CHAPTER 3

Research Methods

3.1 Conceptual Framework

The study conceptual framework is presented in Figure 3.1. This framework tells story about the case study that is adapted from Reyes et al. (2009). With high yield of rice production as end-goal of farmers, they make decision in rice production based on both internal and external elements. Among factors effect on rice production, climate variability is considered as one main factor. The influencing factor would determine the use of SWF to adjust (decision on) rice growing activities to reduce or avoid the risks caused by climate variability, in order to fulfil the goal (good rice yield).

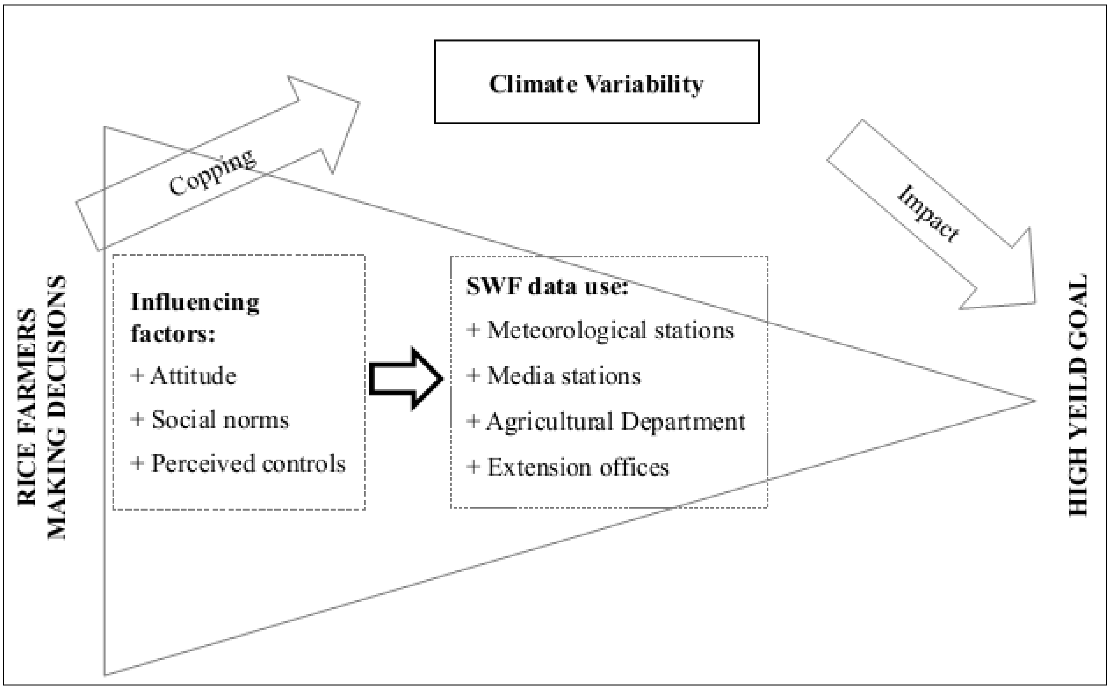

Figure 3.1 Research conceptual framework

Source: Reyes et al. (2009)

In context of climate variability, rice production has been impacted by climate factors such as rainfall, temperature as minimum and maximum. In this situation, SWF data is valuable source to help farmers to adapt to climate variability. However, farmer's SWF use is influenced by various factors, in which farmer's attitude, subjective norms, perceived controls are determinants.

Farmer's attitude can be expressed as beliefs of farmer's on benefit of using SWFs for guiding rice production management such as selecting the best planting and harvesting date, pest and disease management, irrigation management, etc. Subjective norms are farmer's social pressure in encouraging farmer's use of SWFs including 1) people who had more emotional relationship with farmers (spouse, children, relative), 2) people who might be seen as source of information and experience rice crop management (neighbor), 3) those who farmers perceived as experts or crop consultants (woman union, local officers, extension officers), and 4) media such as television and radio. Perceived controls are capacity of farmers (accessing, using and applying) and the SWF obstacles (accuracy, reliability, availability, etc.) that limit the farmers using the SWFs in rice production decisions.

