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industrialization change the use of labor in  
agricultural production at farm households?**

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## The Red River Delta, Vietnam: How does industrialization change the use of labor in agricultural production at farm households?

NGUYEN THI HAI NINH<sup>1\*</sup>, PHILIPPE LEBAILLY<sup>1</sup>  
and NGUYEN MAU DUNG<sup>2</sup>

In this paper, we analyzed the change in labor use for agricultural production at farm households in the Red River Delta, Vietnam under the context of industrialization. By using primary data collected from 130 farm households and 60 exchanged/hired laborers in Bac Ninh, Hai Duong and Thai Binh provinces, we find that family farm laborers popularly have age range from 45 to 54 years old and female laborers in agricultural production are accounted for higher proportion than male laborers. This is because of the fact that industrialization process makes men take advantage in terms of health and skill to seek for off-farm jobs. Also, industrialization in the Red River Delta creates the wave of migration to urban/abroad regions both for male and female labor. Consequently, the shortage of labor supply in farm households is substituted by exchanging and renting laborers, especially in peaking seasons. Based on the sample of 130 farm households, we estimate a multinomial logistic model to quantify the impact of industrialization represented by farmland area, number of migrant laborers, number of family laborers and household income on household's choice in labor use for agriculture. With one more migrant laborer, a household tends to exchange labor with 2.3 times higher than using family labor only, and it likely hire labor with 2.9 times higher than using family labor only. Therefore, creating off-farm jobs in rural areas is an appropriate policy to absorb laborers and to prevent them from migrating far away their home.

**Keywords:** industrialization, agricultural production, use of labor, Red River Delta, Vietnam

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## INTRODUCTION

Since “*Đổi mới*” (*Innovation*) in the 1980s, Vietnam has achieved a high pace of industrialization, which has led to conversions of a large area of agricultural land and other types of land for non-agricultural purposes, and this has forced thousands of farmer households to change their traditional livelihoods and even their lives (Nguyen 2009). The industrialization in Vietnam caused a loss of traditional livelihoods due to the arable land shrink and lack of off-farm employment opportunities in the rural areas. On average, 10 rural workers will lose their jobs when one hectare of arable land is converted into non-agricultural use. Land revocation between 2001 and 2005 was accounted to affect 2.5 million people including 628,000 households and 950,000 rural workers in Vietnam (Tuyen & Doan 2010).

In comparison with other regions in Vietnam, the Red River Delta has the largest number of people affected by the loss of farmland with about 300,000 households and so farmers have to seek various ways to earn their living, increasing the number of labor migrating to cities for non-farm jobs or going abroad for labor export (Hoang 2009). This process has transformed labor structures and supply in many farm households, leading to changes in household's labor used for agricultural production across several dimensions. First, hiring or exchanging agricultural laborers has become common between households. This hiring/exchanging of labor has helped to re-distribute labor amongst households because many farm laborers have migrated, households require additional human labor for agricultural production (Nguyen et al. 2015). Second, industrialization leads to the trend of “feminized agriculture” and “women household heads” (Hoang 2009). In many rural families, the burden of agricultural production rests on the shoulder of the mother and grandparents since middle aged men and young people leave home for seeking jobs in urban areas and industrial parks. The Vietnam employment survey shows that the proportion of women working in agricultural sector in the Red River Delta is accounted for 55.9% of the employment structure; the rest are mainly old aged men (General Statistics Office 2008). This leads to the third dimension is aging rural labor which has been discovered in many provinces of the Red River Delta. In some provinces such as Thai Binh and Hai Duong, most of the people over middle age or elderly stay in the villages (Hoang 2009). A survey of the Institute of Policy and Strategy for Agriculture and Rural Development in the Red River Delta shows that there are almost no laborers under 40 years of age in most of the rural regions (Dang 2008).

In order to see how the industrialization affects labor use for agricultural production in the Red River Delta, this paper examines the change of labor use in terms of gender, age, working hours, seasonal time, type of labor use (family/hiring/exchanging) and type of agricultural activities under the context of industrialization.

## MATERIALS AND METHODS

### *Definition of terms*

**Industrialization.** In our paper, it is important to provide an introductory discussion of the term “industrialization”. Industrialization is normally interpreted as a process

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whereby the share of industry in general and of manufacturing in particular, on total economic activity is increased (Nguyen 2011). Other scholars indicates that the industrialization in many countries is strongly associated with rapid urbanization and economic growth, and these processes are always coincided with the transfer of farming land to industrial infrastructure construction and residential uses (Midmore & Jansen 2003). In Vietnam, the industrialization appeared since the beginning of 1990s with the tentative target is to make Vietnam become an industrialized economy by 2020. During more than two decades, the industrialization process has encroached a large area of agricultural land, this leads to changes in household agricultural production in terms of labor use (Nguyen 2009). Therefore, industrialization in this paper is approached throughout two aspects including transfer of farming land to industrial park building and shift of labor from rural to urban areas for off-farm working.

