Farmland and peri-urban livelihoods in Hanoi, Vietnam: evidence from household survey data

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Abstract

Using data from our own household survey (n=477) in Hanoi's peri-urban areas, this paper attempts to answer (i) what livelihood strategies are pursued by peri-urban households, (ii) which strategies are lucrative and which are not, and (iii) whether access to farmland is the potential barrier to enter remunerative strategies. The paper uses cluster analysis techniques, based on identification of household income shares by source, to provide the first classification of five livelihood strategies pursued by households in Hanoi's peri-urban areas. Income sources and total income are compared across livelihood strategies using Bonferroni pairwise tests and first-order stochastic dominant analysis. The findings of the study show that non-farm income sources mainly contribute to total household income, strategies based on formal wage work and non-farm household businesses are the most remunerative ones and strategies based on farming and informal wage work are the most inferior ones. Factors associated with households' livelihood strategy choice are examined using a multinomial logit model. The findings reveal that farmland is negatively associated with the choice of both high and low return non-farm-based strategies. This suggests that access to farmland is not a potential barrier to enter lucrative strategies. In addition, education of working members has a positive impact on the pursuit of remunerative strategies, implying that better education might shift households away from farming activities. Age of household working members has a negative effect on the choice of wage work-based strategies, suggesting that emerging non-farm opportunities make young workers less interested in farm work. Finally, this paper proposes some policy implications that may help households obtain better livelihood outcomes.

Keywords: Farmland; cluster analysis; informal wage income; formal wage income; household livelihood strategies

1. Introduction

A livelihood can be conceptualised as consisting of five types of capitals (natural, physical, human, financial and social capital), the activities, and the approach to these capitals (mediated by other factors such as institutions and social relationships) that together decide the living of the individual or household (Ellis, 2000). Livelihood strategies are defined as the range and combination of activities and choices that people pursue in order to achieve their

livelihood objectives (Kollmair & Gamper, 2002). According to Scoones (1998), livelihood strategies can be identified at different levels, ranging from the individual, household, and village level, to regional and even national levels. Following Ellis (2000), we defined a household livelihood strategy as a combination of activities that create the means of household survival.

In general, empirical evidence has indicated that rural households and individuals engage in a diverse range of income-generating activities (Davis et al., 2010). Looking at the main income-earning activity that individuals pursued seems to be a simple way to identify various types of livelihoods at the individual level. However, it is more difficult to distinguish different types of livelihood strategies at the household level. As noted by Barrett, Reardon, and Webb (2001), household livelihood strategies cannot be identified by a single income-earning activity. This is because each household member is likely to engage in one or more income-earning activities and furthermore different members in each household often participate in various activities. The data from the Vietnam Access to Resources Household Survey (VARHS) 2008 show that, only about 20 percent of Vietnamese rural households engage in a single activity, while the vast majority of households diversify their labour resources into different activities, with approximately 50 percent engaging in two activities, and around 25 percent participating in three activities (CIEM, 2009).

Classification of household livelihood strategies is useful for both research and policy work (Ellis, 2000). This requires clustering a vector of income-earning activities (Nielsen, Rayamajhi, Uberhuaga, Meilby, & Smith-Hall, 2013). Cluster analysis is a technique that is used to identify meaningful, mutually exclusive subgroups of observations from a larger aggregate group (Hair, Anderson, Tatham, & William, 1998). Therefore, cluster analysis method has been widely used in many empirical studies on rural household livelihoods (e.g., Ansoms, 2008; Brown, Stephens, Ouma, Murithi, & Barrett, 2006; Jansen, Pender, Damon, Wielemaker, & Schipper, 2006; Van den Berg, 2010). Although a number of studies have investigated rural household livelihoods in Vietnam (e.g., Do, 2006; Hoang, Dang, & Tacoli, 2005; Jakobsen, Rasmussen, Leisz, Folving, & Quang, 2007; Nguyen, Vu, & Philippe, 2011; Nguyen, 2009; Vo, 2006), none of which have used cluster analysis method to classify livelihood strategies at the household level. Thus, our study is the first to apply cluster analysis techniques to classify various groups of household livelihood strategies in Hanoi's peri-urban areas, Vietnam.

The main objective of this study is to test the hypothesis that farmland holdings affect access to lucrative livelihood strategies in Hanoi's peri-urban areas. Farmland has not only a direct value in agricultural production but also an indirect value in other economic activities such as collateral for credit (Winters et al., 2009). Therefore, farmland may affect the choice of high return livelihood strategies. For example, households with land endowments can easily access to credit, which in turn may provide them more chance of choosing lucrative livelihood strategies. However, households having more land are more likely to adopt an agriculture-based strategy, which may be less lucrative than non-farm-based strategies. The existing empirical evidence generally supports these conclusions. Jansen et al. (2006) provided econometric evidence for mixed impacts of land on the pursuit of remunerative livelihood strategies in the hillside areas of Honduras. Their findings reveal that households with more land are more likely to pursue a livestock-based strategy, which generates higher income per capita than those based on basic grains farming. Nevertheless, more farmland owned by households is associated with lower probability of adopting a high return strategy based on off-farm work and basic grains. Nielsen et al. (2013) found no impact of land holdings on the choice remunerative livelihood strategies in Bolivia but a positive impact was reported for Nepal and Mozambique. Specifically, in Nepal, land is positively linked to the likelihood of choosing the most lucrative strategy that based on large-scale farming and business operation. In Mozambique, households having more land are also more likely to take up the two most remunerative strategies - one based on business operation and the other based on large-scale farming and off-farm work.

