

Inclusion of Smallholders in Staple Food Contract Farming: A Case of Firm-Cooperative-Farmer Coordination in Thai Binh Province, Vietnam

Thi Cam Van Nguyen,¹ Eustadius Francis Magezi^{1*} and Tsuyoshi Sumita¹

This study investigates how smallholder farmers attract contracts from agribusiness firms. We focus on firm-cooperative-farmer (FCF) contract farming and examine its potential contribution to the income of smallholder rice farmers in Vietnam. We found that participation in FCF is associated with higher paddy yield, revenue, and income from rice cultivation, which is consistent with previous research on staple food crops. Furthermore, this model can be implemented in areas with severely fragmented land, such as Vietnam's Red River Delta region.

Key words: contract farming, staple food supply chains, rice in Vietnam

1. Introduction

Contract farming is considered a solution to address market imperfections in linking farmers to markets by reducing transaction costs in agricultural production. The positive impact of contract farming on farm productivity and household income has been reported in several empirical studies in developing countries (Otsuka *et al.* (2016) and Wang *et al.* (2014) provide a detailed literature review). However, these impacts can hardly be generalized, because most empirical studies focus on exportable commodities or high-value crops, while studies on staple food crops, particularly in Asian developing countries, remain relatively scarce (Bellemare and Bloem, 2018).

In the most common firm-farmer (FF) contract agreement, rational firms tend to refrain from making contracts with smallholder farmers because of high transaction costs (Otsuka *et al.*, 2016; Minot and Sawyer, 2016). Risk-averse smallholder farmers, on the other hand, may hesitate to enter contracts, fearing contract manipulation (Kirsten and Sartorius, 2002). This leads to the following key question: what contract farming scheme is beneficial to smallholder farmers in relation to staple food crops?

One promising approach is firm-cooperative-farmer contract farming (referred to as FCF hereafter), under which agribusiness enterprises make a contract with farmers indirectly through producer cooperatives. The FCF approach is considered effective for all parties, as it reduces transaction costs to contractors while ensuring access to quality inputs and output markets to smallholders (Otsuka *et al.*, 2016). In addition, being represented by the cooperative might grant farmers higher bargaining power

and protect their profits with the enterprise (Niu *et al.*, 2016). Despite the potential of FCF, studies examining such an approach on staple food crops are scarce.

In this study, we examine the contribution of FCF to rice production and the income of smallholder rice farmers using data collected from the Red River Delta in Thai Binh Province, Vietnam. In Vietnam, FCF was first introduced in 2011 as part of an integrated production system, namely, large field models. Specifically, we investigate whether the participation of smallholder farmers in FCF has an impact on production costs, paddy yield, and income. Our study involved rice farmers from four villages, two of which were under FCF and two were not.

We find that although participation in FCF is associated with a decrease in the costs of seed, land preparation, and harvesting, it does not significantly reduce the total costs of rice production. We also found that participation in FCF is associated with higher paddy yield, revenue, and income from rice cultivation, which is consistent with previous studies examining the impact of contract farming on staple food crops (Maertens and Velde, 2017; Khan *et al.*, 2019; Wu *et al.*, 2020).

The remainder of this paper is organized as follows. Section 2 presents information on the evolution of FCF in Vietnam, followed by the study site, data collection, and descriptive analysis in Section 3. In Section 4, we present the estimation strategy, and Section 5 presents the estimation results. Section 6 discusses the conclusion.

2. Large Field Models and FCF in Vietnam

For several decades, the Vietnamese government has implemented various programs to cope with increasing land fragmentation, particularly in the rice sector. In the late 1990s, plot exchange was implemented as a major part of the land

¹Tohoku University
Corresponding author*: eustadius@gmail.com

consolidation policy to concentrate the farmer's fields into larger fields rather than the previously non-continuous and small plots. However, in some regions, particularly in the Red River Delta, agricultural land remains highly fragmented because of conflicts of interest and high transaction costs for implementing plot exchange (Tran *et al.*, 2022).

To promote land consolidation, policymakers in Vietnam introduced a large field model (LFM) in late 2011, following the success of initial trials in the Mekong River Delta. An LFM is defined as a production system in which companies or cooperatives create relationships with farmers to integrate the production process (Cong *et al.*, 2017).

