CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.1 Conclusion

The main staple crop of Chiang Mai province is rice. The rice farmer encounters risk and uncertainty of rice production due to changes of weather condition, cost of input, price of rice production and new technologies of farm management. Farmer must make decision about their farm operations based on expected returns and preferences toward risk.

The study explored the level of biophysical and economic risk for rice production management. The rice farm management strategies under the presence of risk were assessed using crop model incorporated with stochastic dominance analysis. The crop model was a tool for simulating the rice production related to variability of weather and other biophysical conditions based on selected farm management strategy. Crop yield simulation process makes use of climate condition in the previous weather years. The simulated yield represented the expected yield that could occur next year. The stochastic dominance analysis examined the probability distribution of these simulated outcomes by assuming rice farmer as risk averse. The application of stochastic dominance analysis associates a pair-wise comparison of farm management strategies which are preferred by rice farmer. Such analysis derives the most proper rice farm management strategies or set of proper rice farm management strategies.

This study focuses on irrigated rice production areas in San Sai district, Chiang Mai province which cover 4 rice varieties (NSPT, RD6, KDML105 and SPT1), three soil series (Hang Dong, San Sai and San Pa Thong soil series), three different fertilizer management levels (Low, High and Intensive) and weather data in previous 30 years. The study assumed rice farmers to have two distinctive objectives, the rice self sufficiency and optimize rice farm income.

The study interviewed 126 rice farmers in Chiang Mai province in order to collect data on biological, economic and social conditions, and rice farm management strategies. The study also collected data from secondary sources for running crop model such as rainfall, temperature, soil series, genetic coefficient of rice varieties, price of rice and price of inputs.

The analysis of this study, CERES-Rice model in DSSAT v3.5 was used to simulate distribution of rice yield outcomes by using existing biophysical data weather conditions and rice farm management strategies. The simulated yields were then incorporated with cost of inputs and price of outputs to generate the simulated net margin. The stochastic dominance analysis was used to evaluate the distribution of simulated yield and net margin to derive proper farm management strategy or strategies. The first step in this analysis was the construction of probability distribution function and cumulative distribution function (CDFs) for the computed yield and net margin of each management scenarios. Next, the first-degree stochastic dominance (FSD) and/or second- order stochastic dominance (SSD) was then applied to evaluate the rice farm management practice.

Biophysically, Chiang Mai province locates 310 meters above sea level. The total area is 12,567 million rai. The total average annual rainfall was 1,134 mm. and the annual average temperature was 21 – 30 °C. The main soil series those suitable for rice production are Hang Dong soil series. The total agriculture area was 1,468 million rai that the rice planted area was 585,477 rai in crop year 2001/2002.

In San Sai district, farmers favored planting rice in the lowland of this area. The total rice planted area was 33,697 rai. The glutinous rice planted area was 21,947 rai and non-glutinous rice was 11,750 rai. The glutinous rice area was more than non-glutinous rice area because most of farmers in this area consumed glutinous rice. On the average, there were 4 persons per farm household while the full-time labor in agriculture was averaged at 2 persons per farm household. The average farm size was approximately 6.65 rai per farm household.

RD6 was the popular rice variety in rainy season that 58 percent of total farm household planted for food stuff and selling. For dry season, SPT1 was the most favor rice variety as 24 percent of total farm households planted it.

In rice cultivation, farmers use 9 - 10 kg./rai of seed. They usually buy the seeds from agricultural agencies such as sub-district agricultural office and cooperative. However, some of them retained seeds to plant in the next year. Ninety percent of total farm household applied the chemical fertilizer application for rice growing. The average dose of chemical fertilizer use was approximately 20-25 kg./rai. They applied fertilizer twice to increase their farm productivity. Ninety percent of total rice farmer used labor. The average rice grain yield from field survey was 713 kg./rai

Rice farmers usually keep enough rice for household consumption. Only surplus rice was sold for cash income. Merchants in their village would usually come to purchase rice at farm. Fifty percent of total rice farmers sold their product at farm.

The analysis of rice production cost showed that the average cost of material input in rice production was about 482 baht/rai while hired labor cost was nearly 433 baht/rai. The average price of rice at farm was approximately 4.4 – 5.07 baht/kg. depending on rice variety. The average gross margin was 2,258.30 baht/rai and average net margin was roughly 966 baht/rai. The gross margin of KDML105 was highest at approximately 2,470 baht/rai.

For simulated rice yield of rice farm management strategies in rainy season were different in each soil series. On Hang Dong soil series, RD6 with high level of fertilizer management produced the highest average yield. It yielded approximately 1,098 kg./rai with standard deviation of 147 kg./rai. On San Sai soil series, RD6 with intensive fertilizer management level produced the highest average yield with approximately 1,140 kg./rai and also was the smallest standard deviation of nearly 149 kg./rai. On San Pa Thong soil series, KDML105 of intensive fertilizer management level yielded the highest average grain yield of approximately 896 kg./rai with standard deviation of 201 kg./rai while RD6 of intensive fertilizer management level produced 851 kg./rai with the smallest standard deviation of 187 kg./rai.

For simulated rice yield of different farm management strategies in dry season, SPT1 with high level of fertilizer management produced the highest yield on Hang Dong soil series with approximately 965 kg./rai. The SPT1 with intensive fertilizer management level yielded the highest average yield on San Sai soil series and San Pa Thong soil series with 1,178 kg./rai and 653 kg./rai, respectively.