**Labor in agricultural production.** Laborers are defined as the number or inventory of persons at a point in time. Agricultural labor includes all hired, contract, exchange, and unpaid family labor used in agricultural production. Agricultural labor is defined here to encompass what is sometimes distinguished as traditional labor and also includes labor acquired through farm labor contractors and all semiskilled services used in farming, such as mechanics for machinery and building repair (Tsutomu 2008). A broad definition of labor makes for a relatively homogenous input category over time, as specialization and change in the economic organization of farms and of the economy occur. All units of agricultural labor are not assumed, however, to be the same with respect to skill, location, and availability or period of use. Suggestions that hired labor is a fixed input are not compelling, except in the very short run. Even when a farmer makes a contract for a month (or year) with a worker for a certain number of hours of labor, there is generally considerable flexibility about exactly when and what work is done. Thus, labor that might sometimes seem to be “fixed” is really “variable.”

Like many other developing countries, the industrialization in the Red River Delta Vietnam has produced three types of labor which are commonly used in agricultural production as family (unpaid) labor, exchanged labor and hired (paid) labor (Nguyen et al. 2015, Tsutomu 2008). Therefore, the term “type of labor use” in this paper mentions the three types of laborers who are working in farm households with rice cultivation, pig breeding and clam culture in the Red River Delta.

**Research framework.** As mentioned above, industrialization in this paper is considered as the process of agricultural land lost and farm labor movement from agricultural to non-agricultural sectors. This movement is divided into two categories: (i) movement to off-farm jobs but still stay with family in the villages, and (ii) movement to work in non-agricultural activities in cities far from home or abroad (Figure 1).

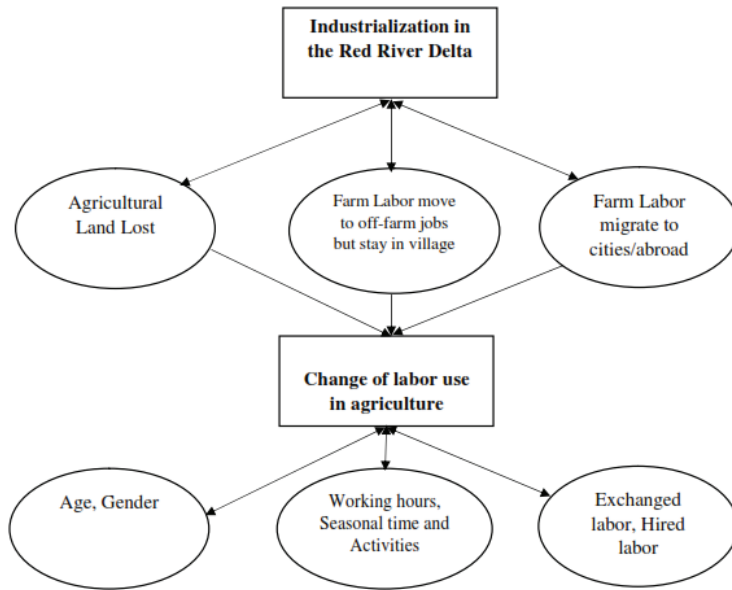


Figure 1. Analytical framework for this study.

**Research sites selection.** The Red River delta of Vietnam covers 11 provinces and cities including Ha Noi, Hai Phong, Hai Duong, Bac Ninh, Vinh Phuc, Hung Yen, Thai Binh, Nam Dinh, Ha Nam, Ninh Binh and Quang Ninh. Of these provinces, Bac Ninh is the northeast gateway to Hanoi capital with land for agriculture occupying over 65% of total natural land area (82,271 ha), and rural people occupying over 73% of the provincial population (Le Xuan 2014). In this province, many large industrial parks as well as arterial highways has been established by the Government in recent years. Therefore, Bac Ninh is known as speedy industrialization province, and land for agricultural production decreases rapidly. Due to the rapid industrialization, the biggest challenge Bac Ninh facing is the shortage of labor in agricultural production, especially at households level.

Besides Bac Ninh, Hai Duong Province is located in the centre of Red River delta, it is 57 km far from Ha Noi. As Bac Ninh Province, Hai Duong is also in the key economic triangle of Ha Noi-Hai Phong-Quang Ninh with many established industrial zones which absorb thousands of laborers across the province and other provinces to work. Although the industrial sector grows fast, in the agricultural sector Hai Duong Province still maintains its strength of pig breeding with many farms in the whole province. In addition to pig breeding, Hai Duong has 40,000 hectares of vegetables which makes this province become one of the largest vegetable cultivation area in Red River delta (General Statistical Office 2016). As a result, the lack of labor engaging in agricultural production is also the problem that Hai Duong Province is coping with.

