Crop Choice Restrictions and Household Labor Allocation: Evidence using panel data from rural Vietnam

Kim Lan Nguyen[1]

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Preliminary, please do not quote

Abstract

Over the past decades, the Vietnamese Government have implemented crop choice restriction policy which strictly restricts 35 percent of national land for rice cultivation for food security purpose. This paper investigates the effects of crop choice restrictions on household labor allocation in rural Vietnam. Using fixed effect model approach and panel data from 2008 to 2014, I found that the incidence of crop choice restrictions has a statistically significant positive effect on women' labor participation on farm. One percentage point increase in the land area under policy restrictions in a household leads to about 0.4% increase in the probabilities of females' working on their own farm and 3.3% increase in the number of working days for females in the field work. Moreover, I found that the policy affects the men less than the women, and among women, the effect is smaller on the younger women.

Keywords: crop choice restriction, female labor supply, rural households

JEL Classification Codes: I18, I24, I31, J43, J82, Q18

[1] PhD Candidate, National Graduate Institute for Policy Studies, Tokyo, Japan
Lecturer, Faculty of International Economics, Foreign Trade University Vietnam
Email: kimlanftu@gmail.com

1. Introduction

In many countries, agricultural land conversion is largely driven by market forces and the pressure from population increases and urbanization. However, concerns about food security, especially for primary goods such as rice, often necessitate the designation for restrictive land use policy. It is typical case of transitional economy like Vietnam where history and cultural surrounding rice production and where sufficient basic staple food is of concerns. Vietnam has experienced rapid agriculture growth since Doi Moi, from a rice importer in early 1980s to a rice exporter in the 1990s and 2000s. However, paddy land is shrinking due to process of industrialization and modernization in rural area[2]. This triggers the Government to strictly control the paddy land i.e prohibiting the conversion of paddy land and compulsory cultivation at least one rice crop during the year in some designated plots, namely crop choice restriction policy. Crop choice restriction is widespread but heterogeneous across regions in Vietnam, accounting for 35 per cent of total national agricultural land (James A. Giesecke et al. 2013).

This paper aims to investigate the impact of this crop restriction policy on household labor supply in rural Vietnam. There are three mechanisms through which crop restrictions can affect the labor allocation in the household: collateral value of land, insecurity of property rights and high cost of migrations out of villages. First, the effects of insecure property rights to land on women's labor market are well-recognized in the literature. Insecure rights imply lower labor force participation as women need to stay back home to provide guard labor (Field, 2007). Second, crop choice restrictions with conditional sales and rental may lower collateral value of land as the bank cannot claim the land in case of a default. When crop restrictions result in loss of collateral and reduce credit accessibility, women are less actively participate in the labor market (KD Bui et

[2] From 2000 to 2010, the non-agricultural land increased 89000 hectares while the land for rice production decreased more than 34000 hectares annually (Bui Minh et al. 2012)

al 2016; Mohamed 2016). Third, crop restrictions increase the cost of migrations substantially as household lose the income stream from the land when they decided to leave the village. For maximization of household income, it is optimal for men to migrate leaving women behind on the farm to hold on the land because of comparative advantage and productivity differences between male and female in home good productions (M.Shahe Emran et al 2017; Timothy J. Halliday 2012).

In this paper, I aim to contribute to the literature in at least two strands. First, I add to the empirical evidence on the impact of crop restrictions on female labor market outcomes by identifying an association between restriction policy and female labor supply using individual-household panel data collected over a four-year period in rural Vietnam. Second, I investigate the extent to which there is a heterogeneity impact of crop restrictions on labor supply by gender and age cohorts.

