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Linkage between Farm and Non-farm Sectors and its Impact on Agricultural Production: Evidence from Vietnam

(農業と非農業セクター間の連関とその農業生産へのインパクト：ベトナムに
おける実証)

By

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Abstract

The non-farm sector of developing countries has gradually been expanding and is considered to play a progressively important role in household income. In Vietnam, the renovation policy—the *Doi Moi* policy—since 1986 has changed the rural economy and brought development to the non-farm sector of rural areas. The first years of the 21st century until now witnessed especially strong development in the non-farm sector in Vietnam's rural areas. The proportion of rural non-agricultural households increased dramatically from 28.9% in 2006 to 46.2% in 2016. There are several causes and conditions for the growth of rural non-farm sector in the post-renovation period until recent years in Vietnam. Firstly, the open market of Vietnam's economy after reform and the establishment and development of the labor market has created opportunities for rural labors easier in participation in off-farm activities. Secondly, the transformation of the rural economy is also one of the important background factors for creating non-farm job opportunities for rural labors.

With this transformation, what has been the impact of the non-farm sector on agricultural production? In a developing country like Vietnam, where the agricultural sector still plays a central role in rural development, and the credit and labor markets are often inadequate or imperfect, the relationship between farm and non-farm sectors remains an issue of concern. This study investigated how the non-farm sector affects agricultural production in the context of imperfect markets and the development of Vietnam's rural economy. The objectives of this study were: (1) to examine the relationship between farms' household participation in non-farm activities and input expenditures in agricultural production activities; and (2) to estimate the effect of the non-farm sector on agricultural output and performance—in particular, on agricultural value-added and production efficiency.

This study used data from the Vietnam Household Living Standard Surveys 2012 (VHLSS 2012). The study focuses on the rural farm households that participate in agriculture, forestry, and aquaculture activities. The study aggregates the three primary sectors (agriculture, forestry, and aquaculture) to evaluate the effect of non-farm employment on all farm activities, not only on a specific sector. The commune survey collects the socio-economic characteristics of the communes, which can be used as instrumental variables (IVs) in the estimation.

This study examined the effect of non-farm income on agricultural input expenditures in Vietnam—in particular, expenses for purchased inputs (such as seeds, fertilizer, breeding, feed, herbicides, and pesticides), hired machines, and hired labor. We applied the Instrumental Variables (IV) Tobit approach to produce a consistent estimation of non-negative agricultural input expenditure equations. The results confirmed a significant and positive effect of non-farm

activities on agricultural expenses in Vietnam. The results of the average partial effect of non-farm income on agricultural inputs expenses indicated that an additional Vietnamese dong (VND) in non-farm income leads to a 0.412 VND increase in agricultural input spending. However, the findings showed that farm households did not use the non-farm income for hiring machines and labor.

The other finding also indicates that the effect of this source of income on agricultural expenses differs across the regions. The developed regions (as Red River Delta and Southeastern Area) seem not to use the non-farm income into the agricultural activity because the non-farm income may be sufficient to guarantee for consumption of farm household. The less developed regions (including Midland and Northern Mountainous, Northern and Central Coast, and Mekong River Delta) tended to use the non-farm income to invest and purchase for the agricultural production.

In the second objective, the hypothesis is tested whether non-farm sector affects the agricultural value-added and production efficiency in Vietnamese agricultural sector. For methodology used in present study, the production function and stochastic frontier production analysis were applied to determine the impact. The instrumental variables method was also applied to address the endogeneity problem of non-farm variables. The estimation results indicated that the non-farm sector had a positive effect on both the agricultural value added and production efficiency. The results meant that a 1 million VND increase in non-farm income enhanced the agricultural value added by 0.23%, or approximately 0.08 million VND, on average, and the inefficiency level decreased by 0.13%. The participation of the household head or spouse in non-farm jobs increased the agricultural value added by 44.1%, or about 16.22 million VND, and led to a reduction in the inefficiency level by 18.9%.

Moreover, the present study also presents the distribution of technical efficiency level of farm households and the frequency of technical efficiency by regions. The mean of technical efficiency level of households is quite low by only 59.2%. There is about 79% of farm households had a technical efficiency level lower than 70%. There are slight differences in technical efficiency level of farm households between all regions. The study observed that the regions with high non-farm income have a higher efficiency level than the lower ones. This result implies a positive relation between non-farm income and technical efficiency level.

The study contributes to the literature on the relationship between the farm and non-farm sectors in Vietnam. The non-farm sector supports agricultural production through a positive impact on agricultural expenditures; this income source can provide cash for farmers to invest in farm production. Thus, non-farm income can help farmers loosen credit constraints. The positive effect of non-farm activities on agricultural value added and technical efficiency indicates that the

use of these earnings for investment in agricultural production can enhance and increase agricultural output and production efficiency. Therefore, to develop the rural economy, policies targeting farm households should consider the non-farm sector, especially policies that support the diversification of income sources of farm households to link the agriculture and non-farm sectors.

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Chapter 1

Introduction

1.1. The non-farm sector in developing countries

The traditional picture of farm households in developing countries showed that they concentrated almost exclusively on agriculture or farm activity and undertake little non-farm activity (Reardon et al., 1998). Agriculture sector was also the core of economic growth in the past of developing countries. However, in recent years, non-farm sector is increasingly more widespread and become an important resource income for farm households. Non-farm earnings account for 35-50% of rural household income across the developing world from the 1990s and 2000s (Haggblade et al., 2010). In which, the proportion of non-farm income in household income is different among regions, continents and countries. Based on the construction of income aggregates from Rural Income Generating Activities (RIGA) Project¹, this section describes the composition of farm household income as well as the role of non-farm income in farm household in some countries from Africa, Asia, and Latin America.

Table 1.1 summarizes data on the composition of farm household income of some Africa countries. It indicates that some case studies point to a positive growth of non-farm income share in total household income over time in a number of countries such as Uganda, Tanzania, Nigeria, Madagascar, and Ghana. The non-farm income share accounts for from over 30% to 62% in total household income (except Ethiopia), in which some of the countries have this figure over 50% such as Kenya (54.53%), Ghana (93.3%), Niger (54.33%), and Tanzania (62.18%). Almost Africa countries are low-income countries, the main source income relies on the income from the agricultural activity. Following the economic development trend, the non-farm income seems to play a significant role in the rural household income in Africa.

According to Choi (2004), the average share of non-farm income was 32% from 1970s to 1990s in Asia. From the 1990s to 2000s, this figure increased up to 51% in this area (Haggblade et al., 2010). The result of Rural Income Generating Activities survey of some Asia countries in Table 1.2 also indicates that the rural non-farm economy was widespread overtime. Similar with Africa countries, the income from non-farm activities occupied the highest proportion the total income of some Asian developing countries, except the countries with too low-income as Tajikistan.

¹ The RIGA Project is a collaboration between FAO, the World Bank and American University in Washington, D.C. Original data can be obtained from the World Bank's Living Standards Measurement Study by visiting the LSMS website at: <http://www.worldbank.org/lsm>.

Table 1.1: Composition of farm household income in Africa

Countries	Name of survey	Year	Share of total household income (%)				GDP Per capita, PPP 2011 USD*
			Farm Income	Non-farm Income	Agriculture wage	Transfer	
Uganda	Uganda National Panel Survey	2005	48	29	10	13	1,223
		2010	49.1	33.38	9.38	8.14	1,516
		2011	50.15	34.42	8.48	6.95	1,603
Tanzania	Tanzania National Panel Survey	2009	49	41	4	6	2,029
		2010/2011	65.2	30.05	2.24	2.51	2,186
		2012/2013	28.37	62.18	4.31	5.14	2,316
Niger	Niger National Survey on Household Living Conditions and Agriculture	2011	32.53	54.33	4.84	8.3	801
Nigeria	Nigeria Living Standards Survey	2004	61.42	36.38	1.25	0.95	4,116
		2013	56.73	42.36	0.82	0.09	5,479
Madagascar	Madagascar Enquête Permanente Auprès Des Ménages	1993	75.22	16.15	5.3	3.33	1,464
		2001	49.57	43.47	4.5	2.46	1,484
Malawi	Malawi Integrated Household Survey	2004	33.06	44.74	15.71	6.49	837
		2011	42.24	38.48	15.12	4.16	1,051
Kenya	Kenya Integrated Household Budget Survey	2005	13.94	54.53	8.18	23.35	2,224
Ghana	Ghana Living Standards Survey	1992	29.71	57.93	5.26	7.1	1,986
		1998	32.38	57.32	2.63	7.67	2,191
		2005	32	58	4	6	2,539
		2013	5.2	93.3	0.4	1.1	3,807
Ethiopia	Ethiopian Rural Socioeconomic Survey	2012	66	23	7	4	1,231
		2013/2014	67	24	5	4	1,425

Source: The statistics of Rural Income Generating Activities (RIGA) Project.

* World Bank database

Table 1.2 : Composition of farm household income in Asia

Countries	Name of survey	Year	Share of total household income (%)				GDP Per capita, PPP 2011 USD*
			Farm Income	Non-farm Income	Agriculture wage	Transfer	
Pakistan	Pakistan Integrated Household Survey	1991	65.4	31.01	2.12	1.47	3,121
		2001	32.4	48.49	6.51	12.6	3,487
Nepal	Nepal Living Standards Survey	1996	49.56	29.19	11.94	9.33	1,391
		2003	45.1	40.42	7.72	6.76	1,598
Bangladesh	Bangladesh Household Income Expenditure Survey	2000	13.93	56.05	13.09	16.93	1,642
		2005	20	58	11	11	1,930
Indonesia	Indonesia Family Life Survey	1993	36.32	49.06	2.66	11.96	5,331
		2000	17.4	60.17	9.33	13.1	5,806
Tajikistan	Tajikistan Living Standards Survey	2003	61.23	13.67	14.22	10.88	1,511

Source: The statistics of Rural Income Generating Activities (RIGA) Project.

* World Bank database

Table 1.3: Composition of farm household income in Latin America

Countries	Name of survey	Year	Share of total household income (%)				GDP Per capita, PPP 2011 USD*
			Farm Income	Non-farm Income	Agriculture wage	Transfer	
Bolivia	Bolivia Encuesta de Hogares	2005	22.41	64.2	5.39	8	4,695
Guatemala	Guatemala Living Conditions Survey	2000	13.96	51.43	19.78	14.83	6,071
		2006	9.36	59.22	17.26	14.16	6,458
Nicaragua	Nicaragua National Household Survey	1998	20.63	49.91	23.3	6.16	3,202
		2001	27.27	48.82	19.3	4.61	3,507
		2005	28.81	41.44	19.55	10.2	3,772
Ecuador	Ecuador Survey of Living Conditions	1995	30.65	47.24	19.35	2.76	7,726
		1998	8.34	83.22	7.53	0.91	7,964
Panama	Panama Living Conditions Survey	1997	17.92	61.44	11.66	8.98	9,846
		2003	3.86	70.32	15.17	10.65	10,749

Source: The statistics of Rural Income Generating Activities (RIGA) Project.

* World Bank database

The share of the composition of farm household income in some Latin America countries is presented in the Table 1.3. Almost those countries are the upper-income countries (except Nicaragua). The Table 1.3 shows that, in all cases, the share of non-farm income is highest in the total household income, occupies from around 40% to over 80%. It also indicates that, in cases of Ecuador and Panama, the proportion of non-farm income increased rapidly over time. In short, the non-farm sector is quite developed and the role of this income source is crucial of farm household in this region.

In general, economic transformation in developing countries shows that the rapid expansion of the rural non-farm economy becomes a major source of growth in household income, employment, and also economic growth. The essence of rural non-farm activity differs over regions. According to Reardon (1998), Africa and South Asia countries are the first stages of rural non-farm sector transformation. During this stage, the non-farm activity tends to be centered on the countryside or the rural and little linkage between rural and urban. Latin America region is in the second stage of the non-farm transformation. Non-farm activity in those countries tends to be a greater weight of rural-urban links than the first stage countries. In developing countries, the expansion of non-farm sector in the rural area also creates the linkage with farming activity. Therefore, the rural economy transformation tendency is one of an important step in the process of agricultural growth.

1.2. Background of the agricultural sector and the rural economy in Vietnam

1.2.1. The Vietnamese agricultural sector

By the mid-1980 (before *Doi Moi* policy or reform policy), the Vietnamese agricultural sector implemented the collective system, group of households formed production teams, which were responsible for meeting government quotas for agricultural production. The agricultural growth was slow and became negative by 1987.

Under the reform policy – *Doi Moi* policy in 1986, the collective agricultural system began to be dismantled, land-use rights were assigned to farmers, agricultural market liberalized. Vietnam's agricultural sector has made enormous progress since then. From being a net food importer before 1986, Vietnam has achieved explosive growth in agricultural exports to become one of biggest agricultural exporter in the world. The country now ranks among the top five global exporters in products as diverse as rice, shrimps, coffee, cashews, and pepper. Hence, Vietnam's agriculture has notched impressive achievements in term of agricultural yield, output, exports, and production efficiency after the reform.

Figure 1.1 show the economic growth rate and agricultural growth rate through 30 years from 1986-2016 in Vietnam. Growth is the process of increasing in size. The definition of

economic growth is the increases in gross domestic product (GDP) per capita or in income per capita as adequate measure of good results (Malizia, 1990). According to Perkins et al. (2013), economic growth is a rise in real national income per capita – that is, a rise in the inflation-adjusted, per person, value of goods and services produced by an economy. In a wider sense, economic growth involves the increase of GDP, GNP and NI ² (Haller, 2012). In Vietnam, economic growth is estimated the increase in GDP. Thus, agricultural growth is the increase of the value of agricultural products produced by a country or area.

As shown in the Figure 1.1, the Vietnam's economic growth has increased rapidly after the reform 1986 from 2.5% in 1987 up to 9.3% in 1996. However, because of the impact of financial crisis in 1998, the annual growth rate tends to decrease until 2000 and then increases steadily thereafter. After the reform, the agricultural growth peaked at 7.2% in 1992. The average agricultural growth rate was 4.6% per year during 1992-2000 (Figure 1). Thus, this implies that the growth of agricultural sector has been the foundation of the economic growth in Vietnam from the post-renovation period until recent years.

It is obvious that the agricultural value-added increased dramatically since *Doi Moi* policy in Vietnam (Figure 1.2). This figure was only 5,824 million US\$ in 1990 and up to 8,946 million US\$ in 2000 and 14,566 million US\$ in 2015. Although the agricultural value-added share in total GDP has been declining (Figure 1.2), the sector has always been the foundation for the development of industry and service sectors in Vietnam. Thus, as a result of rapid agricultural growth, Vietnam has shifted from a self-sufficient economy to one of a strong exporter of agricultural products.

² GDP is gross domestic product. GDP is the sum of the value of finished goods and services produced by a society during a given year, which counts all output produced within the borders of country, including output produced by resident foreigners, but excludes the value of production by citizens living abroad (Perkins et al., 2013).

GNP is gross national product. GNP is the sum of the value of finished goods and services produced by a society during a given year by citizens of the country, including the value of goods and services produced by citizens who live outside its borders (Perkins et al., 2013).

NI is national income. NI has the same concept with GNP (Perkins et al., 2013).

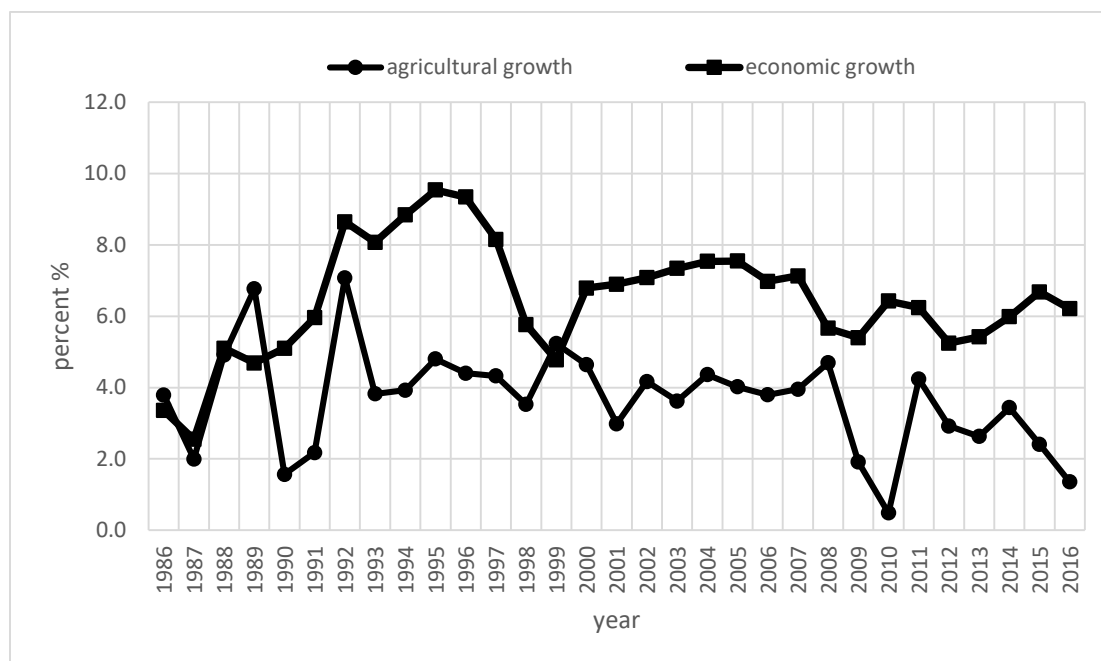


Figure 1.1: Economic growth rate and agricultural growth rate since the Reform in Vietnam

Source: Based on FAOSTAT data (at 2010 price).

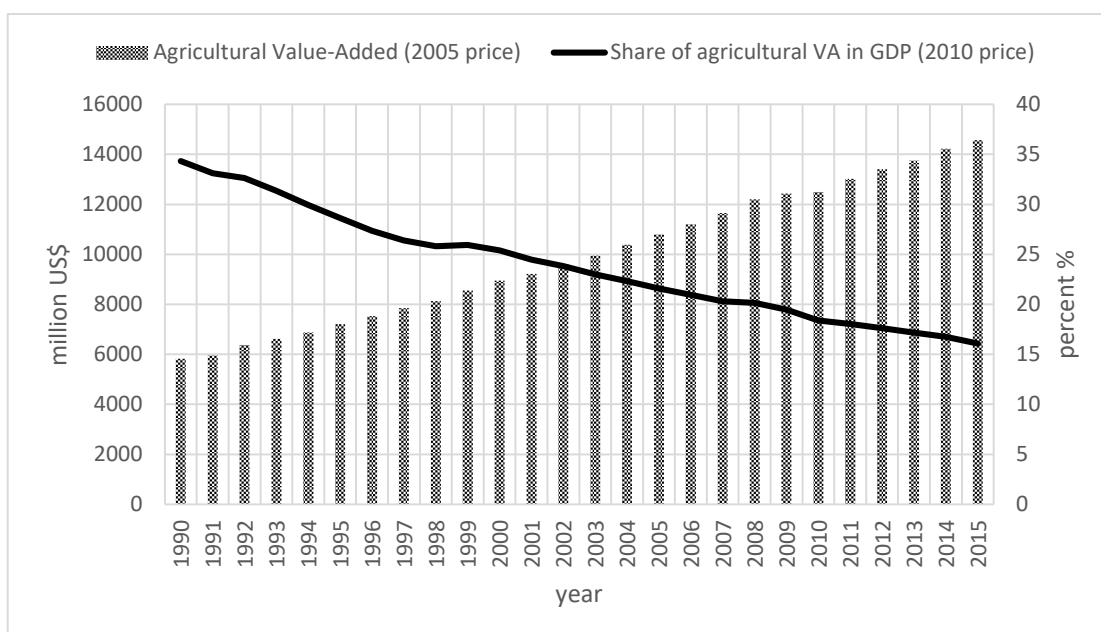


Figure 1.2: Agricultural Value-Added and its share in GDP after the reform in Vietnam

Source: Based on FAOSTAT data.

Table 1.4: Agricultural Value-Added per hectare in selected Asian countries, 1990-2016

Year	China	India	Indonesia	Philippines	Thailand	Vietnam
1990	538.8	911.7	1,330.1	1,363.1	935.3	1,477.4
1991	545.6	889.5	1,485.6	1,379.7	992.6	1,503.9
1992	567.9	944.9	1,585.3	1,390.3	1,043.8	1,547.5
1993	590.2	979.3	1,586.0	1,426.3	1,071.3	1,592.6
1994	608.4	1,028.9	1,596.6	1,470.0	1,149.4	1,642.8
1995	638.8	1,021.9	1,627.4	1,482.5	1,159.2	1,736.6
1996	671.3	1,122.3	1,678.9	1,526.6	1,240.8	1,670.7
1997	694.2	1,092.7	1,673.9	1,541.9	1,260.3	1,706.9
1998	718.0	1,161.2	1,638.5	1,450.0	1,293.8	1,720.8
1999	738.9	1,163.8	1,600.9	1,597.0	1,358.6	1,733.8
2000	758.2	1,157.6	1,586.1	1,651.2	1,464.3	1,738.4
2001	782.6	1,236.5	1,619.8	1,715.7	1,509.9	1,657.5
2002	807.4	1,145.3	1,658.9	1,780.4	1,522.5	1,731.7
2003	831.5	1,259.5	1,626.4	1,846.2	1,716.1	1,779.0
2004	883.3	1,260.9	1,598.3	1,887.3	1,697.0	1,807.6
2005	927.8	1,328.0	1,689.9	1,949.2	1,691.3	1,831.9
2006	980.4	1,385.0	1,758.4	1,980.9	1,749.8	1,896.9
2007	1,016.3	1,467.8	1,767.9	2,037.6	1,774.0	1,975.0
2008	1,071.0	1,466.8	1,818.9	2,064.7	1,803.2	2,031.7
2009	1,115.8	1,477.5	1,836.5	2,034.6	1,727.4	2,060.2
2010	1,163.4	1,610.4	1,891.7	2,031.3	1,704.7	1,980.1
2011	1,212.9	1,690.0	1,935.0	2,056.7	1,812.1	2,062.4
2012	1,268.0	1,715.4	2,023.8	2,085.7	1,793.0	2,117.8
2013	1,318.3	1,810.4	2,090.4	2,107.8	1,785.3	2,161.6
2014	1,373.5	1,806.7	2,179.0	2,143.1	1,775.5	1,997.5
2015	1,393.2	1,819.1	2,261.1	2,145.9	1,674.9	2,041.6
2016	1,442.2	1,908.0	2,334.6	2,118.4	1,684.1	2,068.3

1) Agricultural Value-Added per hectare is calculated as total value-added of agriculture, forestry, and aquaculture (constant at 2005 price) divided by total land of agriculture, forestry, and aquaculture, expressed in hectares.

2) Source: Author's calculation bases on FAOSTAT data.

3) Unit: US\$ per hectare

Table 1.5 :Agricultural Value-Added per worker in selected Asian countries, 1990-2013

	Indonesia	Malaysia	Philippines	Thailand	Vietnam
1990	606.02	5,413.47	879.36	532.30	-
1991	641.20	6,021.89	872.74	597.18	-
1992	655.17	6,538.82	838.57	594.47	-
1993	712.25	6,240.57	831.56	654.94	-
1994	758.12	-	848.97	709.65	-
1995	850.22	6,092.19	850.60	762.52	-
1996	819.09	5,978.48	873.22	842.80	312.25
1997	870.48	6,608.14	915.51	810.42	347.09
1998	781.19	5,887.61	926.73	826.94	348.98
1999	819.64	5,889.62	982.21	917.39	354.82
2000	787.89	5,924.94	1,074.60	947.39	367.30
2001	832.64	7,150.77	1,043.06	1,020.12	379.45
2002	842.49	7,311.34	1,051.34	996.15	395.91
2003	825.48	7,842.02	1,090.82	1,132.18	416.02
2004	846.64	7,957.73	1,121.83	1,152.64	435.47
2005	870.06	8,065.31	1,122.64	1,127.20	-
2006	929.92	8,348.07	1,158.14	1,181.71	-
2007	940.58	8,166.01	1,202.18	1,190.39	-
2008	979.29	8,880.99	1,215.73	1,181.44	-
2009	1,004.53	8,986.05	1,205.59	1,279.87	-
2010	1,041.73	8,085.20	1,212.39	1,260.88	-
2011	1,189.61	10,160.12	1,212.27	1,224.31	-
2012	1,215.41	9,031.31	1,264.37	1,224.84	572.78
2013	1,280.90	8,777.18	1,314.52	1,262.66	591.16

1) Source: FAOSTAT data.

2) Agricultural Value-added at constant 2005 US\$.

3) Unit: US\$ per worker.

In addition, Vietnam's agriculture is impressive in land productivity since 1990 compared to some Asian developing countries as in Table 1.4. This Figure reveals that the agricultural value-added per hectare increased significantly since 1990 until recent years in Vietnam. Compared to the other Asian countries, Vietnam outperformed its neighbors in terms of agricultural value-added per hectare. There is a large gap in land productivity between China and Vietnam. The Vietnam's agricultural value-added per hectare was 1,477 US\$ in 1990 and peaked at 2,161 US\$ in 2013. While, this figure of China was only 539 US\$/ha in 1990 and up to 1,318 US\$/ha in 2013. This is due to the serious deterioration of China's environmental situation, which reduces the quality of land. Excessive use of chemicals and fertilizers caused agricultural and water pollution.

The aggregate patterns of change in agricultural labor productivity among Southeastern Asia countries during the period 1990-2013 has shown in the Table 1.5. The productivity of labor in Vietnamese agriculture has increased gradually after *Doi Moi* until the recent years. However, compared to the other Southeastern countries, the gap between the productivity of Vietnam's farm labor and that of its neighbor is quite large. The Vietnam's agricultural value-added per worker was quite low, only 312 US\$ in 1996, until 2013, this figure increased up to 591 US\$ per worker.

