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Farmland accumulation and rural household income: Evidence from the Red River Delta region of Vietnam

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Abstract: We identify the factors affecting the participation in land accumulation of rural households by using a multinomial logit model and assess the income effects of participation in land accumulation by using the propensity score matching (PSM) method. We use household data from a rural survey in three provinces in the Red River Delta of Vietnam in 2019. Our results show that farmland accumulation is significantly correlated with age and gender of household head, as well as agricultural productive assets, non-farm income, saving and access to credit. The participation in farmland accumulation leads to an increase in total household income, although the effect is different between land increasing and land decreasing groups. We suggest enhancing access to credit and supporting non-farm activities to accelerate the accumulation of agricultural land and consequently improve household income.

Keywords: land accumulation; multinomial logit model; propensity score matching

Land accumulation to increase the economies of scale is an integral part of agricultural transformation (Lewis 1954; Nguyen et al. 2021) and has taken place in both the developed and developing worlds (Hüttel et al. 2013; Wang et al. 2016; Čechura et al. 2022). In the literature, there are different definitions or understandings of land accumulation. From an ownership perspective, land accumulation is defined as the acquisition or gradual gathering of land (Henderson et al. 2015), which means land accumulation is the process of accumulating the ownership of land. From a practical perspective, land accumulation is understood as a way to increase the size of land (Do et al. 2023). It includes the expansion of the farm unit via legal land-exchanging activities such as purchase, rental or sharecropping arrangements (Henderson et al. 2015). In some developing countries where the average farm size is small with several small land parcels, land accumulation is essential in improving farming efficiency, relieving labour for other sectors, increasing household income and facilitating agricultural transformation (Eastwood et al. 2010; Üngör

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2013; Do et al. 2023). This improvement is theoretically possible because land accumulation allows farmers who have extended their farmland to lower their production costs, including the travel costs in the fields (Lazikova et al. 2017). At the same time, this improvement allows farmers who have contracted their farmland to participate in non-farm activities. These changes lead to an increase in the overall welfare of both land users and non-users (Nguyen et al. 2021).

Despite these advantages, some developing countries still impose restrictions on farmland accumulation. In situations where risk is high, credit markets are imperfect and non-agricultural uses drive land purchase demand, land markets may lead to increasing inequality in access to land. The premature of land market operation by better-off households and limit the opportunities for the poor to access the land (Deininger 2003). In addition, in some countries where land accumulation is allowed, the average farmland area per farm is still small, and land market operation does not function well (Amare et al. 2023; Onofri et al. 2023). In this regard, it is important to find further empirical evidence about the factors affecting participation in land accumulation and its welfare effects.

Vietnam is a typical case to examine land accumulation. There are approximately 14 million farm households in this country with a total farmland area of approximately 10 million ha in approximately 70 million plots. Because of the egalitarian distribution of farmland from a state-owned farm system to rural households during the renovation (Doi Moi) process in the 1980s, farmland in Vietnam is highly fragmented (Do et al. 2023). The average number of farmland plots per household in rural Vietnam is approximately four, making Vietnam one of the countries with the smallest farm size in the world. In the past, the government of Vietnam imposed a farm size restriction of not more than 2 ha in the north and not more than 5 ha in the south (Huy and Nguyen 2019). The restriction led to efficiency losses in farm production and constrained agricultural transformation. To improve the economies of scale in agricultural production, the Congress of Vietnam formally introduced the amended land law in 2013, and the government issued Decree No. 43/2014/ND-CP dated May 15, 2014, to facilitate land accumulation by legalising it and simplifying the administration and registration procedure for land accumulation (Do et al. 2023). These policy reforms were undertaken in the entire country and were expected to allow the establishment of large-scale farms to take advantage of the economies of scale. However, after several years, the average farm size in terms of farmland area in Vietnam has increased only marginally (Nguyen et al. 2021), and the agricultural transformation in Vietnam seems to be slower than in its neighbouring countries, such as Thailand and China, during a similar economic growth period (World Bank 2016; Nguyen et al. 2021).

Although the 2013 land law is an important effort to facilitate land accumulation in Vietnam, little research has been undertaken to evaluate the factors affecting participation in land accumulation and its welfare effects in Vietnam. To our knowledge, only Do et al. (2023) examined the effects of land consolidation on rice production cost and poverty in the central region of Vietnam. In our study, we take a step further not only by improving our understanding of the relationships between farmland accumulation and rural households' incomes but also by analysing these relationships for two groups of households participating in land accumulation—namely, the increasing and decreasing farmland groups. In addition, we also clearly show the changes in the income structure of these households when participating in the process of farmland accumulation that the results from previous studies have not shown. Although Do et al. (2023) focussed on the central highland region, our study is in the Red River Delta in the north, one of the two major rice-producing regions in Vietnam (together with the Mekong River Delta in the south of Vietnam).