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Unlike Bac Ninh and Hai Duong, Thai Binh is a coastal province located 110 km away from Hanoi to the southeast. Geographical location of this province is not conducive to the development of industrial zones. Therefore, laborers have to migrate to other provinces to seek for non-agricultural jobs with higher income. In Thai Binh Province, about 45% laborers have moved out of agriculture, 200 thousands work far from home and the percent of people working outside is increasing (Hoang 2009). This movement results the lack of labor supply for agricultural production especially labor in aquaculture production because this is considered as the advantage of this coastal province.

With the above analysis, I select Bac Ninh (typical for rice production), Hai Duong (typical for pig production) and Thai Binh (typical for aquaculture, especially clam culture) to analyze how labor use in agricultural production change under the context of industrialization in these three provinces.

**Data collection.** We gather primary data through the field survey of households and exchanged/hired laborers. There are two survey have been conducted. The first survey was implemented from March to June 2017. The main purpose of this first field survey are to gather both qualitative and quantitative information on agricultural production of the farm households including rice cultivation, pig breeding and aquaculture (number of land plots, areas and kinds of crops in each land plots, crop productivities and crop investment, etc.); the use of labor in farm households (working hour, working condition, labor contract, labor wage, training, etc.). A total of 130 farm households in three selected provinces was randomly drawn for the survey. The personal interviews with farm householders using a standard questionnaire was implemented. The second survey has been performed in April 2018 with aims to collect both qualitative and quantitative data on hired and exchanged laborers who are participating in agricultural production of households in terms of laborers' characteristics (age, gender, educational level, main occupation); working hour; wage rate agreement/satisfaction; labor contract or not; vocational training; working condition, etc. A total of 60 farm laborers in three selected provinces are randomly drawn for this survey.

**Data analysis.** Besides using economic statistical methods including description statistics and comparative statistics to present general situation of laborers such as gender, age, working hours, wage, etc., the authors apply a multinomial logistic model as a quantitative method to analyze the data. This model is used to predict a nominal dependent variable given one or more independent variables. As with other types of regression, multinomial logistic regression can have nominal and/or continuous independent variables (Greene 2012). In our paper, a multinomial logistic regression model is used for quantifying impact of industrialization on the use of labor in agricultural production. The model includes variations as following:

$$\text{Log}(p_i/p_j) = \alpha_{ij} + \beta_{1ij}X_1 + \beta_{2ij}X_2 + \dots + \epsilon_{ij}$$

Where, dependent variation is equal to 0 if a farm household use only family laborers; 1 if a farm household does use exchanging but not hiring laborers; and it is 2 if a farm household use hired laborers regardless of whether or not exchanging laborers. Accordingly, if  $p_0$  is the probability of using only family laborers,  $p_1$  is the



probability of having labor exchange but not labor hire and  $p_2$  is the probability of hiring laborers; then, we have two equations as follows:

$$\text{Log}(p_1/p_0) = \alpha_{10} + \beta_{10}X_1 + \beta_{10}X_2 + \dots + \varepsilon_{10}$$

$$\text{Log}(p_2/p_0) = \alpha_{20} + \beta_{20}X_1 + \beta_{20}X_2 + \dots + \varepsilon_{20}$$

The independent variations represent factors which can affect labor use of farm households under the context of industrialization such as area of farmland, number of family laborers, number of family laborers migrating far away, age, gender and educational level of householders, and income of households, etc.

## RESULTS AND DISCUSSION

### OVERVIEW OF INDUSTRIALIZATION PROCESS IN THE RED RIVER DELTA

**Industrialization is represented by low agricultural land.** Vietnam is an agricultural country, but land for agriculture accounts for only 29% of the total land area. On average, one Vietnamese citizen now has only 0.11 ha of agricultural land (General Statistical Office 2016). The rapid industrialization process concentrated in some localities makes the agricultural land unevenly distributed among regions. Typically, one person in the Red River Delta has an average of only 0.04 ha of agricultural land (Bui et al. 2012). The cause of this phenomenon is that agricultural land in many provinces in the Red River Delta, including Bac Ninh, Hai Duong and Thai Binh, was evicted for the construction of industrial and urban zones. The eviction of farmland use rights started since 1994, and from 2005 to 2008 was the period with the highest percentage of households who were evicted their agricultural land. Agricultural land eviction gradually declined in 2009-2011, and Bac Ninh was the province where the percentage of households with agricultural land evicted was much higher than that of Hai Duong and Thai Binh. Although Hai Duong and Thai Binh are two provinces with a higher land area for agricultural production than other provinces in the Red River Delta; however, surveyed data indicates that a large proportion of households have quite small agricultural land areas from 0.1 to 0.3 ha. This proportion in Bac Ninh is the lowest with about 60% (Figure 2). Consequently, the average agricultural land area per laborer reduces 2.6 times in Bac Ninh and 2.3 times in Hai Duong (Le Thai 2011). This reduction has led to a surplus laborers in agriculture, coupling with higher income attractiveness from industrial and service sectors, resulting in a significant movement of laborers from agricultural to non-agricultural employment.

