CHAPTER 6

Seasonal Weather Forecast Data Use in Rice Production Decisions

This chapter presents two main sections regarding farmer's SWF data use and rice production decisions relevant the SWF data. The first section presents the findings of the focus group discussions and questionnaire survey on how farmers have access to the SWFs; how SWFs related to typical rice production decisions; types and sources of SWF data among farmers and farmer's perception on SWF data in the study areas. The later section reports the key decisions on rice production related to the SWFs, which are derived from the results of the focus group discussions and the household questionnaire survey.

6.1 Farmer's Seasonal Weather Forecast Data Use

6.1.1 Farmers' SWF Data Accessing

For agricultural production in general and rice in particular, the climate is one of the important factors that farmers considered for their cropping. Therefore, when farmers were asked about the role of climate in the rice production, then all the sampled households responded that climate was concerned as a primary factor in their farming. From the total 180 sampled rice farmers, 107 households (59.4%) responded that climate factors were important for the rice production, 54 households (30%) responded medium important and only 19 households (10.6%) responded less important. This suggests that farmers noted climate as a deciding factor in their rice production process.

In addition, the information from the farmer household interviews also indicated that 56.7% of the households regularly access to SWFs every day through several ways such as TV and radio to serve for their daily live (Figure 6.1). These respondents said that this was a regular activity of their family in every evening after watching the

news, they often listened to SWFs for next day forecast, temperature forecast and sunshine forecast, etc. Some other households explained that, in every morning, the village voice broadcasting system usually released SWF data that could disseminate these kinds of information to farmers who were regularly at that time doing housework or working in the fields.

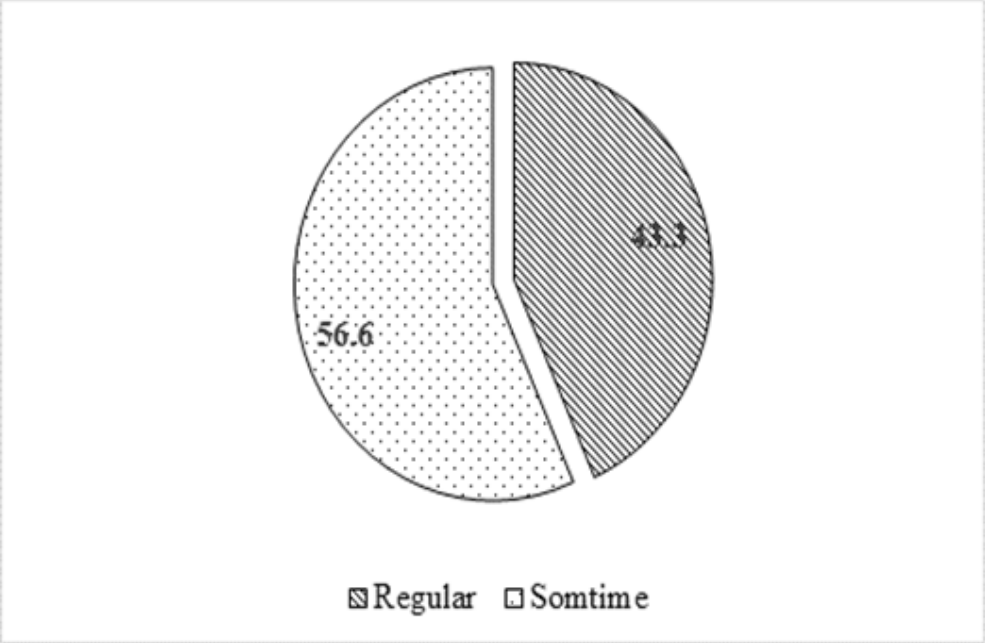

Figure 6.1 Farmer's seasonal weather forecast accessing
Source: Household questionnaire

Besides, Figure 6.1 pointed out that 43.3% of the respondents said that they only accessed weather information when they needed it. For instance, farmer accessed the SWFs right before the beginning of rice production season to prepare for sowing, irrigation. In addition, when the disease occurred, farmers needed to watch the SWFs for the preventive monitoring, especially during the rainy season that was preferable for pests and diseases. Moreover, they often followed SWFs when rainy season began, particularly seasonal storms and flood forecasts to prepare for coping with these extremely weather events.