3.2 Methodological Framework

The methodological framework of this study is presented in Figure 3.2 which consists main components. Firstly, secondary data analysis was conducted to support the overview information about study area. It includes the district livelihood context, rice production and climate characteristics. Moreover, secondary data was analyzed by applying ordinary least square to estimate how climate variability (maximum temperature, minimum temperature, rainfall) on rice production in Nam Dong district. The results from ordinary least square gave evidence that rice production in Nam Dong district was affected climate variability. All detail information was present in chapter 4 and chapter 5 to correspond the first objective in this study.

Secondly, participatory rural appraisal method (PRA) include focus group discussions, timeline, matrix score ranking, score ranking were conducted to determine how rice farmers' SWF use to cope with climate variability in Nam Dong district. The PRA also provided information on types of SWF used among farmers; sources of SWF farmers accessed; characteristics of SWF data were concerned by farmers; typical rice production decision related to SWFs.

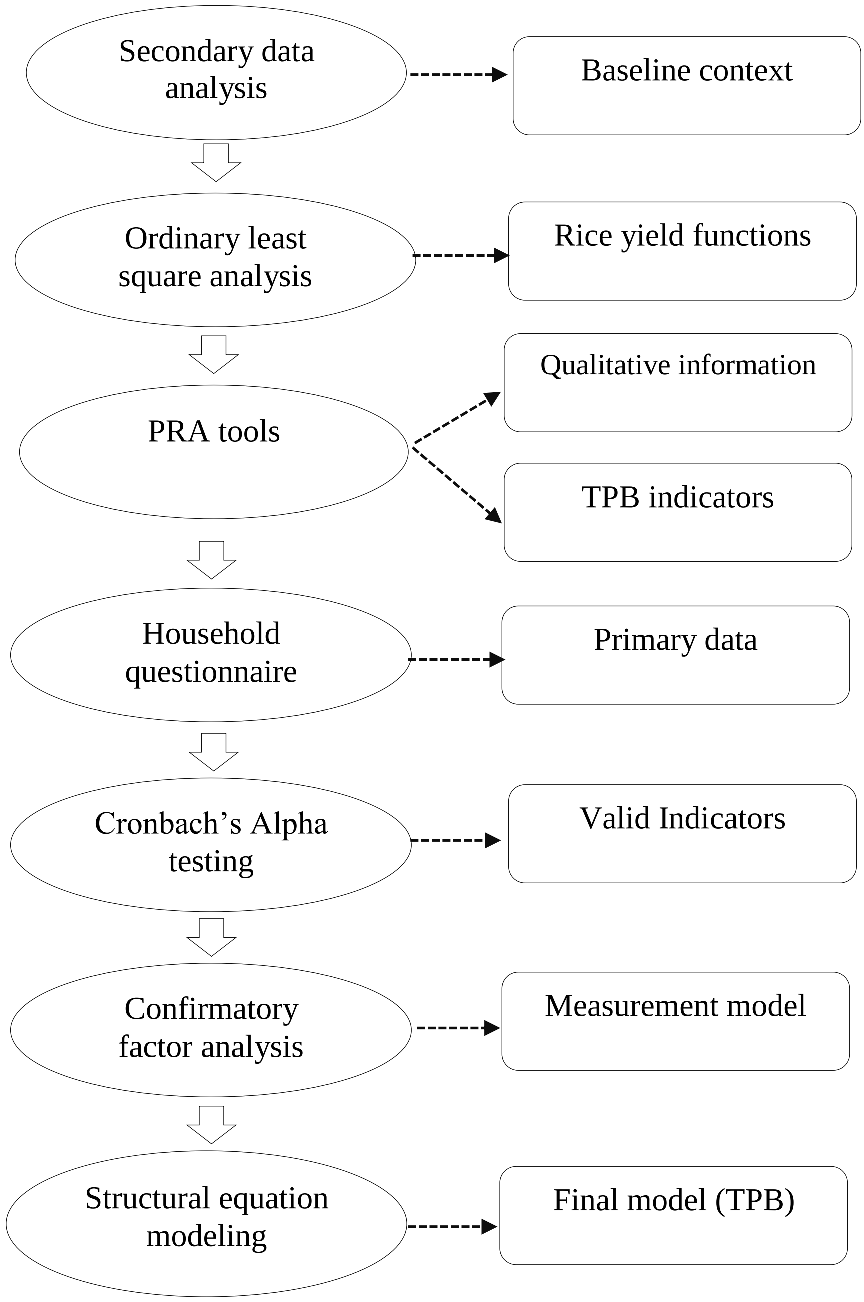

Figure 3.2 Methodological framework of study

Based on PRA results, the indicators for Theory Planned Behavior (TPB) model also developed. Then, questionnaires for these indicators were designed with 180 households. All information from PRA tool and data from questionnaires survey were presented in chapter 6 to respond to the second objective that is shown in chapter 6.

Thirdly, in TPB model, dependent variables are farmer's SWF use in rice production decisions. The independent variables (indicators derived from PRA) are farmer's attitude, social subjective norms and perceived controls. The data for these variables was obtained from questionnaire survey. However, there were many measurement indicators that reflected for each variable. Therefore, Cronbach's alpha was used to test the reliability of the measurement indicators for each variable before putting in study model.

Fourthly, after extracting the key indicators represent for each variable in TPB model, the measurement model was developed and tested by confirmatory factor analysis (CFA) to assess the convergent validity, discriminant validity of studied model.

Lastly, final model was derived by running structural equation modeling (SEM) analysis to quantify the relationships among dependent variable and independent variables.

All information explains for third objective, which regards to explore the factors influence on farmer's SWF data use in rice production decisions by applying the TPB is exhibited in chapter 7.

3.3 Research Methodology of Third Objective

3.3.1 Data Collection

