Doctoral Dissertation

Collective Action among Small-Scale Farmers: Impact Evaluation and Randomized Conjoint Analysis on Green Tea Farmers in Thai Nguyen, Vietnam

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Abstract

Small-scale farms – defined as being less than 2 ha – are predominant in the agricultural sector, especially in developing countries. However, they face major disadvantages caused by high unit transaction costs and weak market power. Collective action through the establishment of farmer-owned organizations, or cooperatives, is a promising solution to the problems of smallholder farmers. Those farmer organizations are increasingly popular in developing countries with collective marketing (i.e., marketing cooperatives) and group certification being the two highly common functions.

This dissertation investigates collective action among small-scale farmers through case studies of tea production in Thai Nguyen, Vietnam. Vietnam is one of the world largest tea producers, and smallholder farmers own up to 70 percent of the national tea plantation area. As with other crops, recent transitions in the food sector – e.g., expansion of supermarkets and increasing concerns about food standards – exacerbate disadvantages of small-scale tea farmers in Vietnam. Collective action, such as collective marketing and group certification, has been promoted to link small-scale farmers to the changing food markets. Thai Nguyen - a province in the northern mountainous region of Vietnam - is a center of green tea production which has highly active development of farmer-owned marketing cooperatives and certification groups. Thus, the province offers a compelling context for studying farmers' collective action.

By focusing common collective activities – collective marketing and group certification – among smallholder green tea farmers in Thai Nguyen, this dissertation contributes to the literature on a central research question: *How do small-scale farmers benefit from collective action?* Current literature could be divided into two strands. On one hand, the first strand of literature quantitatively evaluates the impacts of marketing cooperatives and certification groups, in which impacts on farm income are a common interest. On the other hand, the second strand explores the determinants of smallholder farmers' participation in the collective action. This dissertation identifies three research gaps in the two literature strands and present results from three case studies on small-scale green

tea farmers in Thai Nguyen to contribute to the knowledge of collective action among small farmers.

The first two case studies evaluate the impacts collective marketing and group certification on income of small-scale farmers – belonging the first main strand of literature. To conduct the impact evaluation, original data on smallholder farmers in 4 central tea producing regions (located in 7 communes) of Thai Nguyen were collected through a household survey in Jul - August 2017. The survey followed mixed sampling strategies: all members of marketing cooperatives and certification groups were included if possible; non-members in were sampled randomly. After data cleaning, the sample consists of 476 tea small family farms (households). Of these, 60 were certified cooperative members, 87 were certified farmers but not members of any cooperative, 75 were non-certified cooperative members and 254 were not members of either cooperatives or certified groups (control households).

The first case study investigates the impacts of collective marketing via farmer cooperatives on income of smallholder tea farmers. Although tea is a highly important product for small farmers in many developing countries, little is known about the impacts of collective marketing on tea farmers *(Research gap 1)*. This case study therefore contributes to knowledge on collective marketing by analyzing a sub-sample of 329 farmers from the original data on 476 smallholder tea farmers in Thai Nguyen. The treated group was the 75 non-certified cooperative members, while the comparison group was the 254 control households. Propensity score matching (PSM) was employed to mitigate bias caused by the self-selection of the cooperative membership. However, across different PSM models, this case study could not find conclusive impacts of cooperative membership on the income from tea farming. A plausible and important reason is that collective marketing was inactive for many cooperative members. Another interpretation of the finding is a high divergence in other components of cooperative membership, such as past certification and technical assistance.

By contrast, the second case study shows significant impacts of group certification on income of smallholder tea farmers in Thai Nguyen. Thai Nguyen green tea products are principally consumed in the domestic markets – a compelling context examined by

very few studies on certification standards *(Research gap 2)*. Thus, the case study makes an important contribution to the literature on the impacts of certification programs for groups of smallholder farmers. From the same data 476 small tea farmers in Thai Nguyen, this study selected a different sub-sample of 401 farmers: 147 certified farmers (87 certified non-cooperative members and 60 certified cooperative members) and 254 control farmers. A similar PSM procedure as in the first study was applied. Results show that adoption of group certification significantly increased sales, selling price and net income. Labor costs were also higher for certified tea farmers. The findings of this case study lend evidence-based support to the implementation of voluntary certification standards for specialty green tea production.

The third and last case study contributes to the second strand of literature on factors influencing farmer participation in collective action. This study applies randomized conjoint analysis (RCA) which allow estimating causal effects of design attributes – i.e., certification fee, price premium, record keeping, requirements about the application of fertilizer and pesticides – on farmer participation in hypothetical group certification programs (VietGAP). Despite their importance of design attributes, very few studies examine how those attributes affect farmer participation in certification schemes *(Research gap 3)*. This case study used different sample data on 750 small-scale tea farmers in Dai Tu district. This district is the largest tea producing area in Thai Nguyen, and local tea farmers have high exposure to certification programs, giving favorable conditions for conducting the RCA. Data was collected in June - Jul 2018 with relatively similar mixed sampling strategies as in the two previous case studies. Results indicate that the requirement of combined application of organic and chemical fertilizer, a recommended practice for maintaining soil health, did not reduce the participation significantly. In addition, when this requirement is packaged with delayed payment for organic fertilizer purchase, the participation rate can be enhanced. Importantly, despite the availability of price premiums, the certification fee is a major barrier preventing tea farmers from produced certified food products.

Based on the findings of the three case studies, the dissertation discusses further implications for the central research question as well as for policies related to collective action

among small-scale farmers. First, the economic benefits of collective action through farmer organizations appear ambivalent. When we investigate the effects of membership which does not fully reflect the active participation and which contains diverged intervention components, results could be inconclusive. However, when we examine farmer organizations with high similarity in their function and member activity, clear benefits are more plausible. Second, although economic benefits of collective action could be tangible, low member contribution is a major issue for the realization of such benefits. Thus, one critical challenge for development agencies as well as leaders of farmer organizations lies in encouraging small-scale farmers to pool their resources together.

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Abbreviations

AMCE	**A**verage **M**arginal **C**omponent **E**ffect
ATE	**A**verage **T**reatment **E**ffect
ATET	**A**verage **T**reatment **E**ffect on the **T**reated
CEM	**C**oarsened **E**xact **M**atching
PSM	**P**ropensity **S**core **M**atching
RCA	**R**andomized **C**onjoint **A**nalysis
RCT	**R**andomized **C**ontrolled **T**rial

Chapter 1

Introduction

1.1 Background

1.1.1 Disadvantages of small-scale farmers

Small-scale farms – defined as being less than 2 ha – are predominant in the agricultural sector, especially in developing countries [1]. Of 570 million farms worldwide, 475 million farms (84 percent) are smaller than 2 ha, and those small farms account for 12 percent of the world agricultural farmland. In low and lower-middle income countries, at least 70 percent of farms are small-scale, and smallholder farmers use 30-40 percent of farmlands (Lowder et al., 2016). Small-scale farming therefore provides a livelihood for hundreds of millions of households in developing countries.

However, small-scale farmers face major disadvantages caused by transaction costs. Transaction costs – costs of making economic trades (Williamson, 1985) - include both fixed cost such as partner seeking, negotiation and monitoring and variable costs such as transportation (Key et al., 2000). Small-scale farmers usually have low transaction costs of accessing and monitoring highly motivated family labors; however, their unit costs of non-labor transactions are high (Poulton et al., 2010). For instance, all else being equal, compared to large-scale producers, small farmers have much higher unit costs of accessing input and output markets, obtaining technical knowledge and transferring of the goods. The problems of transaction costs are exacerbated by poverty, low education and underdeveloped transportation and information systems, which are common among small-scale farmers (Poulton et al., 2010).

[1] In the literature on agricultural farms, the two terms: small-scale farms (or smallholder farms) and family farms are often used interchangeably since most of family farms are small-scale (FAO, 2014; Lowder et al., 2016). In this dissertation, small-scale farms also mean family farms.

In addition to transaction cost, a large number of small-scale farms and, usually, a much fewer number of buyers or input suppliers lead to a relatively weak market power to the former. Consequently, small-scale farmers are prone to "opportunistic behaviors" in their trade with buyers or input suppliers (Fischer and Qaim, 2012).

For small-scale farmers in developing countries, the disadvantages are even more critical due to the recent transformation of food markets. Global concerns about food safety, environmental sustainability and social issues (e.g., labor conditions, gender equality and producer welfare) in agricultural production are growing (Narrod et al., 2009; Foley et al., 2011; Potts et al., 2014). Integration with global markets means that safety and sustainability-related standards gradually become important attributes for food and beverages. This trend typically poses severe challenges to numerous small-scale farmers in developing countries due to weak regulatory institutions (Ibanez and Blackman, 2016; Naziri et al., 2014).

Moreover, supermarkets expand rapidly in developing countries and compete directly with traditional wet-markets (Reardon et al., 2009; Rischke et al., 2015). The emergence of supermarkets modernizes procurement practices which prioritize food quality and safety standards and contract-based linkages with producers (Reardon et al., 2009). High transaction costs and weak market power largely prevent individual small-scale farmers from certifying the quality of their products and getting engaged in supply chains for modern markets. Thus, the growth of food markets can put a high risk of market exclusion on small-scale farmers in developing countries (Markelova et al., 2009).

1.1.2 Collective action among small-scale farmers

Collective action – through the voluntary establishment of farmer groups, organizations, or cooperatives – is seen as a key solution to the problems of smallholder farmers (Markelova et al., 2009). In reality, smallholder farmers often spontaneously gather in informal groups, for example, to exchange labors. However, collective action, hereafter, refers to formal farmer organizations which have legal registration of their establishment, purposes, administrative structure and members. Those farmer organizations are also different from the state-owned organizations (e.g., state-owned agricultural cooperatives), as the former are owned and controlled by the farmers themselves.

Previous studies have explained the potential benefits of collective action through farmer organizations. By acting collectively, smallholder farmers can reduce unit transaction costs by achieving better economy of scale and overcome common market failures in developing countries such as information asymmetries and imperfect property right.

(Markelova et al., 2009; Ouma et al., 2010; Shiferaw et al., 2011). Rural farmer organizations can also facilitate farmers' access to support from government and non-government organizations regarding capacity building, information exchange and innovation (Fischer and Qaim, 2012; Rao and Qaim, 2011).

Farmer organizations can offer various services related to all stages of agricultural production, ranging from input purchase, agricultural extension, financial services, processing to selling Fischer and Qaim (2012). This dissertation focuses on two highly common functions of farmer organizations: collective marketing and group certification.

Firstly, collectively selling products via farmer-owned agricultural cooperatives is an important marketing strategy for farmers not only in developing but also in developed countries. For instance, marketing cooperatives make up about 54% of agricultural cooperative in the U.S in 2017 (USDA, 2017). In European countries such as Finland, Italy and the Netherlands, more than half of the agricultural products are sold via farmer cooperatives (Tchami, 2007). Recently, there is a renewed interest in marketing cooperatives in developing countries. Many studies show that, after the dissolution of state-owned or colonial cooperatives, marketing cooperatives are increasingly established by smallholder farmers in Sub-Saharan Africa (e.g., Chagwiza et al., 2016; Fischer and Qaim, 2012; Olwande et al., 2015) and Asia (e.g., Roy and Thorat, 2008; Scholl et al., 2016; Hao et al., 2018).

Members of marketing cooperatives bulk their farm output together and sell collectively, which reduces the unit transaction costs and eases access to new markets (Markelova et al., 2009). Marketing cooperatives can also improve bargaining power, and reduce price uncertainty for farmers (Cakir and Balagtas, 2012; Agbo et al., 2015). Therefore, collective marketing is widely considered as a promising path to integrate smallholder farmers into markets and to improve their welfare.

Secondly, group certification schemes for smallholder farmers in developing countries has gained considerable momentum. As mentioned above, although food certification standards have become increasingly important for penetrating modern agricultural markets, smallholder farmers have great difficulties in acquiring those standards individually. Thus, a large number of voluntary certification standards involving groups of smallholder farmers in developing countries have been introduced. Those certification schemes typically declare their highest goals as achieving sustainable agriculture by addressing three aspects i.e., economic, environmental and social (DeFries et al., 2017). As of 2016, there are more than 200 sustainability standards (ITC, 2016). Several popular schemes are Fairtrade, Organic and UTZ. In addition to periodic external monitoring from third parties, these certification schemes rely on self-managed groups in which farmers voluntarily participate to enforce compliance with standardized farming practices.

From an economic perspective, one rationale for the benefits of the group certification is that smallholder farmers receive a price premium for their collectively certified products. That price premium derives from consumers having additional willingness to pay for certification labels, which has been shown to be plausible in many studies (e.g., Marette et al., 2012; Rousseau and Vranken, 2013). Further, improved access to input and output markets and dissemination of technical information also contribute to the economic impacts of certification programs.

In consideration of their practical and academic significance, this dissertation exclusively examines marketing cooperatives and certification groups established by smallholder farmers in developing countries.

1.1.3 Tea production

This dissertation investigates collective action among small-scale farmers through case studies in tea production, primarily because tea is a highly important crop for small-scale farmers in many developing countries.

From the demand side, in 2013, with a total consumption of around 4.8 million tonnes, tea – *Camellia sinensis* – is the most consumed beverage (FAO, 2015a). From the supply side, world tea production increases steadily and reaches approximately 5 million tonnes in 2013. Strikingly, as much as 98% of total tea production comes from developing countries (FAO, 2015a). Big producers are mainly found in Asia, e.g., China, India, Sri Lanka, Turkey Indonesia, and Vietnam, while one of few exceptions is Kenya in Africa. Thus, tea production and trading form a significant industry in many developing countries.

Moreover, small-scale farmers have become a major factor in the tea industry in many developing countries. Most of the tea plantations were traditionally operated in large-scale farms. However, in many leading tea producing countries, there has been a dramatic growth in the small-scale tea farms. Tea cultivation is able to give a stable income throughout the year, does not needs large investment and bears little serious risk. These characteristics explain the large number of small-scale tea farms (Van Der Wal, 2008). For example, more than 60% of tea in Kenya, 76% in Sri Lanka are grown by smallholder farmers (FAO, 2015b). In Vietnam, small farmers own up to 70% of tea plantation areas (Ha, 2014). As such, a vast number of rural families in developing countries rely on small-scale tea farming as a crucial income source.

Tea also has additional characteristics that make it an interesting study context for collective action among smallholder farmers. Compared to staples or fruits, tea products

requires relatively more processing – such as drying and roasting. This processing gives high added-value to tea products. Further, since tea drinking is rooted deeply, tea has an important cultural value in many countries, especially in Asia. Multiple classes of tea products are available, from ordinary tea for daily use to very premium tea for special occasions like tea ceremonies or gifting. Tea therefore has the potential to become a high-value product or to move beyond local markets, giving favorable conditions for collective action among smallholder farmers.

Due to the aforementioned reasons, tea production offers an appealing context to study farmers' collective action. In this dissertation, I present case studies on small-scale green tea farmers in Thai Nguyen, Vietnam. Elaboration on tea production and collective activities in the study sites will be provided in chapter 2.

1.2 Academic gaps and research questions

Since collective action among small farmers – collective marketing through farmer co-operatives and group certification – has gained popularity in developing countries, a considerable body of literature has investigated the question: *How do small-scale farmers benefit from the collective action?*

In order to answer the above-mentioned broad question from a quantitative perspective, current literature could be divided into two strands [2]. On one hand, the first strand of literature quantitatively evaluates the impacts of collective action. Impacts of farmer cooperatives and certification standards are assessed on various outcomes such as market access (Olwande et al., 2015; Snider et al., 2017), technology adoption (Abebaw and Haile, 2013; Chagwiza et al., 2016) and environmentally friendly practices (Chiputwa et al., 2015; Giuliani et al., 2017). Nonetheless, since welfare improvement is typically a key goal for farmer organizations, economic impacts on income of smallholder farmers are of high-interest (Fischer and Qaim, 2012; Ma and Abdulai, 2016; Rijsbergen et al., 2016). To understand the economic impact path of collective action, studies regularly examine effects on components of farm income including sales, production, productivity and costs.

On the other hand, the second strand explores the determinants of smallholder farmers' participation in the collective action. These studies investigate factors which are related to contextual settings, organizational structures as well as farmer characteristics affecting

[2] There are also qualitative studies examining organizational aspects (J. Barham and Chitemi, 2009; Narrod et al., 2009) or farmers' attitude to collective action (Cechin et al., 2013). However, this dissertation primarily focuses on quantitative evidence to answer the research question. Findings from qualitative studies are mainly used to support arguments related to research gaps.

the membership of farmer cooperatives or certification groups (Mojo et al., 2017; Latynskiy and Berger, 2016; Handschuch et al., 2013; Kersting and Wollni, 2012). Findings from this strand of literature are vital to understand when collective action can deliver benefits to participants and what type of farmers are likely to receive the benefits.

This dissertation contributes to the growing literature on the central research question:

Central research question: "How do small-scale farmers benefit from collective action?"

I identify three research gaps – corresponding to three component research questions – in the studies on this central question, particularly on marketing cooperatives and certification standards. This dissertation is structured to address these three research gaps with case studies on smallholder green tea farmers in Thai Nguyen, Vietnam.

The first two research gaps are related to the literature about impact evaluation of the collective action - the first strand. To be specific, whether collective action can improve farm income is largely unknown in many contexts. First, in regards of collective marketing, economic impact evaluation has been found in the context of important crops for small farmers in developing countries, such as rice, banana, apple or grape (Abdul-Rahaman and Abdulai, 2018; Fischer and Qaim, 2012; Ma and Abdulai, 2016; Roy and Thorat, 2008). However, although small-scale tea farming is crucial income sources for millions of rural households in developing countries, I am not aware of any quantitative studies estimating the effects of collective marketing on small tea farmers. As mentioned in the previous section, tea has distinctive characteristics for a compelling case study. For processed agricultural products and longer value chains – as it is the case for tea products, collective marketing through cooperatives could have favorable conditions to deliver economic benefits (Markelova and Mwangi, 2010). Hence, the dissertation evaluates the impacts of marketing cooperatives on small-scale tea farmers in Thai Nguyen, Vietnam with the first research question as follows:

Research question 1: "Can collective marketing improve income of small-scale tea farmers?"

The second research gap is about impact evaluation of the group certification. Almost all studies to date only examine economic impacts of certification standards on crop farmers with well-established links to export markets (e.g., Holzapfel and Wollni, 2014; Rijsbergen et al., 2016; Subervie and Vagneron, 2013). Rising living standards and rapid expansion of modern retails have led to the emergence of voluntary certification standards, even in the domestic markets of developing countries (Berdegué et al., 2005; Henson and Reardon, 2005; Mergenthaler et al., 2009b). While results for certified export crops cannot be directly applied, there are very few studies examine impacts of

certification on small-scale farmers in the context of domestic markets. The dissertation thus addresses this research gap by evaluating economic impacts of group certification on of small-scale tea farmers in Thai Nguyen, Vietnam who are producing specialty green tea principally for domestic markets. The second research question is stated as below:

Research question 2: "Can group certification improve income of small-scale tea farmers?"

To answer research question 1 and 2, I used a sample of 476 smallholder tea farmers collected in 2017 and employed propensity score matching (PSM) to mitigate the self-selection bias.

Finally, the third research gap is in the second strand of literature which examines factors affecting farmer participation in collective action. For this research, I particularly focus on farmer participation in group certification schemes. Other studies primarily explore the farm and regional characteristics which are correlated with participation in certification programs (e.g., Kersting and Wollni, 2012; Handschuch et al., 2013). Meanwhile, design attributes of certification schemes – certification fee, price premium, record keeping, requirements about the application of fertilizer and pesticides – play a crucial role in participation decision. The significance of design attributes has been examined for institutional arrangements involving smallholder farmers, such as contract farming (Abebe et al., 2013; Schipmann and Qaim, 2011), supermarket contracts (Ochieng et al., 2017) and soil conservation (Marenya et al., 2014). Similar studies for certification are scarce. To fill this knowledge gap, I conducted a randomized conjoint analysis (RCA) – a choice experiment to study stated preference – on 750 small-scale tea farmers in Thai Nguyen, Vietnam in 2018. The third research question is as below:

Research question 3: "Which design attributes of certification programs can affect small-scale tea farmers' participation?"

By answering the three above research questions with case studies on small-scale tea farmers in Vietnam, this dissertation makes an original academic contribution to the literature on the central research question. Moreover, based on the results from the case studies, the dissertation also gives insightful implications for policies related to collective action among small-scale farmers.

1.3 Dissertation structure

This dissertation consists of 6 chapters with the structure illustrated in Figure 1.1.

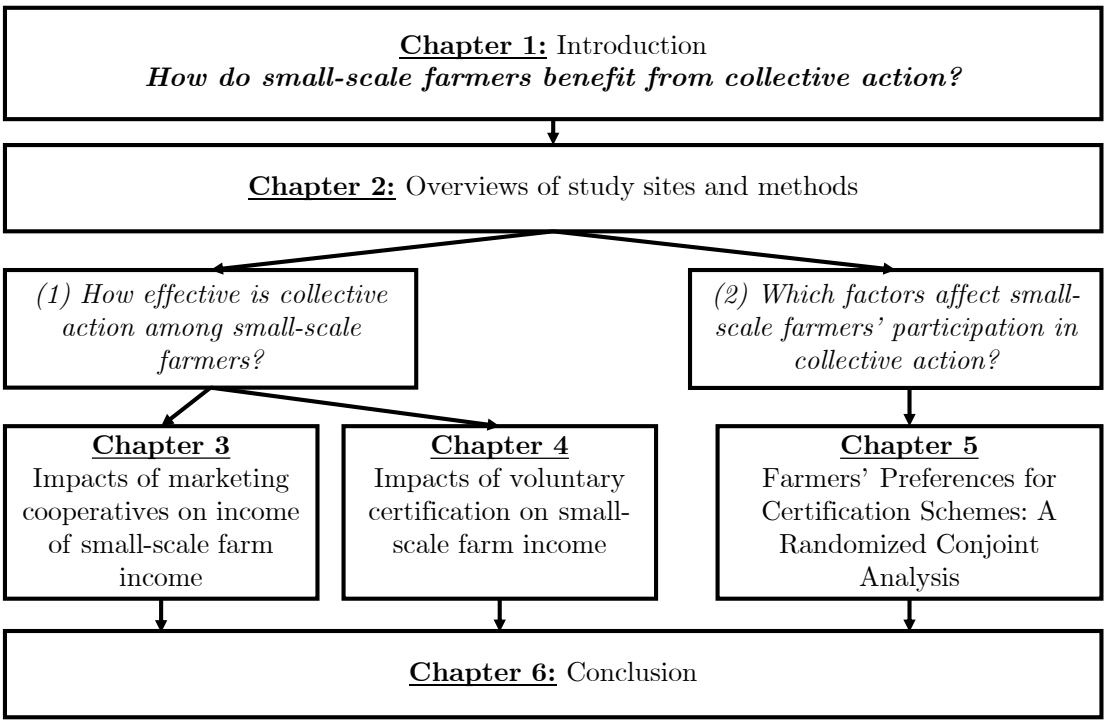


FIGURE 1.1: Dissertation structure

Chapter 1 has so far provided background information on collective action among small-scale farmer and tea production. Importantly, it has explained the significance of the central research question and 3 related research gaps in the two strands of current literature.