Empirical studies on the impacts of crop restrictions are very scantly due to data limitation of restriction information. So far, most of the existing studies of Vietnam's land policies have focused on the effects of land tenure security and land transfer aspects (Ravallion and Van de walle 2008; Do and Iyer 2008; Deigniger and Jin 2008). To the best of my knowledge, there are four papers have examined the impacts of crop restriction in Vietnam. Two of them, Giesecke, Nhi, Erwin and Steven (2013)[3] and Chu, Khoi, Kompas, Hoa, Trinh (2016)[4] applied macro methodology approach. They found that if some protected rice land can be converted into other crops, it will increase both economic efficiency and overall equality. The other two studies, Kutzman (2015) and Markussen, Finn and Katleen (2011) have both used panel data set collected

[3] They used an economy-wide model with detailed modelling of region-specific land use, agriculture activity, poverty and food security measures.
[4] They used a combination of an optimization routine, stochastic general equilibrium modelling and microsimulation techniques.

from the Vietnam Access to Resource Household Survey (VARHS) with fixed effect model approach. Kutzman (2015) found that land use restrictions are ineffective at increasing household rice production and lower agriculture profits. Markussen, Finn and Katleen (2011) exploited two rounds panel data from 2006-2008 to investigate the relationship between restricted land and labor inputs in crop agriculture and total household labor supply. They found that crop restrictions do not decrease household income, but increase labor input per worker, both in crop agriculture and on the aggregate.

By employing four waves panel data collected biannually from 2008 to 2014 of approximately 3,000 farm households in 12 provinces in Vietnam, I found that crop restrictions have a statistically significant positive effect on women' labor participation on farm. One percentage point increase in the land under policy restrictions in a household leads to about 0.4% increase in the probabilities of females' working on their own farm and 3.3% increase in the number of working days for female in the field work. The policy has no significant impacts on men and among women, the effect is smaller on the younger women.

Vietnam is not the only country implementing this crop restriction policy. Other countries such as Myanmar, China and some countries in Central Asia also apply the similar policies by either direct regulations or financial incentives to facilitate the production of specific crops. The issues investigated in my study could not only be used to analyze the case of Vietnam, but can be generalized to other contexts.

The rest of our paper is organized as follows. Section 2 provides a brief review of the historical development of crop restriction's implementation in Vietnam. Section 3 provides the theoretical analysis. Section 4 illustrates the empirical estimation strategy of the paper. Section 5

discusses the data and descriptive statistics. Section 6 reports the main results. Section 7 concludes.

2. Background of Crop Choice Restriction Policy

To see the impacts of crop choice restrictions on household labor allocation, it is important to understand how restrictions are determined and its institutional background. Crop restrictions are implemented by top-down approach through Land Use Plans. At first, the State Planning Commission makes a five-year national land use plan and specifies how many acreage devoted to each category of land, such as rice land, other annual land, perennial land, forest, aquaculture and non-agricultural land. This plan is made in consideration of some factors such as domestic consumption, export goals and local land conversion for infrastructure or development projects[5]. The national targets are then divided by lower-level (province, district and communes) to implement. Communes are the direct units to impose restrictions by parcels mainly based on the suitable land characteristics for rice growing. There are two major types of restrictions: (1) obligation to grow rice all seasons for wet-rice land in delta or valley areas and (2) obligation to grow rice in some seasons for midlands or high lands.

Each commune will have a specific restriction quota given by authorities at higher-levels. Therefore, any changes in land-use must be approved by local authorities and consistent with land-use planning. Formally, households can apply for a change in land use purposes. In practice, however it is very difficult for farmers to change or remove restrictions on their plots because any changes must be consistent with plans at higher-levels (Markussen, Finn and Katleen.2011). There are some specific cases in which paddy land can be transformed to alternative agricultural

[5] For example, 3.8 million hectares must be reserved for rice cultivation by 2020, a reduction of 4.2 million hectares compared to 2010 (Resolution 17/2011/QH13 on National Land use plan 2011-2015 and 2020)

uses: paddy land affected by saline intrusion will be converted to aquaculture; paddy land in peri-urban areas will be used for vegetables or ornament plant production; paddy land can be converted to maize production where drainage services are improved; paddy land near the coast and ecologically sensitive sites will play multi-functional roles (Land Law 2003).

