CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Nam Dong is one of the mountainous districts located in the Southwest of Thua Thien Hue province. It has an important position in conserving and protecting ecological environment and agricultural production for plain areas. This district is diverse in terms of their natural resources as well as the culture of people, but they also bear their own constraints. The geography and topography in natural conditions are one of main factors causing slightly differences in different parts in the district; The district consists of valley, medium hill, and high hill zone. In addition, the custom and mode of agricultural production of people also were important factors contributed to diversified and feature of agricultural production especially crop production systems in each micro-zone.

In Nam Dong district, agriculture field, especially cultivation system was important factor in terms of livelihood. Agricultural domain made up high percentage compared with other sectors; it was about 35% in total product value of the district. However, the agricultural land is still more limited (6.18% of total natural land area) and distributed differently between communes. The commune has the largest agricultural land area is Huong Phu commune with 1,018.92 ha. While Huong Loc commune just has almost 100 ha, is the commune has the smallest agricultural land area in the district. In addition, the use of agricultural land in this district focused on perennial industrial crops, followed by food crops, tuber crops, etc. The land is used for temporary industrial crops and other perennial crops occupied small area.

Although there were many crop production systems (CPSs) in Nam Dong district, those CPSs are somewhat different with each other due to natural and socio-economic conditions. However, considering specific areas, some CPSs dominate and occur popularly in that area. Hence, to capture and assess the sustainability of CPSs in this district, this study selected three communes (Huong Loc, Huong Phu, and Thuong

Quang) to investigate. Those are the communes represented for three micro-zones as valley (Huong Loc), medium hill (Huong Phu), and high hill zone (Thuong Quang).

In Huong Loc and Thuong Quang commune, the land used for field crops made up a high rate, followed by homestead or orchard. Conversely, in Huong Phu commune, the land used for homestead or orchard was dominant as compared with others. Through looking at CPSs found that in each micro-zone specifically in three communes, farmers applied difference of land use, crop production system (CPS), as well as crop diversification. In the valley zone, where has more facilities for agricultural production, the farmers (in Huong Loc) mainly applied CPS such as Rice-A.Crop, I.A.Crop, and Fruit-I.P.Crop pattern. But in Huong Phu commune, one of the communes represented for medium hill zone, with abundant of agricultural land, so the farmers cultivated a little different in CPS, they also had three popular CPSs such as Rice-Fish-A.Crop, I.A.Crop, and Fruit-I.P.Crop pattern. However, in each production pattern there are evidently different in crop proportion. Meanwhile, in Thuong Quang commune that located in the West of Nam Dong district, where the Kinh and Cotu ethnic group living together. Although this commune locates in a high place compared with other communes in the district, but with rather densely networks of river and stream, land in low terrain and along streams is salvaged to be cultivated. The Rice-Fish-A.Crop, Fruit, and Veg.Str. pattern are dominant. The proportion of crop types in each commune was different for each CPS. Even in the same CPS but different communes were also not the same.

The farmers practiced differently for each CPS such as soil fertility management, pest-disease management, and input self-sufficiency. Therefore, they obtained different profitability, yield stability, as well as potential created more labor participated and issues related with food security. In the context of Nam Dong district, although the economic is developing rather quickly, but in general the standard livelihood of farmers was still low compared to the national level and Thua Thien Hue province in particular. In addition, the environment was still not too bad at present. So the alternatives and priorities for sustainable indicators of farmers in agricultural production process are considered mainly in economic dimension with high priority.

Although in each commune, farmers had differences in terms of alternatives. However, besides profitability and input self-sufficiency, the soil fertility management, pest-disease management, and yield stability still got high priority as compared with land use and crop diversification.

Through calculating by analytic hierarchy process (AHP) method, the I.A.Crop pattern was the highest sustainability in Huong Loc commune, followed by Fruit-I.P.Crop and Rice-A.Crop pattern, these results were also same with sustainability indicator analysis (SIA) method that assumed all of indicators are equal important. For the other two communes, the results of assessment of sustainability of CPS were different from two methods. In Huong Phu commune, according to AHP method, the Fruit-I.P.Crop pattern got the highest ranking. Meanwhile, in SIA method, the I.A.Crop was the most priority. For Thuong Quang commune, the Veg.Str. pattern was the best alternative in both methods. Those results indicated sustainble CPS at household level corresponding with each micro-zone.

At the commune level, five indicators, namely land use, crop diversification, input self-sufficiency, labor use, and food security (Table 4.1) are taken into assessment and weighed by authorities in the district. These priorities were somewhat different from the concern of farmers at the household level assessment. In this case, the potential to create employment (labor) of each CPS as well as food security were issues are put up first, followed by input self-sufficiency, crop diversification, and land use. Hence, the Rice-A.Crop, I.A.Crop, and Fruit-I.P.Crop pattern are seemed as the order of overall ranking in Huong Loc commune according to the AHP method. Similarly, in Huong Phu commune, the Rice-Fish-A.Crop pattern was the highest overall ranking, followed by Fruit-I.P.Crop pattern, and the last was I.A.Crop pattern. For Thuong Quang commune, the most priority was also the same with Huong Phu commune. While, the Veg.Str. pattern was the fist priority under household level, then right now it got the second order in alternative. In fact, those results were different slightly with SIA method. In general, all of three communes the CPS that got the highest overall priority was still field crop pattern (Rice-A.Crop pattern: Huong Loc; Rice-Fish-A.Crop pattern: Huong Phu and Thuong Quang).