- Step 1: To achieve this objective, secondary data on rice yields in two seasons from the year 1986 to 2012 was collected from district statistical offices. In addition, climate data was taken from Thua Thien Hue Hydro-meteorological Station and National Hydro–meteorological station about monthly maximum temperature, minimum temperature and monthly rainfall in the 1986-2012 periods. These data are source for running multiple regression models to identify the impact of climate variability on rice yield of two growing seasons.

- Step 2: In addition, two focus group discussions were held to understand the farmers' perception about the change in climate factors and its' impact on rice crop in study site. Historical time line, a PRA tool was applied in this focus group discussion.

There were 15 farmers involved in discussion. They were asked questions to recall their memory about which climate events that perceived as abnormal climate phenomena in last ten years. From different climate events of year by year, farmers discussed how they affected their livelihood and which related attributes reflect for that climate event. After discussion, a number of climate events, which is presented by year from 2002 to 2012, were developed with their attached explanations.

3.2.2 Data Analysis

1) Independent Variable

Three climate variables as independent variables which are average maximum temperature, average minimum temperature and average rainfall were used as determinant variables. Monthly data on maximum temperature, minimum temperature and average rainfall were obtained from the National Hydro-meteorological Center in year 2012 for the 1986-2012 periods. These monthly data were then converted as the average of the growing periods for two rice seasons. Therefore, the climate variables are represented by maximum average temperature and minimum average temperature and average rainfall for the growing seasons of the concerned rice crops in period of 27 years.

2) Dependent Variable

The yield of two different rice seasons as winter-spring and summer-autumn are dependent variables in this study. Because of the distribution of the rice yield for two rice seasons was normal distribution, so the ordinary least squares (OLS) was applied in this study

This objective aims to explore the relationship between rice yield and climate variables to estimate the potential effects of seasonal temperature and rainfall on the rice yield of two seasons using regression model. Since the number of samples of this study was less than 50, so the distribution of rice yield of two seasons were checked the distribution by using Komogorov-Smirnov and Shapiro-Wilk test in SPSS software. The results of distribution testing revealed that yield of two different seasons followed normal distribution. Therefore, ordinary least squares is suit for estimation of coefficient of determinants.