Markussen, Finn and Katleen (2011) pointed out that restrictions are binding and impose real constraints on behavior of farmers. If restrictions were lifted, farmers would change their choice of crops. From an administrative perspective, local authorities bear the responsibility for the plan's implementation so that it will be consistent with government planning. On the other hand, farm households have incentives to comply with commune directions as most important agricultural inputs, such as credit, extension services and fertilizers, are provided preferentially to rice producers (World Bank, 1998). Moreover, rice farming will receive an additional financial support: 22 $/year/ha for wet rice land, and 5 $/year/ha for other type of rice.

The Land Administration Officers of the commune are in charge of monitoring the restricted land. They need to produce a detailed land-use plan annually and submit land-use reports once per year to higher-level authorities to keep all land-use plans consistent. Households violating restrictions are punished: if the restricted land is *illegally used, ineffectively used or not operated within 12 months,* the authority can confiscate that land (Land law 2003, article 38; Decree 102/2014/ND-CP). Some anecdotes suggest that this punishment and confiscation are binding in case of the violation of restrictions. For example, some farmers in southern Vietnam were prevented from converting their rice fields into shrimp farming. Other farmers in Red river delta were not allowed to grow fruits trees in their land designated for growing rice (Vasavalul, 2006, chap 11, p.227). Hanoi People's committee confiscated 50 hecta of *illegally used* land in 2002 (Marsh and Macauley, 2006). Such as strict control of the restricted land forces households

to grow rice, otherwise they may lose the land by authorities' confiscation. Given that rice farming in Vietnam is not beneficial[6], the questions of who will operate the restricted land and how the households can allocate their time use to maximize household's utility in response to restriction policy is the main objectives in this paper.

3. Theoretical Analysis

I consider the simple model of agriculture household with two members: a female and a male. I assume that each household own specific amount of farm land. Each household member will choose to allocate their labor supply into two activities: working on their own farm or working in other activities outside home. Assume that job opportunities are available in rural labor market for both members. In addition, wage gained from activities outside home is greater than shadow wage from own farm. To maximize the household utility, all household members will choose to allocate all their time-use (after performing some house work) to work outside home to increase household income. However, they also need to consider the cost of travelling from home to workplace and cost of not operating their farm land.

The case of no crop choice restrictions

Without any restrictions on farm land, the household can be absentee landlord and can earn the profits from renting out the land. The optimal decision facing household is:

$$\text{Max } U(C) \quad \text{where } C = \prod_a + w_0 L_0$$

$\prod_a$ is the profit from renting out the land, w_0 is wage gained from working outside home, L_0 is the labor supply for each member. In this case, each member will allocate maximum their time-use to work outside to increase household income.

[6] https://www.economist.com/news/asia/21594338-vietnams-farmers-are-growing-crop-no-longer-pays-its-way-against-grain

The case of crop choice restrictions

When households' land is under crop restrictions, households will face the risk of losing land if they don't operate within 12 months (Land law 2003, article 38). Thus, restricted land is set to be zero if all members work outside home and no one operate farm land. To avoid the cost arising from land restrictions, (1) the households need to leave at least one member back home to operate the land or (2) renting out the land. However, searching for someone who want to rent in the paddy land to operate is not so easy as households' rice land tend to be small scale and fragmented in rural Vietnam. Even when households can find someone to rent the restricted land, they cannot expect to earn much from land rental because of cheap value of rice land. This issue will be investigated in another paper of mine. In this paper, I only focus on the first case when household allocate their labor supply into farm and other activities to optimize household utility by reducing the cost of losing land.

Heterogeneous impacts of crop restrictions by gender and age

If households need to leave someone to stay back home to keep the land, it is often the case of women.[7] Because women has more comparative advantage for home production, they are also supposed to engage more in farm work[8]. Statistics from my data show that most of restricted land are managed by female, which reveal some predictions of more female labor supply in restricted land.

The theoretical model has so far considered households with two adults members: a male and a female. If I extend the model by age groups, I would expect that the migration costs to be different between old and young women. Older women tend to bear most of the responsibility for home and farm products as they could accumulate advantages and experiences in rural Vietnam

[7] Women are expected to face less migration costs than men if they stay back home as a guard labor (Field, 2007).
[8] Most of rice production in Vietnam for self-consumption purpose.

(M.Shahe Emran et al.2017). Moreover, having and older women in the household means less burden of taking care of farm land so that young women can participate and spend more time on work outside home.