8.2 Limitations of study

This study was not yet carried out and assessed completely all aspects of agricultural production. The indicators in sustainability of CPS that are used in this study were still not strong enough to capture all aspects of production, etc., especially, in view of Nam Dong district where the diversification presented both natural and socio-economic conditions. In fact, this study has some limitations as follows:

- Indicators used to assess sustainability of CPSs at the household level were still not balanced enough. The indicators in ecological domain were more dominant than economic and social domain. Therefore, when referring this finding results should be considered with specific situations corresponding with specific assessments. In general, it is better if one can set up a balanced set of sustainable indicators.

- In addition, this study was also not yet considered about sloping level of land between CPSs in each commune. Therefore, it somewhat is limited in interpretation with respect to this characteristics. Ideally, soil erosion for each slope and CPS should be measures. Further studies are needed in this direction.

- Moreover, the assessment of difference of soil fertility through analyzing soil profile before and after applied patterns was not carried out. This suggests further studies to take care of this aspect.

8.3 Recommendations

The decision-making process for the farmers and the authorities in Nam Dong district to choose the best production practice is not just considering the methods mentioned above, we have to trade-off so many factors in both natural and socio-economic characteristics. Because when a CPS is better than another for some criteria, it is usually worse for others, so that many pairs of comparison remain incompatible with respect to a dominant relation. Based on the findings of this study and combining with the view of AMOEBA, the following issues are recommended:

- In context of limited agricultural land area at present in Nam Dong district and based on the existing conditions of each micro-zone, all of three CPSs corresponding with each micro-zone should be continually applied and developed.

- At present, the environment in this district is not serious issue yet. However, concerning on future aspects of sustainable agricultural base, the present practice in terms of chemical fertilizer and chemical pesticide management needs to be improved considerably. In fact, Rice-A.Crop pattern in Huong Loc, Fruit-I.P.Crop pattern in Huong Phu, and Rice-Fish-A.Crop pattern in Thuong Quang are patterns that need to be carried out firstly.

- The I.A. Crop pattern in Huong Loc commune was the best pattern compared with others in both AHP and SIA method. At the same time it also satisfied expectation of the farmers and authorities in the district at present. Farmers should note that bitter melon and sugar cane are two main crops to be developed in this area. Areca is the crop that is developed for along time in this area and should remain. This crop needs support of the government in terms of setting up processing industry to help farmers preserving products as well as increasing profit.

- The Fruit-I.P.Crop in Huong Phu commune somewhat did not yet satisfy the expectations of the sustainability indicators at the commune level. Nevertheless, this pattern is the best alternative for this area. Particularly, farmers should consider citrus and orange. However, this pattern needs to be reduced in the use of chemical fertilizer and pesticide. This can be done through salvaging dung from livestock field or by mechanical methods to prevent pests and diseases. The Rice-Fish-A.Crop also needs to remain because it can meet both food demand for farmers and also preserve the existing favourable conditions of this area. Ta Trach river, especially with Katu lake, can supply water for irrigation and fish feeding.

- For Thuong Quang commune, located in high hill zone of the Nam Dong district, farmers need to add in the Fruit pattern high value crops beside the citrus, orange, pineapple, and banana that already existed. At the same time the farmers need to

invest more on intensive farming. Rice-Fish-A.Crop pattern needs to remain and expand if possible. Because of the present favourable conditions as well as the fact that this commune is far from district center where food and food-stuff for livelihood can be obtained, this pattern is seem as one of solutions. Particularly, with high density of stream network, the present practice, and as well as biological characteristics of *Sa Lac Son*, Veg.Str. pattern would be the best alternative in this area when household's land is available (land along streams). But with the fluctuation of marketing at present, the government needs to have positive programs to help farmers to retain areas for this crop. This issue needs involvement of the government as well as private companies to build up marketing channels.

- This study used three methods that were mentioned in previous chapters to assess sustainability of CPS. Each method has its relative advantages and disadvantages. Therefore, based on the real situation, one of these three methods should be chosen or at best choose one more method. For a simple study, it is better using SIA method because this method does not require weighting of indicators. The results of this method are also satisfied enough for alternatives of optimum CPS. For AHP method, this method is relatively complex. Therefore, it should be applied in the places where farmers have good knowledge, cooperation as well as large scale studies. While, AMOEBA approach should be applied all of studies because through this approach the aspects of CPSs would be shown clearly.

In summary, the continuing debate on sustainable CPS has raised wide concerns and has brought about the integration of environmental, economic, and social aspects into the development decision-making process. This paper developed a framework for environmental-economic-social decision-making of sustainable CPSs. These include the environmental and economic criteria, and local people's preferences in the context of an upland agriculture of Nam Dong district using multi-criteria decision-making techniques. The results of the multi-criteria analysis combining all environmental, economic, and social sustainable criteria are discussed, and incentives for sustainable intensification of upland agriculture were outlined.