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A MICROECONOMIC ANALYSIS OF HOUSEHOLD FOREST PLANTATION IN THE NORTHERN UPLANDS OF VIETNAM: CONTRIBUTIONS TO PAYMENTS FOR ENVIRONMENTAL SERVICES POLICY

Dissertation

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This dissertation is dedicated to my mom, Supasara Nisapakul

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EXECUTIVE SUMMARY

It is uncontested that forests are imperative for environmental conservation and economic development. Benefits from forests are immense and multidimensional: Forests can support local livelihoods, assist poverty alleviation, and provide environmental services for local communities and greater society. Over the past 50 years, about half of the world's original forest cover has been lost. Vietnam is among the countries where forest degradation is a serious issue. Several measures have been implemented to alleviate forest degradation, including forest land allocation and forest plantation programs. The current and growing international interest of civil society and governments in the acknowledgement of forest environmental services has become mainstream: Vietnam is among several countries who appreciate the need for payment or compensation to local communities for forest values through the payment for environmental services (PES) mechanism. Since 2010, Vietnam has officially introduced a payments for forest environmental services (PFES) scheme to pursue conservation and development goals. However, there is still a lack of knowledge for farmers' preferences for policy design and implementation. In spite of a number of studies examining the impacts of forest policies in northern Vietnam, there is limited research on incentive and forest management at the household level. Such an analysis would provide insightful information and entail implications for PES policy, especially in terms of effective participation and cost efficiency. This dissertation attempts to fill this research gap by examining farmers' behavior on forest management and their experiences with forest policies that are necessary for determining effective incentives that can bring about changes in behavior related to forest conservation practice in a mountainous area. The research is based on two survey rounds of 300 representative households in Da Bac district, located in the upstream area of the Hoa Binh reservoir in the northwestern region of Vietnam.

The dissertation is composed of three main parts. The first part examines why farmers have adopted forest plantation and how they have managed their forests under the current incentive scheme taking several aspects of forest plantation into account. Gross margin analysis indicates that growing trees is not profitable and is unable to compete with growing cash crops. Government policies, namely, forest land allocation and forest plantation programs, are the main reasons why the majority of households still plant forest,

even though it is less profitable. From a benefit viewpoint, planting forest is another way to generate income whereby farmers can reap benefits regularly from non-timber forest products. Heckman sample selection estimation examines both determinants of the decision to plant forests and the intensity of planting forests. Seedling support positively determines the intensity of planting forest, whereas cash support does not. However, the magnitude of the impact from seedling support is relatively low and does not appear to stimulate farmers to plant more trees. Therefore, there is limited evidence of impacts of government support on the sustainability of forest plantation. The findings also highlight another issue of forest plantation programs: Despite the fact that some transaction costs of participation are fixed, given that the benefit is paid on an area basis only, wealthier households receive more support because they own more land. This underlines the strong linkage between land allocation and forest conservation policies, especially in mountainous areas which suffer from land scarcity. Lack of formal land security is not found to hinder investments in forests, which contradicts expectations and the literature. However, this unexpected finding may be explained by the behavior of households who do not hold formal land security. Such households may expect that their participation will later facilitate the recognition of plot ownership by the local government. Due to the conditions in mountainous areas where forest plots are located outside of the village, the results indicate that the degree of trust among villagers that the planted forests are secured is an important factor promoting forest plantation.

The second part then explores whether new incentives could encourage farmers to participate in a stricter forest conservation program. It sheds light on the cost efficiency and preferences of local farmers on forest conservation programs. The hypothetical baseline assumes that every household is allocated a plot of land of the same size and conditions. This assumption is made to avoid bias from land holding inequality and to explore the potential demand of forest conservation. The use of the stated preference method allows the examination of farmers' preferences beyond their current practice. A choice experiment estimates the willingness to accept (WTA) planting and conserving forest and investigate different attributes of forest plantation contracts. Results show that pecuniary aspects of forests are the most important factors of the contract, but that farmers also consider other aspects when deciding to participate in a program. Results from the WTA estimation show that on average, farmers are willing to pay to participate in a contract in which they can exploit half of the timber with minimum care and weak

regulations. On the other hand, stricter forest conservation contracts demand a subsidy that is greater than that offered in previous afforestation programs and in the pilot PFES policy. However, the result from the comparative analysis reveals that the WTA is far lower than forgone income from cash crops cultivation. This indicates that encouraging farmers to plant and conserve forest is not as costly as the opportunity cost of land. Even though local farmers tend to associate forests with monetary benefits, the results indicate that given the well-functioning land allocation policy, there is room for stricter forest conservation programs as long as farmers are adequately compensated.

The final part of the dissertation focuses on transaction costs (TCs) incurred by households who participated in previous forest plantation programs. Measuring actual TCs is necessary to examine whether TCs could be a constraint to participation in programs. Results indicate that TCs incurred by households are not likely to be a constraint for participating in future PES programs if farmer involvement and monitoring mechanisms remain the same. Despite the low absolute level of TCs, they are equivalent to more than one-third of program benefits, which is quite high compared to other agricultural or conservation programs in developed countries where the nature of the programs are more complex. Policy design that increases the benefit to balance TCs will improve efficiency. The regression analysis on determinants of TCs reveals that the household head's education, gender, and perception towards afforestation programs have large and significant effects on the magnitude of TCs. Social capital is insignificant for explaining participation in the afforestation programs which were implemented in a top-down fashion with little community involvement. Therefore, strengthening social capital may not be effective in influencing the level of TCs if the program is based on a top-down approach which involves less collaboration from participants regarding program implementation and no significant conflict among participants and authorities.

As previous afforestation programs are based on a top-down approach, this dissertation contributes to the limited research on the potential demand for and farmers' preferences in forest management. The analysis provides policy implications for a PES scheme where voluntary participation and cost efficiency are crucial for its success. This dissertation also contributes to a small but growing body of literature on choice experiment application to the field of forest conservation schemes in developing countries. In addition, the analysis of TCs borne by households under the forest management scheme can

contribute to the limited number of studies that have empirically analyzed private TCs, particularly in developing countries.

The results of our research underline the inadequacy of previous forest plantation support and recommend that when land is limited, higher financial incentives are needed to make forest conservation attractive in a PES scheme. Depending on the contract, there exists a potential demand for forest conservation with a small subsidy or even without a subsidy if extra land is allocated. This suggests that policymakers should integrate land allocation into PES policies to obtain better cost efficiency. As the results indicate that households have different degrees of willingness to participate in forest conservation programs, we recommend that policies target PES campaigns to households who have less interest in forest conservation, such as households with livelihoods that depend mainly on agricultural production, who have not previously joined the forest programs either due to their ineligibility or distrust in local government authorities, and who have limited market access due to poor road conditions. In addition, given that the security of forests influences the decision to plant forest, strengthening monitoring mechanism or introducing insurance to reduce the risk of plantation failure is recommended as another option to promote participation.

This dissertation reveals that the amount of incentives that farmers are willing to accept to plant and conserve forest instead of engaging in farming activities is higher than previous subsidies. In mountainous areas where ethnic minorities still live in poverty, a higher subsidy is expected to achieve both environmental conservation and poverty alleviation outcomes. Nevertheless, a critical question arises as to whether a higher subsidy can lead to sustainable household forest management. This question should be addressed by future research by examining longitudinal data on household livelihood and forest management under a PES scheme. It has not been possible to empirically measure TCs of farmers engaged in community-based forest management where such information would provide interesting results on this matter. The implications on this study could be developed further by expanding the survey and gathering data from participants of community-based forest management. Further research on the comparison of TCs associated with community and individual management is recommended to provide information to policymakers and researchers.

ZUSSAMENFASSUNG

Es ist unbestritten, dass Wald unverzichtbar sowohl für den Umweltschutz als auch für die wirtschaftliche Entwicklung ist. Der Nutzen von Wald ist enorm: Wälder sind Lebensgrundlage für die lokale Bevölkerung, unterstützen Armutsminderung und bieten Umweltdienstleistungen für Gemeinden vor Ort und die weitere Gesellschaft. In den letzten 50 Jahren hat sich die Waldfläche global um ungefähr die Hälfte verringert. Vietnam gehört zu den Ländern, in denen Entwaldung ein schwerwiegendes Problem darstellt. Eine Reihe von Maßnahmen wurde eingeführt um Entwaldung abzumildern, darunter die Zuteilung von Waldflächen sowie Aufforstungsprogramme. Das gegenwärtige und wachsende internationale Interesse von Zivilgesellschaft und Regierung an der Würdigung von Waldumweltdienstleistungen ist zum Mainstream geworden: Vietnam ist ein Land unter vielen, das die Notwendigkeit einer Bezahlung oder Entschädigung für Wälder im Rahmen des PES-Mechanismus (Bezahlung für Umweltdienstleistungen) für Gemeinden anerkennt. 2010 hat Vietnam offiziell ein PFES-Programm (Bezahlung für Waldumweltdienstleistungen) eingeführt, um Walderhaltungs- und Entwicklungsziele zu verfolgen. Die Präferenzen von Landwirten für Politikgestaltung und Programmimplementierung sind jedoch noch nicht bekannt. Trotz mehrerer Studien, die die Auswirkungen von Waldprogrammen im Norden Vietnams untersuchen, gibt es nur wenig Forschung zu Anreizen und Waldbewirtschaftung auf Haushaltsebene. Eine solche Analyse würde aufschlussreiche Informationen und Schlussfolgerungen für das PES-Programm liefern, insbesondere hinsichtlich wirksamer Beteiligung und Kosteneffizienz. Die vorliegende Dissertation versucht diese Forschungslücke zu schließen, indem sie das Verhalten der Landwirte bei der Waldbewirtschaftung und ihre Erfahrungen mit Forstprogrammen untersucht. Das ist notwendig um wirksame Anreize festzulegen, die Verhaltensänderungen hinsichtlich Walderhaltungspraktiken in Bergregionen herbeiführen können. Basis dieser Studie sind zwei Haushaltsumfragen mit 300 repräsentativen Haushalten im Da Bac-Bezirk, oberhalb des Hoa Binh-Stausees im Nordwesten Vietnams.

