CHAPTER 4

Study Site Description

This chapter aims to give a picture about study sites such as location, topography, climate condition, land resource and rice production in Nam Dong district. The social-economic characteristics of the research area also are presented. Social information focuses on population, labor structure and infrastructure conditions. Economic status describes as production value of economic sectors and focuses the details in agricultural and rice production aspects. Moreover, SWF system is also involved in this chapter to provide overview about organizations and relationships between related agencies in term of producing and delivering SWFs to users.

4.1 General Natural Condition

4.1.1 Location

Thua Thien Hue is one province of Central Coastal Economics Region of Vietnam. Its mainland ranges from 16º00' to 15º00' North latitude and 107º00' to 108º15' East longitude. Total area of province is about 506,000 ha, of which about classified as forestland and plantation forest.

According to Figure 4.1, Thua Thien Hue is bounded by Quang Tri province to the North, by Quang Nam province to the South, by Laos to the West and by the sea to the East of South China Sea. The province is divided into nine administrative units including one municipal city (Hue) and eight districts Quang Dien, Phu Vang, Phu Loc, Phong Dien, Nam Dong, Huong Tra, Huong Thuy and A Luoi and two of those are highland and mountainous districts. Agricultural land accounts only 12% of total natural land area, but, there is about 70% of population employs in agricultural sector.

Figure 4.1 Research study area

Nam Dong is one of highland district lies in the South-West of Thua Thien Hue province in central Vietnam. Nam Dong is located in a monsoon tropical highland zone and bounded by Quang Nam province to the south, Huong Thuy to the north, Phu Loc in the east and A Luoi prefecture to the west. The total area is 656 square kilometer

4.1.2 Topography

Thua Thien Hue extends about 60 km in width and 127 km in length from North to South, it slopes from West to East. The province has many streams and rivers systems. Province photography is divided into five zones: mountainous western zone, hilly zone, plain zone, lagoon zone, and sandy coastal zone. Nam Dong district is one mountainous area with the average height is 1,000 meters above sea level and the average slope is from 25^{o} to 30^{o} .

4.1.3 Climate

Thua Thien Hue's climate in general and Nam Dong district in particular is significantly influenced by monsoon, so theoretically it could be divided into two main seasons: dry and rainy (or hotter and cooler) seasons. However, beside the influences of cold fronts from the North and North-East monsoon which may start from April-May, creating first "summer" rainy period, there is also dry and hot South-West monsoon from Cambodia and Laos, going through Truong Son high mountain and creating "interruption" of summer rains. This period of year (Jun-July) is usually dry with low rainfall, but then, from August to December, the "real rainy season" will start rapidly with very high rainfall and continuing precipitation.

Province annual average temperature is around 17^{o}C -25.5^{0}C which has a decrease with the height following the gradient of 0.50^{0}C/100m, in which Nam Dong district average temperature is 15^{0}C – 22^{0}C. The average maximum temperature is 38^{o}C – 40^{o}C, and the minimum is 10^{o}C. Thua Thien Hue is one of the provinces with the largest amount of rainfall in the country with annual average rainfall of 2800–3400 mm (Thua Thien Hue meteorological station, 2013).

Hot and dry westerly wind is one special climate pattern representing the climate condition in central of Vietnam with high temperature, low humidity and wind of the West direction. The highest temperature can reach to 40^{o}C – 42^{o}C with humidity under 60%. There are average 35 days with hot and dry climate in the province and 55 days in Nam Dong district in the plain from March to August, at most in July (12 days). There are cases in which hot and dry Westerly lasts more than one month leading to severe drought (Thua Thien Hue meteorological station, 2013).

4.1.4 Land Use and Cover

The total land area of the province and Nam Dong district are 505,399 ha, and 64,777.8 ha respectively. The mainland is classified into four major categories of land utilization (Table 4.1).

Table 4.1 Land types in Nam Dong district, 2012

Land use / land cover	Area (ha)	Ratio (%)
Agricultural land	4,870.80	7.52
Annual crop	*4,810.40*	*7.43*
Aquaculture	*55.5*	*0.09*
Other	*4.9*	*0.01*
Forest land	54,568.70	84.24
Non-agricultural land	2,145.30	3.31
Residence	*904.5*	*1.40*
Special use	*481.6*	*0.74*
Streams	*758.2*	*1.17*
Other	*1*	*0.00*
Unused land	3,193	4.93
TOTAL	**64,777**	**100**

Source: Nam Dong Statistical Office, 2013

The largest proportion was forestry at 84.24% and follow by agricultural land with 7.52%, and the lowest percentage was non-agricultural land. Annual crop area accounted for 7.43% in total land area, meaning that agricultural production was decisive role in district productions.

4.2 Social Economic Characteristics

4.2.1 Social Characteristics

Table 4.2 illustrates general information of Nam Dong district in year 2012. Nam Dong is the largest in Thua Thien Hue province, but with only 5,738 households. According to district statistic office in 2012, the total population was approximately 24, 815 people, including ethnic minorities, such as Ta Oi Katu, Koh Pa, Ta Hy Pru-Van Kieu that accounted for nearly 50% and the rest was Kinh Vietnamese. The population density was relatively low about 38 households living per square kilometer, and it was considered as the poorest district with an average income of 572 USD per capita per year, and with the poverty ration of 13 percent (Nam Dong socio-economic annual report, 2012).

