Sustainability Analisys and The Effect Of Honeybee-Coffee Plantation Integration Model On Improving The Honey and Coffee Bean Product

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Intisari

Analisis Keberlanjutan Penerapan Model Integrasi Kebun Kopi Lebah Madu Dalam Rangka Meningkatkan produksi Madu dan Biji Kopi dilakukan di Provinsi Bengkulu Indonesia. Tujuan dari penelitian ini adalah untuk mengevaluasi keberlanjutan dan untuk mengevaluasi peningkatan produksi madu *Apis cerana* yang ditempatkan di kebun kopi. Percobaan disusun dalam rancangan acak lengkap dengan dua perlakuan dan sepuluh ulangan. Hasil analisis dari penelitian ini menunjukkan bahwa indeks keberlanjutan peningkatan ke 76.00 (sangat baik) dari 59.50 (baik). Hasil lainnya adalah produksi madu *Apis cerana* di perkebunan kopi secara signifikan lebih tinggi sebesar 114% dibandingkan dengan di luar perkebunan dan biji kopi meningkat sebesar 10,55%. Secara umum, penerapan model integrasi lebah madu dan perkebunan kopi bisa meningkatkan pendapatan petani dan mengubah pemeikiran petani bahwa pohon harus dijaga karena sumber pakan lebah madu (nektar dan serbuk sari). Sebagai kesimpulan bahwa integrasi lebah madu dan kebun kopi dapat dilakukan untuk meningkatkan keberlanjutan serta produksi madu dan produktivitas kopi

Kata kunci: madu, kopi, integrasi, berkelanjutan, indeks

Abstract

The objective of this study was to evaluate the sustainability and the improvement of *Apis cerana* honey production which was placed at Coffee Plantation. The experiment was arranged in a Completely Randomized Design with two treatments and ten replications. The result of this study was the sustainability index was increase to 76.00 (very good) from 59.50 (good). The other result was the honey production of *Apis cerana* at coffee plantation was significantly higher by 114% than that outside the plantation and the caffee been productivity was inproved as muach as 10.55%. The integration of honey bee and coffee plantation was able to inprove the farmer general income and change their mind that vegetation (trees) must be saved due to the source of honey bee feed (nectar and pollen). As a conclusion that integrated honeybee and coffee plantation effected on improving of sustainability as well as *Apis cerana* and coffee bean productivity

Key words: ***Honey, coffee, integration, sustainability, index***

Introduction

Government policy to increase the beekeeping business seen from the various activities as reported (Erwan , 2006), among others, (1) the preparation of the general plan of coaching and development of national beekeeping (2) institutional strengthening through the development beekeepers pilot unit, assistance beekeeping production facilities, business meeting, organization of training, education and research, and (3) monitoring and evaluation . In an effort to move the business of encouraging and non-governmental income generation, nutrition and health have been conducted activities and equipment package bee colonies, while for institutional strengthening has been established Indonesian Beekeeping Association (API) which is a set of beekeeping community as an equal partner governments to cooperation to develop beekeeping in Indonesia.

Beekeeping can provide enough income to the farmer, as well as does not require the cost of feed (feed zero cost), honey can be harvested every two weeks or seven months of the year (Sihombing, 2005) . If the box has a 100 super, meaning in one productive season he was able to produce three to four tonnes of honey per year. Chances are very high that the market demand of honey in the country by 3150 tons per year still has not been fulfilled so as to meet the shortage of honey, Indonesia imported from Vietnam, the PRC and Australia by 250-580 tons per year. Other benefits besides producing honey, bees also produce royal jelly, pollen (bee pollen), wax, glue (propolis), and bee venom. All these products have economic value that can help to improve nutrition and increase income for beekeepers. Benefits are not directly related to the preservation of forest resources, increasing crop productivity, and a mutually beneficial symbiotic relationship. Plants will put out flowers that contain lots of nectar and pollen as food for bees, while the bees will help pollinate the flowers of the plant .