In summary, agriculture has been a foundation source of both economic and social stability for Vietnam after the reform, with the contributions to the GDP, economic growth, exports, and employment.

1.2.2. The transformation of Vietnam's rural economy after *Doi Moi* – reform policy

Since *Doi Moi* policy in 1986, the structural changes occur not only within the agriculture sector but also the whole rural economy in Vietnam. The tendencies include a consolidation of landholdings, increased mechanization and use of purchased inputs in agricultural production, a significant growing of non-farm employment and other income from other sources in the rural area, and the changes from subsistence agriculture to commercial agricultural commodity production.

Land fragmentation remains a significant limitation on agricultural production and agricultural modernization. Under the Land Law in 1993, farmers were granted rights for land used which included transfer, exchange, lease, inheritance, and mortgage (Marsh S. P. and MacAulay T. G., 2002). Land reform encouraged the emerging of a land market in Vietnam. However, it still constrained and underdeveloped due to high transaction cost in land transfers. Under the land reform, the Vietnamese government also has aimed to reduce land fragmentation by implementing land consolidation and land accumulation. The effect of policies can be seen in

evidence of reducing the number of plots, larger farm size, and increase in the number of rural households with no land (Marsh S. P. and MacAulay T. G., 2002). This has prompted landless farmers and small size farms to become more involved in rural non-farm jobs and migrate to major cities.

The effectiveness of land reform is also reflected in the increase in plantation area in the post-renovation period in Vietnam (Table 1.6). The area planted of total crops have risen considerably from 9,040 thousand hectares to 12,831.4 thousand hectares, approximately growth 41.9% (1990=100), in the period 1990-2002. In which, the annual crop area increased from 8,101.5 thousand hectares to 10,595.9 thousand hectares, approximately growth 30.8% (1990=100), in the same period.

Table 1.6: Area planted of total crops, annual crops and its growth in Vietnam, 1990-2002

Year	Total crops		Annual crops	
	Area planted (thousand hectare)	Growth index (1990=100)	Area planted (thousand hectare)	Growth index (1990=100)
1990	9,040.0	100.0	8,101.5	100.0
1991	9,410.0	104.1	8,475.3	104.6
1992	9,752.9	107.9	8,754.4	108.1
1993	10,028.3	110.9	8,893.0	109.8
1994	10,381.4	114.8	9,000.6	111.1
1995	10,496.9	116.1	9,224.2	113.9
1996	10,928.9	120.9	9,486.1	117.1
1997	11,316.4	125.2	9,680.9	119.5
1998	11,740.4	129.9	10,011.3	123.6
1999	12,320.3	136.3	10,468.9	129.2
2000	12,644.3	139.9	10,540.3	130.1
2001	12,507.0	138.4	10,352.2	127.8
2002	12,831.4	141.9	10,595.9	130.8

Source: General Statistics Office database (GSO (a), 2019).³

In the early years of transition after *Doi Moi*, a labor market was gradually developed. The openness and liberalization of the market after reform have facilitated for the development

³ Website: https://www.gso.gov.vn/default_en.aspx?tabid=778

of labor market which farm labors can easily participate into other employments outside agricultural activity. Especially, after Labor Law was issued in 1994⁴, together with the trend of diversifying the economic sectors, many new firms established. The number of people entering the labor market was increasing, especially in the rural area, with a shift of labor force from the agricultural sector to the industrial and service sectors. Agricultural workers accounted for 72% of the total number of workers in the period 1988-1991. This figure fell to 65% in 2000 and 47% in 2012 (World Bank Group, 2016). Thus, there was a transformation of labor and employment structure in Vietnam's rural areas, with a decreasing in agricultural labor and an increasing in non-agricultural labor, namely labors working in construction, manufacturing and services sectors.

In addition, the urbanization process has created the wave of movement of labor from rural areas to urban areas. This shift due to several reasons: (1) the surplus of rural labor force and the lack of employments in rural area; (2) the households who don't have land to cultivate; (3) the farm income cannot be sufficient for household's consumption; and (4) finding higher income sources and improving household's income.

The development of infrastructure⁵ in the rural area was also one of the tendencies of the rural economy. It was not only a background for the growth of agriculture sector but also non-farm sector. The level of Infrastructure Development in Vietnam have improved from 0.91 in 1991 to 3.27 in 2005 (Bhattacharyay, 2009). Rural roads were rehabilitated and upgraded to connect communes to each other, to district towns, or to the national or provincial road network (ADB, 2010). In 2002, there was 57.3% of the total communes in rural areas which had received government investment programs or programs of other organizations on economic and infrastructure development (Man, 2005)⁶. This proportion have increased to 74.4% and 81.3% in 20012 and 2016, respectively (GSO (k), 2018). The proportion of communes having the concrete cement road accessible by car to the commune has increased from 41.5% in 2006 to 74.1% in 2016 in the total communes (GSO (k), 2018). In 2001, there was 56.1% communes having access to market in the total communes in the whole country (Man, 2005). Up to now, the proportion of communes having the communal/intercommunal market was 71.1% in the total communes in

⁴ The Labor Law 1994 was issued with the aim of protecting the rights of employees, their rights and other rights, and protecting the legitimate rights and interests of employers. In which, this law has developed specific regulations on employment, labor contracts, wages, working time and rest time, regulations on discipline and responsibilities of labor and security, labor safety and hygiene, and social insurance, etc. In addition, the law also provides specific regulations for female workers, juvenile workers, disabled workers, workers with high technical expertise, and foreign workers working in Vietnam.

⁵ Infrastructure can be categorized into hard infrastructure and soft infrastructure (Bhattacharyay, 2009). This study refers the hard infrastructure in rural areas. They are physical structures or facilities that support the society and economy, such as transport (e.g., ports, roads, railways); energy (e.g., electricity generation electrical grids, gas and oil pipelines); telecommunications (e.g., telephone and internet); and basic utilities (e.g., drinking water supply, hospitals and health clinics, schools, irrigation, etc.) (Bhattacharyay, 2009).

⁶ The author based on the commune data of VHLSS 2002.

2016 (GSO (k), 2018). The development of rural transportation networks and routes connecting with urban areas induced the development of agricultural commodities and began to create the non-farm employment opportunities. In addition, this also facilitated the formation of migration flows from rural to urban areas. Because the rural infrastructure investments can lead to higher farm and nonfarm productivity, employment, and income opportunities, and increased availability of wage goods, thereby reducing poverty by raising mean income and consumption (Ali & Pernia, 2003).

The trend of transformation from farm to non-farm activities at the household level is reflected in the household's income structure. Figure 1.3 presents the proportion of income from different source of farm household in Vietnam in the early years after the reform from 1992 to 2002. The share of farm income (include crop and livestock) in farm household income tended to decline from 56.3% in 1992 down to 48.8% in 2002. While, the share of non-farm income (consist of income as non-farm wage and non-agriculture self-employment) increased slowly after 10 year from 30.7% in 1992 to 32.6% in 2002. Therefore, income source from non-farm activities was raising lightly after *Doi Moi* policy. It showed that the transformation trend from farm to non-farm activities has been ongoing since *Doi Moi* in the rural economy. This trend prompted many rural labors to seek economic opportunity in cities or faster growing area of the country.

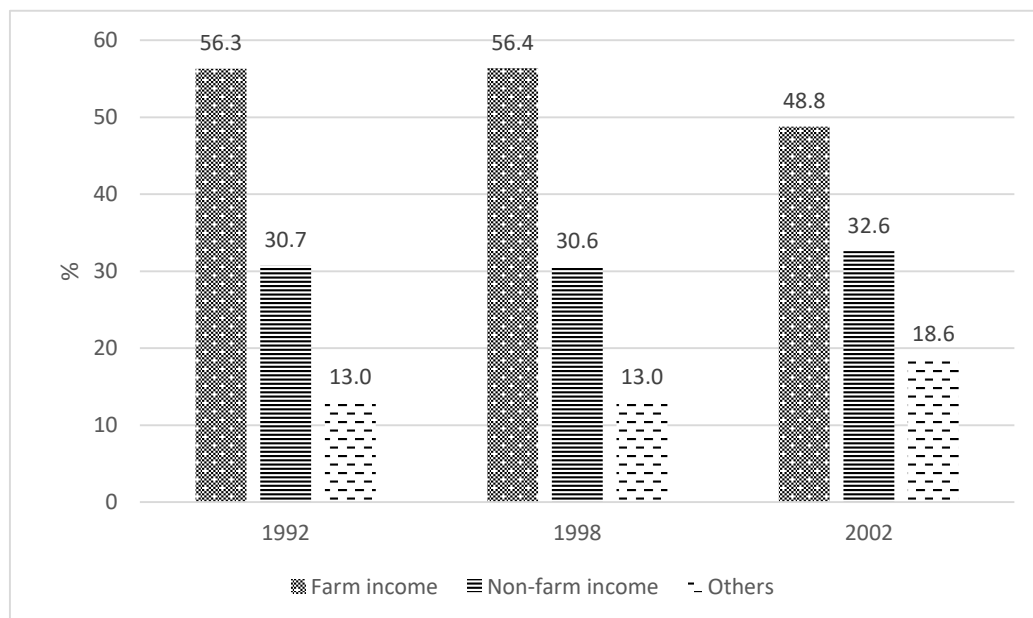


Figure 1.3: Structure of farm households' income in Vietnam after the reform, 1992-2002

Source: RIGA based on VHLSS 1992, 1998, 2002.

Another effect of the reform policy on Vietnam's agriculture and rural economy was the shift from self-sufficiency to commodity production. It is reflected in the increase of area planted of annual crops, especially industrial crops which could bring high value for trade and export. Some of the products from industrial crops are key export such as coffee, rubber, black pepper, cashew nut, tea, and cassava and cassava products. Especially, Vietnam is the world's second largest coffee exporter currently, behind only Brazil. In the 90 decade, there has been a significant increase in the production of cereal crops cash crops (Marsh S. P. and MacAulay T. G., 2002). A number of the main cash crops in Vietnam are such as vegetables, and fruits; the cereal crops are rice, maize, kinds of bean. In which, Vietnam's rice exports ranked second in the world and vegetable and fruits are one of the major agricultural export products. From 1990 to 1999, the land area planted of annual food crops increased from 6,476.9 thousand hectares to 8,349 thousand hectares, approximately 28.9% compare to 1990 (Table 1.7). Especially, at the same time, the land area planted of the annual industrial crops rose dramatically 64.1% compare to 1990 (Table 1.7). However, in the early years of the 21st century (2000-2002) until recent years, there has been a gradual increase in the area of annual cereal crops and a decline in the area of annual industrial crops. In particular, the planted area of annual cereal crops has risen to 8,890.6 thousand hectares in 2016, approximately 37.3% compare to 1990 .While this figure of annual industry crops has decreased to 633.2 thousand hectares in 2016. Meanwhile, the most dramatic increase is reflected in the area planted of perennial industrial crops. In the few years after the reform, the planted area of perennial industrial crops has increased slightly from 657.3 thousand hectares in 1990 to 809.9 thousand hectares in 1994. After then, the area planted of this crop has increased rapidly and dramatically by 2,345.7 thousand hectares in 2016, increased approximately 256.9% compare to 1990.

In conclusion, the transformation of Vietnam's rural economy after *Doi Moi* policy are presented in the following characteristics: (1) the land reform led to the emerging of land market and the implementing of land consolidation and land accumulation; (2) the formation of the labor market and a shift of labor force from the agricultural sector to the industrial and service sectors; (3) the gradually improving the rural infrastructure; (4) the change in the household's income structure with the light increasing in non-farm income; and (5) the shift of agricultural and rural economy from self-sufficiency to commodity production. These are the background for creating non-farm job opportunities for labors in the rural area.

Table 1.7: Area planted of annual food crops, annual industrial crops and its growth in Vietnam, 1990-2012

Year	Annual cereals		Annual industrial crops		Perennial industrial crops	
	Area planted (thousand hectare)	Growth index (1990=100)	Area planted (thousand hectare)	Growth index (1990=100)	Area planted (thousand hectare)	Growth index (1990=100)
1990	6,476.9	100.0	542.0	100.0	657.3	100.0
1991	6,752.7	104.3	578.7	106.8	662.7	100.8
1992	6,956.3	107.4	584.3	107.8	697.8	106.2
1993	7,058.3	109.0	598.9	110.5	758.5	115.4
1994	7,135.7	110.2	655.8	121.0	809.9	123.2
1995	7,324.3	113.1	716.7	132.2	902.3	137.3
1996	7,620.6	117.7	694.3	128.1	1,015.3	154.5
1997	7,768.2	119.9	728.2	134.4	1,153.4	175.5
1998	8,016.0	123.8	808.2	149.1	1,202.7	183.0
1999	8,348.6	128.9	889.4	164.1	1,257.8	191.4
2000	8,399.1	129.7	778.1	143.6	1,451.3	220.8
2001	8,224.7	127.0	786.0	145.0	1,475.8	224.5
2002	8,322.5	128.5	845.8	156.1	1,491.5	226.9
2003	8,366.7	129.2	835.0	154.1	1,510.8	229.8
2004	8,437.8	130.3	857.1	158.1	1,554.3	236.5
2005	8,383.4	129.4	861.5	158.9	1,633.6	248.5
2006	8,359.7	129.1	841.7	155.3	1,708.6	259.9
2007	8,304.7	128.2	846.0	156.1	1,821.7	277.1
2008	8,542.2	131.9	806.1	148.7	1,885.8	286.9
2009	8,527.4	131.7	753.6	139.0	1,936.0	294.5
2010	8,615.9	133.0	797.6	147.2	2,010.5	305.9
2011	8,777.6	135.5	788.2	145.4	2,079.6	316.4
2012	8,918.9	137.7	729.9	134.7	2,222.8	338.2
2013	9,074.0	140.1	730.9	134.9	2,110.9	321.1
2014	8,996.2	138.9	710.0	131.0	2,133.5	324.6
2015	9,008.8	139.1	676.8	124.9	2,154.5	327.8
2016	8,890.6	137.3	633.2	116.8	2,345.7	356.9

Source: General Statistics Office (GSO) database.

1.3. Justification of the Study

Rural household livelihoods have become diversified owing to multiple incomes from many different activities, and non-farm income sources are considered to play a progressively important role over time. Previous empirical evidence has indicated that the non-farm sector of developing countries has gradually been expanding in recent years to play an important role in household income. By the mid-2000s, this non-farm income source comprised 34% of total rural household income in Africa, 47% in Latin America and the Caribbean, and 51% in Asia (Haggblade et al. 2010). The progressive transformation of the rural economy from agriculture to non-agriculture is considered as an essential feature of the economic development of developing countries.

Not out of the trend of economic development, the transformation of Vietnam's rural economy has also started after renovation policy or *Doi Moi* policy. The specific objectives of these policies are to create more jobs, to raise the agricultural and rural industry- related income, and to develop non-farm activities (Diep & Vien, 2017). The subsequent openness and liberalization of Vietnamese markets has played a crucial role in the development of the non-farm sector. Some of the policies were designed directly and indirectly to elate the income diversification process in Vietnam and in rural areas in particular. In 1993, 16.5% of the workforce of rural households was engaged in the non-farm economy (Hoang et al., 2014). This proportion had risen to 34% by 2008 (Hoang et al. 2014) and 46.15% by 2016 (GSO (j), 2018). The share of households' non-farm income was 29% in 1998; the proportion had risen to 42% by 2008 (Hoang et al., 2014). Moreover, this sector also played a crucial role towards improving farm households' income as well as contributing to poverty reduction in Vietnam. From 2002 to 2008, the increase in the share of non-farm working hours relative to total working hours increased from 8% to 14% the probability of exiting poverty and more than 50% household expenditure (Hoang et al., 2014). The growth of the Vietnamese agricultural sector has lagged the non-agricultural sector, and non-agricultural income has grown more rapidly than agricultural income (Stampini & Davis, 2009).

The share of agricultural labor in the total labor decreased gradually after the reform to the present, but still comprises the highest single proportion of the total labor force, falling from 65% in 2000 to 47% in 2012 (World Bank Group, 2016). Farming activity primarily depends on household labor (De Brauw, 2010). The shift of household labor from farm activity to non-farm activities might affect agricultural production activity. Meanwhile, Vietnam's agricultural sector has notched impressive achievements in agricultural yield, output, and exports in the last period from the 90s decade until now. Vietnam has achieved explosive growth in agricultural exports to become one of the biggest agricultural exporters in the world. Thus, it leads to the following

questions. How has Vietnamese agriculture maintained its competitive position in global agricultural production at the same time as its non-farm sector has expanded and developed in recent years? Is there a link between the farm and non-farm sectors in Vietnam's rural economy? Is the relationship competitive or complementary?

In developing countries, although the agricultural sector still plays a central role in rural development, the promotion of complementary engines for rural growth is essential (Davis et al., 2010). The credit and insurance markets are often inadequate and, in some cases, absent in the rural areas of many developing countries. Hence, the role of the non-farm sector is not only consumption smoothing but also relaxing credit constraints on the agricultural production of farm households. In recent years, the relation between agriculture and non-farm sectors has been the primary concern of development economics. Empirical evidence suggests that the income from non-farm activities can provide the capital for farm investments in the case of failure of credit markets or lack of an adequate insurance market (Pfeiffer et al., 2009; Hertz, 2009).

Therefore, Vietnam is an interesting place to study the linkages between farm and non-farm sectors for several above reasons. In this study, we attempt to investigate how the non-farm sector affects agricultural production, output, and production efficiency in the context of imperfect markets and the development of Vietnam's rural economy. Little attention has been paid to analysis of the relationship between the non-farm sector and agricultural production.

A few studies have previously addressed this issue in the context of Vietnam. In particular, the research of Stampini & Davis (2009) was on the relationship between participation in nonagricultural labor activities and the use of inputs, and De Brauw (2010) investigated the effects of seasonal migration on agricultural production. However, both studies only evaluated the situation of Vietnam during the 1990s, just after the reform, when the non-farm sector had not developed or become popular. The transformation of the rural economy has accelerated in recent years due to the fruitful integration between the Vietnamese economy and new development policies. Hence, in this study, we focus on the experience of Vietnam in 2012 which is representative of the period of international integration. In addition, this is also the year that Vietnam has overcome the financial crisis of 2008. Therefore, choosing 2012 to study this topic will not need to be concerned about the impact of the crisis factor.

The present study will provide the advocacy of the perspective on the importance of the non-farm sector to the development of rural economy in Vietnam. The study will contribute to the existing literature on the linkages between farm and non-farm sector in Vietnam as a case study. The findings of the study are expected to be a helpful information for rural development economists, researchers, as well as policy makers. It also will provide useful information for the further development of both agriculture and non-farm sectors in rural economy in Vietnam.

1.4. Objectives and Hypotheses of the Study

The main objective of this research is to investigate the linkages between farm and non-farm sector in Vietnam. The specific objectives are as follow: (1) to describe the overview and the role of non-farm sector in the Vietnam's rural economy; (2) to examine the relation between farm household participation in non-farm activities and input expenditures in agricultural production activities; (3) to estimate the effect of the non-farm sector on agricultural output and performance, in particular agricultural value-added and production efficiency; and finally, (4) to suggest and recommend policy implication based on the findings of the study.

Based on the above objectives, the following hypotheses are tested:

(1) Whether the income from non-farm activities facilitates household spending inputs in agricultural production. In particular, how the non-farm income impacts on purchased inputs, hired machines and hired labor costs of farm activity.

(2) Whether the non-farm sector influences the output and performance of the Vietnamese agricultural sector. In particular, how the non-farm income affects agricultural value-added and production efficiency.

1.5. Literature review

1.5.1. Definitions of the rural non-farm activities

According to Lanjouw J. et al. (2001), the rural non-farm activities is defined that includes all economic activities in rural areas except agriculture, livestock, fishing and hunting. The authors also indicate that the rural non-farm activity undertaken by farm households as independent producers in their homes, non-farm activity in the village and rural town enterprises, and migration of rural residences to urban non-farm jobs (Lanjouw et al., 2001).

The definition of rural non-farm employment that is initiated by Haggblade et al. (2010) that follow the standard convention. They define that the non-farm economy includes all economic activities other than the production of primary agricultural commodities. Non-farm activities include mining, manufacturing, utilities, construction, commerce, transport, financial, government services, and personal (Haggblade et al., 2010). In addition, rural labors that work in agro-processing such as the transformation of raw agricultural products by milling, packaging, bulking or transporting are one of the components of the rural non-farm activities (Haggblade et al., 2010).

Moreover, Reardon et al. (1998) defines the income from rural non-farm sector that is from wage-paying activities and self-employment in commerce, manufacturing and other services. However, the author argues that the earning source from migration is not included in non-farm income.

1.5.2. Motivation to participate into non-farm activities of rural households

Decisions to participate in rural non-farm activities of rural households generally depend on two main factors (Reardon et al., 1998). The first is the “incentives offered”, such as the relative profitability and risk of farm and rural non-farm activities (Reardon et al., 1998). The second is the household’s capacity (determined by education, income and assets and access to credit...) to undertake such activities.

The literature indicates that households are motivated to participate into non-farm activities by two main factors, namely pull factors and push factors. The “pull factors” are incentives, which induce farm households to participate into non-farm sector when non-farm activities offer higher return than the farm activities (Barrett et al., 2001). The “push factors” which drive households to undertake rural nonfarm activities are including: first, this is necessary to increase the household income when farm income cannot supply sufficient livelihood (Minot et al., 2006); second, the risks of farming or limited risk-bearing capacity which induce households to select a portfolio activities in order to manage income and consumption uncertainties (Reardon, 1997; Barrett et al., 2001); and third, an absence or failure of farm input markets or input credit markets which compelling households to pay for farm inputs with their own cash resources (Reardon, 1997).

1.5.3. Literature on the linkage between farm and non-farm sectors

The linkages between farm and non-farm sector is an issue of great concern to economist today. Because the growth of non-farm sector in rural economy leads to the changes in farm production activity intra household and then induces the changes in outcome of agriculture. The relation of farm and non-farm sectors in rural economy is showed up in household model of Singh et al. (1986). In an agricultural household with perfect competitive markets, the loss on-farm family labor due to working off the farm or the receipt of non-farm income does not affect to household efficiency. Because the household will make production decision that is independent from consumption and input allocation decisions. If agricultural labor market is perfect competitive, the farm household is able to substitute his/her own agricultural family labor for hired labor. When labor markets fail, agricultural household models are no longer separable. Hired labor is imperfect substituted for household’s own labor by due to transaction costs or etc. Thus, when some family member who engaged in non-farm sector, agricultural labor input of their farming can’t be compensated by rural labor market. This induces the *lost-labor effect* on agricultural production and farm efficiency. If household is constrained by limited liquidity or credit, the income from working non-farm can use to purchase inputs for agricultural production (Pfeiffer et al., 2009).

According Pfeiffer et al. (2009), the effects of non-farm activities on agricultural production within households can be positive, negative or nil (equal zero) depending on the household's degree of integration with factor or product markets. We summarize different empirical evidences on the relationship between non-farm activities and agricultural production, namely the agricultural input expenditures. Research on the linkages between the non-farm sector and agricultural inputs use or farm investment has flourished in several countries. Table 1.8 summarizes the literature showing the relationship between non-farm sector and agricultural production expenses of the previous studies in several developing countries.

The positive relation between non-farm participation and the acquisition of productive agricultural assets has been explored in many countries, including Nigeria, Ghana, Mexico, Bulgaria, the Philippines, and Vietnam (Hertz, 2009; Oseni & Winters, 2009; Pfeiffer et al., 2009; Stampini & Davis, 2009; Takahashi & Otsuka, 2009; Anríquez & Daidone, 2010).

Pfeiffer et al. (2009) studied the impact of off-farm income on agricultural production in Mexico by using the 2003 Mexico National Rural Household Survey. The authors concentrated to analyze the effect of off-farm income on farm production and input demand. The result of their research indicated that off-farm income has a significant positive effect on the purchased inputs in crop production. They pointed out that the lost-labor impact seem to be greater than any increase in purchased input use, hence leading to an overall decrease in agricultural output. They believed loosening of liquidity constraints on agricultural production when households participate in non-farm jobs.

The study of Oseni & Winters (2009) examined the effect of participation in non-farm activities on crop expenses of farm households in Nigeria by using the Nigerian Living Standard Survey 2003. Their result uncovered a positive and significant relation between non-farm income and crop expenses in Nigeria and, in particular, the payment for hired labor and inorganic fertilizer. The separate analysis by six geopolitical zones also indicated that the regions where non-farm participation appears tend to use more hired labor cost. They concluded that non-farm participation can help to relax credit constraints, in particular paying more for inputs in crop production.

Table 1.8: Summary of literature showing the relationship between the non-farm sector and agricultural production expense

Authors	Country	Year of data	Dependent variable	Non-farm variable	Impact	GDP per capita (PPP)
Pfeiffer et al. (2009)	Mexico	2003	Purchased inputs	Off-farm income	Positive	15,251
Oseni & Winters (2009)	Nigeria	2004	Total crop expenses	Non-farm income	Positive	4,116
			Hired labor	Non-farm participation		
			Inorganic fertilizer			
Anríquez & Daidone (2010)	Ghana	1998	Demand for farm inputs	Non-farm activities	Positive	2,191
Hertz (2009)	Bulgaria	2003	Farm input expenditure	Non-farm income	Positive	10,730
Takahashi & Otsuka (2009)	Philippines	1979, 1986, and 2003	The investment in tractors	The growth in the rural non-farm sector	Positive	4,442 (2003)
Mathenge et al. (2015)	Kenya	2000-2004	Fertilizer use and hybrid seed	Non-farm income	Negative	2,132-2,158
Kilic et al. (2009)	Albania	2005	Crop expenditure	Non-farm income	Negative	7,733
			Livestock expenditure		Positive	
Stampini & Davis (2009)	Vietnam	1992-1998	Crop inputs include seeds, services, hired labor	The participation in non-agricultural labor activities	Positive	1,699-2,343
			Total livestock inputs expenditure		Positive	

1) Source: Authors' synthesis.