Table 4.2 General profile of Nam Dong district, 2012

Criteria	**Unit**	**Total**
Number of households	Household	5.738
Population	People	24.815
Ethnic population	People	11.044
Density	People/km^2	37.98
Average income per capital	USD	572
Poor household	%	13
Number of labor	People	13.553

Source: Nam Dong Statistic Office, 2012.

Figure 4.2 gives information on distribution of working age population in different sectors in the 2008 and 2012. The working age in Nam Dong district was divided into four sectors as agriculture, aquaculture, industry and construction. It is clear that agricultural sector attracted the highest number of labor with increasing trend from 2008 to 2012 at 62.77% to 64.31% respectively, due to the development of new crops (rubber and acacia) in the district.

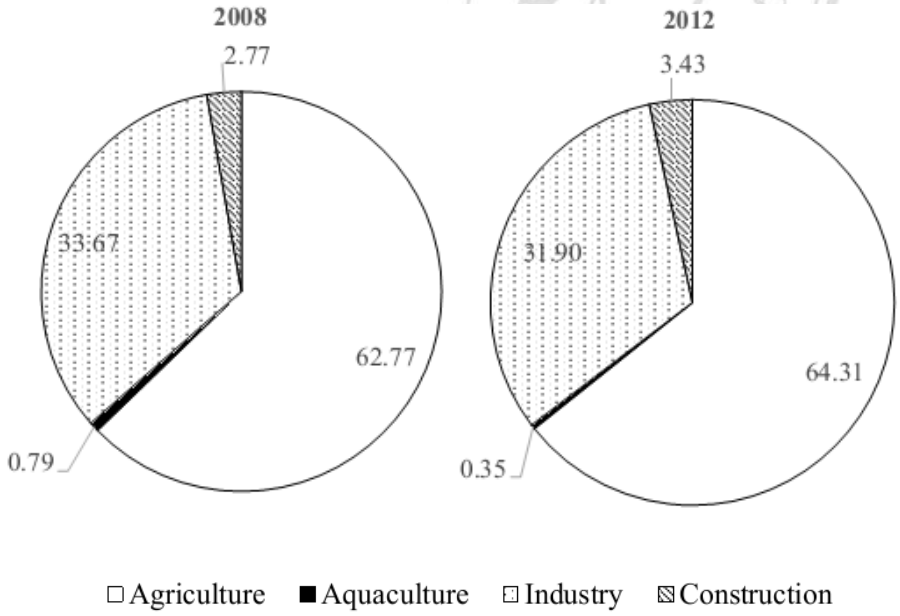

Figure 4.2 Labor structure in district economic sectors

Source: Nam Dong Statistical Office, 2012

While the lowest percentage of labor is in aquaculture sector which is less than 1% and lower than previous year because the difficulty in farming conditions as lacking regular

water resource, feed, etc. The Figure 4.2 also points out that percentage of employees in industry sector decreased slightly from 33.67% in 2008 to 31.90% in 2012.

Facility condition is one of the criteria to evaluate the level of economic development and social welfare of the district. Nam Dong district consists of 11 communes and each commune is composed of number of villages. Table 4.3 shows the district infrastructure condition in 2012. It shows facility conditions of Nam Dong district such as electricity using, loudspeaker, television, radio, irrigation system and concrete road was improved year by year. Since this is mountainous area, so that ratio of households using electricity has not yet reached 100% (only 99.74%) up to 2012. In addition, in 2012, there was only 18% of household used cleaning water and most of households were just using safety water (99.8%), while small ratio of households still had to use water directly from streams.

Table 4.3 also shows each commune in district were equipped with a loudspeaker to broadcast announcement to farmers as seasonal calendars, warning of natural disasters, diseases outbreak warning, SWFs, etc. However, due to the sparse population density, the loudspeaker system could reach only low number of listeners. Moreover, number of households having television reached 93.4% in 2012, which was the main source to access information, and entertainment in this mountainous district.

Table 4.3 District infrastructure condition of Nam Dong district, 2012

Criteria	**Unit**	**2010**	**2011**	**2012**
No. of communes	Commune	11	11	11
Ratio of household using electricity	%	99.6	99.7	99.74
Ratio of household using hygienic water	%	99.8	99.8	99.8
Ratio of household using fresh water	%	-	-	18
No. of commune have loudspeaker	Commune	9	11	11
Ratio of household has television	%	90	91.7	93.4
Ratio of household has radio	%	11.9	11.1	10.3
No. of Km irrigation system	Km	55.8	55.8	50.3
No. of Km local road	Km	71.5	71.5	73.2

Source: Nam Dong Statistical Office, 2012.