Die Dissertation besteht aus drei Teilen. Der erste Teil untersucht, warum Landwirte aufforsten und wie sie ihre Wälder im Rahmen des gegenwärtigen Anreizschemas bewirtschaften, hierbei werden mehrere Aspekte der Aufforstung berücksichtigt. Die Bruttogewinnmarge sagt aus, dass Aufforstung nicht profitabel ist, und es ist nicht möglich

mit dem Anbau von Marktfrüchten zu konkurrieren. Regierungsprogramme, und zwar die Zuteilung von Waldfläche und Aufforstungsprogramme sind die Hauptgründe, warum die Mehrheit der Haushalte immer noch aufforstet, obwohl es weniger rentabel ist. Betrachtet man den finanziellen Nutzen, ist das Aufforsten eine alternative Einkommensquelle, Landwirte ziehen einen regelmäßigen Nutzen aus Nichtholzprodukten. Die Stichprobenauswahlanalyse nach Heckmann untersucht sowohl die Determinanten für die Entscheidung zur Aufforstung als auch zur Intensität der Aufforstung. Saatgutunterstützung beeinflusst die Intensität der Aufforstung positiv, wohingegen reine finanzielle Unterstützung keinen Einfluss hat. Das Ausmaß der Auswirkung der Saatgutunterstützung ist relativ niedrig und scheint die Landwirte nicht dazu zu bringen, mehr Bäume zu pflanzen. Deswegen gibt es nur wenig Anhaltspunkte zu den Auswirkungen von Regierungsprogrammen auf die Nachhaltigkeit der Aufforstung. Die Ergebnisse verdeutlichen auch einen weiteren Aspekt der Aufforstungsprogramme: Ungeachtet der Tatsache, dass Transaktionskosten fest sind, werden die Gelder auf Basis der Fläche ausgezahlt; somit erhalten reichere Haushalte, die mehr Land besitzen, mehr Geld. Das unterstreicht den starken Zusammenhang zwischen Zuteilung von Landfläche und Walderhaltungspolitik; insbesondere in Bergregionen, die unter Landknappheit leiden. Mangelnde Landrechte halten die Landwirte nicht davon ab in Wälder zu investieren, dies widerspricht Erwartungen und Literatur. Dieses unerwartete Ergebnis kann jedoch mit dem Verhalten der Haushalte, die keine offiziellen Landrechte haben, erklärt werden. Diese Haushalte können erwarten, dass ihre Beteiligung an der Aufforstung später die Übertragung eines Grundstücks durch die Kommunalverwaltung erleichtert. Aufgrund der Bedingungen in Bergregionen wo sich Waldflächen außerhalb der Dörfer befinden, lassen die Ergebnisse erkennen, dass das Vertrauen unter Dorfbewohnern, dass die bepflanzten Flächen geschützt sind, ein wichtiger Faktor für die Aufforstungsförderung ist.

Der zweite Teil der Dissertation untersucht, ob neue Anreize die Landwirte ermutigen können, an einem strikteren Walderhaltungsprogramm teilzunehmen. Er gibt Aufschluss über Kosteneffizienz und Präferenzen der ansässigen Landwirte für Walderhaltungsprogramme. Das hypothetische Referenzszenario nimmt an, dass jedem Haushalt eine Fläche mit derselben Größe und den denselben Bedingungen zugeteilt wird. Diese Annahme wurde gemacht, um eine Verzerrung hinsichtlich Ungleichheit beim Besitz von Landfläche zu vermeiden und um die potenzielle Nachfrage nach Walderhaltung zu untersuchen. Die Methode „Stated Preferences” erlaubt die Untersuchung der Präferenzen

der Landwirte über ihre gegenwärtige Praktiken hinaus. Ein Choice-Experiment schätzt die Bereitschaft der Landwirte, Wald aufzuforsten und zu erhalten (Willingness to accept: WTA) und überprüft verschiedene Eigenschaften von Aufforstungsverträgen. Ergebnisse zeigen, dass finanzielle Aspekte die wichtigsten Faktoren des Vertrages sind, dass Landwirte aber auch andere Aspekte berücksichtigen, wenn sie sich dafür entscheiden an einem Programm teilzunehmen. WTA-Ergebnisse zeigen, dass Landwirte durchschnittlich bereit sind, einen Vertrag zu akzeptieren, in dem sie die Hälfte des Holzes abbauen können, bei minimaler Pflege und schwacher Regulierung. Andererseits verlangen striktere Walderhaltungsverträge eine Subvention, die höher ist als in bisherigen Aufforstungsprogrammen und im PFES-Pilotprogramm. Wie die Ergebnisse der komparativen Analyse jedoch zeigen, ist die geforderte Subvention deutlich niedriger als der Einkommensausfall aus dem Marktfrüchteanbau. Das zeigt, dass die Unterstützung von Landwirten bei der Bepflanzung und Erhaltung des Waldes nicht so teuer wie die Opportunitätskosten sein muss. Obwohl die ansässigen Landwirte Wald eher mit monetärem Nutzen in Verbindung bringen, zeigen die Ergebnisse, dass aufgrund der gut funktionieren Landzuteilungspolitik und solange Landwirte angemessen entschädigt werden, striktere Walderhaltungsprogramme möglich sind.

Der letzte Teil der Dissertation fokussiert Transaktionskosten (TK) von Haushalten, die bei früheren Aufforstungsprogrammen teilnahmen. Um zu untersuchen, ob TK eine Einschränkung für die Teilnahme in Programmen sein können, ist es notwendig Transaktionskosten zu bestimmen. Die Ergebnisse zeigen, dass Transaktionskosten, die in Haushalten anfallen, keine Einschränkung für die Teilnahme an zukünftigen PES-Programmen darstellen dürften, falls die Einbeziehung der Landwirte und Überwachungsmechanismen dieselben bleiben. Trotz der absolut niedrigen TK stellen sie mehr als ein Drittel der gesamten Programmunterstützung dar, was im Vergleich zu anderen komplexen Landwirtschafts- oder Erhaltungsprogrammen in Entwicklungsländern relativ hoch ist. Die Konzeptionierung von Maßnahmen, die die Subvention erhöht und den Anteil der TK reduziert, wird die Effizienz des Programms verbessern. Die Regressionsanalyse zu Determinanten der TK ergab, dass Bildungsstand und Geschlecht des Haushaltsvorstandes und die Wahrnehmung von Aufforstungsprogrammen eine große und signifikante Wirkung auf die Höhe der TK haben. Sozialkapital kann die Beteiligung an Aufforstungsprogrammen, die nach dem Top-down-Prinzip mit wenig Mitwirkung der Gemeinden eingeführt wurden, nicht beeinflussen. Deshalb dürfte, wenn das Programm auf

einem Top-down-Ansatz beruht, der wenig Mitarbeit von Teilnehmern hinsichtlich Programmimplementierung und keinen bedeutenden Konflikt zwischen Teilnehmern und Verantwortlichen umfasst, eine Stärkung des Sozialkapitals die Höhe der TK nicht effektiv beeinflussen.

Da frühere Aufforstungsprogramme auf einem Top-down-Ansatz basieren, leistet diese Dissertation einen Beitrag zur begrenzten Forschung zu potenzieller Nachfrage nach Waldbewirtschaftung und Präferenzen der Landwirte bei. Die Analyse liefert politische Implikationen für PES-Vorhaben, in denen Freiwilligkeit und Kosteneffizienz entscheidend für deren Erfolg sind. Diese Dissertation trägt ebenfalls zur kleinen aber wachsenden Literatur über die Anwendung von Choice-Experimenten im Rahmen von Walderhaltungsprogrammen in Entwicklungsländern bei. Darüber hinaus kann die Analyse der TK, die bei Haushalten im Rahmen von Waldbewirtschaftungsprogrammen besonders in Entwicklungsländern anfallen, zur begrenzten Anzahl an Studien, die private TK empirisch analysiert haben, beitragen.

Die Ergebnisse der vorliegenden Forschung betonen die Unzulänglichkeiten früherer Aufforstungsprogramme und empfehlen im Falle von begrenzter Fläche höhere finanzielle Anreize, um Walderhaltung in einem PES-Programm attraktiv zu machen. Abhängig vom Vertrag gibt es eine potenzielle Nachfrage nach Walderhaltung mit einer niedrigen Förderung oder sogar ohne Zuschuss wenn zusätzliches Land zugeteilt wird. Dies deutet darauf hin, dass politische Entscheidungsträger Landzuteilung in PES-Programme integrieren sollten, um eine höhere Kosteneffizienz zu erreichen. Da die Ergebnisse aussagen, dass Haushalte ein unterschiedliches Ausmaß an Bereitschaft zur Teilnahme in Walderhaltungsprogrammen haben, wird empfohlen, dass PES-Kampagnen sich auf Haushalte mit weniger Interesse an Walderhaltung richten, wie Haushalte, deren Lebensgrundlage hauptsächlich auf landwirtschaftlicher Produktion beruht, Haushalte, die bisher nicht für die Teilnahme Waldprogrammen berechtigt waren oder aufgrund von Misstrauen gegenüber den örtlichen Behörden nicht teilgenommen haben und Haushalte, die begrenzten Marktzugang aufgrund mangelhaften Straßen haben. Da der Schutz des Waldes die Entscheidung zur Aufforstung beeinflusst, wird als eine zusätzliche Möglichkeit zur Förderung der Teilnahme empfohlen, Überwachungsmechanismen zu stärken oder Versicherungen zur Reduzierung von Aufforstungsrisiken einzuführen.

