CHAPTER 8

Conclusions and Recommendation

8.1. Conclusions

Nam Dong is poor mountainous district in the Central Highland of Vietnam. The average per capita was low and the infrastructure for production activities and social welfare were poor. In addition, half of the population of the district was ethnic minorities with low literacy levels. The main livelihood activities were forestry and agricultural production, in which agriculture played a key role for 45% of total annual production value of the district.

Paddy was the main crop accounted for 77% of the total crop area and 30% of the total annual crop area of the district. Paddy was divided into two seasons as winter- spring rice (from December to next May) and summer-autumn rice (May to September).

About 96% of farmers had experience of rice production more than 10 years. The average farm size was quite small at 0.346 ha/household. Irrigation for rice production mainly depended on small check dams along streams. Land fallowed due to drought occurrence and landside due to storms and floods were problems faced by rice farmers in Nam Dong district.

Over period 27 years, district rice yield was different in two seasons, in which winter-spring yield almost was higher than summer-autumn season. Rice yield in both seasons was not stable during the 27 years period, especially, 1998, 2003, 2006 and 2012 experienced a sharp drop in rice yield. The fluctuation of rice yield in the district was explained as being due to the impact of land policies, technology applications and changes in weather conditions. The information from in-depth interviews showed that droughts, storms, pests and diseases caused the losses and damages in rice production,

while disease was the most serious cause. Moreover, summer-autumn rice was affected by these factors than in another season.

The timeline tool (PRA tool) used in exploring farmer's experience of impact of climate variability on rice production in last 10 years pointed out that there were many abnormal climate events such as heavy rainfall, drought, storms, floods which had negative impact on rice production. In addition, some weather phenomena such as hot weather in the end of year, hail in the early year, and droughts in September were perceived as unusual occurrences and did not fit with the former weather pattern as culturally and locally perceived. The impacts of these events were loss of rice yield, pests, diseases outbreak, landslide, land fallow and lacking of water for cultivation.

Seasonal average rainfall, average highest temperatures and average lowest temperatures fluctuated considerably in last period of 27 years in the Nam Dong district. It was recorded that during period of 27 years (from 1986 to 2012), the average maximum temperature was high ranged around 33.4^{o}C to 37.5^{o}C in winter-spring season, while it was higher in summer-autumn rice season from 37.2^{o}C to 38.6^{o}C. In opposite, the lowest temperature was low in winter-spring rice season at 14.8^{o}C to 18.1^{o}C, but it was quite normal in summer-autumn season at 21.5^{o}C to 23^{o}C over 27 years. Moreover, both these weather factors had stronger fluctuation in winter-spring season than another season, especially they fluctuated more sharply in the later years of the 27 years period and had slight increasing trends over period.

In the Nam Dong district, the rainy season started from September to December and a lesser rainfall extends from February to July, which fell into two growing seasons of rice. Over the 27 years period, rainfall in summer-autumn season was almost higher than winter-spring season. It experienced high fluctuation in rainfall in both rice seasons. Summer-autumn rainfall fluctuated strongly from 7.8% to 97.4%, but winter-spring rainfall fluctuated smaller from 7.2% to 55.4%.

The results from ordinary least square model showed that seasonal average rainfall, average highest temperatures, and average lowest temperatures had significant effect on rice yield. While, it was found that the seasonal rainfall factor had positive relationship with rice yield in both rice seasons, the seasonal maximum temperatures affected

adversely on rice yield in the two seasons. In addition, rice yield in the summer-autumn season did not relate to seasonal minimum temperatures, but this weather variable had positive impact on winter-spring rice yield at statistical significant level.

In context the impact of climate variability on rice production, SWFs were considered as a need of farmers to assist their living, but also was for agricultural production activities. The result of study showed that 56.7% of farmers accessed to weather forecasts every day and 43.3% of farmers approached to SWFs when they needed. There was 70% of farmers indicated that SWFs influenced on their rice production at different levels based criteria such as farmer's following the commune production calendar, using the recommendations and announcements of local officers and farmer's initiative in accessing and applying SWFs from different sources in their rice cultivation.