**Industrialization is represented by the shift of farm labor to non-agricultural sectors.** In this paper, the concept of laborers in a farm household is identified through three aspects: (i) laborers live in villages and spend full time on farming; (ii) off-farm laborers are who live in villages but daily move to work in non-agricultural occupations, they involve in agricultural activities during the peaking seasons, and (iii) migrant laborers who migrate to work away from their villages and do not participate in agricultural production.



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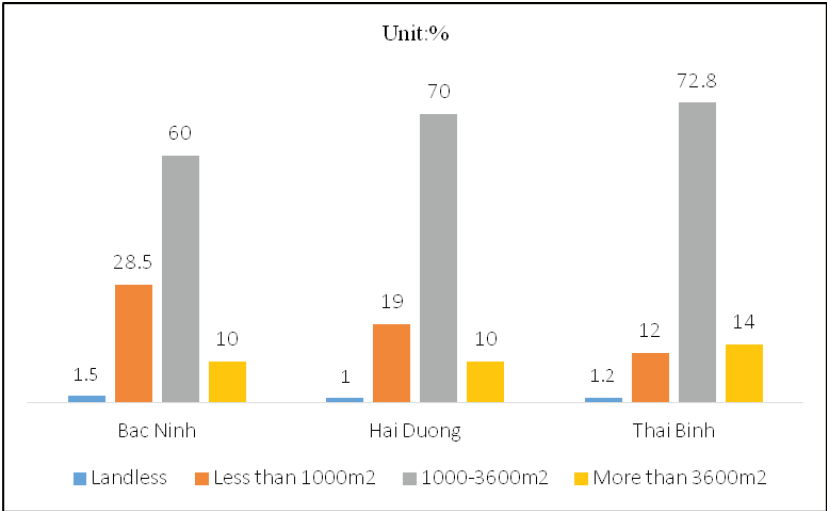


Figure 2. Agricultural land ownership in the Red River Delta, Vietnam (Source: Bui et al. 2012)

Table 1. Industrialization aspests represented by labor in farm households.

Descriptions	Units	Bac Ninh (n=50)	Hai Duong (n=50)	Thai Binh (n=30)
1. Full time family laborers	Person (Household)	76 (50)	63 (50)	49 (30)
2. Off-farm laborers	Person (Household)	70 (47)	40 (40)	22 (19)
3. Migrant laborers	Person (Household)	15 (15)	34 (31)	13 (13)

Source: Households survey in the Red River Delta, Vietnam 2017

Previous research results show that the number of agricultural laborers in the Red River Delta tends to decrease sharply in comparision with the period of the strongest agricultural land eviction in 2005. The largest number of agricultural laborers decreased is in Hai Duong Province. In contrast, the number of laborers who work in the industrial and service sectors tend to increase (Le Thai 2011). With regard to laborers who migrate far from home, Hai Duong is also a province where the percentage of farm households with migrant laborers (especially laborers exported) is higher than in Bac Ninh and Thai Binh Provinces. Statistical data from our surveyed households shows that 62% of farm households in Hai Duong have migrant laborers, while this proportion in Bac Ninh and Thai Binh is approximate 34 and 44%, respectively (Table 1). In general, migrant workers can not help their families in doing farm activities, instead they send money to assist families in

hiring agricultural laborers at harvesting time. Contrastingly, non-agricultural workers who do not move out of their villages remain as a significant labor supply for agricultural production at the time of harvest. In Bac Ninh, the percentage of farm households with non-agricultural workers who still stay in the locality is rather high with 94%, which is explained by the fact that Bac Ninh is a small area province comparing to Hai Duong and Thai Binh and it has many industrial parks, so that laborers have opportunity to find off-farm jobs in their localities without having to go far. In Thai Binh, about 63% of interviewed households has off-farm laborers. It is because aquaculture sector brings higher income and higher job opportunities than many other agricultural activities, therefore farm laborers are attached to this sector in their localities without having to look for off-farm jobs elsewhere.

### ***Labor use in agricultural production***

***Family labor use in agriculture by gender.*** Women play a very important role in social-economical activities in rural areas. In the Red River region, the role of women in agricultural production becomes even more crucial in the process of economic restructuring with an increasing rate of women involved in agriculture while that of men is reducing (ADB 2002). Within our research sites, women may not be householders but they directly participate and contribute the most in agricultural production, especially in rice cultivation. Female labor is accounted for nearly 53% of total family labor while male laborers proportion is more than 47%. Greater proportion of female laborers possibly is because they are laborious and hard-working and, therefore, they are more suitable to rice production. Similarly, in the aquacultural households, the percentage of family female laborers engaged in all production stages is higher than male laborers' proportion with about 53% (Figure 3). Conversely, in pig raising households in Hai Duong, male laborers are responsible for more workload, thus the proportion of them occupies more than 54% of total family labor. These findings are consistent with the arguments that in agricultural production, women undertake almost all activities relating to cultivation and livestock while men are only confined to some work such as land preparation and assisting women in tending and harvesting crops and livestock breeding (Hoang 2009).