Chapter 2 justifies the selection of study sites in Thai Nguyen, Vietnam. In doing so, I describe intriguing features of tea production in Vietnam as well as in Thai Nguyen. The chapter further elaborates on collective action among small-scale farmers in Vietnam and tea farmers in Thai Nguyen, particularly in regards to marketing cooperatives and group certification schemes. An overview of the two methods used this dissertation – PSM and RCA – are also provided in this chapter.

Chapter 3, 4 and 5 are core contents of the dissertation, which present case studies to address the three mentioned research questions. Specifically, chapter 3 and chapter 4 answers the first two research question related to impact evaluation of collective action. Chapter 3 present economic impacts of marketing cooperatives on income from small-scale tea farming. Meanwhile, chapter 4 evaluates the economic impact of certification groups. Because both the two chapters use the same sample of small-scale farmers in Thai Nguyen, Vietnam and the same PSM method for the impact evaluation, details on data collection and PSM procedure are only described in chapter 3. Chapter 5 answers the third research question with a randomized conjoint analysis which shed light on the causal impacts of design attributes on farmers' stated preference of certification programs.

Chapter 6 concludes findings from the three core chapters. In addition, based on the findings, this chapter also discusses implications for studies and policies related to collective action among smallholder farmers. Lastly, the chapter acknowledges the limitations of the dissertation and give recommendations for future research.

Chapter 2

Overviews of study sites and methods

2.1 Tea production and collective actions among small-scale tea farmers in Vietnam

Tea production in Vietnam provides a compelling case study for collective actions among small-scale farmers for two reasons. First, Vietnam is a top-rank tea producing country where small-scale farmers are a crucial part of the national tea industry. Second, collective actions among small-scale farmers, due to the rapid transformation of food markets, have been blooming in Vietnam. The following subsections further justify the selection of study sites in Vietnam

2.1.1 Tea production in Vietnam

Vietnam is a top-rank tea producing country and also a cradle of tea consumption. In 2016, with a harvested area of 118,824 ha, Vietnam has a total dried tea production of 240,000 tonnes - ranked sixth worldwide (FAOSTAT, 2016). The largest tea producing zone is located in the northern mountainous area due to suitable climate and topography (Hong and Yabe, 2015). Main products are black tea and green tea with almost equal proportion; there are also other minor products such as Oolong tea. Vietnam also exports both black and green tea; however, most exports products are in large packaging without labels and brands (Viet Khoi et al., 2015) [1]. On the consumption side, tea drinking is an

[1] Vietnam is ranked fifth in the volumes of tea exports in 2013 (90,296 tonnes) (FAOSTAT, 2016) According to statistic from ITC in 2016, approximately 95% of exports tea are in immediate packaging of more than 3 kg (ITC, 2016).

embedded culture among Vietnamese consumers (Wenner, 2011). The presence of tea in daily communication as well as formal ceremonies has been maintained for thousands of years, which gives it a special cultural value. Preferred types of tea differ from the North to the South; however, bitter green tea is the most popular (Wenner, 2011).

Regarding the tea value chain in Vietnam, highly fragmented and small-scale production, processing and trading are prominent features. The first key actor in the chain is about 400,000 smallholder tea farmers who own approximately 70 percent of the total national tea cultivation area (Ha, 2014). Fresh green tea is often home-processed into dried tea or sold to other small household processors. The dried tea is mostly sold to local middlemen, who then distribute the products to downstream wholesalers and retailers. (Viet Khoi et al., 2015).

As with other crops, there are huge challenges induced by a transitional food sector for small-scale tea farmers in Vietnam. The rapid expansion of supermarkets, derived from fast economic growth and urbanization, gradually drags consumers from traditional wet markets and small retail stores. (Wertheim-Heck and Spaargaren, 2016; Moustier et al., 2010). In addition, integration with global markets as well as domestic consumers' rising concerns about food safety put greater emphasis on certification standards for foods and beverages. (Mergenthaler et al., 2009b; Mergenthaler et al., 2009c; Nguyen, 2017). Smallholder farmers can hardly compete with large-scale farms to get engaged in supply chains for modern supermarkets and overseas markets. They also face prohibited costs to individually adopt certification standards. Vietnamese small-scale farmers are therefore at risk of exclusion from modern and high-value markets, which may push them down to left-behind groups of economic development. Collective action has been promoted to link small-scale farmers to changing food markets.

2.1.2 Collective action small-scale tea farmers in Vietnam

Collective action among small-scale farmers has significant progress in Vietnam. First, there is a resurgent interest in farmer cooperatives. In Vietnam, agricultural production was once solely organized in state cooperatives under a central planning economy system. Entire harvest belonged to the cooperatives, and farmers were paid based on their work points - merely measuring their attendance. Agricultural production stagnated since the system offered little working motivation. Thanks to drastic reforms in economic policies, particularly in the Land Law during the 1980s and 1990s, vast farmland of state

cooperative was divided and distributed to families (Wolz and Duong, 2010) [2]. Small-scale farms, where farmers are free to make production decisions, began to flourish, which greatly boosts agricultural production. Meanwhile, most of the state cooperatives were dissolved; some were transformed into membership-oriented cooperatives - hereafter, transformed cooperatives - but have little operation (Wolz and Duong, 2010; Scholl et al., 2016).

Nonetheless, due to the aforementioned changes in modern food markets, there is an urge for collective activities among small-scale farmers. Cooperative Law, adopted in 1997, was revised in 2012 to facilitate the establishment of new farmer-owned cooperatives. Those new cooperatives are founded by a small number of farmers (between 10 and 60), who focus more on selling only one type of agricultural product (Naziri et al., 2014). These characteristics are different from the transformed cooperatives, which often have large membership (between 200 and 2,000) and focus on input services (e.g., irrigation and electricity) for paddy crops (Naziri et al., 2014).

A similar pattern of development can be seen for tea cooperatives. State tea cooperatives, which owned vast tea plantation, were dissolved in the 1990s, followed by a surge in the number of small-scale tea farms. Groups of those smallholder tea farmers then found their own tea cooperatives with the primary objective being to market their tea products collectively. Although there is no official number available, many new tea cooperatives have been established typically in central areas for tea production such as the northern mountainous area.

Second, voluntary certification schemes for groups of small-scale farmers have gained popularity. One important motive is to facilitate the incorporation of Vietnam's foods and beverages into international supply chains (Mergenthaler et al., 2009c). Emerging food safety concerns caused by the overuse of agrochemicals in small-scale farms and the rapid expansion of modern retailers are also important drivers (Mergenthaler et al., 2009b; Nguyen, 2017). Both international and domestic certification schemes are available for various food products from crops, animal livestock to aquaculture.

Two types of certification are currently being adopted by small-scale tea farmers: VietGAP and UTZ. VietGAP is a domestic set of standards launched in 2008 by the Ministry of Agriculture and Rural Development following ASEAN's announcement of its GAP standards in 2006. Whereas, UTZ is a well-established label with more stringent international standards. Notably, neither VietGAP nor UTZ strictly requires organic

[2] Note that private land ownership is not allowed in Vietnam, farmers however have the right to use the agricultural land up to 50 years. The land-use rights are transferable on land markets and can be used as collateral for economic transactions.

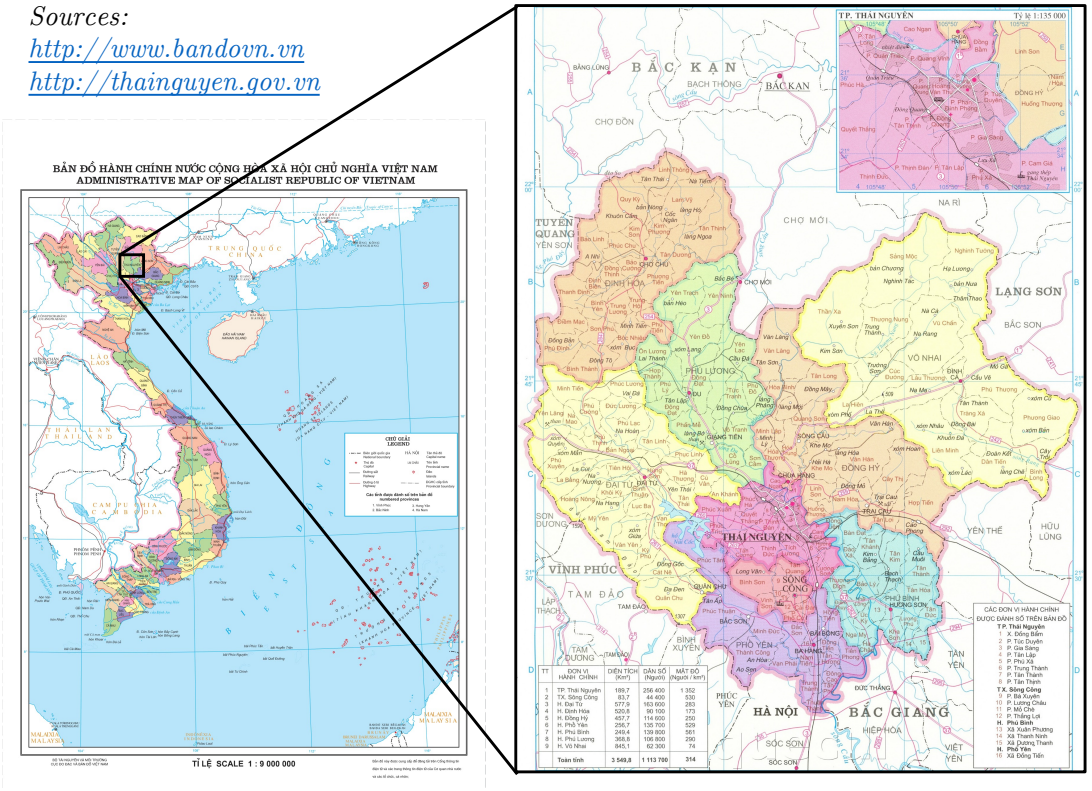


FIGURE 2.1: Thai Nguyen province, Vietnam

production. Instead, certified farmers are allowed an appropriate use of synthetic fertilizers and chemical pesticides. Equally important, neither of these labels guarantees a minimum price for certified products. As of March 2018, there were 68 VietGAP-certified tea groups in operation nationwide, whereas there was only one UTZ-certified tea cooperative (VietGAP, 2018; UTZ, 2018).

2.2 Small-scale tea farmers in Thai Nguyen

Thai Nguyen is a province in the northern mountainous area – the largest center for tea production in Vietnam. Figure 2.1 shows the location of Thai Nguyen. The province has attractive characteristics for studying collective action among small-scale farmers in Vietnam

Thai Nguyen is a leading province of tea production in Vietnam. In 2016, the provincial harvested area was 17,380 ha, and total fresh tea production was 194,200 tons (GSO, 2016). Only Lam Dong province, located in the central highlands region of Vietnam, presents higher figures. However, Lam Dong specializes in producing black tea for export; whereas Thai Nguyen's main product is green tea. Thai Nguyen boasts the most famous

brands for specialty green tea in domestic markets which consume up to 90 percent of provincial green tea production. Only a few products are exported to foreign markets.

In addition, as thousands of small-scale farmers are principle contributor to tea production, collective action among tea farmers has developed significantly in Thai Nguyen. Local policy-makers encourage the establishment of farmer cooperatives to facilitate market access through collective marketing of tea products. According to the provincial statistics, there were 35 registered tea cooperatives as of March 2017. Two of them were previously state-owned cooperatives. They have more than 60 members and are under the process of transformation. The rest 33 cooperatives are new farmer-owned cooperatives with member size from 7 to 46. Among the 33 cooperatives, 30 were just established since 2011 afterward.

The tea cooperatives function primarily at the selling stage; tea growing and processing are still conducted in individual households. The cooperative members - mainly cooperative managers - seek large-scale buyers for their tea products. If tea is sold through cooperatives, dried tea is packaged under the brands of the cooperatives. In only a few cooperatives where collective processing devices are available, cooperative members do final processing steps and packaging together.

Moreover, Thai Nguyen is the most active location for the development of tea certification in Vietnam. The only UTZ-certified tea cooperative and 40 of the 68 VietGAP-certified groups are based in the province. VietGAP certification is flourishing, partly owing to subsidy programs from the local and central governments. The subsidy programs cover the certification fee when farmer groups are in the first two-year certification period. After the subsidy period, the groups must pay the costs on their own if they wish to continue certified production. However, in many cases, because funding is available in their communes or districts, groups that extend VietGAP certification after the first two-year period are still able to receive support for paying the certification fee. It noted that certification groups sometimes include tea cooperative members; however, they can also simply be farmer groups that are solely focused on producing certified tea rather than engaging in collective marketing.

Due to those above characteristics, tea production in Thai Nguyen offers an ideal case study for collective action among small-scale farmers.

2.3 An overview of methods

To answer the research questions, I employ two methods: Propensity score matching (PSM) for evaluating the impacts of collective action, and randomized conjoint analysis

(RCA) for estimating the impacts of design attributes on farmers' preference. This section justifies the selection of the two methods.

2.3.1 Propensity score matching

To see the validity of PSM, it is necessary to overview the potential outcome framework (Rubin, 1974) for studying treatment effects. Accordingly, consider a scenario where hypothetical treatment w is binary, as it is the case in this dissertation. For a unit of observation i in a population of size of N, w_i takes on the value 1 for a active treatment (e.g., a member of marketing cooperatives) and 0 for a control treatment (e.g. non-member of marketing cooperatives). $Y_i(w_i = 1)$ denotes the potential outcome level (e.g., production volume) if unit i receive the active treatment, and $Y_i(w_i = 0)$ denotes the potential outcome level if the same unit i at the same time receive the control treatment. The causal effect of treatment w on unit i (i.e., unit treatment effect) is then defined as the difference between $Y_i(w_i = 1)$ and $Y_i(w_i = 0)$. By averaging the effect on all units, we have an average treatment effect (ATE).

However, in the real world, we can observe only one of the two potential outcomes for all $i \in N$. Let $W_i = [0, 1]$ be the real word treatment. Then, we can only observe either $Y_i(w_i = 1)|W_i = 1$ (for units in the treatment group) and $Y_i(w_i = 0)|W_i = 0$ (for units in the control group). We can never observe counterfactual outcomes $Y_i(w_i = 1)|W_i = 0$ and $Y_i(w_i = 0)|W_i = 1$. Hence, unit treatment effect and average treatment effect cannot be calculated. The fact that only one of the potential outcomes is observed is called "the fundamental problem of causal inference" (Holland, 1986). Estimation of the counterfactual outcomes is the most critical challenge in impact evaluation studies

A randomized control trial, where treatment status is randomly assigned, is ideal for estimating the causal effect. In this condition, because of random assignment, we can generate the treatment and control groups that are identical in all background characteristics. Thus, the average outcome level of the control group ($E(Y_i(w_i = 0)|W_i = 0)$) is an unbiased estimate for the potential outcome of the treatment group had it not been treated ($E(Y_i(w_i = 0)|W_i = 1)$). Similarly, the average outcome level of the treatment group ($E(Y_i(w_i = 1)|W_i = 1)$) is an unbiased estimate for the potential outcome of the control group had it been treated ($E(Y_i(w_i = 0)|W_i = 1)$). Subsequently, we can estimate simply ATE by taking the difference in the outcome level between the treatment and the control group. In addition to ATE, there are many occasions when we are interested in the treatment effect on the people who are targets of a program. Thus, another highly common causal quantity is average treatment on the treated (ATET) (Heckman

and Smith, 1999), which is estimated by equation 2.1.

$$\tau_{ATET} = E[Y(w = 1|W = 1)] - E[(Y(w = 0|W = 1)] \quad (2.1)$$

In observational studies, treatment assignment is often non-random (or endogenous), such as membership of marketing cooperatives and certification groups. Instead, treatment status is self-selected. As a result of the self-selection problem, treatment and control groups are essentially different in their characteristics. A simple difference in the outcome of the two groups masks the influence of factors that impact both with treatment status and outcome – covariates X. For instance, size of agricultural land owned by small-scale farmers can affect their cooperative membership since the marketing cooperatives often prioritize farmers with large landholding. On the other hand, agricultural landholding obviously affects total production. A simple difference in production volume between coop members and non-members, therefore, include the impact of agricultural landholding, rather than the coop membership itself, on production.

Propensity score matching (PSM) (Rosenbaum and Rubin, 1983) is widely applied in impact evaluation using observational data. PSM belongs to a family of matching algorithms, whose basic idea is to find of similar groups of control and treatment units regarding all covariates X. Subsequently, the counterfactual averaged outcome of the treatment group had it not been treated, for example, is estimated by averaging outcomes of the matched control group. The matching approach is based on two assumptions. The first assumption is unconfoundedness (or conditional independence assumption), meaning that potential outcomes are independent of treatment assignment, conditioning on the same X. The second assumption is overlap (or common support assumption), requiring all units with the same X to have a positive probability of receiving the treatment. When the two assumptions hold, ATET can be estimated as given in equation 2.2.

$$\tau_{ATET} = E_{X|W=1}[E(Y(w = 1|W = 1, X) - E(Y(w = 0|W = 0, X)] \quad (2.2)$$

When there are a number of potential X – high dimensional vector X, matching on all X is difficult. Thus, Rosenbaum and Rubin (1983) suggested matching based on the propensity score $P(W = 1|X)$ (or simply $P(X)$) - the probability for a unit to receive the treatment given the observed covariates X. They proved that if the unconfoundedness assumption holds conditional on all X, it also holds conditional on $P(X)$. Equation 2.3 shows PSM estimator for ATET.

$$\tau_{ATET} = E_{P(X)|W=1}\{E[Y(w = 1|W = 1, P(X))] - E[Y(w = 0|W = 0, P(X))]\} \quad (2.3)$$

The PSM method involves two major steps, although some studies developed detailed procedures with more steps (e.g., Caliendo and Kopeinig, 2008). The first step is to estimate the propensity score, which often uses probit or logit models. Based on the estimated propensity score, treatment and control units are matched. Various matching algorithms are available (see Caliendo and Kopeinig (2008) for a discussion). In this dissertation, I only select one-nearest-neighbor matching for its simplicity. The second step is to estimate treatment effects on outcome variables. As indicated in 2.3, PSM estimator is the mean difference in outcomes over the common support weighed by the distribution of the propensity score.

PSM is widely applied in impact evaluation studies in diverse fields, partly because it is suitable for simple cross-sectional data. Regarding collective action among small-scale farmers in developing countries, a vast number of studies use PSM to estimate its effects (e.g. Chagwiza et al., 2016; Fischer and Qaim, 2012; Giuliani et al., 2017; Jena et al., 2012; Verhofstadt and Maertens, 2015) Given the cross-sectional nature of the data, this study also applies PSM to estimate economic impacts of marketing cooperatives and certification groups (chapter 3 and 4). Chapter 3 will further elaborate on the detailed PSM procedure.

2.3.2 Randomized conjoint analysis

This dissertation uses RCA – one type of choice experiment – to study impacts of the design attributes on farmers' stated preference of certification programs in chapter 5.

Stated preference experiments, or choice experiments, are highly popular in various fields of social sciences. Ideally, impacts of design attributes on people preferences are revealed by conducting randomized field experiments, due to the aforementioned fundamental problem of causal inference. However, it takes a huge amount of resources to conduct field experiments. Further, if researchers want to have multiple combinations of design attributes, field experiments can hardly be implemented. Compared to revealed preferences through field randomized experiments, stated preferences are much less costly to elicit through choice experiments. Choice experiments typically ask respondents to choose from or rank hypothetical alternatives of a policy, a product or a service with different combinations of design attributes. Hence, design of the choice experiment allows researchers to study the impacts of attributes on hypothetical choice (stated preference) of the respondents. Because of their affordable costs and design flexibility, choice experiments are widely used in marketing, politics and economics.

Many studies also conducted choice experiments in the context of policies or services involving small-scale farmers (e.g., Abebe et al., 2013; Schipmann and Qaim, 2011;

Meemken et al., 2017). However, due to the design of their choice experiments, causal impacts of design attributes can hardly be estimated. To be more specific, almost all studies employed d-optimal design, which imposes restrictions on sets of attribute levels appearing in choice tasks. Consequently, such partly randomization renders serious statistical challenges for estimating effects of attributes levels on the choice decision.

Hainmueller et al. (2014) suggested a new design of the randomized conjoint analysis (RCA) to overcome the shortcoming of the conventional choice experiments. Due to a full randomization design of attribute levels, attribute position and pairs of alternatives, RCA can achieve equal distribution of all potential confounders across choice tasks. Thus, casual impacts of design attributes could be non-parametrically identified under the potential outcome framework.

The causal quantity estimated from the new RCA design is the average marginal component effect (AMCE). AMCE measure impacts of attributes on the choice probability of a hypothetical alternative. I adopt notations and instructions from Hainmueller et al. (2014) to demonstrate how AMCE is estimated.

Consider a scenario where each respondent i in a sample of N completes K choice tasks. In each choice task $k^{th} \in K$, respondent i choose from or ranks J hypothetical alternatives. A hypothetical alternative (a profile) consists of L attributes, and attribute l has D_l levels. The alternative faced by respondent i in alternative j^{th} of k^{th} choice task is denoted as T_{ijk}, and T_{ijkl} represent l^{th} attribute of the alternative. Y_{ijk} denotes choice outcome of respondent i for alternative j^{th} of choice task k^{th}

The AMCE is estimated based on two assumptions. The first assumption is no effects of the round of choice tasks and the order of alternatives on choice outcomes [3]. The second is full randomization. Under these two assumptions, AMCE of a change in the level of attribute l from t_0 to t_1 is defined by the following equation

$$\hat{\bar{\pi}}(t_1, t_0) = \bar{Y}_{ij|T_{ijl}=t_1} - \bar{Y}_{ij|T_{ijl}=t_0} \tag{2.4}$$

where $\bar{Y}_{ij|T_{ijk}=t_1}$ and $\bar{Y}_{ij|T_{ijk}=t_0}$ are conditional average of observed choice outcomes.