Diese Dissertation zeigt auf, dass die Höhe der Anreize, bei der Landwirte bereit sind, aufzuforsten und den Wald zu erhalten, anstatt andere landwirtschaftliche Aktivitäten

auszuüben, höher sind als frühere Subventionen. In Bergregionen, wo ethnische Minderheiten noch in Armut leben, wird eine höhere Förderung erwartet, um sowohl Umweltschutz als auch Armutsminderung zu erreichen. Nichtsdestotrotz stellt sich die Frage, ob eine höhere Förderung zu einer nachhaltigen Waldbewirtschaftung auf Haushaltsebene führt. Diese Frage sollte im Rahmen zukünftiger Forschung geklärt werden, mithilfe der Untersuchung von Längsschnittdaten auf die Lebensgrundlage und die Waldbewirtschaftung im Rahmen eines PES-Programms. Es war nicht möglich, TK von Landwirten, die in ihrer Gemeinde an einer gemeinsamen Waldbewirtschaftung beteiligt sind, wo solche Informationen interessante Ergebnisse liefern würden, empirisch zu messen. Die Implikationen dieser Studie könnten weiter entwickelt werden, wenn Umfrage und Datenerhebung von Teilnehmern der von lokalen Gemeinschaften getragenen Waldbewirtschaftung ausgeweitet werden. Weitere Forschung zum Vergleich von TK, wie sie bei Gemeinde- und individueller Bewirtschaftung anfallen, wird empfohlen, um politischen Entscheidungsträgern und Forschern Informationen zur Verfügung zu stellen.

Translated by Christine Bosch

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LIST OF ABBREVIATIONS

AES	agri-environmental scheme
ANOVA	analysis of variance
ASC	alternative specific constant
CE	choice experiment
IIA	independence of irrelevant alternatives
MARD	Ministry of Agriculture and Rural Development
NPVs	net present values
OLS	ordinary least square
PES	payments for environmental services
PFES	payments for forest environmental services
PRA	participatory rural appraisal
RPL	random parameter logit
SFE	State Forest Enterprise
TC	transaction cost
USD	United States Dollars
VIF	variance inflation factor
VND	Vietnamese Dong
WTA	willingness to accept
5MHRP	Five-Million-Hectare Reforestation Program

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CHAPTER 1

INTRODUCTION

It is uncontested that forests are imperative for environmental conservation and economic development. Benefits from forests are immense and multidimensional: Forests can support local livelihoods, assist poverty alleviation, and provide environmental services for local communities and greater society. However, over the past 50 years, about half the world's original forest cover has been lost at a rate of about 12-15 million hectares annually (WWF, 2014). The best method of managing forest resources to achieve development and environmental goals is a very important issue for policymakers, especially in developing countries with constrained resources. Historically, the public sector has dominated forest management in most countries in Asia, but over the past two decades this pattern has changed towards the greater involvement of local communities (Enters and Durst, 2004). Vietnam is not an exception. The management of the forestry sector in Vietnam has been decentralized since *Doi Moi* (renovation) policies in 1988. Through these polices, Vietnam has achieved dramatic poverty alleviation and economic development through the conversion of a centrally planned economy to a market based economy.

Challenges remain for reducing poverty in the upland areas where poverty alleviation and forest management cannot be treated as separate issues since a high incidence of poverty overlaps with the remaining natural forest cover. In Vietnam, mountainous areas cover more than two-thirds of the country. As of 2012, the population of the Northern Uplands is 11.4 million people, representing about 13% of the country's inhabitants (General Statistics Office of Vietnam, 2014a). The population has been increasing mildly at a rate of about 0.12% per year from 2000 to 2012. In the mountainous area, ethnic minorities, who are the poorest and most marginalized members of Vietnamese society (World Bank, 2009), live in unfavorable conditions. The Northern Uplands are one of these areas, where poverty rates are far above the national average (ADB et al., 2003). Mountains were extensively covered by forests until the mid-twentieth century when forest cover declined rapidly due to intensified logging to supply timber, generate money to fund the war, and accommodate lowland settlers (Poffenberger and Nguyen, 1998).

Many poor farmers in this mountainous area have long depended on forest resources and will continue to do so in the future. Forest resources prevent people from slipping into

poverty or from becoming poorer by serving as a safety net through its source of cash income. Forest resources can also help lift households out of poverty by functioning as a source of savings, investment, asset growth, and livelihood diversification, which can lead to permanent increases in welfare (Sunderlin and Ba, 2005). Increases in income can accrue through the sale of timber and non-timber forest products, conversion of forests to agriculture, employment, and indirect benefits such as income from eco-tourism (Sunderlin et al., 2003). Environmental services provided by forests are also as important, if not more, for the livelihood benefits of forests. Forests provide various direct environmental services to people living in the vicinity of forests, such as improved soil fertility, the protection of water quantity and quality, pollination, weed control, and the maintenance of biodiversity (Jamieson et al., 1998). For example, loss of forests in the uplands causes siltation of downstream irrigation systems and increased severity of floods and droughts (ADB, 2000).

1.1 Forest management in Vietnam

Deforestation has been a serious issue in Vietnam for decades. The main causes of deforestation have been population-driven demand for forest products and agricultural land (Poffenberger and Nguyen, 1998; De Koninck, 1999) and wood exploitation for local and urban needs (McElwee, 2004), especially from intensive logging by State Forest Enterprises (SFEs) (ADB, 2000). However, since the mid-1990s, the trend has been largely reversed and forest cover has increased through natural regeneration, extension of tree plantations, dramatic changes in agricultural and forestry policies, and economic and political responses to forest and land scarcity (Meyfroidt and Lambin, 2008). The main policy response to forest scarcity was the allocation of forest land to households, which restricted slash-and-burn cultivation on hillsides and provided incentives for the sound management of allocated land (Meyfroidt and Lambin, 2008). Under the Land Law in 1993, households were given long term rights to use, transfer, exchange, inherit, rent, and mortgage land. Several factors are considered to be the driving force of decentralization of forest land: (1) deforestation rates were high; (2) productivity of SFEs were declining and many were financially insolvent; (3) exports of timber were insufficient for national growth targets; and (4) large areas of the uplands lacked any forest cover and were susceptible to soil erosion (Sikor, 1995 cited in McElwee, 2012). Along with the devolution of forest management, forest plantation campaigns began in the beginning of the 1990s. The

government launched two major nationwide initiatives: the Greening of Barren Hills Program (or Program 327) and its successor, the Five-Million-Hectare Reforestation Program (5MHRP or Program 661). In the Northern Uplands, there are also other programs that provide support for household forest plantation, such as a resettlement program for households affected by the construction of Hoa Binh dam and a program to help alleviate poverty among ethnic minorities, even though the main goal of these programs differ.

1.2 Incentives and household forest plantation

It is clear that Vietnam is a remarkable case representing a trend of the transition from state forestry to household forestry with the goals of achieving both livelihood development and environmental improvement. According to Sunderlin and Ba (2005), whether forest resources help alleviate poverty depends on the transition from a natural forest economy to a plantation economy. From 2005 to 2010, there is an increasing nationwide trend of planted forest area by an average of 7.6% (General Statistics Office, 2014b). In the Northern Uplands, this rate has been much higher (16.5%), although it has declined slightly since 2011 (General Statistics Office, 2014b).

Farm households and their interactions with policies are considered to be critical for achieving successful forest plantation development. One study finds that compared to areas where forest was managed by state entities, areas where the devolution of lands to individual households took place were more effective in increasing forest cover and raising incomes (Sandewall et al., 2010 cited in McElwee, 2012). However, there is evidence questioning the effectiveness of government forest plantation campaigns. Several studies in the Northern Uplands have observed that an increase in afforestation was not farmers' direct response to the set of incentives provided by government programs and devolution of land management. Instead, it resulted from other factors, such as agricultural intensification and disruption of customary institutions regulating upland management that transformed farmers to a more sedentary livelihood system (Castella et al., 2006; Clement and Amezaga, 2009; Sikor, 2001). According to Clement et al. (2009), an expansion of planted forest was largely driven by state organizations on protected state-owned land. Clement and Amezaga (2009) reveals that 5MHRP has not successfully involved households in the forestry sector and has not contributed to poverty reduction or to

economic development, citing a problem of inadequate incentives to effectively involve households.

Vietnam is the first country in the region to introduce the concept of a market-based forest conservation policy in the form of payment for forest environmental services (PFES) to pursue conservation and development goals. In 2008, the government launched a pilot policy of PFES in two provinces for a period of two years. Since 2010, the expansion of PFES projects nationwide has been allowed under the new national Biodiversity Law (McElwee, 2012). In the setting of forest conservation where upland farmers provide significant environmental services that benefit downstream communities, the use of a PFES scheme to internalize positive externalities is more likely to yield satisfactory outcomes (Wertz-Kanounnikoff and Rankine, 2008). However, the implementation of a piloted PFES scheme was not without flaws. Even though government officials have strongly praised the PES approach, presenting it as a clear win–win for Vietnam, it is argued that PES is not likely to tackle the issues of land tenure inequality and the lack of participation of local communities in conservation, which are considered key underlying causes of forest degradation (McElwee, 2012). The incentive used in the piloted PFES scheme is based on the so-called K-factor framework, in which the payment to forest owners is determined by forest status, type, and origin, as well as the degree of difficulty of forest management (Dam et al., 2014) without taking into account farmers' opportunity costs or preferences. The importance of the involvement of local stakeholders in the design of the scheme is crucial for achieving cost efficiency and effective participation, as well as to realize the pro-poor element of the scheme in the case of PFES policy in Vietnam (Dam et al., 2014).