These statistical data lead us to conclude that industrialization process in Bac Ninh, Hai Duong and Thai Binh has created an increasing in female laborers' proportion involved in agricultural activities. This conclusion is in accordance with a result from the survey on Vietnamese families in transitional period which has shown that in rural areas, the proportion of wives working in farming (72%) is higher than husbands (62%), while the proportion of husbands engaged in non-agricultural work is higher than wives (Do 2007). Additionally, a research implemented by the Institute of Social Development Studies also indicates that women labour force working in agriculture in the Red River Delta account for 80 percent against about 50%, 20 years ago. In Thai Binh, this figure is even 90% and more, and male household heads work far away from home creates a trend of femalizing household heads in reality (Dang 2008).

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Figure 3. The proportion of family labor by gender (Source: Households survey in the Red River Delta, Vietnam 2017).

**Family labor use in agriculture by age.** Statistical data of the survey on family labor in agricultural production lead us to the conclusion that family laborers popularly have age range from 45 to 54 years old (Figure 4). In Bac Ninh province, 70% of laborers are at this age and this proportion in Hai Duong and Thai Binh is about 61 and 58%, respectively.

According to interviewees, in order to adapt to agricultural land reduction and to improve household's income, laborers have to find off-farm jobs depending on their age, health conditions and working skill. In general, enterprises in industrial zones open employment opportunities for young and skilled people. For young laborers, it is easier to get non-agricultural work with those who are under 35 years old. For laborers at the age of 35-44 years old, they still have chance to work at industrial zones in Bac Ninh, Hai Duong and Thai Binh Provinces if they are high skilled. However, the percentage of farm laborers who lost land has been given job training (by companies that took over land) in Hai Duong is only 0.01% and Bac Ninh is zero percent. Meanwhile, job training given by the local government in the agricultural landlost areas in Bac Ninh is only 1.2% (Nguyen 2008). This explains the reason why middle aged laborers can not find jobs in industrial zones, they have to be freelancers depending on the labour market in their locality, or they move to work in the cities far from home. In these cases, men seem to have more advantage than women. As consequence, men leave their villages for older and women laborers.

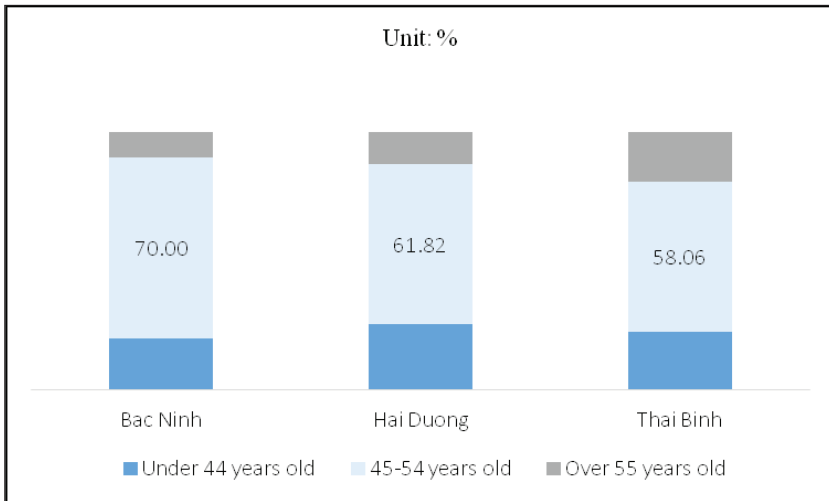


Figure 4. The proportion of family labor by age (Source: Households survey in the Red River Delta, Vietnam 2017).

*“There are five people in my family, I am forty, my husband is forty two years old and three children, they are in school. With only 6 “sào” (1 “sào” is 360m<sup>2</sup>) of agricultural land, we cultivate rice in summer and spring and I do almost all the work in rice cultivation. In order to improve our income, my husband works as a constructor far from home. He only come back to help me in harvesting season. In my village, most of the people work for companies, particularly females aged between 18 and 40 years. They work for SamSung, Chinese Electronic Companies, and mostly for Garment Companies. At my age, it is difficult to find a suitable off-farm job since Garment companies do not want to recruit me and I can not work far from home since I have to take care my children”* (Female, 40 years old in Bac Ninh Province, Secondary educational level).