The overall objective of this study is to contribute to the understanding of income-generating activities, important sources of income amongst households and the factors affecting their choice of livelihood strategies in Hanoi's peri-urban areas. More specifically, the paper seeks to answer (i) what livelihood strategies are pursued by peri-urban households, (ii) which strategies are lucrative and which are not, and (iii) whether farmland is the potential barrier to enter remunerative strategies. The paper is structured as follows: the next section describes the context of the study district, followed by the data and methods in Section 3. Section 4 reports results and discussions, and followed by the conclusion and policy implications in Section 5.

2. Description of study area

Our research was conducted in Hoai Duc, a peri-urban district of Hanoi. Hoai Duc is located on the northwest side of Hanoi, 19 km from the Central Business District (CBD) (WB, 2011). The district occupies 8,247 hectares of land, of which agricultural land accounts for 4,272 hectares and 91 percent of this area is used by households and individuals (Hoai Duc District People's Committee, 2010). Of the districts of Hanoi, Hoai Duc has the biggest number of land acquisition projects and has been experiencing a massive conversion of farmland for non-farm uses (Huu Hoa, 2011). In the period 2006-2010, around 1,560 hectares of farmland were acquired for 85 projects (Hà nội mới, 2010). The average size of farmland per household in the district was about 840 m^2 in 2009 (Statistics Department of Hoai Duc District, 2010), which was much lower than that in Ha Tay Province (1,975 m^2) and much smaller than that of other provinces (7,600 m^2) in 2008 (Central Institute for Economic Management (CIEM), 2009).

Hoai Duc was merged into Hanoi City on the 1st of August 2008. There are 20 administrative units under the district, including 19 communes and one town. Hoai Duc has around 50,400 households with a population of 193,600 people. In the whole district, employment in the agricultural sector dropped by around 23 percent over the past decade. Nevertheless, a significant proportion of employment has remained in agriculture, accounting for around 40 percent of the total employment in 2009. The corresponding figures for industrial and services sectors are 33 and 27 percent, respectively (Statistics Department of Hoai Duc District, 2010).

3. Data and methods

3.1 Data

Data for this paper were drawn from our own household survey in Hoai Duc District. First, six communes were randomly selected. Then from each of these communes, 100 households, including 20 households for reserves, were randomly selected, for a target sample size of 480 households. The survey was carried out from April to June 2010 and 477 households were successfully interviewed. Adapted from General Statistical Office (GSO) (2006), a household questionnaire was designed for the survey to gather quantitative data on household livelihood assets (human, social, financial, physical and natural capitals), economic activities (time allocation data), and livelihood outcomes (income and consumption expenditure).

3.2. Methods

Empirical studies on household livelihoods have widely used income shares by source as the main criterion to classify household livelihood strategies (Nielsen et al., 2013). This approach is appropriate because incomes from various sources are the result of working time and livelihood assets that are allocated to different economic activities. In our study, livelihood strategy identification requires clustering a vector of income share variables. Therefore, we used cluster analysis techniques to identify household livelihood strategies using data on various income sources in the last 12 months before the time of the survey (see more in Appendix 1). Following suggestions by Punj and Stewart (1983), a two-stage procedure was applied for cluster analysis. First, data on income shares of each household were used as input variables for performing a hierarchical method using the Euclidean distance and Ward's method to identify possible numbers of clusters. At this stage, the values of coefficients from the agglomeration schedule were used to seek the elbow criterion for defining the optimal numbers of clusters (Egloff, Schmukle, Burns, Kohlmann, & Hock, 2003; Simonson, Gordo, & Titova, 2011) (see Appendix 2). Then, the cluster analysis was rerun with the optimal cluster number which had been identified using k-mean clustering.