Nonparametric estimators of the AMCE of attribute levels can be obtained by linearly regressing observed outcome Y_{ij} on dummy variables for the levels of T_{ijl}. The linear regression model is as follows:

[3] Under this assumption, Y_{ijk} and T_{ijkl} can be simply referred as Y_{ij} and T_{ijl}

$$Y_{ij} = \beta_0 + \sum_{l=1}^{L} \sum_{d=1}^{D_l - 1} \beta_{ld} W_{ijl} + u \tag{2.5}$$

where W_{ijl} is the vectors of $D_l - 1$ dummy variables for the levels of T_{ijl} excluding the one for $T_{ijl} = t_0$. β_{ld} is the AMCE estimator of a change in attribute l from t_0 to t_d. A robust standard error of the AMCE, also estimated from the regression model, is clustered at the respondent level to correct for correlations between choice outcome within one respondent.

Since the two assumptions of the new RCA design can be easily satisfied, this method offers a powerful tool to study the causal impacts of design attributes on choice probability. Many recent studies have applied this method to measure the causal effects of program attributes in different contexts (e.g., Gampfer et al., 2014; Hninn et al., 2017; Sydavong et al., 2019). Therefore, I consider RCA as an ideal approach to study the impacts of design attributes on small-scale farmers' preferences of certification programs. Detailed design and implementation of the RCA will be specified in chapter 5.

Chapter 3

Impacts of marketing cooperatives on small-scale farm income

3.1 Introduction

Collective marketing through farmer cooperatives – or marketing cooperatives – helps reduce transaction costs of marketing products from small-scale farms. When there are opportunities to reach new high-value markets, a group of smallholder farmers could share the transaction costs of market access (Markelova et al., 2009). Further, by selling products together, small farmers can improve bargaining power, and reduce price uncertainty (Cakir and Balagtas, 2012; Agbo et al., 2015). Both effects might eventually lead to higher production, selling price and income for small-scale farmers. Therefore, collective marketing is usually a principal component for the establishment of farmer cooperatives.

A significant body of literature evaluates the economic impacts of membership in cooperatives where collective marketing is a key component. Studies cover various major crops for small-scale farmers in developing countries. For example, Abdul-Rahaman and Abdulai (2018) measure effects on rice farmers in Ghana. Fischer and Qaim (2012) analyzed impacts of banana cooperatives in Kenya. Effects of cooperative membership on apple farmers in China were studied by Ma and Abdulai (2016) and Hao et al. (2018) Roy and Thorat (2008) presented a case study on Indian grape, while the impacts of cooperatives on small-scale coffee farms were reported in Wollni and Zeller (2007).

Despite the importance of tea crop, very few empirical evidence of the effects of marketing cooperative on small-scale tea farmers. Chapter 1 explains the significance of small-scale tea farming for millions of livelihoods in developing countries. As with other crops,

smallholder tea farmers have great difficulties at the marketing stage, and collective marketing is a promising solution. However, I am not aware of any empirical studies examining the impacts of marketing cooperatives on small-scale tea farmers in developing countries.

Benefits from marketing cooperatives depend on product types and their potential markets. For example, staple crops (e.g., rice, potato and wheat) offer little gain from collective action, because they are often locally sold at the farm gate or wholesale markets. Whereas, marketing cooperatives can play a significant role in high-value agricultural products (Markelova et al., 2009). Processed tea products are able to move beyond local markets and penetrate various high-value markets, such as supermarkets, restaurant chains and export markets. Further, since tea has a special cultural value, high-value specialty tea products are popular in many Asian countries. Collective marketing of such specialty tea products to modern retailers could be profitable to small-scale tea farmers. Therefore, tea gives a compelling case study for the economic impacts of marketing cooperative on small-scale farmers.

This study contributes to previous literature by evaluating the impacts of marketing cooperatives on small-scale green tea farmers in Thai Nguyen, Vietnam. As mention in Chapter 2, Thai Nguyen province is a center for specialty green tea production in Vietnam, and collective marketing through cooperatives have re-emerged rapidly. To achieve the research objective, this study analyzes an original sample of 329 smallholder green tea farmers, among which 75 are cooperative members. Propensity score matching (PSM) is applied to account for the self-selection bias in the impact evaluation.

The rest of this chapter is as follows. Section 3.2 specifies the methods for data collection and data analysis. Section 3.3 reports the results, and a discussion of the findings is presented in section 3.4. Section 3.5 concludes and gives implications.

3.2 Methods

3.2.1 Study site and sampling method

The data in the study come from a household survey conducted in July and August 2017. The survey targeted four groups of green tea farmers: members of marketing cooperatives, members of certified tea groups, members of both cooperatives and certified groups, and farmers who were not members of cooperatives or certified groups. A two-step sampling procedure was employed: the first step dealt with the selection of study regions within Thai Nguyen province, and the second addressed household sampling.

Sources:
http://www.bandovn.vn
http://thainguyen.gov.vn

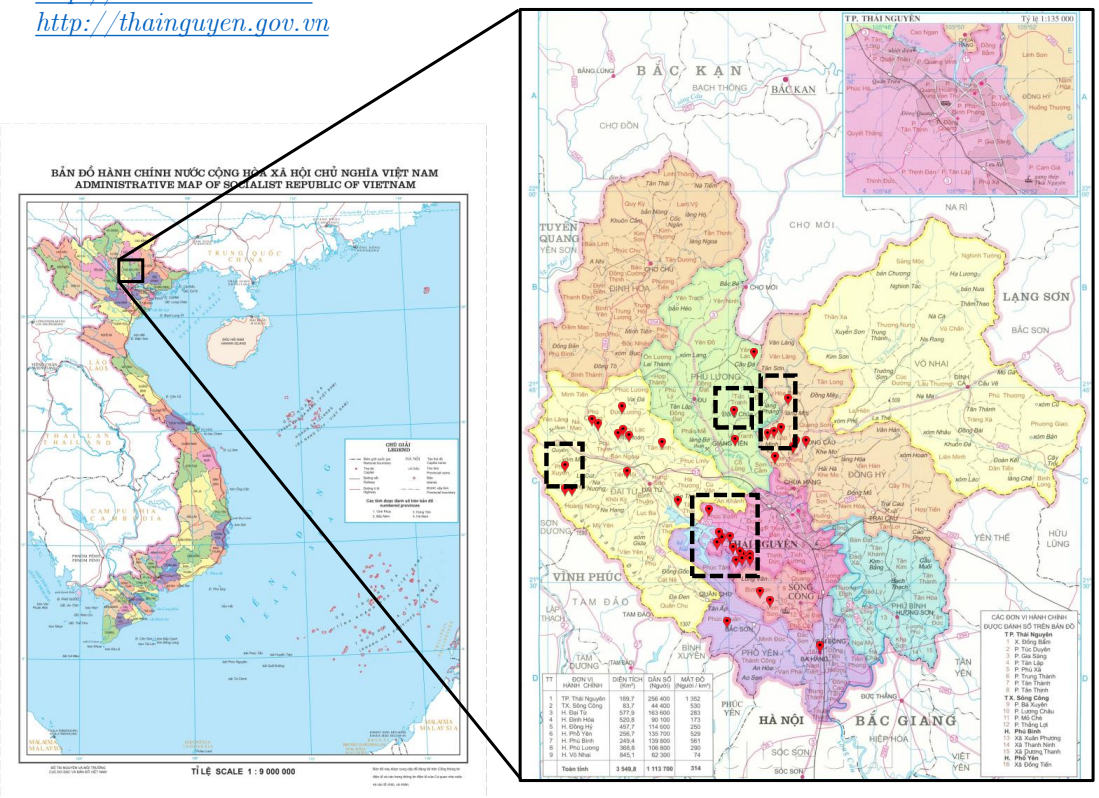


FIGURE 3.1: Four central tea farming regions in Thai Nguyen province, Vietnam

In the first step, I purposively selected the 4 regions with the most famous local specialty green tea brands in Thai Nguyen [1]. Specific locations of the four study sites are illustrated in Figure 3.1. These regions have a long tradition of green tea cultivation, and almost every household owns a tea farm. Importantly, these regions exhibit high densities of tea cooperatives and certified groups. Regarding resource constraints, the region selection is the first step towards identifying a sufficient sample of treated observations to study. The first region, named *Tan Cuong*, is the most well-known in Vietnam for specialty green tea production. The *Tan Cuong* region is located in the outskirts of Thai Nguyen city and consists of three communes: Phuc Xuan, Phuc Triu and Tan Cuong. The other three regions are *Tuc Tranh, La Bang* and *Trai Cai*, which are located in the districts surrounding the city. *Tuc Tranh* and *La Bang* regions each contains one commune with a similar name. *Trai Cai* region has two communes: Minh Lap and Hoa Binh.

When the survey was conducted, there was one UTZ certified cooperative, 3 VietGAP

[1] The term "region" does not denote an administrative level. Regarding formal administrative levels in Vietnam, from the highest to the lowest, they are divided primarily into province, city or district, and commune. Below the commune, the village is a semi-formal administrative level where village leaders are part-time administrators. The locations of the four study regions are identified by communes to which the registered local tea brands refer. Each of the four regions is located within one district, but it might contain more than one commune.

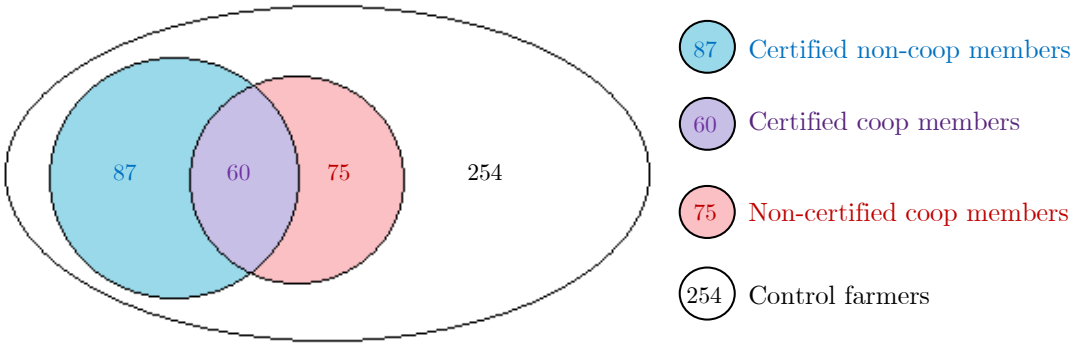
certified cooperatives, 4 VietGAP certified groups and 15 tea cooperatives without any certification operating in the 7 communes mentioned above. The survey successfully accessed totally 18 cooperatives and certification groups: including all 4 certified cooperatives, 4 certified groups, and 10 non-certified cooperatives. Among those farmer organizations, 15 was established within the last 6 years. Two certified cooperatives were established in 2001, but they only started operation in marketing and group certification in 2011. The rest cooperative had VietGAP certification from 2008, but remained largely inactive after the certificate expired in 2010.

The leaders of the cooperatives and certification groups were interviewed based on a questionnaire. According to the interviews, all cooperatives and groups were supplying specialty green tea to domestic markets only. The UTZ cooperative, despite adopting an internationally recognized standard, had few exports to North America in 2014 and 2015. Member lists of the cooperatives and certification groups were also provided by their leaders during the meetings. In addition, village leaders provided household lists for the villages where the cooperative or certification groups are based.

In the second step, households were sampled for face-to-face interviews. Due to the relatively small numbers of cooperative members and certified producers, all of them were interviewed when possible. The control households, which were members of neither a cooperative nor a certification group, were randomly selected from households living in the same villages as the treatment groups based on the lists of villagers (17 villages in total). In every village, I sampled an approximately equal number of control and treatment households regardless of whether the treatment was membership in a marketing cooperative, a certification group, or both. Household representatives were invited to come to village centers where the interviews took place. If a selected household, especially a treated household, was unable to travel to the venue, the investigators visited the home to conduct the interviews.

Household information was collected by seven investigators who were staff at Thai Nguyen University of Agriculture and Forestry using a smartphone-based questionnaire in Vietnamese [2]. In detail, the questionnaire first asked information regarding household rosters, land ownership and membership in cooperatives and certified groups as of the end of April 2017. Importantly, the questionnaire focused on information about household tea production. The household representatives were asked for information on tea farm characteristics, devices used for tea production, detailed tea sales and input use during the last 12 months (i.e., from the beginning of May 2016 to the end of April 2017)

[2] The household survey used ODK Collect, an open source Android application for smartphones, to accelerate the interview process and data entry. Prior to the main survey, a pilot survey was conducted in February and March 2017 with a sample of 107 households. During the pilot, the investigators were trained to use the smartphone-based questionnaire. The questionnaire was also revised according to insights into local tea production gained from the pilot survey.



	Certified	Non-certified	Total
Coop member	60	75	135
Non-coop member	87	254	341
Total	147	329	476

FIGURE 3.2: Data structure

[3]. The household representatives were also asked to report total cash income and costs for other agricultural and non-agricultural livelihoods in the last 12 months. Ownership of important durable assets was also recorded. Each household interview took approximately 35 minutes on average, and the household representatives were given 50,000 VND (approx. 2.5 USD) for taking part in the survey.

3.2.2 Data and variable selection

In total, a sample of 481 households was collected through the household survey. Five households that did not report tea production in the survey period or could not complete important sections of the questionnaire were excluded, leaving a total of 476 households. Figure 3.2 demonstrates the number of households by treatment statuses, i.e. membership in cooperatives and certification groups.

To evaluate the impacts of marketing cooperatives, this study uses a subset of the data to construct treatment and control groups. On one hand, for the treatment group, I only select the 75 non-certified coop members, rather than all coop members regardless of their certification status. This selection is to ensure that the estimated effects can be purely attributed to members of the marketing cooperatives. On the other hand, the control groups consist of 254 non-certified, non-coop households. As a result, we analyzed a subset of 329 households

[3] The decision to consider this period eases farmers' recall of their tea production because the main tea harvesting season starts in early May.

From the data, basic indicators of tea farm performance as outcome variables are selected, covering tea farm size, sales volume, fresh production and farm expenses. Furthermore, I compute tea yield, average selling price and net income from the tea farm for each household and use them as additional outcome variables.

Furthermore, potential covariates, predetermined factors that can affect both treatment status and outcome variables, are chosen from the household characteristics. 16 covariates are selected in total. A detailed description of the selected covariates and the outcome variables is provided in Table A.1 of Appendix A. Among the covariates and outcome variables, eight are clearly unaffected by the treatment, including the city dummy, market distance, family and labor sizes (i.e., family members aged from 15 to 65), the female-headed household dummy, age and education of the household head, and ethnicity of the household head. The rest of the variables are seemingly less exogenous or time-invariant. Thus, I cautiously justify the selection of these variables. Village leadership and agricultural landholdings can be assumed to be time-invariant. Village leaders typically maintain their positions for years. Similarly, landholdings are primarily inherited from previous generations, and agricultural land transactions are very few. A credit dummy is also included as a plausible covariate [4]. The final covariates are a set of separate variables indicating ownership of valuable assets to capture the effects of household wealth. The motorbike ratio (i.e., the number of motorbikes owned by a household divided by family size), car dummy and computer dummy are unlikely to be affected by collective marketing or certification, which has been initiated recently. The number of tea-roasting machines increases only if the household production scale increases dramatically, which is not typically the case for both of the treatments [5].

3.2.3 Data analysis

This study employs PSM to mitigate the self-selection bias associated with the observable covariates (Rosenbaum and Rubin, 1983). The method constructs the counterfactual by matching observations with those of the other treatment status based on their propensity scores, estimated for each observation using a set of observed covariates. Under the unconfoundedness assumption, the average treatment effects can be estimated by averaging the difference in the outcomes of the matched treated and control observations. Average treatment effects on the treated (ATETs) are estimated because of the limited sample

[4] Membership of cooperatives or certification groups may also affect credit demand. Therefore, in the analyses, I dropped the control for the credit dummy in some models. Consistent results were still observed.

[5] One noteworthy limitation is that with the cross-sectional data, it is hard to prove that the covariates that we control for are truly time-invariant or exogenous to the treatment. The covariates are selected based on their selection in previous studies using matching techniques and my qualitative knowledge of the study sites.

size of the treatment group. This study applies a two-step process to obtain estimated ATET for each of the outcome variables. In doing so, I adopt several major recommendations from Imbens and Rubin (2015) and Abadie and Imbens (2016). The following subsections elaborate on the implementation.

a. The first step: Matching to improve balance

The purpose of the first step is to obtain a balanced sample with respect to the selected covariates after matching.

As is standard, I first use the treated and control observations to estimate propensity scores by using Probit models. One critical point here concerns the specification of the Probit models. As suggested in Imbens and Rubin (2015), there is no point in attempting to obtain a value that is as close as possible to the true propensity score. Instead, it is more important to have estimated propensity scores that lead to a balanced matched sample. I therefore specify 10 models with different combinations of covariates to find those with the best matching quality.

Next, the one-to-one nearest neighbor matching technique is applied based on the propensity scores estimated by each Probit model. I apply a caliper of 0.01 to avoid bad matches. Treated units for which no control units can be found within the specified caliper are excluded. Moreover, I employ matching with replacement, meaning that a control observation can be used more than once for matching.

Finally, following Imbens and Rubin (2015), I check the balance under each model after matching by treating selected covariates as pseudo-outcome variables and estimating pseudo-ATETs on them [6]. To examine the statistical significance of the pseudo-ATETs, their standard errors are estimated following Abadie and Imbens (2016) [7]. Good matching should have pseudo-ATETs that are close to zero and statistically insignificant, as this implies the plausibility of the unconfoundedness assumption. Based on such criteria, I select all satisfied models to proceed to the next step

Note that the unconfoundedness assumption is often less plausible when there are unobserved covariates. However, even when unobserved covariates exist, if I select appropriate observed covariates, the back-door criterion could still be satisfied (Pearl, 1995). For example, high motivation for tea farming usually leads to more investment in production assets, which ultimately affects the outcomes of interest. By controlling for the observed

[6] Imbens and Rubin (2015) estimate pseudo-ATEs on covariates after stratification matching. I apply this practice to the one-to-one nearest neighbor matching.

[7] The bootstrap method, which is often used in empirical studies employing PSM, does not provide reliable estimates of the standard error for ATET estimated by nearest neighbor matching (Abadie and Imbens, 2008). The method of Abadie and Imbens (2016) accounts for the fact that the propensity is estimated.

number of tea-roasting machines, which is not likely to be affected by the treatments, I can mitigate the endogeneity caused by unobserved motivation. Thus, it is still possible to identify causal effects by PSM.

b. The second step: Estimating ATETs

For each selected model, the ATETs for the outcome variables are estimated based on equation 2.3 in chapter 2. The term $E[Y(w_i = 1)|W_i = 1, P(X)]$ is estimated by averaging the realized outcomes of the non-certified cooperative members. The counterfactual term, $E[Y(w_i = 0)|W_i = 1, P(X)]$, is estimated by averaging the outcomes of the matched control farmers, $E[Y(w_i = 0)|W_i = 0, P(X)]$. The standard errors of the ATETs are estimated following Abadie and Imben (2016) for further statistical tests.

For each outcome variable, in addition to the ATET estimation using the difference in the means, I also conduct ATET estimation using the difference in the means of the ranks. I rank households based on their values of the outcome variable with a correction for ties using all 476 households in the sample. Those ranks are subsequently used in the ATET estimation instead of ordinary values. Many potential outliers are present in all the outcome variables, as depicted in Figure A.1 in Appendix A. Since the sample size is quite limited, the outliers may significantly affect the variance of the estimators. The transformation into rank outcomes helps improve the efficiency of the estimators, resulting in more power for the statistical tests (Banerjee and Duflo, 2017, chapter 3, pp.87). Estimation of ATETs using rank statistics also offers an extra sensitivity check for the results [8] .

3.3 Results

3.3.1 Descriptive statistics

Table 3.1 reports the results of t-tests for mean differences in the potential covariates and the outcome variables between the non-certified coop members and control groups. There is a substantial imbalance in the selected covariates. First, the difference in the city dummy is a result of the sample selection. Control households were sampled with a slightly higher proportion in city area, i.e., the *Tan Cuong* region. However, because there were only a few non-certified cooperatives in the city, the mean statistics are significantly smaller for the treated group. By contrast, as I will show in chapter 4, certified cooperatives were mostly located in the city. This could suggest a regional effect on the certification status of the cooperatives. I intentionally incorporate the city

[8] However, for labor costs, the ATET estimators using rank statistics are less reliable, because there are many observations with zero labor costs (Banerjee and Duflo, 2017, chapter 3, pp.87).

	Non-certified coop members (n = 75)		Control group (n=254)		Difference	
	Mean	S.D.	Mean	S.D.	Mean	S.E.
Potential covariates						
City dummy (1=yes, 0 = no)	0.31	0.46	0.58	0.49	-0.28***	0.06
Market distance (km)	1.71	0.93	1.98	1.23	-0.28*	0.15
Family size	3.84	1.40	4.00	1.27	-0.16	0.17
Labor size	2.93	0.99	2.85	0.96	-0.09	0.12
Female-headed dummy (1=yes, 0 =no)	0.19	0.39	0.20	0.40	-0.01	0.05
Age of the household head	51.44	9.91	48.32	11.84	3.12**	1.50
Education of the household head (years)	7.88	2.22	7.12	2.55	0.76**	0.33
Kinh ethnic head dummy (1=yes, 0 = no)	0.92	0.27	0.94	0.24	-0.02	0.03
Village leader dummy (1=yes, 0 = no)	0.19	0.39	0.09	0.29	0.09**	0.04
Credit dummy (1=yes, 0 = no)	0.61	0.49	0.50	0.50	0.12*	0.07
Total agricultural land holding (Thousand m2)	8.07	6.02	7.41	7.50	0.67	0.94
Cropland holding (Thousand m2)	4.27	2.86	4.07	2.20	0.20	0.31
Motorbike ratio	0.63	0.34	0.52	0.25	0.11***	0.04
Computer dummy (1=yes, 0= no)	0.32	0.47	0.20	0.40	0.12**	0.05
Car dummy (1=yes, 0= no)	0.04	0.20	0.04	0.19	0.00	0.03
Number of roasting machines	1.33	0.58	1.24	0.73	0.10	0.09
Outcome variables						
Sales value (Mil. VND)	135.00	107.82	91.09	72.52	43.91***	10.76
Fresh production (Ton)	3.55	2.87	2.59	1.73	0.96***	0.27
Tea farm size (ha)	0.34	0.27	0.29	0.18	0.04*	0.03
Productivity (Ton/ha)	11.23	4.61	9.41	4.55	1.83***	0.60
Average price (Mil. VND/ Ton)	38.43	15.52	35.00	12.98	3.43*	1.79
Input costs (Mil. VND)	17.33	12.06	15.74	10.03	1.59	1.38
Labor costs (Mil. VND)	10.32	14.10	4.84	7.41	5.49***	1.23
Net income (Mil. VND)	107.34	91.80	70.51	64.14	36.83***	9.38

** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 3.1: Mean differences: Non-certified coop members vs. Control households

dummy in order to control for the potential regional difference between the *Tan Cuong* and the other three regions.