With this background, we aimed in this study to answer two questions: *i*) what are the factors affecting the participation in farmland accumulation? and *ii*) how are the income effects of the participation in farmland accumulation in Vietnam? Answering these questions provides useful information for policymakers to promote farmland accumulation and agricultural transformation in Vietnam. Our empirical analysis is based on a survey of 540 rural households in 2019 in the Red River Delta of Vietnam. We used a multinomial logit model to identify the drivers of participation in farmland accumulation and a propensity score matching technique to assess the income effects of the participation.

Farmland policy in Vietnam. After reunification in 1975, Vietnam followed centrally planned economic policies throughout the country as in other former socialist economies (Nguyen et al. 2021). Farmland was nationalised and managed in a system of state-owned farms. These centrally planned economic policies turned Vietnam into one of the poorest economies in the world in 1985 (Glewwe et al. 2004), forcing the country to commence the renovation policy package

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and to begin the transition toward a market-oriented economy, which is known as Doi Moi.

In the agricultural sector, a series of reforms were undertaken. First, land use contracts were assigned to individual farmers (Directive 100); second, farmland was distributed to farmers (Resolution 10); and third, farmland was formally allocated to individuals and households on a more permanent basis (Deininger and Jin 2008). The 1993 land law granted five more rights to farmers in addition to land use rights, namely, rights to transfer, exchange, inherit, lease and mortgage. These additional rights mean that farmers are allowed to transfer, exchange, inherit and mortgage rights to use their land to other individuals or households. The duration for land use was defined as 20 years for annual cropland and 50 years for perennial cropland, and certificates of land use right were provided (Do and Iyer 2008).

The egalitarian redistribution of farmland resulted in pro-poor growth (Ravallion and van de Walle 2008). Improved land tenure security encouraged farmers to increase their farm output by using more labour, their most abundant input at that time. Evidence of the labour intensification included gains in agricultural production achieved with only modest growth in the use of market inputs and with little or no technological change (Che et al. 2006). Labour intensification in the farming sector also supported (demand-led) growth in the rural non-farm economy (Hazell et al. 2007). Vietnam transformed itself into one of the most successful countries in the developing world in terms of economic growth and poverty reduction (Amare and Hohfeld 2016; Do et al. 2019). The real annual rate of agricultural growth averaged 4.2% during the period from 1990 to 2003 (FAO 2006). In 1993, 58% of the population lived in poverty, which declined to 14% in 2008 (World Bank 2016).

However, one of the side effects of the egalitarian redistribution of farmland was land fragmentation (Do et al. 2023). During the distribution, each household was granted an amount of land on the basis of the number of household members to ensure equality of land area (Van Hung et al. 2007). Later, land fragmentation also occurred through land inheritance, as parents divided their farmland into smaller plots for their children (Huy and Nguyen 2019).

According to Vietnam's constitution, land is owned by the entire people represented by the state. This means that the state is the sole owner of all land. The 2003 land law allowed farmers to sell their land use right, which meant that the markets of land use right were officially established. However, the farmland size of each farm household was regulated with land ceilings of 2 ha in the north and 3 ha in the south for annual cropland and 10 ha for perennial cropland and forested land. This regulation indicates that the markets of land use right were constrained with several administrative barriers (Huy and Nguyen 2019; Nguyen et al. 2021).

This latest 2013 land law stipulates that the land use term for all types of land (including land for annual crops, aquacultural land, production forestland or land with unknown use purposes) is 50 years. It also removes the land ceilings and simplifies the administration and registration procedure for land accumulation. In addition, farmers are also allowed to donate their land use right or to contribute their land use right for public use, to use their land use right as a sort of capital in joint investment activities or as a share in a joint venture. This use is referred to as capital contribution with land use right. In essence, this 2013 land law facilitates the operation of the land use right markets. However, after several years, the average farm size in terms of farmland area in Vietnam has increased only marginally, and this is the context in which we wanted to investigate the factors affecting participation in farmland accumulation and its income effects.