2) GDP per capita (PPP): Source from World Bank database.

3) Unit of GDP per capita is USD. Base year is 2011.

Similarly, Anríquez & Daidone (2010) analyzed the effect of non-farm activity on the farm production cost and demand for farm inputs in Ghana. The data which is used in this article is Ghana Living Standard Survey 1998/99. Their results indicated that rural non-farm activity provides significant cost complementarities for the farm sector, especially for livestock and food crops. Another finding is that the expansion of non-farm activities increases the demand for farm inputs. Thus, their conclusion is that non-farm sector can ease household cash constraints.

With using the 2003 Multitopic Household Survey, Hertz (2009) documented the relationship between non-farm activities and agricultural investment in Bulgaria. In particular, the study focused on the non-farm income from primarily incomes and pension, and the agricultural investments include expenditures on working capital such as feed, seed, and herbicides and investment in livestock. The results found a positive relation between non-farm income and farm input expenditures in Bulgaria. He noted that this is consistent with the presence of a farm credit constraint that induces farmers to fund farm expenditures with non-farm income.

Takahashi & Otsuka (2009) examined the effects of the increasing non-farm income on the use of tractors and threshers and on the hired labors of rice growing households in Philippines. This study used the Central Luzon Loop Survey 1979, 1986, and 2003. There have been sharp increases in non-farm income among Philippines' farm households during 1979-2003 period. The results showed that the growth in the rural non-farm sector increased investment in tractors. In addition, they found that the increase in non-farm income leads to increase of hired labor as a substitute for family labor. This study indicated that the increased non-farm income helped relax liquidity constraints for farmers, thereby contributing to financing long-term investment.

In case of Vietnam, Stampini & Davis (2009) used the Vietnam Household Living Standard Survey 1992/93 and 1997/98 to analyze the relationship between participation in non-agricultural labor activities and the use of inputs in farming production. The research reported that farm households participated in off-farm activities spend significantly more on seeds, services, hired labor, and livestock inputs in Vietnam's agriculture. They concluded that non-farm labor helps relaxing such credit constraint to farming.

Hence, in all these cases, the growth of the non-farm sector is mainly driven by farm credit constraints, which induce the necessity of alternative sources of liquidity (Davis et al., 2009).

However, in Albania and Kenya, non-farm employment has been found to have a negative impact (Albania, Kilic et al., 2009; Kenya, Mathenge et al., 2015) on farm input expenditures. The result of Kilic et al. (2009) indicated that non-farm earning and crop input expenditure are negative relationship in Albania. Diversifying non-farm income could not enhance the input expenditures of crop production. They concluded that non-farm employment is more of substitute than a complement to crop production of households in Albania. Similarly, the study of Mathenge et al. (2015) found that the non-farm income has a negative influence on demand for fertilizer and hybrid seed in maize production in Kenya. In both cases, non-farm employment was considered an alternative to the intensification of farming. Farm households from low-income countries such as Kenya are almost poor; hence, the earnings from non-farm employment are used for household consumption. In these contexts, investing in agricultural production is difficult because households' income is used to ensure food security rather than increase in investment on agricultural production. Albania is a representative case of a middle-income country, which is less restricted on credit issues. The credit market, insurance market, and labor market of middle-income countries are rather developed; thus, the use of non-farm income for investment in agricultural production may not be necessary.

In summary, the existing literature implies that the effect of non-farm income on agricultural production under the existing factor market imperfection. Particularly, in the context of market imperfections, if farm households face to the liquidity and/or credit constraints, the non-

farm income can help the liquidity relaxing in agricultural production, which supposes a potential increase in farm expenditure/investment (Pfeiffer et al., 2009).

1.5.4. Literature on the effect of non-farm sector on agricultural performance and production efficiency

The previous studies have asserted that there is a synergistic relationship between the farm and non-farm sectors. Participation in the non-farm sector by farm households is a decision that influences not only farm income but also agricultural performance. A wide range of empirical studies indicate the inextricably linked between farm and non-farm sectors and also have found various results for the direction of non-farm sector effects on agricultural production output and production efficiency. This section summarizes the empirical evidence in several countries on the relationship between non-farm income and farm output and production efficiency.

Table 1.9 presents the summary of literature showing the relationship between non-farm sector and agricultural output and production efficiency. The results of empirical studies show that the non-farm sector has both positive and negative impacts on agricultural production efficiency and output. The studies have found a positive effect of off-farm income/employment on agricultural output and production efficiency in some countries, such as Nigeria, Slovenia, China, and Vietnam.

Shittu (2014) examined the impact of off-farm employment on production efficiency of farm household rural southwest Nigeria. The result showed a positive relationship between off-farm income and production efficiency. The study also revealed that increased participation of farm household members in the non-farm sector contribute to household income and significantly improve production efficiency. The author suggested that the level of farm's production efficiency was enhanced by adoption of a diversified portfolio of income sources from diversification of labor use to include farm and off-farm activities.

Similarly, Bojnec & Fertő (2011) also investigated the impact of off-farm income on farm technical efficiency in Slovenia by using panel data in the years 2004-2008. This study used farm household-level data from the Slovenian Farm Accountancy Data Network. They found the positive significant impact of off-farm income on farm technical efficiency in Slovenia. Their result indicated that off-farm income increases efficiency over time and off-farm income can improve farm's technical efficiency. They explained that this effect of the off-farm income on farm efficiency might be due to its providing cash into farm activity which can be invested in farm's technological improvements and the relaxation of farm labor surpluses outside the main seasonal work.

Table 1.9: Summary of literature showing the relationship between the non-farm sector and agricultural output and production efficiency

Authors	Country	Year of data	Dependent variable	Non-farm variable	Impact	GDP per capita (PPP)
Shittu (2014)	Nigeria	2005/2006	Inefficiency level	Off-farm income share	Positive	4,149
Bojnec & Fertő (2013)	Slovenia	2004–2008	Technical efficiency level	Off-farm income	Positive	25,963–31,138
Zhang et al. (2016)	China	2002–2010	Technical efficiency level	Number of off-farm labourers	Positive	4,315–9,526
Diirro (2013)	Uganda	2005/2006 and 2009/2010	Technical efficiency level	Off-farm income	Negative	1,223–1,485
Kilic et al. (2009)	Albania	2005	Inefficiency level	Non-farm income	Negative	7,733
Sauer et al. (2015)	Kosovo	2005–2008	Inefficiency level	Migration intensity (% of total available work time per household)	Negative	6,698–7,525
Pfeiffer et al. (2009)	Mexico	2003	Inefficiency level Agricultural output	Off-farm income	Slightly positive Negative	15,251
Lien et al. (2010)	Norway	1991–2005	Inefficiency level	Off-farm work hours	No effect	43,925–62,865
Abdulai & Eberlin (2001)	Nicaragua	1994/ 1995	Inefficiency level	Non-farm work hours	Negative	2,840
De Brauw (2010)	Vietnam	1992/1993 and 1997/1998	Non-rice agricultural revenue	Number of migrants	Positive	1,699–2,343

1) Source: Authors' synthesis.

2) GDP per capita (PPP): Source from World Bank database.

3) Unit of GDP per capita is USD. Base year is 2011.

Zhang et al. (2016) studied the impact of off-farm employment on agricultural technical efficiency in rural China, namely in Jiangsu province. This research used the panel data from Jiangsu Agricultural Household Survey 2002, 2006, and 2010; and concentrated on annual crop production of farm households. The estimation results indicated that there was a positive significant effect of off-farm employment on technical efficiency level. They supposed that industrialization and urbanization contribute to enhance technical efficiency in addition to the creation of more off-farm employment opportunities. Moreover, households with off-farm participation were more likely to adopt new technologies and agricultural machinery in China.

In case of Vietnam, the study of De Brauw (2010) examined the relationship between seasonal migration and agricultural production by using Vietnam Household Living Standard Survey 1992/93 and 1997/98. This study concentrates on rice and non-rice production. The author found weak evidence that migration decreased the revenue of rice production, while migration

increased the revenue from other crops. The author explained that migration could help Vietnamese rural households overcome the credit constraints faced in producing higher valued crops and use the income from migration to facilitate investment in those crops.

In contrast to these studies, a negative effect is found in other countries, such as Uganda, Albania, Kosovo, Mexico, and Nicaragua, and no effect in Norway. The study of Diiro (2013) analyzed the effect of off-farm earning on the level of technical efficiency of maize farming in Uganda by using the Uganda National Household Survey 2005/06 and 2009/10. The estimation result showed a negative relation between off-farm income and farm technical efficiency in Uganda. Farmers without off-farm income were generally more efficient than those with off-farm income. The author suggested that this is because of off-farm opportunities competing for farm household labor.

By using data from the Albania Living Standards Measurement Study 2005, Kilic et al. (2009) conducted to analyze the impact of household non-farm income on technical efficiency of rural farm households. They found that non-farm earning is negatively affected to farm technical efficiency in agricultural production. The authors believed that when agricultural investment is risky, non-farm jobs and investment options may compete for labor and capital of farm households. In addition, they supposed that non-farm employment is more of a substitute than a complement to agricultural production of Albanian rural households. The study also suggested that diversifying farm incomes tends to divert non-farm earnings away from investments in crop production.

Sauer et al. (2015) investigated the effect of migration on farm technical efficiency of agricultural households in Kosovo by using stochastic production frontier analysis followed by a propensity score approach. The data employed in this study were obtained from Agricultural Household Surveys between 2005 and 2008. They found that migration has a negatively significant effect on farm technical efficiency. The author suggested that in the presence of imperfection labor market, farming production relies exclusively on family labor. Thus, they assumed that the adverse effect of migration on farm technical efficiency comes from the 'lost labor effect'.

Pfeiffer et al. (2009), studying the impact of off-farm income on agricultural production in Mexico, found that off-farm income has a negative effect on crop output and a slight efficiency gain on farm households participating in off-farm activities. Another research from Latin America also found a negatively significant relationship between non-farm employment and technical efficiency of rural households in Nicaragua (Abdulai & Eberlin, 2001). Their result indicated the participation in non-farm activities of farmers tends to reduce production efficiency. They

suggested that increases in non-farm works are accompanied by a reallocation of time away from farm activities, this led to the decreasing in production efficiency.

Meanwhile, Lien et al. (2010) examined the impact of off-farm work on farm technical efficiency of grain farmers in Norway by using farm-level unbalanced panel data. Their analysis revealed no effect of off-farm work on farm technical efficiency.

Table 1.9 also combines with GDP per capita of each country. Three groups, excluding Slovenia, are evident from the analysis. The lowest-income countries (e.g. Uganda and Nicaragua) show a negative effect, the lower-income countries (e.g. Nigeria, China, and Vietnam) show a positive effect, and the middle and upper-income countries per capita (e.g. Albania, Kosovo, Mexico, and Norway) show a negative or no effect. Farm households in the lowest-income countries are almost always poor, and thus, use earnings from non-farm employment for consumption. Therefore, it is difficult for these households to invest in agricultural production, because their focus is on food security rather than improving agricultural income, while in some cases, rural markets, such as credit or insurance markets, might not exist. For the second group of countries, that is, the lower-income group (e.g. Vietnam), capital markets in rural areas are not developed; thus, non-farm income can ease credit constraints and be used for investment in agricultural production. However, middle and upper-income countries are less credit constrained because of their effective agricultural policies to protect and subsidize the agricultural sector. In addition, the credit, insurance, and labor markets of this group of countries are quite developed, and thus, the non-farm sector does not seem to have an effective impact on agricultural performance.

1.6. Organization of the thesis

The present research explores the linkage between the rural non-farm and agriculture sectors in Vietnam. In addition, the research evaluates the impact of the income from non-farm activities on production efficiency. By understanding the relationship between farm and non-farm sectors, the research can recommend necessary suggestions for policy makers. In order to process the necessary outline, this research consists of five chapters.

In Chapter 1, we introduce the world's non-farm sector, background of Vietnamese agricultural sector and the rural economy after *Doi Moi* policy, justification, objectives and hypotheses of the study, and literature review.

Chapter 2 provides an overview of the rural non-farm sector in Vietnam. The status of Vietnamese labor market, namely the supply and demand of the labor market, is discussed in this chapter because the establishment and development of labor market creates opportunities for rural labor to participate in non-farm works. Policies to promote non-farm employment are very

important for the development of this sector that also is mentioned in this chapter. In addition, the other contents describe the development of non-farm sector in rural areas and the role of non-farm income in rural household's income in Vietnam.

Chapter 3 aims to identify the linkages between non-farm sector and agricultural production. This chapter will examine whether non-farm income facilitates the inputs expenditure in agricultural production, namely three kinds of main expenditures include purchased inputs, hired machines, and hired labor expenses.

Chapter 4 aims to study whether the non-farm sector affects the output and performance of the agricultural sector. This chapter will analyze the effect of non-farm income on the agricultural value-added and production efficiency.

Finally, the discussion, conclusion and policy recommendations that are drawn based on the results and discussions will be addressed in the last chapter.

Chapter 2

Overview of the rural non-farm sector in Vietnam

2.1 Introduction

The renovation policy – *Doi Moi* policy has created the change in the rural economy and the development of the non-farm sector in Vietnam's rural areas. The objective of the chapter is to provide an overview of the rural non-farm sector in Vietnam. Firstly, this chapter describes the overview of Vietnam's labor market in the context of economic integration, in particular the supply and demand of labor market, especially the supply of rural labor. Secondly, it will introduce some specific policies to encourage the development of rural non-farm employment, which is issued by Vietnamese government. Because in another aspect, the development of this sector can be facilitated by development policies. Thirdly, this chapter will describe the development of the rural non-farm sector in Vietnam after reform until the recent years, and the difference by regions. And lastly, it also depicts the role of this income source in rural household's income.

2.2. The labor market in Vietnam

In the economic integration period⁷, Vietnam has expanded economic relations with a number of countries and regions, becoming members of economic and trade organizations such as WTO, FTA, and APEC. This has created many opportunities for Vietnam to develop the economy, conduct trade activities, and attract the investment source from the foreigner. Along with the process of international economic integration, the Vietnam's labor market has developed with the shifting trend from agriculture labor to industry and services labor. The number of people entering to labor market, especially the rural areas, has been more and more increasing. However, Vietnam's human sources were still many inadequate such as the lack of skilled labor. This section describes the view of Vietnam's labor market in the context of the economic integrate, especially rural labor, includes the supply-demand and the structure.

2.2.1. Population of the working age

The OECD regional typology based on criteria of population density to classify the rural and urban units. The region as rural if their population density is below 150 inhabitants per square kilometer (OECD, 2011).⁸ Different countries have varying definitions of "rural" for statistical

⁷ The economic integration period is from the first years of 21st century (2000 or 2001) until now.

⁸ 500 inhabitants for Japan and Korea, to account for the fact that its national population density exceeds 300 inhabitants per square kilometer.

and administrative purposes. The definition of rural in Vietnam is showed in the Circular No. 54/2009 / TT-BNNPTNT dated August 21st, 2009 of the Ministry of Agriculture and Rural Development. In particular, the rural area is a territory not belonging to the inner city, towns of cities, towns, and townships managed by the grassroots administrative level is the commune people's committee.

According to the report of the Labor Force Survey, the rural population in Vietnam was 60.42 million people (GSO (b), 2011), approximately 69.5% of the national population in 2010 (Figure 2.1). After five years, the rural population seems to be not changed much by 60.89 million people in 2015, approximately 66.4% in the total national population. However, the share of rural population was decreasing in the national population after 5 years, 66.4% in 2015 (Table 2.1). In comparison with the urban area, Vietnam's rural area provides a huge labor force for the economy.

Table 2.1: Population proportion between urban and rural areas in Vietnam, 2010-2015

Year	Urban		Rural	
	Number (<i>thousand persons</i>)	Proportion (%)	Number (<i>thousand persons</i>)	Proportion (%)
2010	26,516	30.5	60,417	69.5
2011	27,888	31.7	59,952	68.3
2012	28,810	32.5	59,966	67.5
2013	29,032	32.4	60,683	67.6
2014	30,035	33.1	60,694	66.9
2015	30,817	33.6	60,887	66.4

Source: Labor Force Survey 2010-2015 (LFS) reports, GSO.

Table 2.2: The structure population aged 15 and over by urban/rural residence and gender in the period 2010-2015

Year	Entire country	Urban/rural residence		Gender	
		Urban	Rural	Male	Female
2010	100	31.2	68.8	48.5	51.5
2011	100	32.8	67.2	48.5	51.5
2012	100	33.3	66.7	48.6	51.4
2013	100	33.2	66.8	48.6	51.4
2014	100	34.0	66.0	48.4	51.6
2015	100	34.2	65.8	48.4	51.6

1) Source: Labor Force Survey 2010-2015 (LFS) reports, GSO.

2) Unit: percent (%).

The total population at the working-age ⁹ counted in the survey was 65.71 million people in 2010 (GSO (b), 2011), and increased by 69.74 million in 2015 (GSO (g), 2016). In which, the population at the working-age in rural areas was 45.22 million in 2010, which accounted for 74.85% of the total rural population (GSO (b), 2011). The population at the working-age in urban areas was 20.49 million in 2010 (GSO (b), 2011), which was 77.01% in the total urban population. Thus, having a high percentage of the population in the working-age is a big pressure for labor and employment in the upcoming years, especially in the rural areas.

Regarding to the structure population at working age, the rural areas had a higher proportion of the population aged 15 and over by 68.8% in 2010; while, the urban areas only occupied 31.2% in 2010 (Table 2.2). Moreover, the rate of the working-age population in the rural areas tended to decrease slightly in the period 2010-2015. The structure of Vietnam's working-age population had a relative balance between the share of males and females in the 2010-2015 period (48.5% and 51.5% respectively). Therefore, it indicates that the rural areas in Vietnam have a huge working age population as well as labor force.

2.2.2. Rural labor force

With a huge working age population (more than 65%), the rural areas have contributed a large labor force for the labor market. The analysis of the rural labor force will show the characteristics of supply labor source from the rural areas. From then, it indicates that the solving employment and finding jobs outside farm activity for rural labor is very important in Vietnam when the farm income is not enough for the standard of living.

The rural labor force ¹⁰ population increased from 36.61 million in 2010 (GSO (b), 2011) to 37.07 million in 2015 (GSO (g), 2016). This occupied around 81% of the total rural population at the ages of 15 and over. Table 2.3 shows the labor force participation rate of population aged 15 and over by urban and rural areas. The labor force participation rates in rural and urban areas were significantly uneven. The average of labor force in urban areas was 70.2% in the period 2010-2015, while this figure was 81% in the rural areas (greater 10.8% than that in urban areas). In addition, the trend of this rates in the rural and urban areas tend to increase slightly in this

⁹ The definition of the International Labor Organization (ILO): Based on the latest international statistical standards, the population of working age in a country may be classified according to their labor force status in a short reference period into three mutually exclusive and exhaustive groups: Persons in employment, persons in unemployment and persons outside the labor force. In Vietnam, the population in working age for males are from 15 to 59 and females are from 15 to 54.

¹⁰ The definition of the International Labor Organization (ILO): The labor force is the sum of persons in employment plus persons in unemployment. Together these two groups of the population represent the current supply of labor to produce goods and services taking place in a country through market transactions in exchange for remuneration.

period. Those figures indicate that the labor force in the rural area is quite huge, thus, this also creates a pressure for the government that to solve employment for this labor force.

Regarding to structure by gender, the Table 2.4 presents the rural labor force participation rate of population aged 15 and over by gender. The number of male labor force is higher than that of female. Thus, the percentage of males participating in the labor force is greater than that of females. The average participation rate in rural labor force of male was approximately 85% in the 2010-2015 period, while this figure of female was lower by 76.8%. Rural men still have many occupational options apart from doing agriculture activities. Meanwhile, rural women take on more responsibilities in family management and rarely have occupational mobility.

Table 2.3: Labor force participation rate of population aged 15 and over by urban/rural, 2010-2015

Year	Urban			Rural		
	Population aged 15 and over (<i>thousand persons</i>)	Labor force (<i>thousand persons</i>)	Labor force participation rate (%)	Population aged 15 and over (<i>thousand persons</i>)	Labor force (<i>thousand persons</i>)	Labor force participation rate (%)
2010	20,491	14,231	69.5	45,220	36,606	81.0
2011	22,023	15,349	69.7	45,142	36,375	80.6
2012	22,701	15,886	70.0	45,495	36,462	80.1
2013	22,813	16,042	70.3	45,875	37,203	81.1
2014	23,551	16,526	70.3	45,793	37,222	81.6
2015	23,841	16,911	71.1	45,895	37,073	81.3

Source: Labor Force Survey 2010-2015 (LFS) reports, GSO.

Table 2.4: Rural labor force participation rate of population aged 15 and over by gender, 2010-2015

Year	Male			Female		
	Population aged 15 and over (<i>thousand persons</i>)	Labor force (<i>thousand persons</i>)	Labor force participation rate (%)	Population aged 15 and over (<i>thousand persons</i>)	Labor force (<i>thousand persons</i>)	Labor force participation rate (%)
2010	21,990.2	18,663.9	84.9	23,229.9	17,942.4	77.2
2011	22,154.7	18,720.7	84.5	22,987.4	17,654.3	76.8
2012	22,314.3	18,788.6	84.2	23,180.7	17,673.4	76.2
2013	22,556.7	19,128.1	84.8	23,318.3	18,074.9	77.5
2014	22,573.8	19,278.0	85.4	23,219.2	17,944.0	77.3
2015	22,348.0	19,197.0	85.9	23,547.0	17,876.0	75.9

Source: Labor Force Survey 2010-2015 (LFS) reports, GSO.

In term of age structure, Table 2.5 shows the rural labor force by aged group in the 2010-2015 period. The main labor force in rural areas almost concentrates to the young and middle-aged groups (aged groups from 20-49). The participation rate in rural labor force of aged groups from 20-49 was 71% in 2010, but a slightly decreasing in 2015 by 66.7%. Thus, in the recent decade, the labor force and working age population of rural area in Vietnam will continue to increase parallel to the labor force aging trend; or the other word, the rural workforce is quite young and dynamic.

Table 2.5: Age structure of rural labor force aged 15 and over, 2010-2015

Age group	2010	2011	2012	2013	2014	2015
15-19	8.0	7.1	5.4	6.1	5.6	5.7
20-24	11.9	10.9	9.6	10.1	9.6	10.1
25-29	12.9	12.3	11.4	11.2	11.2	11.0
30-34	12.2	12	11.5	11.4	11.6	12.0
35-39	12.1	12.1	12.2	11.9	11.7	11.4
40-44	11.3	11.5	12.2	11.8	11.8	11.5
45-49	10.6	11.2	12	11.4	11.1	10.7
50-54	8.5	9.0	9.9	9.8	10.3	10.2
55-59	5.6	6.3	7.3	7.4	7.7	7.8
60+	6.9	7.8	8.5	9.0	9.5	9.7
Total	100	100	100	100	100	100

1) Source: Labor Force Survey 2010-2015 (LFS) reports, GSO.

2) Unit: percent (%).

2.2.3. Labor demand in the labor market

In recent years, along with the economic integration and the transformation of the economic structure towards industrialization and modernization, the demand of Vietnamese labor market is gradually improved and increased. The growth of the economy is an important motivation for the increase in demand of the labor market. Vietnam is considered a strong growth economy with the average economic growth rate of 6.17% per year in the period 2010-2017 (ILSSA, 2018). In addition, the favorable and stable macroeconomic conditions including economic integration, international trade and investment have promoted job creation in Vietnam. In particular, the specific factors have promoted in the increasing of the demand of the labor market in Vietnam which is included the transformation of economy toward market mechanism, the industrialization, modernization and international integration, and the urbanization trend.

Firstly, under the transformation of the economy toward market mechanism, the private and foreign investing sectors have developed and expanded gradually. This created a numerous

employment opportunity for labor market. Regarding to each sector of the economy, Table 2.6 shows the number of employed populations by economic sector in the period 2007-2015. The state-owned sector employed 5.074 million people in 2007. However, this figure slightly fluctuated in the period 2007-2015, decreased by 4.78 million in 2010, increased considerably by 5.336 million in 2012, and then decrease slightly in 2015. Meanwhile, the number of workers in the non-state economic sector (self-employed, household enterprises, and private enterprises) increased significantly in this period. The number of workers in the self-employed was 36.811 million in 2007 and increased to 39.498 million in 2015. The quantity of workers in the private enterprise sector increased dramatically in this period from 2.751 million workers in 2007 up to 5.836 million in 2015. Along with the economic integration and the increasing of foreign investment, the quantity labors work in foreign invested enterprises raised sharply from 968 thousand people in 2007 up to 2.203 million people in 2015.

Table 2.6: Number of employed populations by economic sector in 2007-2015

Economic sector	2007	2010	2012	2015
Self-employed/ household enterprise	36,811	38,820	39,879	39,498
Private enterprise	2,751	3,746	4,362	5,836
State-owned	5,074	4,780	5,336	5,186
Foreign invested enterprise	968	1,756	1,700	2,203

1) Source: Labor Force Survey 2010-2015 (LFS) reports, GSO.