There are three main types of LFM in Vietnam depending on the nature of the linkage. The most common is FCF, in which agribusiness enterprises sign contracts directly with farmers or cooperatives and provide them with production inputs and output purchasing commitments. The second type is one under which farmers provide their land and labor to farmers' cooperatives. Third, farmers sell or lease their lands to enterprises (Cong *et al.*, 2017). Generally, these linkages aim to increase the efficiency of rice production by reducing production costs and ensuring access to quality inputs.

In this study, we focused on FCF, which is widely regarded as an appropriate approach in areas with highly fragmented land. Under the FCF framework, cooperatives play a managerial role by acting as intermediaries to ensure a smooth exchange of inputs and outputs between farmers and enterprises. Contracted farmers synchronize farming processes including irrigation and harvest timing. However, each contracted farmer makes their own decisions regarding the management of rice crops and retains ownership of the cultivated plots. This allowed us to assess the effect of participating in the FCF scheme at the household level.

3. Study site and data

1) Study site and data

This study was conducted in Thai Binh, an agricultural province in Vietnam's Red River delta. The Red River Delta is the second largest rice-growing region after the Mekong Delta, accounting for approximately 70% of the total rice area in the country. Compared with the Mekong Delta, the rice value chain in the Red River Delta is more fragmented and less developed.

From the rosters of villages with FCF schemes in Thai Binh province, we randomly selected two villages, Binh Dinh and Dong Tra. We refer to these villages as FCF villages. The cooperatives in the two villages were voluntarily formed by rice farmers, and they are managed by boards of directors

comprising of elected members and salaried employees. The cooperatives' staff supervise input distribution at the beginning of the cultivation season and collection of paddy and payment to farmers after harvest. In addition, they oversee the maintenance of the irrigation infrastructure and facilitate access to farm machinery and other services for their members. Since nearly all rice farmers in these villages participate in the LFM contract farming scheme, we could hardly find non-contracted farmers with similar characteristics to contracted farmers.

Therefore, to evaluate the effects of FCF, we randomly selected two villages that did not have the LFM contract scheme in the province: Tan Hoa and Dong Tan. We refer to these villages as non-FCF villages. Despite the differences in FCF status, the selected villages have similar characteristics in terms of rice cultivation conditions and access to essential infrastructure. In addition, farmers in all four villages grow rice twice a year, as is the case in most Thai Binh province.

The main household survey for this study was in March 2021, followed by a supplementary survey in January 2022 to collect additional information on key household characteristics. The surveys covered 203 randomly selected rice farming households in four villages. We used a structured questionnaire to ask farmers about rice production costs and productivity during the two seasons of 2020. Information on basic household characteristics, participation in contract farming, and household income structure in 2020 was also collected. After data cleaning, 173 sample households were considered valid for analysis, of which 73 were contract farmers from FCF villages (37 in Binh Dinh and 36 in Dong Tra) and 100 were non-contract farmers from non-FCF villages (50 from each village in Tan Hoa and Dong Tan).

2) Terms of contracts in FCF villages

Although both contracts in Binh Dinh and Dong Tra are operated in conjunction with an FCF scheme, they are signed with separate companies and under different terms of contracts. In Binh Dinh, the company provides farmers with inputs such as seed, fertilizer, and extension services by a technical staff member assigned to monitor production practices in the village. After harvesting, farmers must dry the paddy according to the instructions to achieve the purity and humidity threshold required in the contract and sell it to the company at a pre-agreed price. For the 2018–2019 and 2019–2020 seasons, the contract price in Binh Dinh was fixed at 9,800 Vietnamese Dong (VND) per kilogram of paddy.

On the other hand, farmers in Dong Tra were contracted by another firm that also provided seed and fertilizer, but technical support from the company was only delivered during the initial

year after the FCF scheme was implemented. In addition, paddy is carried to the collection site immediately after harvesting before drying, and the contracting firm offers farmers a fixed margin of 200VND above the market price. In Dong Tra, the price was 6,500 VND per kilogram in 2019–2020.

Contracts in both villages were written and signed by the company and farmer representatives (the heads of the agricultural cooperatives, where farmers are members). At the end of each season, the cost of inputs is deducted from the rice sales revenue. Payments were made two weeks after procurement.