Only 50.3 kilometers of concrete irrigation canal have been built across the district. This irrigation cannel mostly focused on the areas that were usually dry, lacking of water in cropping seasons. In comparison with period years, the total kilometer of irrigation canal was lower than 0.5 km due to the landslide and flash flood occurred in 2012. The stream is the main source of water of this irrigation canal system. The volume entirely depends on weather conditions, so when streams dried up, the drought happened. This is one of the main constraints and risks for agricultural production in the district.

4.2.2 Economic Characteristics

Figure 4.3 presents the production value of different economic sectors in Nam Dong district up to year 2012. It reveals that agriculture and industry were the major contributors to the economic value of the district during 2008-2012, in which the value of agricultural production increased annually from 33.72% in 2008 to 44.95% in 2012 due to the development of new economic crops policy (rubber and acacia) that introduced to the farmers. The contribution of industry value had decreasing trend in district annual income structure from 41.53% (2008) to 38.28% (2012). In addition, the contribution of the services sector in the annual total production value also reduced from 25.04% (2009) to 16.75%.

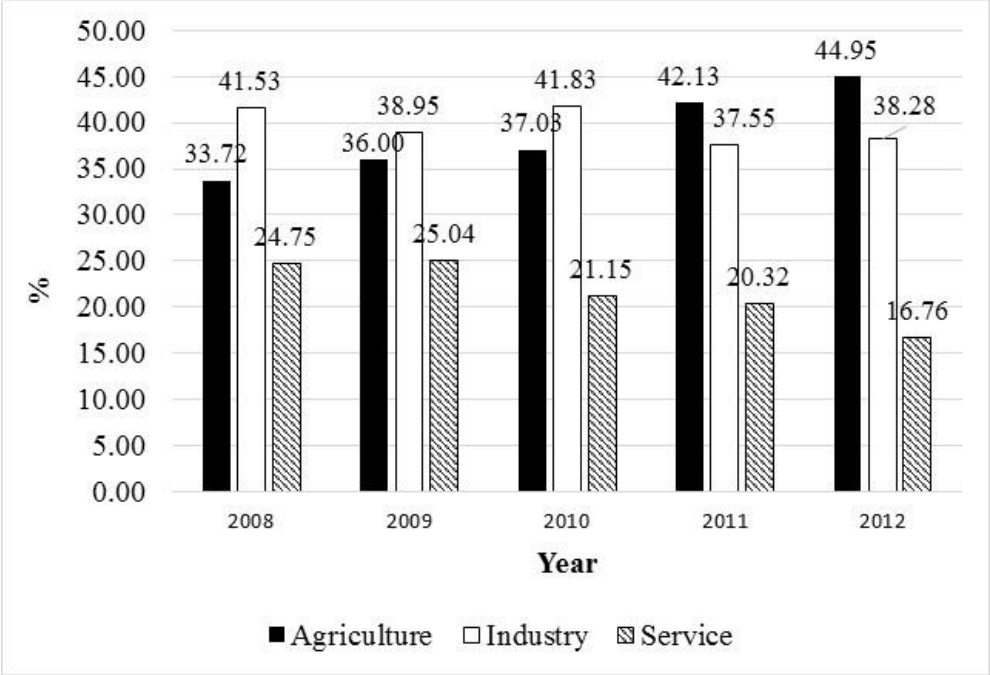

Figure 4.3 Production value of different economic sectors

Source: Nam Dong Statistical Office, 2012.

The downward trend in industry and service production value by years was determined by poor infrastructure and complex climate condition that constrained the development of factories, commercial activities, and tourism services (Nam Dong socio-economic annual report, 2012)

4.3 Agricultural Production Structure

4.3.1 Annual Production Value of Agricultural Sector

The structure of production value in agricultural sector in Nam Dong district from 2008 to 2012 is shown in Figure 4.4. The line chart indicates that contribution from crop through years accounted for the highest percentage and had increasing trend, except in the year 2009. Besides, the production value from forestry also developed gradually from 14, 39% to 23, and 30% which was resulted from the land forest allocation policies implemented in the district.