2) Unit: thousand persons.

Secondly, under the industrialization, modernization and international integration, the Vietnam's labor structure shifted from the agriculture sector to industry and service sectors. Before *Doi Moi* policy, there was over 80% of population working in the agriculture sector and rural area. At the beginning of the 21st century, there was a quick change in the sectoral structure of labor market. Table 2.7 indicates a shift in the distribution of employment by three main industrial sectors in the 2005-2015 period. The number of employed labor force in agriculture, forestry and fishery was decreased slightly after ten years. However, agricultural workers accounted for 44% of the workforce in 2015, with a remarkable decline of 11.1 percentage points as compared to 2005. By contrast, the number of the labor force working in the industry and construction and services sectors increased rapidly during this period from 7,524 thousand persons to 12,018 thousand persons in the industry and construction sector and 11,687.7 thousand persons to 17,562.9 thousand persons in the services sector. The share of employment in industry and construction increased from 17.6% to 22.8% and that of services increased 27.3% to 33.2%

in the same period. In brief, the decreasing of labors in agriculture, forestry and aquaculture sector and the increasing of labor in industry and service sectors showed that there was a change of labor market towards the industrialization and modernization in Vietnam.

Table 2.7: Employed population by industrial sector and its structure proportion in 2005-2015

Year	Agriculture, forestry and fishery		Industry and construction		Services	
	Number (thousand persons)	Percent (%)	Number (thousand persons)	Percent (%)	Number (thousand persons)	Percent (%)
2005	23,563.2	55.1	7,524.0	17.6	11,687.7	27.3
2007	23,931.5	52.9	8,565.2	18.9	12,711.2	28.1
2008	24,303.4	52.3	8,985.5	19.3	13,171.9	28.4
2009	24,606.0	51.5	9,561.6	20.0	13,576.1	28.4
2010	24,279.0	49.5	10,277.0	21.0	14,492.5	29.5
2011	24,362.9	48.4	10,718.8	21.3	15,270.2	30.3
2012	24,357.2	47.4	10,896.5	21.2	16,168.7	31.4
2013	24,399.3	46.8	11,086.0	21.2	16,722.5	32.0
2014	24,408.7	46.3	11,229.0	21.5	17,106.8	32.2
2015	23,259.1	44.0	12,018.0	22.8	17,562.9	33.2

Source: General Statistics Office of Vietnam database (2019).

Thirdly, under the urbanization process, there have been a shift of labor from the rural areas to the urban areas. It can be shown clearly in the Table 2.8. In the 1999-2009 period, there was a sharp increase in rural-urban migration, specifically, from 1,215,955 persons to 2,112,071 persons. However, in the period of 2009-2014, this migration flow decreased to 1,642,186 persons in 2014. Instead, there was an increase in urban-to-urban migration and urban-rural migration.¹¹ There are regional differences in rural-urban migration flows. The less developed economic regions such as Midlands and Northern Mountainous Areas, Central Highlands, Mekong River Delta, the rural-urban migration flow is the lowest, with percentages of 5.1%, 3.4%, and 9.3% in 2014, respectively. For the two most developed regions of the country, Red River Delta and Southeastern Area, this migration flow accounts for the highest proportion, in particular 18.1% and 52.2% in 2014 respectively.

¹¹ Source: Population and Housing survey: migration and urbanization report 2014, General Statistics Office of Vietnam (GSO (h), 2016).

Table 2.8: The number and structure of rural-urban migration flows by regions, 1999-2014

	1999		2009		2014	
	Number (person)	Percent (%)	Number (person)	Percent (%)	Number (person)	Percent (%)
Whole country	1,215,955		2,112,071	100.0	1,642,186	100
Red River Delta	-	-	395,053	18.7	296,902	18.1
Midlands and Northern Mountainous Areas	-	-	118,636	5.6	83,959	5.1
Northern and Central Coast	-	-	272,948	12.9	196,386	12.0
Central Highlands	-	-	88,526	4.2	55,120	3.4
Southeastern Area	-	-	1,038,426	49.2	856,723	52.2
Mekong River Delta	-	-	198,483	9.4	153,096	9.3

Source: Population and Housing survey: migration and urbanization report 2014, GSO.

2.3. Policies for development of non-farm employment

Every year, more than 1 million young people are added to the national labor force in Vietnam (Anh, 2006). With having a high percentage of the population working age and labor force, there is a big pressure for the government to solve the labor and employments problem, especially the rural areas. In addition, the migration flow from the rural areas to urban areas takes place quite strongly from the first of 21st century until now in Vietnam. Thus, the promotion to create more jobs and diversify income for farm households is considered one of the targets of socio-economic development.

The economic reform or *Doi Moi* policy after 1986 have created favorable conditions for the development of the non-farm sector in Vietnam. The Vietnamese government considers enacting policies in order to encourage the development of non-farm sector and improve household's income in the rural areas as a prioritized long-term task. These policies aim to create more jobs, diversify rural employment, increase household income, and reduce poverty.

In particular, the Decision No. 132/2000/QD/TTg¹² signed by the Premier Minister on 24th November 2000 obviously reflects this policy. According to the Decision, the rural trades are encouraged to develop, in order to meet the domestic consumption and export demand, to attract labor, reduce poverty and to preserve and promote the traditional culture. The rural trades include

¹² No. 132/2000/QD/TTg is the name of the Decision.

(1) cottage-industrial and handicraft production in the rural areas such as processing and preservation of agricultural, forestry and aquatic products, production of construction materials, wood furniture, bamboo and rattan articles, porcelains and pottery, glassware, textiles and garments, treatment and processing of materials and raw materials in service; (2) production of handicraft and fine art articles; and (3) construction, intra and inter-communal transport and other services. The detailed plans and orientation for the development of the rural trades or non-farm activities are enacted to cope with the market mechanism in a sustainable manner, carry out the agricultural and rural industrialization and modernization, and combine the traditional craft establishments with cultural tourism. These policies also encourage the consumption and use of rural non-farm products and services, particularly products made from local materials such as timber, rattan, bamboo, which could limit the adverse effect of industrial, chemical and plastic products and industrial waste on the environment.

Some specific tools of rural trades development policy are as follows. (1) Some specific regulations on the use and rent of land for the production of rural craft establishments are facilitated and eased. For instance, the State shall permit the conversion of part of the agricultural and forestry land for the development of the rural trades under the land use plannings and plans of the provinces or the centrally-run cities. (2) For raw materials used for production, the policy sets out the regulations on the use and exploitation of raw materials for production more preferred. For instance, the rural craft establishments wishing to exploit raw materials being minerals resources shall be given priority in the granting of exploitation and use permits according to law provisions. (3) For investment and credit, the rural craft establishments shall enjoy investment preferences under the Government's Decree. In addition, a number of regulations on loan conditions and procedures for the rural craft establishments are facilitated and simplified. (4) In taxes and fee, the rural craft establishments shall enjoy preferential tax rates, and any charges and fees contrary to law shall be cancelled and the collection thereof from the rural craft establishments is strictly forbidden. (5) In addition, this Decision raised the other necessary regulations to develop the rural non-farm employments, such as the protection of the intellectual property, technological know-hows, and inventions and innovations, the establishment of local professional associations in order to support for craft establishments, supplying information, marketing, advertising, job training, research and technology transfer.

Moreover, the Vietnamese Government promulgated policies to promote the establishment and development of small and medium enterprises¹³. Developing small and

¹³ Definition of small and medium enterprises (SMEs): SMEs are independent production and business establishments, which make business registration according to the current law provisions, each with registered capital not exceeding VND 10 billion or annual labor not exceeding 300 people.

medium sized enterprises is a significant task in the strategy for socio-economic development and promotion of the industrialization and modernization. The Decree No. 90/2001/ND-CP dated November 23rd, 2001 of the Government on support for development of small and medium sized enterprises. According to this Decree, the regulations and supporting policies toward to small and medium enterprise in order to encourage and create favorable condition for the development of these enterprises. The detailed objectives in this Decree are included (1) bring into play their activeness and creativeness, (2) raise their managerial capability, (3) develop sciences, technologies and human resources, (4) expand their cooperative ties with enterprises of other forms and increase the business results as well as competitiveness on the market, (5) develop production and business, (6) create jobs and improve the laborers life.

In summary, these policies are enacted with the aim that to encourage and create favorable conditions for the development of the non-farm activities, diversification household's income, and improve household life conditions, especially in rural areas.

2.4. The development of non-farm sector in Vietnam's rural area

The Vietnam's rural non-farm sector was expanded and developed gradually after the reform policy or *Doi Moi* policy under the openness of the economy. The openness and market liberalization facilitated for rural households easily to participate into the other activities outside farm activities. The structure of rural economy became more diversified together with the expansion of non-farm sector. The household businesses have become the most important source of job creation in the rural economy (Pham, 2007). Thus, the income from non-farm sector has become an important source of income for rural households in Vietnam.

In the post-renovation period¹⁴ 1993-2002, the development of rural non-farm has been clearly shown in rural Vietnam. The study of Pham (2007) presented the structure of rural employment in Vietnam in 1993-2002 period based on Vietnam Households Living Standard Survey (VHLSS) 1992/93, 1997/98 and 2002 (Table 2.5). According to this study, the employment share of the rural non-farm sector has increased from 21.46% to 32.1% between 1993 and 2002. The expansion of this employment was mainly due to the strong shift of rural economy toward services. The proportion of services employment has risen from 9% in 1993 to 19.24% in 2002. Meanwhile, the non-farm manufacturing activities have constantly contributed around 13% of rural employment in this period.

Regarding by regions, there is also a difference in the rural employment across regions in Vietnam. The map of Vietnam by regions is showed in the Figure 2.1.

¹⁴ The post-renovation period was from after *Doi Moi* policy 1988-2000.



Figure 2.1: Map of Vietnam by regions¹⁵

¹⁵ Midland and Northern Mountainous Areas includes North East and North West regions. Northern and Central Coast includes North Central and South Central Coast regions.

The Midlands and Northern Mountainous Areas and Central Highlands regions are less diversified in rural employments than the other regions. The share of rural non-farm sector in these regions is very low by only from 9.1% to 14.5% in the 1993-2002 period. While, the Southeast and Mekong River Delta are more diversified which the share of rural non-farm employment in both regions is quite high by 40.3% and 38.5% in 2002, respectively. The Red River Delta and South Central Coast regions have shown the rapid growth of the non-farm sector. The share of the rural non-farm employment of Red River Delta increased from 17.2% in 1993 up to 41.3% in 2002, and this figures of South Central Coast rose from 22.1% in 1993 to 40.3% in 2002.

Table 2.9: Structure of Rural employment, 1993-2002

	Agriculture			Manufacturing sector			Services sector		
	1993	1998	2002	1993	1998	2002	1993	1998	2002
Rural Vietnam	78.5	72.0	67.9	12.5	13.6	12.9	9.0	14.5	19.2
Midlands and Northern Mountainous Areas	90.6	88.2	85.5	6.1	6.4	4.1	3.3	5.4	10.5
Red River Delta (incl. Hanoi)	82.8	71.2	58.7	8.9	11.6	17.2	8.3	17.2	24.1
North Central Coast	83.9	70.8	74.7	10.6	15.3	8.3	5.5	13.8	17.0
South Central Coast	77.9	70.8	57.1	11.3	12.6	16.7	10.8	16.6	26.2
Central Highlands	89.4	88.5	82.5	6.1	3.8	7.3	4.5	7.7	10.2
Southeast (incl. HCMC)	51.5	52.3	59.7	27.6	25.3	20.3	20.9	22.4	19.9
Mekong River Delta	69.8	64.5	61.5	18.5	18.2	16.1	11.7	17.3	22.4

Source: Pham (2007), calculations from the VHLSS 1992/93, 1997/98, and 2002.

In the integration period, there have been also witnessed the development of the non-farm sector in rural Vietnam. Table 2.10 indicates the structure of rural households and by regions in 2006-2016 period. In this period, the number of rural non-agriculture households increased double from 3.46 million to 6.32 million (GSO (i), 2012; GSO (j), 2018). The proportion of rural non-agricultural households has increased dramatically from 28.9% in 2006 up to 46.2% in 2016. Meanwhile, the percentage of agriculture, forestry and fishery households have decreased considerably from 71.1% down to 53.9% through ten years.

There is a big difference in the structure of rural households across the county. Red River Delta and Southeastern Areas are two regions which have the highest percentage of rural non-agriculture households. These regions are also the developed regions with the two biggest cities Hanoi and Ho Chi Minh located. Thus, they have high opportunities to participate in non-farm activities. Meanwhile, rural households in Midlands and Northern Mountainous Areas and

Central Highlands regions mainly operate agricultural production activities, just a relatively small percentage of rural households operating in the non-farm sector, by approximately 75-87% and 85-89% in 2006-2016 period, respectively. Both regions are in the mountainous areas and far from the center areas and major cities. Hence, farm households in these regions have low chances to diversify their jobs.

Table 2.10: Structure of rural households by regions in 2006-2016 period

	Agriculture, forestry, fishery households			Non-agriculture households		
	2006	2011	2016	2006	2011	2016
Whole country	71.1	62.2	53.9	28.9	37.8	46.1
Red River Delta	60.5	47.4	35.8	39.5	52.6	64.2
Midlands and Northern Mountainous Areas	87.0	81.2	75.4	13.0	18.8	24.6
Northern and Central Coast	73.7	66.2	56.7	26.3	33.8	43.3
Central Highlands	88.8	86.3	85.0	11.2	13.7	15.0
Southeastern Area	50.8	39.0	31.7	49.2	61.0	68.3
Mekong River Delta	73.1	65.6	58.2	26.9	34.4	41.8

Source: The Rural, Agricultural and Fishery Census 2006, 2011 and 2016 reports.

Regarding the growth of non-agriculture households in the 2006-2016 period, the regions include Red River Delta, Southeastern Areas, Northern and Central Coast, and Mekong River Delta which have the proportion of non-agriculture households increased rapidly. In particular, the growth of number non-agriculture households in Red River Delta region rose from 39.5% to 64.2% in this period, in Southeastern Areas was 49.2% to 68.3%, in Northern and Central Coast was 26.3% to 43.3%, and Mekong River Delta was 26.9% to 41.8% (Table 2.10). This indicates that the transformation of rural economy of these regions changed quite strong together with the integration economic in these regions. While, the percentage of non-agriculture households in Midlands and Northern Mountainous Areas and Central Highlands regions grew slowly through ten years. This rate in Midlands and Northern Mountainous Areas increased only from 13.0% to 24.6% and in Central Highlands was from 11.2% to 15.0% (Table 2.10).

The Labor Force Survey is also conducted by the General Statistic Office which investigates the labor all around the country. The Table 2.11 presents the structure of employment in rural Vietnam and by regions in 2010-2014 period. In this period, the rate of non-agricultural labor in the rural area does not change much by nearly 40% in the total employed rural population.

While, the agriculture labor still occupied mainly in the rural area approximately 60% in the same period.

However, the rural employment structure differs across regions. In Red River Delta and Southeastern regions, the number of workers working in the non-agricultural sector is larger than that of the agricultural sector. In particular, the proportion of non-agriculture employment in Red River Delta slightly fluctuated from 49% to 53% in 2010-2014. This figure in Southeastern regions fluctuates more from 47% to 62% in the same period. Meanwhile, the number of rural workers involved in non-farm activities is quite small in Midlands and Northern Mountainous Areas and Central Highlands regions. The share of non-agriculture labor in rural Midlands and Northern Mountainous Areas was only over 20% and in Central Highlands regions was around 17% in the recent years. Regarding the growth of the rural non-agriculture employment, there was an increasing in Midlands and Northern Mountainous Areas and Northern and Central Coast regions, a decreasing in Red River Delta and Southeastern regions, and a constant in Mekong River Delta and Central Highlands regions during the 2010-2014 period (Table 2.11). Therefore, this indicates clearly that the non-farm activities operated strongly in developed regions.

Indeed, we can see that the rural labors participate into non-farm sector more and more after the reform and the recent years. So, what is the factor leads to the participation more and more of rural labor into non-farm activities? According to Barrett et al. (2001), one of factors to participate into non-farm sector of farm households when non-farm activities offer a higher return compared to farm activities. Table 2.12 shows the comparison in average monthly income of workers in three main industrial sectors in the rural areas in the 2011-2015 period. The statistic results indicate that the average monthly income of labor in agriculture, forestry and fishery sector is lower than the industry and construction and services ones. In addition, the growth of monthly income of rural labor in industry, construction and services sectors was faster considerable than in agriculture, forestry, and fishing ones in the 2011-2015 period. In particular, the average income of workers in agriculture, forestry and fishing sector increased from 2.404 million VND in 2011 to 3.097 million VND in 2015, by grew average 7.2% annual. While, this figure in industry and construction sector raised from 2.906 million VND in 2011 up to 4.246 million VND in 2015, equivalent to an average annual growth of 11.5%. Particularly, the growth of rural labor income in the services sector increased rapidly in this period with the average annual growth rate of 12.7%.

Table 2.11: The rural employment by regions and its structure in Vietnam, 2010-2014

		Agriculture					Non-agriculture				
		2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Rural Vietnam	Number	22,184.7	22,262.9	21,786.1	22,129.5	22,115.1	13,654.8	13,587.1	14,224.0	14,569.5	14,620.9
	Percent	61.9	62.1	60.5	60.3	60.2	38.1	37.9	39.5	39.7	39.8
Midland and Northern Mountains	Number	4,699.6	4,621.4	-	4,605.3	4,623.0	1,156.5	1,394.4	-	1,465.1	1,447.8
	Percent	80.1	77.8	-	77.4	77.3	19.9	22.2	-	22.6	22.7
Red River Delta	Number	3,899.8	4,110.8	-	4,113.0	3,927.5	4,414.2	4,165.5	-	4,395.2	4,459.2
	Percent	46.9	51.0	-	49.3	47.8	53.1	49.0	-	50.7	52.2
Northern and Central Coast	Number	5,729.7	5,557.3	-	5,545.7	5,574.6	2,608.0	2,810.2	-	3,142.4	3,188.0
	Percent	68.7	67.3	-	64.9	64.4	31.3	32.7	-	35.1	35.6
Central Highlands	Number	1,726.9	1,826.7	-	1,763.4	1,839.1	352.7	385.2	-	468.5	477.7
	Percent	83.0	84.3	-	81.5	82.7	17.0	15.7	-	18.5	17.3
Southeastern Area	Number	1,339.5	1,401.7	-	1,559.1	1,550.8	2,187.6	1,655.1	-	1,868.6	1,858.6
	Percent	37.8	52.6	-	47.8	47.8	62.2	47.4	-	52.2	52.2
Mekong River Delta	Number	4,789.2	4,745.0	-	4,543.4	4,601.3	2,935.3	3,176.5	-	3,229.1	3,188.9
	Percent	62.0	60.9	-	59.6	60.4	38.0	39.1	-	40.4	39.6

Source: Labor Force Survey 2010-2014 (LFS) reports, GSO.

Table 2.12: Average monthly income of wage workers in rural areas, 2011-2015

	Agriculture, forestry, and fishing	Industry and construction	Services
2011	2,403.8	2,905.7	2,973.2
2012	2,495.0	3,311.0	3,578.0
2013	2,537.6	3,528.4	4,022.1
2014	2,746.0	3,853.0	4,209.0
2015	3,096.6	4,246.3	4,476.9

1) Source: Labor Force Survey 2011-2015 (LFS) reports, GSO.

2) Unit: Thousand VND.

3) At the price of the calculation year.

In summary, together with the openness economy and integration economic, the non-farm sector has developed and expanded more and more in rural Vietnam. The participation of rural households in non-agriculture activities was increasing after the reform until recent years. This also indicates that the structural transformation of the rural economy has taken place across the country. Particularly, this trend takes place stronger in developed regions.

2.5. The role of non-farm income in rural household income

The diversification of income sources in the rural household is one of the orientations of the Vietnamese Government with the aim to improve household's income and especially reduce the poverty in rural areas. Since the reform policy and opened the economy, the rural labors had more chances to participate in the labor market and diversify their income sources.

In the post-renovation period, when the labor market has started to establish, the non-farm income has gradually shown its role in the farm household's income. The Table 2.13 shows the proportion of income from different source of farm households in Vietnam after the reform 1992-2002 based on Vietnam Households Living Standard Survey. In this period, the farm income was still the main income source in rural households, especially the income from the crop. This income source has decreased dramatically from 56.4% in 1998 down to 48.8%. The non-farm income also played an important role in farm household income which occupied around 30% in the total income. In this period, non-farm income just has increased slightly in 2002. The non-farm income includes the

earnings from non-farm wage and non-agriculture self-employment. There was a different change of two kind incomes in this period. In particular, the non-farm wage has increased rapidly from 6.7% in 1992 up 16.2%. While there was a declining of non-agriculture self-employment income from 24.0% in 1992 to 16.4% in 2002. In short, in the post-renovation period, the non-farm income only plays the second role, after agricultural income.

Table 2.13: Proportion of Income from different source of farm household in Vietnam after the reform, 1992-2002

	1992		1998		2002	
	Returns (thousand VND)	Percent (%)	Returns (thousand VND)	Percent (%)	Returns (thousand VND)	Percent (%)
Farm income	2,139	56.3	5,799	56.36	3,224	48.8
<i>Crop</i>	1,624	48.32	4,233	42.39	2,430	43.23
<i>Livestock</i>	515	7.98	1,566	13.97	795	5.57
Agricultural wage	213	5.48	637	5.59	672	6.18
Non-farm income	3,069	30.68	8,878	30.58	4,920	32.62
<i>Non-farm wage</i>	325	6.66	1,274	9.22	2,445	16.16
<i>Non-agriculture self-employment</i>	2,744	24.02	7,604	21.36	2,475	16.46
Transfer	258	7.1	610	7.14	1,161	10.49
Other	22	0.44	40	0.33	229	1.91
Total income	5,701	100	15,964	100	10,192	100
No. of rural household observations	3,732		4,236		22,330	

1) Source: RIGA based on VHLSS 1992, 1998, 2002.

2) At the price of the calculation year.

In the first years of 21st century until now, thanks to policies to encourage the rural employment diversification, the role of non-farm was increasing in the total farm household income. Table 2.14 presents the structure of monthly income per capita by sources of income in rural areas of Vietnam in the 2004-2012 period. The rate of income from agriculture, forestry and fishery source in the total monthly income per capita in rural areas has tended to decrease during this period. Namely, this rate was 42.0% in 2002 and reduced to 31.8% in 2012. While the percentage of income source from industry, construction, trade, and services did not change much through ten years by around 18% in the total monthly income per capita. The wage income includes agriculture wage and non-agriculture wage. This income source was increasing rapidly in this period from 26.0% in 2004 up to 38.4% in 2012. This indicates that the participation of farm households into off-farm activities more and more.

The Figure 2.2 shows the structure of rural households by main income sources the 2006-2016 period based on the Vietnam Rural, Agricultural and Fishery Census¹⁶. In 2006, the number of households with the largest income from agriculture, forestry and fishery still accounts for the largest proportion in rural areas. However, this figure tends to decrease in the 2006-2016 period. After ten years, the proportion of households with income sources from agriculture, forestry and fishery decreased from 67.8% in 2006 down to 57.1% in 2011 and 49.0% in 2016. The proportion of households with the main source of income from non-agricultural activities increased rapidly during this period, from 32.2% in 2006 and surpasses this percentage of the agriculture, forestry, and fishery activity in 2016 by 51.0%. In particular, the proportion of households with the main income from industrial and construction activities increased the most, accounting for 11.3% in 2006 up to 17.3% in 2011 and 22.7% in 2016 (The Rural, Agricultural and Fishery Census 2006, 2011 and 2016 reports). The increase in this percentage from services activities is considerable in this period from 15.2% to 20.4%. These results reflect the production development trend and the income of farm households no longer depends too much on agricultural production.

¹⁶ The Rural, Agricultural and Fishery Census is conducted to investigate overall households in the rural areas in Vietnam.

Table 2.14: Monthly income per capita by source of income in rural areas, 2004-2012

	2004		2006		2008		2010		2012	
	Income	Percent	Income	Percent	Income	Percent	Income	Percent	Income	Percent
Agriculture, forestry and fishery income	158.5	42.0	199.7	39.4	300.3	39.4	357.5	33.4	502.7	31.8
Wage income	98.1	26.0	140.0	27.7	216.4	28.4	389.5	36.4	607.1	38.4
Income from industry, construction, trade and services	66.9	17.7	88.4	17.6	135.4	17.7	210.7	19.7	294.5	18.6
Others	54.6	14.3	77.6	15.3	110.1	14.5	112.7	10.5	175.1	11.2
Total income	378.1	100	505.7	100	762.2	100	1,070.4	100	1,579.4	100

1) Source: Vietnam Households Living Standard Survey (VHLSS) 2012 report, GSO.

2) At the price of 2012.

3) The unit of income is thousand Vietnam Dong.