Once the sample households were partitioned into various groups of livelihood strategies, we used description statistics to provide a detailed picture of households' livelihood assets and livelihood strategies. Then, we compared livelihood strategy incomes using Bonferroni pairwise tests and first-order stochastic dominant analysis. Finally, we modeled the determinants of households' livelihood strategy choice using a multinomial logit model. This model provides a set of equations each of which presents the impact of explanatory variables on the log-odds ratio $\ln\left[\frac{Pij}{Pik}\right] = x_i\beta_j$: for each unit change of x_i, the coefficients β_j show the change in the log-ratio between the likelihood of choosing livelihood strategy *j* and the likelihood of choosing livelihood *k* (Greene, 2003). The reference group *k* against other livelihood strategies in this paper is the farm work-based livelihood group. Following the frame work for micro policy analysis of rural livelihoods proposed by Ellis (2000), we selected asset-related variables as being important to the choice of livelihood strategy. These were (i) household size, dependency ratio (calculated by the number of household member under 15 and over 59, divided by the total members aged 15-59), number of male working members, age of household head, average age of working members, average education of working members (human capital); (ii) total number of group memberships (social capital); (iii) owned farmland size per adult (natural capital); (iv) Natural log of total values of all productive assets per working members (physical capital) and (v) two dummy variables of

access to formal and informal credit (financial capital). Finally, commune dummy variables were also included in the model to control for fixed commune effects.

4. Results and discussion

4.1. Livelihood strategy classifications

Based on the detailed information about different types of income earning activities that each household member engages in, we distinguished four major types of labour income-generating activities at the household level (Table 1).

Table 1: Labour-based income-generating categories

Categories	Definitions
1. Farm work	Self-employment in household agriculture, including crop and livestock production and other related activities.
2. Non-farm Self-employment	Self-employment in non-farm activities (non-farm household businesses)
3. Informal wage work	Wage work that is often casual, low paid and often requires no education or low education levels. Informal wage earners are often manual workers who work for other individuals or households without a formal labour contract.
4. Formal wage work	Wage work that is regular and relatively stable in factories, enterprises, state offices and other organizations with a formal labour contract and often requires skills and higher levels of education

Source: Survey data and authors' compilation from Becker (2004), Maxwell et al. (2000), Cling et al. (2010), and Nguyen (2010).

Table 2 provides background information about household income by source and participation rate in activities. In addition, it also indicates the extent to which various income sources contribute to total household income in the sample. The results show that the overwhelming majority of the surveyed households (84 percent) derived income from farming, which, however, only accounted for about 27 percent of total income on average. This suggests that farming has remained relatively important in terms of food security and cash income. Many households have continued rice cultivation as a source of food supply while others produced vegetables and fruits to supply Hanoi's urban markets. Almost all surveyed households (90 percent) participated in at least none non-farm activity and income from non-farm sources contributed about two thirds of total income on average. Amongst these activities, informal

wage income accounted for 24 percent of total income with a participation rate of around 41 percent. Similarly, about 40 percent of the household sample reported engaging in non-farm household businesses, and on average around 24 percent of total income was contributed by this activity. About 28 percent of the sample households received income from formal wage work, accounting for 18 percent of total income on average. Finally, about one third of the surveyed households received other income; but this source only contributed 6.8 percent of total income on average.

Table 2: Composition of household income and participation rate in activities

Income sources	Annual income per household (1,000) VND		Share of total household income (%)		Participation rate (%)
Farm work	14,046	(16,502)	27.14	(30.4)	84
Nonfarm self-employment	15,561	(26,478)	24.13	(34.13)	40
Informal	12,035	(18,399)	24.04	(34.06)	41
Formal	14,555	(28,973)	17.89	(31.81)	28
Other income	3,491	(8,849)	6.8	(17.16)	33
Total	59,688	(31,156)	100		

Note: Standard deviations are in parentheses. 1 USD equated to about 18,000 VND in 2009.
Source: Own calculation from authors' survey.

Table 3 shows some statistical description of household livelihood strategies that were identified via cluster analysis techniques. As shown in this table, four main labour income-based livelihoods were classified (strategies A-D). Cluster analysis also identified 21 households that pursued a non-labour income-based strategy (strategy E). The main features of household livelihood strategies according to their livelihood assets are presented in Table 3 and Table 4. As indicated in Table 3, around 26 percent of the total households pursued livelihood A, with their main income derived from manual labour. Household members in this livelihood group were commonly employed as carpenters, painters, construction workers, and in other casual jobs. However, they still relied on farm production for subsistence or cash income to some extent. These households were characterised by their relatively low human capital as compared to those in other labour income-based livelihoods. In addition, their natural capital in the form of owned farm size was rather smaller than that of households in other livelihoods. In addition, their level of productive assets was much lower than that of those with livelihood D.

Livelihood B (about 21 percent of the sample) consisted of households who derived income mainly from formal wage work. Similar to those in livelihood A, many households in this livelihood still maintained farming activities for their food consumption or cash income. However, unlike those in livelihood A, households in this livelihood group owned a much higher level of human and social capitals than those in other livelihoods. The working members in this group had the highest level of schooling years and were the youngest. Surprisingly, while households in this livelihood group owned the second largest of farmland size, farm income contributed only a small proportion to the total household income.