Providing incentives to households to achieve successful forest conservation, whether in PES scheme or not, generates transaction costs (TCs). Recent research has observed that high TCs are involved in the implementation of PES schemes and in farmers' participation (e.g., Dunn, 2011; FAO, 2007; To et al., 2012). Some studies find that higher TCs are likely to be greater obstacles to the participation of poor households in PES than households’ own capacity and resources (Behera and Engel, 2004; Engel et al., 2008; Locatelli et al., 2008; Wunder, 2008). Studies on agri-environmental schemes which emphasize voluntary participation state that TCs incurred by farmers can form a significant constraint to participation (Falconer, 2000; OECD, 2005). Research on nature conservation also address the issue of potentially high TCs for participating stakeholders and emphasize the need for the quantification of TCs (Mburu et al., 2003). Besides the issue of barriers to

participation, TCs involved in a PES scheme can reduce the cost-effectiveness and hence undermine its sustainability. Few studies have empirically estimated individual farmers' TCs involved in agricultural and conservation programs and most have been conducted in developed countries (OECD, 2005; Falconer, 2000; Mburu et al., 2003; Falconer and Saunders, 2002; Vatn et al., 2002, Rørstad et al., 2007; Mettepenningen et al., 2009). Understanding and measuring TCs incurred by households provide insight and policy implications for forest conservation under a PES framework.

1.3 Conceptual framework and outline of the dissertation

This dissertation analyzes farmers' behavior on forest management at the micro level and examines interactions between farmers and forest policies that are necessary for determining effective incentives that can bring about changes in behavior related to forest conservation. This empirical analysis of farmers who supply forest environmental services in a mountainous area can provide insight and policy implications to improve the effectiveness and efficiency of PES or other benefit-sharing initiatives among upstream and downstream communities. Under the current setting of forest management in Vietnam, only production forest[1] provides the individual with ownership conditions. Since we are more interested in understanding individual decisions under which PES can operate, the scope of the dissertation is limited to production forest management.

The dissertation has the following main objectives and research questions:

Objective 1: To analyze the adoption of household forest plantation.

- Question 1.1: What is the profitability of forest production compared to cash crop cultivation?
- Question 1.2: What is the distribution of government support for forest plantation among different groups of households?
- Question 1.3: What are the factors determining the decision and intensity of forest plantation?

[1] According to the Law on Forest protection and development issued in 2004, forests in Vietnam are classified into three kinds based on their major use purposes: production, protection and special use. Production forests are used mainly for production and trading of timber and non-timber forest products in combination with protection, which contributes to environmental protection (FAOLEX, 2014). Production forest does not have restrictions on the volume of timber harvest whereas the other two types, protection forest and special use forest, have certain level of restrictions on timber harvest.

Objective 2: To estimate the willingness to accept (WTA) forest plantation and to analyze farmers' preferences for forest conservation contracts.

- Question 2.1: How much is the WTA of farmers to plant and conserve forest?
- Question 2.2: What are the attributes of forest plantation schemes that encourage farmers to participate?

Objective 3: To analyze transaction costs (TCs) incurred by farm households who participated in forest plantation programs.

- Question 3.1: What are the process and transactions related to the past forest plantation programs?
- Question 3.2: How much are the TCs incurred by households who participated in forest plantation programs?
- Question 3.3: What factors determine the value of household TCs of participation in forest plantation programs?
- Question 3.4: Can community-based forest management reduce TCs below those incurred from individual forest management?

First, it is necessary to understand why farmers adopted forest plantation and how they managed forests under the current incentive scheme. Several studies have examined the impacts of forest policy in the Northern Uplands by using imagery data and qualitative analysis (e.g., Castella et al., 2006; Sikor, 2001), emphasizing relevant institutions (Clement and Amezaga, 2009) or conducting quantitative analyses at the commune level (Clement et al., 2009) or at the household level but focus only on forest land allocation (Dinh, 2005). The first objective of this study fills this research gap by examining factors influencing forest plantation at the household level, taking into account local conditions that impact government support. As Clement et al. (2009) suggest, the effect of state policies on forest cover change depends on local social and biophysical conditions. For a PES scheme to function effectively, it is important that it results in the provision of additional environmental services. This means that the incentive payment should cause forest environmental benefits to occur where it would not have occurred otherwise. Thus, only investigating farmers' practice on production forest is insufficient to provide useful policy implications for PES schemes. There is also a concern that opportunity costs for protecting forests rather than planting crops may be too high for PES schemes to mitigate

(McElwee, 2012). In addition, in developing countries like Vietnam, the cost efficiency aspect of a conservation scheme is crucial as governments strive to minimize incentive payments while maximizing conservation outcomes. Therefore, the focus of this study's second objective is to explore the possibility of new incentives that can encourage farmers to participate in stricter forest conservation practice. Finally, since reducing TCs can contribute to the improvement of a program's efficiency and help alleviate potential constraints on the participation of smallholder farmers, TCs incurred by households that participated in past forest plantation programs are analyzed in the third objective.

Figure 1.1 illustrates the concept of PES[2] between upstream and downstream stakeholders in which the three studies in this dissertation provide a comprehensive analysis of households in a mountainous area as suppliers of forest environmental services. According to the figure, when households in the upstream area plant forests, apart from income and environmental services they obtain from forests, they also generate environmental services that benefit stakeholders for downstream areas or wider society. A principle of a PES scheme is that downstream stakeholders are buyers of forest environmental services that upstream households provide through planting forests. Payments for environmental services from buyers can be used as financial incentives for households to conserve more forest. The first objective of the dissertation captures the current practice of household forest plantation by examining costs (e.g., seedlings, fertilizer, herbicide, etc.), benefits obtained from forests, forgone income from not using the land for other activities, and other factors influencing forest plantation. Although environmental services that households obtain from the forest are important and can be substantial, the valuation of such services is beyond the scope of this study. The second objective of the dissertation examines households' WTA and preferences for stricter forest conservation that could yield additional forests upstream. The third objective of the dissertation examines TCs incurred by households participating in forest plantation programs.

[2] We consider PES schemes in a broad sense, which includes: 1) payments from the government to households; 2) formal markets with open trading between buyers and sellers under either a regulatory or voluntary framework (e.g., the international carbon market); and 3) private PES in which there are no formal regulatory markets and no or little government involvement (Forest Trends et al., 2008).

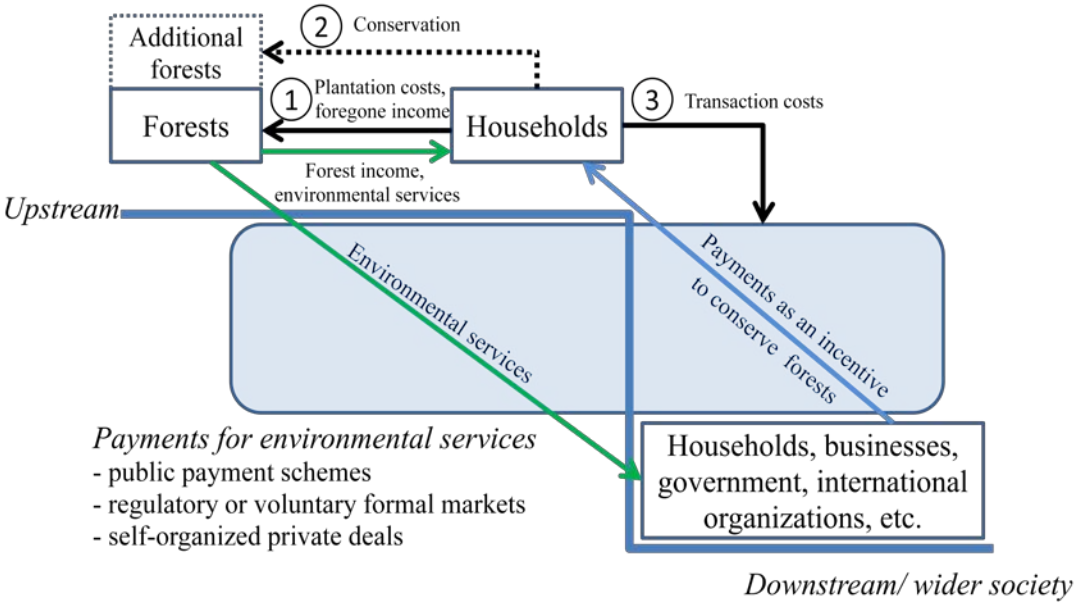

Figure 1.1 Conceptual framework of the dissertation

This dissertation is based on data collected from household survey in Da Bac district, Hoa Binh province in northwestern Vietnam. Da Bac district is a mountainous area located in the upstream of Hoa Binh reservoir (shown in Figure 1.2). Two survey rounds were conducted: one from November to December 2011 and another from September to October 2012 using structured interviews with 300 representative households. Besides household survey data, data was gathered from key informant interviews, focus group discussions, and reviews of secondary data and literature.