From the information above, SWF data can be considered very important for the farmers and the majority of the farmers received SWF data to serve for their daily life as well as to support the production activities.

6.1.2 Farmers' Consideration of SWF Influence on Rice Production

The pie chart in Figure 6.2 explains the awareness of the respondents about the influence of SWF data on their decisions in rice production by selecting the scale from "0" that means "no apply SWF data" to "6"which is "greatly influence."

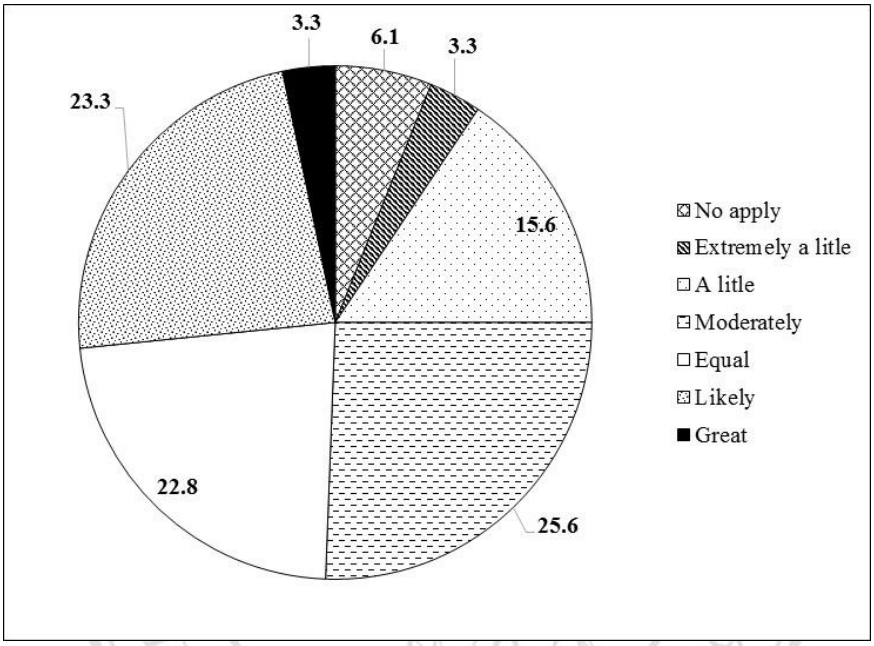

Figure 6.2 Influence scale of seasonal weather forecast data on rice production

Source: Household survey, 2013.

Criteria for assessing the impact degree of SWFs on rice production were discussed in focus group discussions. Participants said that many households have been accessing seasonal weather information, but they still practiced farming by their experience without applying SWFs, so these households can be ranked as "0" as no apply SWFs.

In addition, the local production seasonal calendar of farmer could be also a good criterion to assess the impact degree of SWFs on the rice production decisions because the seasonal calendar provides precise dates for sowing, harvesting, disease prevention, and it also took into account the weather factors in forms of SWFs. Thus, nowadays when the weather events tend to occur more unusual or unpredictable, farmers are forced to comply with the production seasonal schedule of communes and districts to avoid losses. Moreover, for mountainous farmers, the seasonal calendar became very important tool, which agricultural officers and agricultural extension workers could intervene to help farmers better in farming techniques as well as pest, disease and irrigation management. Rice

seasonal calendar was often sent to farmers before starting new crops by village meetings or broadcasting to whole communities via loudspeaker system.

The third criterion discussed by participants in the focus group discussion was announcements and recommendations of local offices in rice production, especially in warning of some extremely weather events before rainy season or guiding irrigation methods for rice when drought happened. Most of participants said that in real practicing, many households complied with these recommendations in production, but some others did not take into the consideration.

Accessing and applying SWF data to support the decisions for rice production activities was the last criterion that reflects the influence SWF data. Therefore, farmer who had this criterion would have the most influential level by the SWFs because they perceived how important SWFs are in rice production. However, according to the results of the group discussions, the number of households who reached to this active level in using SWFs in Nam Dong district was very low because of their perception of SWFs was limited.