Blesmeijer and Slaa (2006) states that the application of system integration with the honey bee plant concepts to consider both interspesificcompetition competition (competition between species)or intraspesific competition (competition within a species), so it does not impact on resource and habitat damage. Blesmeijer & Slaa (2006) divided the bees into two groups: (1) medium size non - aggressive forager, for example *A. mellifera* and (2) super aggressive generalist forager , for example *A. Trigona*. Looking at the two groups of bees is envisaged that group of medium size non - aggressive forager no bias coupled with aggressive generalist forager super group (Nasution (2009) stated that unlike other insects (eg butterflies and ants) bees pollinating flowers run with no adverse consequences that hurt the plant. Therefore not bee pests, but instead to help raise production. According Sumoprastowo and Suprapto (1993), that with the help of pollination by bees , the production of cotton fields, orchards, sunflower garden, and a garden of cucumbers reach consecutive increase production by 25 %, 25-50 %, 50-60 %, and 62.5 %

Bees are insects that are important both ecologically (pollinators) and economically (financially rewarded for his services as pollinators (Byrne and Fitzpatrick, 2009). Slaa et al. (2006) proved that bees managed to increase agricultural production doubled. Nearly all agricultural crops/plantations are not self-pollinating insects require assistance in order to produce seeds/fruit pollination is complex and vitally important process in the life cycle of plants, especially the occurrence of fertilization, fruit formation and seed formation (Slaa et al., 2006). Bees act as pollinators are more effective and efficient for plants (Saepudin, 2013; Frietas and Faxton 1998; Heard, 1999; Richards, 2001; and Krement and Thorp, 2002).

Pollination is the transfer of pollen from the mechanism of the male sex cells (anther) to the female sex cell (stigma) on flowers. There is a symbiotic mutualism between bees and flowers. Bees get the nectar and pollen of flowers, and at the same time the bees to pollinate crops. Department of Agriculture and Food Western Australia (2009) reported that the spread of bee colonies in the area of food crops in Australia and in Brazil could increase its agricultural production and the number of bees that is spread varies depending

on the type of plant, place (location), and the type of bees. Therefore the Department of Agriculture and Food Western Australia (2009) merekombinasikan that to increase pollination of coffee plants (*Coffea arabica , C. canephora, C. Liberica*) can be placed 100 million worker bees during the flowering season. In this way coffee production could increase by about 22%. Honey produced by bees fed sucrose nectar has a coffee (28 %) and amber-colored light (amber light) and flavor (Department of Agriculture and Food Western Australia, 2009) . Pusbahnas (2008) reported that the coffee honey (honey that comes from bees fed nectar coffee) efficacious in improving endurance, making restful sleep, improving brain function and can heal burns

Implementation of sustainable development implies that development of the government or the private sector seeks to keep the current generation dinikmanti what still can be enjoyed by future generations. Ridwan (2006) argues that sustainable development was popularized by the report Our Common Future, prepared by the World Commission on Environment and Development, or often referred to by the Commission Brutland which has the main task, namely: 1) propose long-term environmental strategies for achieving sustainable development started in 2000 and 2) to identify how the relationship between people, resources, environment and development can be integrated in the national and international policy. According to the needs assessment that needs to be more clear and detailed so Umaly (2003), defines sustainable development is a dynamic process of development and resource use, the use of technology for development, institutional and socio-cultural changes, including population, and the use of investment (economic) for harmony and balance of the current and potential future of the welfare of mankind . Furthermore Umaly (2003) suggested that there were four main principles of sustainable development, namely (1) the principle of efficiency which means the wise use of natural resources is not excessive, (2) the principle of fulfillment, namely the use of limited resources by taking into account the interests of future generations , (3) consistency principle, namely subsystem must be united with the other sub - systems without anyone feeling more or less the world's ecosystems , and (4) the principle of caution , namely the threat of serious or irreversible damage if not careful use of natural resources careful. Soenarno (2003) mentions the paradigm of sustainable development is viewed from three interrelated pillars , namely economic goals related to efficiency and growth, ecological objectives related to natural resources and the maintenance of social goals berlaitan with ownership rights and justice. Mersyah (2005) in her work on sustainable beef cattle farms in South Bengkulu and Fauzy and Suzy (2002) who conducted a study on the sustainability of Coastal DKI Jakarta , using the five dimensions of sustainability of the ecological dimension/environmental, economic, technological, socio-cultural and legal dimensions and institutional. Ridwan (2006) to assess the sustainability of dairy agribusiness add one dimension into six of the legal and institutional dimensions split into two, the legal dimension and institutional dimensions FAO (1989), says there are four dimensions of sustainability for the fishery is the economic, social, and ecological dimensions of institutional or governmental. Integration of inter-

dimensional diagrams built by Mersyah (2005), Fauzy and Suzy (2002), referred to with the same kite diagram as digunakapkan by FAO, just different names and the number of dimensions (Ridwan , 2006)

Methods

The next research step is to analyze whether beekeeping through the integration of systems containing the principles of sustainability. At this stage the attributes will be identified and analyzed sustainability index.