Differences in the rest household-level covariates imply the self-selected problem. Compared to the control households, coop members live closer to the markets. Their household heads are also older, more highly educated and more likely to have leading positions in the villages. Credit dummy shows higher mean statistics for the treatment group, but it is marginally significant. Although members of the treatment group do not own a significantly larger land area, there are large differences in indicators of asset holdings, including the motorbike ratio and the computer dummy.

In addition to the imbalance in the observed covariates, there could also be an imbalance in the unobserved covariates. For instance, motivation is usually an unobserved factor. Motivated tea farmers are more likely to participate in cooperatives, and their farming performance also might be better than the performance of those with little motivation for tea farming. Furthermore, balance in the knowledge of tea farming, which can positively affect both coop membership and farm outcome, cannot be easily verified.

Regarding the outcome variables, the treated units present significantly higher mean values than the control units on all variables except for the input costs. For instance, the value of the former's tea sales is nearly 1.5 times that of the latter's tea sales. Similarly, fresh production, farm size, productivity and labor costs are significantly larger for the treatment group.

However, households self-selected whether to participate in the cooperative. The differences in the outcomes could result from the initial imbalance in the characteristics between the treated and control households rather than from the effects of the programs themselves. For example, coop members have a higher sales value than the control households because the former are older farmers and so more experienced in tea farming, rather than because coop participation improves their farm sales. In other words, simple mean comparisons of the outcome variables between the two groups lead to heavily biased conclusions about the treatment effects. Thus, to identify causality, I rely on PSM estimators which account for the self-selection in the treatment status.

3.3.2 ATETs of marketing cooperatives

	Before matching (n = 401)		After matching									
			Model 1		Model 2		Model 3		Model 4		Model 5	
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E
City dummy	-0.28***	0.06	**0.00**	**0.08**	**0.00**	**0.08**	**0.07**	**0.08**	**0.06**	**0.08**	**-0.04**	**0.07**
Market distance	-0.28*	0.15	**0.06**	**0.21**	**-0.20**	**0.18**	**0.04**	**0.18**	**-0.04**	**0.20**	**0.31**	**0.20**
Family size	-0.16	0.17	-0.10	0.29	0.14	0.26	-0.32	0.25	-0.15	0.25	-0.10	0.27
Labor size	-0.09	0.12	**0.09**	**0.23**	**0.14**	**0.18**	**-0.01**	**0.20**	**0.01**	**0.19**	**0.14**	**0.20**
Female-headed dummy	-0.01	0.05	0.09	0.07	-0.09	0.08	0.03	0.07	-0.01	0.08	-0.04	0.08
Age of the household head	3.12**	1.50	**3.09**	**2.31**	**0.52**	**1.95**	**0.81**	**1.91**	**-0.48**	**2.14**	**0.07**	**1.89**
Education of the household head	0.76**	0.33	**-0.76**	**0.59**	**-0.02**	**0.52**	**0.04**	**0.46**	**0.04**	**0.45**	**-0.44**	**0.42**
Kinh ethnic head dummy	-0.02	0.03	-0.03	0.05	-0.06	0.05	0.01	0.05	0.06	0.06	-0.03	0.05
Village leader dummy	0.09**	0.04	**0.07**	**0.08**	**-0.03**	**0.07**	**-0.04**	**0.07**	**-0.03**	**0.07**	**-0.03**	**0.07**
Credit dummy	0.12*	0.07	**0.00**	**0.10**	0.08	0.10	**0.06**	**0.09**	**0.04**	**0.08**	**0.14**	**0.10**
Total agricultural land holding	0.67	0.94	0.16	0.12	0.14	0.11	0.04	0.10	-0.09	0.12	0.01	0.12
Cropland holding	0.20	0.31	**0.00**	**0.04**	**0.05**	**0.05**	**0.01**	**0.04**	**0.00**	**0.05**	**-0.02**	**0.05**
Motorbike ratio	0.11***	0.04	**0.03**	**0.05**	**0.03**	**0.06**	**0.07**	**0.05**	**0.07**	**0.05**	**0.08**	0.07
Computer dummy	0.12**	0.05	**-0.07**	**0.10**	**-0.05**	**0.10**	**-0.04**	**0.09**	**-0.04**	**0.09**	0.11	0.08
Car dummy	0.00	0.03	-0.04	0.04	0.02	0.03	0.00	0.03	**0.03**	**0.02**	**0.00**	**0.03**
Number of roasting machines	0.10	0.09	-0.12	0.13	**-0.09**	**0.11**	**0.03**	**0.11**	**0.03**	**0.11**	**0.10**	**0.12**
			67 matches		65 matches		68 matches		67 matches		73 matches	

In each model, boldface numbers indicate corresponding covariates are included in the Probit model.
A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 3.2: Balancing check: Non-certified coop members vs. Control households

Table 3.2 illustrates the results of the first step in the PSM procedure. Among 10 models, five satisfy the selection criteria. In the 5 models, mean differences in covariates that are significantly different between the two groups before matching, such as city dummy, market distance, age and education of the household head, become statistically insignificant after matching. Moreover, for almost all covariates, the magnitudes of the mean differences are also reduced sharply to nearly zero. In some models, the balance in covariates is not much improved, for example, the age and education of the household head in model 1, but the mean differences remain statistically insignificant after matching. I

therefore still consider them as valid models and examine the consistency of the ATETs for each outcome variable across all the five models.

The results of ATET estimation using the differences in means, the second step, are reported in Table 3.3. In general, the estimators lack consistency, especially in the results of statistical tests, across the five models. Membership of marketing cooperatives increases sales value, average price and net income for tea farmers. Nonetheless, the positive values and statistical significance of the estimators fluctuate considerably. For example, the impact on sales value is relatively large, more than 40 Million VND, and significant at 5 percent level in model 1 and model 5. However, in the rest three models, the impact reduces to around 30 Million VND and is only significant at the 10 percent level. Likewise, ATET on average price become insignificant in model 2, although the estimators are significant at more than 5 Million VND/ ton in the rest four models.

	Model 1		Model 2		Model 3		Model 4		Model 5	
	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.
Sales value (Mil. VND)	43.59**	16.22	32.19*	17.72	33.61*	15.14	29.70*	16.36	42.22**	18.13
Fresh production (Ton)	0.61*	0.33	0.63*	0.38	0.45	0.41	0.39	0.42	0.66	0.46
Tea farm size (ha)	0.00	0.03	0.04	0.04	0.14	0.42	0.02	0.45	0.13	0.43
Productivity (Ton/ha)	2.06**	0.93	0.79	0.95	1.00	0.85	0.96	0.82	1.63*	0.87
Average price (Mil. VND/ Ton)	5.64*	3.34	3.51	3.44	5.16**	2.51	5.52**	2.75	5.92***	2.09
Input costs (Mil. VND)	-0.39	2.39	0.05	2.12	0.12	2.02	1.07	2.04	-0.61	2.52
Labor costs (Mil. VND)	5.41**	2.40	4.27*	2.35	4.07*	2.15	3.43	2.47	3.93	2.41
Net income (Mil. VND)	38.57**	13.84	27.87*	15.71	29.41**	12.73	25.20*	13.87	38.91**	15.23
	67 matches		65 matches		68 matches		67 matches		73 matches	

A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 3.3: ATET using mean statistics: Non-certified coop members vs. Control households

I also cannot see any significant and consistent impacts on the rest outcome variables. Positive impacts can be seen fresh production, productivity and labor costs, but in many models, I cannot reject the null hypothesis that they are not different from zero. Meanwhile, ATETs of tea farm size and input costs are small and insignificant in all the five models.

The poor consistency of the estimated ATETs is possibly derived from large proportions of potential outliers in all outcome variables. Therefore, I use the same 5 selected models to estimate ATETs on all outcome variables converted into ranks. Results of this analysis are shown in Table 3.4 As can be seen, even after the rank transformation, consistent estimated ATETs cannot be found for any outcome variables. ATETs on sales value and net income are only significant and positive in model 1 and 5 but become insignificant in the rest three models. Estimated impacts on the other outcomes display more or less similar patterns with those in the analysis using the mean statistics.

	Model 1		Model 2		Model 3		Model 4		Model 5	
	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.
Sales value	66.26**	25.35	39.76	24.33	31.91	23.21	23.33	23.31	51.64**	25.86
Fresh production	39.28	24.52	19.81	21.41	8.75	23.34	-0.86	22.42	29.54	25.43
Tea farm size	-10.31	25.82	0.18	22.89	-11.59	24.66	-22.71	23.59	-0.03	25.68
Productivity	65.60**	28.48	34.70	28.38	30.79	25.16	30.97	24.11	50.01*	25.81
Average price	69.96**	29.83	48.82*	29.35	43.55	27.15	50.85*	28.77	55.24**	23.81
Input costs	-15.70	29.46	-11.84	24.91	-9.68	26.25	-5.19	25.8	-13.11	28.68
Labor costs	57.07**	24.99	39.05	24.54	33.94	23.6	29.44	23.58	27.27	26.2
Net income	71.19**	26.15	45.01*	25.35	33.40	22.25	24.49	22.76	61.00**	25.34
	67 matches		65 matches		68 matches		67 matches		73 matches	

A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 3.4: ATET using mean statistics: Non-certified coop members vs. Control households

To sum up, based on the results of the PSM procedure, I cannot find any clear impacts of marketing cooperatives on the small-scale green tea farmers. Interpretations of the results are discussed in the following section.

3.4 Discussion

The insignificant ATETs estimators could be derived from the insufficient sample size. However, there are also other important explanations for the unclear impacts of the marketing cooperatives on income from small-scale green tea farms. This section discusses two potential reasons, both related to the cooperative membership status.

First, the membership of the marketing cooperative does not necessarily mean active participation in collective marketing. Only 23 among 75 non-certified coop members reported having tea sales through cooperatives. On average, sales via tea cooperatives accounted for 24 percent of the total sales value in the treated group. Especially, the 10 non-certified cooperatives, which consist of 55 among 75 non-certified coop members, had a low or inactive level of collective marketing. Success in the marketing stage often depends heavily on cooperative leaders, who were responsible for finding stable buyers of tea products. The leaders are smallholder tea farmers with limited marketing ability and financial muscle. As a result, a few cooperatives manage to have revenue from collective marketing; many fail to function.

To make the problem worse, the membership is sometimes only nominal. The Cooperative Law requires at least 7 members to establish a farmer cooperative. Since newly established cooperatives are eligible for support from the governments, such as input

subsidy, cooperative founders just list their blood-relative households to satisfy the requirements. Therefore, some cooperative members did not actually have any collective activities.

Second, I select coop membership as a proxy for collective marketing; however, the membership may contain other components. For example, before May 2016 (the starting time for recalling tea production in the survey), 41 among 75 non-certified coop members reported having produced certified green tea. Further, since marketing cooperatives were highly promoted by the government and NGOs, the members also received subsidized processing devices, or agricultural training when the cooperatives were established. Such supports were widely different across the cooperatives.

Because of the two above reasons, coop membership in the study is an intention-to-treat for collective marketing with potential divergence in its components. Subsequently, this study obtains ATETs with a relatively high variance - meaning the statistically insignificant impacts.

These two issues related to accessing the impacts of collective marketing through farmer cooperatives are not exclusive to the study. Previous studies also show inactive participation among cooperatives members. For instance, Fischer and Qaim (2012) found positive impacts on farm income only for members who actively participated in collective marketing through banana cooperatives in Kenya. However, because active participation itself is endogenous, their interpretation of the results and conclusions might be negatively affected. Likewise, Mujawamariya et al. (2013) emphasized the severity of side-selling among members of coffee cooperatives in Rwanda.

Previous studies often defined their treatment as membership of cooperatives (or farmer organizations) so impacts could hardly be attributed to any particular collective activities. For instance, Hao et al. (2018) and Ma and Abdulai (2016) reported positive impacts of cooperative membership on apple farmers in China. Components of the membership were however different across study sites and covered various collective activities: collective marketing, production services, group acquirement of food safety standard. Similarly, studies in Africa (Abdul-Rahaman and Abdulai, 2018; Fischer and Qaim, 2012; Latynskiy and Berger, 2016, e.g.,), membership of cooperative, or farmer organizations, was highly diversified in its components, such as collective input purchase, provision of new technologies, and group marketing.

Hence, I argue that the impact evaluation of marketing cooperatives is prone to mixed results. In addition, the analysis using membership of marketing cooperative as a treatment also says little about whether collective marketing, or other collective activities, is effective for small-scale farmers.

3.5 Conclusions

This study evaluates the impacts farmer marketing cooperatives on income from small-scale green tea farms. It uses data of 329 small-scale green tea farmers in four central regions of tea production in Thai Nguyen, Vietnam PSM is utilized to address the self-selection problem of cooperative membership. The study estimate ATETs on the selected outcome variables, including sales value, fresh production, farm size, productivity, average price, input costs, labor costs and net income. I could not find consistent ATET estimators for any of the outcomes across the models. In addition to the small sample size, I argue that there are two crucial reasons leading to the unclear impacts. The first is a low intensity of member participation in collective marketing through the tea cooperatives; the second is the diversified treatment components of the membership across marketing cooperatives. I also point out that these two issues are rather common in the relevant literature.

Although this study cannot obtain any concrete findings of the impacts of marketing cooperatives tea farmers, based on the discussion, two implications are induced for broad literature about farmer cooperatives. First, beyond the nominal membership, studies should investigate factors encouraging (or hindering) the active participation. To date, there are quite many studies analyzing determinants of cooperative membership (Bernard and Spielman, 2009; Mojo et al., 2017; Wollni and Zeller, 2007, e.g.,) Nonetheless, membership does not equate active participation which is more essential for tangible effects on farm performance. Very few empirical studies quantitatively examine factors affecting how intensively small-scale farmers participate in cooperative activities [9]. One example is the study of Fischer and Qaim (2014); however, their findings, based on regression models, may suffer from bias. Thus, further studies on causal impacts of interventions at individual or group level on farmers' active participation in collective activities are necessary.

Second, impact evaluation of farmer cooperatives should isolate the impacts of specific collective activities. Because different cooperatives usually offer different sets of collective actions, it is hard to attribute the average impacts to any individual components. Given the budget constraint in developing countries, policy-makers and managers of cooperatives often have a great interest in which specific collective activities (or sets of them) are effective for improving the welfare of the members. Thus, whenever possible, future research should shed light on the impacts of a single collective action in order to give substantial policy implications.

[9] Several empirical studies use qualitative methods to address institutional elements facilitating active collective actions among small-scale farms (J. Barham and Chitemi, 2009; Narrod et al., 2009, e.g.,).

This study has some shortcomings. The sample size is small, resulting in a weak power for the statistical tests. Studies with sample size satisfying power calculation, which is rare in current literature, are needed to produce precise conclusions about the impacts of marketing cooperatives. Importantly, membership of marketing cooperatives in this case study also contained group certification of sustainability standards, although the certificates had been expired. This group certification for small-scale farmers, which itself has constituted a significant body of literature, may still affect the estimated ATETs of the marketing cooperatives. Given this limitation and the insight from the second implication, Chapter 4 presents a case study on the impacts of certification groups, where members only focus on acquiring certification standards.

Chapter 4

Impacts of voluntary certification on small-scale farm income

4.1 Introduction

A substantial body of literature analyzes the economic impacts of voluntary certification on small farms in developing countries. Many studies focus on standards for crops with well-established links to export markets. This is straightforward because many international certification schemes were originally designed for crops exported to developed countries (e.g., Fairtrade, UTZ). Moreover, as consumers in export markets apparently place greater weight on food certification than do domestic consumers, it is feasible to assume positive economic effects on the participants.

Research results are mixed (see DeFries et al. (2017) and Oya et al. (2018) and for reviews). For instance, in several cases, the adoption of sustainability standards by export coffee farmers is found to increase their selling prices and/or yields (Arnould et al., 2009; B. L. Barham and Weber, 2012; Chiputwa et al., 2015; Rijsbergen et al., 2016; Valkila and Nygren, 2010; Vellema et al., 2015). Insignificant economic impacts on coffee farms have also been reported (Beuchelt and Zeller, 2011; Giuliani et al., 2017; Jena et al., 2012). A few studies have revealed economic benefits for producers of export fruits (e.g., Handschuch et al., 2013; Holzapfel and Wollni, 2014; Kleemann et al., 2014; Subervie and Vagneron, 2013).

Voluntary certification standards are increasingly popular, even in the domestic markets of developing countries. In many low- and middle-income countries, food systems are undergoing a significant transformation. On the demand side, among the components of agricultural sustainability, food safety is increasingly a concern for domestic customers,

mainly owing to rapidly rising living standards (Mergenthaler et al., 2009b). On the supply side, food standards are more frequently used by supermarkets, which are expanding their reach in many countries, to distinguish their products from those marketed through other retail channels (Berdegué et al., 2005; Henson and Reardon, 2005; Holzapfel and Wollni, 2014). Beyond the penetration of well-known international standards, many national voluntary certification schemes for good agricultural practices (GAP) have been developed by governments in developing countries (e.g., VietGAP, ThaiGAP, ChinaGAP, ChileGAP). As a result, even for food products without a strong connection to export markets, an increasing number of small-scale producers are becoming engaged in certification programs.

However, previous results for certified export crops might not be directly applicable in the domestic market context for several reasons. Domestic consumers, even in metropolises, might still have insufficient knowledge of sustainability standards (My et al., 2017), which constrains the market price premium for certified food products. Furthermore, domestic certification standards are in many cases less stringent than international standards for export crops because the former adopt some more relaxed standards. For example, regarding the utilization of plant protection products, the application of integrated pest management (IPM) is essential for GlobalGAP. However, IPM is only a recommended practice in VietGAP. Together with dubious enforceability due to underdeveloped auditing and sanction systems, consumers many raise concerns about the credibility of certification schemes. Thus, when empirical evidence remains scarce, it is worthwhile to examine the economic benefits of certification standards in the context of domestic markets.

This chapter addresses this literature gap by analyzing the economic impacts of certification standards on small-scale green tea farmers in Thai Nguyen, Vietnam. Unlike Vietnam's tea export products, Thai Nguyen tea farmers produce specialty products which are typically consumed in the domestic market. Due to a long tradition of green tea drinking, these specialty products are highly popular among Vietnamese consumers (Wenner, 2011). This study continues to use the original sample of small-scale green tea farmers in Thai Nguyen. However, I select different subsets of farmers who actively participated in voluntary certification group. Thus, in contrast to the results of chapter 3, clear and consistent impacts of the collective action are expected.

The remainder of this paper is organized as follows. Section 4.2 explains the methods of impact evaluation in detail. Section 4.3 presents the results, and discuss the results is given in section 4.4. Section 4.5 concludes the chapter.

4.2 Methods

To evaluate the economic impacts of voluntary certification on small-scale farms, this case study uses the same data and methods as in Chapter 3. However, a different subset of the data is selected. The PSM procedure is also slightly tailored to the certification status.

In detail, this study still utilizes the original data on 476 small-scale green tea farmers in Thai Nguyen, Vietnam. Among 4 subgroups of farmers, as depicted in Figure 3.2 in Chapter 3, I select only 3 subgroups for further analyses. The first treatment group contains 87 certified non-coop members of 4 VietGAP certified groups. These groups focused exclusively on the acquirement of VietGAP certification. The group members, however, sold their certified tea products individually rather than collective marketing. The second treatment group includes 60 certified cooperative members. As explained in Chapter 3, there is 1 UTZ cooperative with a UTZ and 3 VietGAP. These 60 farmers not only obtained the certification together as groups, but they could also sell products collectively under the brands of their cooperatives. The impacts therefore can be attributed to both certification and collective marketing. I intentionally consider the two treatment groups to examine if there are large differences in their impacts on the outcome variables. The control group is the same as in Chapter 3, which consists of 254 non-certified, non-coop households. In total, this chapter analyses a sample of 401 smallholder tea farmers, including 147 treated and 254 control observations.

This study also selects the identical outcome variables and covariates for impact evaluation of voluntary certification. Outcome variables are still sales value, fresh production, farm size, productivity, average selling price, input costs, labor costs and net income from tea farm. Mean differences in the covariates and outcome variables between the two treated groups (i.e., certified non-coop members, and certified coop members) and the control group are shown in Table A.2 and A.3 in Appendix A.

Lastly, regarding data analyses, I duplicate the two-step PSM procedure in chapter 3 to estimate ATETs. Nonetheless, in addition to analyses using all 401 households, I also run the same PSM procedure but restrict the control observations (control farmers) to the regions where each of the two treatments is available. I incorporate this analysis because certification programs or certified cooperatives are not available in all four regions studied. During the survey period, there were no certified programs in the Trai Cai region. Furthermore, certified cooperatives are only available in the Tan Cuong and La Bang regions. Analysis using regions where the treatments do not exist may fall to account for regional differences between the control and treated households. Therefore, I report ATET results for all models that satisfy the balancing criteria using the full

sample and restricted sample. For each outcome variable, I continue to estimate ATETs on the ordinary values and the rank values. With those variations in sample selection and outcome statistics, I can thoroughly check the consistency of the findings.

4.3 Results

I first report ATET results when treatment is membership in voluntary certification groups. I then show ATET results when treatment is membership in certified cooperatives. In general, results are fairly similar between the two treatments.

4.3.1 Impacts of voluntary certification

Table 4.1 demonstrates the sample balance results for four selected models. There are large mean differences in many covariates before matching, such as city dummy, market distance, family and labor size, landholding, and asset holding. Balance in covariates improves drastically after matching in all the four models. None of the covariates show significant differences after matching.