The Figure 6.2 shows the diverse influential levels of the SWF data on their rice cropping that perceived by the farmers. About 70% of the respondents indicated the moderately to likely levels of SWFs influence on rice production decisions. There was 25.6% of the respondents said that the SWFs had moderate impact on rice production activities, while only 3.3% (six households) answered that the impact of SWF information were extremely a little to their decision-making. In addition, the impacts that were considered as equal and likely on farmers' decisions making account for 22.8% (forty-one households) and 23.3% (forty-two households) for each. Only 3.3% (six households) mentioned that their decisions related to rice production activities were greatly affected by the SWF data. There was 6.1% (eleven households) said that did not use the SWFs for the rice cultivation.

6.1.3 Types of Seasonal Weather Forecast Data among Farmers

In general there are five types of SWF data specifically tailored to farmers such as seasonal temperature, seasonal rainfall, droughts, storms and floods. Few of these products also included recommendations on how to respond to the forecast weather

events or climatic variability with the aim of reducing the risks of farm loss as well as helping the farmers to take advantage of favourable weather conditions.

According to the interviews of the officers from the meteorological station, seasonal temperature and seasonal rainfall forecast data were usually disseminated 3 months or 6 months in advance before starting the rice seasons. Most of these forecasts are broadcasted through the television, radio and sent to the relevant agencies such as Department of Agriculture and Rural Development and Department of Natural Resources and Environment by documents. Then, the forecasts were transferred to government organizations at lower levels and reached farmers by official announcements or integrating into the seasonal calendar. Therefore, through these dissemination channels, farmers would foresee what precipitation, temperature, drought, storms and floods that would occur in the coming season. It can be applied for planning production activities accordingly. Normally, the forecasts of precipitation and temperature are accompanied by the forecasts of drought, especially in dry time happening in last months of winter- spring season and early months of summer – autumn season which is a very sensitive for the rice growth stage as well as rice productivity. The drought forecasts might help farmers in preparing actively for rice irrigation, as well as disease prevention.

In addition, the information from in-depth interviews also showed that forecasts of storms and floods was made before each rice season, especially, summer– autumn season that usually had the many storms, altogether with floods that greatly affected rice productivity. Hence, early warnings of storms and floods were often mentioned in the seasonal calendar or in regular community meetings, so these encouraged farmers to comply with the commune production seasonal plan to avoid losses.

The focus group discussions on SWF issues also covered types of SWF that they knew, after that these information was collated with official information from meteorological stations. Then, the results were applied to the questionnaire design to assess what kind of SWF data farmers had accessed and which one attracted farmers' concern the most. The results of household questionnaire survey are presented in Table 6.1.

Table 6.1 shows the types of SWF data that the180 farmers have accessed and used for rice production decisions in 2013. The results indicate that most of the farmers knew

about SWFs, in which drought and storm, flood forecasts were the most interest at 97.2%, 90% and 85% respectively. According to the interview results, the farmer concerned on drought forecast because this is mountainous area, so water shortages occurred regularly during the dry season, not only influenced in farming but also in daily life activities. In addition, because of this district located in the central region, so it is often affected by natural disasters, especially storms. Hence, storm forecasts also get the farmers' attention.

Table 6.1 The Seasonal weather forecast types in study area

SWF types	**Frequency**	**Percentage (%)**
Temperature	86	47.8
Rainfall	74	41.1
Drought	162	90.0
Storm	175	97.2
Flood	153	85.0

Source: Questionnaire survey, 2013 (N=180)

In addition, according to farmers' experience, these two kinds of events tent to occur unusually and their local knowledge to predict these events were no longer applicable. These forecasts were also discussed the most by village leaders and agricultural extension officers in local meetings to prepare for the upcoming crop, as well as in preventing the occurrence of diseases. One farmer stated that *"being alert to storms and floods is always a part of life of people living in central region of Vietnam, so when rainy season comes, we have to watch SWFs to have suitable coping plan for our family and crops"*.

Furthermore, seasonal temperature and precipitation forecasts only attracted the attention of 42.1% and 47.8% of the interviewed households. They explained that these forecasts were only general and unclear because they did not know the exact date of the highest and lowest temperatures, so it was very difficult to apply. However, in the village meeting before the rice season, extension officers often gave recommendations on the trends of temperature and precipitation in the next season, therefore this information could assist farmers to adjust their farm plan.

6.1.4 Sources of Seasonal Weather Forecast Data

An in-depth group discussion with four rice farmers, two extension officers, and two local leaders was conducted to understand the source of SWFs that farmers accessed and apply in rice production decisions. Participants raised a list of social groups that could provide SWF data to farmers as shown in Table 6.2.