3) Descriptive analysis

In Table 1, we present a descriptive comparison of key variables using two columns: (1) consists of all farmers under

contracts (FCF), and (2) consists of all non-contract farmers (non-FCF). We conduct a *t*-test to examine if there is any significant difference attributed to participation in contract farming by comparing the observations in columns 1 and 2. We indicate whether the difference is statistically significant using asterisks in column (3). In general, our descriptive results in Panel A suggest that FCF farmers have slightly lower education levels, less experience, smaller household sizes, less labor use, own more land, and cultivate a larger area than non-FCF farmers. However, no significant difference was found in age, gender of household head, number of rice plots, or non-farm asset value.

Panel B presents the descriptive results for rice production costs. Our results show that although contracted farmers have significantly lower costs for seed, fertilizer, land preparation, harvesting, and other

Table 1: Descriptive analysis of household characteristics, rice cultivation and income variables

Variables	FCF (1)	Non-FCF (2)	Difference (3)
<i>Panel A: Household characteristics</i>			
Age of the HH head	57.85	57.93	-0.08
Years of education of HH head	8.04	8.79	-0.75**
Female-headed household (dummy)	0.1	0.06	0.04
Household size	3.23	4.08	-0.85***
Number of working-age HH members	2.67	3.19	-0.52***
Number of rice fields	2.43	2.24	0.19
Total landholdings (ha)	0.43	0.38	0.05**
Value of non-farm household assets (000 VND)	40,969.18	42,416.90	-1447.72
Experience in rice farming (years)	35.95	37.97	-2.02*
Total area under rice cultivation (ha)	0.32	0.25	0.067***
<i>Panel B: Rice production cost</i>			
Cost of seed (000 VND/ha)	1,977.69	2,798.91	-821.22***
Fertilizer cost (000 VND/ha)	12,015.42	8,420.52	3594.90***
Land preparation cost (000 VND/ha)	6,254.57	7,855.04	-1600.47***
Crop establishment cost (000 VND/ha)	3,293.44	2,528.14	765.30
Cost for weed control (000 VND/ha)	1,493.23	1,429.38	63.85
Cost of pest control (000 VND/ha)	6,177.32	5,823.58	353.74
Harvesting cost (000 VND/ha)	6,181.25	6,871.83	-690.58***
Other costs (000 VND/ha)	1,278.97	1,760.23	-481.26***
Total rice production cost (000 VND/ha)	38,671.89	37,487.64	1184.25
Village-level paddy price (000 VND/kg)	8.17	7.10	1.07***
<i>Panel C: Rice productivity and household income structure</i>			
Paddy yield (t/ha)	12.72	12.001	0.723**
Revenue from rice cultivation (000 VND/ha)	106,688.44	80,814.72	25873.72***
Income from rice cultivation (000 VND/ha)	68,016.55	43,327.08	24689.47***
Income from rice cultivation (000 VND)	20,420.34	10,646.80	9773.54***
Income from non-rice agricultural production (000 VND)	5,308.22	7,021.00	-1712.78
Non-agricultural income (000 VND)	48,950.68	57,011.40	-8060.72
Total household income (000 VND)	74,679.24	74,679.20	0.04
Observations (households)	73	100	

Source: Authors (2022)

Note: 1) *** denotes significant at 1%, ** significant at 5%, and * significant at 10% in *t*-test comparison between labeled categories.

2) As of December 2020, 1 USD was approximately equal to 23,200 VND.

miscellaneous costs (such as transportation), their total rice production costs are not significantly different from those of non-contract farmers. Regarding rice productivity and household income structure, the results in panel C show that contract farmers achieve an annual paddy yield of 12.7 tons per hectare, equivalent to 6.3 tons per hectare in each season. This is significantly higher than 6 tons per hectare of non-contract farmers and is above the Red River Delta's average paddy yield of 6.06 tons per hectare (GSO, 2021). In addition, contracted farmers obtain higher revenue and income from rice cultivation than non-contract farmers. However, we found no significant differences in the total rice production cost or total household income between the two groups of farmers.