The Procedure: To calculate the sustainability index using the model modification approach RAPFISH RAPBEE -based MDS (Multidimentional Scaling) with emphasis on the five attributes of the sustainability attributes of the technology (cultivation), environmental, economic, social, cultural and legal/institutional. Data about the sustainability attributes of the technological, economic, social, cultural, environmental and legal/institutional will be drawn from primary and secondary data. Secondary data will be obtained from relevant agencies such as CBS, Bappeda, KSDA and other relevant agencies. Primary data were obtained from the survey with interviews with all stakeholders choiced proportionally. Questionnaire will be validated by testing at an early stage and if there is bias it will be repaired. Respondents will be selected by purposive sampling of 30 respondents representing policy makers, beekeepers, surrounding communities and from the university. To get good data and to reduce bias then conducted Focus Group Discussion (FGD) at the beginning and end of the activity. FGD is used for the underlying weighting each attribute on each dimension of sustainability. Data to be collected will be tabulated made scale (scoring) and computed sustainability index (IkRapBee) (Table 1) and to test the error of this method was tested to the Monte Carlo method. The assessment data was presented in the form of tables and graphs kite. Ordinal scale used was 0 for 4 for the worst and the best conditions. Sensitivity analysis is done to see which attributes were most instrumental in determining sustainability, so that the smaller the value the greater role.

Table 1 . Sustainability status The integration model models (Mersyah, 2005)

Category index	Value
0 - 25	Very Poor
26 - 50	Poor
51 - 75	Good
76 - 100	Very Good

Sustainability analysis conducted to assess sustaibility index of bee farms integrated with coffee plantation in Kepahiang District, Bengkulu. Sustainability level assessment wasdone by using the method of multidimensional scaling (MDS) called Rafbee Rapfish adoption of research results. Indicators used to analyzed sustainability using indicators based on the original acquisition of the stakeholders form Focus Group Discussion (FGD) and interviews (filling the questionnaire). To see the influence of The integration model the sustainability index, the analysis is done twice earlier activities as a database and at the end of the activity as a result of the

application of the integration model. Fistly, sustainability attributes grouped into five dimensions of sustainability then there is found the number of attributes of each dimension following environmental, economic, legal / institutional, technological (cultivation) and socio- cultural, respectively 10, 10,9 ,10 and 9 total there are 48 attributes or attributes . Results obtained from the analysis of sustainability attributes indicates that beekeeping sustainability index before and after the implementation of system integration honeybees and coffee plantations (IkRafBee) in Bengkulu Regency Kapahiang amounted to 59.50 and 76.00on a scale of 0-100 sustainability. Based on Table 2 Susttainability, IkRafBee at 59.50 and 76.00 this means good continuity before the integration model status increased to a very good status after execution the integration model. Increased sustainability status the integration model achieved because all the attributes of sustainability has increased status. Increased sustainability status is the highest dimension of culture/technology that was of less being very good Table 2 below.

Table 2 . Bee sustainability indices before and after The integration model

No.	Dimension	IkRafbee		Status	
		Before	After	Before	After
1	Agiculture / Technology	49,11	76,19	poor	Very good
2	Ecology / Environment	69,53	84,20	good	Very good
3	Economy	57,06	79,24	good	Very good
4	Law and Culture	49,62	54,90	poor	good
5	Socio-Cultural	73,18	85,28	good	Very good
6	The integration model	59,50	76,00	good	Very good