The analysis above leads to following testable hypothesis:

(1) Crop restrictions induce more female labor supply in farm work compared with men.

(2) Crop restriction induce more labor supply of older women compared with younger cohort.

4. Empirical Strategy

The above hypothesis can be tested using individual fixed effects model as following:

$$Y_{ihcdt} = \alpha_h + \beta_1 R_{hcdt} + \beta_2 X_{hcdt} + \beta_3 C_{cdt} + \Omega_{it} + \delta_{dt} + \varepsilon_{hcdt} \qquad (1)$$

where Y_{ihcdt} are individual labor supply of household *h* in commune *c* district *d* in year *t*. The dependent variables in all regressions are dummy (1 if participating on farm) and number of working days on farm for men and women in the last 12 months. R_{hcdt} is household restricted land area. For the dependent variables, I included two sets of controls for household and commune characteristics. The first set, X_{hcdt} is vector of household characteristics including household size (the number of people living in the household), distance from home to road, years of education, age and gender (male, dummy) of household head who may have the most say in household decisions. Age of the head is proxy for farming experience, gender of head may have different risk attitudes and level of education is to control for skills, technology adoption and managerial quality. Household assets and total land holdings (total land size, in acre) are proxies for wealth and political power[9].

[9] Some anecdotal evidences suggest that it is common for leaders or administrative staffs in local authorities to hold more land in rural area of developing countries.

The second set C_{cdt} is vector of commune socio-economic conditions including population density which is instrument for population pressure on rice production and restriction imposition. Ratio of concrete road and number of enterprises with at least ten employees are proxies for modernization and industrialization process, which may affect restriction quota in each commune. Enterprise variable is also instrument for job opportunities in the communes. Lastly, I control for farm-gate rice price[10] as increasing price may motivate both households to grow rice and local authorities to impose more restrictions. The dependent and independent variables (household restricted area, total land holdings, distance, population density, rice price) are transformed into logarithmic form to reduce the potential outliers[11].

The introduction of individual fixed effects will help remove individual characteristics which are fixed over time such as gender, ethnicity and birth order. It also allows to control some important household characteristics, i.e, culture, geography and topography (i.e households living in delta and mountainous areas). Idyosyncratic errors ε_{hcdt} are clustered at household level which are assumed to be independent between different households but auto-correlated within households. In all regression, birth year dummy is included which help to compare the labor inputs with the people who are at the same age. In addition, I included the interaction between year dummy and district dummy δ_{dpt} rather than year dummy only which would control for time trends by districts such as exogenous nature shocks (i.e drought or flood).

[10] Rice price is calculated by the average price received by households in commune. For communes that do not trade rice, I use average district price.
[11] Logarithmic transformed based on Cameroon and Trivedi 2008, chapter 4.

5. Data and Descriptive statistic

5.1. Data

The data source is from Vietnam Access to Resources Household Survey (VARHS) which was conducted biannually in the rural households of 12 provinces: ex-Ha Tay, Lao Cai, Phu Tho, Lai Chau, Dien Bien, Nghe An, Quang Nam, Khanh Hoa, Dak Lak, Dak Nong, Lam Dong and Long An. I employed four waves of the panel that were fielded in the month of June and July of 2008, 2010, 2012 and 2014. The 2008 survey covered 3,269 households in 477 communes. Out of these, 2,934 households were resurveyed in the next round in 2010, 2012 and 2014 (implying an attrition rate of 10%). I focused on households that own and operate at least one agriculture plots and have information about restrictions[12]. There are two sets of survey questionnaires for commune and household level. I further exploited the detailed information of individual and plot characteristics which are contained in the household survey to construct my outcomes of interest and key variables.

5.1.1. Labor supply within the household

The data from household survey listed various income-generating activities and asked each household members[13] how many days [name] spent in this activities in the last 12 months. I picked up data for "field labor" which was asked in the survey "For how many days was [name] involved in crop activities including rice cultivation, maize cultivation and other crops. I restricted the sample of households that have both working-aged male and female members[14].