Table 6.2 SWF sources in study area

SWF sources	**Details**
Emotional relationships	Spouse
	Children
	Relative
Exchanging relationships	Friend and neighbor
	Chemical and fertilizer seller
Government	Local officer
	Extension officer
	Woman union
	Meteorological stations
Expert	University
	Project
Media sources	Television
	Radio
	Internet
	Newspaper, magazines, posters

Source: In-depth group discussion.

Regarding emotional relationship group, participants discussed that, in the family, the spouse would be the first one who conveyed weather information to family members, especially the information gained from the village meetings. In addition, group members also shared that husbands concerned more about SWFs than wives did because they were interested in watching news in every evening. Besides, some participants reported that their children also helped them in watching weather information and communicating the news, particularly drought, storm or flood forecasts, back to their parents. It is explained that because of many families mainly spoke ethnic languages and some parents could not read

or understand fully Vietnamese language on the SWFs, so sometimes they had to ask their children to interpret.

About exchanging relationship group, friends and neighbors were also considered as sources of SWF provision to farmers. Some participants stated that, usually, when friends or neighbors interacted with each other in some events like festivals or meetings or working in the field, the topic of weather was sometimes brought into discussions. Therefore, through this, farmers knew the useful weather information not only for rice production but also for family activities. In addition, chemical and fertilizer sellers were included as a source of weather information, because according to the participants, when farmers buy fertilizers, pesticides or herbicides for the crop, the shop owners offered advice related to SWF data that they have known to farmers. For instance, *"according to weather forecast in this season, storm would come sooner, so you should use less nitrogen fertilizer to avoid trees vulnerable to collapse".* According to participants' experiences, rice disease outbreak always related to weather factors. Hence, when farmers decided to buy pesticides, they were instructed how to use them based on specific weather conditions.

The third source of SWFs was government organizations such as local leaders, extension workers, and women union. Local leaders expressed their roles in providing SWFs through official announcements to the villagers or direct meetings with farmers to discuss about preparation and necessary responses before disease outbreak, drought, storm and flood occurrence. Meanwhile, the extension workers were main consultants that worked and communicated directly with farmers about everything regarding rice production from planning until harvesting. Group discussed that extension officers incorporated SWFs into rice seasonal calendar, cultivation advisories and disease management recommendations. One participant shared that *"sometimes, diseases (rice spots, yellow leaf, etc.) and pests (brown plant hopper, rice leaf folder, etc.) appear on rice fields. Then we decide to spray chemicals, but extension officers advised us not to use because with favorable weather conditions forecast, farmers just need to take care their rice fields well, so disease or pest will be cleared up after a few days".* On the other hand, one farmer stated *"we follow the seasonal calendar of agricultural officers, it proves we did use SWFs, because the seasonal calendar took into account climate*

factors and therefore we have to follow their instructions." Moreover, there were two meteorological stations in the study area where raw SWF data was collected and transferred directly to the provincial meteorological station. Therefore, by participant's opinion, local meteorological stations could play important role in providing in weather forecast information to farmers as well as to other relevant local departments.

Furthermore, since this was a mountainous district, there were many rural development programs and projects implemented by both government organizations and NGOs. These projects have informed farmers about technologies, information and finance to help farmers develop their livelihoods. Thus, according to the group discussion, these organizations also would be seen as an expert group that could advise farmers on SWFs.

The last type of SWF provision is means of communication including television, radio, internet, newspaper and magazine, etc. Participants explained that television was the most common channel that farmers accessed the SWFs since almost all families in the communes had television. Whereas the commune radio system also broadcasts weather forecasts three times per day, but only households who lived close to the loudspeakers might listen to this kind of information from this media. In addition, nowadays, few numbers of households had accessed to the internet, thus, it is also considered as a SWF source. Newspapers and magazines also contain information about SWFs, but only a small number of the farmers who can read Vietnamese language could access information from this source.

According to the information gained from in-depth group discussion about the sources of weather information provision to farmers, the results were included in questionnaire applied to the interview of the 180 rice growers. Figure 6.3 shows the results from household interviews about the sources of SWFs available in the study area that farmers considered in their decision making on rice production activities.