It is clear that the relationship between climate factors and rice yield was not always linear since the increase of rainfall or temperature would be advantageous for rice yield at a limited threshold, so if these factors continued develop beyond this threshold, it may adversely influence on rice growth (Mahmood et al., 2012). Moreover, this study deals with a small number of observations at 27 years. Therefore, logarithmically transforming variables were applied in this non-linear relationship (Benoit, 2011). The ordinary square model was taken log both sides as follows:

$$\mathbf{LnYs_t = \beta_0 + \beta_1\, Ln\, (rain_t) + \beta_2\, Ln\, (maxT_t) + \beta_3\, Ln\, (minT_t) + \varepsilon_t} \qquad (1)$$

Where,

Ys_t is rice yield (ton/ha) of two seasons (winter-spring and summer-autumn)
$rain_t$ is the average rainfall (mm) by seasons
$maxT_t$ is the average maximum temperature (^oC) by seasons
$minT_t$ *is* the average maximum temperature (^oC) by seasons
ε_t is the error term and t is the time (year).

The data for winter-spring rice model was observed in 6 months from December to next May, but data was used for summer-autumn model obtained in 4 months from May to August over 27 years. These data was run by using SPSS software 16.0 package.

3.4 Research Methodology of Second Objective

3.4.1 Data Collection

First step: There was an in-depth interview with 8 participants as 1 local leader, 2 agricultural extension officers, 1 district meteorologists and 4 key farmers in order to deeply understand the following aspects about:

+ Farming system and rice production situation in commune
+ Climate variability influence on rice faming management
+ The current SWF products, sources and forecast delivery systems.
+ SWF data constraints in study area
+ SWF use by rice farmers and farmers' decisions making on rice production.
+ Policies and programs to support farmers in using SWF in term of adapt to climate variability at the study sites.

In-depth interview was also tool to gather more information necessary for focus group and designing questionnaires.

Second step: There are two focus group discussions in district help to understand farming situation and rice production contribution for highland farmer's livelihood. More importantly, this step identified the common rice production decisions and the climate predictions/information that farmers accessed. Group discussion also assisted in designing questions to questionnaire survey in step three to get deeper understanding about farmers' decisions and SWF use.

In the first focus group discussions was in-depth discussion with 6 participants including extension officers, local leaders and key rice farmers, which discussed about the seasonal weather forecast issues at local.

The second focus group discussion concentrated on using seasonal calendar tool to know the calendar of activities of rice production process that farmer was applied. Then, basing on this calendar, farmer discussed about their decisions making in term of using SWF data that relate to each activities. It means that farmers shown which kind of SWF data that they assessed and applied on their rice farming activities. Farmer also indicates groups of individual or institutions were influential on their using SWFs for decision making.

This focus group discussion information was used for designing questionnaires in questionnaire survey in next step that helped to answer for objective three.

Fourth step: From the results of in-deep interview and focus group discussion, a structure questionnaire were designed and carried out with up to 180 farmers. It is applied to get information about decisions were made by farmers on their farm.

Household questionnaire survey conducted to identify the particular decisions on rice faming activities from using SWFs. This information helps to understand how farmers adopted SWFs in rice production decisions to cope with climate variability.

3.4.2 Data Analysis

+ Focus group discussion information analysis

In this chapter, descriptive statistics applied to analysis the information from focus group discussion and some information from interviews.

+ Cronbach' alpha coefficient application for household interviews information

The variety of farmers' decisions according to influence of SWFs was tested the internal consistency by using the Cronbach's alpha before they became the dependent variable in Theory planned behavior model about the factors influence on farmers SWF use in rice production decisions.

Assumption variables use in Cronbach's alpha were setting planting date, soil preparation, seed variety, planting density, brewed rice, sowing, weeding, applications of pesticides, herbicides application, fertilizers application, irrigation application, planting harvest date and post-harvest made throughout the year on accessing SWF products. The result from Cronbach's alpha will be used as input for TPB model for third objective.

3.5 Research Methodology of Third Objective

3.5.1 Sampling

To fulfill this objective, household survey was conducted. Sample for the study was rice holders. The number of samples for questionnaire survey was 180 households out the total 1853 households in district, calculated using Yamane's formula which determines the error at the level of significance.