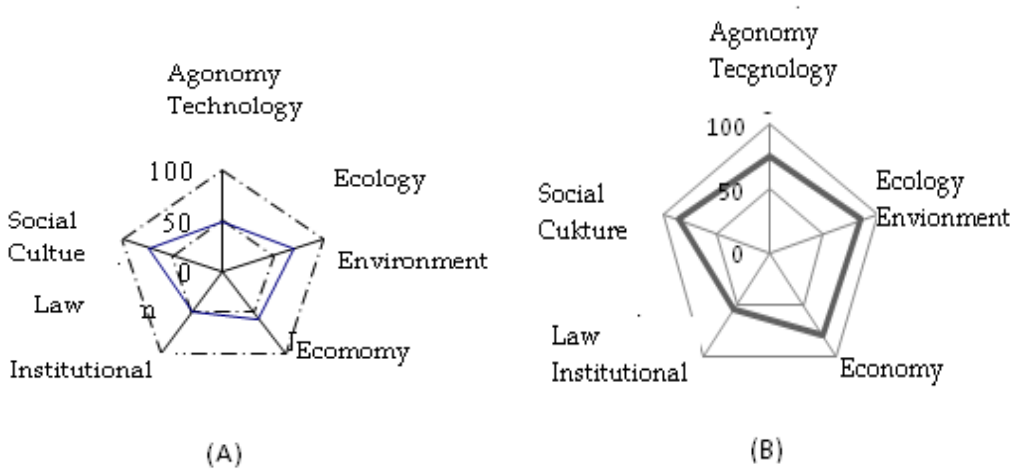

Figure 1 Diagram kite (A) before and (B) after the application of the integration model

The increasung dimensional cultivation due at the time of the study, farmers improved their skills through bee research. Sustainability values was still low was legal and institutional dimensions , it was rather difficult to increase the public because it was closely

related to the role of government. So to be able to raise the status of being very good, the government's role in supervising and coaching is needed. Changes in the value of continuity between the before and after can be seen in the diagram the integration model kites Figure 1.

Stress value and the value of determination (R2) both before and after the application The integration model analysis showed that the results have been good and proper use of variables already . It dutunjukan with stress values < 0.25 and oefisien determination > 80 % (Table 3).

Table 3 . Stress value and the value of the determinant (R^2) initial activity

No.	Dimension	Before		After	
		Stress value	R^2 (%)	Stress value	R^2 (%)
1.	Agriculture/Technology	0,1428	94,90	0,1375	95,30
2.	Ecology/ Environment	0,1362	95,25	0,1315	95,22
3.	Economy	0,1368	93,40	0,1340	94,26
4.	Law and Culture	0,1456	94,93	0,1381	94,81
5.	Socio-Cultural	0,1339	95,06	0,1339	94,19

From the results of the analysis showed that Laverage that sensitive factors that intervene in analyzing the attributes of each dimension of sustainability is something to do with the role of government as a source of capital and education became the main lever on economic legal and institutional socio-cultural dimension. The third attribute is the responsibility of the government. Another attribute is the main lever technology feed and fertility of the land to be shared responsibility between the government and the farmers and other stakeholders.

Technology and Ecological Dimension

Sustainability index of technological dimensions at baseline was 49.11 up to 76.19 at the end of the study, meaning that the position of the technological dimension is the category of less turned out to be very good. The leverage analysis aimed to analyze attributes that were most sensitive to sustainability was transportation, information attributes, use of bees as pollinators and harvesting equipment. That all changed after the application the integration model which attributes are most influential feed technology, and harvest nectar availability. If viewed from the achievement index value technology dimension compared to other dimension, was the highest change of index value. Sustainability means the integration model based on dimentional technology has already supported the implementation of sustainable agricultural practices, but when viewed from the contribution of each attribute, the highest attribute was the role in encouraging sustainable integration model.

Sustainability index of ecological dimension at a time before The integration model was implemented at 69.53, which means that the position of the ecological dimension is in either category. Of leverage analysis shows that the attributes that a lever (key factor) is the attribute of soil fertility, land and agro-climatic. So efforts to improve the sustainability of ecological is to emphasis on the three attributes. Another factor that could be fixed immediately is the way of maintenance and land cover attributes. Improvement of both these attributes to improve the ecological status of the sustanilility index was good to very good (84.20) at the end of the activity.

Sustainability as a lever factor is an attribute the integration model soil fertility, climate and land cover. Attention to sustainability indices before and after implementation of the the integration model soil fertility remains a factor lever, so to implementation the integration model forward there needs to be an effort that soil fertility can be improved with a fixed based on sustainable business development.

Height attribute was an attribute that is fixed and can not be changed anymore (Ridwan, 2006), therefore the height attribute in the Kepahiang district was one of the considerations when improving sustainable honey farm, because the height is very closely relate to the temperature and humidity Which greatly affects the availability of food and the quality of the honey produced.