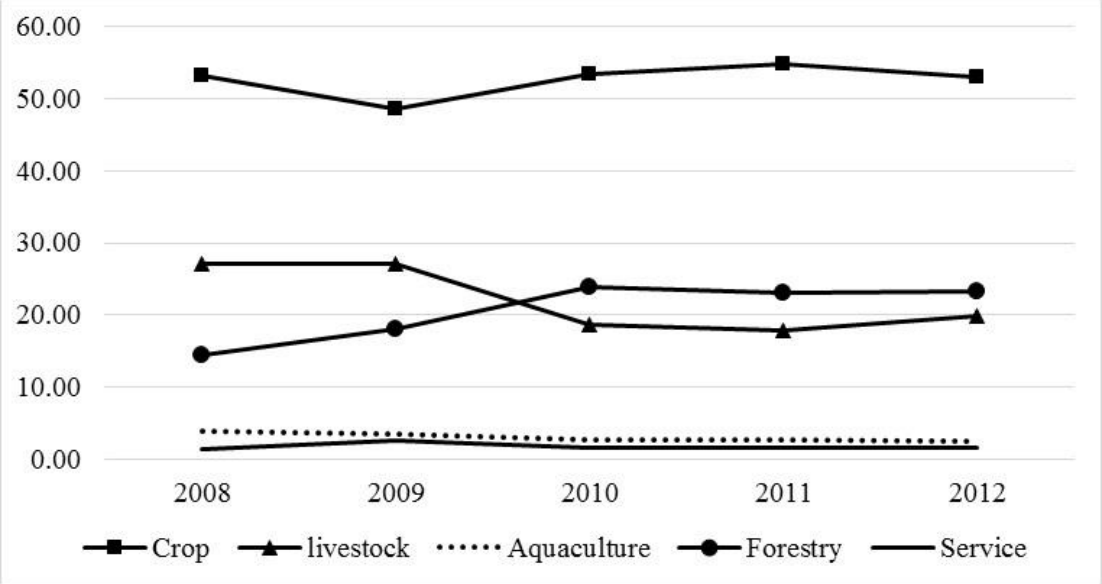

Figure 4.4 Production value of agricultural sectors

Source: Nam Dong Statistical Office, 2013.

In contrast, the proportion of the livestock production value to agricultural sector reduced strongly from 27.1% (2008) to 19.85% (2012) because farmers less invested in raising and poor climatic conditions leaded to lack of natural food for livestock. During 5 years period, the contribution of aquaculture in total agricultural production value kept

at the low proportion under 4%, while the value of agricultural service was the lowest at less than 2% every year.

4.3.2 Cropping Pattern and Area

The cropping pattern and its area of Nam Dong district from 2008 to 2012 can be classified into two categories as annual crops and perennial crops that is presented in Table 4.4.

Table 4.4 Area under Annual and Perennial Crop

Unit: Ha

Criteria	**2008**	**2010**	**2012**
Annual crop	***2,568***	***2,238***	***2,547***
Food crop	*953*	*904*	*961*
+ Rice	768	740	742
+ Maize	185	164	219
Root crop	*1229*	*984*	*1224*
+ Cassava	1002	747	1001
+ Batata	156	171	161
+ Others	71	66	62
Vegetable	*292*	*295*	*319*
Annual industrial crops	*72*	*33*	*22*
+ Peanut	42	20	2
+ Sugar cane	30	13	20
Other annual crop	*22*	*22*	*22*
Perennial crops	***4,198***	***4,345***	***4,256***
Perennial industrial crops	3450	3578	3568
Fruit tree	500	519	485
Others	248	248	203
TOTAL	**6,766**	**6,582**	**6,803**

Source: Nam Dong Statistical Office, 2012

On overall, annual crop areas were quite stable during five years, at the same time, perennial crop areas had a very little change from 4,198 to 4,256 ha, particularly in the

industrial crop areas due to the expansion of rubber and acacia area. Among the annual crops, the largest area was root crops and followed by food crop area, in which rice was the major food crop of the district at about 80.1%. Cassava was suitable for growing in the poor soil conditions, which accounted for about 82% of the total area of root crops in year 2012. In addition, vegetables and short-term industrial crop occupied the smallest area since poor soil quality and complex climate condition.

Table 4.4 also shows that there was a significant decline in the area of annual crops in 2010 compared with the previous year at 330 ha. This was explained by droughts that caused many planted areas fallowed due to lack of water. Besides, part of the annual cropland was converted to perennial crop growing (rubber, acacia). However, in 2012 recorded a slight decreasing in the perennial crop area with 87 ha as the influence of typhoon made rubber and acacia fell down.

4.4 Rice Production in Nam Dong District

4.4.1 Rice area distribution over 20 years in Nam Dong district

Vietnam generally and Thua Thien Hue in particular, rice is the most important food staple. Rice farming emerged at the same time the people settled this area. Most of the dwellers here were ethnic minorities, in which rice plays a significant role for their essential food supply (Local leader in-depth interview).

There are two seasons of paddy rice including winter-spring and summer – autumn season. For winter - spring crop, planting time is in December and harvesting time is in May of the next year. For summer - autumn, the planting time is in May and harvesting time is in September. Farmers planted the same patch of lands in two seasons excepting some areas only cultivated in winter-spring season and fallowed in later season since no water for irrigation.

Figure 4.5 displays the distribution of rice area into two seasons in Nam Dong district over 20 years. This data was recorded by district statistic office in period 1993 to 2012. The Figure 4.5 shows that there was a fluctuation in area of both two seasons over 20 years particular in first 10 years of period. In 1995 experienced a sudden drop in the summer-autumn rice area from 416 ha to 274 ha in comparison with 1993, after that it

increased slightly and returned to its original area at 416 ha and kept a slightly rise at under 400 ha in the years later. In contrast, the winter-spring rice area dropped to the lowest point in 1997 and then had rising steeply to peak the highest number in 2007 with 388ha, then it stayed less than 38 ha per year in the following years.