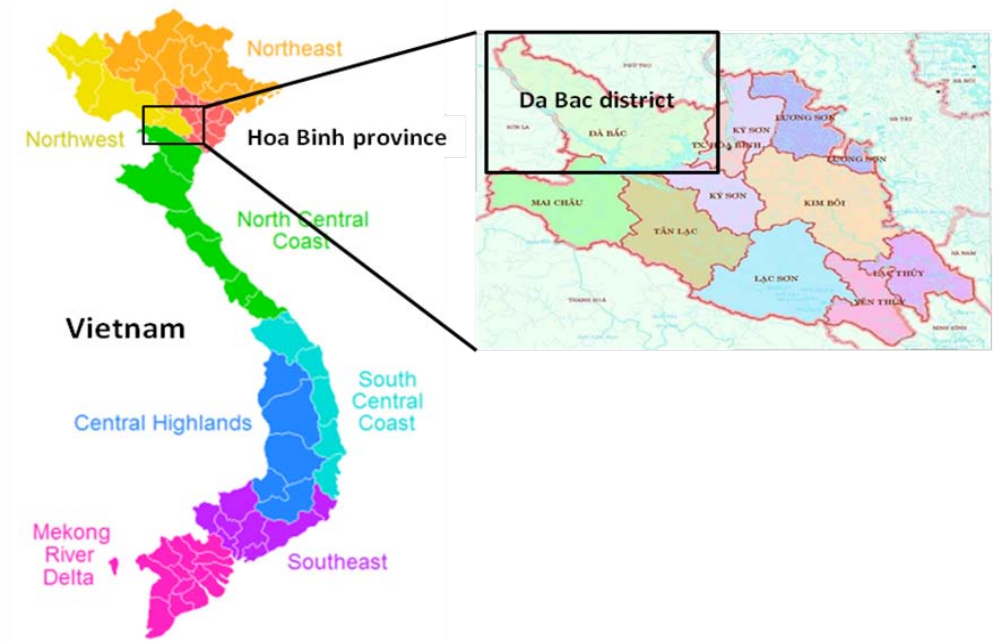

Figure 1.2 Location of the study area

The dissertation is composed of three main chapters addressing the main objectives, which are followed by a conclusion. Chapter 2 first analyzes current practices of household forest management by comparing the profitability of forest plantation to cash crop cultivation as well as by examining farmers' dependency on forest products. Then, the distribution of households participating in PES-like programs, such as Program 327 or Program 661, is examined. The main focus of Chapter 2 is to identify factors determining the decision to plant forest and its intensity using a Heckman sample selection model. The regression analysis tests different variables that are hypothesized to affect forest plantation behavior, including household demographic and socioeconomic characteristics such as social capital indicators, plot characteristics, and participation in forest plantation support programs. Chapter 3 presents a non-market valuation to explore farmers' preferences for conservation oriented forest management versus the current production oriented management. Choice experiment estimates the WTA planting and conserving forest under a hypothetical baseline scenario. Apart from the amount of subsidy, preferences on other attributes of forest management are investigated. The use of a random parameter logit (RPL) model reveals the trade-off between subsidy and other program attributes, as well as identifies whether there exists heterogeneity in farmers' preferences. Chapter 4 explores data on transactional burdens experienced by farmers when participating in forest plantation support programs. The main focus is on measuring private TCs; however, determinants of TCs are also investigated to test the hypothesis of whether TCs vary according to household and program characteristics. The end of Chapter 4 reviews related literature and provides a discussion on the issue of TCs in individual and community forest management. Finally, Chapter 5 provides conclusions, policy implications, and suggestions for further research.

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CHAPTER 2

DETERMINANTS OF HOUSEHOLD FOREST PLANTATION IN THE NORTHERN UPLANDS OF VIETNAM

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Abstract

Forestry is an important sector in the mountainous area of northern Vietnam, providing significant economic benefits to sustain households' livelihoods and generating ecological benefits to downstream areas. The Vietnamese government has allocated forest land to individual households and has provided support for household forest plantation with the objectives of economic development and forest cover expansion. This study aims to find out the extent to which forests play a role in farmers' livelihoods and to examine the underlying factors determining the decision to plant forests and intensity of planting forests. The results can provide useful information for designing more effective incentives under the payment for environmental services scheme between upstream and downstream stakeholders. Data of 300 households in the upstream area of the Hoa Binh reservoir are analyzed. Heckman sample selection estimation examines the determinants of the decision to plant forests and the intensity of planting forests. The results showed that growing trees is not profitable and is unable to compete with growing cash crops. Therefore, a sufficient amount of subsidy is needed to promote more households to plant and conserve forests. Seedling support positively determines the intensity of forest planting, but the magnitude of the impact is relatively low and cannot encourage farmers to plant more trees. Cash support does not achieve positive impact on intensity of forest planting. The results shed light on the importance of monitoring and the optimum incentive needed to achieve the sustainability of the forest plantation scheme.

2.1 Introduction

Forestry is an important sector in the mountainous area of northern Vietnam, providing significant economic benefits to sustain households' livelihoods as well as generating ecological benefits such as reducing soil degradation and improving water flow to downstream areas. In the 1960s, forest management in Vietnam was under centralized state control, yet since the beginning of the 1990s it has moved towards the empowerment of local bodies, especially households (Sunderlin and Ba, 2005). Since 1994, the Vietnamese government has allocated forest land to individual households under the 1993 Land Law. In addition, the government has provided financial and technical support for household forest plantation through several programs that pursue multiple objectives, namely poverty alleviation, economic development, and forest cover expansion. Poor countries like Vietnam are unlikely to reach the desired planting capacity by relying only on government resources through structured government projects. To overcome this resource constraint, forest plantation has been proposed as part of the payment for environmental services (PES) scheme between upstream farmers and downstream beneficiaries or even beyond the local context, such as the formal market under greenhouse gas emission initiatives. From the perspective of the government or ecosystem service buyers, it is crucial to understand the current context and differences in patterns of farmers' behavior to encourage individual households to participate in forest conservation (FAO, 1986).

Several studies have examined the impacts of forest policy in the Northern Uplands by using imagery data and qualitative analysis (e.g., Castella et al., 2006; Sikor, 2001), emphasizing relevant institutions (Clement and Amezaga, 2009), or conducting quantitative analyses at the commune level (Clement et al., 2009) and at the household level but focusing only on forest land allocation (Dinh, 2005). This study fills the research gap by examining forest management at the household level in the northern mountainous area of Vietnam. In particular, we aim to find out the extent to which forests play a role in farmers' livelihoods and to examine the underlying factors determining the decision to plant forest and intensity of planting forests. Special attention is given to the impact of government support on forest plantation. The scope of the study is limited to the decision of farmers to plant trees with a production purpose where individual ownership of land and trees is given to households. The study does not consider forest protection activities because there is a large variation in the management of forest protection activity among local government units. For example, in some villages every household participates in a

forest protection group, whereas in other villages households manage individual protection activities. The remainder of this paper is structured as follows: Section 2.2 describes the study area and provides a brief summary of forest plantation support programs in the study site; the methodology, including data collection, economic model, and econometric estimation procedure, is presented in Section 2.3; Section 2.4 reports and discusses the results; and Section 2.5 provides conclusions.

2.2 Study Area

The study area is the mountainous district of Da Bac, the largest district of Hoa Binh province located in the northwestern region of Vietnam. Da Bac district is the largest district in the province and is located at the highest altitude above sea level (560 meters). In addition, it has the lowest population density in the province (66 persons per square km) (Hoa Binh Statistical office, 2011). The majority of the population is comprised of ethnic groups, which are the Tay, the Muong, and the Dao. The study area in Da Bac district has diversified economic activities due to its proximity to Ha Noi, which is about 100 km away, as well as its varied geography which includes the Hoa Binh reservoir in the south and a steep mountainous area in the north. Over two-thirds of the area is covered by natural forests (39%) and production forests (28%). Because the government had previously provided bamboo and acacia seedlings to farmers, these are the main trees planted in production forest areas. Other tree species, such as Eucalyptus, Chinaberry (*Melia azedarach*), Bodhi tree (*Ficus religiosa*) and *Manglietia conifera* are also planted in production forest areas. Agricultural areas, including paddy fields, are merely 7% of the total land area of the district. Nearly one-fifth of the district is identified as unused land. Rice is grown as a subsistence crop in irrigated paddy fields of the lowlands, whereas main crops, namely maize, cassava, and arrow root, are cultivated in the uplands. In general, households also manage to have small-scale livestock farming for home consumption and income generation. Fishery and aquaculture are practiced in the communes located near the reservoir.

In Da Bac district, forest land has been allocated to individual households since 1994 under the 1993 Land Law. Households received a Land Use Certificate (also known as a 'Redbook') as proof that its holder has the legal rights to exchange, transfer, lease, inherit, and mortgage the land use right for the purpose of forestry for 50 years. Land that is

classified as 'forest land' is usually located on steep slopes where agriculture is forbidden. The process of land allocation in the study area was from 1994 to 1995, which may differ across communes.

Past and current forest plantation support programs

There is a series of government programs that provides supports for forest plantation with varying time spans and subsidy amounts. These are summarized in Table 2.1. The most well-known and participated-in program is the resettlement program, also known as Program 747, for households who relocated from the Hoa Binh dam construction site and its reservoir area. The goal of this program is to promote economic growth and alleviate poverty for the majority of population there, ethnic minorities who are on average extremely poor. In particular, the investment on short-term growing trees, such as bamboo, is supported by provision of seedlings and cash which is used to compensate labor costs for a period of three years, as well as training on techniques of tree plantation and maintenance.

The Five-Million-Hectare-Reforestation Program, or Program 661, is another government initiative which has the main goal of supporting forest plantation at the national level. The program initially offered loans to companies for reforestation for the purpose of forest protection and began in 1998 after Program 747. The program has evolved to include the provision of direct support to plantations established by households since 2006 (Sikor, 2011). The government only provides a broad framework and indicates a set of policies, whereby local authorities are given a degree of freedom to design activities (MARD, 2000). There are two types of support to individual households according to the purpose of plantation, which is either forest protection or production. Support differs in terms of the amount and period of benefits, as well as the policy of harvesting timber products. Program 661 provides tree seedlings, mainly acacia and other slow growing tree species, and cash as labor compensation. The program has a maximum total value of support of 2-3 million VND (approximately USD 95-144)[3] per hectare, depending on the cost of tree seedlings. The payment for labor compensation is not fixed, but is contingent on the quality and survival rate of the trees. As a worst case scenario, farmers will not receive any compensation for labor if the percentage of tree cover is less than 50% of the pre-determined number of trees per hectare. If, on the other hand, the tree

[3] The average exchange rate in 2012: USD 1=20,899 VND (Vietcom Bank)

cover is maintained at more than 85%, farmers would receive the full amount of labor compensation one year after the beginning of the contract.

Table 2.1 Summary of major forest support programs in Da Bac district

Program	747	661	327	135
Implementing period	1983 - 2008	1999-2010	1992-1998	1998 - present
Tree species	Bamboo	Acacia and slow growing trees	Bamboo	Acacia, eucalyptus, etc.
Type of support	Tree seedlings and cash	Tree seedlings and cash	Tree seedlings and cash	Tree seedlings and cash
Amount of subsidy (in thousand VND)	1st year: 1,000-1,300 2nd year: 400-500 3rd year: 300-400	1st year: 840-1,665	1st year: 250	1st year: 2,500 2nd year: 1,200 3rd year: 800 4th to 8th year: 600 and decreasing by 200 every year

Note: Data on subsidies are from interviews with officers and focus group discussions with farmers. The amount of subsidy for each program is not the same for all communes due to varying situations at the commune level.