Table 3: Household livelihood strategies

	Livelihood strategies of households				
	A Informal wage work-based livelihood	**B** Formal wage work-based livelihood	**C** Non-farm Self-employment - based livelihood	**D** Farm work - based livelihood	**E** Non-labour-based livelihood
Number of households	**125**	**100**	**128**	**103**	**21**
Proportion of total households	26%	21%	27%	22%	4%
	Mean income share by source per household (%)				
Other income	**3** (8)	**6** (13)	**3** (8)	**2** (6)	**75** (18)
Farm work	**16** (15)	**11** (13)	**13** (14)	**77** (19)	**8** (13)
Non-farm self-employment	**3** (8)	**3** (9)	**76** (17)	**9** (15)	**2** (5)
Informal wage work	**77** (17)	**3** (9)	**4** (11)	**8** (14)	**14** (18)
Formal wage work	**1** (6)	**76** (17)	**3** (10)	**4** (10)	**1** (4)

N=477. Standard deviations are in parentheses.
Source: Own calculation from authors' survey.

Livelihood C (27 percent of the sample) represents households who earned their living mainly by non-farm self-employment activities. Such businesses included small-scale trade or production units, using family labour, with an average size of 1.7 jobs. Households' business premises were mainly located at their own homes or on residential land plots, which were prime locations for opening a shop, workshop or small restaurant. However, many amongst them still continued to maintain farm work as a source of food supply or an extra income. The household heads in this livelihood were younger than those in other livelihoods. Also, households in this livelihood had the second highest level of education of working members.

Households in livelihood D accounted for 22 percent of the sample and were characterised by those who based their living primarily on crops and livestock production. Common crops included cabbages, tomatoes, water morning glory, various kinds of beans, oranges, grapefruits, and guavas, etc. Animal husbandry mainly involved pig or poultry breeding on small-farms or grazing of cows. These activities have significantly declined due to the spread of cattle diseases in recent years. Besides farm work, many of them also engaged in activities related to wage work or non-farm self-employment. Households falling into this livelihood group had the largest size of farmland but their working members were older and had a lower level of education than those in other livelihoods (excluding livelihood E).

Table 4: Mean household livelihood assets by livelihood strategy

Livelihood assets	**Types of livelihood strategies**					
	All	**A**	**B**	**C**	**D**	**E**
Human capital						
Household size	4.50 (1.62)	4.70 (1.73)	4.92 (1.35)	4.26 (1.38)	4.64 (1.64)	2.05 (1.05)
Dependency ratio	0.60 (0.65)	0.62 (0.57)	0.63 (0.76)	0.60 (0.62)	0.51 (0.63)	0.89 (0.96)
Gender of household head (=1 if male)	0.78 (0.41)	0.78 (0.42)	0.79 (0.41)	0.76 (0.42)	0.87 (0.33)	0.43 (0.51)
Age of household head	51.35 (12.60)	51.94 (13.85)	52.57 (12.84)	48.08 (11.47)	50.80 (10.77)	65.4 (8.19)
Education of household head	6.81 (3.46)	6.18 (3.31)	8.47 (3.61)	7.12 (3.30)	5.90 (2.74)	5.15 (4.60)
Average age of working members	40.73 (9.12)	38.93 (7.67)	36.92 (6.80)	41.06 (8.19)	43.02 (8.68)	61.37 (11.18)
Average education of working members	8.17 (2.95)	7.70 (2.26)	10.90 (2.55)	8.02 (2.68)	6.83 (2.32	4.60 (3.53)
Social capital						
Total number of formal group memberships	2.52 (1.54)	2.23 (1.40)	3.59 (1.66)	2.10 (1.50)	2.40 (1.22)	2.4 (1.23)
Total number of informal group memberships	0.90 (1.00)	0.70 (0.87)	1.51 (1.22)	0.86 (0.89)	0.67 (0.73)	0.55 (1.05)
Total number of group memberships	3.42 (2.06)	2.93 (1.77)	5.1 (2.34)	2.96 (1.82)	3.07 (1.53)	2.95 (1.90)
Natural capital						
Farm land size (m^2)	1,047 (938)	757 (616)	1,121 (998)	843 (631)	1,820 (1,221)	440 (446)
Farmland per adult (m^2)	310 (251)	215 (165)	283 (9243)	274 (207)	472 (312)	225 (247)
Physical capital (1,000 VND)						
Total value of productive assets	20,810 (19,174)	13,109 (11,511)	24,457 (19,027)	24,431 (21,446)	24,990 (20,688)	5,827 (13,539)
Total value of productive assets per working member	8,819 (9,276)	5,089 (4,621)	8,499 (6,064)	11,787 (12,133)	10,735 (10,459)	4,168 (7,299)
Financial capital						

Access to formal credit	0.26	0.29	0.17	0.30	0.26	0.19
(=1 if yes)	(0.44)	(0.45)	(0.38)	(0.46)	(0.44)	(0.40)
Access to informal credit	0.20	0.19	0.18	0.19	0.26	0.09
(=1 if yes)	(0.40)	(0.39)	(0.39)	(0.39)	(0.44)	(0.30)

Note: Standard deviations are in parentheses. Values of physical in 1,000 VND (1 USD equated to about 18,000 VND in 2009).
Source: Own calculation from authors' survey.

