CHAPTER 5

CONCLUSIONS

I begin with the overall goal to assess farmers' criteria for management practices of the transformed FDR production systems situation in DWR area in the eastern plain of Thailand. There is a wealth of information from extensive rice research on FDR for other rice ecosystems, but very little information about DWR areas and in particular using systems approach to understand and deal with the situation. In order to understand the transformations in the area, it is necessary to conduct farmers' interview for current situations as well as complete a series of field experiments to generate high quality data sets to calibrate and validate the process-oriented CSM-CERES-Rice model. The model is used to assess various management practices possible for the farmer. This chapter provides key conclusions of the study as follows.

5.1 Current situation and farmer's criteria for transformation to flooded rice

The current situation of DWR production system can be summarized by the fact that traditional DWR production area is continuously declining. It is being transformed into FDR production system. A significant factor for the transformation is the availability of water supply for FDR during the dry season. The associated factors are a higher rice yield and a shorter growing season as compared to DWR, since it can be grown twice per one year compared to a single crop of DWR. Three

farmers' criteria are; 1) variety selection, growth duration less than 110 day after planting and non photosensitive, 2) appropriate planting date, the farmers' practice for ERS planting date is in early May while the DS is in early November, and 3) suitable fertilizer management in term of rate of application, timing and mode of application.

The interview also reveals that farmers exchanged knowledge or acquire information from various sources prioring to making a decision to convert their fields from DWR to FDR. Unfortunately, there is currently insufficient information available for farmers with respect to appropriate management practices. It is, therefore, important for the Rice Department of the Thai Government and other research and development organizations to obtain a better understanding of the situation of these DWR farmers and to prioritize their research strategies and agenda for the timely development of alternatives for the transition from DWR to FDR.

5.2 Cultural practices for flooded rice

The research concludes that the PSL2 rice variety is suitable for any planting date from May to July for FDR production during the ERS rice crop. For the DS, PTT1 should be planted in early November. Given the common problem for transition from the DWR production to the FDR production, it is expected that these recommendations are applicable to regions that have similar conditions. The ANOVA analysis and income return calculation indicates that LCC technique with BC is the most suitable methods for chemical fertilizer application technique for FDR production in deepwater area. The LCC technique with BC gives double net returns as compared to farmer practice in term of fertilizer management. In addition, LCC technique with DP is a high fertilizer use efficiency and relative practical application

technique. However, manual DP has costly. Small machine for applying fertilizer using DP method is needed to improve the efficiency of chemical fertilizer application in FDR.

5.3 Model calibration and evaluation

GENCALC and GLUE genetic coefficients estimators were used to estimate rice GC. The results show that GENCALC estimator is more efficient for rice GC calibration than GLUE in terms of grain number and yield simulation GENCALC used less computational time than GLUE estimator. Overall evaluation of CSM-CERES-Rice model application on FDR production system in deepwater area indicates that there is no significantly different between observed and simulated data. The simulated development phases and growth parameters are in good agreement with observed values. However, it is overestimation of top weight biomass and caution is needed to estimate this parameter. The CSM-CERES-Rice model can be used to simulate FDR production in deepwater area for testing the alternatives before making decision to improve the system.

The CSM-CERES-Rice model requires daily weather data set for specific site simulation. The distance of the simulation site and the weather station and quality of weather data affects the precision of model. Measured solar radiation data is one of the important dataset and most of weather stations in Thailand have no sensor to record solar radiation data. It has to be calculated based on measured or recorded minimum and maximum temperature.

5.4 The whole system view of the transformation

The DWR area trends to reduce continuously since 1986. It has been replaced by FDR production system. Difficulty for FDR production during the transition is lack of appropriate technologies for FDR production system. Most of the farmer obtained technologies from nearby neighbors. A series of experiments is conducted to find out appropriate rice variety, suitable planting date and a good management, e.g., fertilizer application. However, rice varieties with short growth duration, resistant to lodging, cold temperature, and pest and diseases are needed. This is whole system view of transition from deepwater rice to flooded rice production system in deepwater area. The formulated appropriate managements from the research are transferred to the farmers to evaluate the adoption before implementation.

Variety

The farmers tend to eject PTT1 and CNT1 rice varieties, due to lodging problem before harvest, long growing duration, and susceptible to many diseases. Most of interviewed farmers tend to adopt PSL2 variety, due to short stem and resistant to lodging. However, some of the farmers tend to eject PSL2 variety, since it is susceptible to cold temperature, especially during the DS production period. The expected characteristics of FDR variety for planting in the deepwater area are short growth duration, resistant to insect pests and diseases, resistant to lodging and produce a high yield.

Planting date

Most of the farmer tends to adopt the May date for ERS, because of sufficient water supply throughout the growing season, and the rice can be harvested before flooding occur. All of interviewed farmers tend to adopt the planting date of DS in November for FDR production. They start to grow FDR as soon as possible after receding of flood water in the field.

Fertilizer application

The best chemical fertilizer alternative as a result of this research is to apply twice, one at the vegetative phase and at the panicle initiation stage with total nitrogen rate of 59 kg ha^{-1} and the application mode of broadcasting. The farmers' interview showed that 80% of farmers agree with this alternative of fertilizer management. Some are interested in this fertilizer management technique and intend to conduct trial-and-error experiments on their fields.

5.5 Future research and suggestions for system development

There are three research topics should be conducted to improve FDR production in deepwater area.

1. Water management for FDR production systems in newly transformed and developed deepwater rice areas is crucial for irrigation scheme operation and for on-farm water scheduling. Rain water during the rainy season should be stored and distribute for DS rice crop in the dry season. This will greatly reduce risk of floods in the rainy season and control coming sea water into in the dry season. In addition, the impact of salinity on the DS

crop and the risk of flooding on ERS crop is an obvious knowledge gap to be investigated at the field level. Knowledge of Thai rice scientists about FDR rice variety development and growth in these situations is needed and there are gaps where field experiments can be conducted to investigate the key processes.

2. A potential for utilizing the CSM-CERES rice model in evaluating and testing new rice improvement technologies generated under the directives of the Rice Department. The model allows rice researchers to generate outputs of various rice production technologies, which will stimulate discussion and selection of appropriate rice production technology. The model can also be used in combination with a Geographic Information System to produce recommendations for appropriate resource use, such as water management at irrigation scheme and on farm scheduling, in response to major changes to the rice farming environments, such as one that in its transition from DWR to FDR systems.
3. Rice variety for FDR production systems in the deepwater area, with short growing duration of less than 110 days, resistant to insect pests and diseases, resistant to lodging and produce a high yield is needed. Resistant to cold temperature during the DS crop is an additional criterion for flooded rice varietal improvement program. The participation of local rice farmers in future rice varietal breeding programs is important and will allow incorporation of farmer's criteria for breeding a specific rice variety for the area. Fertilizer application technique for improving efficiency of

FDR rice production systems should be incorporated as a component in the new breeding program.