In addition to these two main programs, there is another program for the "strengthening of reforestation, re-greening of open land and bare hills as a way to reduce harvesting in natural forests" (MARD, 2000, p.1), which is widely known as Program 327. Program 661 can be considered as the continuation of Program 327, which began in 1992 (Nguyen and Baulch, 2007). Lastly, the program for socio-economic development of the communes in ethnic, mountainous, boundary, and remote areas (known as Program 135) has been nationally implemented since 1998. The major support of the program is for infrastructure development, however, there are some components of the program that provide seedlings and cash support for afforestation purposes as well.

2.3 Methodology

2.3.1 Sampling and data collection

A household survey was conducted from November-December of 2011 in Da Bac district. A two-stage cluster sampling procedure was employed where a village-level sampling frame was constructed based on the number of households per village. At the first stage, 20

villages were randomly selected using the Probability Proportionate to Size method (Carletto, 1999), resulting in larger villages having a higher probability to be selected. Then, 15 households were randomly selected in each of the selected villages using village level household lists. For the two villages that did not have a household list, the random walk method was used to select the sampled households. In total, the dataset consists of 300 households which are representative at the district and village levels. The survey covered a wide range of topics ranging from demographic, socio-economic data, food security, social capital, land use, land tenure, agricultural production, and forest protection and production activities. In addition, focus group discussions using the participatory rural appraisal (PRA) technique in five villages from different communes were conducted to collect detailed information on: community history; government programs for the forestry sector implemented in the community and their evaluations; institutional settings for land allocation in the community; and information on how households want to improve their practices in forest production and forest protection. Four interviews with key informants at the district office and state forest enterprise were conducted to obtain insightful information on forest plantation support programs.

2.3.2 Economic model

This study follows previous research on tree plantation and adoption of conservation practices (e.g., Gebreegziabher et al., 2010; Godoy, 1992; Saint-Macary, 2010). In principle, factors affecting the decision to plant forest and the intensity of forest plantation depend strongly on how the decision to plant trees is conceptualized. An analytical model is developed by assuming that the decision by individual households to plant forest is based on utility maximization. In other words, a household decides to plant forest if the utility from planting forest is larger than the utility from not planting. The utility of adopting forest plantation is a function of vector X as $U_{pi} = V(X_{pi}) + u_{pi}$, where p = 1 for decision to plant forest and p = 0 for the decision to not plant forest. The utilities U are random and the ith household chooses to plant forest if it generates more utility than it would by choosing to not plant forest, i.e., $U_{1i} > U_{0i}$. However, since the marginal benefit of planting forest compared to not planting forest is not observable, we model the differences between utilities as an unobservable variable y*, such that:

$$y_{1i}^{*} = U_{1i} - U_{0i} = X_{1i}^{'}\beta_1 + u_{1i} \text{ where } y_{1i} = 1 \text{ if } y_{1i}^{*} > 0;\ y_{1i} = 0 \text{ if } y_{1i}^{*} \leq 0 \qquad (1)$$

where X_{1i} is a vector of explanatory variables affecting the decision to plant forest and u_{1i} is an error term. We do not observe the net utility. Instead, we observe whether the household decides to plant forest (y_{1i}). To analyze the intensity of forest plantation, we examine the number of trees farmers planted (y_{2i}), which is denoted as:

$$y_{2i}^* = X_{2i}'\beta_2 + u_{2i} \text{ where } y_{2i} = y_{2i}^* \; if \; y_{1i}^* > 0; \; y_{2i} = 0 \; if \; y_{1i}^* \leq 0. \quad (2)$$

The variables y_1* and y_2*are unobserved, whereas y_1 and y_2 are observed. The error terms u_1 and u_2 are expected to be positively correlated. For example, farmers who are only able to achieve a low profit from growing forest given the low availability of their own land will decide not to plant forest. It is assumed that u_1 and u_2 have a bivariate normal distribution.

2.3.3 Econometric estimation procedure

In our case, forest planting is only observed for a subset of the sample population and it is likely that households who planted forest are not a random subsample of the population. Self-selection bias could arise if unobservable factors affect the decision of farmers to plant trees or if farmers selected themselves into the forest planting group. In such a case, regressing the number of trees on exogenous factors will result in biased parameters. In theory, for the case of truncated data where only households with a positive number of trees are observed, the Tobit model is a potential option as employed by a previous study on innovation adoption (Adesina and Zinnah, 1993). However, since we assume that factors affecting the decision to plant forest would be different from factors determining how many trees are planted, the Heckman sample selection model is considered to be more appropriate than the Tobit model as the latter assumes that the factors for the two stages of the decision are the same (Kennedy, 2008). Following the Heckman (1979) approach of two-step estimation, the conditional expectation of y_2* is given by:

$$E(y_{2i}^*|x_{2i}, y_{1i}^* > 0) = x_{2i}'\beta_2 + E(u_{2i}|u_{1i} > -x_{1i}'\beta_1) = x_{2i}'\beta_2 + \frac{\sigma_{12}}{\sigma_1}\frac{\phi\left(-(x_{1i}'\beta_1/\sigma_1)\right)}{1-\Phi\left(-(x_{1i}'\beta_1/\sigma_1)\right)} \quad (3)$$

where $\phi(.)$ and $\Phi(.)$ denote the density and cumulative density functions of the standard normal distribution, respectively. The aim is to estimate the inverse Mills ratio:

$$\lambda(x_{1i}'\beta_1/\sigma_1) = \frac{\phi\left(-(x_{1i}'\beta_1/\sigma_1)\right)}{1-\Phi\left(-(x_{1i}'\beta_1/\sigma_1)\right)} \quad (4)$$

by employing a Probit model as the first step. In the second step, we estimate

$$y_{2i} = x_{2i}'\beta_2 + \frac{\sigma_{12}}{\sigma_1}\lambda(x_{1i}'\beta_1/\sigma_1) + \varepsilon_2. \quad (5)$$

First, the selection equation (1) with a decision to either plant forest or not as the dependent variable is estimated to obtain the inverse Mills ratio. Then, the outcome equation (5), which has the number of trees planted as the dependent variable, and the inverse Mills ratio and other relevant explanatory variables are estimated.[4] Since the sample selection model is considered to be more vulnerable to collinearity problems (Puhani, 2000), we impose the exclusion restriction to the model, which requires that the selection equation have at least one exogenous variable that is excluded from the outcome equation (Cameron and Trivedi, 2009). The explanatory variables are selected not only based on the literature, but also based on the local context. Table 2.2 presents the explanatory variables for both equations, their descriptive statistics, and expected signs.

Considering the scarcity of land due to the geographical condition of the study area and the state control of land use purposes, we hypothesize that land constraint is a crucial factor in determining whether a household decides to plant forest. A previous study in Vietnam claimed that lack of land is the main reason for not planting forest (Dinh, 2005). Thus, for the selection equation, we examine variables that could affect the land acquisition process of households. According to Sowerwine (2004), the implementation of forest land allocation has often been captured by the local elite due to the discretionary power of local authorities. Hence, factors indicating the connection to local authorities are chosen. HIGHESTAGE denotes the highest age of a household member. It is hypothesized that households with older members are more likely to be allocated with forest land and will therefore have a higher probability of planting forest. Another variable that may affect access to forest land is MEMORG: Households with more memberships in local organizations may have a stronger social network and are therefore expected to have a higher possibility of receiving land compared to households who are not as actively involved in the community. Nonetheless, access to forest land does not always result in deciding to plant forest. Due to the weak monitoring system, farmers may not feel obliged to plant trees in the forest land. Instead, they may try to maximize benefits they obtain from all of their land. AREAPC measures the land area per capita (excluding residential land). It is hypothesized that households with more land availability per capita are more likely to use extra land to plant forest (Gebreegziabher et al., 2010; Schwarz, 2012).

[4] This approach of estimating the likelihood by way of a two-step method is called the limited information maximum likelihood (LIML) method (Puhani, 2000).

Table 2.2 Explanatory variables and descriptive statistics

Variable	Description	Mean	s.d.	Expected sign
Outcome equation: ***Dependent variable***				
TREE	Number of trees the household planted since the inception of household until 2012	1,247.0	1,616.1	N/A
Explanatory variables				
AGE	Age of household head (in years)	44.4	10.9	+/-
EDUC	1 if the household head has a high school certificate, 0 otherwise	0.5	0.5	+
ACTIVES	Number of non-disabled adults in the household aged 18-60	3.0	1.2	+
FORESTAREA	Share of forest area in the total area excluding residential area (%)	60.0	40.0	+
DISTANT	Walking time from the house to the forest plot (in minutes)	36.7	36.5	-
REDBOOK	1 if the household has a Redbook for forest land at the first time of plantation, 0 otherwise	0.6	0.5	+
TRUST	1 if the household trusts other households in the village, in general, 0 otherwise	0.4	0.5	+
INCOMEPC	Annual household income per capita excluding income from forest (in thousand VND)	6,247.2	6,774.2	+
SEEDSUP	Amount of tree seedlings the household received from government programs	757	1,255	+
CASHSUP	Amount of cash support for forest plantation that the household received from government programs (in thousand VND)	1,056.9	3,609.2	+
Selection equation: ***Dependent variable***				
PLANTFOR	1 if the household decided to plant forest, 0 otherwise	0.9	0.3	N/A
Explanatory variables				
HIGHESTAGE	The highest age of a household member (in years)	50.2	15.0	+
EDUC	1 if the household head has a high school certificate, 0 otherwise	0.5	0.5	+
ACTIVES	Number of non-disabled adults in the household aged 18-60	3.0	1.2	+
TRUST	1 if the household trusts other households in the village, in general, 0 otherwise	0.4	0.5	+
INCOMEPC	Annual household income per capita excluding income from forest (in thousand VND)	6,247.2	6,774.2	+
AREAPC	Total area per capita (in square meters)	4,655.9	5,077.2	+
MEMORG	Total number of memberships in local organizations of all household members	2.2	1.5	+
VILLAGE	Village where household is located	-	-	+/-