In comparison with information from in-depth focus group discussion in Table 6.2 above, the results from questionnaire survey showed that there were only 9 actors that provided SWFs to farmers as spouse, children, relative, neighbor, local leader, woman union, extension officer, television and radio. Whereas, other groups such as chemical and fertilizer sellers, project organizations, and hydro-meteorological stations were not

considered as sources of SWF data of farmer, while these groups associated closely with farmers. Figure 6.3 points out that neighbors and televisions were the two significant sources of information that farmers most often accessed corresponding to 90.6% and 89.4% respectively, whereas only 54.4% of the interviewed households have accessed to SWF data through radio.

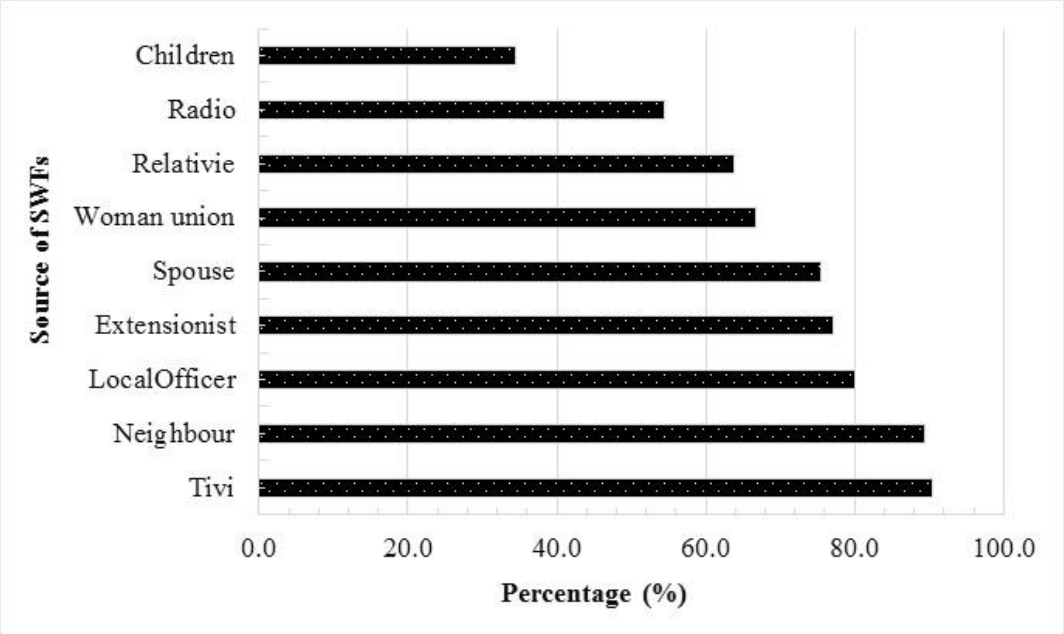

Figure 6.3 Sources of the seasonal weather forecast data of farmers
Source: Household questionnaire (n=180)

The results also indicate that local officers and extension officers accounted for quite high percentage of the respondents, 80% and 77.2% respectively, while 75% of the respondents reported that their husband/wife would share their information about SWFs to family members if they know. Moreover, children, relative and women union also were the sources of SWF data in term of delivering information to farmers at 34.4%, 63.9% and 66.7% accordingly. Some households explained that their children can help them in reading, interpreting and communicating the forecast on television to parents, but they were not interested in watching or listening to this kind of information.

6.1.5 Farmers' Perception on Seasonal Weather Forecast Data

The use of SWFs by farmers were greatly affected by various factors in which the limitations of the forecasting system by itself is a main determinant. Table 6.3 presents

the results of focus group discussion with the participation of 15 farmers using a scoring and ranking tool. Participants listed out the SWF attributes that would have influence on farmer's SWF using. Therefore, based on rice farmer's knowledge and practical experience, then each person gave a score to rate how importance of each restriction had influence to their use of climate information. The score 1, 2, 3, means "it is extremely a little important ", "it is important" and" it is greatly important" respectively. Ranking column is the sum score of the 15 participants, in which the highest score in each cell would be 45(15x3) and lowest score is 15 (15x1).