MATERIAL AND METHODS

Study sites and sampling. We focussed on the Red River Delta in the north of Vietnam, as it is one of the two deltas in Vietnam that contribute most to national rice production. The delta consists of 10 provinces and Hanoi, the capital of the country. It covers a natural area of approximately 2 126 thousand ha, of which the farmland area accounts for 37% (corresponding to 792 thousand ha). The provinces with a large proportion of farmland area in total natural land area are Thai Binh (57.7%), Ha Nam (47.3%) and Hai Phong (31.3%) (General Statistics Office 2021). The delta is very densely populated, and farming is constrained, with an average area of farmland per household of approximately 2 600 m^2. This small farmland area is fragmented in several plots, and the fragmentation has been increasing owing to population growth (Manjunatha et al. 2013; Goswami et al. 2014; Vu and Kawashima 2017). It is thus of interest to examine to what extent the latest 2013 land law has facilitated farmland accumulation and its income effects in this important rice-producing region of the country.

Our data sampling procedure was as follows. We purposely selected three provinces with the larg-

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est farmland shares in their natural land area, namely Thai Binh, Ha Nam and Hai Phong. In each province, we randomly selected two districts, and in each selected district, we randomly selected four villages. These steps provided us a list of 24 villages in the Red River Delta. The local authorities then helped us to establish a list of farm households in each selected village that had been in the villages at least since 2013, along with their farmland data in 2013 (the number of plots and plot area). From this list, we randomly selected 20 to 25 farm households for our survey, which resulted in a sample of 565 rural households.

We then undertook a survey of these sampled households. Our survey was from June to July 2019 with a structured questionnaire to be answered by the head of each sampled household. The questionnaire included several sections, such as demographic characteristics, livelihood assets and activities, and household income. A separate section was designated to record detailed information about farmland, including changes in farmland area since 2013 and the causes of the changes. The reference period for farm and income data was the last 12 months before the survey. After screening the data, we excluded 25 households because of missing data for important variables. Thus, the final sample for our analysis included 540 households from 24 villages. All monetary values (for income) were recorded in Vietnamese dong and then converted to the USD.

Household characteristics and livelihood assets. Our sample of 540 farm households included those whose farmland area did not change, increased or decreased as compared with their land records in 2013. Thus, we divided the sample into three groups: the decreasing group that included 327 households (more than 60% of the sample) with decreased farmland area, the increasing group that included 117 households (approximately 22% of the sample) with increased farmland area and the non-participating group that included the remaining 96 households without changes in farmland area. The first two groups can be considered those participating in farmland accumulation (Table 1).

Table 2 presents a description of the livelihood assets of the surveyed households for the whole sample and for each of these three groups of households [definitions of the variables are in Table S1 in the Electronic Supplementary Material (ESM)]. We based the selection of the variables on the livelihoods framework of Ashley and Carney (1999). In this framework, the livelihood platform of a rural household in developing countries includes natural capital such as farmland, physical capital such as farm equipment, human capital such as education level of household heads and financial capital such as savings. In our study, we used farmland area and the number of farmland plots to represent natural capital. We used whether the household had a tractor, a water pump or other farm productive assets to represent physical capital. We used age, gender and education level of the household head; household size; household labour; and agricultural household labour to represent human capital. We used household savings, access to credit and non-farm income to represent financial capital.

Table 2 shows that the groups had differences in their livelihood assets. The head of the household in the increasing group was the youngest, whereas the head of the household in the decreasing group was the oldest. The educational level of the household head in the increasing group was the lowest, which is reasonable, because in developing countries better educated people often look for a job outside the farming sector. However, because farming requires more labour than do non-farm activities, the numbers of labourers and agricultural labourers of the increasing group were higher than those of the other two groups. Savings and access to capital of the increasing group were also higher, probably because large-scale agricultural production

Table 1. Household group classification

No.	Household group	Abbreviation	Number (share) of observations
1	Households participating in farmland accumulation with a decrease in farmland area	Decreasing group	327 (60.5%)
2	Households participating in farmland accumulation with an increase in farmland area	Increasing group	117 (21.7%)
3	Households do not participate in farmland accumulation	Non-participating group	96 (17.8%)
–	Total	–	540 (100%)

Source: Authors' own compilation from the survey data

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Table 2. Descriptive statistics of the variables representing livelihood assets of surveyed households