For simulated net margin of rice farm management were generated using simulated yield, total cost of production and price of outputs. In rainy season, KDML105 produced the highest average net margin in every soil series. KDML105 of high level fertilizer management produced the highest net margin on Hang Dong soil series with approximately 4,810 baht/rai and standard deviation of 1,380 baht/rai. KDML105 of intensive level fertilizer management produced the highest average net margin on San Sai soil series and San Pa Thong soil series with nearly 4,950 baht/rai and 3,879 baht/rai. In dry season, SPT1 with high level of fertilizer management produced the highest net margin on Hang Dong soil series. It produced approximately 2,740 baht/rai with the standard deviation of 2,507 baht/rai. On Sai Sai soil series, SPT1 of intensive fertilizer management level yielded the highest average net margin approximately 3,734 baht/rai with standard deviation of approximately 2,303 baht/rai. On San Pa Thong soil series, SPT1 of intensive fertilizer management level also produced the highest average net margin of nearly 1,100 baht/rai with the standard deviation of 1,813 baht/rai.

For risk analysis for self sufficiency farm, the preferred farm management strategies were classified by soil series and season as following.

In rainy season, the proper farm management strategy on Hang Dong soil series was the high fertilizer management level of RD6 (FMS8) that was preferred by second degree of stochastic dominance (SSD). The proper farm management strategies on San Sai soil series was the intensive fertilizer level of RD6 (FMS18) as classified by using second degree of stochastic dominance. On San Pa Thong soil series, the set of proper farm management strategies were KDML105 with intensive level of fertilizer management (FMS21), NSPT with high level of fertilizer management (FMS23), NSPT with intensive level of fertilizer management (FMS24) and RD6 with intensive level of fertilizer management (FMS27). They were selected using second degree of stochastic dominance (SSD).

In dry season, SPT1 at high fertilizer management (FMS29) and SPT1 at intensive level of fertilizer management (FMS30) were the set of proper farm management strategies of SSD on Hang Dong soil series. On the San Sai soil series, the solely proper farm management strategy was the intensive fertilizer management level of SPT1 (FMS33) that it was preferred by first degree of stochastic dominance. On San Pa Thong soil series, set of proper farm management strategies were SPT1 at high level of fertilizer management (FMS35) and SPT1 at intensive fertilizer management level (FMS36). They were selected using second degree of stochastic dominance.

For risk analysis of commercial farm, the selected farm management strategies were classified by soil series and season as following.

In rainy season, KDML 105 with high level of fertilizer management (FMS2) and RD6 with high level of fertilizer management (FMS5) were the set of proper farm management strategies on Hang Dong soil series by SSD. The set of proper farm management strategies on San Sai soil series were KDML105 with intensive level of fertilizer management (FMS12) and RD6 with intensive level of fertilizer management (FMS18). These were selected using second degree of stochastic dominance. On San Pa Thong soil series, the proper farm management strategy was only KDML105 with intensive level of fertilizer management (FMS21) by SSD.

In dry season, SPT1 with high level of fertilizer management (FMS29) and SPT1 with intensive management level (FMS30) were the proper farm management strategies as developed by second degree of stochastic dominance on Hand Dong soil series. SPT1 with intensive level of fertilizer application (FMS33) was only the proper farm management strategy on San Sai soil series that selected using first degree of stochastic dominance. On San Pa Thong soil series, SPT1 at high level of fertilizer management (FMS35) and SPT1 at intensive fertilizer management level (FMS36) were the risk-efficient farm management strategies suggested by SSD.

7.2 Recommendations

The study has illustrated the potential of combining crop growth simulation models with stochastic dominance tools for evaluating crop management strategies in the form of rice grain yield and net margin. The biological outputs and management inputs can be combined with economic factors to determine the risk associated with the various management practices that are being evaluated.

The approach provides the information to support the decision maker in their farm management and assesses the farm management under risk and uncertainty. The government can apply this approach to recommend the proper crop farm management in each area.

Although the approach presented has been shown to be potentially useful in evaluating alternative management options, some cautionary remarks and suggestions for further research are made as following.

1. A sound eco-physiological crop growth model enables the estimation of probability distributions of yields under varying environmental conditions, which can hardly be derived from other sources of information. The study presented that the simulated rice grain yield outcomes of this study were larger than actual yield. This was because possible yield limiting factors such as management performance,

nutrients, pests and diseases that may operate in the area were not considered by crop model. The substantially lower average yield on farmers' fields could be also due mainly to harvesting and post-harvest (Ekasingh, 2002). Therefore, the crop model may incorporate more factors for yield simulation such as harvesting and post-harvest factor, pest and diseases factor.

2. The risk analysis of stochastic dominance is a tool to evaluate rice farm management strategies under risk and uncertainty. The first step in risk analysis consisted of constructing cumulative distribution functions (CDFs) for yield and net margin for each management scenario. The second step consisted of identifying options that were risk-efficient in the first degree. If a single dominated farm management strategies was not defined by FSD. The efficient set was further screened using the criteria of the second degree stochastic dominance assuming risk averse farmer. The FSD and SSD may not yield the best choice of farm management strategies but a set of risk efficient farm management strategies. Therefore, it needs more advance step of stochastic dominance analysis to select the single best farm management strategy.