	Before matching (n = 341)		After matching: Model 1		Model 2		Model 3		Model 4	
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E
City dummy	-0.19***	0.06	-0.09	0.10	-0.10	0.10	**-0.07**	**0.10**	**-0.07**	**0.10**
Market distance	0.89***	0.16	**-0.20**	**0.25**	**-0.17**	**0.23**	**0.10**	**0.25**	**-0.16**	**0.24**
Family size	0.31**	0.16	-0.03	0.26	0.20	0.27	-0.07	0.26	0.14	0.26
Labor size	0.29**	0.12	**-0.23**	**0.20**	**-0.23**	**0.21**	**-0.07**	**0.21**	**0.14**	**0.21**
Female-headed dummy	-0.01	0.05	-0.01	0.08	0.01	0.08	0.03	0.08	-0.01	0.08
Age of the household head	0.04	1.41	**-0.26**	**1.79**	0.64	1.99	**-0.17**	**2.10**	**1.04**	**2.19**
Education of the household head	0.53*	0.31	**0.71**	**0.57**	**-0.01**	**0.48**	**-0.03**	**0.49**	**-0.01**	**0.49**
Kinh ethnic head dummy	0.01	0.03	-0.03	0.02	-0.01	0.05	-0.01	0.03	-0.03	0.04
Village leader dummy	0.08**	0.04	**0.06**	**0.06**	**0.06**	**0.06**	**0.04**	**0.07**	**0.05**	**0.07**
Credit dummy	0.16**	0.06	**0.07**	**0.10**	0.09	0.10	**0.13**	**0.08**	**0.05**	**0.09**
Total agricultural land holding	0.21**	0.09	-0.16	0.16	-0.11	0.14	0.05	0.13	-0.03	0.16
Cropland holding	0.17***	0.03	**-0.02**	**0.06**	**0.02**	**0.05**	**-0.05**	**0.05**	**-0.02**	**0.04**
Motorbike ratio	0.01	0.03	**-0.05**	**0.06**	**0.01**	**0.05**	**-0.05**	**0.06**	-0.01	0.06
Laptop dummy	0.18***	0.05	**0.00**	**0.10**	**0.03**	**0.10**	**-0.10**	**0.10**	**-0.04**	**0.10**
Car dummy	0.02	0.03	**0.03**	**0.04**	**0.04**	**0.04**	**0.01**	**0.04**	**0.01**	**0.04**
Number of roasting machines	0.50***	0.09	**-0.01**	**0.13**	**0.04**	**0.12**	**-0.13**	**0.12**	**-0.14**	**0.15**
			70 matches		69 matches		72 matches		72 matches	

In each model, boldface numbers indicate corresponding covariates are included in the Probit model.
A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
Model 3 and 4 restricts control farmers to communes where the treatment is available.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 4.1: Balancing check: Certified non-coop members vs. Control households

ATETs estimators using ordinary mean statistics from the four models are shown in Table 4.2. Compared to results of marketing cooperatives in Chapter 3, this study shows consistent and positive effects of voluntary certification on small-scale farm performance.

	Model 1		Model 2		Model 3		Model 4	
	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.
Sales value (Mil. VND)	53.23**	22.71	54.78**	22.54	38.51*	21.43	49.45**	21.61
Fresh production (Ton)	0.60	0.41	0.61	0.44	0.16	0.40	0.56	0.40
Tea farm size (ha)	0.03	0.05	0.06	0.04	-0.03	0.05	-0.01	0.04
Productivity (Ton/ha)	0.84	0.88	0.26	0.97	1.41	0.93	1.60*	0.94
Average price (Mil. VND/ Ton)	5.55*	3.30	7.07***	2.70	5.23*	3.15	5.36*	3.08
Input costs (Mil. VND)	2.96	2.52	5.06*	2.63	1.86	2.03	3.49*	2.01
Labor costs (Mil. VND)	7.40***	2.85	8.65***	2.78	6.36**	2.59	7.52**	2.72
Net income (Mil. VND)	42.87**	19.86	41.07**	19.90	30.29	19.23	38.44**	19.18
	70 matches		69 matches		72 matches		74 matches	

A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
Model 3 and 4 restrict control farmers to communes where the treatment is available.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 4.2: ATET results using mean statistics: Certified non-coop members vs. Control households

First, certification improves farmers' sales value, primarily because it results in a higher price for their tea products. In particular, sales value increases significantly by approximately, and the magnitude of the impact varies across models - from around 40 to 55 million VND (equivalent to an increase of 28 - 46 percent compared to the matched control group). Fresh production and tea farm size both have insignificant impacts. Although there is an increase in productivity, it fluctuates across models and is only marginally significant in model 4. By contrast, I find fairly consistent evidence of a higher price for certified farmers. The average price is significantly improved by approximately 5–7 million VND per ton, equal to a 16 - 23 percent increment.

In addition, certified farmers can obtain higher net incomes, despite an increase in production costs. Expenses for fertilizers, pesticides and other materials do not differ significantly for the treated side. However, certification leads to a significant increase in hired labor expenses of approximately 6–9 million VND. Lastly, I find a positive effect of certification on net income from tea farms. This effect is significant and fairly consistent in its magnitude of around 40 million VND in model 1,2 and 4 – equal to a 40 percent increase compared to the matched control group. However, it falls to about 30 million VND and becomes insignificant in model 3.

The small sample size and potential outliers in the outcome variable make the results, particularly those of the statistical test, differ somewhat across models Thus, to further check the consistency of the results, I additionally report ATETs using rank statistics in Table 4.3. Using rank outcome variables, certification shows much more clear trends of its impacts. Positive impacts on sales value, average price, labor costs and net income display a high degree of consistency Whereas, ATETs for the rest outcome variables are insignificant in almost all models.

	Model 1		Model 2		Model 3		Model 4	
	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.
Sales value	57.30**	24.79	65.10***	25.01	56.69**	23.94	69.78**	24.57
Fresh production	24.11	22.35	40.64*	23.91	32.90	24.58	46.29	26.22
Tea farm size	10.44	21.58	29.84	21.90	-1.78	22.67	-1.40	20.56
Productivity	17.66	27.31	0.70	28.07	42.79	27.96	50.88	28.70
Average price	88.03***	29.81	84.94***	28.47	70.75**	29.88	69.49**	28.88
Input costs	37.57	23.82	61.94**	25.83	33.68	23.49	43.95	24.68
Labor costs	64.86**	25.73	76.51***	28.56	61.55**	26.76	70.07**	25.76
Net income	52.91**	26.01	54.77**	25.34	50.06**	25.09	62.13**	25.44
	70 matches		69 matches		72 matches		74 matches	

A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
Model 3 and 4 restrict control farmers to communes where the treatment is available.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 4.3: ATET results using rank statistics: Certified non-coop members vs. Control households

4.3.2 Impacts of certified cooperatives

ATETs of certified cooperative using mean statistics and rank statistics are indicated in Table 4.4 and 4.5 respectively In total, there are 7 models satisfying the balancing criteria. Balance checking for the 7 models are displayed in Table A.4 in Appendix A. Overall, the results are similar to those of certification groups. However, I can see wider fluctuations in the estimated ATETs, typically in the analysis using mean statistics.

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.
Sales value (Mil. VND)	42.93**	20.54	35.97	23.32	51.39**	21.99	56.98*	29.81	48.41	0.13	39.57*	21.94	38.68**	19.12
Fresh production (Ton)	0.55*	0.31	0.31	0.36	0.71**	0.32	0.79**	0.35	0.52	0.16	0.54	0.33	0.53*	0.30
Tea farm size (ha)	0.04	0.04	0.04	0.04	0.04	0.04	0.02	0.05	0.03	0.36	0.01	0.04	-0.02	0.05
Productivity (Ton/ha)	0.86	1.17	0.16	1.20	1.79*	1.08	2.24**	1.03	0.86	0.48	1.59	0.98	2.25**	0.92
Average price (Mil./ Ton)	7.40***	2.70	8.33***	2.28	7.31***	3.10	8.94**	4.51	7.52**	0.06	7.31**	3.14	6.71**	3.10
Input costs (Mil. VND)	3.61	2.21	2.58	2.44	3.27	2.35	2.13	2.55	0.92	0.70	1.33	2.55	0.92	2.49
Labor costs (Mil. VND)	6.71**	2.83	7.63**	3.07	8.17**	3.22	5.66*	3.16	6.17*	0.08	7.15**	2.92	6.73**	2.83
Net income (Mil. VND)	32.61*	18.37	25.77	20.91	39.95**	19.61	49.19*	26.88	41.32	0.15	31.09	19.18	31.04*	16.36
	54 matches		53 matches		52 matches		55 matches		56 matches		53 matches		53 matches	

A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
Model 4 to 7 restrict control farmers to communes where the treatment is available.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 4.4: ATET results using mean statistics: Certified coop members vs. Control households

In detail, according to Table 4.4, certified coop members receive higher sales value, but the impacts are not consistent and insignificant in model 2 and model 5 Fresh production and productivity have significant ATETs in some models, while farm size has ATETs close to zero. The average price has a high consistency of significantly positive ATETs

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.	ATET	S.E.
Sales value	82.17***	29.11	61.57***	29.22	84.16**	28.99	97.05***	31.47	67.75**	31.67	70.81**	31.52	71.51**	25.28
Fresh production	49.32*	27.48	25.27	29.10	58.58**	27.47	69.08**	29.83	44.63	28.60	42.97	28.75	47.19*	24.80
Tea farm size	17.05	26.35	6.65	27.22	8.26	26.79	7.52	30.61	10.24	25.54	-4.21	28.80	-16.69	28.98
Productivity	52.90*	30.56	29.03	31.96	65.88**	30.89	84.47***	30.32	55.59*	31.32	47.51	30.15	80.17**	28.89
Average price	88.88***	25.54	101.00***	22.02	101.78***	24.31	108.00***	27.47	87.32***	27.87	97.40***	25.95	103.00***	23.73
Input costs	24.70	27.00	13.47	31.49	22.96	28.13	13.35	31.71	-0.57	30.80	2.14	28.88	1.46	29.85
Labor costs	32.72	28.73	33.82	27.79	39.64	32.49	34.31	33.07	45.17	31.61	27.86	30.18	27.50	24.90
Net income	80.56***	28.45	59.82***	28.47	83.70**	28.76	102.90***	30.64	77.76***	31.37	69.56**	31.78	74.33***	23.73
	54 matches		53 matches		52 matches		55 matches		56 matches		53 matches		53 matches	

A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
Model 4 to 7 restrict control farmers to communes where the treatment is available.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 4.5: ATET results using rank statistics: Certified coop members vs. Control households

of approximately across the 7 models. There no significant impacts on input costs, while labor cost significantly increases The impact on net income, although being positive, shows a low level of statistical significance in most models.

In Table 4.5, similar impacts as with certification groups after rank transformation can be seen. Sales value, average price and net income all have positive and significant ATETs across 7 models. However, I cannot find any significant ATETs for labor costs, which is possibly due to there are too many zero values in this subgroup analysis. The table also shows significant impacts on fresh production and productivity, although they are not consistent throughout models.

In summary, as with certification groups, this study finds similar positive impacts of certified cooperatives on sales value, selling price, and net farm income. The impacts should however be attributed to both collective marketing via the cooperatives and voluntary certification. Note that the ATETs of the two treatments are not directly comparable. The ATET estimation considers only the counterfactual for the treated group. As indicated in Table A.5 in Appendix A, because there are significant differences in the observed covariates between the two treatment groups (i.e., certified coop members and certified non-coop members), different samples of control households are used to construct the counterfactual. In other words, ATETs for the two treatments are estimated from two samples with significant differences in their background characteristics. Given one outcome variable, a direct comparison of the ATET between the two treatments does not correct for these background differences and therefore might suffer from biases.

4.4 Discussion

Unlike the results of the marketing cooperative in chapter 3, this study can find evident impacts of certification programs. In detail, there are positive effects on selling price, sales and net income. This is consistent with findings from studies that examine export crops in other countries (e.g., Arnould et al., 2009; Subervie and Vagneron, 2013; Valkila and Nygren, 2010; Vellema et al., 2015). Although comparisons are hard to draw, the magnitude of the positive impact on net income – about a 40 percent increase – might be smaller than findings from other studies. For instance, Subervie and Vagneron (2013) found that GlobalGAP certification led to an increment of more than 60 percent in sold quantity for lychee farmers in Madagascar. Certification also doubled net income from raspberry production in Chile (Handschuch et al., 2013).

Compared to membership of non-certified cooperatives – the treatment in chapter 3, membership of certification groups has more favorable conditions for clear economic impacts. First, the issue of inactive participation is less likely. There are no certification groups that only existed on the paper without any practical activities. To obtain the group certification, members were required to actively participate in the training and monitoring process.

Second, impacts of marketing cooperatives are subject to sub-components of membership as well as leader-related characteristics. As explained in chapter 3, those characteristics often differ across cooperatives. By contrast, components of the certification system were fairly constant across groups. The majority of certified farmers - 113 out of 147 - were following VietGAP standards with the similar implementation of the scheme [1]. Group leaders played mostly managing role rather than decided the group effectiveness, as it is the case in marketing cooperative. Because of the two above reasons, this study can obtain significant ATET estimates of certification.

I explore interpretation for important effects of the voluntary certification. Positive impacts on selling price and farm sales could be resulted from higher penetration into high-value markets of certified tea products. Rapid economic development and urbanization are shifting domestic shoppers towards supermarkets, which emphasize the importance of public and private standards (Wertheim-Heck and Spaargaren, 2016; Wertheim-Heck et al., 2015; Fuchs et al., 2011). Such requirements from retailers consequently drive changes upstream in the value chain. Wholesale traders and private companies that supply supermarkets may have a higher demand for tea from certified farms. In addition, certified cooperatives might even have capabilities for engaging in direct supply to

[1] The rest 34 UTZ certified farmers are in certified coop members, for whom I could not isolate impacts of voluntary certification from collective marketing.

modern retailers (Moustier et al., 2010). The high potential for penetration into modern, lucrative markets results in certified farms experiencing higher selling prices and subsequently better farm sales.

Certified farmers may also increase their production of high-quality tea with more stringently selected fresh materials, leading to higher selling prices and sales value, Consumers' preference for certified products is income elastic (Mergenthaler et al., 2009a). Farmers may therefore produce high-quality tea products, which target high-income consumers, more intensively.

The higher costs of hired labor are possibly the result of additional labor needs among certified producers. In the context of specialty green tea production, households typically hire labor for harvesting fresh tea (70 percent of hired labor costs, on average), although neighboring farmers commonly exchange labor with each other during harvest periods. Because of the requirements of the standards (e.g., restrictions on the use of agro-chemicals), the management of certified tea farms is usually more labor intensive than that of non-certified tea farms. Therefore, certified farmers may have less time for labor exchange, which consequently raises the costs of harvesting on their own farm. In addition, the adoption of certification programs could induce farmers to produce specialty tea of high quality, which requires a more selective harvest of fresh leaves and intensive family labor during the processing stage. Hence, significant additional hired labor for the harvest is needed.

4.5 Conclusions

This study analyzes original data on 401 green tea producers in Thai Nguyen to evaluate the impacts of voluntary certification on farm economic indicators. PSM is again applied to estimate ATETs. I carefully check for the balance in the observed covariates after matching to mitigate selection bias.

The results indicate that smallholder tea farmers are able to obtain a higher average selling price by participating in voluntary certification programs. The impact on production is unclear, and farm size and yield exhibit no significant effects. Certified farmers have a significantly higher sales value, primarily owing to the better price they obtain. Input costs are insignificantly affected, while hired labors costs rise sharply. Finally, certification significantly increases the adopters' net farm income. The analyses, where treatment is certified cooperative, yield results consistent with the baseline analysis.

Thus, the findings could first lend evidence-based support to the implementation of voluntary certification standards for specialty green tea production. Although the vast

majority of this product is currently consumed in domestic markets, where there are less-favorable conditions regarding the benefits of food quality and safety standards, small-scale farmers can still receive positive impacts on price, sales and net income. In addition, the positive impacts of certification programs on hired labor costs may potentially imply an employment effect at the local level. Nonetheless, because the demand for hired labor (mainly for harvesting) is quite infrequent and clustered among groups of neighbors, this job-creation effect might be small.

The certified non-coop members include only VietGAP certified farmers. The positive results for the impacts of certification on non-coop farmers suggest that the adoption of VietGAP, a set of domestic voluntary standards, also contributes to better tea farm performance. Hence, the results could support the current Vietnamese government's promotion of VietGAP for specialty green tea production. The adoption of the domestic standards may also serve as preparation for tea farmers to achieve stricter international standards in the future when links to export markets are strengthened.

The results in this chapter have some limitations. Primarily, the matching procedure might not eliminate bias caused by the unobserved covariates. As I could not verify whether those variables become well balanced after matching, the ATET estimator might be vulnerable to self-selection bias. However, I took several steps to ensure the reliability of the findings. I cautiously tested the sensitivity of the estimates using different Probit models. Strong consistency in the results was observed across models.

Moreover, to rigorously check the consistency of the findings, I rely on the coarsened exact matching (CEM) method (Iacus et al., 2012). The CEM method has desirable statistical properties, namely, imbalance bounding and non-violation of the congruence principle, which allow it to generate robust and less-biased inferences. CEM results for the full sample analysis, reported in Table A.6 in Appendix A, are generally consistent with the previous PSM estimators [2].

Finally, the ATET estimator for net income does not exactly reflect the additional profit from certification. There are costs associated with certification (e.g., certification fee and opportunity costs from additional household labor on tea farms) that are not considered in the results. Thus, the net gain from certification could be smaller than the estimated effect on net income.

[2] In this analysis, I pool certified non-coop members and certified coop members into one treatment group. This aggregation is necessary because the sample size is too small for each treatment group. With many observations excluded after coarsened matching, I cannot have enough power for the statistical tests of the estimated impacts (after matching, the sample sizes of certified non-coop members and certified coop members are 23 and 25, respectively).

Chapter 5

Farmers' Preferences of Certification Schemes: A Randomized Conjoint Analysis

5.1 Introduction

Voluntary certification for small-scale farms undergoes gradual development in Vietnam. With support from the government and NGOs, farmer groups under various certification schemes have been established nationwide. Among different schemes, VietGAP, a domestic agricultural certificate, is the most familiar to Vietnamese small-scale farmers.

Although the protocol of VietGAP is regulated by the Ministry of Agriculture and Rural Development, the certification is voluntary and issued to farmer groups by third-party entities [1]. Since the first implementation in 2008, VietGAP has been actively promoted for various agricultural products, from crops to fisheries and animal husbandry. The outreach of the program is nonetheless rather limited. For instance, among about 34,000 registered agricultural farms in 2017, only 1900, equivalent to around 5.5 percent, are VietGAP certified. Surprisingly, the certified planted area for tea is merely 3 percent, although tea is a focused commodity of VietGAP [2]. Thus, measures to improve the participation of smallholder farmers in VietGAP are highly necessary.

Although how to attract small-scale farmers to certification programs is often of great interest, there is a shortage of studies examining this issue. The most significant body of literature evaluated the socio-economic and environmental impacts of certification

[1] The third parties are either state agencies or private companies.

[2] The statistics were collected from the Ministry of Agriculture and Rural Development and the Vietnam General Statistic Office and computed by the author.

schemes (see DeFries et al. (2017) and Oya et al. (2018) for reviews). There are some studies exploring factors, mainly farm, household and contextual characteristics, correlated with the participation decision (Kersting and Wollni, 2012; Handschuch et al., 2013, e.g.,). Because causal interpretations are hardly be inferred from those correlation findings, policy implications are often limited.

Farmers' preference of design attributes of certification schemes plays a crucial role in participation decision. Perceived costs and benefits from the design attributes are components of utility gained from a certification scheme, subsequently allowing farmers to decide whether the program is viable and beneficial. The significance of design attributes has been examined for institutional arrangements involving smallholder farmers, such as contract farming (Abebe et al., 2013; Schipmann and Qaim, 2011), supermarket contracts (Ochieng et al., 2017) and soil conservation (Marenya et al., 2014). Similar studies for certification are scarce.

Meemken et al. (2017) is the only study explicitly tests the impacts of design attributes on farmers' participation in certification programs. Nonetheless, as with the above studies, Meemken et al. (2017) employed a conventional choice experiment with d-optimal design. As mentioned in chapter 2, the causal impacts of the attributes can hardly be estimated in this design.

Thus, to address this gap in the literature on voluntary certification standards, the case study in this chapter applies the new RCA design (Hainmueller et al., 2014) to evaluate causal effects of design attributes on farmer participation. The case study was still conducted in green tea production area in Thai Nguyen, Vietnam. In the randomized conjoint experiment, small-scale green tea farmers were asked to choose whether to engage in hypothetical VietGAP programs. The active development of certification programs for small tea farmers in Thai Nguyen, as mentioned in Chapter 2, offers a contextual validity for the choice experiment.

The rest of this chapter is organized as follows: Description of the study sites, methods for data sampling, choice experiment procedure and data analysis are explained in detailed in section 5.2. Section 5.3 presents results from the randomized conjoint analyses. A discussion of the results is provided in section 5.4, and section 5.5 concludes.

5.2 Methods

5.2.1 Study site and sampling method

a. Study site

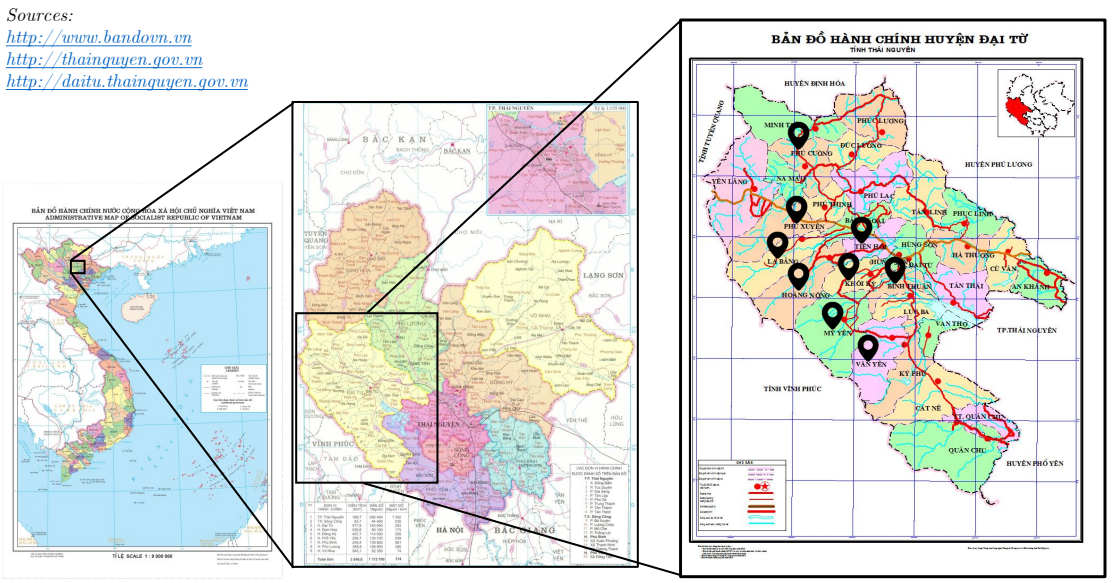


FIGURE 5.1: Study sites in Dai Tu district, Thai Nguyen province, Vietnam

This study is based on a randomized conjoint experiment on Vietnamese small-scale green tea farmers conducted in Thai Nguyen province in July 2018. As aforementioned in chapter 3, certification standards, such as VietGAP, are increasingly familiar among small-scale tea farmers in Vietnam. This case study, hence, is highly suitable for shedding light on farmers' preferences for the certification programs. Thai Nguyen is again chosen due to the large tea production area and a high density of VietGAP certified tea groups.