[12] 31 households that have no farm land were excluded

[13] Household member is defined as someone who is tied to the family by blood or marriage

[14] Working-aged male and female are defined as members who are greater than 15 years old.

5.1.2.Crop choice restriction

The information of crop choice restriction status were available at plot-level dataset of four round surveys. It is possible that each household will own multiple plots. In each plot, the households were asked "Are there any formal restrictions on your household's choice of crops?" and "if yes, choose which restrictions apply to your choice of crops (1. Must grow rice in all seasons; 2. Must grow rice in some seasons and 3. Other). 98% of restrictions are applied to paddy land either being restricted in all seasons or some seasons, therefore in this paper, crop restrictions are referred to rice crop. Given the land size of the restricted plots, I summed all restricted area at plot-level by household-level[15]. My measurement of crop restriction is real value of household restricted land area (in logarithm).

5.1.3.Timing of events in the survey

The variables on labor supply within the household measured number of working days on farm-work in the last 12 months prior to the survey date. The restriction status of plot was asked at the point-in-time in which the survey was conducted (which was in the month of July of 2008, 2010, 2012 or 2014). However, the restriction decision was embedded in local land use policy which was made in the beginning of surveyed year and became effective during one-year-period. Since the timing of the restriction policy occurred between labor supply measurements, a regression of the change in restriction area on intra-household time-use during the last one year will provide a test of whether or not an additional restriction induce a change in household labor allocation.

[15] 11,758 plots (19% of total observations) were excluded because of missing restriction status. Most of them are residential plots.

5.2. Descriptive statistics

Table 1a shows the restriction status of plots by each survey round from 2008 to 2014. A total of 43,684 cultivable plots were constructed for this analysis, 30% of them are held with restrictions. The percentage of restricted plots are kept stable over years except the reduction in 2010 due to the severe drought that farmers were not obliged to grow rice on their plots. There are approximately 23% of plots changed restriction status (i.e from restrictions to non-restrictions and the other way around) between 2008-2010, 2010-2012 and 2012-2014. The last two rounds of table 1 presents the real value of household restricted land and total household land over years. On average, household land under restrictions is 1,372 m2 (accounting for 16% of total land holdings of farm households).

[Insert Table 1a here]

Table 1b compares the mean of household characteristics and labor allocation variables between restricted and unrestricted households. Restricted households are defined as households having at least one restricted plots in the last 12 months. These households are generally smaller, with more senior members, less total land holdings and are more likely to be headed by older and more educated male. However, number of labor force and household assets are not significant different between two types of households which suggests that these characteristics are not important factors affecting restriction decision. In term of labor allocation, there is reduction in on-farm work for male while unchanged female on-farm labors. These simple comparison provide only preliminary evidence of the difference between restricted and unrestricted households although these results do not control for other factors that may affect the outcomes of interest.

[Insert Table 1b here]

6. Empirical results

6.1. Fixed effect estimates

The estimation results of equation (1) are presented in Table 2. The first three columns report the estimates for the labor-supply dummy using linear individual fixed effect model, while the last three columns show the estimates for working days on farm of each member (in logs). I measure the degree of crop choice restriction by the household-level agricultural land subject to restrictions (in logs). In all regressions, I always include an interaction of year dummy and district dummy is included. The fixed effect regression indicate no significant correlations between crop restrictions and labor force participation of males on their own farm. However, the effect is larger in magnitude and in statistical significance for females. One percentage point increase in the area of crop restricted land in a household leads to about 0.4% increase in the chance of females engaged in farm activities and 3.3% increase in the number of working days for female in the field work. The evidence on labor participation in farm work is consistent with the predictions from the theoretical framework in this paper that land restrictions hold back women at home because of insecurity of land rights.

[Insert Table 2 here]

Table 3 presents the estimated causal effects of crop restrictions on female labor supply on own farm activities by age cohorts. I spilt the sample into two age groups: older women [age>=50 years old] and younger women [15-49 years old]. The crop restrictions have significant and positive impacts on intensity of work of both groups, but the magnitude of effect is much larger for older women compared with younger one. One percentage increase in crop restrictions induce 6.7% increase in working days on farm for older group while its effect is only 2.8% for younger

cohort. The patterns of estimates between age-group is consistent with my expectations when older women play a greater role in the provision of home goods including agricultural products.