**Family labor use in agriculture by working time.** It is difficult to define exactly working time of family laborers in agriculture. With full time farmers, working time is longer. Besides working in daytime, they use their nighttime to do some more works. They are employers and employees as well. So that, they use thoroughly their time to cut cost for hiring outsource labor. On average, a main family laborer in Bac Ninh, Hai Duong and Thai Binh works from 5 to 6 hours per day. However, the proportion of laborers who work from more than 8 hours per day is rather high, particularly in rice cultivation in Bac Ninh Province. As we observe from our survey, family laborers in rice cultivation extend their daily working time to more than 8 hours in peaking seasons, they explain that ploughing, transplanting and harvesting are three important activities which need to be done quickly in time so they need to work more than usual.

As discussed earlier, the process of industrialization has narrowed down farmland of households. On average, a household in the Red River Delta owns

**Industrialization change the use of labor in agricultural production**

small farmland area with 1,200 m<sup>2</sup> (OECD 2015). This figure explain why the working time in agricultural production in this region is not so high. Only 18% agricultural labourers work 210 days/year and more and the rest only under 210 days/year, of which 21% only work 90 days/year with an average working time of 4 to 5 hours/day (Tran 2008). Accordingly, our calculation shows that about 81% of laborers in pig breeding work more than 20 days per month; a majority of laborers in rice cultivation work from 10 to 20 days per month, and average working days of laborers in clam culture are less than the two formers (Table 2).

Table 2. Family labor division by working time.

Descriptions	Bac Ninh		Hai Duong		Thai Binh	
	Laborers	(%)	Laborers	(%)	Laborers	(%)
1. Farm laborers	70	100	55	100	62	100
2. Daily working						
Under 6 hours	35	50.0	32	58.2	42	67.7
6-8 hours	20	28.6	18	32.7	15	24.2
Over 8 hours	15	21.4	5	9.1	5	8.1
3. Monthly working						
5-10 days	10	14.3	2	3.6	32	51.6
10-20 days	48	68.6	8	14.6	10	16.1
Over 20 days	12	17.1	45	81.8	20	32.3
4. Seasonal working						
of off-farm laborers	40	-	45	-	10	-
Beginning of season	30	75.0	20	44.4	2	20.0
End of season	20	50.0	8	17.8	3	30.0

Source: Households survey in the Red River Delta, Vietnam 2017

Concerning the working time in agriculture of off-farm laborers, most of them participate in only few production stages including transplanting at the beginning of season and harvesting at the end of season, thus their working time is about 7 to 10 days for each season. The research results show that in peaking seasons off-farm laborers who still stay in the villages involve in agricultural production with higher proportion (75% in Bac Ninh Province and 44.4% in Hai Duong Province) than those migrate to work far from home (Table 2). In fact, the nearest destination of migrated laborers from Thai Binh, Hai Duong and Bac Ninh is Hanoi, further places are Dong Nai, Binh Duong and Ho Chi Minh City in the South. Hence, it is difficult for migrated laborers to come back home as it's very costly and they can not arrange their time as well. Instead of come back home for doing farm work in peaking seasons, they send money to wives/husbands to hire agricultural laborers (Le Thai 2011).

***Hired and exchanged laborers in farm households.*** Previous studies argue that paddy rice production in Vietnam requires considerable labor input, especially

during transplanting and harvesting. In order to organize this labor input, farmers mutually depend on each other for a certain level of cooperation (Bergstedt 2012). Labor exchange between households during planting and harvesting is thereby very important (Mai & Doan 2000).

Table 3. Hiring and exchanging laborers in farm households by production scale.

Descriptions	Small scale		Large scale	
	Farmlands	Types of Labor	Farmlands	Types of Labor
1. Bac Ninh	Less than 3,600 m <sup>2</sup>	Seasonal hiring/ exchanging	More than 3,600 m <sup>2</sup>	Seasonal hiring/ Monthly hiring
2. Hai Duong	Less than 100 pigs	Seasonal exchanging	More than 100 pigs	Monthly hiring/ Seasonal exchanging
3. Thai Binh	Less than 2 ha	Seasonal hiring/ exchanging	More than 2 ha	Monthly hiring/ Seasonal hiring

Source: Households survey in the Red River Delta, Vietnam 2017.

In Bac Ninh Province, a rice cultivation household does exchange laborers if their farmland area is less than “10 sao” (equal to 3600 m<sup>2</sup>) (Table 3). Additionally, our synthetic data indicates that small scale households exchange laborers only for transplanting which is a rice cultivation stage need to accomplish in time. The typical form of exchanging is equal days for equal types of work (transplanting or harvesting for example). Under the context of industrialization, process of mechanization is reducing labor input in paddy rice production especially for harvesting stage. Therefore, both small scale and large scale households use paid machine service for harvesting from other households in their villages instead of exchange for labor. However in larger farmland area, we observe that households prefer hiring laborers for all production stages including land preparing, transplanting, weeding and harvesting (Table 4). In pig breeding and clam culturing, our survey results also show that labor exchange is more popular in small production scale households and in the last production stage such as harvesting clam or selling pigs.