Nam Dong district has five types of SWF products specifically to be delivered to farmers, which include seasonal temperature, seasonal rainfall, drought, storm and flood. These information productions included not only forecasts but also advisories on how to respond to the weather events and take advantage of favorable weather conditions. It found that farmers were more interested in seasonal storm, drought and flood forecast than temperature and rainfall forecast regarding rice production decisions.

When exploring the current channels and sources used by farmers to communicate the weather information, it was noted that spouses, children, relatives, neighbors, local leader, woman union, extension officers, television and radio were sources for farmers getting SWFs. While television, neighbors, and local officers were identified as main sources of proving SWFs, extension officer, spouses also played second role in this function through their recommendation, disaster warning, rice seasonal calendar, etc. Moreover, the study also indicated a low percentage of farmers identified their children and radio as effective sources in transferring SWFs.

By the information from applying score ranking tool in farmer focus group discussion, the accuracy, reliability and understandability of the SWFs were demonstrated as the most challenges to farmers to make use SWFs in rice production decisions making. Moreover, the forecast availability and timeliness also were discussed as important

limitations of SWFs. However, farmers less concerned the forecast diversity that limited them in using.

Matrix ranking tool was applied to understand how farmers use weather information in rice production. It revealed that the relationship among five types SWF in each rice production decision was still low from a little to moderate scale. Selecting planting dates, harvesting dates and pesticide application were three decisions that related the most to SWFs. Other rice production decisions such as selecting seed variety, time of brewing seed also had relationship with SWFs. In contrast, fertilizer and irrigation application decision for paddy field were identified less relevant to SWFs. Moreover, results from matrix ranking tool indicated that drought, storm and flood forecast played the important position in rice production decisions, in which drought forecast was the most consideration in all decisions.

The average frequency of SWF use in rice growing decisions identified from 1.5 to 3.5. About 50% of farmers reported that SWF data were used from rarely to occasionally in their decisions of planting and harvesting date decision, pesticide application, and irrigation management. Moreover, the Cronbach's alpha testing marked that planting date selection, harvesting date selection, pesticide application decision were three main keys of rice production decision that had the influence of SWFs.

The study results pointed out that most of farmers had bad attitude on SWFs, especially on outcomes like selecting the suitable seed variety, getting higher yield and ensuring food security. Mean of belief measurements ranked at low points from 2.21 to 3.08 for each possible outcome by using SWFs. It indicated farmer's had low belief on forecast benefits in rice production decisions. These results were consistent with the low use and influence of SWFs on rice production decisions. The results from Cronbach's alpha revealed that selecting the best planting date, cost saving, pest and irrigation management, selecting the best harvesting date, getting higher yield, avoid extremely weather events and ensuring food security represented for farmer's attitude.

About 70% of rice farmers rated the other social views influenced on their SWF use in rice production decisions was at low scale 2 to 5 (slightly influential to influential). By Cronbach's alpha testing, three social group as neighbor, extension officer, and

television served for subjective norms factor that had influence on farmer's SWF use in rice production decisions.

Moreover, above 60% of farmers had negative perception on SWF controls such as accuracy, reliability, timeliness, understandability, diversity in channels and localization. Cronbach's alpha coefficients showed that farmer's SWF access ability, understandability, forecasts accuracy, reliability, availability and understandability represented for perceived control factor in influencing on farmer's SWF use in rice production decisions.

The result of structural equation model analysis by applying Theory of planned behavior indicated that the probability of farmer's SWF use in rice production decisions will increase 53.1% when 1% of change in farmer's attitude toward to the forecasts. While, the increase 1% in social norms effect will lead to an increasing in probability of SWFs in rice decisions by 21.8%. Lastly, if forecast obstacles are improved by 1%, the likelihood of farmer's SWF use in rice production decisions will increase by 27.6%.

Moreover, farmer's attitude, social subjective norms and perceived controls had positive and significant relation to farmer's SWF use in rice production decisions. Farmer's attitude was determined as the greatest direct effect on farmer's use of SWF and perceived controls followed by second factor of influence, while subjective norms were the least effect on farmer use of SWFs in rice production decisions making.

Finding from this study showed that although were considered as important role in rice production, the rice farmer's attitude about SWFs was still low. Moreover, the role of different social groups in term of SWF communicating was weak. Besides, farmers had poor perception on SWF attributes. Therefore, these contributed to the less using of SWFs in farmer's decision making in rice production.