[Insert Table 3 here]

6.2. Robustness checks

In this subsection, I report a number of robustness check for the estimations of Table 2. The first robustness check deal with the issue of endogeneity of the key variable (Restriction area) when households made any land transactions. If households dispose or newly equip more restricted land to expand or narrow their farm size, the impact of crop restriction on family labor inputs will be bias as it does not reflect the true effects of the policy variables. Previous literature did not pay attention to this matter, they constructed proportion of restriction which calculated by restricted area over total household agricultural land (Markusen et al.2011, Daley 2015). I address the issue by excluding households that have any transactions of restricted land i.e having new restricted plots and/or having restricted plots that being departed by sale, giving away, exchange and being expelled during survey period from 2008 to 2014[16]. The estimated effects of crop restrictions (Table 4, column 1 and 2) are nearly unchanged for female participation on farm in both significance level and magnitude.

[Insert Table 4 here]

Second, the estimation results might be driven by a few outliers coming from households with very high incidence of land restrictions. Therefore, I perform the sensitivity check by excluding households with 100 percentage of agricultural land under restrictions. The restricted sample loses 1,308 households (accounting for 14.1% of the full sample). The estimated effects

[16] 389 households (9% of total sample) that equipped more restricted land were excluded, No household disposes restricted land.

are still significant at one percent and a bit larger in magnitudes (0.5% for female participation on farm and 3.4% for working days on farm activities (Table 4, column 3 and 4).

7. Conclusion, Policy Implications and Limitations

This paper examines the effects of crop choice restrictions on female labor supply decisions in rural context of Vietnam. By using longitude panel data from 2008 to 2014 and fixed effect model approach, I found that crop restrictions have a statistically significant positive effect on women' labor supply. One percentage point increase in the land area under policy restrictions in a household leads to about 0.4% increase in the probability of females' working on their own farm and 3.3% increase in the number of working days for females in the field work. The results showed a greater burden of crop restrictions on old women compared to young women. However, there is no significant effect on men. The evidence are consistent with the predictions from theoretical analysis, such crop restrictions induced a higher opportunity cost of working outside for women, which results in an increase in women's participation on farm in rural area.

The positive relationship between crop choice restrictions and labor supply of older women on farm implies an important issue: aging workforce on agriculture. This raise another concern of aging labor population on agricultural productivity and land use efficiency. Because agricultural production requires not only labor inputs, but also physical strength and technology development. In addition, there is the threat of future land abandon once the elderly died. Thus, policy makers should also take into consideration this matter. Second, as crop restrictions induce more female labor participation on farm, it may have the impacts on child education and health, fertility and mother' pregnancy. Future research need to be done to evaluate these impacts.

I acknowledge several limitations of my data and analysis. First, the measurement of time spent on farm work is number of working days, not working hours. Working days do not reflect precisely the intensity of work and seasonality of various activities rather than working hours. Second, the outcomes of interest are aggregated working days in the last 12 months, but not in the form of time-use when specific task of individual is recorded (seeding, ploughing, harvesting). The gender differentiated time-use may be associated with specific tasks. Third, the data does not include detailed information of how many percentage of land area is restricted for specific plots. However, given the restricted land size is small, I assumed that restrictions are applied for all farm size once plot is restricted.

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Table 1a- Restriction status of plots

	All plots		2008	2010	2012	2014
	Observations	%	%	%	%	%
Total plots	18,052					
Restricted plots all seasons	2,762	15.3	13.3	5.7	23.0	19.2
Restricted plots some seasons	3,161	17.5	17.5	15.5	19.1	18.0
No restriction	12,129	67.2	69.2	78.8	57.9	62.3
Changes in restriction status	4,739	26.3	...	27.2	38.3	39.5
Restricted area all seasons		12.5	10.5	5.0	18.7	15.8
Restricted area some seasons		15.1	15.0	14.0	16.2	15.1