4. Estimation strategy

We estimated a set of linear regression models to examine the effects of FCF on rice production performance. Initially, we intended to estimate the causal effects of FCF on rice production variables, but we failed to do so because of a lack of proper instrumental variables to address the self-selection bias that arises due to farmers' decision to participate in FCF. Therefore, our results aim to provide a view of the difference between farmers who use FCF and those who do not, and the results should be interpreted as the association, rather than the causal effects of participation in contract farming. Our regression equation takes the form of:

$$Y_i = \beta_0 + \beta_1 FCF_i + \mathbf{X}_i \boldsymbol{\nu} + \varepsilon_i \quad (1)$$

where Y represents the rice production and income variables of household i , FCF is a dummy variable that takes a value of 1 if the household cultivates rice under contract, and \mathbf{X} is a vector of basic household-specific characteristics. β_0 , β_1 , and $\boldsymbol{\nu}$ are the regression parameters to be estimated, where β_1 captures the association between contract farming and the outcome variable Y_i , and ε is the error term. We perform a set of estimations for different outcome variables using ordinary least squares (OLS) with robust standard errors to account for heteroscedasticity.

Our dependent variables include total rice production costs per hectare, paddy yield, revenue, and income per hectare, as well as total household income and its subcomponents. In each set of estimations, the key independent variable was the FCF (dummy). We adjusted our estimation using the age of the household head, years of education of the household head, whether the household

head is female (dummy), number of working-age household members, total landholdings, value of non-farm assets (000 VND), total amount of credit by the household (000 VND), whether the household has received training or uses extension services (dummy), and distances for the household's homestead to the nearest agrochemical dealers (meters), and to the district capital (kilometers).

Since the sample farmers in each village have a similar FCF status, we cannot include village-level fixed effects in our regression to control for the possible correlation between similar production environments and outcome variables, which increases concerns of omitted variable bias. To address this, we employed the methodologies proposed by Oster (2019) to test the robustness of the significantly estimated coefficient of FCF β_1 to unobservable factors. According to Oster (2019), β_1 is confirmed to be robust to unobservables if (i) the degree of selection on the unobservable $\delta > 1$ assumes a proportional selection relationship on observed and unobserved variables, and (ii) coefficient bounds do not include zero.¹⁾ As a robustness check, we estimate the average treatment effects on the treated (ATT) using a propensity score matching (PSM) model with nearest neighbor methods (Abadie and Imbens, 2006). In PSM, we use similar sets of variables as in OLS and specify the number of matches per observation to be 1.²⁾

5. Estimation results

Table 2 presents the estimation results of the OLS and PSM models for the association between participation in FCF contracting farming and rice production and income variables. Column 1 presents the estimated β_1 coefficients and their associated robust standard errors in parentheses.³⁾

Columns 2 and 3 show the δ values and bounds in Oster's (2019) test for the robustness of β_1 . The δ values are greater than one for most rice cultivation variables, including the cost of seeds, fertilizer, land preparation costs, harvesting costs, paddy yield, revenues, and income from rice cultivation, confirming the robustness of regression estimates to unobservables. The estimates for the PSM model are presented in Column 4. Since the coefficients estimated by the two models are largely consistent, except for a few variables, we focus our discussion on OLS estimates that pass Oster's (2019) tests.

As presented in Panel A, participation in FCF contract

1) One bound is the value of β_1 when $\delta = 0$, while the other bound is the value of β_1 when $\delta = 0$ and $R^2 = 1.3\bar{R}$, where \bar{R} denotes the value of R^2 with all observables included.

2) We use a Stata command *psacalc* to implement Oster's (2019) tests and *teffects* to estimate the PSM model.

3) For brevity, we present only estimated coefficients for CF and its associated tests. However, the complete sets of analysis tables can be obtained from the corresponding author upon request.

farming is associated with lower costs for seeds, land preparation, and harvesting. These results suggest that access to quality seeds and technical support allows contracted farmers to apply seeds efficiently, and synchronizing land preparation and harvesting activities enables them to use machinery and labor at discounted

rates. On the other hand, we find that participation in contract farming is associated with an increase in fertilizer costs, suggesting that due to high requirements for rice quality, contract farmers use qualified inputs, resulting in higher prices.