However, this study only sampled households in one district named Dai Tu, rather than spread the sample throughout the province as in chapter 3 and chapter 4. A detailed map of the study sites is shown in Figure 5.1. Dai Tu district, accounting for about 30 percent of Thai Nguyen's planted tea area, owns the largest green tea farming area in the province. In December 2017, 16 VietGAP groups were newly established in the district, owing to subsidy for certification fee from the local government. In total, Dai Tu has 20 VietGAP groups, the largest number of VietGAP groups in Thai Nguyen. Given the high exposure of local farmers to the VietGAP programs, the district is an ideal study site.

b. Sampling method

This study is a part of a project with three objectives: (i) evaluating the impacts of information provision and subsidy on farmers' adoption of organic fertilizer by a randomized control trial (RCT), (ii) eliciting farmers' preference for the design of VietGAP certification programs by a randomized conjoint experiment, (iii) evaluating the socio-economic impacts of VietGAP on small-scale farmers. The randomized conjoint experiment was conducted in a sub-sample of the project's full sample.

Regarding data collection for the whole project, this study followed a two-step procedure, village sampling and household sampling, to obtain data of 1287 tea-farming households. In the first step, 9 communes were selected, as demonstrated in Figure 5.1, in Dai Tu district which had newly established VietGAP groups in December 2017 [3]. In each commune, I chose all villages with active VietGAP groups and their neighboring villages without active VietGAP groups [4]. In total, 30 villages were selected: four for a pilot survey and 26 for the main survey. In the second step, tea-farming households were randomly selected using villager lists and VietGAP member lists provided by local officers. In each village, the survey team visited 45 households during the main survey and 36 households during the pilot survey [5]. In villages with an active VietGAP group (hereafter, VietGAP villages), the survey included all VietGAP members group due to their relatively small numbers. The remaining households, if any, were randomly selected from the VietGAP non-members. In villages without an active VietGAP group (hereafter non-VietGAP villages), 45 tea-farming households were selected.

Based on the list of 1287 households for the whole project, I further selected a subsample of 750 households to conduct the randomized conjoint experiment on [6]. Due to the small number of the VietGAP members, compared to the non-members, I prioritized the sampling of the former whenever possible. In detail, in VietGAP village, I randomly chose 35 VietGAP members from the member lists if possible. If the certified group size was less than or equal to 35, all members joint the choice experiment. Further, I selected around 40 percent of the VietGAP non-members on the project list in both VietGAP and non-VietGAP villages. As a result, I chose 750 households for the randomized conjoint experiment. Among which, 301 was VietGAP members and 449 was non-members.

All selected households, regardless of their participation in the conjoint experiment, was home-visited by the investigators [7]. The household representatives must be family members who regularly made main decisions regarding tea farm production. If the household

[3] The purpose of this commune selection is to collect farm information before the intervention, which is fundamental for the third objective of the project. I initially chose 10 communes, but only got permission to conduct the project in 9 communes indicated by black location marks in Figure 4.1 (namely, Binh Thuan, Tien Hoi, Khoi Ky, Phu Xuyen, Van Yen, My Yen, Phu Cuong, Hoang Nong and La Bang).

[4] In Hoang Nong Commune, I conducted the experiment and survey only in villages with VietGAP tea groups following a request from the local government.

[5] The number of sampled households in each village was not always as planned due to availability of the selected households or the insufficient number of tea farming households in that village.

[6] I did not conduct the conjoint experiment on the whole project sample because of resource constraint. One important constraint was that in each village the survey must be finished within one day. This was to prevent information spillover, a requirement of the RCT.

[7] 12 investigators who were students and staff in the Thai Nguyen University of Agriculture and Forestry get engaged in the survey. In a two-day training, they were carefully instructed about how to carry out the RCT, the conjoint experiment and household survey using a smartphone-based questionnaire. Before the main survey, a pilot survey was conducted in 4 villages when the investigators were practically trained. The investigators were always divided into two teams of six. The two teams operated in two neighboring villages simultaneously on a single day.

representatives were not available during the visiting day, alternative households, which were prepared in advance on the list, was selected as substitutes [8].

5.2.2 Randomized conjoint analysis

a. Selection of design attributes

A certification scheme is a package of requirements and benefits. Changes in those attributes might significantly improve (or hinder) the uptake of the program. This study purposively selected five attributes of the certification program and tested their impacts on the participation of the small-scale tea farmers. Table 5.1 shows a list of chosen attributes and their definitions. Levels of each attribute are demonstrated in Table 5.2, where the Level 1 – the baseline level – corresponds the status quo of current VietGAP program in the study sites. This section justifies the choice of the five attributes.

No.	Attributes	Explanation
1	Certification fee	Fee for a two-year certification period (VND/Sao or VND/ha)
2	Record keeping	Whether keeping record of purchasing and using input materials, harvest and sales is mandatory or not
3	Application of organic fertilizer	A requirement for applying bio-compost on tea farm
4	Free shipping for organic fertilizer	Whether household have free shipping of bio-compost or not for their VietGAP group purchase
5	Delayed payment for organic fertilizer	How many days household can delay payment of bio-compost for their VietGAP group purchase

TABLE 5.1: Definitions of selected attributes

No.	Attributes	Level 1	Level 2	Level 3	Level 4	Level 5
1	Certification fee	0	VND 36,000 /Sao (VND 1 Mil./Ha)	VND 72,000 /Sao (VND 2 Mil./Ha)	VND 144,000 /Sao (VND 4 Mil./Ha)	VND 288,000 /Sao (VND 8 Mil./Ha)
2	Record keeping	Mandatory	No			
3	Application of organic fertilizer	Not mandatory	Harvest-based with chemical fertilizers combinable	Only organic fertilizer allowed		
4	Free shipping for organic fertilizer	No	Yes			
5	Delayed payment for organic fertilizer	No	30 days	60 days		

TABLE 5.2: Levels of selected attributes

[8] The lists of alternative households included non-selected households in the village were sorted randomly.

The first attribute is *certification fee*. Payments from the farmers are necessary to cover a third-party's costs such as initial farm inspection, training and monitoring. An increase in the fee obviously reduces the outreach of the scheme. However, very few studies investigated the sensitivity of small farmers to this very tangible costs. Such negligence could be due to the fact that the certification fee is heavily subsidized by NGOs or governments in many cases. The certification costs of the active VietGAP groups in the study sites were also fully supported by the local government. Nonetheless, it is still crucial to examine how farmers react to different fee levels so as to design better subsidy and fee-sharing programs.

The second attribute is a requirement of *record keeping*. Documentation of used inputs, harvests and sales is a foundation for traceability of the certified products, which in turn might improve consumers' trust in the labels. In addition, farmers may believe that record-keeping is conducive to the effective management of their production. Meemken et al. (2017) indeed found a positive effect of record-keeping on the participation rate. However, keeping a sufficient and credible record is notoriously challenging, even for highly educated farmers. Hence, the impact of this attribute remains ambiguous.

The next three are hypothetical attributes related to organic fertilizer. Soil degradation due to the overuse of chemical fertilizer is prevalent in tea and other crops farming in Vietnam (Nguyen, 2017). Combination of organic fertilizer with the chemical one is recommended to mitigate the environmental damage caused by the latter and sustain soil fertility (Duan et al., 2016; Ji et al., 2018). Sustainability certification scheme has a potential role to play in escalating the proper utilization of fertilizer [9]. Hence, I additionally included new hypothetical attributes related to the application and purchase of organic fertilizer. The first is a requirement of *application organic fertilizer*. I specified three levels as shown in Table 5.2. The second level is a usual recommendation from producers of organic fertilizer, while the third one is an extreme case where farmers can only use organic fertilizers for tea farming. The other two are benefits that farmers can obtain when purchasing organic fertilizers from their certification group, namely *free shipping* and *delayed payment*. Although those services are rarely provided in reality, there are rooms for the incorporation. Certification always relies on the establishment of farmer organizations (FOs). Hence, in addition to quality assurance, the FOs can introduce services related input purchases to make the best use of their collective action (Poulton et al., 2010). I expect that those new services attract more farmers into the certification program.

[9] International certification schemes, such as GlobalGAP and UTZ, have stringent guidelines for the application of fertilizers. In its official document, VietGAP also recommends farmers to limit the use of chemical fertilizer while increase using organic fertilizer.

Lastly, although it is not included in Table 5.1 and 5.2, I also test the impact of price premium on farmers' participation. The price premium is the most tangible benefits for farmers to join an agricultural institution. Hence, the elasticity of farmers to premium levels is often examined in literature (Meemken et al., 2017; Ochieng et al., 2017). I specified 5 levels of premium per 1 kilogram of certified dried tea: 0 VND; 5,000 VND; 10,000 VND; 20,000 VND; 40,000 VND. Those levels are decided based on the results of the previous studies about the impacts of the certification on tea selling price. It is noteworthy that the premium levels were not randomized at choice task level but at the respondent level. The premium levels were assigned randomly to respondent joining the choice experiment and were fixed across all choice tasks of a respondent. As such, the price premium could be regarded a scenario treatment for the choice experiment [10].

b. Experiment procedure

750 households joining in the randomized conjoint experiment follow a three-step procedure:

(1) an RCT on household purchase of organic fertilizer,

(2) a randomized conjoint experiment on preference for hypothetical VietGAP scheme,

(3) a questionnaire-based interview for information on household tea production and other income sources in 2017.

Elaboration of the RCT step is skipped because it is out of the scope of this study. In brief, households were assigned randomly to three groups: the control group, information treatment group and subsidy group. The outcome of interest is the respondents' immediate decision on purchasing an organic fertilizer product offered by the project. After this decision-making, they continue to the randomized conjoint experiment.

This study constructed a scenario where one household decides whether to join hypothetical VietGAP programs. First, to maintain the respondent's full understanding of VietGAP, the investigators briefly introduced the purpose and main requirements of VietGAP [11]. The respondent was then asked: *"If there are hypothetical VietGAP programs with following features, we would like to know whether your household want to join the programs or not"*. The choice tasks, as an example is shown in Figure 5.2, were presented.

[10] Certification fee and price premium are both pecuniary attributes. If both of them are randomly assigned at the choice task level, the respondents might get confused easily. Therefore, I randomized certification fee at the choice task level, while the premium was randomized at the household level and remained unchanged across all choice tasks of a household. Before each choice task, the investigators were required to mention the price premium again.

[11] In all selected communes, there were active VietGAP groups, and VietGAP training was also conducted by local officers. Hence, the respondents usually had a decent knowledge of the program. Before the introduction, the investigators confirmed whether a household was a member of any current active VietGAP group. The non-members were given a more detailed introduction of the program.

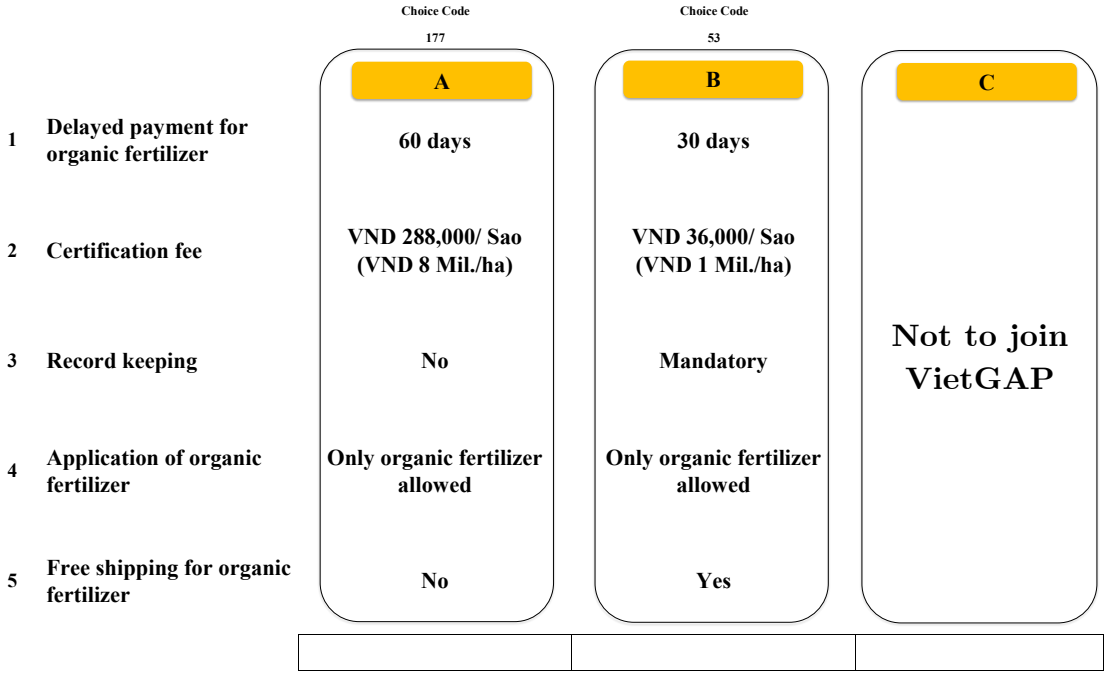


FIGURE 5.2: An example of a choice task

Each choice task contained 3 alternatives: A and B were to join hypothetical VietGAP programs with corresponding attributes, while C meant not to join the program. The investigators explained thoroughly the meaning of each attribute in alternative A and B. Importantly, hypothetical levels of the price premium for participation in VietGAP programs were introduced. If the respondent chose either A or B, their certified tea would be purchased at the market unit price of the non-certified tea plus the premium.

In every choice task, levels of the five attributes in alternative A and B were fully randomized following Hainmueller et al. (2014). Order of the attributes was also randomized by households to eliminate any ordering effects. However, for one household, price premium level was fixed across all choice tasks.

After confirming the respondent's complete understanding of the scenario, the investigators asked him/her to rank the three options. The investigators first asked the respondent to name the alternative s/he liked the most, which is numbered 1. After that, among the rest two options, the respondent was asked to choose which s/he preferred, numbered 2. The rest option was numbered 3. Each respondent had to finish 5 choice tasks.

5.2.3 Data analysis

Based on the regression procedure in chapter 2, AMCEs of all attributes are estimated. Because there are three alternatives in total in each choice task, there are two choice

results. In external choice, the choice outcome takes on the value 1 ($Y_{ijk} = 1$) if a hypothetical VietGAP program (alternative A or B) is preferred to no-participation (alternative C), and 0 otherwise. In internal choice, $Y_{ijk} = 1$ if a hypothetical VietGAP program is preferred to the other VietGAP alternative in the same choice task, and 0 otherwise. Since the main objective is to examine how the design attributes affect the participation in VietGAP programs, this section only reports results of external choice. Results for internal choice are shown in Appendix B.

In addition to design attributes, this study also estimates the impacts of the price premium on the choice outcome. Because the levels of the price premium is a random scenario for all choice tasks, their impact on the choice probability of VietGAP can be estimated by a similar linear regression. Standard errors of these estimators are also clustered by respondents as the premium levels are randomly assigned at the respondent level. I then compare the impacts of price premium and that of the certification fee. The former implies for farmers' willingness-to-accept (WTA) of a VietGAP program; the later reflects their willingness-to-pay (WTP). Although estimation of WTP and WTA is beyond the scope of this study, I quantitatively test the difference in the impacts of the two pecuniary features.

Finally, this study estimates conditional AMCEs see heterogeneity in the impacts of the attributes. In detail, I first estimate AMCEs conditional of VietGAP membership. VietGAP members and non-members are different in their experience of the certification program as well as other background characteristics. Hence, it is compelling to investigate if there are differences in the preferences between the two groups. Further, because the randomized conjoint experiment was conducted after the RCT in the first step, one may concern that AMCEs estimators are affected by the treatments of the RCT. The two treatments, 50% subsidy and information, are designed to support the trial purchase of an organic fertilizer product. They therefore might affect treated farmers' preferences of attributes related to organic fertilizer. AMCEs conditional on RCT treatments are estimated to investigate such interaction.

5.3 Results

5.3.1 Descriptive statistics

Table 5.3 indicates mean comparisons in household characteristics between the collected sample for this study and that of chapter 3 and 4. First, there are some statistically significant differences in demographic variables. Households in the new sample have a

Variable	Survey 2018 (n = 745)		Survey 2017 (n = 476)		Mean diference	
	Mean	S.D.	Mean	S.D.	Mean	S.E.
Subsidy dummy	0.34	0.48				
Information dummy	0.34	0.48				
Current VietGAP member dummy	0.40	0.49				
Age of the respondent	47.03	10.74				
Education level of the respondent (years)	7.52	2.32				
Female respondent dummy	0.49	0.50				
Head dummy	0.56	0.50				
Distance to the nearest market (km)	1.89	1.20	2.02	1.27	-0.13*	0.07
Family size	3.84	1.37	4.06	1.30	-0.22***	0.08
Age of the household head	49.99	10.90	49.07	11.00	0.93	0.64
Education level of the household head (years)	7.18	2.36	7.42	2.46	-0.24*	0.14
Female-headed dummy	0.12	0.33	0.19	0.39	-0.06***	0.02
Annual cropland holding (ha)	0.09	0.10	0.09	0.10	-0.01	0.01
Perennial cropland holding (ha)	0.35	0.27	0.36	0.25	0.00	0.02
Tea farm size (ha)	0.33	0.24	0.34	0.23	-0.01	0.01
Motorbike ratio	0.51	0.30	0.55	0.27	-0.05***	0.02
Computer dummy	0.10	0.30	0.28	0.45	-0.18***	0.02
Car dummy	0.03	0.17	0.05	0.22	-0.02***	0.01

** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE 5.3: Mean difference in household characteristics of the two samples

slightly smaller size and are less likely to be female-headed. Differences in the education level of household head and market distance are only marginally significant.

Second, land holdings are very similar between the two samples, while asset holdings reveal considerable differences. Households in the recent data are worse off regarding all indicators of asset holdings, including motorbike ratio, computer dummy, and car dummy. This is reasonable since Dai Tu is an economically disadvantaged district in Thai Nguyen province.

Due to the above differences, the sample might not well represent the population of smallholder tea farmers in Thai Nguyen province but are more specific to tea farmers in Dai Tu district.

5.3.2 AMCEs of certification attributes

Results of AMCEs for the external choice analyses are illustrated in Figure 5.3 [12]. Specifically, the certification fee has a strong and negative effect on VietGAP participation. An increase in the fee from zero to 1 million/ ha reduce joining likelihood by nearly 7 percentage points on average ($p < 0.01$). From that level, every doubling of the fee additionally leads to an average drop of around 6 percentage points in the choice probability of the VietGAP program ($p < 0.01$). Removal of mandatory record keeping has an insignificant impact on joining VietGAP, which indicates record keeping does not necessarily prevent smallholder farmers from producing certified products

[12] Values of estimated coefficients are shown in table B.1 in the Appendix

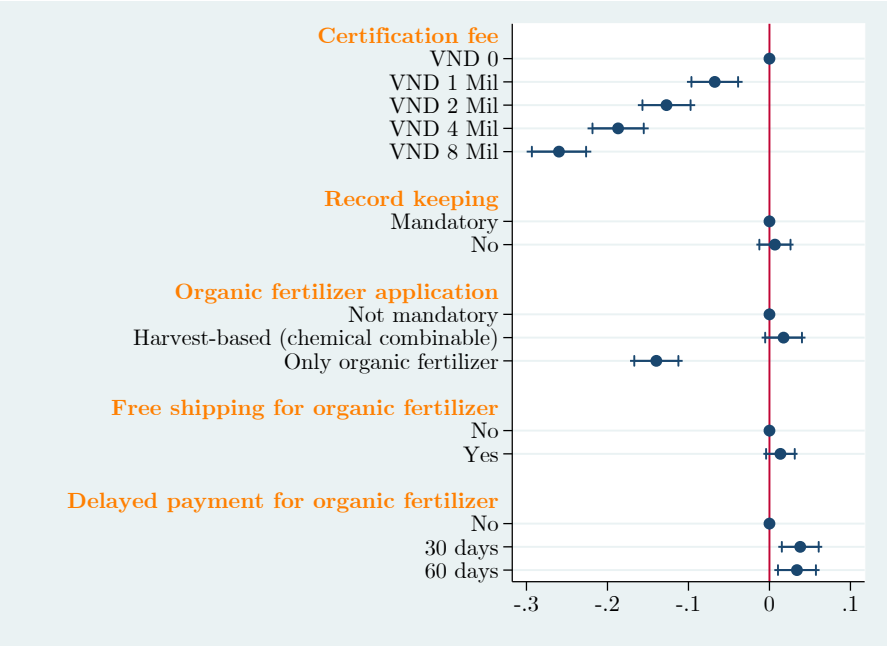


FIGURE 5.3: AMCEs for external choice

In addition, attributes related to organic fertilizer reveal statistically significant effects on VietGAP choice. Although harvest-based application combined with chemical fertilizer does not lead to any significant changes in the external choice, it has a marginally positive impact of about 2.5 percentage points in the internal choice ($p < 0.1$). By contrast, the extreme requirement of only using organic fertilizer for tea farming strongly reduces the choice likelihood of VietGAP by 15 percentage points or so ($p < 0.01$). Moreover, free shipping for organic fertilizer purchased through VietGAP groups does not significantly make VietGAP more attractive than the opt-out. Whereas, delayed payment options do have a positive impact of around 3.5 percentage points ($p < 0.05$).

