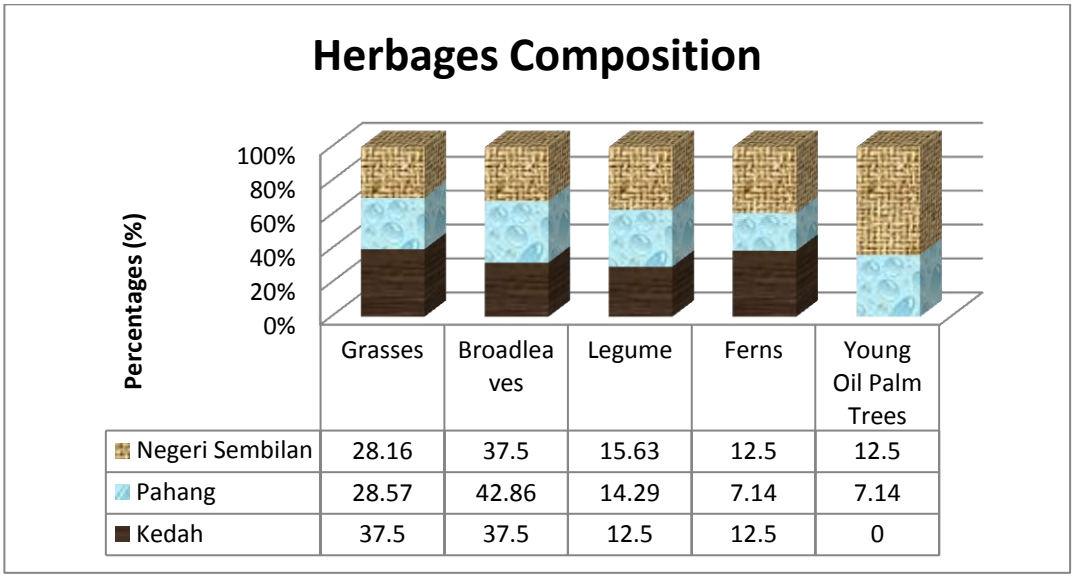


Figure 1. Number of farmers/settlers and trend of participation in cattle-crops plantations integrated production systems

3.2. Herbage composition, dry matter yield and carrying capacity

All three plantations studied showed similar botanical composition of undergrowth vegetations (Figure 2). Almost all species of herbage found were palatable to cattle as reported by Dahlan et al., (1993). The dominant groups of herbage found in all plantations were grasses (28.2 – 37.5%), broadleaves (37.5 – 42.9%), legumes (12.5 – 15.6%) and ferns (7.1 – 12.5%). Negeri Sembilan showed the highest dry matter yield followed Pahang and Kedah, respectively (Table 1).The result showed that oil palm plantations produced more dry matter than rubber plantation. Based on availability of undergrowth vegetations, the estimated carrying capacity for oil palm plantations was 0.26 – 0.27 AUE / ha and 0.19 AUE / ha for rubber plantation. Negeri Sembilan showed the highest ECC of 108.5 AUM but actual carrying capacity (CC) was only 86.5 AU. For Pahang, ECC of 125.6 AUM but actual CC was 72 AU in the area. Whereas in Kedah ECC of 17 AUM but actual CC was 33.7 AU.The result in Kedah showed overstocking condition in CRIPS. Due to this condition, they let the cattle to graze outside of the rubber plantation, i.e. along roadside, orchard and other farm areas outside the plantation. This condition created serious social problems in the plantation and nearby villages.



	Grasses	Broadleaves	Legume	Ferns	Young Oil Palm Trees
Negeri Sembilan	28.16	37.5	15.63	12.5	12.5
Pahang	28.57	42.86	14.29	7.14	7.14
Kedah	37.5	37.5	12.5	12.5	0

Figure 2. Botanical composition of undergrowth in oil palm and rubber plantations

3.3. Amoeba analysis of negative drives

Amoeba analysis of negative drives show in Figure 3. The study showed that for Negeri Sembilan; strong negative drives were social factor 1 (S1) - the plantation own by other party and social factor 2 (S2) – cattle poisoning problems. For Pahang; strong negative drives were S1 and social factor 3 (S3) – not using electric

fencing, cattle roam around freely in the plantation and disturb others. For Kedah; strong negative drives were S3 and S1. Economic and environmental factors contributed minimal problems for CCPIS. Social factors were the main management problems encountered by settlers in CCPIS especially in CRIPS. Most of social factors affecting the successfulness of the production system can be solved through introduction of cooperative type of business. Future direction of CCPIS production system can be improved through producing high quality and healthy animals, planned cattle breeding program in relation to plantation management and centralized marketing system which can determine and control the market through cooperative management system. CCPIS considered as one of the most efficient agricultural production system and based on this study the triple bottom line - economic, social and environment driving factors (TBL indicators) were identified and rectified in order to turn CCPIS into strong positive drives and ensured their sustainability.