Regarding rice productivity and household income (Panel B),

Table 2: Association of participation in FCF and rice cultivation and income variables (OLS and PSM estimates)

Variables	OLS Estimates			PSM Estimates
	(1)	(2)	(3)	(4)
	Coefficient	δ	Bounds	ATT
<i>Panel A: Rice production cost</i>				
Cost of seed (000 VND/ha)	-823.58*** (129.93)	1.20	[-823.58; -838.16]	-934.54*** (214.98)
Fertilizer cost (000 VND/ha)	3,637.51*** (422.90)	1.25	[3,637.51; 3,841.04]	3,414.26*** (1,132.85)
Land preparation cost (000 VND/ha)	-1,202.69*** (193.44)	1.32	[-1,202.69; -514.40]	-1,017.36*** (350.17)
Crop establishment cost (000 VND/ha)	1,141.60 (916.18)	-28.91	[1,141.60; 1,323.74]	1,438.38* (817.55)
Cost for weed control (000 VND/ha)	-44.75 (370.95)	-1.12	[-44.75; -94.61]	12.83 (317.19)
Cost of pest control (000 VND/ha)	81.79 (348.68)	0.67	[81.79; 45.10]	532.66 (464.81)
Harvesting cost (000 VND/ha)	-408.60*** (118.36)	2.00	[-408.60; -247.74]	-408.12** (183.54)
Other costs (000 VND/ha)	-127.44 (107.02)	0.78	[-127.44; 40.82]	41.20 (255.03)
Total rice production cost (000 VND/ha)	2,253.85* (1,151.44)	-6.98	[2,253.85; 2,744.30]	3,079.31** (1,515.30)
<i>Panel B: Rice productivity and household income structure</i>				
Paddy yield (t/ha)	0.98*** (0.34)	252.41	[0.98; 1.11]	1.34* (0.71)
Revenue from rice cultivation (000 VND/ha)	22,518.21*** (3,955.61)	1.84	[2,2518.21; 1,8105.34]	21,350.59*** (3,924.56)
Income from rice cultivation (000 VND/ha)	20,264.36*** (4,217.50)	1.87	[20,264.36; 15,250.20]	18,271.28*** (4,168.07)
Income from rice cultivation (000 VND)	7,194.68*** (1,287.17)	1.51	[7,194.68; 3,945.55]	7,783.26*** (1,642.07)
Income from non-rice agricultural production (000 VND)	-3,952.25** (1,792.01)	-5.33	[-3,952.25; -4,943.81]	-4,739.73* (2,787.35)
Non-agricultural income (000 VND)	-11,659.71 (8,649.49)	-55.99	[-11,659.71; -13,362.68]	-52,437.81** (21,023.66)
Total household income (000 VND)	-8,417.27 (8,782.81)	-3.06	[-8,417.27; -12,155.05]	-49,394.27** (22,312.43)

Source: Authors (2022)

Note: 1) *** denotes significant at 1%, ** significant at 5%, and * significant at 10%.

2) Robust standard errors in parentheses.

3) The estimation is based on 173 observations.

we find that participation in FCF contract farming is associated with higher paddy yield, revenues, and income from rice cultivation. These findings suggest that the quality of inputs and technical support offered by contract companies contributes to better rice productivity. However, the income gained from rice cultivation does not translate into high household income, as we find that the coefficient is insignificant. Our results are consistent with those of previous studies that reported positive effects of FCF on farm productivity in general staple foods (Maertens and Velde, 2017; Wu *et al.*, 2020).

6. Conclusion

This study applied data from four villages in Thai Binh province, Vietnam, to examine whether participation in the Large Field Model's firm-cooperative-farmers (FCF) contract farming is beneficial to smallholder rice farmers. Our estimates show that participation in the FCF contract farming is associated with lower costs for seeds, land preparation, and harvesting and higher costs of fertilizers. We also found that contracted farmers achieved a higher paddy yield, revenue, and income from rice cultivation. These findings are consistent with the empirical literature on the effects of contract farming.

Although our analysis examines the association rather than the causal effects, our findings suggest that contract farming under the FCF framework might have the potential to improve access to quality inputs at affordable prices as well as services such as extension and mechanization, which may result in high rice productivity. The results also reinforce the discussion of Otsuka *et al.* (2016), who suggest that producers' cooperatives can reduce barriers to smallholder farmers' participation in contract farming. However, since we find no positive relationship between FCF participation and household income, a rigorous investigation of the cost structure, labor use, and profit would benefit policymakers in making FCF beneficial for all parties involved.

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