Yamane formula:

$$n = N/ 1+N (e^2) \quad (2)$$

Where, n = Sample size

N= Total number of coconut smallholders

e = Error of sampling

3.5.2 Data Collecting

Household questionnaire survey apply in this objective to get information about the factors was influencing on rice farmers' SWF use in their decisions making. From the results of in-deep interview and focus group, a structure questionnaire will be carried out with up to 185 farmers in study area.

3.5.3 The Theory of Planned Behavior

To understand the internal factors affecting farmer forecast use in farming decisions, we can use tools and perspectives from the social sciences. This current study uses the Theory of Planned Behavior (TPB) (Ajzen, 1985, 1991) which originates in social psychology.

$$A = f\ (attitude,\ social\ norms,\ perceived\ control) \qquad (3)$$

Where, *A* is action, and *f* is a function of the causal factors on intention and action. Attitude, social norms, perceived control were factors influence on A (farmer's SWF use in rice production decisions). In this objective, I focus attention on the actual behavior, ***A***, defined as the extent to which SWFs are having an influence, as perceived by farmer decision making.

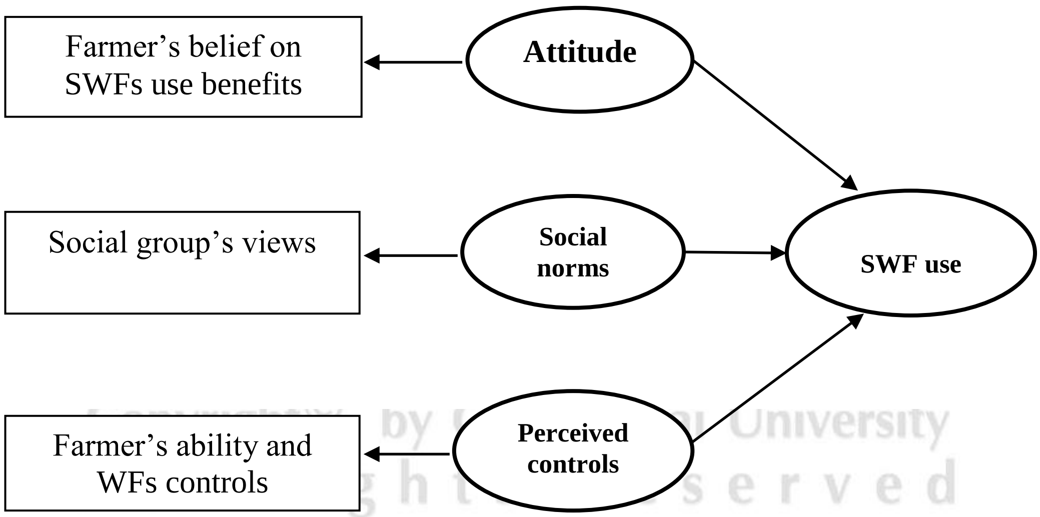

Figure 3.3 Study theory model

Enhancing farmer's use of SWFs can be determined by applying the TPB as framework. Figure 3.3 presents the framework of factors influence on farmer's SWF use in rice production decisions based on TPB model. There are three constructs in this study model. The first construct is attitude construct that aim to identify how farmers evaluate the use of SWFs. The second construct is subjective norms, which is to explore the role of perceived social encourage upon farmers to use SWFs. The last construct is perceived controls to investigate the farmer's perception on their capacity to access, use and apply SWF and on SWF limitations in their decision-making.

It was believed that farmers' attitude, social subject norms, perceived controls had impact on farmer's use of SWFs in rice production decisions making. Therefore, the hypothesis related to three factors of theory planned behavior model in this study is proposed as following:

H1: Farmer's attitude had influence on farmer's SWF use in rice production decisions.

H2: Subjective norm had influence on farmer's SWF use in rice production decisions.

H3: Perceived controls had influence on farmer's SWF use in rice production decisions.

