CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The data collection for the study of sustainability of integrated coffee-based farming systems in Bali province, Indonesia was conducted during March to May 2008. The study involved 119 households as samples from three villages: Catur, Belantih, and Pengejaran villages in Kintamani sub-district, a mountainous area surrounding Mount Batur in central part of Bali, which is the largest area of arabica, coffee production in Bali province. The study was aimed to characterize the integrated coffee-based farming systems, to assess the sustainability in term of ecological, social, and economic aspect, and find out the potential and constraint to the sustainability with mainly focusing at household level.

The assessment of sustainability in this study employed nine farm-level sustainability indicators. The suitability of ecological aspect was determined by soil fertility, water saving, and organic input use indicators. The acceptability in social aspect was determined by employment generation, farmers' awareness of usefulness of intercropping, and input self sufficiency indicators. In term of viability of economic aspect, the assessment was focusing on land productivity, profitability, and income stability indicators. In order to get the overall sustainability, all of nine indicators were aggregated together by using the normalized value. One of the advantages of

the proposed normalization of indicators is the clear compatibility of different indicators, since all indicators are normalized.

The assessment of sustainability in this study was differentiating into two conditions: a) sustainability indicators assumed having equal weight, and b) sustainability indicators assumed having un-equal weight. Three methods were used: sustainability indicator analysis (SIA), analytical hierarchy process (AHP), And AMOEBA diagram.

As summary regarding the characteristics of integrated coffee-based farming systems in the study area, there are three systems observed: a) integration of coffee with tangerine and livestock (CTL) (79 farmers); (b) integration of coffee with clove and livestock (CCL) (30 farmers); and (c) coffee with livestock (CL) (10 farmers). Generally, the three systems were mostly similar in terms of soil type, average age of coffee, farming practices (organic farming, input – output relationships), and kind of shade trees that farmer use. In addition, there is a strong point highlighted from the social economic condition of farmers in the three integrated coffee-based farming systems, where all farmers are actively participated in farmers' organization, known as *subak abian*. *Subak abian* has a fundamental role in sustaining and up-scaling the integrated coffee-based farming systems in the study area. However, the differences among the three systems appeared in the percentage of trees per hectare unit of land, number of livestock possessed, and in sustainability indicators such as cost of land use to determine the soil fertility, water-saving status, profitability, farmers' income stability.

The outcomes of ecological suitability assessment shows that farmers in CCL spent highest cost of land used compared to CTL and CL, which indicated that the soil infertility caused by crop production in this system was high. On the evaluation of water saving indicator, the result shows that CCL required significantly highest additional water (8,601m^3/ha/year) than CTL (7,850m^3/ha/year) and CL (5,508m^3/ha/year), this indicated CCL is the least water-saving system while CL is the most among the three systems. For organic input use assessment, it was found that all farmers have been applying organic input in their coffee-based farming systems since 2007 after the recommendation of government.

The result of social aspect assessment, the average normalized value of employment generation indicator shows the CTL is acknowledged as a system that generated more sustainable than CCL and CL. In terms of farmers' awareness indicator, overall, CCL was viewed by farmers as the most useful system rather than the other two systems. And, in terms of input self sufficiency, CL is valued more sustainable than CTL and CCL.

In economic aspect assessment, the result of farmers' income stability normalized value shows CTL and CL as systems that more sustainable than CCL, this is due to high-fluctuated price of clove production in CCL. The main aim of integrated coffee-based farming systems is to minimize the coffee price-fluctuation risk. When the integrated crops were also having high-fluctuation price, it brought higher risk to farmers' livelihood. In terms of profitability, the differences in time for harvesting had affecting the NPV and IRR of the three systems; however, the normalized value shows CTL is more profitable than CCL and CL.

In assessment of overall sustainability, Sustainability indicator analysis (SIA) was used to assess the sustainability when indicators were assumed to have equal weight. Based on SIA results, CTL is the most sustained system with overall score 5.81 is the most sustain system compared with CCL (4.87) and CL (5.65). Afterward, the overall sustainability of the three systems was illustrated by the area of polygon, with crest points are the average normalized values of nine indicators of sustainability being used with AMOEBA diagram and the domain of sustainability is inside of each polygon. For ecological aspect evaluation, CL has strong points in all indicators (soil fertility, water saving, and organic input use) which indicated that this system has strong sustainability in ecological aspects compared to other systems. In terms of social aspects evaluation, the crest point of CTL and CCL in employment generation (EG) and farmers' awareness (FA) indicator are mostly equal, but CCL having more values on FA indicator, while, CL is weakest in these two indicators but the strength of CL is pointed in input self sufficiency (ISS) indicator. Hence, it can be concluded that CTL and CCL systems are somewhat better than CL system in term of social aspect. For economic aspects appraisal, the crest point of land productivity (LP), profitability (Pt), and income stability (IS) of CTL were highest compare to the other two systems. This indicated that CTL system is the best in term of economic viability compared to other systems. For CCL, the weak point located at income stability (IS), while CL is weak in land productivity (LP).