Livelihood E was a very small group (21 households), representing about 4 percent of the sample. Households following this livelihood depended mainly on non-labour income sources. They were households with a very small size and higher dependency ratio, consisting mainly of very old and poorly educated members. Most of them were land-limited farmers, living separately from their children, with income derived mainly from rental income or interest earnings, remittances and gifts from their children, and other social assistance. These households were excluded from econometric analysis because of their small number.

4.2. Comparing livelihood strategy incomes

Following Nielsen et al. (2013), we evaluate which livelihood strategies have (i) higher outcomes in terms of income per capita and per adult (the income per capita and per adult is assumed to reflect the expected outcome of a selected livelihood strategy) and (ii) higher likelihoods of getting higher incomes relative to other livelihood strategies (the sample distributions are assumed to be approximately the underlying distribution for each livelihood strategy). Households that select a livelihood strategy with low expected income or low probability of earning higher income could reflect the fact that they face constraints that restrict their livelihood strategy choices.

Table 5 shows mean income per adult from various sources and total income per capita and per adult earned for each livelihood strategy. In order to rank the outcomes of each livelihood strategy in terms of total mean income per capita and per adult and investigate what income components contribute income differences, Bonferroni pairwise tests were conducted across the four labour-based livelihood strategies (see the results in Appendix 3). While livelihood B and C both have much higher levels of welfare (income per capita and per adult) than other strategies, their welfare outcomes do not differ between these two strategies. Livelihood A and D are the least lucrative ones and no statistically significant difference in welfare was found between them. Unsurprisingly, the farm work-based livelihood (D) earned a significantly higher farm income than other non-farm-based livelihoods (A-C). Livelihood C received a much higher income from non-farm household businesses than other livelihoods,

while livelihood A earned a considerably higher income from casual and low paid jobs than other livelihoods. Livelihood B derived their main income from stable and high paid jobs, which is much greater than that in other livelihoods. Interestingly, livelihood B earned a higher level of other income than livelihoods A, C and D. The results above show that what generates outcome differences are activities related to formal wage work and non-farm household businesses. Households that pursued these activities as their dominant livelihoods have significantly higher incomes compared to those with livelihood A and D. This is mainly due to their earnings from formal wage work and non-farm household businesses. This suggests that these non-farm jobs are important for improving local household livelihoods.

Table 5: Mean and composition of household income, by livelihood strategy

		Livelihood strategies				
Variables	Total sample	A	B	C	D	E
Annual total income	14,147	11,113	17,490	16,293	11,794	14,734
per capita	(7,345)	(4,004)	(8,880)	(8,077)	(5,607)	(6,926)
Annual total income	17,963	14,875	21,088	21,576	14,741	15,247
per adult	(9,410)	(6,079)	(9,696)	(10,834)	(8,519)	(6,6480
Annual income						
per adult by source						
Farm work	4,067	2,145	2,075	2,417	10,950	1,296
	(5,151)	(2,232)	(2,787)	(2,834)	(6,164)	(2,242)
Informal wage work	3,712	11,469	684	942	1,089	1,697
	(5,856)	(5,541)	(1,969)	(3,146)	(2,279)	(2,551)
Formal wage work	3,792	167	16,037	884	630	301
	(7,696)	(1,190)	(8,538)	(3,338)	(1,891)	(691)
Nonfarm self-	5,105	538	655	16,578	1,648	495
employment	(8,677)	(1,565)	(1,866)	(9,336)	(3,086)	(1,320)
Other income	1,287	556	1,636	754	423	11,457
	(3,334)	(1,360)	(3,644)	(1,928)	(1,750)	(6,793)
Number of households	**477**	**125**	**100**	**128**	**103**	**21**

Note: Standard deviations are in parentheses. Income and its components in 1,000 VND (1 USD equated to about 18,000 VND in 2009).
Source: Own calculation from authors' survey.

Following Brown et al. (2006) and Nielsen et al. (2013), we also rank livelihood strategy outcomes using first-order stochastic dominant analysis. According to Whitmore and Findlay (1978), a livelihood strategy first-order stochastically dominates another strategy is one that - for all possible income levels - has a lower cumulative density relative to other strategies, reflecting a higher probability of earning higher incomes. Figure 1 shows that many observations of livelihood B and C overlap. This is also the case for livelihood A and D. Therefore, it is quite unclear which strategy is the most remunerative one and which is the most inferior one. However, the figure indicates that two strategies (B and C) stochastically dominate the two lowest return strategies (A and D), suggesting that livelihood B and C have

a greater likelihood of getting higher incomes compared to livelihood A and D. The cumulative density distributions, therefore, confirm the Bonferroni test results and combined together, they show that some livelihood strategies are to be superior to others assuming that households try to maximize their income.