Variable	Whole sample	(1) Decreasing group	(2) Increasing group	(3) Non-participating group
N	540	237	117	96
Age_hh[b]	55.10 (11.43)	57.28[3*] (10.84)	49.17[1***] (11.30)	54.90[2***] (11.04)
Gender_hh[c]	75.74 (50.46)	66.97[3*] (47.10)	66.67[1] (47.34)	77.08[2*] (45.11)
Education_hh[a]	2.31 (0.52)	2.35[3] (0.55)	2.18[1***] (0.41)	2.32[2**] (0.53)
Household_size[b]	3.58 (1.51)	3.65[3] (1.64)	3.61[1] (1.26)	3.31[2] (1.28)
Household_labor[b]	2.31 (1.24)	2.28[3] (1.36)	2.51[1*] (0.92)	2.16[2**] (1.14)
Agri_ Household_labor[b]	1.35 (1.03)	1.14[3**] (1.06)	1.94[1***] (0.61)	1.34[2***] (1.06)
Water_pump_D[c]	13.15 (33.82)	0.92[3***] (9.55)	44.44[1***] (49.90)	16.67[2***] (37.46)
Tractor_D[c]	1.48 (12.09)	0.31[3**] (5.53)	3.42[1***] (18.25)	3.13[2] (17.49)
Other_assets_D[c]	6.11 (23.98)	0.31[3***] (5.53)	22.22[1***] (41.75)	6.25[2***] (24.33)
Household_save_D[c]	28.33 (45.10)	6.73[3***] (25.09)	84.62[1***] (36.24)	33.33[2***] (47.39)
Access_to_credit_D[c]	8.33 (27.66)	0.61[3***] (7.81)	30.77[1***] (46.35)	7.29[2***] (26.14)
Non_farm income_D[c]	22.41 (41.74)	25.69[3] (43.76)	17.09[1*] (37.81)	17.71[2] (38.37)
Number_ plots[b]	2.61 (1.41)	2.79[3***] (1.39)	2.44[1*] (1.26)	2.21[2*] (1.57)

*,**,*** significant at 10%, 5% and 1%, respectively; standard deviation in parentheses; [a]*T*-test; [b]nonparametric two-sample test: Mann–Whitney *U* test, [c]chi-squared test; [1, 2, 3] compare with group (1), (2), (3), respectively; for variable definitions see Table S1 in the ESM

Source: Authors' own compilation from the survey data

requires more capital. This group also had more agricultural machines and tools such as water pumps, tractors and other assets for agricultural production than did the other groups. The decreasing group had more plots of farmland than did the other groups, which might imply that if households have several farmland plots, they will be more willing to sell, rent out, lend or contribute their land than the others would be. In contrast, households with a low number of plots tended to increase their farmland area. The decreasing group had a higher percentage of households that had non-farm income than did the increasing group, indicating that when rural labourers have non-farm jobs, they tend to reduce their farmland area. This finding is consistent with the fact that in the Red River Delta nowadays the proportion of labourers leaving the agricultural sector is increasing (General Statistics Office 2021).

Land accumulation and household income. Table 3 summarises the decreases in farmland area of the decreasing group. On average, each household in this group had more than 1 930 m^2 of farmland in 2013 (before the agricultural land accumulation policy was promulgated). This area decreased and was only 630 m^2 in 2019 (a decrease of more than two-thirds), mainly with transferred and leased land. The land transferring households were those with a member having permanent non-agricultural employment, whereas the land-leasing households had several plots or a member with temporary off-farm employment. In addition, only a small proportion of households leant their land to relatives (for free) or contributed their land for public work such as for constructing schools or roads.

Table 4 shows that of the 327 households with farmland decrease, 237 households sold their land, accounting for more than 72% of households in the decreasing group. The major causes of land transfer of these households included having another job (18%), unprofitable farming (47%), need of money for doing business (22%) and coping with shocks (12%).

From the increasing group, Table 5 shows that the increase in farmland area was due to several reasons such as land transfer, lease, borrowing or bidding. These households had a relatively larger farmland area of more than 2 000 m^2 in 2019, on average, which increased more than 2.5 times from 2013. The main reasons were land bidding (79%) and land transfer (61%). Land rent and land borrowing were of less importance.

Table 6 presents household income and income sources for the whole sample and for each group. The income of survey households was from farm, non-farm and other sources such as transfers from relatives. For the whole sample, the average income per household was approximately USD 6 550 per year of which farm income and non-farm income accounted for 26% and 56%, respectively. This finding indicates the development of non-farm sectors in a traditionally agricultural

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Table 3. Decrease in farmland of the decreasing group from 2013 to 2019

Cause of change	Amount of change (m^2)	Rate of change (%)
Land area before accumulation (2013)	1 931.09 (994.33)	100.0
Transfered land	928.88 (1 075.43)	48.1
Leased land lease	307.32 (450.00)	15.9
Land for lending	14.08 (149.31)	0.7
Land for contribution	52.36 (252.82)	2.7
Land area in 2019	628.45 (734.52)	32.5