In the case that all indicators were assumed to have un-equal weight, , the weights of nine indicators are subjectively based on the decision makers' (farmers') judgment. A workshop was held to capture the farmers' decision scale to the nine

indicators of sustainability by using AHP. In the workshop, the decision making process was based on the judgment of farmers representatives of the three villages as one group. This was done to avoid the single judgment of those who practicing different integrated coffee-based farming systems that could be affected the different weight result. It was found that among the three aspects of sustainability employed in this study, farmers were given weight more on economic aspect (0.72) rather than social (0.20) and ecology aspect (0.08), which small-scale farmers that usually focused more on how they can sustain their income from farming systems activities. This judgment of course has affected the result of overall sustainability score which assigned CTL with overall sustainability score 0.531 to be the most sustained system compared with CCL and CL with score 0.392 and 0.335 respectively.

7.2 Recommendations

Based on the findings in this study, the following issues are recommended to sustain the integrated coffee-based farming systems in the study area in the long term:

a. The social economic condition is important foundation to be maintained in sustaining integrated coffee-based farming systems. With well-cooperation between farmers' organization (*subak abian*) and the local government recently especially in terms of agricultural extension, it would be suggested that this relationships should be strengthened to up-scale and improve the integrated coffee-based farming systems in the future.

b. The coffee-tangerine-livestock (CTL) system was the best integrated coffee-based farming systems resulted from SIA method and in the view of

AMOEBA. Also, when small-scale farmers were focused more on improving and maintaining their livelihood (AHP weight on economic aspect 0.72) CTL is the most sustainable system compared with CCL and CL. This system at current satisfied farmers' and authorities' conviction. It generated more employment; more profitable and has less fluctuation of farm income, which viably maintained the stability of farmers' income. Nevertheless, this system need to be improved in terms of ecological suitability, where the decline of soil fertility caused by crop production in CTL was higher compared with CL. So, it would be suggested for the government of Bali province that to maintain CTL with more concern on improving soil fertility and organic farming program that farmers have been applying since 2007.

c. The integration of coffee with clove and livestock (CCL) somehow did not yet satisfactory in SIA result and the view of AMOEBA. The main weaknesses of this system are found in water-saving indicator, where the crops companion in this system required more water than the other two systems. This is a threat for the sustainability since water resources in the study area is limited. Another weakness point was at income stability indicator, where farmers in CCL were having highest income variation because of the high fluctuation price of clove production. This is also a risk to the sustainability since the alternative crops integrated with coffee to reduce the effect of coffee fluctuation price. It would suggested that the provincial government introduce other alternative crops to be integrated with coffee with low-fluctuation-price that suit with the physical condition of the study area, and can be harvested in the short term. Also,

government should set-up the standard price policy for crops and livestock, so that the price will be stabilize and farmers will be protected from price fluctuation

d. The result of SIA and the outlook of AMOEBA for the integration of coffee and livestock (CL) system were showing some limitations especially in term of land productivity and farmers' awareness. In this study, the results proofed that integration between two crops or more showing better land equivalent ratio compared to mono-cropping. From normalized value in farmers' awareness indicator, CL was recognized as least useful of system in maintaining farmers' livelihood and the role of plan protection. However, this system has strong point on ecological aspect. This condition should be maintained, and it would be recommended that government should extend and up-scaling the integrated farming system program in the study area, to improve farmers social and economic condition.

7.3 Limitation of study

This study was not carried out and assessed completely all aspects of agricultural systems. The indicators that were used in this study to define the sustainability were not strong enough to capture all aspects in integrated coffee-based farming systems in Bali province, Indonesia. Due to limitation of data collection time, budget, and knowledge regarding agronomical aspect of sustainability such as soil erosion evaluation, bio-diversity measurement, and technical feasibility, those indicators were not applied in this study. These indicators remain important in

determining sustainability in the study area, so, further study regarding these matters is recommended.

For normalization purpose of raw values of the indicators, a score range procedure was applied. In term of sustainability, there are no recommendations or standard range for the indicators. The study has used existing maximum and minimum values of each indicator in the sample to construct the range for normalization purpose. If any farmer gets one as their normalized values for each indicator, it only implied the best practices of one farmer among samples but not as recommended in GAP, and if anyone get zero as their normalized indicator value it only implied that those farmer done the minimum practice or having least value among the samples. So, these normalization values were not imply the absolute sustainability. This study has used sustainability indicator values only to compare the three systems observed of the integrated coffee-based farming systems in Kintamani sub district. Therefore, the result of the study only shows comparative overall sustainability of the three systems in the sub district.