Table 6.3 The farmer's perception on the importance of SWF attributes

Attributes	**Sum score**	**Ranking**
Accuracy	40	**I**
Reliability	37	**II**
Timeliness	28	VI
Availability	32	V
Understandability	35	**III**
Diversity of channels	25	VII
Localization	34	IV

Source: Farmer focus group discussion, 2013

There were seven SWF attributes perceived by farmers including accuracy, reliability, timeliness, availability, understandability, diversity in channels and localization. Data in total column ranks from 25 to 40 scores, so it indicates that SWF attributes played important role in farmer's decision-making use of forecasts. Results after scoring and ranking show that the accuracy, reliability and understandability of the SWF data were the most important attributes of SWFs at 40, 37 and 43 points respectively. However, the discussion explained that these three attributes had been still weak in this mountainous area. That is the reason why the farmers' trust on SWF data still limited. Thus, the meteorological stations have been working to improve these attributes of the forecasts to support farmers in adapting and copping with the weather events such as drought, storms and floods.

The accuracy of SWFs expressed the probability of actual weather events to happen exactly as in forecasts. A tenant, who was engaging in rice farming, said that *"...in*

2012, the forecasts from television just said that it was hot weather or high temperature but we experienced drought. It started from February and lasted until August. Other crops such as rubber, acacia maybe did not have much impact or the impacts were not clear but for our rice fields, it was visible as there was no water then. The soil was dry and in some areas, even cracked..."

The reliability of SWFs was also discussed in the focus group meeting. Participants reported that the forecast reliability was relevant to the accuracy of forecasts. However, as mentioned above, because SWFs were perceived as not really accurate and specific for their location, the reliability of SWFs was also low. Therefore, this attribute was considered as limited factor influence on farmers.

Understandability is believed as third important attribute of SWFs that influenced on farmer's use. According to the results of focus group discussion, the SWF data, especially on television and radio used the scientific term or general information that made listeners confused and difficult to apply. For example, the SWF data on television used formal and general terms such as "mm of rainfall" or "moderate, heavy and very heavy" that made farmer confused and unmeasurable. Moreover, whilst mean media is main source of forecast provision to farmers, but it lacks interpretation and recommendations related to rice production. This thus has limited rice farmer to access and apply the weather information.

The fourth important attribute is localization of SWFs that means "specific to a location". SWFs were often at provincial scale, while the topography varies over the province. One farmer said, *"Since our commune is near Da Nang province, so we often listen to weather forecasts for Da Nang province on television or radio instead of following Thua Thien Hue province channel."*

Participants discussed that the availability was another important characteristic of SWFs. Although, there were many sources that would support information to farmers, but they still received passively. Additionally, there was no specific SWFs for particular crop such as rubber, rice and coffee. Moreover, the SWFs received from normal channels such as extension officers or local leaders supported to farmers are as top-down manner. For example, production seasonal calendar from extension officers

retailed to farmers before starting rice season without discussing with farmers in advance.

An attribute of SWFs that the participants considered as limiting factor on their SWF data use was timeliness. It means that the forecast information was not provided on time when farmers needed for making decision on rice production. According to the participants, some SWF data arrived late when season began already, so farmers could not use that information for the preparation of rice production. However, farmers said that this attribute was not a serious limitation compared to other restrictions.

The last attribute was the variety of SWF channels to reach. According to farmers, current communication channels were divided in two main groups as media channels (television, radio) and integration (through the seasonal calendar, pest, disease and irrigation management announcement, natural disasters warning) of extension officers and village leaders. Additionally, discussion also pointed out that despite quite many channels of SWFs in study area. However, there was no specific SWF channel in providing advices and regular updates of SWF data for rice farmers.

6.2 Rice Production Decisions Relating to Seasonal Weather Forecast Data

In order to meet one of the research objectives on which is to understand how the farmers used SWFs in rice production. Matrix ranking, a PRA tool, was used in order to know what kind of weather information that farmers accessed the most in rice production process. Moreover, the matrix ranking also shows what type of SWF data was considered the most of farmers in rice production decisions.

This tool application was based on the seasonal calendar of farmers. Farmers indicated what types of SWF related to specific rice activity and then gave score on each decision by the lowest scale of 0 which “is not relevant” to the highest scale of 6 which is “very high relevant”. After scoring was finished, the total score was computed and the results are shown in the Table 6.4.