Despite the fact that labor exchange is a flexible mean to deal with rural labor shortage during peaking time, the mechanization of agricultural production gradually increases number of households paid for agricultural service including machine and laborers hiring (Nguyen et al. 2015). In this paper, we find that hired laborers in agricultural production in Bac Ninh, Hai Duong and Thai Binh Provinces are divided in to two types, seasonal hired laborers and fixed hired laborers (Table 3). Seasonal laborers are rent to work on fields in peaking time from 5 to 10 days per month and they are paid daily wages. All rice cultivation households need seasonal hired laborers for transplanting and harvesting; some households with large paddy area also have to hire laborer for weeding and pesticide control. Similarly, clam households in Thai Binh report their high demand in hiring laborers when stocking baby clam at the beginning of a season and harvesting clam at the end of a season.

Industrialization change the use of labor in agricultural production

Consequently, number of seasonal hired laborers in rice cultivation and clam culture households are higher than fixed hired laborers. In contrast, due to the stability of pig production, pig raising households need more fixed hired laborers than seasonal employees. As observed, fixed employees are laborers who work for households at least 3 months continuously and they are paid monthly wages. A majority of hired laborers in pig production are fixed employees. In clam culture, households also have to rent fixed laborers who can stay long to protect clam in wide beaches. On average, an aquaculture household needs one hired laborer for each 2 ha of clam.

Table 4. Hiring and exchanging laborers in farm households by different production stages.

Descriptions		Family laborers	Exchanged laborers	Hired laborers
Rice production in Bac Ninh Province	Land preparing			
	Transplanting			
	Weeding, pesticides			
	Harvesting			
Pig production in Hai Duong Province	Pig feeding			
	Pigsty cleaning			
	Veterinary applying			
	Pig selling			
Clam culture in Thai Binh Province	Clam netting			
	Baby clam releasing			
	Clam protecting			
	Harvesting			

Source: Households survey in the Red river Delta, Vietnam 2017

**Quantifying the impact of industrialization on labor use in agricultural production.** In this section, we quantify the impact of undustrialization on labor use in agricultural production by applying multinomial logistic model. The manner a farm household use labor for agricultural production is divided into three categories: family laborers only; exchanging but not hiring laborers, and hired laborers regardless of whether or not exchanged laborers. The three manners of labor use are included as dependent variable, of which households use family laborers only are taken as reference category.

Having said that agricultural land loss and labor migration are the key aspects which represent for industrialization process in the Red River region, we take into account farmland area and number of migrant laborers as two key independent variables that can affect labor use in agricultural production. In addition, other independent variables included in multinomial logistic model are age of household head, gender of household head, educational level of household head, number of family laborers, economic status of household and type of agricultural production (Annex 1). The hypotheses are that farmland area and number of migrant laborers have positive effect on labor exchange and labor hire. Similarly, age of household



head and economic status of household are expected to have positive impact on labor exchange and labor hire. In contrast, number of family laborers is likely to have a negative effect on labor exchange and labor hire.

Generally, all estimated coefficients confirm the hypotheses formulated above. The higher farmland area the higher probability a household exchanging and/or hiring laborers. The more migrant members a household has, it is likely to exchange and/or hire laborers. In contrast, if a household has one more family laborer, it will significantly reduce more than 90% the probability of exchanging/hiring laborers (Table 5). These results are consistent with the argument that households that send out migrants would be able to hire labor to substitute for the labor that migrants would have provided on the farm. In case households cannot substitute for migrant labor, they might change to less labor intensive production such as changing from rice cultivation to pig raising or aquaculture. Alternatively, households might substitute land intensive for labor intensive crops (De Brauw 2010).

Table 5. Results of multinomial logistic regression model.

Independent Variables	Labor exchange			Labor hire		
	Coefficient ( $\beta$ )	Std. Error	Exp ( $\beta$ )	Coefficient ( $\beta$ )	Std. Error	Exp ( $\beta$ )
Intercept	2.057	3.729	-	-3.99	5.534	-
Farmland	0.02*	0.001	1.020	0.132***	0.001	1.141
Age	0.031	0.055	1.031	0.059	0.069	1.060
Migrant labor	0.835***	0.268	2.304	1.072**	0.422	2.921
Family labor	-2.65***	0.973	0.070	-2.986***	1.082	0.050
Gender	0.326*	0.039	1.385	0.32**	0.049	1.377
Education1	1.248**	0.192	3.483	0.973*	0.032	2.645
Education2	0.734	0.829	2.083	0.244	1.025	1.276
Agriculture1	-1.283	1.524	0.277	0.571	1.687	1.770
Agriculture2	-1.679	1.69	0.186	1.211	1.949	3.356
Income1	1.250***	0.242	3.490	1.571**	0.178	4.811
Income2	0.513**	0.145	1.670	0.203**	0.053	1.225
Cox and Snell 0.710; Nagelkerke 0.810; Chi-square 160.83; Sig 0.000						

\*\*\*indicates significance at the 10% level; \*\*indicates significance at the 5% level;

\*indicates significance at the 1% level.