Standard deviations in parentheses
Source: Authors' own compilation from the survey data

Table 5. Causes of farmland increase of the increasing group from 2013 to 2019

Main cause of change	Amount of change (m^2)	Share (%)
The land area before accumulation (2013)	2 032.70 (1 107.39)	100.0
Land transfer	1 240.00 (2 517.54)	61.0
Rented land	257.53 (1 209.11)	12.7
Borrowed land	55.18 (311.63)	2.7
Tendered land	1 613.90 (3 203.69)	79.4
Land area in 2019	5 199.31 (3 705.55)	255.8

Standard deviations in parentheses
Source: Authors' own compilation from the survey data

Table 4. Major causes of farmland transfer

Main cause of land transfer	Number of farming households	Share (%)
Having other jobs	43	18.1
Unprofitable farming	112	47.3
Coping with life shocks such as accident and illness	29	12.2
Needing money for business	53	22.4
Total	237	100.0

Source: Authors' own compilation from the survey data

region of Vietnam. The proportion of non-farm income in household income was two times higher than that of farm income for the whole sample. Except for the increasing group where farm income (59%) was higher than non-farm income (21%), non-farm income was higher than farm income in these other two groups.

The increasing group had the highest income (reaching USD 8 390 per household per year, which was 1.28 times higher than the average income of the whole sample). For this group, farm income accounted for nearly 60% of total household income, but non-farm income accounted for only 21%. The average household income of the decreasing group was higher than that of the whole sample (USD 6 930 versus USD 6 550), and the non-participating group had the lowest income (only USD 3 000 per household per year). In all these groups, non-farm income accounted for a high proportion of 21% to 72% of household income. Among the activities that brought income to rural farmers, working in an enterprise provided the highest and most stable income. However, farmers in the increasing group could only take seasonal jobs in places close to home because they had to take care of their farms.

Identifying the factors affecting participation in land accumulation. Given the three household groups, we assessed the probability that a household would belong to a specific group. Thus, the dependent variable representing the probability could take on three discrete outcomes, the respective group number. Probabilities are not well estimated by the linear ordinary least squares methods (Hill et al. 2008); therefore, we opted for a multinomial logit model using the maximum likelihood. The coefficient of an independent variable may therefore be indicative if the variable increases or decreases the probability of a household being in a subgroup rather than the base group. As we aimed at the factors affecting participation in land accumulation, we selected the non-participating group as the base group. We estimated the following:

$$P_{ij} = pr\left(y_i = j\right) = \beta_0 + \sum_{k=1}^{n} \beta_k X_{ik} + e_i \quad (1)$$

where: $P_{i,j}$ – probability that household i belongs to group j, which is either the increasing or decreasing group instead of the non-participating group; e_i – error term;

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Table 6. Household income and income sources

Income source	Whole sample		Decreasing group		Increasing group		Non-participating group	
	thousand USD	%	thousand USD	%	thousand USD	%	thousand USD	%
Farm income	1.71 (2.74)	26.1	0.67 (0.49)	9.6	4.95 (4.29)	59.0	1.30 (1.52)	43.4
Non-farm income	3.68 (3.46)	56.1	5.02 (3.68)	72.3	1.79 (1.55)	21.4	1.42 (1.65)	47.2
Other income	1.17 (1.08)	17.8	1.25 (0.92)	18.1	1.65 (1.43)	19.6	0.28 (0.33)	9.5
Total	6.55 (5.68)	100.0	6.93 (5.10)	100.0	8.39 (7.27)	100.0	3.00 (3.49)	100.0

Standard deviations in parentheses
Source: Authors' own compilation from the survey data

X_{ik} – vector of variables representing the characteristics of the household; β – vector of regression coefficients.

We accounted for several variables representing the characteristics of the household which are included in X_{it}. As the head of the household is the decision-maker, we included age, gender and education level of the head. Because farming in developing countries in general and in Vietnam in particular is labour intensive, we included the household size (number of household members), household labour (number of household labourers) and agricultural labour (number of household labourers working in farming). In addition, we included agricultural productive assets that the household had, such as whether the household had a water pump for irrigating their farmland plots, whether the household had a tractor and whether the household had other agricultural machines or equipment. Furthermore, as farmland accumulation can be influenced by several factors outside the agricultural sector, we included whether the household had saving and non-farm income in 2013 (before the 2013 land law took effect in 2014). We also controlled for the fragmentation of farmland by including the number of farmland plots and for differences among provinces by including provincial dummies. These independent variables are summarised in Table S1 in the ESM. As the number of independent variables was high, we checked the variance inflation factor values to detect potential multicollinearity. The check (Table S2 in the ESM) indicated no signal of multicollinearity.