Note: s.d. = standard deviation, N/A = not applicable

EDUC indicates whether the household head has a high school certificate. Formal education is supposed to enhance farmer's ability to acquire and process information on land access. This variable is also included in the outcome equation as more education is expected to raise awareness on the environmental benefits of planting forest, which might determine the number of trees planted (Nepal et al., 2007; Gebreegziabher et al., 2010). The availability of household labor is measured by the variable ACTIVES, which represents the number of non-disabled adults living in the household aged 18 to 60 years. It is hypothesized that a greater availability of labor will positively affect both the decision to plant forest and the number of tree planted since most farmers use their own household labor (only 6% of households hire labor outside of the household). INCOMEPC denotes annual household income per capita during the previous 12 months, excluding income from forest. This proxies the wealth status of the household at the time of planting forest due to the difficulty of recalling income information since forest trees were first planted, which could be longer than 10 years in some cases. Endogeneity is not a concern since profit from forest is not a major contributor to household income. Wealthy farmers are more willing to forgo current consumption for future benefit and are more likely to assign lower risk premiums on future outcomes. Therefore, it is expected that there will be an observed positive relationship between tree-growing activity and household income (Patel et al., 1995; Dinh, 2005) and hence the income variable is an explanatory variable in both equations. TRUST measures the level of trust among farmers and is expected to positively affect both the decision to plant forest and the intensity of forest plantation (Nepal et al., 2007) since the forest land in the study area is normally located far away from the house and farmers are concerned about timber stealing and damage to forest caused by grazing cattle. VILLAGE denotes the village where households are located to capture the variation of forest land availability across villages.

In addition to the variables in the selection equation, there are more variables considered in the outcome equation. AGE denotes the age of the household head and represents the experience of the farm household. The influence of age is unclear. On the one hand, an older farmer is often considered to be more risk averse and thus less likely to invest in economic activities, such as planting forest which yields benefits in the longer period (D'Souza et al., 1993; Schwarz, 2012). On the other hand, if forest plantation is perceived as a way to earn additional income and thus reduce the scale of the farm operation, it may represent an attractive option for older farmers (Gebreegziabher et al.,

2010). FORESTAREA represents the share of forest land in the total land area allocated to the household. Despite the fact that households are supposed to plant trees on land that is classified as 'forest land', there are a number of households who use the land for food production (Dinh Duc Thuan, 2005). Therefore, it is of interest to test the hypothesis of whether a higher proportion of forestland has a positive relationship with the number of trees farmers want to plant. DISTANT represents the logistic aspect of forest establishment by measuring the time needed for walking from the household to the forest plot.[5] It is hypothesized that greater distances will result in fewer trees planted since the initial plantation cost is higher. Land tenure security is considered a key factor for the decision to implement long term land use. Studies suggest that smallholders must enjoy security over land or trees before they cultivate and care for trees (Godoy, 1992; Dinh, 2005; Gebreegziabher et al., 2010; Saint-Macary et al., 2010; Schwarz, 2012). REDBOOK represents the possession of the official certificate of the land use right for forest land which provides the security of land use for a period of 50 years from the issuance date. Farmers who have a land use certificate are expected to plant more trees than those who do not have legal security over the land. Another determining factor is the extent of government support which has been justified on several grounds, such as the reduction of farmers' financial problems and helping farmers overcome the initial reluctance to invest in tree planting (Godoy, 1992; Saint-Macary et al., 2010; Schwarz, 2012). Two variables, SEEDSUP and CASHSUP, measure the impact of government support in terms of the amount of seedlings and cash that farmers received from the government for the purpose of forest plantation. Since farmers received cash at different time periods, the value of cash support from each observation is adjusted to the same base year (2000) using Vietnamese inflation rates.

2.4 Results and discussion

2.4.1 Household characteristics

The sampled households are comprised of four ethnic groups, i.e., Muong, Tay, Dao, and Kinh, where the Muong ethnic group is the majority (43.7%) and the Kinh (ethnic Vietnamese) is the smallest group (6.7%). Almost all household heads can read and write

[5] Even though some households own more than one forest plots, they are located in the same proximity therefore the distance is the same.

(92%), yet about half have attained a secondary or higher education degree. The average household size is 4.4 persons of which on average of 3 are in the active labor force. The average annual income per capita is approximately 5,719,806 VND[6] (USD 274.6) and 69% of households fall below the rural poverty line of 520,000 VND per month (World Bank, 2012). [7] The largest share of household income is from farm activities (76%). The share of income from forest, including commercial timber and own consumption of non-timber products, is relatively small (9%). About two-thirds of households claim to have experienced a food shortage in the previous 12 months.

2.4.2 Profitability of forest plantation

Profit from forest plantation is a critical factor influencing the decision to plant forest. The net present values (NPVs) of the costs and benefits of two main species of trees, acacia and bamboo, are compared with two main cash crops, maize and cassava (see Appendix C for details). NPVs are calculated using a seven-year cycle of growth of acacia[8] which has the longest harvest cycle compared to other plants, an equivalent period for bamboo, two seasons per year of maize cultivation, and one season per year of cassava. These calculations are based on common practices and average data related to inputs, outputs, and management characteristics obtained from the study site. Regarding the NPV of maize cultivation, it is assumed that there are negative effects of maize monoculture, i.e., the reduction in the top soil and the accumulation of pests and diseases over time. Consequently, with time more fertilizer or pesticides will be required to replace the nutrients and to maintain the same yield, respectively. Therefore, we assume that the cost of fertilizer input for maize is increasing every year by 5% or 10%. The market wage rate of 100,000 VND per labor-day is used as the value of the household labor cost and discount rates of 5%, 10%, and 15%[9] are used for sensitivity analysis. The actual amount of forest plantation support (both seedlings and cash) from the government is also incorporated in the analysis.

[6] This is adjusted for inflation and shown in the 2012 equivalent.
[7] Equivalent to USD 1.83 per day 2005 PPP.
[8] Seven years of harvest cycle is chosen as it is the shortest period that farmers can harvest commercial timber.
[9] To establish the mid-point of the discount rate, we use Vietnamese average inflation rate from 1999-2012 which is approximately 7% (World Bank, 2012) plus opportunity cost of capital at 3%. Then we plus and minus 5% from the mid-point to set the range of discount rates.

Table 2.3 Net present values of cash crop cultivation and forest plantation

Discount rate (%)	Cassava	Maize		Bamboo		Acacia	
		5% increased cost	10% increased cost	no support	with support	no support	with support
5	65,663	119,126	111,658	66,968	73,669	60,482	61,923
10	55,246	100,592	94,765	44,974	51,371	41,818	43,193
15	47,212	86,254	81,636	29,882	36,001	28,892	30,208

Note: The unit is thousand VND per hectare

Table 2.3 shows that, on average, maize cultivation can generate nearly twice as much income compared to growing acacia or bamboo, assuming that farmers reap benefits from harvesting timber and non-timber forest products. Discount rates capture time preferences of households and show that for households with a discount rate of 15%, maize can generate almost three times more profit than planting bamboo or acacia (under the assumption of a 5% increment in fertilizer cost). However, a limitation of this analysis is that in practice, most farmers also plant short-term crops in forest plots and the profit from these crops is not accounted for here. Another shortcoming is that the prices of cash crops and timber products are assumed to be constant over time. Thus, the above calculations can be considered as lower bounds on the profitability of forest plantation. Our finding is comparable with a study in Hoa Binh province (Clement et al., 2007) which found that tree planting is not an economically feasible option, except for the richest farmers. From a benefit viewpoint, planting forest can be seen as an alternative or secondary livelihood where farmers can reap benefits regularly from non-timber products. The results also indicate that the monetary support from the government does not contribute much to the overall profit, but could help relax capital constraints on the establishment cost of forest plantation.

2.4.3 Dependency of forest products

It is useful to understand how forest contributes to the livelihood of households by examining the extent of dependency on forest products. Dependency was measured by the share of income from cash sales and subsistence consumption of timber and non-timber products in total household income. We also divided households into three groups by a

relative poverty index based on several indicators, following Henry et al. (2003).[10] Annual income from forest product is approximately USD 117 per household, accounting for 10% of total income. This indicates a low dependency on forest for farmers in the study area. We did not find significant differences in either absolute forest income or the share of forest income among poverty groups. This is consistent with findings from McElwee (2008) and contradicts the general perception that poverty and forests are always linked.

2.4.4 Household forest plantation and participation in forest support programs

The linkage between poverty and investment in forest was also examined by analyzing the share of households who planted forest in each poverty tercile. Figure 2.1 shows that approximately 90% of households within each group has planted forest and that there is no significant difference in the forest plantation rate among the poverty groups (the ANOVA test result is omitted). Most households could provide information on the program, such as the type and amount of benefits they received, yet they were less certain about the name of the programs. This could be explained by the fact that there are overlaps of the programs in terms of time periods and the type of benefits. More than half of households (56%) participated in Program 747, which has the purpose of supporting resettled households. The amount of cash compensation and type of tree seedlings provided by the program varied across communes. Only 15% of households participated in Program 661. According to the PRA, lack of land was the major obstacle for households to participate in Program 661, especially for households who had participated in Program 747 and did not want to cut down their existing bamboo. There are only a few households who participated in other forest support programs (Programs 135 and 327). The distribution of household participation in these programs by poverty groups is shown in Figure 2.1. As shown, the share of households who received support is significantly different across the poverty groups. Among the high-income level households, a higher proportion received support than in the case of low- and intermediate-income level households. This can be partially explained by the condition of Program 661 which provides support to individual farmers with extra land to plant forest. This resulted in greater participation of better-off farmers since poorer households own less land. Another explanation would be that richer

[10] The indicators that are used for the poverty index are the number of adults who attained at least a high school degree, number of children, child dependency ratio, experience of food shortages, having a balanced meal (whether household can afford the main meals that consists of rice, vegetables and animal protein), toilet availability, quality of the house's floor, quality of the house's roof, total land (excluding residential area), and value of assets per capita.

households are better connected to the authorities and village head and are therefore more able to receive support once they plant trees.