Source: Compiled from analysis result of authors in SPSS 16.0

The results in Table 5 also supplement the trend of “feminized agriculture” in the Northern Vietnam, households with female head tend to exchange/hire laborers rather than others with male household head. With many husbands and adult sons absent working elsewhere, women are now often in charge of agricultural production (Nguyen et al. 2015). Therefore, exchanging and hiring laborers are the primary ways that women use to reduce their burdens. Especially in the context of mechanization of agricultural production in the Red River Delta, we observed

## **Industrialization change the use of labor in agricultural production**

that renting machinery to accomplish tasks takes advantage of labor saving. This mechanization of agricultural labor has, to some extent, also facilitated a feminization of agricultural production.

A part from gender of household head, household economic status also reports a positive effect on exchanging/hiring laborers. Statistically, economic statuses of rural households are divided into three categories: high income households, medium income households and poor households. Estimated coefficient shows that households in high and medium income groups tend to hire laborers with 4.8 and 1.2 times higher than the one in poor group, respectively. There are two possible explanation for this finding that merit further consideration. First, high and medium income household groups are those with higher off-farm and migrant laborers so they have higher income; the others might depend on agricultural production but in large scale so they need to hire laborers. Second, households probably enjoy higher income because of remittances of migrant members (Huynh & Nonneman 2016) so that they prefer hiring laborers rather than doing themselves.

## **CONCLUSION**

As argued in the literature, many developing countries failed to create sufficient employment and improve income distribution during the industrialization because the majority of capital resources were allocated to large-scaled capital-intensive industries and luxurious recreation facilities, such as golf courts, resorts and hotels (Gillis et al. 1992). Vietnam has experienced more than three decades of economic reform and industrialization, and had great changes in employment structure. Because of insufficient off-farm employment, many households still remain agricultural production as an important livelihood strategy in parallel with off-farm activities. In this paper, we show that industrialization creates a way of labor movement to non farm sectors, especially in Hai Duong and Bac Ninh Provinces. In general, migrant workers cannot help their families in doing farm activities, instead they send money to assist families in hiring agricultural laborers at harvesting time. Contrastingly, non-agricultural workers who do not move out of their villages remain as a significant labor supply for agricultural production at the time of harvest.

Under the trend of movement from farm to non-farm jobs, we discover that women mostly in charge in agricultural production, especially in rice cultivation. Female labor is accounted for nearly 53% of total family labor while male laborers proportion is more than 47%. In order to adapt to agricultural land reduction due to industrialization, laborers have to find off-farm jobs depending on their age, health conditions and working skill. However, more employment opportunities open for young, healthy, skilled people and men seem to have more advantage than women. Consequently, men leave their villages for older and women laborers. On average, a female family labor in Bac Ninh, Hai Duong and Thai Binh works from 5 to 6 hours per day. However, in peaking seasons they have to work more than 8 hours per day, particularly in rice cultivation. Laborers explain that ploughing, transplanting and harvesting are three important activities which need to be done quickly in time so they need to work more than usual. In addition, to catch up to seasonal time,

households do exchange laborers. The typical form of exchanging is equal days for equal types of work (transplanting or harvesting for example). In larger farmland area, households have to hire laborers for all production stages. Hired laborers in agriculture in Bac Ninh, Hai Duong and Thai Binh Provinces are divided into two types, seasonal hired laborers and fixed hired laborers. Seasonal laborers are hired to work in peak time from 5 to 10 days per month and they are paid daily wages. Fixed hired employees are laborers who work for households at least 3 months continuously and they are paid monthly wages.

These important findings from the empirical analysis are that farmland area, number of migrant laborers, number of family laborers, gender of household head, and household economic status have significantly impact on household's choice of using family, exchanged or hired labor. The higher number of migrant laborers, the higher probability of hired laborers use in a farm household. Therefore, creating off-farm jobs in rural areas is an appropriate policy to absorb laborers and to prevent them from migrating far away their home.

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# Annex 1. Description of independent variables used in multinomial logistic model.

Names of variables	Description	Frequency/ Mean
Farmland	Farmland area which is currently used by households (m <sup>2</sup> )	3461
Age	Age of household head	49.80
Migrant labor	Number of migrant laborers who work and live far from home	0.47
Family labor	Number of family laborers including who work in off-farm jobs but do not leave home	2.91
Gender	1 if household head is female	37
	0 if household head is male	93
Education	3 if household head achieves high school level	36
	2 if household head achieves secondary school level	66
	1 if household head achieves primary school level	28
Agriculture	1 if household produces rice	50
	2 if household produces pigs	50
	3 if household produces clam	30
Income	1 if household is in high income group	60
	2 if household is in medium income group	62
	3 if household is in poor group	8

Source: Households survey in the Red River Delta, Vietnam 2017.



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