Examining the income effects of participation in land accumulation. In our research, we sought to examine the effects of involvement in land accumulation, whether it entailed a rise or decline in farmland, on household income. We compared income variables, such as total household income, farm income and non-farm income, between households that participated and those that did not. To determine the average treatment effect on the treated (*ATT*), we compared the dependent variables between the treatment and non-participating groups. The treatment groups consisted of households in both the increasing and decreasing land accumulation categories, and the non-participating group served as the control. To account for any observed characteristics that might cause biases, we used the propensity score matching technique. We first calculated the propensity scores by using a probit model to match households between the treatment and control groups.

$$P(Z_i) = P(D_i = 1|X_{it}) \quad (2)$$

where: P – dependent variable to represent the probability of household i participatingin land accumulation; Z_i –vector of independent variables. The dummy variable (D_i) is set to 1 if household i participated, and 0 otherwise. The probability is dependent on vector X_{it}, which is defined in Equation (1). To account for any differences among surveyed provinces, we included provincial dummies.

To estimate *ATT*, we used three methods of nearest-neighbour matching (NNM), kernel-based matching (KBM) and radius matching to match households between the treatment and non-participating groups. We used the five nearest-neighbour method with common support and replacement for the NNM, and we used common support and bandwidth 0.06 for both the KBM and radius matching estimators. For the KBM and radius-matching methods, we bootstrapped the standard errors for 1 000 replications to assess the variability of propensity score matching estimators. However, we did not bootstrap the standard errors for the NNM, as the standard bootstrap was not valid (Abadie and Imbens 2008).

We evaluated the matching methods used for testing by generating histograms of the estimated propen-

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sity scores and conducting covariate balancing tests. The histograms of the estimated propensity scores for both the treatment and control groups are in Figure S1 in the ESM. They showed significant overlap in the common support conditions that were matched. The results of the covariate balancing tests before and after matching, as shown in Table S3 in the ESM, revealed the following:

i) the standardised mean differences (Caliendo and Kopeinig 2008) for overall covariates used in the propensity scores were significantly reduced after matching;

ii) the percentages of bias reductions ranged from 75.9% to 81.7% through matching;

iii) the joint significance of covariates was always rejected after matching but was never rejected before matching and;

iv) the pseudo-R^2 also decreased significantly after matching.

The proposed propensity score specification successfully balanced the distribution of covariates between the treatment and non-participating groups because of the low mean standardised bias, the high percentages of bias reduction, the nonsignificance of the likelihood ratio test and the low pseudo-R^2 after matching.

On the basis of the propensity scores, we modelled the effect of participating in land accumulation on the household's income by estimating the *ATT* as follows:

$$ATT = E\,[Y^T \,|D = 1, P(Z)] - E\,[Y^C \mid D = 1, P(Z)] \quad (3)$$

where: *ATT* – average treatment effect of the treated; *E* – mean operator; *D* – dummy of the treatment (*D* = 1 if yes and *D* = 0 otherwise).; *Y* – outcome variable(s); *T* – treatement group; *C* – control group.

We compared the control (*C*) and treatment (*T*) groups by using dependent variable *Y*, which included household income, household farm income and household non-farm income.

RESULTS AND DISCUSSION

Factors affecting participation in the land accumulation of rural households. Table 7 presents our estimation results on the factors affecting participation in the land accumulation of rural households. The table shows that the factors statistically associated with participation in the land accumulation of rural households included the gender and age of the household head, water pump, other agricultural production assets, household saving, access to credit, non-farm income and the number of farmland plots. The older the household was, the more likely that the household reduced its farmland area, probably because farming becomes harder for the old. Nguyen et al. (2021) and Onofri et al. (2023) also showed that households with older heads were less likely to rent in and more likely to rent out their farmland. Furthermore, female-headed households were less likely to participate in farmland accumulation, possibly because women were less able to find jobs in other sectors. The higher the number of farming labourers, the more likely that the household participated in land accumulation. The households with a large number of farming labourers increased their farmland area and were more likely to remain in the agricultural sector. The effect of farming labourers is reasonable, as farming in the region is very labour-intensive. As expected, the effect of having a water pump was negative for the decreasing group, and the effect of having other agricultural assets was positive for the increasing group. This finding means that if the household had a water pump for irrigation, it was less likely that the household decreased its farmland areas; households with other agricultural assets such as greenhouses and pesticide sprayers tended to increase their farmland area. Having access to credit facilitated rural households to accumulate more land but having non-farm income in 2013 increased the probability of decreasing farmland. This finding is consistent with that of Do et al. (2023) that non-farm employment is one of the factors that drive rural labourers out of agriculture. Our results also showed that households with a higher number of farmland plots tended to reduce their farmland area, probably because they would like to defragment their land. As presented earlier, land fragmentation in the Red River Delta is more severe than in other regions of Vietnam, so defragmentation is one way to become more cost-effective for farmers.