Note: Changes in restriction status (i.e. from restricted to unrestricted, from restricted all seasons to some seasons, or the other way around) between 2008 and 2010, 2010 and 2012, 2012 and 2014

Table 1b-Household characteristics by restriction status

	Unrestricted	Restricted	Difference	Significance
Male wage (days)	668.36	749.65	-81.29	*
Female wage (days)	480.74	397.37	83.37	**
Male farm (days)	62.32	57.50	4.82	*
Female farm (days)	66.87	74.76	-7.89	***
Male nonfarm (days)	19.10	28.35	-9.25	***
Female nonfarm (days)	24.67	29.29	-4.63	
Male head	0.78	0.80	-0.03	
Head's edu	6.14	7.04	-0.90	***
Head's age	48.90	47.58	1.32	**
Household size	4.46	4.47	-0.01	
Political connection	0.30	0.28	0.02	
Distance to road	8.56	3.13	5.43	
Household asset	29538	13376	16162	
Household farm income (,000 VND)	19927	13278	6649	***
Household nonfarm income (,000 VND)	10573	17742	5978	
Household wage income (,000 VND)	22320	21446	874	
Number of household	1481	787		

Table 2. Crop choice restrictions and Labor force participations on farm

	Participating in own farm activities =1			Working days on own farm (log)		
	Pooled	Male	Female	Pooled	Male	Female
Restricted area (m2,log)	0.001	-0.002	0.00427*	0.0212***	0.010	0.0333***
	(0.002)	(0.002)	(0.002)	(0.007)	(0.009)	(0.009)
Male head=1	0.016	-0.027	0.0620*	0.102	-0.161	0.295**
	(0.032)	(0.049)	(0.038)	(0.122)	(0.194)	(0.146)
Head's age	0.00225**	0.00240*	0.002	0.00773*	0.008	0.0101*
	(0.001)	(0.001)	(0.001)	(0.004)	(0.005)	(0.005)
Head's education	-0.002	0.001	-0.00414*	-0.010	0.001	-0.0196*
	(0.002)	(0.003)	(0.003)	(0.008)	(0.010)	(0.010)
Household size	-0.00621*	-0.00843*	-0.005	-0.0786***	-0.0918***	-0.0705***
	(0.003)	(0.005)	(0.004)	(0.014)	(0.018)	(0.017)
Household asset (log)	-0.002	-0.003	-0.001	0.021	0.018	0.0276*
	(0.003)	(0.004)	(0.004)	(0.013)	(0.017)	(0.016)
Total land holdings (acre)	0.000	0.000	0.001	0.005	0.005	0.005
	(0.001)	(0.001)	(0.001)	(0.005)	(0.006)	(0.005)
Distance home-road	0.000	0.000	-0.000336***	0.000	0.001	-0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
% Concrete road	0.000406**	0.000	0.000546**	0.00117*	0.001	0.00199**
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Population density (log)	-0.001	-0.001	-0.003	-0.023	-0.0430*	-0.011
	(0.004)	(0.006)	(0.005)	(0.017)	(0.025)	(0.021)
Number of enterprises	-0.000160**	-0.000267**	0.000	0.000	-0.000651*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Commune rice price	0.002	0.00313*	0.001	0.004	0.010	-0.001
	(0.002)	(0.002)	(0.002)	(0.005)	(0.007)	(0.007)
Birth year dummy	Y	Y	Y	Y	Y	Y
Districts by years	Y	Y	Y	Y	Y	Y
Individual Fixed Effect	Y	Y	Y	Y	Y	Y
Constant	0.737***	0.668***	-0.813***	3.382***	2.288**	-2.691***
	(0.190)	(0.234)	(0.225)	(0.750)	(0.969)	(0.944)
Observations	28307	14192	14115	28307	14192	14115
R-squared	0.061	0.079	0.086	0.086	0.100	0.121
Number of individuals	13413	6688	6931	13413	6688	6931

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3. Female Labor Force participation: by Age Cohorts