The total score and ranking by last two columns shows the relevant level of SWF data on decision for each rice production activity. Whereas, the total score and ranking in the last two columns indicates which types of SWF were the most interest by farmers in

their rice production decisions. Overall, Table 6.4 indicates that the degree of relevance of SWF data on each rice crop decision was quite low. The evidence was that most of farmers selected scale 2 (a little bit relevant) and 3 (moderately relevant) to rank each criterion so that the total scores of 13 participants raking for each cell was just from 7 to 49 in comparison with highest score of 78.

Regards to the relationship of SWFs on certain rice production operations, three key decisions were selected based on the ranked score, which are planting date (209 points), harvesting date (190 points) and pesticide application (184 points). It was explained by the participants that selection of planting date not only affected all subsequent activities particularly on harvesting date, but also showed that farmers could avoid severe weather events such as droughts and storm.

Table 6.4 Key decisions in rice production decisions as related to SWF data

Activities	**SWF types**						RANKING
	Temp.	**Rain**	**Drought**	**Storm**	**Flood**	**Total**	
Rice varieties	7	11	57	49	47	171	IV
Planting date	23	42	50	47	47	**209**	**I**
Brewing seed	39	39	15	14	16	123	V
Herbicide application	13	42	14	10	13	92	VIII
Fertilizers application	32	18	33	20	14	117	VI
Pesticide application	22	35	48	47	32	184	**III**
Irrigation application	24	18	33	20	14	109	VII
Harvesting date	20	53	38	45	34	190	**II**
Total	209	229	288	252	217	1195	
RANKING	V	IV	**I**	**II**	**III**		

Source: Focus group discussion, 2013

Note: Temp: temperature; Rain: rainfall

Farmers determined planting date which based on rice growth length corresponding to the weather condition in that season. In this decision, the two most relevant forecast information were drought and storm forecasts at 57 points and 49 points respectively, while seasonal rainfall and temperature forecast were extremely less relevant with only 7 points and 11 points respectively. Participants explained that summer-autumn crops often lacked water after rice sowing time that leaded to some rice growing areas

abandoned. Meanwhile, some households continued rice cultivation by using their experience without complying the commune seasonal calendar, the harvesting time fell into the occurrence of storms and floods of which caused crop failures. Therefore, according to participants, SWFs on drought, flood and storm season were important for farmers nowadays to help them determine the planting date to avoid bad weather events and crop failure.

Group discussion also pointed out the roles of SWFs in determining the harvesting date. If farmers decided the best harvesting date in winter – spring season, it helped farmers to catch up the seasonal calendar of the following season. Moreover, the suitable harvesting date in summer – autumn rice season decision would help to avoid disaster risks in coming rainy season, especially heavy rain and storms. Therefore, the seasonal weather forecast on rainfall and storms were assessed the highest relevant level with 53points and 45points, while the seasonal temperature forecast was the least concerning in this decision. Besides, in winter-spring crop, the harvesting time usually felt in to high temperature days, and many farmers wanted to prolong the ripening of rice to achieve higher yield, so they did not care about temperature. In contrast, summer autumn crops farmers were concerned more about the storm forecasts since the harvesting time often coincides with the beginning of stormy season. One participant said that *"for summer autumn crops it is always better and safer to harvest earlier to avoid disaster risks"*. It means that if the recommendation of extension officer gave or television/radio announced that it would have rain or storm come early in next season, farmers would harvest early even though the ripening level is only about 60-70 %.

The third decision of farmers that related to SWFs was pest and disease management decision. Based on farmers' previous observations, the current weather conditions were not good as in the past. This was shown by the occurrence of diseases and pests on rice more frequently and complexly. Drought, storm and rainfall forecast were pointed out that had relationship with pest management decision with 48, 47 and 35 scores corresponding. However, seasonal temperature and flood forecast were assumed less relevant to pest control decision. Participants explained that the longer time dry spells, the weaker rice plants, more susceptible to disease, pests attack especially sheath blight and yellow leaf diseases. In addition, heavy rains also created favorable conditions for

variety of diseases such as stem rot and borers to develop. Farmers said that if their family missed rice seasonal calendar of the community, then their rice fields would be very susceptible to disease and have effects on other household fields. Thus, extension officers had to promote and remind farmers to follow proper rice techniques as recommended to avoid disease outbreaks. In addition, the decision on whether to apply chemicals to a rice field or not, also needed a recommendation from extension officers. For the mountainous Nam Dong district in particular and mountainous areas of Vietnam in general, extension officers involved in pest and disease management played a very important role. That is the reason why highland farmers tent to believe and follow the instructions from this actor.