Our results also showed the heterogeneity in the effects of these factors on land accumulation among the surveyed provinces – Thai Binh, Ha Nam and Hai Phong. The number of households with large and growing areas was lower in Ha Nam province than in the other provinces, and the number of households with a decreasing area was increasing. This difference is because the process of industrialisation and urbanisation in Ha Nam is happening more strongly than in other provinces. Therefore, households in Ha Nam province tend to find non-agricultural jobs rather than expand their agricultural land.

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Table 7. Factors affecting the participation in farmland accumulation (non-participating as the base group)

Variable	Decreasing group		Increasing group	
	coefficient	SE	coefficient	SE
Age_hh	0.036**	0.017	−0.021	0.022
Gender_hh	−4.177***	0.666	−3.249***	0.671
Education_hh	0.430	0.311	−0.249	0.447
Household_size	0.163	0.151	0.231	0.183
Household_labor	0.041	0.183	−0.290	0.260
Agri_household _labor	−0.129	0.189	0.609**	0.282
Water_pump_D	−2.747***	0.801	−0.006	0.538
Tractor_D	−1.009	1.656	−1.281	1.079
Other_assets_D	−0.816	1.218	1.024*	0.615
Household_save_D	−1.806***	0.509	1.084**	0.503
Access_to_credit_D	−1.637	1.234	1.491**	0.598
Non_farm income_D (before accumulation)	0.859**	0.433	0.107	0.608
Number_plots (before accumulation)	0.517***	0.157	−0.349**	0.175
ThaiBinh	0.040	0.520	0.677	0.537
HaNam	0.689*	0.395	−2.581**	1.120
Constant	0.454	1.607	3.395	2.074
No. of observations	540			
Log likelihood	−251.80			
Wald $\chi^2(19)$	513.96			
Probability > χ^2	0.000			
Pseudo R^2	0.505			

*,**,***significant at 10%, 5%, and 1%, respectively; for variable definitions see Table S1 in the ESM
Source: Authors' own compilation from the analysis of the survey data

Income effects of participation in land accumulation. The estimation results of the propensity score matching are reported in Table 8. The treatment included households in both the land increasing and the land decreasing groups, and the control included households in the non-participating group. The first panel of Table 8 shows that participation in land accumulation led to increases in household income for both the decreasing group and the increasing group. Specifically, the total household income increased from USD 3 740 to USD 3 830 and from USD 4 240 to USD 4 380 for the increasing group and the decreasing group, respectively. The total household income of the decreasing group was higher than that of the increasing group because most of the households in the decreasing group had gradually shifted their resources to non-agricultural activities with higher incomes. Household income *per capita* of the increasing group and the decreasing group was higher than that of the non-participating group from USD 950 to USD 990 and from USD 1 320 to USD 1 390, respectively. The household income per labourer of the increasing group and the decreasing group was also higher than that of the non-participating group from USD 1 130 to USD 1 370 and from USD 1 720 to USD 1 770, respectively. The increases in both the household income *per capita* and the household income per labourer of the decreasing group were higher than those of the increasing group.

The increases in household income of participating households were due to changes in household farm and non-farm incomes as shown in the second and last panels of Table 8. The table shows that, although the farm income of households in the decreasing group was lower than that of households in the non-participating group, the former's non-farm income was much higher than that of the latter. As households in the decreasing group have shifted their resources from farm to non-farm activities, their farm income has decreased, but their non-farm income has increased, and the increase in non-farm income is higher than that in farm income. This shift has led to an overall increase in household income as presented in the first panel. For households

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Table 8. Propensity score matching (PSM) estimates of the impact of the participation in farmland accumulation on income (*ATT*)