	Young women (15-50 yr)		Old women (age>=50 yr)	
	Participate=1	Farm days (log)	Participate=1	Farm days (log)
Restricted area (m2,log)	0.002	0.0208**	0.0135***	0.0677***
	(0.003)	(0.010)	(0.005)	(0.019)
Male head=1	0.039	0.281	0.088	0.251
	(0.046)	(0.180)	(0.063)	(0.267)
Head's age	0.000	0.002	0.004	0.015
	(0.001)	(0.006)	(0.003)	(0.013)
Head's education	-0.003	-0.015	-0.003	-0.024
	(0.003)	(0.012)	(0.005)	(0.020)
Household size	0.003	-0.0404*	-0.0180***	-0.115***
	(0.006)	(0.022)	(0.007)	(0.028)
Household asset (log)	-0.003	0.017	0.008	0.0623*
	(0.004)	(0.019)	(0.008)	(0.033)
Total land holdings (acre)	0.000	-0.001	0.00244*	0.013
	(0.001)	(0.004)	(0.001)	(0.008)
Distance home-road	-0.000420***	-0.00124***	0.000	0.001
	(0.000)	(0.000)	(0.001)	(0.005)
% Concrete road	0.000620**	0.00231**	0.000	0.001
	(0.000)	(0.001)	(0.000)	(0.002)
Population density (log)	-0.0113*	-0.041	0.0204**	0.0717*
	(0.007)	(0.025)	(0.010)	(0.041)
Number of enterprises	0.000	0.000	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)
Commune rice price	0.003	0.005	-0.005	-0.014
	(0.003)	(0.008)	(0.004)	(0.016)
Birth year dummy	Y	Y	Y	Y
Districts by years	Y	Y	Y	Y
Individual Fixed Effect	Y	Y	Y	Y
Constant	1.120***	3.476***	-0.971***	-2.877**
	(0.296)	(1.288)	(0.314)	(1.322)
Observations	10165	10165	3950	3950
R-squared	0.119	0.137	0.183	0.232
Number of individuals	5318	5318	1898	1898

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Robustness checks: female participation on own farm

	Participate=1	Farm days (log)	Participate=1	Farm days (log)
	(1)	(2)	(3)	(4)
Restricted area (m2,log)	0.003	0.0290***	0.00539**	0.0344***
	(0.002)	(0.010)	(0.002)	(0.010)
Male head=1	0.0679*	0.328**	0.064	0.283
	(0.039)	(0.153)	(0.046)	(0.184)
Head's age	0.002	0.00960*	0.002	0.0121*
	(0.001)	(0.006)	(0.002)	(0.006)
Head's education	-0.00523**	-0.0238**	-0.002	-0.013
	(0.003)	(0.011)	(0.003)	(0.012)
Household size	-0.004	-0.0670***	-0.006	-0.0698***
	(0.004)	(0.017)	(0.004)	(0.018)
Household asset (log)	0.001	0.0334**	0.001	0.0334*
	(0.004)	(0.016)	(0.004)	(0.018)
Total land holdings (acre)	0.000	0.005	0.001	0.005
	(0.001)	(0.005)	(0.001)	(0.005)
Distance home-road	-0.000385***	-0.00106*	-0.000399***	-0.00104*
	(0.000)	(0.001)	(0.000)	(0.001)
% concrete road in commune	0.000513**	0.00190**	0.000	0.001
	(0.000)	(0.001)	(0.000)	(0.001)
Population density (log)	0.000	-0.002	0.001	0.004
	(0.006)	(0.023)	(0.007)	(0.027)
Number of enterprises	0.000	0.000	-0.000252**	-0.000942*
	(0.000)	(0.000)	(0.000)	(0.000)
Commune rice price	0.001	-0.001	0.000	-0.002
	(0.002)	(0.007)	(0.003)	(0.010)
Birth year dummy	Y	Y	Y	Y
Districts by years	Y	Y	Y	Y
Individual Fixed Effect	Y	Y	Y	Y
Constant	-0.836***	-2.269**	0.520**	2.525**
	(0.238)	(1.027)	(0.263)	(1.222)
Observations	12988	12988	12107	12107
R-squared	0.089	0.124	0.096	0.134
Number of individuals	6391	6391	6460	6460

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1