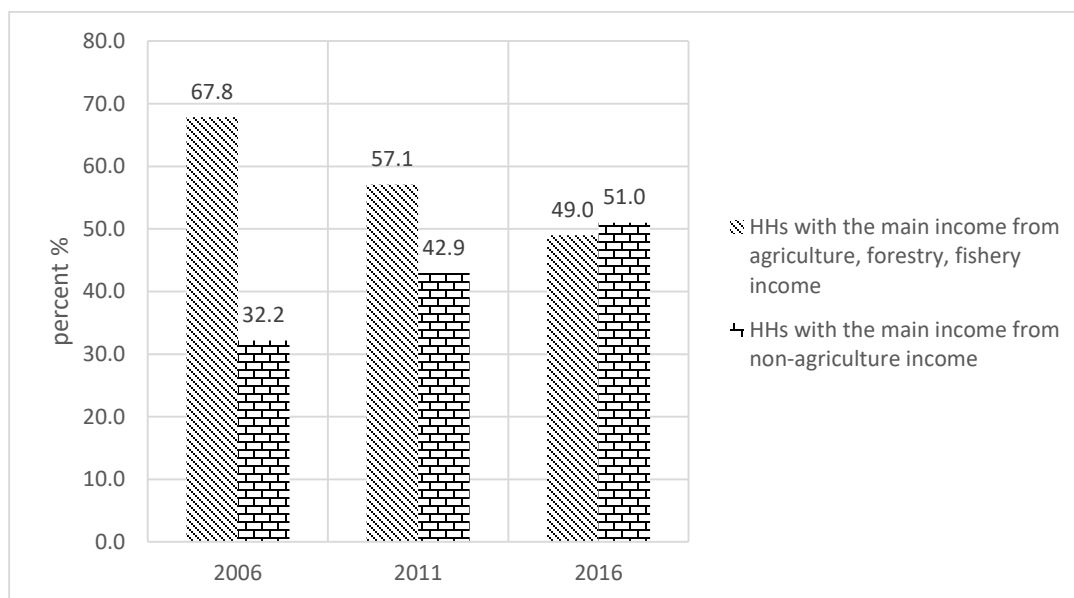


Figure 2.2: Structure of rural households by main income source in the 2006-2016 period

Source: The Rural, Agricultural and Fishery Census 2006, 2011, 2016 reports.

The number of rural households by main income sources by regions and its structure is presented in the Table 2.15. All areas in the country have an increase in the number of households with the main source of income from off-farm activities in the 2006-2016 period. Almost areas in the country have a decrease in the number households with the main income from agriculture, forestry, fishery income except Midlands and Northern Mountainous Areas and Central Highlands. In particular, this figure hasn't changed in Midlands and Northern Mountainous Areas, and also has increased in Central Highland for ten years. However, the change in structure of rural households by main income sources in this period differs across regions. In particular, the percentage of households with the main income source from non-agriculture activities was highest and increased rapidly in Red River Delta and Southeastern regions. This rate rose from 46.5% to 72.1% in Red River Delta and from 49.3% to 68.3% in Southeastern Area in 2006-2016 period. Moreover, this proportion also increased strongly in Northern and Central Coast from 29.92% to 50.3% in the same period. In Midlands and Northern Mountainous Areas and Central Highlands region, the percentage of households with the main income source from non-agriculture activities was very low and slightly increased in the same period, by 16.3% to 31.7% and 11.3% to 15.3% in both regions, respectively.

Table 2.15: The number of rural households by main income source by regions in 2006-2016 period

		Number households with the main income from agriculture, forestry, fishery income			Number households with the main income from non-agriculture income		
		2006	2011	2016	2006	2011	2016
Whole country	Number	9,338,930	8,755,381	7,833,863	4,429,542	6,588,471	8,154,512
	%	67.8	57.1	49.0	32.2	42.9	51.0
Red River Delta	Number	1,876,631	1,413,184	1,117,621	1,634,444	2,428,973	2,885,672
	%	53.5	36.8	27.9	46.5	63.2	72.1
Midlands and Northern Mountainous Areas	Number	1,666,621	1,676,489	1,638,425	325,494	548,337	760,553
	%	83.7	75.4	68.3	16.3	24.6	31.7
Northern and Coastal Central Region	Number	2,375,477	2,190,521	1,857,317	1,010,178	1,465,806	1,878,820
	%	70.1	59.9	49.7	29.9	40.1	50.3
Central Highlands	Number	651,433	743,132	808,012	83,174	119,549	146,254
	%	88.7	86.1	84.7	11.3	13.9	15.3
Southeastern Area	Number	572,182	557,100	490,144	557,510	872,482	1,056,508
	%	50.7	39.0	31.7	49.3	61.0	68.3
Mekong Delta	Number	2,206,568	2,174,955	1,922,344	818,742	1,153,324	1,426,905
	%	72.9	65.3	57.4	27.1	34.7	42.6

Source: The Rural, Agricultural and Fisher Census 2006, 2011 and 2016 reports.

In summary, the structure of rural households has a transformation from agriculture, forestry, and fishery households to non-agriculture households. The income of households in the rural areas no longer depends too much on agricultural production. The earning from non-farm works has gradually become an important source of income for farm households.

2.6. Conclusion

In summary, this chapter described an overview of the non-farm sector in Vietnam. The background of Vietnam's labor market is presented in this chapter in order to understand the supply and demand of the labor market in recent years, especially the supplied labor of rural areas. The result showed that the rural areas provided a huge labor for the economy. However, this also created a big pressure for the government on labor and employment, especially for rural workers when land for cultivation cannot increase as fast as a labor force or for landless households. Thus, it indicates that the demand for jobs outside agriculture activity has been increasing over time. In addition, this chapter revealed the increase in the demand of the labor market due to the transformation of economy toward market, the industrialization, modernization and international integration, and the urbanization trend. The assessment results of the labor market implied on the potential development of the non-farm sector in rural Vietnam.

Moreover, some of policies to encourage and create favorable conditions for the development of the non-farm activities was introduced in this chapter.

This chapter described the development of rural non-farm sector from the post-renovation period until the recent years. The result showed that the rural labors who worked in the non-agricultural activities have increased slightly in the post-reform period. In the integration period, there have been witnessed strong development in the non-farm sector in Vietnam's rural areas with the dramatic increase of the proportion of rural non-agricultural households. Especially, the non-farm activities have developed strongly and fastly in the developed regions as Red River Delta and Southeastern Area. Thus, the role of this income source is increasing the total income of farm households.

Chapter 3

The impact of non-farm sector on agricultural production

3.1. Introduction

As the analysis in the previous chapter, the non-farm sector has developed and expanded since the first years of 21st century in Vietnam. The role of non-farm income is increasing in the total income of rural households. Thus, whether the non-farm sector affect Vietnam's agricultural production when the participation into this sector is increasing of farm households? Is it has a negative or positive or nil effect on farm activities? Especially, in case of developing country as Vietnam when the markets are imperfect or failure, how is the relationship between agricultural production and non-farm sector? This chapter addresses one of main objectives of the study, that is, investigate the impact of non-farm sector on agricultural production of farm households. In particular, this study investigate whether non-farm income facilitates household spending on agricultural inputs, namely, purchased inputs, hired machines, and hired labor. In addition, this chapter analyzes this impact by six regions because of the difference of geographical characteristics and the opportunity to participate in the non-farm employment.

The remaining of this chapter is organized as follow. Section 2 and 3 discusses the conceptual framework and the empirical methodology. The fourth section describes the data used in this study. In section 5 and 6, we present the estimation results and provide conclusive remarks.

3.2. Conceptual framework

The conceptual framework for this study is based on the agricultural household model which was proposed by Singh et al. (1986) and was used and developed by Chavas et al. (2005) and Pfeiffer et al. (2009). In this model, farm's household production, consumption and labor allocation decisions are interdependent. The framework is justified evidences of labor and credit market imperfections for farm and non-farm activities in developing countries. Singh et al. (1986) supposed that increased off-farm income can influence production and consumption in households facing labor and/or liquidity constraints.

Following to Chavas et al. (2005), we consider a farm household making production, consumption and labor allocation decisions during a specific time period. We call L_f is the amount of family labor used working on farm agricultural production of members in the household, and L_{nf} is

the amount of off-farm labor used by family members, generating non-farm income (N). T is the total amount of time available to any family member, and equal to the total on-farm labor (L_f), off-farm labor (L_{nf}) and the time of leisure activities (x_l).

If the substitution household's agricultural labor to hired labor is imperfect because of higher transaction costs, then household may not be able to easily replace family members who have off-farm works (Pfeiffer et al., 2009). Thus, the family labor input into agricultural production cannot exceed the total family members time (T) minus off-farm work and leisure time (Pfeiffer et al., 2009).

$$L_f + L_{nf} + x_l = T \quad (3.1)$$

The equation (3.1) is called the labor constraint of households.

Consider production activities of farm household can be written as a function $Q(L_f, X, K)$ of family labor (L_f), other inputs (X) such as fertilizers and hired labor, and fixed capital (K) including land to produce farm output (Q). According to Pfeiffer et al. (2009), if credit is not available or the credit market is imperfect, expenditures on inputs for agricultural production (including hired labor) cannot exceed own exogenous income and savings (S) plus income received from off-farm work (N),

$$p_x X \leq S + N \quad (3.2)$$

where p_x is the price for inputs X .

The equation 3.2 is the type of liquidity constraint.

Given that farm household consumes goods z , purchased at market price q . Household's income is created by working on-farm and selling the output, working off-farm, the exogenous cash or savings. Consumption decision of household are made subject to the following budget constraint, which states that consumption expenditures cannot exceed farm revenue (PQ), minus production cost ($p_x X$), plus non-farm income (N) and savings (S). That is:

$$qz \leq PQ(L_f, X, K) - p_x X + N + S \quad (3.3)$$

where P is the output price.

In summary, the linkage between farm and non-farm activities of a farm household is showed in the interdependent among production, consumption and labor allocation decisions under the imperfection of the market. The behaviors of household in consumption (including purchased agricultural production inputs) and production are depended on the labor constraint and credit constraint. The increasing of participation in non-farm sector of household's members, hence, affects to household's agricultural production activity and consumption. Particularly, in the context of market imperfections or market failures, off-farm income can have both direct and indirect impacts on agricultural production activities (Pfeiffer et al., 2009).

3.3. Data

All data used in this study are from the Vietnam Living Standards Survey 2012 (VHLSS, 2012) conducted by the General Statistics Office of Vietnam. This survey was arranged in collaboration with the World Bank. The sample used by the survey was stratified by urban and rural regions. In this study, we only use the rural data. There are 6,696 rural households in the survey. However, this article only focuses on the rural farm households that participate in agricultural, forestry, and aquaculture activities. We aggregate the three primary sectors (agriculture, forestry, and aquaculture) to evaluate the effect of non-farm employment on all farm activities, not only on a specific sector. We included forestry and aquaculture samples in the analysis because the forestry and aquaculture activities also belong to farm activities. In addition, in Vietnam, the forestry sector also includes planting forest and aquaculture includes growing aquaculture. Thus, both sectors also purchase the inputs for production activity such as fertilizer, seed in planting forest and breed, feed in growing aquaculture. The expenses inputs are also important in both production activities of forestry and aquaculture sectors.

Some farm households in the survey report missing values for agricultural family labor and are, therefore, discarded. These missing values exist due to some households, the agricultural activity is not the primary nor the second main job. Therefore, those households were not investigated. In addition, we rely on the VHLSS (2012) for the identification of suitable instrumental variables (IVs). The commune survey collects the socio-economic characteristics of the communes, which can be used as instruments in our models. The final number of households in this study is 4,823.

Table 3.1 reports the descriptive statistics for the dependent and independent variables included in the analysis as well as the general characteristics of the farm households in the country.

Table 3.1: Descriptive statistics of the variables used in the analysis

	Explanation	Whole country
<i>Dependent variables</i>		
Purchased inputs	The total purchased inputs expenses including seed, young animals, fertilizer, feed, herbicide, pesticide, and medicines (million VND)	19.95
Hired Machine	Hired machines cost (million VND)	1.65
Hired Labor	Hired labor cost (million VND)	2.42
<i>Household socio-economic characteristics variables</i>		
Head's gender	male=1, female=0	0.83
Head's age	Years	48.92
Head's education	Completed years of schooling	6.68
Household size	Number of household members	4.04
Ethnicity	<i>Kinh</i> =1, other ethnicity=0	0.74
Male labor	Number of male workers	1.22
Female labor	Number of female workers	1.43
<i>Land</i>		
Farm land	Hectare (including crop land, forest land, water surface, garden, and shifting cultivation farm land)	0.86
<i>Non-farm variable</i>		
Non-farm income	Million VND	40.94
<i>Regional dummy variables</i>		
RRD	Red River Delta	0.22
MNM	Midland and Northern Mountainous (base region)	0.24
NCC	Northern and Central Coast	0.24
CHL	Central Highland	0.07
SEA	Southeastern Area	0.05
MRD	Mekong River Delta	0.18
<i>Instrumental variables</i>		
Factory/manufacture location	The factory or manufactory or traditional occupation village is located near the commune from which people commute every day. Yes=1, no=0.	0.65
Time_Town	The time distance from the commune to the nearest town (minute)	31.79
Time_City	The time distance from the commune to the nearest city (minute)	86.58
Number of observations		4,823

1) Source: VHLSS 2012.

2) VND is Vietnam's currency (Vietnamese Dong).

3) 1 million VND = 47.62 US\$ in 2012 (calculated based on *tradingeconomics.com*).

3.4. Empirical methodology

3.4.1. Econometric model

The objective of our analysis is to examine the relation between the participation in non-farm employment and agricultural production. Our study concentrates on agricultural input expenses for all farm production activities and addresses three primary sectors: agriculture, forestry, and aquaculture. The dependent variables for input expenses are expressed in purchased inputs, hired machines, and hired labor. The primary explanatory variable is the non-farm income of farm households.

The value of input expenses can be equal to zero because some farm households use self-supplied inputs and do not hire machines and labor. Hence, some observations take a value equal to zero with a positive probability, but the dependent variable is a continuous random variable over strictly positive values (Wooldridge, 2013). To deal with the zeroes dependent variables, we applied the Tobit model for a corner solution response. The structural equation in the Tobit model reads as follows:

$$y_i^* = \beta X_i + \varepsilon_i, \quad (3.4)$$

where, $\varepsilon_i \sim N(0, \sigma^2)$, and y^* is a latent variable that is observed for values greater than zero. The observed y_i is defined as:

$$y_i = \begin{cases} y^* & \text{if } y^* > 0, \\ 0 & \text{if } y^* \leq 0. \end{cases}$$

where y_i is the dependent variable.

Hence, the relation between the non-farm sector and agricultural input expenses is calculated by the following regression equation:

$$Input_exp_i = \beta_0 + \beta_1 NF_i + \beta_2 \mathbf{Z}_i + \varepsilon_i, \quad (3.5)$$

where,

Input_exp_i is the dependent variable and represents agricultural input expenses for purchased inputs, hired machines, and hired labor of all three primary sector agriculture, forestry, and fishery. In which, the total purchased inputs expenses include seed, young animals, fertilizer, feed, herbicide, pesticide, and medicines costs.

NF_i is the non-farm income in the total earnings from non-farm jobs of all members of a household in million VND.

The coefficient ***β₁*** indicates the parameter of the non-farm income.

Z_i is a vector of variables that comprises the socio-economic characteristics of the *i*-th farm household and regional dummy variables.

Z_{i1} is the household head's gender dummy variable, which takes a value equal to one if the head of the household is male.

Z_{i2} is the household head's age.

Z_{i3} is the education level of the household head, denoted by the number of completed years of schooling of the household head.

Z_{i4} is the household size, namely, the total number of members of the household.

Z_{i5} is an ethnicity variable: it is a dummy variable that equals one if the household head is of *Kinh* ethnicity, the dominant racial identity of Vietnamese people, and zero for other minority ethnicities.

Z_{i6} is the number of male workers in the household.

Z_{i7} is the number of female workers.

Z_{i8} represents the size of farmland.

We also introduced regional dummy variables in the model, and we choose Midland and Northern Mountainous Areas as the base region.

ε_i is the error term.

In order to investigate the difference in the impact of the non-farm sector on the expenditure in agricultural production by regions, we also estimate the effect of non-farm income on agricultural input expenses by regions. Thus, in the econometric model by regions, we remove the regional dummy variables out of the estimation model. Because regional dummy variable is insufficient to evaluate the impact of non-farm income on the agricultural inputs expenses, it just could explain with the comparison to the base region (Midland and Northern Mountainous Areas). While, the analysis by regions could explain obviously the result based on the difference of regional characteristics.

The participation in non-farm activities is not exogenously determined in our model specification. The possible endogeneity of non-farm participation could influence agricultural input expenditure, thus leading to inconsistent estimation results. The endogeneity problem implies that non-farm variables (NF_i) are correlated with the error term (ε_i). To treat this problem, we apply the instrumental variables (IV) approach. The IV framework tries to identify variables that are uncorrelated with ε_i but correlated with non-farm income variables and have no direct effect on agricultural input expenses. In other words, each instrument needs to satisfy two conditions, namely, instrumental relevance and instrumental exogeneity. This enables consistent estimation. A single endogenous regression equation estimates the relation between the instruments and non-farm income, as follows:

$$NF_i = \lambda_0 + \lambda_1 Z_i + \lambda_2 I_i + \mu_i, \quad (3.6)$$

where,

NF_i and Z_i have been previously defined,

I_i is a vector of instruments,

μ_i is the error term.

μ_i is uncorrelated with ε_i . Hence, we can express it as: $\varepsilon_i = \alpha \mu_i + \xi_i$, where $\xi_i \sim N(0; \sigma_{\varepsilon|\mu}^2)$, as ξ_i is uncorrelated with μ_i and has zero mean. This approach jointly estimates two equations using maximum likelihood (Kilic et al., 2009). The likelihood function for the Tobit model with endogenous regressor is expressed as follows:

$$\ln L_i = \ln f(y_i | NF_i, Z_i, I_i) + \ln f(NF_i | Z_i, I_i), \quad (3.7)$$

where $\ln L_i$ is the log likelihood for observation i

$f(\cdot)$ is the joint density.

Finally, the IV-Tobit is applied in our study to determine the corner solution for the dependent variables and treat the endogenous regressor.

3.4.2. Instrumental variables

We identified three instruments that satisfy the two conditions mentioned above. The first instrument, factory/manufacture location, is a dummy variable that takes a value equal to one if communes have a factory or manufactory or traditional occupation village located nearby, and zero otherwise. The proximity of a factory or traditional occupation village to the commune facilitates the participation of households in non-farm employment.

The second instrument, Time_Town, is the time distance from the commune to the nearest town by private or public transportation. The last instrument, Time_City, is the time distance from the commune to the nearest city or provincial capital. These variables could explain the potential household's opportunities for participation in non-farm employment, which depends on whether they live near a town or city and the convenience of the travel time. The relevant data were obtained from the commune survey of Vietnam Living Standards Survey 2012 (VHLSS 2012), conducted on 2,218 communes. However, several surveys reported incomplete answers, which led to a significant reduction in the sample size of both communes and households.

3.4.3. The average partial effect (APE)

The partial effects of Tobit models are less straightforward than those obtained by a linear model because the Tobit is non-linear. According to Wooldridge (2013), in the Tobit or IV Tobit models, the partial effect on the expected value (censored and uncensored observations) is calculated as follow:

$$\frac{\partial E(y|X)}{\partial X_i} = \Phi\left(\frac{X\beta}{\sigma}\right) \beta_i, \quad (3.8)$$

where $\Phi(\cdot)$ represents the cumulative normal distribution function.

$\Phi(X\beta/\sigma)$ is the scale factor and is always between zero and one because $0 < \Phi(X\beta/\sigma) < 1$ for any values of the explanatory variables.

X is a vector of explanatory variables, and σ is $\sigma_{e|\mu}$.

The average partial effect (APE) indicates a unit change in an independent variable X_i that affects all zero and non-zero observations and can be computed as follow:

$$APE = n^{-1} \sum_{i=1}^n \Phi \left(\frac{X\beta}{\sigma} \right) \beta_i. \quad (3.9)$$

3.5. Estimation results

3.5.1. First-stage regression

Table 3.2: First stage regression

	Non-farm income	
	Estimation	S.E.
<i>Household socio-economic characteristics</i>		
Head's gender	-2.479	[1.57]
Head's age	0.149***	[0.05]
Education	2.075***	[0.18]
Household size	5.449***	[0.58]
Ethnicity	13.081***	[1.58]
Farm land	-5.407***	[0.49]
Male labor	9.974***	[1.07]
Female labor	5.812***	[1.22]
<i>Regional dummy (base region = MNM)</i>		
RRD	8.573***	[2.13]
NCC	-3.241*	[1.70]
CHL	-10.994***	[1.82]
SEA	9.108***	[3.39]
MRD	-2.796	[1.86]
<i>Instrumental variables</i>		
Time_Town	-0.057**	[0.02]
Time_City	-0.025**	[0.01]
Factory/manufactory location	7.787***	[1.26]
Constant	-27.043***	[4.33]
Number of observations	4,823	
R ²	0.25	
F-test for instruments	22.96***	

1) ***, **, * indicate statistical significant at 1%, 5%, 10% level, respectively.

2) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: Southeastern Area, MRD: Mekong River Delta.

3) Values in parentheses indicate robust standard errors.

4) Author's estimation.

The table 3.2 reports the first stage regression estimation of the non-farm income equation. It shows the relevance of the instruments. The result indicates that three instrumental variables (Time_Town, Time_City, and factory/manufactory location) are highly significant. As expected, the time distances from the commune to the nearest town and city have a negative impact on non-farm income. The location of factory or manufactory near the commune is positively associated with non-farm income. The F-test demonstrates the relevance condition of all instruments. The result of this test is 22.96 (greater than 10) which indicates that these instruments are strong instrumental variables.

3.5.2. The effect of non-farm sector on agricultural input expenses

The results regarding the influence of the non-farm income on agricultural input expenses are presented in Table 3.3. As discussed above, we examine the impact of non-farm activities on purchased inputs, hired machines, and hired labor expenses for agricultural production. We compute the robust standard errors clustered at the commune level to avoid the intragroup correlation. The number of observations equal to zero for purchased inputs, hired machines, and hired labor expenses is 123, 1,918, and 2,429, respectively. Both the Two Stage Least Square (2SLS) and IV Tobit estimations address all three kinds of agricultural inputs expenditures.

In the 2SLS model, robust standard errors are indicated in the estimation. The results show that non-farm income only has a positive effect on purchased agricultural inputs and hired machines cost, while the coefficient on hired labor is not statistically significant. The coefficients on purchased inputs in both 2SLS and IV Tobit regressions are nearly equal. On the other hand, these figures are different for hired machines and hired labor. This may reflect the fact that the number of observations equal to zero for hired machines and hired labor is large, while this figure for purchased inputs is small.

The results of the IV Tobit model indicate that the coefficients on the non-farm income variables for all three agricultural expenses are positive and significant. The coefficients on purchased inputs, hired machines, and hired labor are 0.524, 0.237, and 0.167, respectively. This indicates that the earnings from non-farm activities have a positive effect on agricultural input expenses, hiring machine cost, and hired labor cost in farm households in Vietnam.

The coefficients on the male labor variable are negative in the hired machines and hired labor models, while the coefficient on female workers is only significant in the hired machines model. This indicates that a higher number of male family workers reduces the cost of hired machines and hired labor. Thus, male labor seems to be the primary source of labor for farm activities. In addition, agricultural expenses increase when the cultivated land size increases.

Table 3.3: Effect of non-farm activities on agricultural input expenses

Independent variables	Purchased Inputs		Hired Machines		Hired Labor	
	2SLS	IV Tobit	2SLS	IV Tobit	2SLS	IV Tobit
<i>Non-farm variables</i>						
Non-farm income	0.501*** [0.13]	0.524*** [0.14]	0.044*** [0.01]	0.273*** [0.07]	0.034 [0.03]	0.167** [0.08]
<i>Household socio-economic characteristics variables</i>						
Household head's gender	2.421 [2.53]	2.834 [2.59]	0.184 [0.15]	0.923* [0.54]	0.427 [0.33]	2.427*** [0.85]
Household head's age	-0.099 [0.08]	-0.084 [0.09]	-0.005 [0.01]	-0.045** [0.02]	-0.036** [0.01]	-0.066** [0.03]
Education	-0.301 [0.34]	-0.176 [0.36]	-0.084** [0.04]	-0.548*** [0.16]	-0.060 [0.09]	-0.303* [0.20]
Household size	-1.405 [0.82]	-1.476 [0.88]	-0.079 [0.09]	-1.276*** [0.39]	-0.136 [0.20]	-1.076** [0.46]
Ethnicity	8.943** [2.82]	8.713** [3.03]	0.189 [0.35]	-2.301** [1.28]	2.536*** [0.62]	2.871* [1.56]
Farm land	10.088*** [1.16]	10.812*** [1.22]	1.372*** [0.19]	2.927*** [0.52]	2.349*** [0.38]	4.786*** [0.73]
Male labor	-1.397 [2.24]	-1.778 [2.32]	-0.368** [0.18]	-2.544*** [0.78]	-0.456 [0.43]	-1.663** [0.99]
Female labor	-0.443 [2.15]	-0.343 [2.22]	-0.233 [0.15]	-1.435*** [0.59]	-0.137 [0.43]	-0.173 [0.81]
<i>Regional dummy (base region = MNM)</i>						
RRD	-7.875** [3.88]	-8.246** [3.98]	0.843*** [0.26]	-0.107 [1.02]	0.291 [0.53]	1.256 [1.36]
NCC	-7.241*** [2.53]	-7.963*** [2.60]	0.887*** [0.17]	2.443*** [0.63]	1.046* [0.46]	4.674*** [1.30]
CHL	10.414*** [2.54]	10.071** [2.61]	0.915*** [0.25]	4.166*** [0.95]	4.288*** [0.61]	11.428*** [1.59]
SEA	-1.687 [8.00]	-3.086 [8.11]	-0.493 [0.44]	-4.949*** [1.69]	3.835*** [1.13]	4.753*** [2.14]
MRD	6.755** [3.08]	3.717 [3.32]	3.519*** [0.33]	4.351*** [0.74]	2.383*** [0.44]	7.365*** [1.17]
Constant	-1.486 [6.17]	-4.194 [6.62]	-0.819 [0.64]	1.650 [2.44]	-1.021 [1.13]	-12.763*** [3.39]
Number of observations	4,823	4,823	4,823	4,823	4,823	4,823
Centered R_squared	-0.122		0.004		0.054	

Uncentered R_squared	0.015	0.129	0.095
Zero observations	123	1,918	2,429
Positive observations	4,700	2,905	2,394
Wald test of exogeneity χ^2	18.56***	15.99***	5.44**
Weak identification test	22.959	22.959	22.959
Overidentification test (Hansen J statistic χ^2)	1.931	4.585	0.808
p-value	0.381	0.101	0.668

1) ***, **, * indicate statistical significance at the 1%, 5%, 10% level, respectively.

2) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: Southeastern Area, MRD: Mekong River Delta.

3) The values in the parentheses indicate the robust standard errors clustered at the commune level.

4) Instrumental variables: Factory/manufacture location, Time_Town, Time_City.

5) Author's estimation.

The parameters of household head's gender show that head's gender has no effect on the purchasing inputs, while male household head tends to spend more on hiring machines and hiring labor for agricultural production activity. The age of household head also does not influence the purchasing inputs. However, households whose head are older less spending on hired machine and hired costs than younger ones. The education level of household head seem to not effect on the agricultural expenses. The coefficients of household size indicate that large farm households spend less hired machines and hired labor costs.

The result of ethnicity variable shows a positive significant in cases of purchased inputs and hired labor. It means that *Kinh* households tend to purchase more agricultural inputs and hired labor cost for production than others minorities. The reason could be that the farming practices of minor ethnicities are shifting cultivation with less use inputs. In addition, the minor ethnicities mainly live in the remote areas and far away from the town, city, and center areas. Thus, they face many difficulties and limitations in access to agricultural input markets as well as new farming techniques. While, the coefficients of ethnicity in hired machine equation are negatively significant in IV-Tobit model and is not significant in 2SLS model. It indicates that ethnicity seems to be no effect for hired machines cost in agricultural production.

For the regional dummy variables, the coefficients of CHL and MRD are positively significant. It means that both regions spend the purchased inputs, hired machines and hired labor in agricultural production higher than MNM region. NCC region has negatively significant in purchased inputs equation and positively significant in the hired machines and hired labor equations. It implies

that this region spends a lower purchased inputs cost and higher hired machines and hired labor cost than MNM region. While, the parameters of RRD are negatively significant in the purchased inputs model and not statistically significant in the hired machines and hired labor models. The parameters of SEA are not statistically significant in the purchased inputs model, negatively significant in the hired machines model, and positively significant in the hired labor model. However, the mean of purchased inputs, hired machines, and hired labor expenses of RRD and SEA regions are higher than MNM region. The non-farm income and non-farm participation rate of those two regions also are higher than the remaining regions (see Table 3.4). It indicates, for the developed regions where high opportunity participation in non-farm employment, this income source may be sufficient to guarantee for farm living, hence, the investment more in farm activity seem not be necessary.

Table 3.4: Agricultural inputs expenses, non-farm income per household and its share by regions

	Purchased inputs (million VND)	Hired Machine (million VND)	Hired Labor (million VND)	Non-farm income (million VND)	Non-farm participation rate (%)
Whole country	20.0	1.6	2.4	40.9	73.0
RRD	18.8	1.4	1.2	58.9	85.6
MNM	15.3	0.4	0.5	29.8	63.6
NCC	13.8	1.3	2.2	40.3	70.2
CHL	26.3	1.5	5.8	21.4	72.3
SEA	31.9	1.4	7.1	49.7	83.0
MRD	29.9	4.2	4.0	40.6	71.5

1) Source: VHLSS 2012.

2) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: Southeastern Area, MRD: Mekong River Delta.

The Wald test of exogeneity on the Chi-squared of the instrumented variables was performed on all three IV Tobit regressions. The null hypothesis is the absence of endogeneity in the estimation. The results of the Wald test in the three models are all significant at the 1% level. This means that the null hypothesis is rejected, that is, non-farm income is an endogenous variable. Thus, our estimation based on IVs to treat the endogeneity problem is adequate.

The weak identification test and overidentification test of the validity of the instruments are performed on 2SLS regression. The value of Stock-Yogo (2002) weak identification test statistics is 22.959. P-value of this statistic is almost equal to 0.10. From this result we consider the null

hypothesis of weak identification is almost rejected. The overidentification test Hansen J statistic are 1.931 with p-value 0.381 for purchased inputs; 4.585 with p-value 0.101 for hired machines; and 0.808 with p-value 0.668 for hired labor. The joint null hypothesis that the instruments are valid instruments is not rejected for purchased inputs, hired machines, and hired labor equations.

3.5.3. The average partial effect (APE)

From Equation (3.9), we can deduce the average partial effect of a change in non-farm income on the spending on agricultural inputs and other costs (Table 3.5).

Table 3.5 shows the result of the average partial effect of non-farm income on agricultural expenses for all households. The t-values of the average partial effect of non-farm income on purchased inputs, hired machines, and hired labor are calculated. The t-value is high in the purchased inputs case, and low in the hired machines and hired labor cases. This implies that the APE of the purchased inputs is statistically significant, while those for the hired machines and hired labor are not statistically significant. Therefore, the result indicates that an additional VND in non-farm income leads to a 0.412 VND increase in the spending on purchased agricultural inputs.

Table 3.5: Average partial effect of non-farm income on agricultural expenses of all households

	Average partial effect	S.D.	t-value	p-value (one-tail)
Purchased inputs	0.412	0.159	2.591	0.005
Hired Machine	0.107	0.116	0.922	0.178
Hired Labor	0.037	0.055	0.673	0.250

1) Author's calculation.

Overall, our results confirm the impact of non-farm income on agricultural input expenses. Farm households that participate in the non-farming sector use this source of income to invest more in agricultural inputs such as seeds and fertilizer. The investment in these high-yielding inputs aims to raise the agricultural output as well as productivity and production efficiency. On the other hand, the use of this source of income for hiring machines and labor seems limited because these costs are somewhat secondary. The mechanization of agricultural production is still limited in Vietnam, especially in small farms. Thus, farmers tend to use simple equipment more than machines. Hiring labor for production is also not necessary for small farms. Finally, our analysis is consistent with the hypothesis that non-farm income can relax the credit constraints on agricultural production.

3.5.4. The effect of non-farm sector on agricultural input expenses by regions

The opportunity to participate in non-farm activities differs across the six regions because of geographical differences. The investment of inputs into agricultural production is supposed significant differences across regions. Given the marked difference across the country, it leads to questioning whether the relationship between farm and non-farm sectors is difference across the six regions. The results for the IV Tobit for each of the regions are showed in the below tables.

(1) *Red River Delta*

From Table 3.6, the results of non-farm income variable in Red River Delta are all insignificant in all three purchased inputs, hired machines, and hired labor models. This implies that the non-farm activities have no effect on farm activities in this region. The coefficient of household head's age is (-0.332) and significant at the 5% significance level in the purchased inputs model. The head's households who younger invest the purchased inputs (such as seed, breed, fertilizer, feed, pesticide...) more than the older ones. The ethnicity variable is significant in purchased inputs and hired machines models. This shows that the *Kinh* households spend the expenditure on purchased inputs and hired machines more than the minor ethnicities ones. In addition, the parameter of female labor variable is only significant in hired labor model. It indicates that if farm households have higher female family labor spend more hired labor cost in agricultural production activity than the fewer female labor households.

The number of zero observations in all three models are 6, 199, and 567 observations, respectively. This figure of hired machines cost is relatively low observations in comparison to other regions. This implies that farm households in this region tend to hire the machine for agricultural production more than the other regions.

Table 3.6: The effect of non-farm activities on agricultural input expenses in Red River Delta

Dependent variables (IV Tobit)	Purchased Inputs	Hired machines	Hired labor
Non-farm income	0.327 [0.38]	-0.003 [0.08]	-0.049 [0.17]
<i>Household socio-economic characteristics variables</i>			
Household head's gender	-0.941 [6.21]	0.179 [0.51]	2.979* [1.63]
Household head's age	-0.332** [0.15]	-0.012 [0.02]	-0.051 [0.07]
Education	0.014 [1.36]	0.015 [0.26]	0.414 [0.61]
Household size	-2.789 [3.59]	-0.008 [0.84]	-1.210 [1.82]
Ethnicity	17.990* [10.22]	3.891** [1.77]	8.833 [6.26]
Farm land	19.21 [12.96]	1.442 [1.76]	3.509 [4.10]
Male labor	0.335 [7.21]	0.326 [1.16]	0.877 [2.50]
Female labor	7.620 [6.98]	0.087 [0.54]	3.278* [1.84]
Constant	-6.852 [20.32]	-3.252 [4.87]	-17.191 [12.16]
Number of observations	1,058	1,058	1,058
Zero observations	6	199	567
Positive observations	1052	859	491

- 1) ***, **, * indicate statistical significance at the 1%, 5%, 10% level, respectively.
- 2) The values in the parentheses indicate the robust standard errors clustered at the commune level.
- 3) Instrumental variables: Factory/manufacture location, Time_Town, Time_City.
- 4) Author's estimation.

(2) Midland and Northern Mountainous Areas

The results of the effect of the non-farm sector on agricultural input expenses in Midland and Northern Mountainous Areas are presented in Table 3.7.

Table 3.7: The effect of non-farm activities on agricultural input expenses in Midland and Northern Mountainous

Dependent variables (IV Tobit)	Purchased Inputs	Hired machines	Hired labor
Non-farm income	0.353* [0.21]	0.068** [0.03]	0.057 [0.04]
<i>Household socio-economic characteristics variables</i>			
Household head's gender	7.570*** [2.52]	0.511 [0.35]	1.267** [0.57]
Household head's age	-0.211** [0.08]	-0.011 [0.01]	-0.025 [0.02]
Education	-0.365 [0.52]	-0.137 [0.09]	-0.16 [0.12]
Household size	-0.748 [0.85]	-0.283*** [0.10]	-0.169 [0.15]
Ethnicity	9.012 [5.89]	-0.582 [0.74]	0.525 [0.96]
Farm land	2.868*** [1.00]	0.085 [0.13]	0.846*** [0.31]
Male labor	1.410 [2.46]	-0.308 [0.32]	-0.369 [0.42]
Female labor	0.305 [2.37]	0.019 [0.22]	-0.249 [0.30]
Constant	4.493 [5.30]	0.054 [0.95]	-2.133* [1.29]
Number of observations	1159	1159	1159
Zero observations	4	650	731
Positive observations	1155	509	428

1) Same for table 3.6.

The coefficients of non-farm income variable are significantly positive in purchased inputs and hired machines models. It means that non-farm income has a positive effect on the expenditure on agricultural production. The parameters of the household head's gender variable are significantly positive in purchased inputs and hired labor models. Households whose heads are male tend to invest

agricultural inputs and hire workers in production activity more than female ones. The result of the age of household head is negative significant in purchased inputs model which implies that the head's households who younger invest the purchased inputs more than the older ones. The coefficient of household size also has a negative effect on hired machines cost. This indicates that households with large size spend fewer hired machines cost than the small size ones.

The number of zero observations in the expenses of hired machines and hired labor in this region are relatively high compared to other regions, by 650 and 731 observations, respectively. This indicates the less developed in agricultural production of this region with many farm households do not use the machine in farm production. Because of the characteristics of mountainous areas, farm households are almost poor and always face the credit constraint, thus, they meet many difficulties in the investment into agricultural production.

(3) Northern and Central Coast region

In Northern and Central Coast region, the effect of non-farm income is positively significant in the models of hired machines and the hired labor and insignificant statistically in purchased inputs model (Table 3.8). This indicates that the more participation in non-farm activities, the more spending in hired machines and hired labor in agricultural production of farm households.

The coefficient of the household head's gender variable is significantly positive in the purchased inputs model. It means that the male household head tends to expense for agricultural purchased inputs in production activity more than female ones. Meanwhile, the result for the household head's age is all negative significant in three models. The households whose head are younger spend the agricultural inputs expenditure in agricultural production more than the older ones. The coefficients of the household size variable show a negatively effect on hired machines and hired labor costs. The large household size less pays for hired machines and hired labor cost in agricultural activity. The male labor variable is negative in the hired machines which shows the higher the number of male labor in farm household, the less in spending hired machines expense. The number of zero observations in all three models are 24, 358, and 553 observations, respectively. This figure of hired machines cost is relatively low which indicates hiring the machine is quite important in agricultural production activity of households in this region.

Table 3.8: The effect of non-farm activities on agricultural input expenses in Northern and Central Coast

Dependent variables (IV Tobit)	Purchased Inputs	Hired machines	Hired labor
Non-farm income	0.341 [0.26]	0.289** [0.13]	0.916** [0.44]
<i>Household socio-economic characteristics variables</i>			
Household head's gender	4.946** [2.08]	1.699 [1.20]	6.920 [4.41]
Household head's age	-0.166** [0.08]	-0.073* [0.04]	-0.307** [0.15]
Education	0.469 [0.52]	-0.476** [0.23]	-1.736** [0.86]
Household size	-2.606 [1.85]	-1.878** [0.86]	-5.445** [2.63]
Ethnicity	4.716 [5.92]	-3.615 [2.95]	-12.839 [9.18]
Farm land	5.938*** [1.39]	1.525*** [0.57]	4.778*** [1.79]
Male labor	0.298 [2.91]	-2.02* [1.23]	-7.120 [4.64]
Female labor	-0.583 [2.51]	-1.122 [1.03]	-3.979 [3.86]
Constant	2.648 [10.73]	8.008 [5.29]	20.187 [16.52]
Number of observations	1145	1145	1145
Zero observations	24	358	553
Positive observations	1121	787	592

1) Same for table 3.6.

(4) Central Highland

The impact of non-farm sector on agricultural input expenses in Central Highland is presented on the Table 3.9. The results show an insignificant statistically in all three models. This implies that the non-farm activities have no effect on farm activities in this region. The coefficient of ethnicity variable is only positive significant in the purchased inputs model. This indicates that the *Kinh* households tend to spend the expenditure on purchased inputs more than the minor ethnicities ones. In addition, the estimation results show a positively effect of farm land on the expenditures of

purchased inputs and hired machines. The number of zero observations in the expenses of hired machines and hired labor are relatively high compared to the total observations of the region by respectively 150 and 130 observations in a total of 364 observations. This shows that the agricultural production of this region less use of machinery and mainly relies on family labor.

Table 3.9: The effect of non-farm activities on agricultural input expenses in Central Highlands

Dependent variables (IV Tobit)	Purchased Inputs	Hired machines	Hired labor
Non-farm income	0.709 [0.63]	0.159 [0.12]	0.310 [1.82]
<i>Household socio-economic characteristics variables</i>			
Household head's gender	-1.410 [7.32]	-0.339 [0.88]	0.819 [4.36]
Household head's age	-0.042 [0.13]	0.004 [0.02]	-0.044 [0.06]
Education	-0.287 [0.87]	-0.13 [0.17]	-0.168 [2.26]
Household size	-0.653 [2.09]	-0.130 [0.33]	-1.017 [4.43]
Ethnicity	18.524** [8.50]	-1.871 [1.34]	2.654 [18.43]
Farm land	14.430*** [4.43]	1.590* [0.82]	7.763 [12.21]
Male labor	-1.612 [3.94]	-0.958 [0.64]	-2.537 [6.84]
Female labor	-0.763 [3.96]	-0.143 [0.64]	1.244 [4.00]
Constant	-9.269 [10.16]	-1.742 [1.66]	-9.000 [7.30]
Number of observations	364	364	364
Zero observations	5	150	130
Positive observations	359	214	234

1) Same for table 3.6.

(5) Southeastern Area

Table 3.10 represents the estimation result of the effect of non-farm activities on agricultural input expenses in Southeastern Area. The result shows an insignificant statistically in all three estimation models (purchased inputs, hired machines and hired labor). The participation of farm households into non-farm activities has no impact on the expenditure of agricultural inputs. The coefficients of farm land variable are positive significant in the purchased inputs and hired labor models. The other variables are not significant statistically in all three models.

Table 3.10: The effect of non-farm activities on agricultural input expenses in Southeastern Area

Dependent variables (IV Tobit)	Purchased Inputs	Hired machines	Hired labor
Non-farm income	0.568 [0.95]	1.780 [4.09]	0.246 [0.42]
<i>Household socio-economic characteristics variables</i>			
Household head's gender	-20.139 [24.52]	31.118 [64.69]	0.113 [8.90]
Household head's age	1.014 [1.18]	-0.093 [0.39]	-0.144 [0.16]
Education	-2.175 [2.10]	-3.118 [5.49]	-1.024 [0.83]
Household size	-8.724 [11.03]	-19.130 [43.96]	-3.456 [4.57]
Ethnicity	14.365 [21.76]	-37.93 [95.19]	11.396 [11.94]
Farm land	16.005* [9.56]	16.063 [35.92]	11.534* [4.52]
Male labor	8.423 [16.04]	-27.715 [66.65]	-4.061 [7.94]
Female labor	-0.167 [10.82]	-2.583 [12.47]	-0.208 [3.47]
Constant	-37.669 [45.15]	30.136 [84.78]	-11.913 [14.75]
Number of observations	229	229	229
Zero observations	6	165	115
Positive observations	223	64	114

1) Same for table 3.6.

The number of zero observations in the expenses of hired machines and hired labor are relatively high compared to the total observations by respectively 165 and 115 observations in a total of 229 observations. In comparison to other regions, Southeastern Area is a developed region, near the biggest city, convenient transportation network, and with high income per capita. Thus, farm households may have their own machine, they do not need to hire the machine for agricultural production.

(6) Mekong River Delta

Table 3.11: The effect of non-farm activities on agricultural input expenses in Mekong River Delta

Dependent variables (IV Tobit)	Purchased Inputs	Hired machines	Hired labor
Non-farm income	1.594*** [0.58]	0.011 [0.37]	0.105* [0.06]
<i>Household socio-economic characteristics variables</i>			
Household head's gender	8.355 [7.69]	-0.1 [1.40]	0.694 [0.80]
Household head's age	-0.042 [0.21]	-0.042 [0.07]	-0.026 [0.02]
Education	-0.91 [1.22]	0.001 [0.59]	-0.056 [0.12]
Household size	2.457 [3.16]	0.986 [0.88]	-0.26 [0.30]
Ethnicity	-5.427 [8.72]	-1.611 [3.62]	-1.704 [1.17]
Farm land	30.240*** [4.49]	6.093*** [2.22]	3.820*** [0.53]
Male labor	-24.590*** [8.95]	-0.681 [4.52]	-0.982 [0.87]
Female labor	-15.842* [8.96]	0.354 [3.77]	-0.529 [0.81]
Constant	-15.541 [18.28]	-5.486 [6.43]	-1.003 [1.94]
Number of observations	868	868	868
Zero observations	78	396	333
Positive observations	790	472	523

1) Same for table 3.6.

In Mekong River Delta, the effect of non-farm sector on agricultural production is represented in the Table 3.11. The estimation result reveals that non-farm income has a positive effect on purchased inputs, hired labor expenses and no effect on hired machines expenses in agricultural production. Thus, the non-farm sector affects on agricultural production in the positive way in Mekong River Delta region. The parameters of farm land variable are all significant in three models. The number of zero observations in all three models are relatively low by 78, 396, and 333 observations, respectively. This result indicates that farm households tend to use the machine and hired labor for agricultural production through the rental market. Because Mekong River Delta is the largest delta of Vietnam and contributes a high quantity to rice and other agricultural products export, hence, mechanization in agriculture is gradually developing and improving to bring high productivity.

Table 3.12 reports the aggregation results on effect of non-farm sector on agricultural input expense by regions. The results indicate that the effect of non-farm income on agricultural input expenses in Midland and Northern Mountainous (MNM), Northern and Central Coast (NCC), and Mekong River Delta (MRD) regions are significant positive. These two regions are the less developed regions in the country; and the participation rates of rural labor in the non-farm works are lowest by 63.6% in MNM, 70.2% in NCC, and 71.5% in MRD (Table 3.4) in comparison to the other regions. For the less developed regions in Vietnam, when the opportunity of the participation in the non-farm sector is low, farm households still depend on agricultural income and also face to the credit constraints in production. Therefore, the non-farm income can help farm households to overcome the lack of credit and improve household agricultural income through investment.

Table 3.12: The aggregation on effect of non-farm activities on agricultural input expense by regions

Dependent variables (IV Tobit)	RRD	MNM	NCC	CHL	SEA	MRD
Purchased Inputs	0.327	0.353*	0.341	0.709	0.568	1.594***
Hired Machine	-0.003	0.068**	0.289**	0.159	1.780	0.011
Hired Labor	-0.049	0.057	0.916**	0.310	0.246	0.105*
Number of observations	1058	1159	1145	364	229	868

1) ***, **, * indicate statistical significant at 1%, 5%, 10% level, respectively.

2) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: Southeastern Area, MRD: Mekong River Delta.

The results for Red River Delta (RRD) and Southeastern Area (SEA) regions are all insignificant. This indicates that the non-farm activities have no effect on farm activities in both regions. They are the most developed regions in Vietnam with two biggest cities are located, that is, Hanoi City and Ho Chi Minh City. Thus, there has the high opportunity for farm labor to access the employment outside the farm. Although the average of non-farm income and non-farm participation rate of two regions are highest in comparison with other regions (Table 3.4), in particular, the participation rate in non-farm activities of farm households in RRD and SEA are 85.6% and 83.0%, respectively. It is obvious from the Table 3.13 that the farm households that the non-participation households in non-farm sector invest more into agricultural production than the participation households. Thus, for developed regions, the income sources from non-farm sector may be sufficient to guarantee for farm household living, and the investment more in farm activities seems not be necessary.

Table 3.13: The mean value of agricultural expenses by the participation and non-participation in non-farm activities by regions

Regions	Purchased Input		Hired machine		Hired Labor	
	Participation	Non-participation	Participation	Non-participation	Participation	Non-participation
RRD	16.29	33.62	1.41	1.26	1.24	1.01
MNM	16.13	13.82	0.50	0.33	0.56	0.50
NCC	14.39	12.44	1.31	1.22	2.50	1.53
CHL	29.42	18.37	1.43	1.57	7.13	2.28
SEA	26.00	60.46	1.28	1.92	6.15	11.69
MRD	28.51	33.32	4.00	4.77	4.12	3.76

1) Source: VHLSS 2012.

2) The unit is million VND.

3) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: Southeastern Area, MRD: Mekong River Delta.

Similarly, the result of Central Highland are also not significant in all three models. However, in this region, the non-farm activities are less developed than the two areas RRD and SEA, and the agricultural production is the main activity. The average non-farm income of farm household is lowest compared to other regions, only 21.4 million VND. Meanwhile, the average of farm income is 51.6 million VND. We can see that the earnings from non-farm works occupies a small percentage in the

total household's income, by 29.6%. Therefore, the income from farm can cover for consumption as well as re-invest into agricultural production. Indeed, the non-farm sector has no effect on farm production in this region.

3.6. Conclusion

This study attempts to examine the relation between farm household participation in non-farm activities and agricultural expenditures in Vietnam. In particular, we assess the agricultural expenses including purchased inputs (such as seeds, fertilizer, breed, feed, herbicide, and pesticide), hired machines, and hired labor. Our results confirm a significant and positive relation between participation in non-farm activities and agricultural expenses in Vietnam. This result indicates that Vietnamese farm households access other income sources through the non-farm sector and spend these earnings for agricultural production, in particular, to purchase agricultural inputs, hire machines, and hire labor to compensate for family labor.

The results of the average partial effect of non-farm income on agricultural inputs expenses indicate that an additional VND of non-farm income leads to a 0.412 VND increase in agricultural inputs spending. However, our findings show that farm households did not use the non-farm income for hiring machines and labor. Although our research is not a direct test of whether farm households are credit constrained, the estimation results seem consistent with this hypothesis. Non-farm income is thought to relax liquidity constraints in Vietnam. There seems to be a significant synergy between agriculture and non-farm sectors. Access to non-farm income sources facilitates farm households in achieving optimal use of inputs or adopting new technologies in agricultural production, thus enhancing productivity.

The preceding analyses suggest that while non-farm participation helps farm households overcome credit constraints, however, our other finding also indicates that the effect of non-farm sector differs across regions. In particular, non-farm income was not spent for agricultural activities the developed regions such as Red River Delta and Southeastern Area. On the other hand, farmers in the less developed regions such as Midland and Northern Mountainous, Northern and Central Coast, and Mekong River Delta tend to spend the non-farm income to invest in the agricultural production. This implies that the non-farm income helps to ease liquidity constraint in farm production. Nevertheless, for developed regions where high opportunity participation in non-farm activities, this income source is sufficient to guarantee for consumption of households, hence, the demand for increasing farm income is low.

Chapter 4

The impact of non-farm sector on agricultural value-added and production efficiency

4.1. Introduction

Vietnam's agricultural sector has notched impressive achievements in agricultural yield, output, exports, and growth in the last period. The openness and liberalization of Vietnamese market after the reform has also played a crucial role for the development of the non-farm sector. However, the growth of the Vietnamese agricultural sector has lagged the non-agricultural sector, and non-agricultural income has grown more rapidly than agricultural income (Stampini and Davis 2009). The shift of household labor from farm activity to non-farm activities might affect agricultural outcome. Thus, how has Vietnamese agriculture maintained its competitive position in global agricultural production at the same time as its non-farm sector has expanded and developed in recent years? In Vietnam, little attention has been paid to analysis of the relationship between the non-farm sector and agricultural production efficiency. In this study, we attempt to investigate how the non-farm sector affects agricultural output and efficiency in the context of imperfect markets and the development of Vietnam's rural economy. In particular, the objective of this chapter is to estimate the effect of the non-farm sector on agricultural value-added and production efficiency.