Figure 5.4 demonstrates a comparison between the impact of the certification fee and that of the price premium on external choice. The average productivity of tea farmers in the sample is approximately 1.8 dried ton/ha/year [13]. Therefore, a minimum premium of 5,000 VND/ dried kg would be more than enough to cover a fee of 8 Million/ ha over a 2-year period of the certificate. However, insignificant impacts of the price premium levels can be seen from the figure. Only when the premium rises to 40,000 VND/ dried kg that it has a positive impact of about 8 percentage points ($p < 0.05$). Meanwhile, as explained above, farmers' choice of VietGAP is highly sensitive to increases in VietGAP fee. A fee level of 8 Million VND/ha reduces participation probability by nearly 26 percent ($p < 0.01$). Thus, the results highlight a considerable gap between the impacts of the two pecuniary attributes.

[13] This is roughly equivalent to fresh productivity of 9 ton/ha since it usually takes 5 kg of fresh tea to produce 1 kg of dried one.

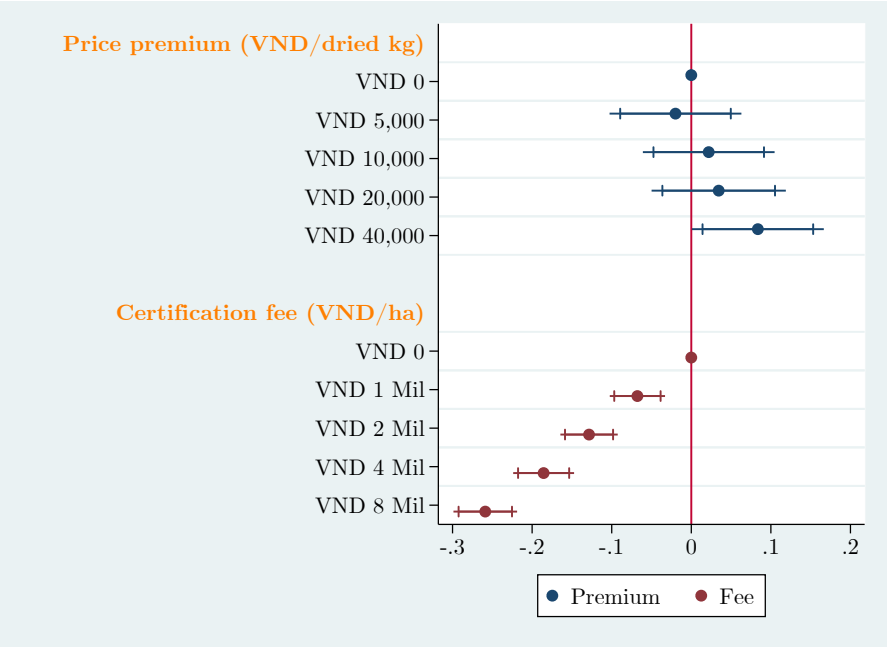


FIGURE 5.4: External AMCEs: Price premium vs. Certification fee

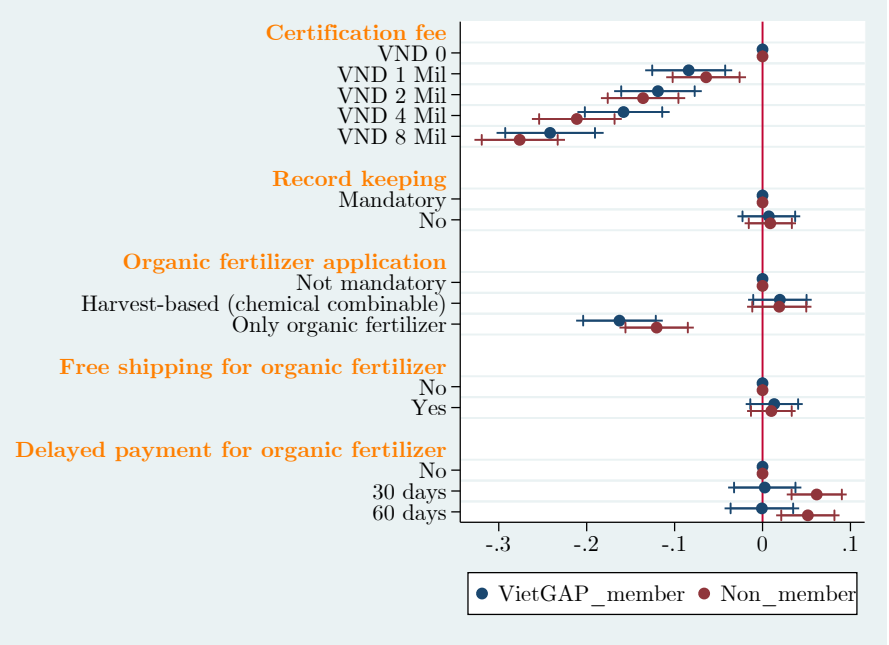


FIGURE 5.5: Conditional AMCEs on VietGAP membership

5.3.3 Conditional AMCEs

External AMCEs of the certification attributes conditional on VietGAP membership are indicated in Figure 5.5. Overall, impacts are almost similar between the two groups. The only significant difference is in the impact of delayed payment for organic fertilizer purchased through VietGAP group. For the current VietGAP members, impacts of 30-day and 60-day delays are close to zero. Meanwhile, for the nonmembers, both levels

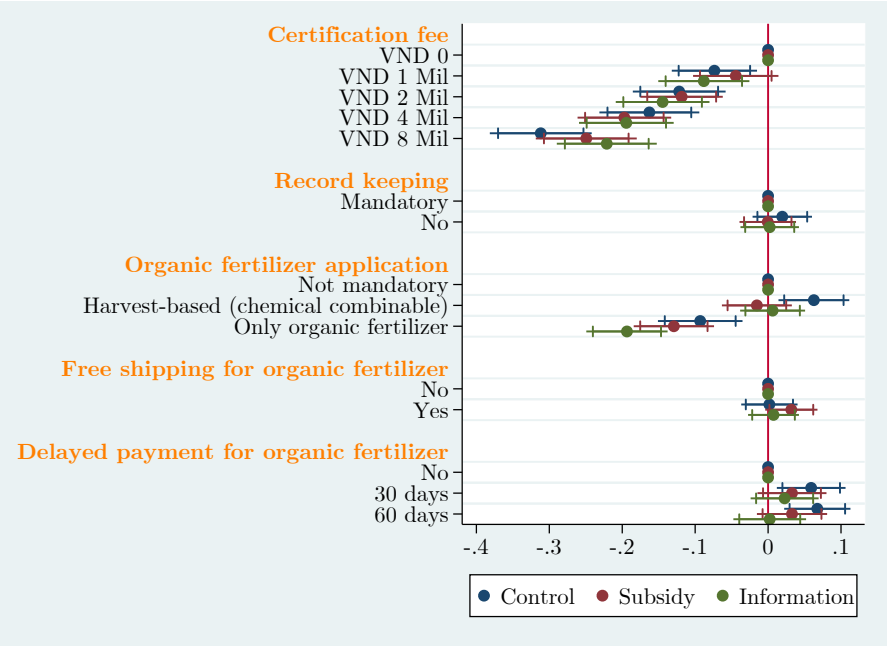


FIGURE 5.6: Conditional AMCEs on RCT treatments

show positive impacts of 6 and 5 percentage points respectively. I also ran a regression model incorporating interaction terms between levels of delayed payment and VietGAP membership to confirm the statistical significance of the differences. Results of the regression model are shown in Table B.2 in Appendix B.

Lastly, Figure 5.6 describes AMCEs conditional on RCT treatment status for external choice. The requirement of applying organic fertilizer is the attribute which shows significant interactions with the RCT treatments. The direction of the interaction effects however contradicts the expectation. Since RCT treatments increase the order of the organic fertilizers [14], I anticipated them to have positive interactions with the VietGAP requirement of applying organic fertilizer. Nonetheless, while harvest-based application increases the choice of VietGAP by about 7 percentage points in the control group, its positive impact significantly diminishes and becomes indifferent from zero in both subsidy and information treatment groups. Likewise, compared to the control group, sole application organic of fertilizer has a more negative impact on VietGAP participation in the two treatment groups [15].

[14] I confirmed the positive impacts of both RCT treatments on the order probability and order amount of the organic fertilizer using statistical tests and regression models.

[15] Significant and negative coefficients of the interaction terms with harvest-based application, shown in Table B.3 in the Appendix, are found for both subsidy treatment ($p < 0.05$) and information treatment ($p < 0.1$) The negative interaction term between only-organic-fertilizer and information treatment is also statically significant ($p < 0.01$).

5.4 Discussion

The results show significant impacts of the selected attributes on VietGAP participation. This section discusses the interpretation of the estimated results and justifies their relative magnitudes.

It can be easily recognized that the certification fee is the most influential factor. This finding partially helps explain a very high dropout rate of certified members once the local government ceases subsidy for the VietGAP fee. Although there were no available statistics at either provincial or national level, during the survey, few VietGAP groups renewed their license after the end of their subsidized period. The large gap in the impacts between the certification fee and the price premium further emphasizes the problem. Farmers usually have to pay for the fee at the beginning of the certification process. Even the hypothetical profit gain from the premium can fully cover the initial payment, it generally cannot compensate for the negative impacts of the former. Strict budget constraint and heavily discounted future benefits of small farmers are possible interpretations. Another reason might come from farmers' skepticism about a guaranteed premium which did not exist in reality.

In addition, there is potential to incorporate attributes related to organic fertilizer in VietGAP scheme. While an extreme requirement of using only organic fertilizer is obviously not acceptable, harvest-based application combined with chemical fertilizers may not deprive the participation. The latter even shows positive effects in some analyses. It is understandable since many respondents had partly realized the damages of overusing synthetic fertilizers by the time of the survey. Supplementation of organic fertilizer was also widely recommended. VietGAP, with a principle goal of achieving sustainable agriculture, can provide a systematic motivation for the combined application of fertilizers. Moreover, higher participation can be achieved through benefits related to group purchase of organic fertilizer. Delayed payment tends to have more consistent positive effects than free shipping. Due to significant improvement in road systems and fertilizer outlets, shipping fee might not constitute a significant part of the fertilizer price. However, rescheduled payment is reasonably preferred by farmers with restricted budgets.

Finally, this section explores the reasons behind the heterogeneity in the estimation of the AMCEs. Compared to the nonmembers, VietGAP members only differ significantly in their preference for delayed payment for organic fertilizers. However, such a difference could not be solely attributed to the membership itself. Because the VietGAP participation is self-selected by a household, there are various confounders of the membership

status [16]. For example, the negative interactions are possibly due to the better wealth status of the members.

In contrast, the RCT treatments are completely randomized, so causal interpretation is plausible. Findings from marketing studies could explain the unexpected negative interactions between the RCT treatments and the hypothetical requirement of applying organic fertilizers. Accordingly, although both information and subsidy treatments successfully encouraged the trial purchase of organic fertilizer, their promotional effects on choice of VietGAP scheme with mandatory application of organic fertilizer subject to unfavorable conditions. In particular, a regular application of organic fertilizer in a 2-year period of VietGAP is a strict requirement for farmers, and there is no certainty about its efficiency. Promotions on a feature which consumers have an uncertain preference of can hurt choice probability of a product (Simonson et al., 1994). Similarly, Darke and Chung (2005) argued a negative perception of the product caused by price promotion when its quality is not assured. Moreover, the procedure of the experiments might have probabilized the negative interactions. Immediately after receiving the treatments and making a decision on trial purchase, the respondents were asked to choose VietGAP plans with the potential obligation of using organic fertilizer. This might unexpectedly provoke a misunderstanding among the treated groups that the investigators strategically enforced them to buy the organic fertilizer in the long-term. As a result, they avoided VietGAP plans with organic fertilizer application required.

5.5 Conclusions

To conclude, this study investigates smallholder farmers' preferences of a certification program. A randomized conjoint experiment was conducted on 745 small-scale green tea farmers in Thai Nguyen, Vietnam. The experiment requires farmers to decide whether to participate in hypothetical VietGAP programs for tea production. Attributes are randomly assigned to each option (profile), consisting of *certification fee, record keeping, application of organic fertilizer, free shipping for organic fertilizer, and delayed payment for organic fertilizer. Price premium* of the certification scheme were randomly assigned at the household level. The study shows three important findings. First, the certification fee has a very strong negative impact on participation decision. Second, harvest-based application of organic fertilizer does not reduce the participation probability. Third, delayed payment for organic fertilizer can slightly enhance participation.

[16] Using the current sample, I ran t-tests to examine differences in background characteristics between the VietGAP members and the non-members. As with the results in Chapter 3, I found significant differences in demographics, land holdings and asset holdings between the two groups.

The findings of this study could give policy-makers and certification entities insightful implications for the design of certification schemes for groups of small-scale farmers in general.

From the second and the third findings, certification entities could possibly include supplementation of organic fertilizer in the scheme with payment benefits for the members. Combined application of organic and synthetic fertilizer, a sustainable farming practice, can be incorporated into the protocol for certified production. As it is required in well-known international standards, such as GlobalGAP, fertilizer application must be based on soil conditions and in consultation with experts. Therefore, certification bodies may collaborate with agricultural experts to prescribe a proper mixture ratio of organic and non-organic fertilizers based on local soil conditions, before requiring compliance from the farmers. At the same time, delayed payment for group purchase of organic fertilizers can be introduced by certification parties. Agreements on input purchase with input suppliers are one of the plausible services offered farmer groups (Poulton et al., 2010). Such collective purchase of agricultural inputs was emerging in the study sites, where government bodies acted as a facilitator for the connection between farmer groups and input providers. Certification parties also have the capacity to substitute the governments' role in such multilateral agreements.

However, based on the first findings, policies dealing with certification fee are crucially important. The large initial fee could heavily prevent small farmers from joining the certification programs which, although, might improve selling prices and farm income later. Low demand caused by large initial costs is also seen for other agricultural services such as crop insurance (Casaburi and Willis, 2018). To reduce the cost burden, a prevalent approach is subsidization from governments or NGOs. Nonetheless, this could make a sustainability certification program itself become unsustainable and distort the production of certified commodities. Other sustainable solutions to the problem caused by the certification fee are highly necessary. Agreements on sharing of certification fee with wholesale buyers or a combination of public and private financing of certification are also promising alternatives (OECD, 2018). In addition, based on the findings of a positive impact of delayed payment for the purchase of organic fertilizer, the same implication could be applied for the certification fee. For instance, rescheduled payment of certification fee, such as monthly or annual installment payment, could reduce the financial burden effectively for the participants.

One major shortcoming of this study is about the validity of farmers' stated preference. There are a range of causes for the biased choice in the survey, such as hypothetical bias, social desirability bias and other cognitive bias (Krosnick and Judd, 2014; Schwarz, 1999). As such, their stated preference in the survey might differ from the revealed preference

when they make the actual choice in reality. However, the recent work of Hainmueller et al. (2015) demonstrated that conjoint analyses have the possibility to reflect real-world behavior. This study also followed their recommendation in using paired conjoint design to maintain the credibility of the stated choice. The study sites – 9 communes in Dai Tu district – also have the favorable conditions for the conjoint experiment due to the high familiarity of farmers with VietGAP program. Therefore, reliability of the stated preference could not be a severe issue of the experimental results.

Chapter 6

Conclusion

6.1 Summary of findings

This dissertation makes original contributions to a central research question: *How do small-scale farmers benefit from collective action?*. The dissertation shows three research gaps, corresponding to three research questions, in the two strands of literature on collective action among small-scale farmers. Those research gaps are addressed with three case studies on small-scale green tea farmers in Thai Nguyen, Vietnam.

In detail, the dissertation contributes to knowledge of how collective action affects income of small-scale farmers – the first large strand of literature on collective action. Chapter 3 evaluates the economic impacts of collective marketing through farmer cooperatives on income of smallholder tea farmers. Although tea is a highly important product for small farmers in many developing countries, we know little about the impacts of collective marketing on tea farmers. Chapter 3 therefore contributes to knowledge on collective marketing by analyzing a sub-sample of 329 farmers from a total sample of 476 smallholder tea farmers in Thai Nguyen. Sample data comes from a household survey in 2017 which uses mixed strategies. All member of cooperatives and certification groups are included if possible, while non-members are sampled randomly. The treatment is defined as membership in non-certified cooperatives, implying that collective marketing is the principal collective action among cooperative members. PSM is employed to mitigate bias caused by the self-selection of the cooperative membership. However, across different PSM models, this case study cannot find conclusive impacts of cooperative membership on the income from tea farming. A plausible and important reason is that collective marketing is inactive for many cooperative members. Another interpretation is the high divergence in other components of cooperative membership, such as past certification and technical assistance.

By contrast, chapter 4 shows significant economic impacts of group certification on smallholder tea farmers in Thai Nguyen. Thai Nguyen green tea products are principally consumed in the domestic markets – a compelling context examined by very few studies on certification standards. Thus, the case study makes an important contribution to the literature on the impacts of certification programs for groups of smallholder farmers. In this chapter, from the same sample of 476 small tea farmers in Thai Nguyen, this study selects a different sub-sample of 401 farmers and continue to apply the same PSM procedure as in chapter 3. Results show that adoption of group certification significantly increases sales, selling price and net income. Labor costs are also higher for certified tea farmers.

Lastly, Chapter 5 contributes to the second strand of literature in factors influencing farmer participation in collective action. The case study is based on an RCA on 750 small-scale tea farmers in Thai Nguyen. The methods allow estimating causal effects of design attributes on farmer participation in hypothetical certification programs (VietGAP). Despite their importance, very few studies examine how design attributes of certification schemes affect farmer participation. Results indicate that the requirement of combined application of organic and chemical fertilizer, a recommended practices for maintaining soil health, does not lead to a significant reduction in participation. In addition, when this requirement is packaged with delayed payment for organic fertilizer purchase, participation rate can be enhanced. Importantly, despite the availability of price premium, the certification fee is a major barrier preventing tea farmers from produced certified food products

6.2 Further discussion

In addition to the discussions the three core chapters, by combining their findings, I discuss further implications for central research question as well as for policies related to collective action among small-scale farmers.

First, from finding of chapter 3 and chapter 4, the economic benefits that small-scale farmers receive from collective action appear ambivalent. Collective action, by definition, covers various activities, and those activities could differ greatly across farmer cooperatives. Moreover, membership in farmer cooperatives does not mean active participation in collective activities. Consequently, when studies evaluate impacts of the cooperative membership – a bundle of different components with different active status, results could be highly diverged. It is also difficult to attribute impacts to any single collective activities, or services, offered by the farmer organizations. Thus, it is recommended to look at farmer organizations focusing on specific one or one set collective activities, as the

study in Chapter 4, to have evident results and policy implications [1]. Similar calls for separating impacts of individual interventions could also be seen in other studies (e.g., Oya et al., 2018) Further, in addition to impacts of the membership *per se*, impacts of active participation worth further analyses (Fischer and Qaim, 2012).

Second, member contribution is a major issue for the realization of benefits from collective action among smallholder farmers. Based on the findings of Chapter 4 and Chapter 5, even when group acquirement of certification is beneficial to small-scale farmers, certification costs may heavily constrain farmers' participation. There is considerable evidence of positive economic impacts of voluntary certification standards on small-scale farmers, as shown in Chapter 4. However, Chapter 5 reveals that loss in participation rate caused by costs can far surpasses gain resulted from a higher price premium. There are also studies reporting that production of certified food can hardly be maintained without substantial support for costs (e.g. Kersting and Wollni, 2012). The same problem can be applied for other collective activities which require large initial costs such as collective processing and storage. It is common that low member' activity deteriorates collective marketing as somewhat reflected in Chapter 3 and in other case studies (Latynskiy and Berger, 2016; Fischer and Qaim, 2014). Thus, one critical challenge for development agencies as well as leaders of farmer organizations lies in encouraging small-scale farmers to pool their resources together.

6.3 Limitations and future research

The findings in this dissertation are subject to two major limitations. The first limitation is in the impact evaluation conducted in Chapter 3 and 4. The PSM procedure might not have thoroughly addressed bias caused by the self-selection of membership in marketing cooperatives and certification groups. The unconfoundedness assumption – the key assumption of PSM – might not be fully satisfied in observational studies. I therefore have made several attempts to assure the reliability of the findings, including a careful balance checking of the covariates and consistency checking of the ATETs across different models. However, to have precise causal inference, future studies should employ methods with less risk of bias such as difference-in-differences or instrumental variables. Such studies are scarce in the current literature (Rijsbergen et al., 2016; Roy and Thorat, 2008). RCT is undoubtedly the best method to see the causal impacts, yet there have been no RCT studies on either collective marketing or certification groups.

[1] However, it is noted that the results of chapter 3 and chapter 4 are not directly comparable because different control observations were used to estimate the ATETs in the PSM procedure. Besides, the insignificant ATETs in chapter 3 does not mean that marketing cooperatives have no effects on farm income. Therefore, the findings from the two chapters do not imply that certification programs are effective in improving small-scale farm income while marketing cooperatives are not.

In addition to the method of impact evaluation, outcome variables examined Chapter 3 and Chapter 4 are only related income from tea farming in a one-shot survey. Participation in marketing cooperatives or certification groups typically leads to farmers' specialization in producing one agricultural product. Despite an increase in income from specialized products, income from other livelihoods could be negatively affected, resulting in ambivalent impacts on total household income (Vellema et al., 2015). Further, the economic impacts of farmer organizations are likely to depend on their operation period. The cross-sectional data in this dissertation does not offer rich enough information to heterogeneous impacts based on the age of the marketing cooperatives or certification groups. Hence, comprehensive future studies which examine broader and longer-term outcomes are necessary.

The second major limitation is about the external validity of the results. The findings from three case studies in this dissertation could be limited to the population of small-scale green tea farmers in Thai Nguyen, Vietnam. Extrapolation of the findings should cautiously consider differences in crop production and characteristics of the small-scale farmers. For example, there are various differences in tea production between the North and the South of Vietnam. Small farmers in the northern region often specialize in producing green tea and follow traditional farming and processing methods. Meanwhile, farmers in the southern region also produce black tea, and they are seemingly more open to the application of new farming methods. Thus, one should take those characteristics in consideration when applying findings of this study to the southern region of Vietnam. Besides, small-scale tea producers in this study mostly supply to domestic markets. Benefits from and participation in collective action could be dissimilar in context with strong links to international markets. Effects of contextual factors on the impacts of collective action are primarily scrutinized in qualitative studies (Oya et al., 2018). It is interesting to have quantitative studies that compare the impacts of a collective activity across food products or regions with distinct characteristics.