3.5.4 Questionnaires Development

1) Dependent Variable Measurement

To determine how farmer's use of SWFs in rice production decisions making a question was rated as "*Please indicate how frequency do you use SWFs in each decisions below by circle a number in* each of the boxes *in this Table."*

Table 3.1 The use of SWFs in rice farmers' decisions

Decisions	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Planting date							
Rice variety							
Seed brewing time							
Herbicide application							
Pesticide application							
Fertilizer application							
Irrigation management							
Harvesting date							

Note: 1= not use; 2= rarely use; 3= occasionally

4= sometimes; 5=frequently; 6= usually; 7= every time.

2) Independent Variable Measurement

2.1) Attitude Variable

According to the TPB, attitudes toward forecasts predict use of the forecasts, and attitudes are determined by expectancies (beliefs) which is presented in table 3.2. The belief component in the first variable, was evaluated on a scale from 1=extremely unlikely" to "7=extremely likely" to the question: "In your experience, how likely it is that SWFs are good at producing the following outcomes?"

Table 3.2 Outcome beliefs of using SWFs on rice productions

No	**Attitude**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Setting best plating date							
2	Suitable rice variety							
3	Cost saving							
4	Pest management							
5	Irrigation management							
6	Selecting best harvesting date							
7	Getting higher yield							
8	Pest postharvest operation							
9	Better rice quality							
10	Avoid extremely weather event							

1= extremely unlikely; 2= Unlikely; 3= somewhat unlikely; 4= neutral
5= somewhat likely; 6= likely; 7= extremely likely

2.2) Social norm variable

In our survey, the social norms affecting forecast use which is the second causal factor on the right-hand side of the TPB.

The variable was measured from answer to the question: "How likely is it that each of these groups believes that SWFs should influence your SWF use in crop-related decisions?" A total of 9 groups are listed on focus group such as spouse/significant other, children, other relatives, friends and neighbors, local officers, extension officers, woman union, TV and radio. Again, 7 scales was used to gauge the influence from "1= not at all influential" to "7=extremely influential.

Table 3.2 Social groups view influence on farmer's SWF use

No	Social groups	1	2	3	4	5	6	7
1	Spouse							
2	Children							
3	Relative							
4	Neighbor							
5	Woman union							
6	Local officer							
7	Extension officer							
8	Television							
9	Radio							

1= not at all influent; 2= slightly influent; 3= somewhat influent, 4= moderately influent; 5= influent; 6= very influent; 7= extremely influent

2.3) Perceived control

Perceived behavioral control, the third variable on the TPB divided in two group of variables: the ability (self-efficacy) of farmers in term of accessing, understanding and applying SWF data, other one base one controls factors of SWFs by itself (perceived controllability).

Perceived behavioral controls were measured by farmers' estimates of how the SWF use on farming decisions was limited by 1) "My accessing, understanding, applying of SWFs". Moreover, farmers were asked, "How do you perceive these obstacles of WSFs in your rice decisions making?" The answer bases on scale from 1 = "very low" to 6 = "greatly high."

Perceived controllability is measured by farmers' estimates of forecast limitations, such as the accuracy of forecasts, reliability of the sources making the forecasts, availability of forecasts for farming area, and the timeliness of the forecast information, etc. Those barriers were identified by the focus groups.

Table 3.3 Perceived control factor influence on rice farmer's SWF use

No	Perceived controls	1	2	3	4	5	6	7
1	Access ability							
2	Understand ability							
3	Apply ability							
4	Accuracy							
5	Reliability							
6	Timeliness							
7	Availability							
8	Understandability							
9	Diversity in channels							
10	Localization							

1= very low; 2=low; 3= somewhat low; 4= neutral;
5= moderately high; 6= high; 7= extremely high

3.5.5 Data analysis

The current study used SPSS 16.0 and AMOS 16.0 to analyze the data. Three steps approach was used, a measurement model was first applied to test the reliability of indicators used to measure the theory planned behavior model was investigated by using Cronbach's alpha coefficient, then, Confirmatory Factor Analysis (CFA) was used to assess of the adequacy of the measurement model. Finally, the Structural Equation Modeling (SEM) was utilized to find the best-fitting model and to test for causal relationships. SEM, multivariate technique, combines aspects of multiple relationships simultaneously, which is not possible using other multivariate techniques (e.g., multivariate analysis of variance, multiple regression, discriminant analysis, factor analysis.