8.2 Recommendations

8.2.1 Policy recommendations

To cope with the impact of climate variability in Nam Dong mountainous district the government should improve investment in rice management practices and supporting policies that focus on improving livelihood for ethnic minorities and poor communities.

It is important to invest in mountainous agricultural research and development in order to supply farmers with more drought-tolerant, storm-tolerant crop varieties, and efficient production practices, which are resilient in all adverse climate conditions.

It is essential to encouraging farmers to adopt production seasonal calendar and developing specific strategies in rice production to cope with the adverse impact of climate factors.

It is clearly that rice yield and food security have relationship with climate variability trends. Hence, the consideration of enhancing technique and improving the availability and predictability of SWFs simultaneously are likely requirement in agricultural sustainable development.

On the one hand, some training should be organized to rice farmers about climate variability and its impact on rice production to increase farmer's awareness about climate issues images. Moreover, the related officials and agencies should provide some knowledge and skills to farmers by setting training courses about the benefits of SWFs and the suitable way to access and use SWF data in rice production decisions. These are valuable methods to enhance farmer's attitude about SWFs.

On the other hand, training program should be carried out to improve SWF communication skills and knowledge for different social groups such as extension officers, village leaders, woman's union, and farmer union who have valuable views in term of encouraging farmer's use of SWFs. Moreover, the role of chemical sellers, current project officers, university about delivering and supporting SWFs should be enhanced to create the diversity sources of SWF supporting for farmers.

Moreover, hydro-meteorological centers and stations should pay attention in improving the characteristic of SWF data to assist farmer such as accuracy, reliability, timeliness, understandability, and localization to increase the farmer's belief and use of SWFs.

In addition, the research found that each district in Thua Thien Hue province has installed meteorological stations, but no SWFs information was shared or given to local farmers. These stations are only responsible for collecting the raw daily weather data without making SWFs in that area. Hence, improving mandates and ability of

meteorological staffs at the local level will contribute to create accuracy and localization of SWFs and that is easy to understand by local farmers in each area, which will help farmers in making a better strategy and approach on using SWFs for their rice production decisions

With mountainous communities, television and radio are their main sources of information approach. Therefore, it is necessary to have separated channel on television and radio that supports SWFs data in different ethnic languages. This will help mountainous farmers understand easily the information and use SWFs more efficiently in their living in general and in rice production decisions in particular.

Developing community media would also be a useful way to improve the intervention of different social groups in the roles of SWFs communication to farmers. Through this media, the understandability, the reliability, and localization of SWFs would be improved. Moreover, by community media, the interpretation of the seasonal SWFs would help farmers better understand how to incorporate this information into their rice production decision-making process.

To better prepare for climate variability and change, the government should help farmers to improve their capacity apply climate forecasts and other agrometeorological information by applying the model of "Climate field school" to farmers as many countries has conducted such as Indonesia, Philippines, Thailand, etc.

8.2.2 Recommendations for further studies

Due to the difficulties in accessing the official observed data set, the LSD analysis in this study could incorporate only few observed data records that cover only rice yield and seasonal temperatures. This data set lacks of some important attributes determining rice yield such as rice variety, water management, pest and diseases and climate-related perturbations. Therefore, further research should cover a larger sample data set from different districts, and focus on comparison among different important factors that determine diversified rice production systems in this region. Likewise, for the further TPB analysis, with respect to comparison analysis between the two different rice growing seasons as well as the different ethnicities to capture more comprehensive how farmer use of SWFs in response to rice production decision-making.

Three relationships among the main constructs (farmer's attitude, subjective norms, perceived controls and SWFs use) were found statistical significant. Hence, the theory of planned behavior is useful to explore the factors influence on farmer's SWFs use. However, it is necessary to develop and improve the currents model by adding more constructs and applying in different contexts, scales, or regions. These can help to generate the better measurement model that contributes to have improving comprehensive picture about the farmer's use of SWFs in response to climate variability in Vietnam.

Moreover, due to time constraints, the author was not able to explore and validate the local knowledge for climate prediction in this study, while this knowledge plays important role with indigenous people. Therefore, further research should pay attention to these issues to produce more convincing data.