Economic dimension

Sustainability of the economic dimension of the index at the time before being implemented The integration model amounted to 57.06, which implies a position bhwa ecological dimensions are in either category. From the analysis of the leverage analysis, it appears that the attribute is a lever (key factor) is a system attribute product sales, how to sell products and market conditions. Fakor levers economic dimension is associated with marketing attributes. So efforts to increase the sustainability of economic The integration model emphasis on marketing.

Economic growth in the field of honeybee related to how much to add and expand business both individuals and groups. For that to succeed in business honeybee status keeps improving sustainability, it is necessary to optimize the utilization of the existing potential. When the condition of the area is very potential, with incentives given to encourage growth in economic dimention means the sustainability (Ridwan, 2006).
At the end of the study, attributes the shift lever of economic dimension attributes the emergence of capital requirements, this shows that beekeepers in the study site has been developed that required additional capital that can not be met from the family capital. Second lever and economic dimensions in the integration model is a way to sell honey and market conditions. To improve the sustainability of the economic dimension is The integration model with paying attention on the attributes of capital adequacy.
Blessings with the results of the analysis, Ogaba (2010) suggests that the cultivation of bees have the potential to overcome poverty in Uganda have been able to utilize the various natural resources are abundant, easily integrated with plants, there are many species of bees, do not require sophisticated technology, not require large capital, and does not require high skills and knowledge. Nevertheless beehive still a lack of legal basis and regulations governing the cultivation of bees, the difficulty of the training and information, poor quality of bee products, the limited market and limited access to financial resources (Ogaba, 2010).

Dimensions of Legal / Institutional and Socio-Cultural

Sustainability of institution dimension of the index at the time before being implemented the integration model amounted to 48.62, which implies a position that institution dimension is in bad category. This is because there was no government regulations applied in the study site, in addition to the existing institutions (Productive Business Group) has not been going well .

From the analysis of the leverage analysis, it appears that the attribute is a lever (key factor) is the intensity of the

attributes of lawlessness, lack of role models society and farmer groups are less fungtional. Therefore to increase the value of the legal dimensions of sustainability index/ institution focused on improving the attributes of law-related course closely related to local government policy. Therefore, for research carried out repairs on institutional issues and try to reduce in order to avoid violations of the law. The activities related to the legal dimension was the integration model based on the legal and institutional dimensions of sustainability. Sustainability index of institutional dimensions of law in the Kepahiang District after applying the model rised to 54.90, or from bad to good status. Factor levers legal and institutional dimension was associated with the institutional attributes of both business groups and financial institutions. So efforts to increase sustainability the integration model based legal and institutional dimensions emphasis on coaching group relating the attributes associated with legal sanctions for violations. Thiose should refer to the rules set by the local government or written regulation, otherwise agreed and in force in the community local. Overall institutional dimension attribute has an important position but there was one attribute the dominant role sustaibility beekeeping seen from the aspect of the institutional dimension. The existence of cheap credit facilities to encourage the implementation of accessible agribusiness beekeeping was not better yet. In addition to upgrading the role of the group members soundly was required for the group member. Status of the socio-cultural dimensions of sustainability index at the time before being implemented the integration model already high at 73.18. Socio- cultural dimension attribute that needs attention is the low level of education in which less than 50 % of the people in the study site not pass the First Secondary School. The high status of the socio-cultural dimensions indices was community participation and family who showed high numbers. Status of the socio-cultural dimensions of sustainability indeces when implemented the integration model after rising to 85.28 implying sustainability status up to be very good. Socio- cultural dimension attribute that successfully repaired the attributes of knowledge about the environment and the role of society.

From the analysis of the leverage of socio- cultural dimensions, attributes most sensitive to sustainability both before and after the application of the model was the level of education, number of family members involved in the cultivation of bees and local government regulations regarding honey bees. So the improving socio- cultural dimensions of sustainability emphasis on the third attribute.

Conclusion

1. The integration model designed based approach to farming activity among honeybee production with coffee farm werw able to improve honey and coffee bean production and achieving environmentally sound
2. Monthly income creation was the main focus of activities of production systems and sustainable revenue and this can be realized in the activity of honey production subsystems, while the coffee is annual income
3. Increased production of honey bee at integrated area (the integration model) was a development that beekeeping sustainability index value of 76.00 (very good) and that needs attention was the legal and institutional dimensions

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