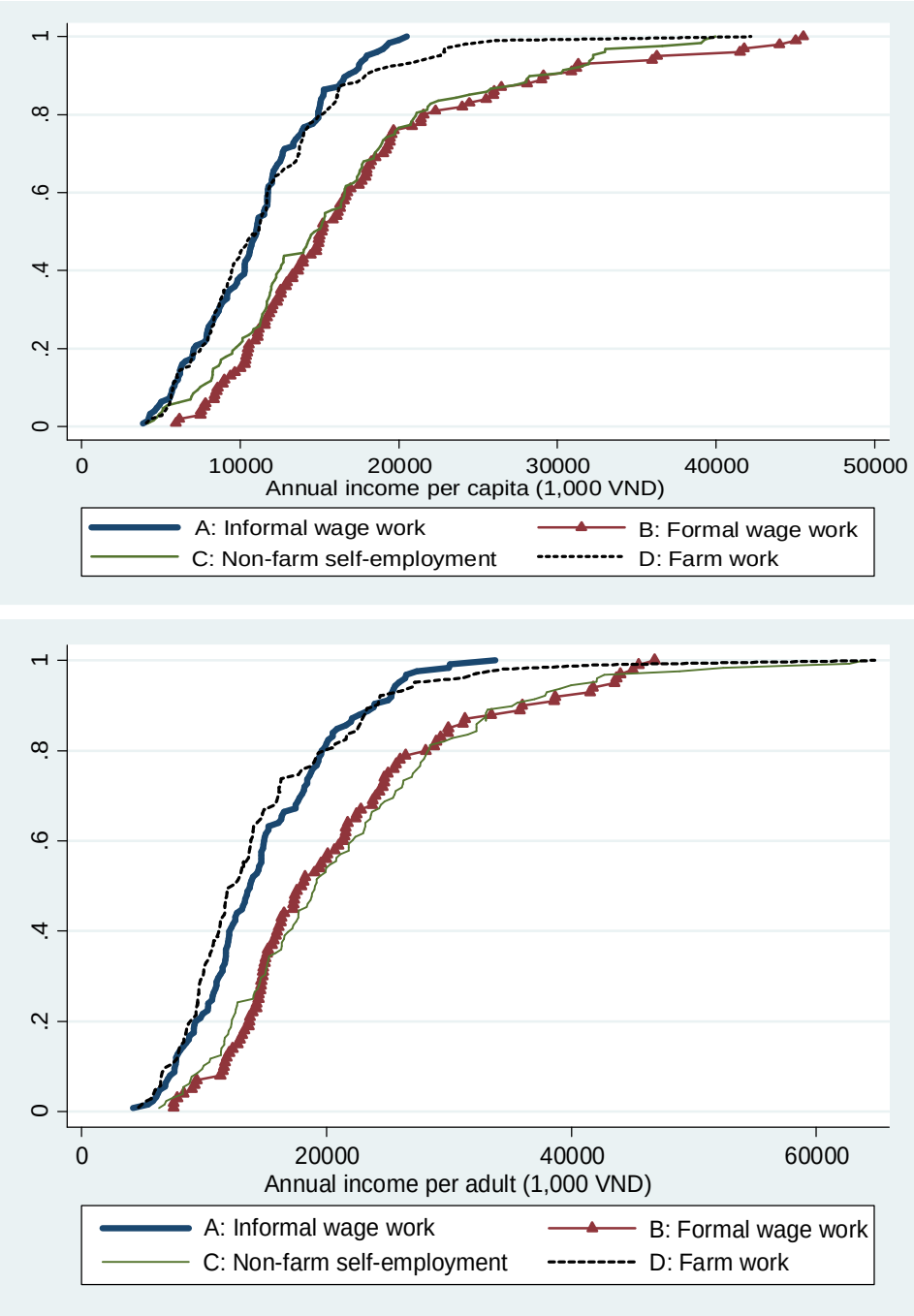


Figure 1: Cumulative density distributions for each livelihood strategy

4.3. Determinants of livelihood strategy choice

Results from the MNL regression are reported in Table 6. The coefficients show the effect of assets on the probability of strategy choice compared to the probability of choosing the farm work-based strategy. The results show that the larger households are, the more likely they specialize in farming as their main living. This indicates that farming is a more labour-intensive strategy than other strategies. Possibly, this reflects the fact that having more family labour allows many households to intensively cultivate vegetables that are more profitable than rice but also require a greater labour input[1]. A similar picture was also observed in Thanh Tri, a peri-urban district of Hanoi (Van den Berg, Van Wijk, & Van Hoi, 2003), and on the peripheries of Ho Chi Minh City (Jansen, Midmore, Binh, Valasayya, & Tru, 1996). Households with more dependants are more likely to take up non-farm self-employment strategy. Age of working members is negatively associated with the choice of wage work-based strategies, suggesting that non-farm emerging opportunities make young workers less interested in farm work. Working members with higher education levels are more likely to pursue formal wage work-based and non-farm self-employment-based strategies, which implies that there are some potential barriers had prevented poorly educated farmers from taking up non-farm jobs. These findings are consistent with Huang, Wu, and Rozelle (2009), who found that young and more educated working members were associated with more participation in off-farm activities in Shandong Province, China.