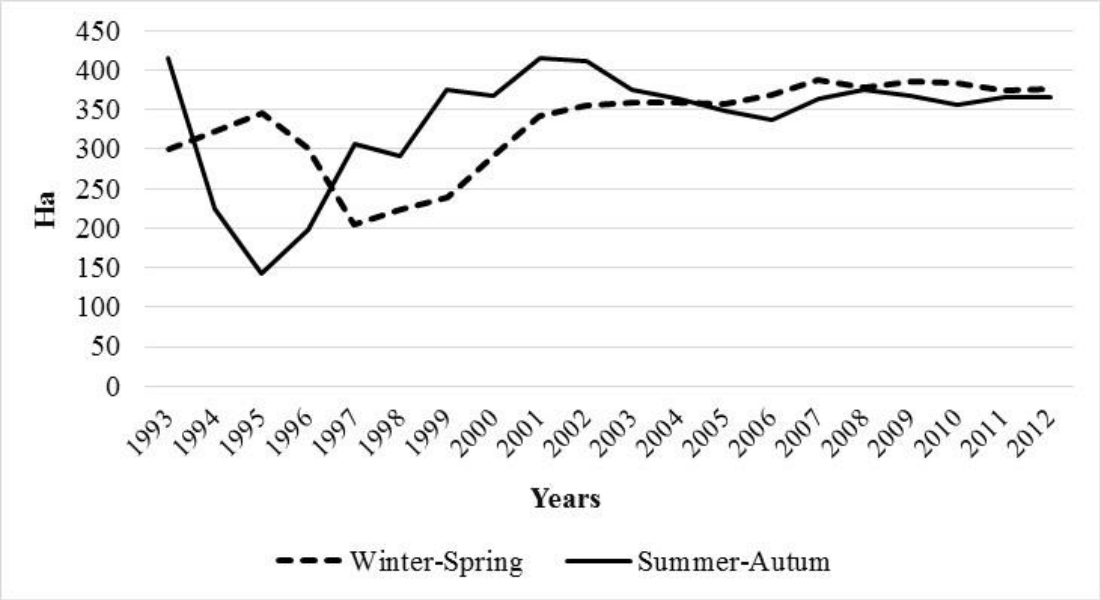

Figure 4.5 Rice area distribution over 20 year in Nam Dong district

Source: Nam Dong Statistical Office, 2012

The fluctuation of rice area in Nam Dong district was assumed due to the impact of agricultural land policies. From 1993 to 2003, there were many agricultural policies issued, especially Vietnamese agricultural land law (1993) and additional revision land law (1998 and 2001), regrouping of lands policy (1998 and 1999), (1998), newest land law (2003), land allocation, etc. Moreover, because most of the rice field (67% of total area) was cultivated under rainfed area, so the total land area of each season was different by years (District agricultural officer in-depth interview, 2013).

4.4.2 Rice Production Practices in Nam Dong District

The Table 4.5 shows the seasonal calendar of paddy rice in Nam Dong district that farmers applied into winter-spring and summer-autumn crop. These tables are the result of focus group discussion with 13 rice farmers, extension officers and local leaders. Activities and the time for these activities were discussed based on their production experience and production calendar of extension and agricultural office.

Production seasonal calendar is a production plan over time of a plant or animal. This calendar provides a detail guide of production from preparation, pest and disease management to harvesting in order to achieve the highest yield and avoid the natural disasters risks. Production seasonal calendar is based on the growth and development length of crop or animal and climate conditions during that season. It is usually send to farmers before starting crop season. Extension and agricultural officers are responsible people to construction and give guide of production seasonal calendar to farmers

Table 4.5 Paddy rice seasonal calendar

Climate condition	*- Low temp.* *-Lest rainfall*	*- High temp.* *- Drought*					**Aug**	*- Rainy season* *- Storm and flood*			*Low temp .*
Activities	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**	**Sep**	**Nov**	**Oct**	**Dec**
Soil preparation												
Seedling												
Transplanting												
Herbicides application												
Fertilizers application												
Pesticide application												
Irrigation application												
Harvesting												

Note: ◆—◆ *Winter - spring;* ▬ *Summer - autumn*

Source: Farmer focus group, 2013

According to Tables 4.5, paddy rice was cultivated from December to the middle of next September. From September to December is rainy season, so it is leisure after harvest time. Rice seasonal calendar was sent to farmers before starting new season by agricultural and extension officers. Normally, this calendar was discussed in village meetings, and then it was broadcasted to whole communities via loudspeaker system.

Rice production activities in Nam Dong district are described in several aspects that include land preparation, varieties, seed treatment, seeding and planting, weeding, pest management, water management, harvest and post-harvest operation as following:

1) Land preparation

The farmers will plow the land to suppress weed and pests, and then apply manure and chemical fertilizer into the soil. In summer-autumn season, farmers prepare the land immediately after harvesting to start right away new crop, but farmers often prepare land 1 month in advance for winter-spring crop. In Nam Dong district, land preparation was done either by using machine or manual labor that depends on purchase afford of household. In winter-spring rice season, farmers preferred prepare land by manual labor, but summer-autumn used machine.