Outcome variable	Matching algorithm	*ATT*	
		decreasing *vs.* non-participating group	increasing *vs.* non-participating group
Household income (thousands USD)			
Household income	NNM	4.24***	3.81***
	KBM	4.26***	3.74***
	radius	4.38***	3.83***
Household income *per capita*	NNM	1.39***	0.95***
	KBM	1.32***	0.98***
	radius	1.37***	0.99***
Household income per labourer	NNM	1.72***	1.37***
	KBM	1.72***	1.13**
	radius	1.77***	1.15**
Household farm income (thousands USD)			
Household farm income	NNM	–0.51*	2.94***
	KBM	–0.50**	2.91***
	radius	–0.45**	2.95***
Household farm income *per capita*	NNM	–0.13*	0.80***
	KBM	–0.16**	0.81***
	radius	–0.14**	0.82***
Household farm income per labourer	NNM	–0.23*	1.11***
	KBM	–0.23**	1.00***
	radius	–0.21**	1.01***
Household non-farm income (thousands USD)			
Household non-farm income	NNM	3.75***	–0.34
	KBM	3.76***	–0.37
	radius	3.82***	–0.32
Household non-farm income *per capita*	NNM	1.20***	–0.20
	KBM	1.17***	–0.18
	radius	1.19***	–0.18
Household non-farm income per labourer	NNM	1.54***	–0.20
	KBM	1.54***	–0.31
	radius	1.56***	–0.30

*, **, *** significant at 10%, 5%, and 1%, respectively; standard errors bootstrapped 1 000 replications only for kernel matching and radius matching; NNM – five nearest neighbor matching with common support and replacement; KBM – kernel matching with common support and band width 0.06; radius – radius matching with common support and band width 0.06

Source: Authors' own compilation from the analysis of the survey data

in the increasing group, their farm income was higher than that of households in the non-participating group. However, the non-farm income of these two groups was almost the same, which shows that participation in farmland accumulation helps households in the increasing group to increase farm income. Our findings on the income effects of farmland accumulation are consistent with those of Nguyen et al. (2021) and Do et al. (2023) for Vietnam and are in line with those of Chamberlin and Ricker-Gilbert (2016) for Malawi and Zambia and Zhang et al. (2018) for China. Obviously, increasing farmland leads to a higher level of farm income, and decreasing farmland allows labourers to work in non-farm sectors and increase non-farm income. As a consequence, both are better off than non-participating households.

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CONCLUSION

An improved understanding of the drivers and income effects of participation in farmland accumulation in rapidly growing but densely populated economies is needed to provide useful information for policymakers. In this study, we examined the factors affecting the participation of farmers in farmland accumulation and determined the income effects of the participation. In the study, we focussed on the Red River Delta, which is one of the two major rice-producing regions of Vietnam. We used the data from a survey of 540 farm households undertaken in three provinces in 2019. We used a multinomial logit model to examine the factors affecting participation in land accumulation and a propensity score matching approach to determine the income effects. In our study, participation in land accumulation included both households that purchased or rented in farmland and households that transferred or rented out farmland.

Our results showed that participation in farmland accumulation of rural households in the Red River Delta of Vietnam was significantly associated with a variety of household characteristics. A household was more likely to decrease its farmland if it had a non-farm income and several farmland plots before the accumulation. A household with savings and agricultural productive assets such as a water pump for irrigation was less likely to decrease its farmland, which was also true for a female-headed household. At the same time, a household with access to credit and saving and more farm labourers was more likely to increase its farmland, whereas a household with many farmland parcels and female-headed households were less likely to increase their farmland. We also found that participation in farmland accumulation, whether by increasing or decreasing farmland area, led to a higher level of income. Our results also demonstrated the heterogeneity in land accumulation among the three sampled provinces.

These findings lead to several policy implications. First, facilitating rural households in a region like the Red River Delta to participate in farmland accumulation is advisable, as this leads to a higher level of income. Second, land accumulation can be facilitated through developing rural non-farm sectors and credit markets, as these measures are positively associated with participation and would contribute to agricultural transformation. Third, development of priority support policies for female-headed households is necessary, as they are less likely to participate in farmland accumulation and thus do not benefit, which might lead to them to being more disadvantaged. Future land-related development interventions should be inclusive by accounting for female-headed households.

Even though our study results provide useful insights on the factors affecting participation in land accumulation and its income effects on rural households, it is subject to a number of limitations. First, our sample was small with only 540 households, and our data were cross-sectional. Land accumulation is a gradual process and should be examined with a long-term dataset. Second, given the cross-sectional nature of the data, we can only apply the propensity score matching in our impact evaluation. This method accounts for differences in observable factors but is not able to do so for unobservable factors. Last, our data cover only three among 11 provinces in the Red River Delta. We suggest future studies to increase the spatial and temporal coverage of the data, which can allow use of the empirical methods that account for both observable and non-observable factors.

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