One of the other important decisions regarded to SWFs was seed variety selection in each crop. Farmers explained that there were many varieties of rice cultivated in the province including local varieties and new varieties. Therefore, the selection of seed varieties depended on the preferences of each household and expected weather conditions of each season. Participants showed that drought, storm, and flood forecasts before cultivation season were very important to rice farmers in decisions on how rice seed varieties ratio should be applied in the next season. That is why these three kind of SWFs took high scores in this decision at 50 scores (drought forecast), 47 (both storm and flood forecast) and 42 scores (rainfall forecast). Participants interpreted that the first months of winter – spring rice season felt into cold and dry weather, so farmers often selected drought- tolerant and cold-tolerant seeds. In contrast, in summer – autumn season, drought often occurred in first stage of rice growth, while storm and heavy rain happened in rice harvesting time, so farmers prioritized use of drought-tolerant, short, and short-term varieties. Under group discussion, through rice seasonal calendar, extension officer gave advices to farmers on percent of different varieties should sow according to each season weather condition. Therefore, nowadays, the majority of rice farmers follow the advice of extension the office on when to apply new varieties that got high productivity and disease-resistant.

Seed soaking was a step that farmers prepared to provide good conditions for rice seed germination before sowing in the fields. Participants interpreted that, the selection of seed soaking day was no relevant or a little relevant to forecast of drought (15 points),

storms (14 points) and floods (16 points), but it was quite relevant to the prediction of rainfall and temperature with the same score at 39 points. In spring season, sowing time felt into the cold weather months, so the temperature forecast is considered to decide the seed soaking time. Therefore, based on SWFs and rice seasonal calendar, farmers chose warm weather time for seed soaking. While, summer - autumn season, sowing time was usually hot and dry weather, so forecasts of precipitation was important to identify suitable sowing date and seed soaking. Some members stated that, before starting new season, seed-soaking day was recommended by extension officers and sent via commune's loudspeakers to help farmers in decision making.

Decision about fertilizer application related to SWF data at really low level, in which drought and temperature forecast shave higher score at 33 points and 32 scores for each, while the other forecast were extremely a little in relationship with this decision. Farmers emphasized that if they knew drought would occur in coming season, then they would use more fertilizers to assist rice to develop and grow well.

The focus group discussion also provided information that some farmer's applied SWFs assisted farmers in irrigation management, especially seasonal drought forecasts. However, farmers evaluated the role of other SWFs such as rainfall, storm and flood at low scores as 18, 20, and 14 points respectively. Participants discussed that for irrigation management, they were much interested in drought forecasts to preserve and share water resources efficiently on their fields.

The final decision that farmers pointed out related to SWFs was herbicides application. At the discussion, most of participants gave very low point (0 and 1) on each SWF relevant to this decision, in which storm forecast took the lowest score at 10. Seasonal forecasts on rainfall accounted for the highest score at 42. It means that this forecast had quite strong relationship with this herbicide application decision. It was explained that, normally after sowing about 1 to 3 days, if forecast was no rain, the farmers would spray herbicides to kill bud weeds, conversely, they would wait 10 days after the rain for spraying. Two different types of herbicides applied at different times of spray decisions. Some of the information shared that, if rain came after spraying, the use of herbicide would not work, and farmers had to spray again in 10 days after sowing. Therefore, they might lose quite big cost for this activity. That is the reason why farmer

tend to access SWF data on television, radio or following advisory of extension officers in making decision whether to apply chemical in their field or not.

On the other hand, Table 6.4 indicates that drought, storm and rainfall were the most interest by the farmers in rice production decisions with 288, 252 and 229 points respectively. The results of focus group discussion also were the same as the results of household interviews that SWF data of droughts and storms were of the top concern of farmers in this mountainous area. Participants pointed out that droughts often occurred during rice growth period, which caused rice diseases and abandoned lands due to water shortage, while storms happened unusually in rice harvesting time which local knowledge such as observations of astronomical phenomena and biological behaviors of wild animal species were no longer applicable to forecast these events. This led to bad harvesting in some seasons in previous years. In addition, most of farming areas were rainfed, so water resource for irrigation depended mainly on rainfall in growing season. Therefore, it can be clearly seen that the SWFs data played important role in rice production decision making of the farmers in this area.