2) Rice varieties

Rice varieties applied in this area are different between two seasons in accordance with the season length and climate condition. In Nam Dong district, the rice varieties and their calendars are presented in Table 4.6 and Table 4.7.

In winter-spring crop, the main seeds are X21, Xi23, PC6 and Khang dan that took account with 90% of total area because they are drought and cold tolerant varieties. The remaining area was DV108 and PC6 (10%). Whereas, PC6, DV8 were the key seeds of summer-autumn crop at 90%, and Khang Dan accounted for 10%.

The seed variety selection depends on their growth duration and the climate condition in each season, so farmers need to decide which varieties would be used for next crop. Table 4.7 points out that PC6, DV108 were short day varieties (90-95 days), so farmers prioritized to apply for summer-autumn crop (short day season) because it needs to be harvested before rainy season coming in September to avoid damage such as storm, flood, cyclone. However, Khang Dan, DV108, PC6 were widely used for two seasons as they are drought resistance varieties

The rice varieties as X21, Xi23, PC6, DV108 are obtained from government, while Khang Dan is stored by farmer from period season.

Table 4.6 Winter-spring rice varieties and their calendars

Variety	Growth duration (day)	Winter-spring			Flowering date	Harvesting date
		Seedling	Sowing	Transplanting		
- X21 - Xi23	145-155	10-20/12	20/12-5/1	10-25/1	10-25/4	10-25/5
Khang dan	115-125	10-20/1	20/1-5/2	5 - 15/2	10-25/4	10-25/5
PC6 DV108	90-95	15-20/1	25/1-5/2	5 - 15/2	10-25/4	10-25/5

Source: Nam Dong District Agricultural Office, 2013

Table 4.7 Summer-autumn rice varieties and their calendars

Variety	Growth duration (day)	Summer-autumn			Flowing date	Harvesting date
		Seedling	Sowing	Transplanting		
Khang dan, DV108	115 - 125	5-20/5	10-25/5	25/5 - 10/6	5/8-15/8	5 -15/ 9
PC6	90 - 95	15 - 25/5	20-30/5	5 - 15/6	5/8-15/8	5 - 15/9

Source: Nam Dong District Agricultural Office, 2013

3) Seed treatment

This step aims to create good condition to speed up paddy seed sprout before sowing on the field. This is a very important step for the following rice development stages, especially in winter-spring season when outside temperature in rice sowing time is usually low.

The seed treatment goes by two stages: seed and incubating. The duration of these practices rely on climate condition. If it is cold weather, farmers soak rice seeds in warm water for 2 days and 3 nights for seeds absorbing enough water for germination. Then, seeds will be kept warm in next two days to promote development and growth. If the weather is warm, they use normal water and the time for soaking and brewing is shorter.

4) Planting

In Nam Dong province, farmers conducted planting in two forms including sowing and transplanting which depend on soil and irrigation condition of each paddy field. As experience of farmers, areas located high position with no irrigation, sowing method often applies. However, for the fields close to stream or irrigation system and soft soil, farmers would apply transplanting.

5) Weeding

Normally, weeding was done after seeding one to three days by spraying herbicide if there was no rain. If rain happened, farmers would spray herbicide after sowing from seven to ten days with special kind herbicide. Weeding was also done manually which would allow rice to absorb fertilize more efficiently and enhance developing of the root system.

6) Pest management

In the time of rice growth, there were many diseases and pests outbreak such as rice blast disease, sheath blight, stem borer, etc. In Nam Dong district, agricultural and extension officers had responsibility for looking after field in order to detect, forecast and inform farmers when diseases or pests occurred or might occur, and to recommend appropriate pesticide to this farmers. Nowadays, most of mountainous farmers follow the instruction and advisory of the extension officers. However, it still had some farmers who applied pesticide based on their experience even if there was no advisory from agricultural and extension staffs. Farmers also depended on SWFs to predict the probability of pest or disease occurrence to plan the applying solution. For example, they reduced the seed rate in sowing would help to decrease pest and disease in growing season.

7) Water management

Water management is also an important practice in rice production. Since this is rainfed area, farmers used water for their rice field mostly from irrigation system which water source is taken from small dams along streams. Water application depends on rice development stages. For example, farmer often stop irrigated for one week after seeding to dry the land for suppressing sprout weeds. Irrigation management also applied in case

of disease management in disadvantage climate cases. For example, when the paddy field got sheath blight disease, farmers had to withdraw water out and dry field in some day to kill the disease.

8) Harvest and post- harvest

Rice was harvested depending on the rice variety and seasonal calendar as well as weather status. After harvesting, the threshing process was completed. Currently, most of farmers still use their own traditional threshing method, but in rainy weather, they needed to hire modern threshing machines. Grains then were dried in house yards and stored in bamboo barrels, tanks, or bags for household consumption.

4.5 Information of the Sample Households

4.5.1 Characteristic of the Sampled Households

The questionnaire survey was conducted with 180 households in the Nam Dong district. All information about sampled households is presented in table 4.8. The respondents were 117 men and 63 women; most of them (about 70%) were between 31 and 60 years old. However, the education of most of sample households was low at primary school around 50% and 25% for secondary level, while 12.78% was no education. The percentage of higher education level took at low number at nearly 13% for high school, in particular there was no one educated at university. These characteristics are due to this is mountain area and about 51% were of minority groups.