Table 6: Multinomial logit estimation for determinants of livelihood strategy choice

Explanatory variables	A vs D		B vs D		C vs D	
	Coef.	Se	Coef.	Se	Coef.	Se
Human capital						
Household size	-0.25*	(0.135)	-0.34**	(0.154)	-0.31**	(0.126)
Dependency ratio	0.31	(0.315)	0.40	0.416)	0.49*	(0.292)
Number of male working members	0.10	(0.276)	0.28	(0.335)	-0.25	(0.294)
Household head's gender	-0.09	(0.502)	-0.24	(0.565)	-0.53	(0.459)
Household head's age	0.02	(0.019)	-0.00	(0.020)	-0.02	(0.018)
Age of working members	-0.11***	(0.028)	-0.10***	(0.029)	-0.02	(0.025)
Education of working members	0.09	(0.088)	0.55***	(0.091)	0.16**	(0.076)
Natural capital	-0.61***	(0.102)	-0.35***	(0.083)	-0.45***	(0.076)
Physical capital	-0.91***	(0.209)	-0.72***	(0.216)	0.02	(0.185)
Social capital	-0.03	(0.106)	0.30**	(0.117)	-0.05	(0.102)
Financial capital						
Access to formal credit	0.20	(0.398)	-0.52	(0.477)	0.41	(0.352)
Access to informal credit	-0.72*	(0.410)	-0.74	(0.482)	-0.75*	(0.393)
Commune	(0.410)		(0.482)		(0.393)	

[1] In some places of Hoai Duc District, the mean net return per year per hectare for fresh vegetable production is between 3-4 times higher than for rice. The vegetable cultivation has short durations; about 40-60 days (depending on types of vegetables), which allows farmers to harvest 5-6 crops per year (Son Tung, 2010). Therefore, vegetable production requires a higher labour input than rice.

Song Phuong	-3.15***	(0.691)	-1.27*	(0.702)	-0.55	(0.602)
Kim Chung	0.65	(0.913)	1.13	(0.946)	1.04	(0.941)
An Thuong	-0.13	(0.736)	0.17	(0.753)	0.75	(0.705)
Duc Thuong	-1.77***	(0.605	-1.29*		-0.89	(0.613)
Van Con	-0.88	(0.626)	-1.42*	(0.797)	-0.09	(0.641)
Constant	15.24***	(2.521)	7.98***	(2.707)	4.73**	(2.296)
Wald chi2(51)			254.06			
Prob > chi2			0.0000			
Pseudo R2			0.3105			
Observations	451		451		451	451

Note: **A**: informal wage work, **B**: Formal wage work, **C**: Non-farm self-employment, **D**: Farm work
Se: Robust standard errors. *, **, *** mean statistically significant at 10%, 5% and 1%, respectively

Unsurprisingly, farmland per adult is negatively associated with the likelihood of choosing non-farm-based strategies, suggesting that more farmland moves households away from non-farm activities. This finding complements an earlier study which shows there is a negative relationship between farmland holdings and non-farm participation in Vietnam and other developing countries (Carletto et al., 2007). Especially, a negative association between farmland and the choice of the two most lucrative strategies (B and D) suggests that farmland is not a potential barrier to enter high return strategies. Households that pursued farm work-based strategy have higher levels of physical capital than those pursuing strategies based on paid jobs possibly because farm production often requires a higher amount of productive assets. Households with the formal wage work-based strategy have a higher number of group memberships, which may be explained by the fact that those who work in factories, enterprises and state offices tend to join many groups and association as requirements of these organizations.

5. Conclusion and policy implications

Using cluster analysis techniques, our study is the first to provide a detailed picture of household livelihood strategies in Hanoi's peri-urban areas. Four main types of labour-based livelihood strategies were identified at the household level. The results from Bonferroni pairwise tests and first-order stochastic dominant analysis indicate that while the formal wage work-based and non-farm self-employment-based strategies are the highest return ones, the informal wage work-based and farm work-based strategies are the least remunerative ones. Our econometric evidence shows a negative association between farmland endowment and the choice of non-farm-based strategies. Households with less farmland are more likely to choose either a low return strategy (informal wage work) or high return ones (formal wage work or non-farm household businesses). Thus, farmland is not a potential barrier prohibiting households from pursuing remunerative strategies. The findings above suggest that land-limited households might be pushed into non-farm jobs as a way to cope with the adverse

context of land shortage or might be pulled into non-farm activities because of high income from these activities. This implies that, given the context of farmland conversion for urbanization and industrialization in Hanoi's peri-urban areas, landlessness and land shortage should not be seen as a negative phenomenon. Such a trend seems similar to that in several developing countries where farmland scarcity is highly related to more engagement in both agricultural and non-agricultural paid jobs and therefore leads rural households to pursue this way of enhancing their wellbeing (Winters et al., 2009).