The remainder of this chapter is organized as follows. In Section 2, we present the methodology applied in this study. In Section 3 and, we explain the data and empirical model sketching the relationship between the non-farm sector and value-added and efficiency. In Sections 5, and 6, we present the estimation results and conclusion, respectively.

4.2. Methodology

The methodology applied in this study encompasses direct and indirect methods: estimation of the value-added production function and stochastic production frontier. The estimation of the production function is a direct approach that investigates the effect of the non-farm sector on agricultural value-added. The stochastic production frontier analysis is an indirect approach consisting of two stages of estimation that aid analysis of the impact of non-farm activities on production efficiency.

4.2.1. Production function

The Cobb–Douglas production function is considered a suitable method to estimate the effect of non-farm variables on output. We use the Cobb–Douglas production function model with both conventional and non-conventional inputs. The estimation equation of the production function is as follows.

$$Y_i = \beta_0 + \beta X_i + \gamma W_i + \eta_i \quad (4.1)$$

where Y_i is the output or agricultural value-added of the i -th farm;

X_i is a vector of conventional inputs used by farm i ;

W_i represents non-conventional inputs, such as household characteristics and managerial ability (represented by the education level of household heads), which are known to the household when they decide capital and labor; and

η_i represents the disturbance term, or any shock affecting output that is unknown, and is assumed to be independent of inputs.

4.2.2. Stochastic Production Frontier Analysis

Stochastic production frontier analysis is an appropriate method to estimate the efficiency of production for this study. The stochastic production frontier model introduces a noise term that represents the measurement error and exogenous shocks beyond the control of production units. The production frontier and technical efficiency can be estimated in two stages. The first-stage estimates the stochastic production frontier model. In the second stage, the effect of the non-farm sector on production efficiency can be identified by estimating the inefficiency model.

The stochastic production frontier approach was first proposed by Aigner et al. (1977) and Meeusen and Van den Broeck (1977). The stochastic frontier production function is defined as

$$Y_i = f(X_{ij}; \beta) \exp(V_i - U_i) \quad (4.2)$$

where Y_i is the output of the i -th farm; X_{ij} is input j used by farm i ;

β is a vector of parameters to be estimated; and

V_i is a disturbance associated with the stochastic effects outside the firm's control (e.g., weather, natural disasters, luck, and measurement errors in production).

The random error V_i is assumed to be independently and identically normal distributed as $N(0, \sigma_v^2)$. σ_v^2 is the variance of V_i . U_i represents the technical inefficiency of agricultural production, which is assumed to be non-negative and independently distributed (Coelli et al. 2005). The distribution of term U_i is half-normal or exponential or gamma (Aigne et al. 1977; Meeusen and Van

den Broeck 1977). We assume the term U_i follows a half-normal distribution, $N(0, \sigma_u^2)$. V_i and U_i are assumed to be independent. Following Battese and Coelli (1995), the technical inefficiency term U_i is specified by

$$U_i = \delta Z_i + \mu_i \quad (4.3)$$

where Z_i is a vector of explanatory variables of the i -th farm. δ is a vector of parameters to be estimated. μ_i is a disturbance term following identically distribution.

The parameters of β of the stochastic production frontier model (2) are estimated by maximum likelihood. The likelihood function consists of the joint density function of V_i and U_i . Aigner et al. (1977) suggested that the maximum-likelihood estimates of the parameters of the model can be obtained in terms of the parameterisation, $\lambda = \sigma_u / \sigma_v$ and $\sigma^2 = \sigma_u^2 + \sigma_v^2$.

According to Battese and Corra (1977), the ratio of variance parameter γ , which represents the variability sensitivity of U_i to total variance σ^2 , can be calculated as follows: $\gamma = \sigma_u^2 / \sigma^2$. The value of γ is bounded between 0 and 1 ($0 \leq \gamma \leq 1$). A value of γ to 0 indicates that the deviation from the frontier is entirely due to noise, and a value of 1 indicates that all deviations are due to technical inefficiency.

Following Jondrow et al. (1982), the value of technical inefficiency (U_i) for the half-normal model can be computed directly with the following equation:

$$E[U_i | \varepsilon_i] = \frac{\sigma \lambda}{1 + \lambda^2} \left[\frac{\phi(z_i)}{1 - \Phi(z_i)} - z_i \right]$$

where, $z_i = \frac{\varepsilon_i \lambda}{\sigma}$, $\varepsilon_i = V_i - U_i$.

$\phi(\cdot)$ represents the standard normal probability density, $\Phi(\cdot)$ represents the cumulative normal probability distribution function.

Technical efficiency of an individual farm is defined in terms of the ratio of observed output Y_i to the corresponding frontier output Y_i^* , given the levels of inputs used by that farm (Battese 1992). Therefore, in the context of the stochastic frontier production function, the technical efficiency is estimated by using $E[U_i | \varepsilon_i]$ as follows:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{f(X_i; \beta) \exp(V_i - U_i)}{f(X_i; \beta) \exp(V_i)} = \exp(-\hat{U}_i) \quad (4.4)$$

$\hat{U}_i$ is the predicted value of U_i .

4.3. Data

For statistical purposes, this study refers to the Vietnam Household Living Standard Surveys 2012 (VHLSS 2012). This survey of household living standards was conducted by the General Statistics Office of Vietnam within the framework of the World Bank's Living Standard Measurement Surveys (LSMS). In the VHLSS 2012, 9,399 households were interviewed, comprising 2,703 urban households and 6,696 rural households.

In this research, we choose households that were engaged in agricultural, forestry, and aquaculture activities. We aggregate the output of the three primary sectors—agriculture, forestry, and aquaculture—because we want to evaluate the impact of the non-farm sector on the output and production efficiency of farm activities. Households with missing values for family labor are eliminated. There are missing values for family labor in the dataset, because in some households, agricultural activity is not the main or even second main job. Thus, family labor for agricultural production of those households was not investigated. We also use the commune survey of the VHLSS 2012 for instrumental variables (IVs). This survey investigated the socio-economic characteristics of the communes to facilitate the choice of IVs. However, some communes have missing values. Therefore, the number of households in our analysis is reduced to 4,823.

4.4. Empirical model

4.4.1. Empirical model

The purpose of our empirical analysis is to answer whether the non-farm sector affects production efficiency and value-added from agricultural activities. The non-farm variables used in this analysis include non-farm income and non-farm participation of the household head or spouse. For the estimation strategy of the non-farm sector on farm value-added, we use the following production function model, specified as

$$\ln Y_i = \beta_0 + \sum_{j=1}^5 \beta_{1j} \ln X_{ij} + \sum_{j=1}^5 \beta_{2j} D_{ij} + \sum_{k=1}^{13} \beta_{3k} Z_{ik} + \beta_4 N_i + \varepsilon_i \quad (4.5)$$

where, Y_i is value-added in thousand Vietnamese dong (VND) of agricultural (including crops, livestock, and agricultural services), forestry, and aquaculture production activities of household i . Value-added is defined as the total agricultural output revenue minus the cost of intermediate inputs, including seed breeds, fertilizer, pesticide, herbicide, energy, and other intermediate costs. Hence, the input variables of value-added estimation include land, labor, and capital. We estimate the value-

added model to control the differences of technical efficiency resulting from the agricultural product mix.

X_{ij} ($j=1,\dots,5$) is input j used for the i -th farm household, in which:

X_{i1} is family agricultural labor, measured by working days. Family agricultural labor is calculated by the total working days of members in a family who undertake farming activities. Labor input consists of the most time-consuming job (main job) and the second most time-consuming job (supplementary job) in agriculture, forestry, and aquaculture activities.

X_{i2} is farmland, which is the total farmland area in hectares.

X_{i3} is the fixed asset depreciation cost;

X_{i4} is the hired machine cost; and

X_{i5} is the hired labor cost.

D_{ij} are dummy variables that take the value one if the i -th input quantity is zero, except family labor. A number of households have input values of zero. Because it is impossible to calculate the log of zero, we introduce dummy variables. The values of dummy and $\log(X_{ij})$ variables of such inputs are redefined as follows:

$$D_{ij} = \begin{cases} 1 & \text{if } X_{ij} = 0 \\ 0 & \text{if } X_{ij} > 0 \end{cases}$$

Therefore, we set the value of $\log(X_{ij})$ as follows:

$$\log(X_{ij}) = \begin{cases} \log(X_{ij}) & \text{if } X_{ij} > 0 \\ 0 & \text{if } X_{ij} = 0 \end{cases}$$

Z_{ik} ($k=1,\dots,13$) are variables representing the socio-economic characteristics of i -th farm households and regional dummy variables.

Z_{i1} is the household head's gender dummy variable, which takes the value one if the head is male.

Z_{i2} is the head's age.

Z_{i3} is the education level of the household head, denoted by the number of completed years of schooling of the household head.

Z_{i4} is household size, or the total number of members of the household.

Z_{i5} is an ethnicity variable; it is a dummy variable that equals one if the household head is of *Kinh* ethnicity, the major racial identity of Vietnamese people, and zero for other minority ethnicities.

Z_{i6} is extension services; it is a binary variable that takes one if farmers perceived a benefit from extension services in agriculture, forestry, and fisheries and zero for farmers that did not perceive a benefit or did not know.

Z_{i7} is a policy support variable representing policy support in agricultural production for farm households, such as support in machinery, production inputs (fertilizer, breed animals, and seedlings). It equals one if farmers benefitted from the policy and zero for farmers that did not benefit or did not know about the policy.

Z_{i8} is a credit variable representing the total farm household credit borrowed from banks and other financial institutions for agriculture, forestry, and fisheries production during the year.

Z_{ik} ($k = 9, \dots, 13$) are regional dummy variables. We choose Midland and Northern Mountainous Areas as the base region. ε_i is the disturbance term.

N_i represents the non-farm variables, including non-farm income or non-farm participation of the household head or spouse. Non-farm income is the total earnings from non-farm jobs of all members of a household in million VND. The non-farm participation of the household head or spouse is a dummy variable. It takes the value of one if the household head or spouse participates in non-farm work, and otherwise zero.

To estimate the relationship between the non-farm sector and production efficiency, we apply a stochastic frontier production function as the first stage. The production frontier represents the maximum output attained from the combination of inputs. Farm households that produce on the frontier are technically efficient, and those below the frontier are inefficient. The utilization of the stochastic frontier approach allows us to compute each agricultural household's degree of technical inefficiency. The Cobb–Douglas stochastic frontier production function model is specified as follows.

$$\ln Y_i = \alpha_0 + \sum_{j=1}^5 \alpha_{1j} \ln X_{ij} + \sum_{j=1}^5 \alpha_{2j} D_{ij} + V_i - U_i \quad (4.6)$$

In the second stage, we estimate the inefficiency model in order to measure the impact of non-farm income and non-farm participation on production efficiency. The effect is computed by the following regression equation:

$$U_i = \delta_0 + \sum_{k=1}^{13} \delta_{1k} Z_{ik} + \delta_2 N_i + \mu_i \quad (4.7)$$

4.4.2. Estimation strategy

The estimation of equations (4.5) and (4.7) is challenging because the participation in non-farm activities is not a random process and non-farm variables are not exogenous but endogenous. The main econometric issue that we need to take care of is the endogenous nature of participation in

the non-farm sector. To deal with this problem, we deploy the IV method as the estimation strategy. The endogeneity problem is that non-farm variables (N_i) are correlated with the error term (μ_i). The IV framework attempts to find suitable proxy variables that are uncorrelated with μ_i and correlated with non-farm variables but have no direct effect on the outcome. This in turn enables consistent estimation. A single endogenous regression equation is expressed as follows:

$$N_i = \lambda_0 + \lambda E_i + \lambda_1 I_i + \xi_i \quad (4.8)$$

where, E_i is a vector of exogenous variables that include household characteristic variables (gender, age, household size, etc.) and regional dummy variables. I_i is a vector of IVs.

We choose three IVs to treat the endogeneity problem of non-farm variables. The first instrument, Time_Town, is the commuting time from the commune to the nearest town. The second instrument, Time_City, is the commuting time from the commune to the nearest city or provincial capital. The unit of both instruments is minutes, and both assume that the mode of commute is private or public transport. We propose that the time taken for a household member to travel from the village to the nearest town or city could be good instruments for non-farm activities. These variables could explain the potential opportunities for participation in non-farm employment of households if they live near a town or city and the convenience of travel time. To obtain these data, we use the commune survey of VHLSS 2012, conducted in 2,218 communes. However, there are a number of missing values, reducing the sample size of both communes and households. The last instrument is the education of the household head. The purpose of using education as an IV is to justify the model. Education is considered important for non-farm participation in theory. Potential participation in non-farm work and the magnitude of non-farm income depend greatly on the level of the household's education. Hence, the education variable also correlates to non-farm variables. However, the education level seems to correlate more with both non-farm participation and agricultural outcome. This might not satisfy the relevance condition of the instrument. According to the statistics, the education level of households that participate in non-farm activities is higher than those that do not participate, by 7.03 and 5.74 grades respectively. This finding implies that a higher education level is necessary to participate in non-farm activities, while a high education level is not required for agricultural production. Thus, the correlation between the education variable and non-farm variables may be stronger than the correlation between education and agricultural outcome (which are agricultural output and efficiency, in this case). To adjust the models, we use education as an IV.

Table 4.1 presents the descriptive statistics of the dependent variables, independent variables, and IVs used in estimating the production function, stochastic frontier, and inefficiency models.

Table 4.1: Descriptive statistics of variables

Variables	Explanation	Mean	Min	Max
Value-added	Thousand VND	36,776	45	1,196,440
<i>Production input variables</i>				
Family agricultural labor	Day	743	5	2118
Farmland	Hectare (e.g. crop land, forest land, water surface, garden, and shifting cultivation farmland)	0.86	0	9.7
Fixed asset depreciation	Thousand VND	1,072	0	71,190
Hired machine	Thousand VND	1,650	0	102,547
Hired labor	Thousand VND	2,416	0	361,903
<i>Household socio-economic characteristic variables</i>				
Head's gender	Male=1, Female=0	0.83	0	1
Head's age	Years	49	16	94
Education	Schooling completed years	6.68	0	12
Household size	Number of members per household	4.04	1	11
Ethnicity	<i>Kinh</i> =1, other ethnicity=0	0.74	0	1
Extension services	Yes=1, no or does not know=0	0.13	0	1
Supporting policy	Yes=1, no or does not know=0	0.09	0	1
Credit	Million VND	2.85	0	300
<i>Regional dummy variables</i>				
RRD	Red River Delta	0.22	0	1
MNM	Midland and Northern Mountainous (base region)	0.24	0	1
NCC	Northern and Central Coast	0.24	0	1
CHL	Central Highland	0.07	0	1
SEA	South-eastern Area	0.05	0	1
MRD	Mekong River Delta	0.18	0	1
<i>Non-farm variables</i>				
Non-farm income	Million VND	40.94	0	646.2
Non-farm participation	Participate in non-farm work by head or spouse=1, no=0	0.73	0	1
<i>Instrumental variables</i>				
Time_Town	The time from the commune to the nearest town (minute)	31.79	3	420
Time_City	The time from the commune to the nearest city (minute)	86.58	2	720

1) Source: VHLSS 2012.

2) Number of observations = 4,823.

3) VND is Vietnam's currency (Vietnamese Dong).

4.5. Estimation results

4.5.1. Impact of non-farm sector on agricultural value-added

Table 4.2 presents the results of the production function estimation, which illustrates the effect of the non-farm sector on agricultural value-added. We also apply both ordinary least squares (OLS) and IV approaches with robust standard errors in our analysis and compare the results of two these approaches. In IV models, we compute the robust standard errors clustered at the commune level to avoid the intragroup correlation. The coefficients from the OLS models indicate the contrary impact of the non-farm income variable and the non-farm participation variable on farm value-added. On the other hand, the parameters of both non-farm variables from the IV approach also show a trend of positive impact. Thus, the estimation of the IV approach yields a reasonable result, and it is consistent for solving the endogeneity problem.

The coefficient of non-farm income indicates that a 1 million VND increase in non-farm income enhances agricultural value-added by 0.23%, or approximately 0.08 million VND on average. The participation of the household head or spouse in non-farm jobs increases agricultural value-added by 44.1%, or about 16.22 million VND. In general, the impact of the non-farm sector on agricultural value-added is positive.

The use of production inputs, namely, family agricultural labor, farm land, fixed asset depreciation, hired machine, and hired labor, have positive effect on agricultural production in all OLS and IV models. The human capital variables or household characteristics have both effects and no effects on value-added. Specifically, the household head's gender, household size, and ethnicity have positive and significant effects on agricultural value-added in all OLS and IV models. This result indicates that if the head's households are male, the agricultural value-added is increased. Similarly, the household with large size can get higher the value-added in agricultural production than the small size ones. The positive coefficients of ethnicity variable show that the farming practices of *Kinh* households bring a higher agricultural value-added than the minor ethnicities ones. The parameter of the household head's age shows a negative impact, indicating that households whose heads are younger can create higher value-added than older ones can. The result also shows that extension services, supporting policy, and credit have no effect on agricultural value-added.

Table 4.2: Production function model

	Dependent variable: Value-added (log)			
	OLS		IV	
	NF income	NF participation	NF income	NF participation
<i>Non-farm variables</i>				
Non-farm income	-0.001*** [0.00]		0.002** [0.00]	
Non-farm participation		0.051** [0.02]		0.442** [0.19]
<i>Production input variables</i>				
Family agricultural labor (log)	0.348*** [0.02]	0.367*** [0.02]	0.394*** [0.02]	0.420*** [0.03]
Farmland (log)	0.277*** [0.01]	0.281*** [0.01]	0.290*** [0.02]	0.290*** [0.02]
Fixed asset depreciation (log)	0.219*** [0.01]	0.219*** [0.01]	0.220*** [0.01]	0.215*** [0.01]
Hired machine (log)	0.171*** [0.01]	0.170*** [0.01]	0.165*** [0.01]	0.168*** [0.01]
Hired labor (log)	0.242*** [0.01]	0.242*** [0.01]	0.245*** [0.01]	0.236*** [0.01]
<i>Dummy variables</i>				
Farmland	-0.900*** [0.10]	-0.913*** [0.10]	-0.928*** [0.11]	-0.946*** [0.11]
Fixed asset depreciation	0.901*** [0.07]	0.898*** [0.07]	0.901*** [0.07]	0.872*** [0.07]
Hired machine	0.914*** [0.09]	0.902*** [0.09]	0.876*** [0.10]	0.887*** [0.10]
Hired labor	1.378*** [0.08]	1.378*** [0.08]	1.399*** [0.09]	1.341*** [0.09]
<i>Household socio-economic characteristic variables</i>				
Head's gender	0.109*** [0.03]	0.105*** [0.03]	0.099*** [0.03]	0.092*** [0.03]
Head's age	-0.007*** [0.00]	-0.007*** [0.00]	-0.008*** [0.00]	-0.007*** [0.00]
Education	0.007** [0.00]	0.004 [0.00]		
Household size	0.049*** [0.01]	0.038*** [0.01]	0.013 [0.01]	0.030*** [0.01]
Ethnicity	0.295*** [0.03]	0.276*** [0.03]	0.248*** [0.04]	0.216*** [0.05]
Extension services	0.001 [0.02]	0.003 [0.03]	0.008 [0.02]	0.004 [0.03]

Supporting policy	0.003 [0.04]	0.004 [0.03]	0.002 [0.03]	0.024 [0.03]
Credit	0.001 [0.00]	0.001 [0.00]	0.002 [0.00]	0.002 [0.00]
<i>Regional dummy variables (base region = MNM)</i>				
RRD	0.087** [0.03]	0.088** [0.03]	0.084** [0.04]	0.099*** [0.04]
NCC	-0.186*** [0.03]	-0.174*** [0.03]	-0.160*** [0.04]	-0.132*** [0.04]
CHL	-0.140*** [0.04]	-0.128*** [0.04]	-0.094* [0.05]	-0.129*** [0.04]
SEA	0.179*** [0.07]	0.173*** [0.07]	0.159** [0.08]	0.169** [0.08]
MRD	-0.049 [0.04]	-0.038 [0.04]	-0.023 [0.05]	0.005 [0.05]
Constant	3.996*** [0.17]	3.920*** [0.17]	3.898*** [0.18]	3.518*** [0.27]
Number of obs.	4,823	4,823	4,823	4,823
R-squared	0.72	0.72		
Center R_squared			0.71	0.70
Uncenter R_squared			0.99	0.99
Weak identification test			82.136	28.232
Overidentification test (Hansen J statistic χ^2)			1.428	0.196
<i>p_value</i>			0.490	0.907

1) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: South-eastern Area, MRD: Mekong River Delta.

3) Values in parentheses indicate robust standard errors. In the IV models, the standard errors is clustered at the commune level.

4) Instrumental variables: Time_Town, Time_City, Education.

5) Authors' estimation.

The weak identification test and overidentification test of the validity of the instruments are performed on IV regression. The value of Stock-Yogo (2002) weak identification test statistics of non-farm income and non-farm participation models are 82.136 and 28.232, respectively. P-value of this statistic is almost equal to 0.10. From this result we consider the null hypothesis of weak identification is almost rejected. The overidentification test Hansen J statistic are 1.428 with p-value 0.490 in non-farm income model; 0.196 with p-value 0.907 in non-farm participation model. The

joint null hypothesis that the instruments are valid instruments is not rejected for both non-farm income and non-farm participation of head or spouse models.

4.5.2. Impact of non-farm sector on production efficiency

4.5.2.1. Stochastic frontier production function

The maximum likelihood estimates of the parameters of the stochastic production frontier are presented in Table 4.3.

Table 4.3: Stochastic frontier production function model		
Dependent variable: Value-added (log)		
	Est.	S.E.
<i>Production inputs variables</i>		
Family agricultural labour (log)	0.326***	[0.01]
Farmland (log)	0.255***	[0.01]
Fixed asset depreciation (log)	0.241***	[0.01]
Hired machinery (log)	0.198***	[0.01]
Hired labour (log)	0.259***	[0.01]
<i>Dummy variables</i>		
Farmland	-0.699***	[0.06]
Fixed asset depreciation	1.023***	[0.07]
Hired machinery	1.113***	[0.09]
Hired labour	1.523***	[0.08]
Constant	4.341***	[0.15]
Log-likelihood	-4914.992	
Number of obs.	4,823	
σ_v	0.523	
σ_u	0.708	
σ^2	0.774	
Γ	1.353	

1) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2) Authors' estimation.

All coefficients of inputs in the stochastic frontier production model have positive signs and are significant at the 1% significance level. The result indicates that family labor has the highest production elasticity among all of the inputs with a coefficient of 0.326. The estimation also shows a higher elasticity of family labor use than for hired labor and the total sum of labor elasticity is 0.585. This result may reflect the relative importance of family laborers over hired laborers, because the

former usually pay more attention to their own production and are characterized by higher labor quality. The sum of elasticity of all inputs is 1.279. This result indicates that on average, the agricultural output value of farm households has increasing returns to scale.

4.5.2.2. The endogenous regression for inefficiency model

The Table 4.4 reports the endogenous regression estimation of the non-farm income and non-farm participation equation for inefficiency model.

Table 4.4: The endogenous regression for inefficiency model

Dependent variable	NF Income		NF participation	
	Coef.	S.E.	Coef.	S.E.
<i>Household socio-economic characteristics</i>				
Head's gender	-2.475	[1.69]	-0.006	[0.02]
Head's age	0.197***	[0.05]	-0.001***	[0.00]
Household size	9.036***	[0.40]	0.006	[0.00]
Ethnicity	17.196***	[1.93]	0.171***	[0.02]
Extension services	-3.220*	[1.92]	-0.017	[0.02]
Supporting policy	1.216	[2.33]	-0.041*	[0.02]
Credit	-0.214***	[0.06]	-0.001	[0.00]
<i>Regional dummy (base region = MNM)</i>				
RRD	10.057***	[2.14]	0.029	[0.02]
NCC	-4.237**	[1.98]	-0.078***	[0.01]
CHL	-16.115***	[2.54]	0.018	[0.03]
SEA	6.733**	[3.17]	0.052	[0.03]
MRD	-3.471	[2.20]	-0.063***	[0.02]
<i>Instrumental variables</i>				
Time_Town	-0.090***	[0.02]	-0.001***	[0.00]
Time_City	-0.041***	[0.01]	-0.0003***	[0.00]
Education	2.264***	[0.19]	0.010***	[0.00]
Constant	-23.455***	[4.10]	0.661***	[0.04]
Number of observations	4823		4823	
R squared	0.21		0.09	

1) ***, **, * indicate statistical significant at 1%, 5%, 10% level, respectively.

2) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: Southeastern Area, MRD: Mekong River Delta.

3) Author's estimation.

The results show that three instrumental variables including Time_Town, Time_City, Education are highly statistically significant at 1% of the significance level for both estimation models (non-farm income and non-farm participation of head or spouse). As expected, the time distances from the commune to the nearest town and city have a negative impact on non-farm income and the participation of head or spouse into non-farm employment. The coefficients of education variable are positively associated with non-farm income and non-farm participation. Thus, the instrumental variables are consistent instruments.

4.5.2.3. Inefficiency model

Based on the estimation from the stochastic frontier production function, we obtain the predicted inefficiency level of each household. The inefficiency model gives some insights into the factors affecting the technical efficiency of Vietnamese farm households, in which negative signs means that the variables reduce technical efficiency and positive signs mean that the variables increase technical efficiency. We also use both OLS and IV approaches in the inefficiency model. Table 4.5 below represents the combined regression results of the OLS and IV inefficiency models with robust standard error. In IV models, we compute the robust standard errors clustered at the commune level to avoid the intragroup correlation.