Rice production was the traditional crop of Nam Dong district, so when children were round 10 years old, they went to farm to help their family. Therefore, most of farmers had experience in rice with more than 10 years, took account for 96.11%, while only 3.89% respondent was lower 10 years in rice cultivation.

The Table 4.8 indicates that all households had income from crop, while other additional income as livestock and forestry also were important activities of around 50% sample households. Moreover, 55% household had income from non-agriculture sources such as hired labor, mansion, business, and pension.

Table 4.8 Characteristic of the sampled households

Items	Classify	Sample amounts	Percentage (%)
Gender (people)	Male	117	65.00
	Female	63	35.00
Age (years)	>18	0	0.00
	18-30	28	15.56
	31-60	126	70.00
	>60	26	14.44
Education (years)	No	23	12.78
	Primary	89	49.44
	Secondary	45	25.00
	High school	23	12.78
	University	0	0.00
Ethnicity	Kinh	81	45.00
	Minority	91	50.56
Rice production experience (years)	<10	7	3.89
	>10	173	96.11
Income sources	Crop	180	100.00
	Livestock	88	48.89
	Forestry	90	50.00
	Non-Agriculture	99	55.00

Source: Households survey, 2013.

4.5.2 Rice Production Status of Sampled Household

Table 4.9 provides information about rice area and fallow status of sample households. The average rice area per household in this district was low 0.346 ha, in which the lowest area was about 0.1 ha and the highest area was 0.78 ha with standard deviation was 0.168. Due to the major mountainous landscape of the district, the farmers could only do rice cultivation in areas that is near or along streams to have water source for irrigation, so that paddy land area per household was relatively low.

Table 4.9 Rice area and fallow of sampled households

Criteria	N	Mean	min	max	SD
Rice area (ha)	180	0.346	0.1	0.87	0.168
Rice fallow area year (ha)	106	0.029	0.01	0.1	0.014

Source: Households survey, 2013.

Irrigation play significant role in rice production in general and in particular for places where the farmers have to rely on climate condition for agricultural production as does the Nam Dong district. Table 4.10 exhibits the irrigation system and land characteristic of household samples. It indicates that 51.11% of the interviewed households had non-irrigation in rice areas and the rest of households had rice field located nearby canals or streams (48.89%). According to the rice farmers, non-irrigated rice areas are located on high position plots and far from streams and cannels, so it is difficult to take water to these areas. Therefore, farmers often cultivated on winter-spring season and left fallow (58.89% of household) in the summer-autumn season because dry weather usually occurred in this season (June to July) which leads to lack of water for rice planting and growing. Table 4.9 pointed out there were 0.029 ha in average abandoned in summer-autumn season, in which the lowest average area and largest average area were 0.01 ha and 0.1 ha respectively with standard deviation at 0.014.

Table 4.10 Irrigation and rice land characteristic of sampled households

Items	Classification	N	Percentage
Irrigation	Yes	88	48.89
	No	92	51.11
Fallow area	Yes	74	41.11
	no	106	58.89
Landslide	No	66	36.67
	Mild	44	24.44
	Moderate	39	21.67
	Severe	31	17.22

Source: Household survey, 2013.

In addition, landslides were also problem that happened in this district caused by storms and flooding every year. Table 4.10 shows that 63.3% of the rice households were

affected by landslides caused by storms and floods. According to household survey information, landslides were divided into 3 levels as mild, moderate and sever at 24.44%, 21.67% and 17.22%, respectively. Farmers explained that due to rice field places on slope terrain and closes to streams, landslide often happened during the rainy season. That is why some rice areas were lost and irrigation canals were damaged.

4.6 Seasonal Weather Forecasts System Status

In regards to organization, hydro-meteorological forecast system with forecasting task is divided into 3 levels as presented in Figure 4.6.

The Central level: The national hydro-meteorological center is an operational unit under the national hydro-meteorological service, Ministry of Natural Resource and Environment. Its function is to carry out the hydro-meteorological forecasting and implement the specialized hydro-meteorological telecommunication networks for the whole country and related areas with the aim to meet all the requirements for the disaster prevention and preparedness.

The Regional level: There are nine regional hydro-meteorological centers that were settled in order to provide forecast service at regional scale, including northwest, mid north, northeast, red river delta, north central, mid central, south central, central highland, south.

The Provincial level: there are 54 provincial hydro-meteorological forecasting centers to deliver weather forecast information at provincial scale.

Regarding to data collection and processing for SWF operation, there are several hydro-meteorological stations set up in each province to monitor, record raw data and send back data to the province center. All observed data (from stations and provinces level) are transmitted to regional hydro-meteorological centers by telephone or computer networks. Data is then transferred to national center for hydro-meteorological forecasting by computer networks. In the national center, data was encoded, processed, and organized to make a database for the forecast services and uploaded to the website networks to serve hydro-meteorological agencies and related agencies (Ministry of Agriculture and Rural

Development, Central Committee for Flood and Storm Control, Ministry of Resource and Environment, etc.).