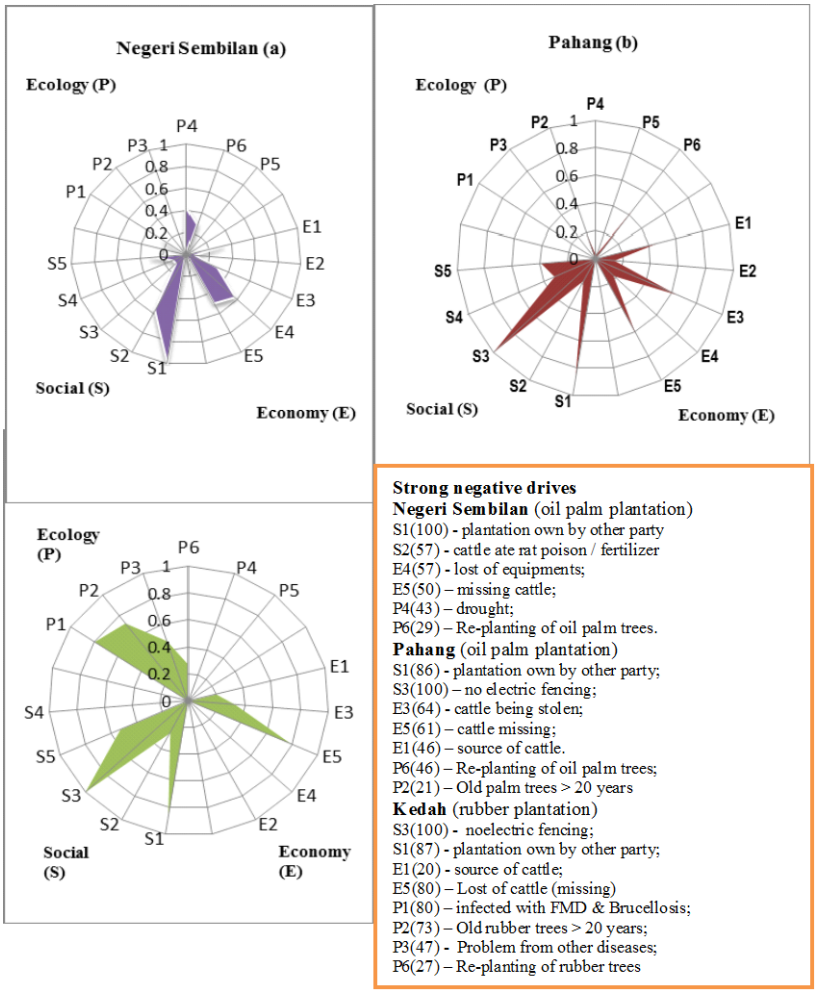


Figure 3. Amoeba diagrams for Negeri Sembilan, Pahang and Kedah

Table 1. Stocking rate of cattle in oil palm and rubber plantation

	Location of Plantations		
	N. Sembilan[a]	Pahang[a]	Kedah[b]
AU samples in the plantations	86.45	72.05	33.73
Dry matter yield (kg/ha)	91.1	87.2	64.3
Area (ha)	400	480	90
Total herbage availability (kg/ha)	18220	20928	2893.5
Cattle requirement (kg/month)[c]	168	168	168
Stocking Rate (AU/ha)	0.27	0.26	0.19
Monthly stocking[d]	108.5 AUM[e]	125.6 AUM	17 AUM

[a]Oil palm plantations [b]Rubber plantation [c]80% of cattle weigh around 210kg (1 AU) in the plantations

[d]Total monthly stocking. [e]AUM (Animal Unit per Month) is number of animal unit (AU) for one month stocking in the area.

Adult KK cow = 1 AU (210kg); Crossbred cow = 1.4 AU (295 kg)

4. Conclusions and recommendation

Cattle-oil palm and cattle-rubber integrated production system are considered as one of successful and sustainable integrated agricultural production systems in Malaysia. Studies in states of Pahang and Negeri Sembilan for cattle-oil palm integrated production systems and Kedah for cattle-rubber integrated production system shows that FELDA settler/ farmers have increase their family income and standard of living through involvement in integrated farming systems in the plantation. Local Kedah-Kelantan and crossbreds cattle are very suitable for CCPIS. Most of management problems encountered in CCPIS were due to social factors. Most of social factors affecting the successfulness of the production system can be rectified through introduction of cooperative type of business management. Future direction of CCPIS can be improved through producing quality and healthy animals, planned cattle breeding program in relation to plantation management and centralized marketing system which can determine and control the market through cooperative management system. CCPIS was considered as one of the most efficient agricultural production system in the tropics.

Future works are needed in order to ensure sustainability of cattle-crop plantations production systems through the development of "Agricultural Integrated Production System Accreditation Certification Systems", "development of Cooperative Marketing System for livestock-crops (LICRO) integrated production systems in Malaysia, and development of high quality and healthy livestock products from LICRO integrated production systems. Lastly, in order to ensure the sustainability of cattle-crop plantations integrated production systems, active participation from all sectors are needed, especially serious involvement and

commitments from industrial crop plantations sector. This integrated production systems will contribute toward sustainability of cattle industry, efficient land use system and support national food security agenda.

Acknowledgement

This study was funded by the Ministry of Science, Technology and Innovation (MOSTI) Malaysia. The authors would like to acknowledge all settlers and managers from Chini, Palong and Bukit Tangga FELDA Schemes for the support and participation in the study.

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