Appendix A

An appendix for chapter 3 and 4

Variables	Description
Potential covariates	
City dummy	1 if the household is in Tan Cuong commune; otherwise 0
Market distance	Distance from household to the nearest village market (km)
Family size	Total number of household members
Labor size	Total number of household members who age from 15 to 65
Female-headed dummy	1 is the household is female-headed; otherwise 0
Age of the household head	Age of the household head
Education of the household head	Years of education of the household head (years)
Kinh ethnic head dummy	1 if the household head is Kinh ethnic, which is a major ethnic group; otherwise 0
Village leader dummy	1 if the household head has a position in local governing bodies; otherwise 0
Credit dummy	1 if the household took out a loan from local banks within the last 5 years; otherwise 0
Total agricultural land holding	Includes cropland holding and forest land holding (ha)
Cropland holding	Total area of land available for crop cultivation owned by the household (ha)
Motorbike ratio	The number of owned motorbike divided by family size
Computer dummy	1 if the household possesses a computer or laptop; otherwise 0
Car dummy	1 if the household possesses a car or truck; otherwise 0
Number of roasting machines	Total number of tea roasting machines owned by the household
Outcome variables	
Sales value	Total revenue from selling tea products in the last 12 months (Million VND)
Fresh production	Physical amount of fresh tea production during the last 12 months (Ton)
Tea farm size	Area of cultivated tea farm (ha)
Productivity	Fresh production divided by tea farm size (Ton/ha)
Average price	Sales value divided by fresh production (Million VND/Ton)
Input costs	Costs of fertilizers, pesticides, herbicides and plantlets in the last 12 months (Million VND)
Labor costs	Costs of hired labor in the last 12 months (Million VND)
Net income	Sales value deducted by input costs and labor costs (Million VND)

Table A.1: Description of covariates and outcome variables

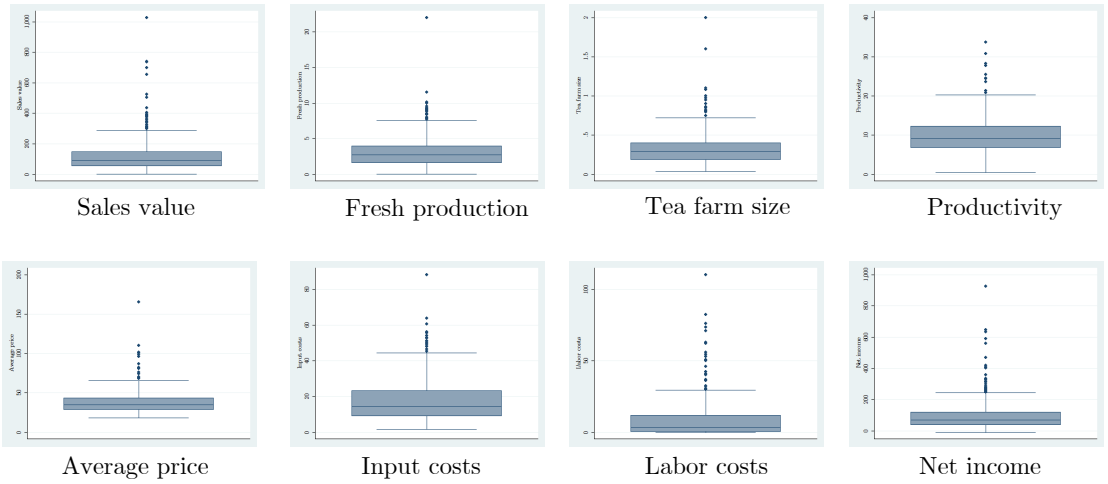


FIGURE A.1: Box graphs of the outcome variables

	Certified non-coop members (n = 87)		Control group (n=254)		Difference	
	Mean	S.D.	Mean	S.D.	Mean	S.E.
Potential covariates						
City dummy (1=yes, 0 = no)	0.39	0.49	0.58	0.49	-0.19***	0.06
Market distance (km)	2.87	1.36	1.98	1.23	0.89***	0.16
Family size	4.31	1.26	4.00	1.27	0.31**	0.16
Labor size	3.14	1.02	2.85	0.96	0.29**	0.12
Female-headed dummy (1=yes, 0 =no)	0.18	0.39	0.20	0.40	-0.01	0.05
Age of the household head	48.37	9.79	48.32	11.84	0.04	1.41
Education of the household head (years)	7.66	2.35	7.12	2.55	0.53*	0.31
Kinh ethnic head dummy (1=yes, 0 = no)	0.94	0.23	0.94	0.24	0.01	0.03
Village leader dummy (1=yes, 0 = no)	0.17	0.38	0.09	0.29	0.08**	0.04
Credit dummy (1=yes, 0 = no)	0.66	0.48	0.50	0.50	0.16**	0.06
Total agricultural land holding (ha)	0.95	0.69	7.41	7.50	0.21**	0.09
Cropland holding	0.58	0.29	4.07	2.20	0.17***	0.03
Motorbike ratio	0.53	0.23	0.52	0.25	0.01	0.03
Computer dummy (1=yes, 0=no)	0.38	0.49	0.20	0.40	0.18***	0.05
Car dummy (1=yes, 0= no)	0.06	0.23	0.04	0.19	0.02	0.03
Number of roasting machines	1.74	0.62	1.24	0.73	0.50***	0.09
Outcome variable						
Sales value (Mil. VND)	173.04	129.42	91.09	72.52	81.96***	11.23
Fresh production (Ton)	4.34	2.33	2.59	1.73	1.76***	0.24
Tea farm size (ha)	0.48	0.26	0.29	0.18	0.19***	0.03
Productivity (Ton/ ha)	9.86	4.47	9.41	4.55	0.45	0.56
Average price (Mil. VND/ Ton)	38.37	13.03	35.00	12.98	3.37**	1.61
Input costs (Mil. VND)	22.82	12.88	15.74	10.03	7.08***	1.34
Labor costs (Mil. VND)	14.33	16.55	4.84	7.41	9.49***	1.31
Net income (Mil. VND)	135.90	113.95	70.51	64.14	65.38***	9.91

** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE A.2: Mean differences: Certified non-coop members vs. Control farmers

	Certified coop members (n = 60)		Control group (n=254)		Difference	
	Mean	S.D.	Mean	S.D.	Mean	S.E.
Potential covariates						
City dummy (1=yes, 0 = no)	0.87	0.34	0.58	0.49	0.28***	0.07
Market distance (km)	1.31	1.04	1.98	1.23	-0.67***	0.17
Family size	4.23	1.36	4.00	1.27	0.24	0.18
Labor size	3.05	1.08	2.85	0.96	0.20	0.14
Female-headed dummy (1=yes, 0 =no)	0.17	0.38	0.20	0.40	0.03	0.06
Age of the household head	50.25	9.93	48.32	11.84	1.93	1.65
Education of the household head (years)	7.78	2.44	7.12	2.55	0.66*	0.36
Kinh ethnic head dummy (1=yes, 0 = no)	0.93	0.25	0.94	0.24	0.00	0.04
Village leader dummy (1=yes, 0 = no)	0.15	0.36	0.09	0.29	0.06	0.04
Credit dummy (1=yes, 0 = no)	0.43	0.50	0.50	0.50	-0.06	0.07
Total agricultural land holding (ha)	0.80	0.77	7.41	7.50	0.05	0.11
Cropland holding (ha)	0.48	0.23	4.07	2.20	0.07***	0.03
Motorbike ratio	0.64	0.30	0.52	0.25	0.12***	0.04
Computer dummy (1=yes/ 0=no)	0.45	0.50	0.20	0.40	0.25***	0.06
Car dummy (1=yes/ 0= no)	0.12	0.32	0.04	0.19	0.08**	0.03
Number of roasting machines	1.47	0.83	1.24	0.73	0.23**	0.11
Outcome variable						
Sales value (Mil. VND)	158.90	168.22	91.09	72.52	67.81***	14.08
Fresh production (Ton)	2.99	1.83	2.59	1.73	0.41	0.25
Tea farm size (ha)	0.33	0.22	0.29	0.18	0.03	0.03
Productivity (Ton/ ha)	9.90	4.30	9.41	4.55	0.49	0.65
Average price (Mil.VND/ Ton)	48.20	19.87	35.00	12.98	13.20***	2.09
Input costs (Mil. VND)	17.23	14.01	15.74	10.03	1.50	1.56
Labor costs (Mil. VND)	13.34	20.83	4.84	7.41	8.51***	1.62
Net income (Mil. VND)	128.32	148.35	70.51	64.14	57.81***	12.43

** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE A.3: Mean differences: Certified coop members vs. Control farmers

	Before matching (n = 314)		After matching													
			Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E	Mean	S.E
City dummy	0.28***	0.07	**0.04**	**0.04**	**0.02**	**0.06**	**0.00**	**0.06**	**-0.02**	**0.08**	**0.04**	**0.08**	**0.08**	**0.08**	**0.06**	**0.09**
Market distance	0.67***	0.17	**-0.06**	**0.21**	**-0.24**	**0.22**	**-0.16**	**0.23**	**-0.07**	**0.22**	**0.09**	**0.20**	**0.00**	**0.22**	**-0.09**	**0.22**
Family size	0.24	0.18	0.24	0.28	0.26	0.25	0.31	0.29	0.16	0.28	0.36	0.25	0.49	0.32	0.19	0.30
Labor size	0.20	0.14	**0.09**	**0.19**	**-0.04**	**0.20**	**0.13**	**0.23**	**-0.05**	**0.19**	**0.00**	**0.22**	**0.32**	**0.20**	**0.09**	**0.23**
Female-headed dummy	0.03	0.06	-0.02	0.10	0.02	0.08	0.02	0.09	0.02	0.08	0.00	0.08	-0.02	0.09	-0.02	0.08
Age of the household head	1.93	1.65	**1.24**	**2.17**	**0.58**	**2.38**	**-0.75**	**2.69**	0.13	2.29	0.64	1.97	**-1.62**	**2.45**	**-1.28**	**2.50**
Education of the household head	0.66*	0.36	**-0.02**	**0.60**	**-0.26**	**0.56**	**-0.06**	**0.63**	**0.38**	**0.57**	**-0.25**	**0.56**	**0.55**	**0.62**	**-0.02**	**0.53**
Kinh ethnic head dummy	0.00	0.04	0.00	0.06	-0.04	0.05	-0.02	0.06	0.02	0.06	0.00	0.06	0.02	0.06	0.02	0.06
Village leader dummy	0.06	0.04	0.02	0.08	**0.00**	**0.08**	0.00	0.08	0.05	0.06	-0.05	0.08	0.04	0.08	0.00	0.08
Credit dummy	-0.06	0.07	**-0.02**	**0.11**	**-0.06**	**0.10**	**-0.02**	**0.11**	0.00	0.11	-0.11	0.10	0.17	0.12	**0.11**	**0.11**
Total agricultural land holding	0.05	0.11	-0.10	0.15	-0.17	0.16	-0.17	0.18	-0.01	0.15	0.02	0.17	-0.05	0.15	-0.13	0.18
Cropland holding	0.07**	0.03	**0.00**	**0.04**	**-0.02**	**0.05**	**0.00**	**6.00**	**-0.03**	**0.05**	**0.01**	**0.04**	**0.02**	**0.05**	**-0.03**	**0.05**
Motorbike ratio	0.12***	0.04	**0.02**	**0.05**	**-0.03**	**0.06**	**-0.02**	**0.06**	**0.00**	**0.05**	**0.00**	**0.06**	**-0.01**	**0.05**	**0.00**	**0.05**
Computer dummy	0.25***	0.06	**-0.07**	**0.08**	**-0.09**	**0.09**	**-0.06**	**0.08**	0.13	0.10	**0.04**	**0.09**	**0.08**	**0.09**	**0.09**	**0.08**
Car dummy	0.08**	0.03	-0.06	0.07	**0.04**	**0.06**	**0.08**	**0.05**	**0.00**	**0.07**	**0.05**	**0.07**	**0.04**	**0.06**	0.04	0.06
Number of roasting machines	0.23***	0.11	**-0.06**	**0.17**	**-0.08**	**0.16**	**0.00**	**0.15**	**-0.04**	**0.18**	0.09	0.15	**-0.11**	**0.18**	**0.02**	**0.17**
			54 matches		54 matches		52 matches		55 matches		56 matches		53 matches		53 matches	

In each model, boldface numbers indicate corresponding covariates are included in the Probit model.
A caliper of 0.01 is applied for one nearest neighbor matching based on propensity score.
Model 4 to 7 restrict control farmers to communes where the treatment is available.
** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE A.4: Balance checking: Certified coop members vs. Control farmers

	Certified non-coop members (n = 87)		Certified coop members (n = 60)		Difference	
	Mean	S.D.	Mean	S.D.	Mean	S.E.
Potential covariates						
City dummy (1=yes, 0 = no)	0.39	0.49	0.87	0.34	-0.48***	0.07
Market distance (km)	2.87	1.36	1.31	1.04	1.56***	0.21
Family size	4.31	1.26	4.23	1.36	0.08	0.22
Labor size	3.14	1.02	3.05	1.08	0.09	0.18
Female-headed dummy (1=yes, 0 =no)	0.18	0.39	0.17	0.38	0.02	0.06
Age of the household head	48.37	9.79	50.25	9.93	-1.88	1.65
Education of the household head (years)	7.66	2.35	7.78	2.44	-0.13	0.40
Kinh ethnic head dummy (1=yes, 0 = no)	0.94	0.23	0.93	0.25	0.01	0.04
Village leader dummy (1=yes, 0 = no)	0.17	0.38	0.15	0.36	0.02	0.06
Credit dummy (1=yes, 0 = no)	0.66	0.48	0.43	0.50	0.22	0.08
Total agricultural land holding (ha)	0.95	0.69	0.80	0.77	0.16	0.12
Cropland holding (ha)	0.58	0.29	0.48	0.23	0.10**	0.04
Motorbike ratio	0.53	0.23	0.64	0.30	-0.11**	0.04
Computer dummy (1=yes/ 0=no)	0.38	0.49	0.45	0.50	-0.07	0.08
Car dummy (1=yes/ 0= no)	0.06	0.23	0.12	0.32	-0.06	0.05
Number of roasting machines	1.74	0.62	1.47	0.83	0.27**	0.12

** 10% significant level, ** 5% significant level, *** 1% significant level*

TABLE A.5: Mean differences: Certified non-coop members vs. Certified coop members

	Certified farmers vs. control farmers					
	Model 1		Model 2		Model 3	
	ATET	S.E.	ATET	S.E.	ATET	S.E.
Sales value (Mil. VND)	48.81***	15.38	44.06***	14.33	38.33***	14.31
Fresh production (Ton)	0.47*	0.25	0.35*	0.21	0.31	0.21
Tea farm size (Ha)	0.02	0.02	0.00	0.01	0.01	0.01
Productivity (Ton/Ha)	0.54	0.54	0.63	0.53	0.51	0.53
Average price (Mil.VND/ Ton)	6.41***	2.23	6.37***	2.24	5.10***	2.21
Input expenditure (Mil. VND)	0.03	1.52	-0.51	1.38	0.84	1.40
Labor expenditure (Mil. VND)	5.85***	1.82	5.37***	1.73	4.85***	1.75
Net income (Mil. VND)	42.93***	13.65	39.20***	12.94	34.33***	12.92
	n = 227 (82 treated and 145 control after coasened matching)					

The three models are different in control variables in the regression after coarsened exact matching

TABLE A.6: ATET results with CEM

Appendix B

An appendix for chapter 5

	Coef.	S.E
Certification fee		
VND 1 Mil	-0.07***	0.02
VND 2 Mil	-0.13***	0.02
VND 4 Mil	-0.19***	0.02
VND 8 Mil	-0.26***	0.02
Record keeping		
No	0.01	0.01
Application of organic fertilizer		
Harvest-based (chemical combinable)	0.02	0.01
Only organic fertilizer	-0.14***	0.02
Free shipping for organic fertilizer		
Yes	0.01	0.01
Delayed payment for organic fertilizer		
30 days	0.04***	0.01
60 days	0.03**	0.01
Constant	0.71	0.02
n	7418	

10% significant level, ** 5% significant level, * 1% significant level*
Standard errors are clustered at household level

TABLE B.1: Regression coefficients of AMCEs for external choice

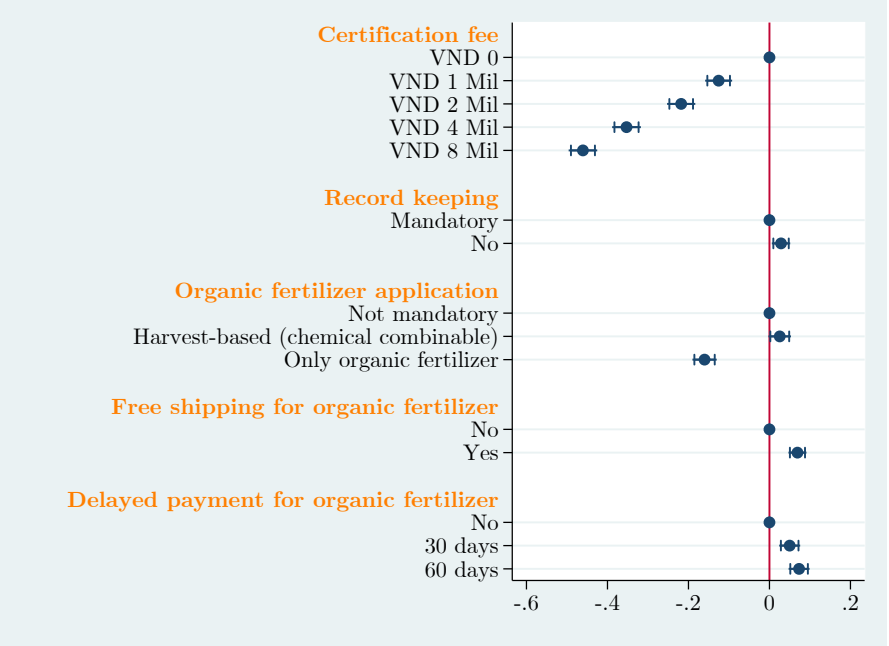


FIGURE B.1: AMCEs for internal choice

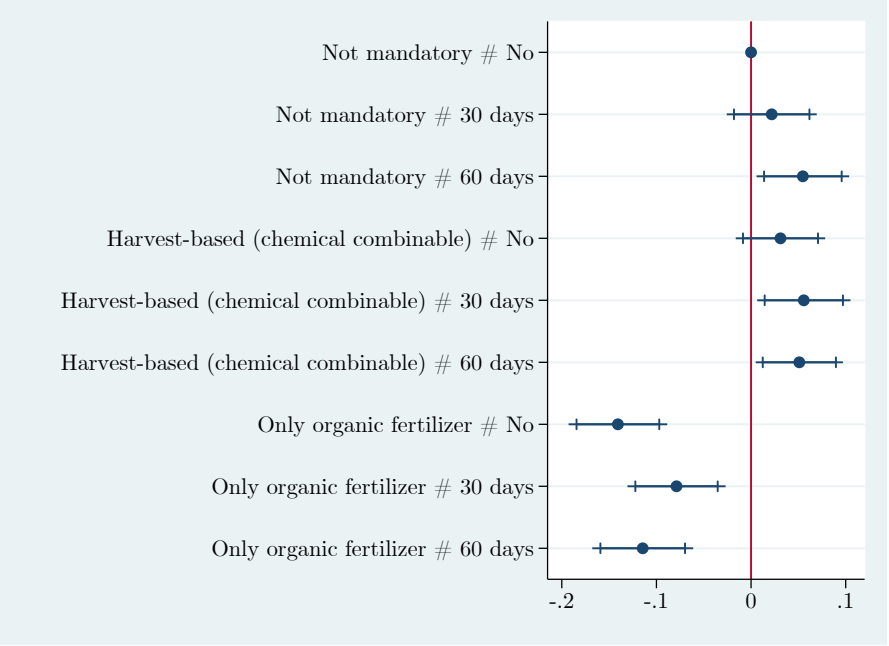


FIGURE B.2: Interaction between application of organic fertilizer and delayed payment

	Coef.	**S.E.**
VietGAP dummy		
yes	0.23***	0.04
Certification fee		
VND 1 Mil	-0.06***	0.02
VND 2 Mil	-0.14***	0.02
VND 4 Mil	-0.21***	0.03
VND 8 Mil	-0.28***	0.03
Certification fee # VietGAP dummy		
VND 1 Mil#yes	-0.02	0.03
VND 2 Mil#yes	0.02	0.04
VND 4 Mil#yes	0.05	0.04
VND 8 Mil#yes	0.03	0.04
Record keeping		
No	0.01	0.01
Record keeping # VietGAP dummy		
No#yes	0.00	0.02
Application of organic fertilizer		
Harvest-based (chemical combinable)	0.02	0.02
Only organic fertilizer	-0.12***	0.02
Application of organic fertilizer # VietGAP dummy		
Harvest-based (chemical combinable)#yes	0.00	0.03
Only organic fertilizer#yes	-0.04	0.03
Free shipping		
Yes	0.01	0.01
Free shipping # VietGAP dummy		
Yes#yes	0.00	0.02
Delayed payment		
30 days	0.06***	0.02
60 days	0.05***	0.02
Delayed payment # VietGAP dummy		
30 days#yes	-0.06**	0.03
60 days#yes	-0.05*	0.03
Constant	0.62	0.03
n	7418	

10% significant level, ** 5% significant level, * 1% significant level*
Standard errors are clustered at household level

TABLE B.2: Heterogenous effects by VietGAP membership

	Coef.	**S.E.**
RCT treatment		
Information	0.04	0.05
Subsidy	0.05	0.05
Application of organic fertilizer		
Harvest-based (chemical combinable)	0.07***	0.02
Only organic fertilizer	-0.08***	0.03
Application of organic fertilizer # RCT treatments		
Information#Harvest-based (chemical combinable)	-0.09	0.04
Information#Only organic fertilizer	-0.05	0.04
Subsidy#Harvest-based (chemical combinable)	-0.06*	0.03
Subsidy#Only organic fertilizer	-0.11***	0.04
Free shipping		
Yes	0.00	0.02
Free shipping # RCT treatments		
Information#Yes	0.04	0.03
Subsidy#Yes	0.01	0.03
Delayed payment		
30 days	0.06**	0.02
60 days	0.07***	0.02
Delayed payment # RCT treatments		
Information#30 days	-0.03	0.03
Information#60 days	-0.03	0.03
Subsidy#30 days	-0.04	0.03
Subsidy#60 days	-0.07*	0.04
Constant	0.55	0.03
n	7418	

10% significant level, ** 5% significant level, * 1% significant level*
Standard errors are clustered at household level

Table B.3: Heterogenous effects by RCT treatments

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