The results from Bonferroni pairwise tests and first-order stochastic dominant analysis show that households that pursued formal wage work and non-farm household businesses as their main livelihoods tend to have higher welfare levels than those following other strategies. This implies that moving from farming or manual labour jobs to formal wage work or non-farm household businesses will be a way to improve household welfare. Econometric evidence indicates that working members with higher levels of education and were young are more likely to pursue lucrative non-farm activities such as formal wage work or non-farm household businesses. Therefore, a possible implication here is that investment in children's education may be a way to seize high-return livelihood opportunities for the next generation. In addition, job generation policies for rural young workers, especially non-farm jobs should be implemented.

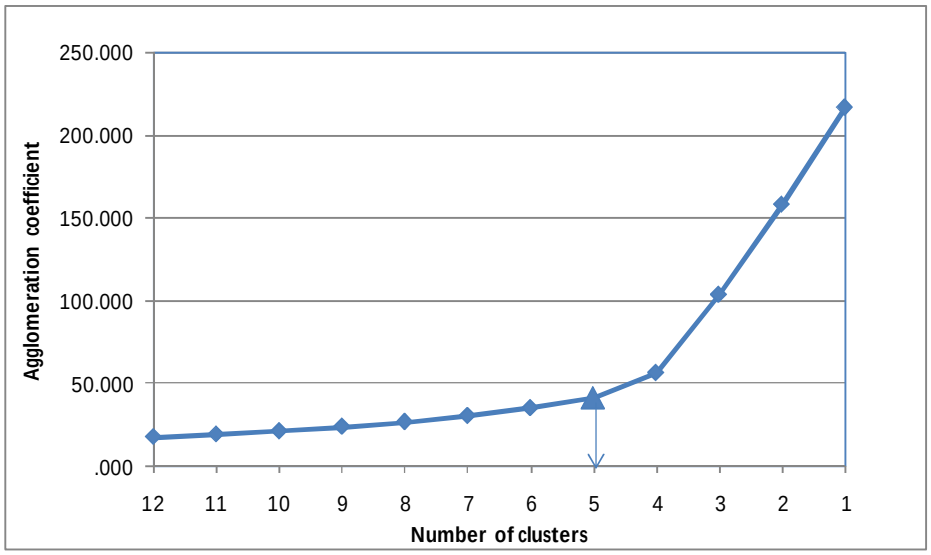
As previously discussed, although farm income is not an important source for those with non-farm-based livelihood strategies, many households in these livelihoods still maintained farming as a source of food supply or cash income. For households following a farm work-based strategy, their income may be considerably improved by learning successful experiences in farming transitions from some other localities in Hanoi. For instance, in the Tu Liem peri-urban area, Tay Ho and Hoang Mai urban districts, farm households have gained much benefit by shifting from cultivation of staples to higher value products such as fresh vegetables, flowers and ornamental plants (Lee, Binns, & Dixon, 2010). Consequently, agricultural extension polices that assist farmers to change to more profitable crop plants should be of practical use.

Appendix 1: **Some descriptive statistics on income share data for cluster analysis**

Mean income share by source	Farm work	Non-farm self-employment	Informal wage work	Formal wage work	Other income	Total income
(%)	**27.14** (30.40)	**24.13** (34.13)	**24.04** (34.06)	**17.89** (31.81)	**6.80** (17.16)	**100**

N=477. Standard deviations are in parentheses.
Source: Own calculation from authors' survey.

Appendix 2: Elbow-Criterion: Decision about the number of clusters of household livelihood strategies



Appendix 3: Pairwise comparison of income and its components using Bonferroni method

Livelihood strategy comparison	Farm income	Nonfarm self-employment income	Informal wage income	Formal wage income	Other income	Total income	Annual income per capita
A vs B			10,785 (0.000)	-15,870 (0.000)	-1,080 (0.003)	-6,213 (0.000)	-6,377 (0.000)
A vs C		-16,040 (0.000)	10,527 (0.000)			-6,700 (0.000)	-5,180 (0.000)
A vs D	-8.805 (0.000)		10,380 (0.000)				
B vs C		-15,922 (0.000)		15,153 (0.000)	882 (0.023)		
B vs D	-8,875 (0.000)			15,460 (0.000)	1,213 (0.001)	6,347 (0.000)	5,696 (0.000)
C vs D	-8,532 (0.000)	14,930 (0.000)				6,834 (0.000)	4,499 (0.000)

Note: Results reported are mean differences and *P*-values below 10% (in parentheses). All variables in columns 1-6 are annual income per adult. Unit: 1,000 VND and 1 USD equated to about 18,000 VND in 2009.

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