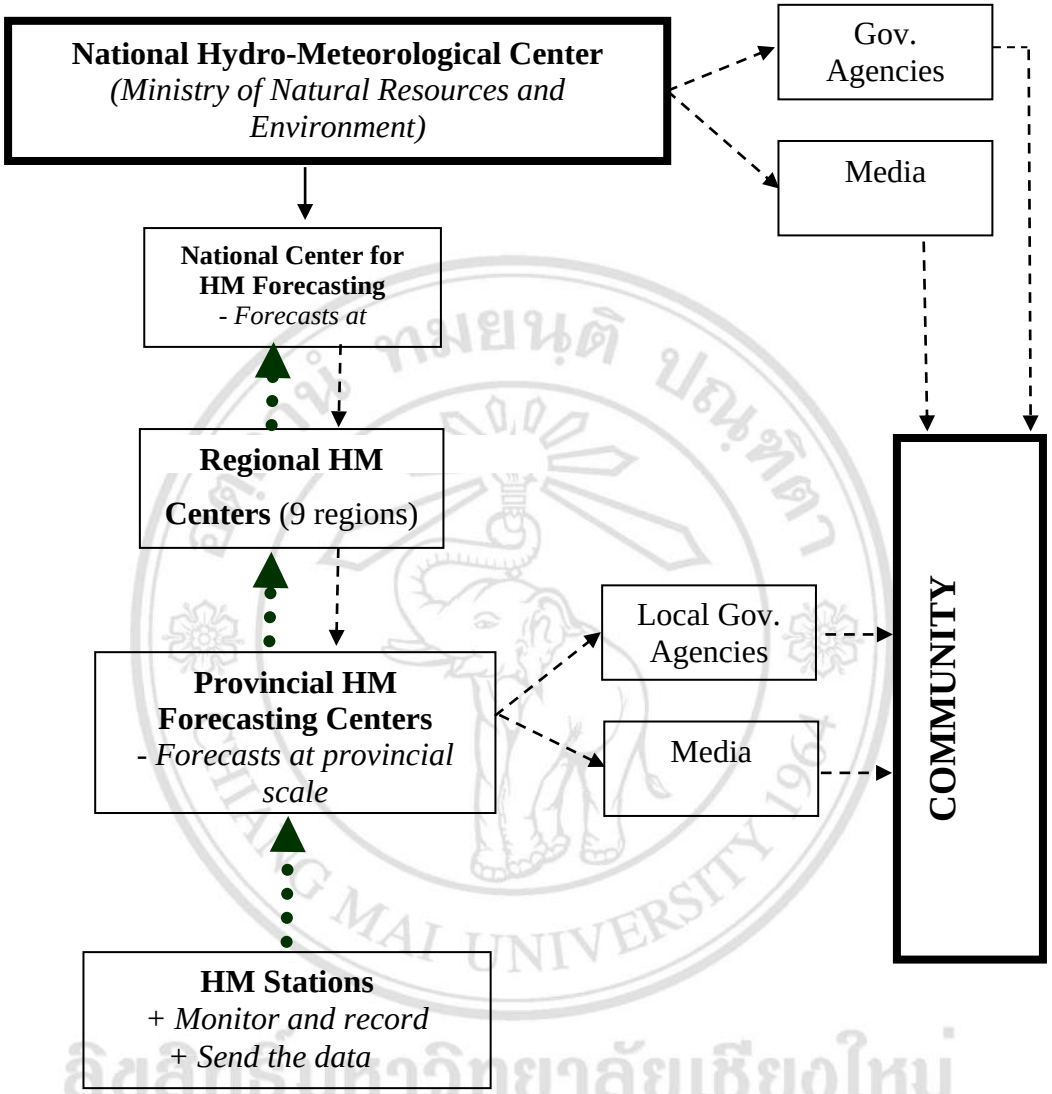

Figure 4.6 Weather forecast system in Vietnam

Source: TTH Hydro-Meteorological Office in-depth interview, 2013

At the provincial level, after climate forecasts database from National Hydro-meteorological center was sent back to provincial hydro-meteorological centers, it was adjusted based on the data from provincial stations and local condition. Then, forecasts data was finalized and distributed to users by two ways: related agencies (Provincial

People's Committee, Department of Agriculture and Rural Development, Provincial Committee for Flood and Storm Control, Reservoirs stations, Hydro plants, etc.), mass and electric media.

The climate forecast data is divided in two types before delivering to user, which are:

Short-term forecast that is issued daily such as temperature, precipitation, relative humidity, wind speed and cloud thickness, tropical cyclone monsoon forecasts, short-term hydrological forecast.

Long-term forecasts include five-daily, monthly and seasonal weather. These are delivered as seasonal hydro-meteorological forecasting bulletins that have been supplied periodically one time per five days, one time per month in all year. Temperature, rainfall, storm, flood, water level, discharge, and possibility of drought and lack of water are major forecasting.