Table 4.5: The impact of the non-farm sector on farm efficiency level by inefficiency models

	Dependent variable: inefficiency level ($\hat{U}_i = -\log(TE_i)$)			
	OLS		IV	
	NF income	NF participation	NF income	NF participation
<i>Non-farm variables</i>				
Non-farm income	0.0004*** [0.00]		-0.0013*** [0.00]	
Non-farm participation		0.001 [0.01]		-0.189** [0.07]
<i>Household socio-economic characteristic variables</i>				
Head's gender	-0.056*** [0.01]	-0.057*** [0.01]	-0.061*** [0.01]	-0.060*** [0.01]
Head's age	0.003*** [0.00]	0.003*** [0.00]	0.003*** [0.00]	0.003*** [0.00]
Education	-0.004*** [0.00]	-0.003*** [0.00]		
Household size	-0.023***	-0.020***	-0.008	-0.019***

	[0.00]	[0.00]	[0.00]	[0.00]
Ethnicity	-0.096***	-0.087***	-0.059***	-0.051**
	[0.01]	[0.01]	[0.02]	[0.02]
Extension services	-0.011	-0.013	-0.017	-0.016
	[0.01]	[0.01]	[0.01]	[0.01]
Supporting policy	-0.013	-0.013	-0.015	-0.025*
	[0.01]	[0.01]	[0.01]	[0.01]
Credit	0.00003	-0.0001	-0.0004	-0.0002
	[0.00]	[0.00]	[0.00]	[0.00]
<i>Regional dummy variables (base region = MNM)</i>				
RRD	-0.021*	-0.016	0.001	-0.006
	[0.01]	[0.01]	[0.02]	[0.01]
NCC	0.084***	0.082***	0.078***	0.069***
	[0.01]	[0.01]	[0.01]	[0.01]
CHL	0.073***	0.067***	0.048**	0.075***
	[0.02]	[0.02]	[0.02]	[0.02]
SEA	-0.001	0.003	0.013	0.016
	[0.03]	[0.03]	[0.03]	[0.03]
MRD	0.064***	0.063***	0.060***	0.056***
	[0.02]	[0.02]	[0.02]	[0.02]
Constant	0.623***	0.607***	0.558***	0.702***
	[0.03]	[0.03]	[0.03]	[0.05]
Number of obs.	4,823	4,823	4,823	4,823
R-squared	0.07	0.07		
Center R_squared			0.01	-0.01
Uncenter R_squared			0.79	0.78
Weak identification test			73.863	54.432
Overidentification test (Hansen J statistic χ^2)			0.380	1.292
<i>p_value</i>			0.827	0.524

1) ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2) RRD: Red River Delta, MNM: Midland and Northern Mountainous, NCC: Northern and Central Coast, CHL: Central Highland, SEA: South-eastern Area, MRD: Mekong River Delta.

3) Values in parentheses indicate robust standard errors. In the IV models, the standard errors is clustered at the commune level.

4) Instrumental variables: Time_Town, Time_City, Education.

5) Authors' estimation.

In IV inefficiency models, our analysis shows a positive effect of the non-farm sector on farm production efficiency. The coefficients of the two non-farm variables (non-farm income and non-farm participation) are both statistically significant at the 1% significance level (-0.0013 and -0.189, respectively). This means that if households earn or obtain more than 1 million VND from non-farm work, the inefficiency level would decrease 0.13%. Participation of the head or spouse in non-farm employment would lead to a reduction in the inefficiency level by 18.9%. Thus, our results reveal that farm households that participate in non-farm work have higher technical efficiency. This effect can be interpreted as a significant positive effect of relaxing liquidity constraints. Labor supply to the non-farm sector has a positive effect on the production efficiency of the farming sector.

The results in all inefficiency models show that the coefficients of head gender, household size, and ethnicity have positive signs. The positive sign of the household head's gender indicates that male household heads are more efficient than female household heads are. The household size variable has a positive impact on farm technical efficiency, which means that large farm households will increase efficiency. The coefficient of the binary ethnicity variable is significant and shows a positive relationship with efficiency level, which indicates that *Kinh* households could produce their agricultural output with higher technical efficiency than other minorities could. The reason could be that the farming practices of minority ethnicities are shifting cultivation, with less use of inputs that increase productivity, such as fertilizers and machinery; hence, this reduces the production efficiency of minorities relative to *Kinh* households. By contrast, the coefficient of the household head's age shows a negative impact on technical efficiency, which indicates that households with younger heads are more technically efficient than are those with older heads.

In addition, the estimation shows that the variables of extension services, supporting policy, and credit are not significant. The insignificance of extension services and supporting policy variables implies that those extension services and policies for farm households are not strong enough to help farmers improve their efficiency.

The credit variable is not significant in the inefficiency model. Theoretically, providing credit for farming can relax liquidity constraints and improve technical efficiency. If farmers are capital constrained, then credit can contribute to improving agricultural production. However, our result shows no impact of credit on technical efficiency, which is contrary to the above-mentioned theory. First, we consider the relationship between non-farm income and credit, which is shown in Table 4.6. The result indicates that households with credit have lower non-farm income than do those with no credit. A t-test is used to examine the mean difference in non-farm income between non-credit and

credit households. The probability of the case mean difference being greater than zero is 0.000, which implies that the mean values of non-farm income are different in the two groups and the non-farm income of non-credit households is greater than that of credit households. This finding implies that non-farm income sources are quite important for households and can substitute for credit. Moreover, households might not use this loan for investment or purchasing inputs in agricultural production and may use it for consumption or education. For these reasons, the credit variable is not significant in these models.

Table 4.6: Non-farm income with credit and non-credit households

	Non-credit households		Credit households		T-test (mean difference>0)
	Mean	S.D.	Mean	S.D.	
Non-farm income	43.95	48.48	25.96	28.49	0.000***

1) Source: VHLSS 2012.

2) Unit: million VND.

The coefficients for technical efficiency of Northern and Central Coast, Central Highland, and Mekong River Delta have negative signs. This result implies that those regions are less efficient than the Midland and Northern Mountainous Areas. Meanwhile, the coefficients for technical efficiency of Red River Delta and South-eastern Area are statistically insignificant.

The weak identification test and overidentification test of the validity of the instruments are performed on IV regression. The value of Stock-Yogo (2002) weak identification test statistics of non-farm income and non-farm participation models are 73.863 and 54.432, respectively. P-value of this statistic is almost equal to 0.10. From this result we consider the null hypothesis of weak identification is almost rejected. The overidentification test Hansen J statistic are 0.380 with p-value 0.827 in non-farm income model; 1.292 with p-value 0.524 in non-farm participation model. The joint null hypothesis that the instruments are valid instruments is not rejected for both non-farm income and non-farm participation of head or spouse models.

4.5.3. Technical efficiency level

Table 4.7 presents the distribution of technical efficiency of farm households based on the stochastic production frontier estimation. In this study, the technical efficiency level of households had a big gap, ranging from around 5.1% to 92.2%. The mean of technical efficiency is only 59.2%. The technical efficiency distribution shows that about 79% of farm households had a technical

efficiency level lower than 70%. This result implies that the production efficiency of Vietnamese agriculture is still low, which could yield big opportunities for farmers to improve technical efficiency.

Table 4.7: Frequency distribution of technical efficiency of households

TE level	Number	Percentage
-50	1,037	21.5
50-60	1,284	26.6
60-70	1,502	31.1
70-80	837	17.4
80-90	162	3.4
90-100	1	0.0
Mean		59.2
Minimum TE		5.1
Maximum TE		92.2

1) Calculated based on Table 4.3.

2) The technical efficiency (TE) level is in percent (%).

Table 4.8: Frequency distribution of technical efficiency and non-farm income of households by regions

Regions	Mean TE	Number of households	Percentage	Non-farm income
Red River Delta	62.2	1,058	21.9	58.9
Midlands and Northern Mountainous Areas	59.3	1,159	24.0	29.8
Northern and Coastal Central Region	56.8	1,145	23.7	40.3
Central Highland	57.1	364	7.6	21.4
South-eastern Area	62.6	229	4.8	49.7
Mekong River Delta	58.6	868	18.0	40.6

1) Calculated based on Table 4.3.

2) The technical efficiency (TE) level is in percent (%).

3) Unit of non-farm income: million VND.

Table 4.8 shows the frequency distribution of technical efficiency by region. There are slight differences in the level of efficiency between all regions. On the one hand, Red River Delta and South-eastern Area have the highest technical efficiency level of all regions. We observe that regions with high non-farm income have a high technical efficiency level, such as Red River Delta and South-

eastern Area (with non-farm income shares of 58.9 million VND and 49.7 million, respectively). On the other hand, the lowest non-farm income region has a lower level of technical efficiency, namely, Central Highland (with non-farm income of 21.4 million VND). Hence, this result implies a positive relationship between non-farm income and technical efficiency.

4.6. Conclusion

This chapter reveals the impact of non-farm sector on agricultural output and performance in Vietnam, namely, the agricultural value-added and production efficiency. The empirical results indicate that there is a positive impact of the non-farm activities on agricultural value-added and production efficiency. In particular, the results indicate that a 1 million VND increase in non-farm income enhances agricultural value-added by 0.23% or approximately 0.08 million VND on average, and the inefficiency level would decrease 0.13%. The participation of the household head or spouse in non-farm jobs increases agricultural value-added by 44.1%, or about 16.22 million VND, and lead to a reduction in the inefficiency level by 18.9%. This positive effect may derive from the liquidity-relaxing effect of non-farm income because this earning could help farmers to invest backward into agriculture through purchasing quality inputs or machinery for agricultural production.

The study reveals that the mean of technical efficiency level of Vietnam's agriculture is quite low, only 59.2%. There is about 79% of farm households had a technical efficiency level lower than 70%. This result suggests that there is a big opportunity to improve technical efficiency among the farmers by using technology and inputs more efficiently. This study also found that regions with high non-farm income have a high technical efficiency level, and the lowest non-farm income region has a lower level of technical efficiency.

Chapter 5

Summary, discussion, conclusion and policy recommendation

5.1. Brief background

The development of rural non-farm sector has taken part in boosting in Vietnam's rural economy as well as the country's economy since the reform policy – *Doi Moi* policy (1986). The development of this sector has become stronger from the first years of 21st century until now. There are several causes and conditions for the growth of rural non-farm sector in the post-renovation period until recent years in Vietnam. Firstly, the open market of Vietnam's economy after reform and the establishment and development of the labor market has created opportunities for rural labors easier in participation in off-farm activities. Secondly, the transformation of the rural economy is also one of the important background factors for creating non-farm job opportunities for rural labors.

Like any other developing country as Vietnam, agricultural production is the main production activity of farm households in the rural area. However, with the growth of the rural population, the income from agricultural activity seems not enough to cover for the consumption of farm households. Especially, when this agricultural production activity is highly risky due to external factors such as weather and pests, or internal factors of farm households such as lack of capital sources. This has motivated members of rural households to seek other job opportunities outside the farm production. Moreover, diversifying employment for rural households can help them to improve their income and guarantee households' expenditures. The role of non-farm income has also gradually changed with the increase in the proportion of this income in total household income. However, the participation in other jobs outside agriculture activity of farm households may influence on agricultural production. The direct impact of non-farm activities is the shift of family labor from farm activity to non-farm activities. Hence, this study is expecting to identify the role of the non-farm sector with respect to agricultural production in Vietnam. In particular, the study focuses on 1) the linkage between farm and non-farm sectors, 2) how the non-farm activities affect the agricultural output and production efficiency.

5.2. Summary, discussion and conclusion

First of all, this study provides the overview of the world's non-farm sector, in particular in developing countries. From the 1990s and 2000s, non-farm income accounts for 35-50% of rural

household income across the developing world. The study describes the composition of farm household income as well as the role of non-farm income source in some countries from Africa, Asia, and Latin America by using the secondary data from Rural Income Generating Activities (RIGA). The economic transformation in developing countries shows that the rapid expansion of the rural non-farm economy becomes a major source of growth in farm household income.

The study also provides a few features of the situation background of Vietnam's agriculture since the reform – *Doi Moi* policy. The agricultural sector has notched impressive achievements in terms of agricultural yield, output, and exports after the reform. In the period 1992-2000, the annual growth rate of the agricultural sector including forestry and fishery was 4.6%. The agricultural value-added has increased dramatically in the 1990-2015 period, from 5,824 million US\$ to 14,566 million US\$ at the 2005 price. In addition, this achievement can be shown in the impressive increase in land productivity and labor productivity of Vietnam's agriculture since 1990. The agricultural value-added per hectare has increased from 1,477 US\$ in 1990 to 2,161 US\$ in 2013. The productivity of agricultural labor in Vietnam was quite low and has increased gradually after reform until recent years. Although the share of agriculture in GDP has been declining, this sector has been the foundation of economic growth and the development of industry and service sectors.

The study highlighted the characteristics of the transformation of Vietnam's rural economy after the reform – *Doi Moi* policy. Specifically, land reform led to the emerging of the land market and the implementing of land consolidation and land accumulation. The labor market was established and gradually developed with the shift of labor force from the agricultural sector to the industrial and service sectors. The urbanization process has begun to create the wave of movement of labor from rural areas to urban areas. The infrastructure in rural areas was gradually improving, namely the development of rural transport networks and the transport routes connecting with urban areas. Another effect of the reform policy on the rural economy transformation was the shift of agricultural production from self-sufficiency to commodity production. These are the background for the development of the non-farm sector in rural areas.

The present study describes the overview of Vietnam's labor market in the context of economic integration, in particular the supply and demand of labor market and focuses on the supply of rural labor. The result indicates that the rural areas have provided a huge labor force for Vietnamese economy, however, this also creates pressure for the government to solve employment for this labor force. In particular, the rural population occupies approximately 67.7% of the national population on average in the 2010-2015 period. In which, the population at the working-age in the rural areas accounted for 66.9% of the national working-age population on average in the same period. With the

high labor force participation rate (about 81% in the 2010-2015 period), the proportion of rural labor force was approximately 70% in the country's labor force. The study also points out the demand of Vietnamese labor market is gradually increased and improved thank to the robust economic growth, the favorable and stable macroeconomic conditions, the economic integration and international trade. In particular, the transformation of the economy toward market has motivated the development and expansion of the private and foreign invested sectors. The industrialization, modernization, and international integration induced the shift of labor structure from the agriculture sector to industry and service sectors with the rapidly increasing in the number of labors in industry and service sectors. Moreover, the urbanization process has created a migration flow of labor from rural areas to the urban areas, especially in the 1999-2009 period.

The study introduces some policies which are enacted by the Vietnamese government in order to encourage the development of the non-farm sector and improve the household's income in rural areas. The Decision in 2000 is issued to encourage the development of the rural trades including cottage-industrial, the handicraft production, fine art articles, construction, and services. The aims of this policy are to meet the domestic consumption and export demand, to attract labor and create employment for rural labor, to improve the household's income and reduce poverty, and to preserve and promote the traditional culture. Moreover, the Decree of the Government in 2001 is promulgated with the regulation and supporting policies toward to small and medium enterprises in order to encourage and create favorable condition for the development of these enterprises. The purpose of this policy also creates more jobs for the rural labor force.

The study describes the development of rural non-farm sector from the post-renovation period to the integration period. The rural labors participate into non-farm employment more and more after the reform until the recent years. The rural labors who worked in the manufacturing and services sectors have increased slightly in the post-reform period. In the integration period, from the first years of 21st century until the recent years, there have been witnessed a strong development in the non-farm sector in Vietnam's rural areas. The proportion of rural non-agricultural households increased dramatically from 28.9% in 2006 to 46.2% in 2016. The study also indicates the difference in the rural employment and the development of rural non-farm sector across regions. Red River Delta and Northern Central Coast have shown the rapid growth of the non-farm sector in the post-renovation period. While, the rural non-farm employment in Southeastern Area and Mekong River Delta are more diversified, but its share in both regions does not fluctuate much in the same period. The Midlands and Northern Mountainous Areas and Central Highlands regions are less diversified in rural employment than the other in the post-renovation period. In the integration period, the rural non-farm

sector has expanded more in all regions except Midlands and Northern Mountainous Areas and Central Highlands regions, with the increasing in number of non-agriculture households and the share of non-agriculture labor in the rural areas.

This study also shows the role of non-farm income in the total rural household income in Vietnam by using secondary data. In the period after the reform, the earnings from non-farm activities were not the main income source in farm households. However, the role of non-farm income was increasing in the total farm household's income in the later period until recent years. The non-agriculture income has increased in the total monthly income per capita in the rural areas. The number and percentage of households with the main source of income from non-farm activities in rural areas increased rapidly during the 2006-2016 period. This result reflects the income of farm households no longer depend too much on agricultural production. This trend of increasing non-farm income has taken place in most regions in Vietnam except Midland and Northern Mountainous Areas and Central Highlands region.

The main content of the thesis focuses on the roles of non-farm sector with the respect to agricultural production in Vietnam. The specific objectives are to explore the impact of farm household participation in non-farm activities on input expenditures in agricultural production activities; to explore the effect of the non-farm sector on agricultural output and performance—in particular, on agricultural value-added and production efficiency; and finally to recommend policy implications based on the key findings of the study.

Based on the above objectives, the following hypotheses have been tested:

The study used the Vietnam Household Living Standard Surveys 2012 (VHLSS 2012) data in analyzing the impact of non-farm activities participation on agricultural production at the household's level. The study focuses on the rural farm households that participate in agriculture, forestry, and aquaculture activities. The study aggregates the three primary sectors (agriculture, forestry, and aquaculture) to evaluate the effect of non-farm employment on all farm activities, not only on a specific sector. The commune survey collects the socio-economic characteristics of the communes, which can be used as instrumental variables (IVs) in the estimation. The final number of households in this study is 4,823.

In the first objective, the IV Tobit model was applied to determine the effect of non-farm income on agricultural input expenditures. The study assesses the expenses for purchased inputs (including seeds, fertilizer, breed, feed, herbicide, and pesticide), hired machines, and hired labor. The findings of the study indicate that the relationship between non-farm income and purchased

inputs, hired machines, and hired labor is significant positive effect. This result indicated that Vietnamese farm households that could access other income sources in the non-farm sector could spend those earnings for purchasing agricultural inputs and hiring machine and labor to compensate for shortfalls in family labor. The results of the average partial effect of non-farm income on agricultural inputs expenses indicated that an additional Vietnamese dong (VND) in non-farm income leads to a 0.412 VND increase in agricultural input spending. However, the findings showed that farm households did not use the non-farm income for hiring machines and labor.

Regarding the discussion in this result, under the perfect market mechanism, farm households can separate production and consumption activities. Even when the endowment destined to production are not sufficient, the market functions could fill the gap of production activity; for example, if in credit market farm households could borrow to supplement the gap. However, in rural developing countries such as Vietnam, the credit and insurance markets are often imperfect, farm households face credit constraints and are often unable to ensure against production risks. Seeking an alternative income source is, therefore, necessary to overcome these constraints. Kilic et al. (2009) suggested that non-farm earnings may lead to a decline in households' risk and provide capital for agricultural expenses and long-term investment, thus overcoming the credit and insurance market failures. Thus, participation in non-farm activities could help farmers loosen credit constraints in Vietnam. The linkage between the farming and non-farming sectors implies that non-farm income might be used for agricultural production, thus increasing the spending cost on production.

The other finding also indicates that the effect of this source of income on agricultural expenses differs across the regions. The developed regions (as Red River Delta and Southeastern Area) seem not to use the non-farm income into the agricultural activity because the non-farm income may be sufficient to guarantee for consumption of farm household. Thus, farm households don't need to invest more in farm activities. The less developed regions (including Midland and Northern Mountainous, Northern and Central Coast, and Mekong River Delta) tended to use the non-farm income to invest and purchase for the agricultural production. The non-farm income can help rural households in less developed regions overcome liquidity constraint in farm production through investment.

In the second objective, the hypothesis is tested whether non-farm sector affects the agricultural value-added and production efficiency in Vietnamese agricultural sector. For methodology used in present study, the production function and stochastic frontier production analysis were applied to determine the impact. The instrumental variables method was also applied to address the endogeneity problem of non-farm variables. The production function was used to

estimate the impact of non-farm variables on agricultural value added. The empirical results show that there is a positive impact of the non-farm activities on agricultural value-added. In particular, one million VND increase in non-farm income enhances agricultural value-added by 0.23% or approximately 0.08 million VND on average. The participation of the household head or spouse in non-farm jobs increases agricultural value-added by 44.1%, or about 16.22 million VND. The stochastic production frontier was estimated to derive the inefficiency level of each household in the first step; in the second stage, we estimated the impact of non-farm income on the inefficiency level. The finding of study is that non-farm activities had a positive effect on production efficiency of farm households. A one million VND increase in non-farm income reduced 0.13% the inefficiency level. The participation of the household head or spouse in non-farm activities decreased 18.9% the inefficiency level.

Regarding the discussion, this finding is consistent with the results of Bojnec and Fertő (2011), Shittu (2014), and Zhang et al. (2016), who found a positive relationship between off-farm work/income and technical efficiency. These authors assumed that the liquidity-relaxing effect of non-farm income induces a positive effect on efficiency. The diversification of non-farm activities is directly aimed at contributing to farm household income generation and may relax credit constraints, because there is a positive relationship between credit constraints and supply of non-agricultural labor (Stampini & Davis 2009). The positive effect of non-farm activities on farm value-added and production efficiency in Vietnam seems to be through providing capital or credit for farmers to purchase quality inputs or machinery for agricultural production. In other words, in the presence of liquidity constraints, access to credit or other sources of income might allow farmers to adopt new technology packages or apply mechanization in order for their production to approach the production frontier. Because differences in the quality and quantity of used inputs in production contribute to overall technical efficiency, increasing purchases of quality and high-yielding inputs could shift the entire input–output relationship and lead to higher technical efficiency. However, under the constraint of family labor in an imperfect labor market, the participation of household members in non-farm work influences the decisions of household labor allocation, which induces increasing non-farm household labor use and decreasing on-farm labor supply. This outcome is called the lost-labor effect. In the presence of labor market failure, the lost labor may reduce efficiency and output, because it cannot be perfectly substituted by hired labor. However, the impact of this sector on technical efficiency is positive, and hence, the liquidity-relaxing effect seems to outweigh the decrease in efficiency induced by the lost labor effect. This is because, first, the income from non-farm activities could allow households to hire labor to substitute family members in non-farm labor. Second, this

type of earnings is a cash source for households to buy or hire agricultural machine in order to replace family labor. Thus, diversifying income sources in non-farm sector seems to enhance the agricultural value added and the production efficiency of Vietnamese agriculture.

Moreover, the present study also presents the distribution of technical efficiency level of farm households and the frequency of technical efficiency by regions. The mean of technical efficiency level of households is quite low by only 59.2%. There is about 79% of farm households had a technical efficiency level lower than 70%. There are slight differences in technical efficiency level of farm households between all regions. The study observed that the regions with high non-farm income have a higher efficiency level than the lower ones. This result implies a positive relation between non-farm income and technical efficiency level.

In summary, this positive effect of non-farm sector on agricultural production and production efficiency may derive from the liquidity-relaxing effect of non-farm income because this earning could help farmers to invest backward into agriculture through purchasing quality inputs or machine for agricultural production.

5.3. Policy implications and recommendations

Based on the major findings from the present study, the following policy implications and recommendations are made:

The study contributes to the literature on the linkage between rural non-farm employment and agricultural production, the impact of non-farm sector on agricultural performance and production efficiency by providing an in-depth analysis of the case of Vietnam. These findings emphasize the importance of participation in non-farm activities as a strategy to raise farm income and enhance production efficiency. This study provides support for the perspective on the importance of the non-farm sector to the development of the rural economy to helping ease credit constraints. For the lower-income developing countries as Vietnam, the study contributes positive evidence that the non-farm sector can support agricultural production activity and enhance production efficiency by loosening credit constraints and providing capital for agricultural investment. The study suggests that there is quite high applicability of the results to other developing countries, whose rural households, like those in Vietnam, are credit constrained and whose labor markets are also imperfect.

The findings of this study could help policy-makers to introduce the optimal policies for developing the Vietnamese rural economy and agricultural sector. To develop rural economies, policies targeting farm households should consider the non-farm sector because encouraging the

development of non-farm activities is essential. In particular, policies focusing on the rural sector should encourage sustainable non-farm employment opportunities for surplus and seasonal labor of farm households. Furthermore, the government should enact new policies supporting the link between the agricultural and non-farm sectors. These policies should create synergy between the farm and non-farm sectors. For example, policies can support farm households to access the market in order to facilitate farmers to conduct trading their agricultural products after processing. In particular, policies focusing on the promotion of non-farm employment should toward sustainability and stable jobs, namely develop the handicraft village, small-industry jobs, trading services, and other services in the rural areas. In addition, policies should focus on the rural areas, especially the poor and mountainous areas where are difficult in the transportation, market access, and trading. Thus, policies should support the construction of infrastructure, communication, and market infrastructure in the rural area. Those policies may help the rural labors to access to non-farm activities, such as, migrate to the big cities, and facilitate for trading the agricultural commodities to the other regions. Therefore, this could create the non-farm employment opportunities and promote the development of agricultural production. In addition, for developing countries like Vietnam, where credit market is less developed and less liquid, our study suggests that policy-makers should focus on developing credit markets to help farmers obtain sufficient credit for investment in agricultural production.

Overall, the findings of this study are expected to be a helpful benchmark, baseline, information for economists, researchers as well as policy-makers and provide useful information for the further development of rural economy in Vietnam. In addition, the study may also provide useful information to the researchers for further research in this area.

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