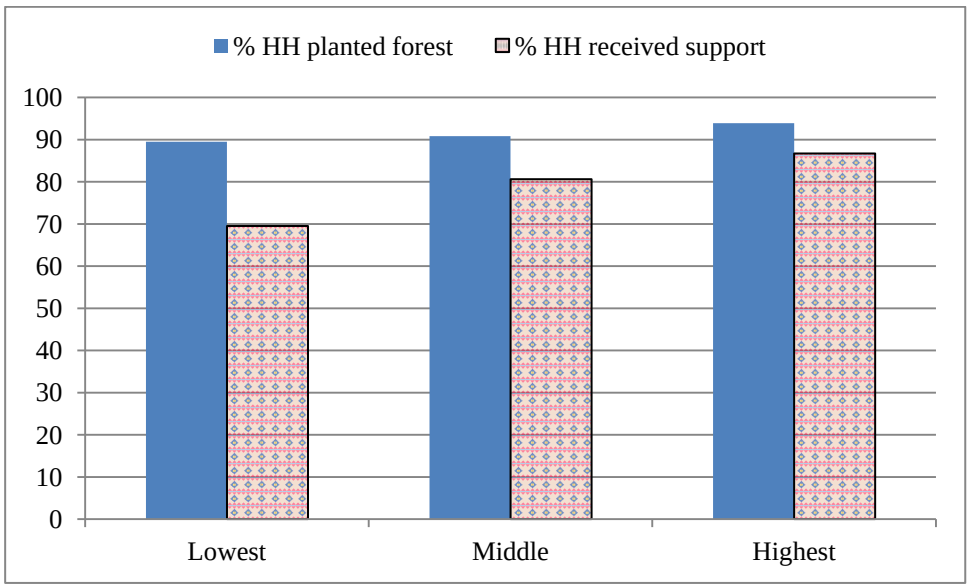

Figure 2.1 Share of households who planted forest and households who received support

2.4.5 Determinants of household forest plantation

Analysis of profitability in forestry cannot capture differences across households in terms of factors and resources which are likely to create variation in the relative benefits of forest plantation. There are also other factors affecting the decision to plant forest and the amount planted. Estimation results from a Heckman two-step estimation are shown in Table 2.4. Since sample selection model is considered to be more vulnerable to collinearity (Puhani, 2000), we first try to detect potential collinearity between explanatory variables in the outcome equation and inverse Mills' ratio. The Variance Inflation Factor is equal to 1.1, which is lower than the threshold of 10, indicating that multicollinearity does not pose a problem (Myers, 1990). Another test of collinearity is conducted to test the robustness of the model by calculating the condition number.[11] The result shows that the condition number is 18.37, which is lower than the threshold of 20 suggested by Leung and Yu (1996), indicating that the sample selection model is more robust than its alternative (i.e., a

[11] Condition number is defined as the square root of the ratio of the largest to the smallest eigenvalue of the moment matrix of regressors.

subsample OLS or two-part model). The inverse Mills' ratio (MILLS) is statistically significant at 5% of error probability, providing evidence of sample selection.

Table 2.4 Estimated coefficients from the Heckman sample selection model

Variable	Coefficient estimate	
	Coefficient	Z-statistic
Outcome equation: Number of trees planted		
AGE	-6.467	-0.82
EDUC	27.156	0.16
ACTIVES	68.114	0.97
FORESTAREA	771.948***	3.41
DISTANT	-0.464	-0.2
REDBOOK	202.381	1.22
TRUST	88.149	0.52
INCOMEPC	0.004	0.32
SEEDSUP	0.623***	9.47
CASHSUP	0.023	1.02
Constant	323.826	0.69
Selection equation: Decision to plant forest or not		
HIGHESTAGE	0.042***	2.85
EDUC	-0.672*	-1.85
ACTIVES	0.137	0.81
TRUST	0.822**	2.15
INCOMEPC	-0.00003*	-1.72
AREAPC	0.0008***	4.62
MEMORG	0.328**	2.27
VILLAGE	0.067**	2.08
CONSTANT	-3.443***	-3.66
MILLS	-880.619**	-2.14
Observations	291	
Censored	25	
Wald chi2 (10)	123.06***	

Note: ***, ** and * indicate significance at 1%, 5% and 10% of error probability, respectively.

The results from the selection equation show that the highest age of a household member and membership in organizations are positive and statistically significant. This supports the hypotheses that an older household and a household with more ties to local organizations tend to have more access to land and hence a higher probability to invest in forest. The area per capita is positive and statistically significant, indicating that households with more land tend to invest more on other alternative activities, like forest, and do not concentrate only on cash crops. Education and income per capita are negative and weakly significant, suggesting that households with higher education and higher

income are less likely to plant forest. These results are contrary to the vast literature on conservation agriculture (e.g. D'Souza et al., 1993; Anley et al., 2006; Saint-Macary et al., 2010) and adoption studies of trees plantation (Nepal et al., 2007; Gebreegziabher et al., 2010;) that claim that education and income have positive impacts on the probability of adopting conservation practices. Our results can be explained by the view among farmers that forest plantation is purely an income generating activity with relatively little profit and is therefore not as attractive compared to other income-generating activities. The labor constraint is not significant, implying that labor force is not a critical factor determining the decision to plant forest. This result could also stem from the practice of borrowing labor from neighbors in the village. Therefore, household labor is not a binding constraint for farmers since they can still utilize labor from outside the household without incurring a significant cost. This demonstrates that forest plantation does not require much labor force beyond household capacity. The level of trust is positively significant, indicating that farmers are concerned about the security of their forest products since forest plots can be far away from their homes and the monitoring mechanism is not sufficient. Finally, the village variable is significant, suggesting that location determines the availability of forest land in the study area. In addition, it could be due to the different governance structures of forest management across villages.

Regarding the determinant of plantation intensity, households' socioeconomic indicators (age, education, income, and labor) are found to be statistically insignificant. The share of forest land is positive and significant, indicating that farmers with more forest land tend to grow more trees even though they have the option to grow cash crops in forest land as well. The amount of seedlings received from the government is positive and significant: The marginal effect[12] of seedling support is 0.623, implying that farmers are not encouraged to grow additional trees from the amount they receive. On the other hand, the extent of cash support is not significant, implying that cash support does not function as an incentive for farmers to grow more trees. Farmers may view the cash payment as merely their labor cost and not an incentive to invest more in forest. The result regarding the impact of government support is consistent with other studies on the poor capacity of Program 661, which provided inadequate incentives to make forestry an attractive option (Clement and Amezaga, 2008; Dinh Duc Thuan, 2005; Ohlsson et al., 2005). The distant from the plot to the house is not a significant factor determining the number of trees

[12] The marginal effect is equal to the estimated coefficient in the case of the OLS estimation of the outcome equation.

farmers want to plant. Having a Redbook is also not significant, providing evidence that land security does not affect the intensity of the forest. In fact, a number of farmers planted forest before they received the Redbook for their forest land. This can be explained by the fact that villagers have never experienced reallocation in the district, which contrasts with other areas in Vietnam where reallocation has occurred and where land tenure insecurity is an issue for farmers (Saint-Macary, 2010).

2.5 Conclusions

This study has examined socioeconomic aspects of individual forest plantation in the northern uplands of Vietnam, providing useful information for the design of more effective incentive mechanisms for households to plant forests in the future. Data from 300 households in Da Bac district were comprehensively analyzed using descriptive statistics, gross margin calculations, and econometric estimation. Our results show that a large share of households has engaged in forestry, mainly for commercial purposes. The dependency on forestry for household income is low. Indeed, it is clear from the gross margin analysis that growing trees is less profitable and is unable to compete with growing cash crops. Therefore, a sufficient subsidy from the government or other sources is needed to promote more farm households to plant and conserve forest. It is also interesting to observe that some poor households plant forests occasionally without external support. One explanation is the lack of market access for alternative products in some areas, making forest products more attractive due to the low maintenance cost of forests. This indicates that profitability is not the only factor explaining why farmers engage in forest plantation. Interviews with farmers revealed that they are aware of the environmental benefits of planting forest, but that it is not the determining factor in the decision of whether to plant forest.

A Heckman sample selection model investigated the determinants of the intensity of household forest plantation. Availability of land is a necessary condition for the decision to invest in forest, whereas labor availability is not found to influence the decision to plant forest. The level of trust among villagers can be a barrier that keeps farmers from investing in forest. Therefore, an effective monitoring mechanism could help lessen this barrier, particularly in areas with timber stealing or illegal logging. Education and wealth are found to have a negative relationship with the decision to invest in forest, which contradicts results in adoption studies on forest plantation and conservation practices. Farmers may

only view forest as an income generating business without other non-monetary benefits. Therefore, wealthier households prefer to use the resource for more attractive investments, such as maize cultivation. Even though the lack of landholding security is always the key factor inhibiting farmers to invest in activities that accrue profit in the long-run, such as planting forest or conducting conservation practices, there is no evidence in our study that farmers' land tenure security affects the intensity of forest plantation. The lack of previous land reallocation experience by farmers in the study area could influence this finding. Furthermore, support provided by the government may act as a *de facto* guarantee of land use rights for farmers to plant trees on land where the land use certificate has not yet been issued. Our finding also reveals the importance of institutional and governance factor of forest support programs at the local government units where they have certain degrees of freedom to implement forest policy. This has implications on the mechanism to check the transparency and accountability of local authorities in implementing forest policies to achieve the desirable policy outcomes.

Our regression analysis indicates that seedling support positively determines the intensity of forest planting, whereas cash support does not achieve similar impact. However, the magnitude of the impact from seedling support is relatively low and does not appear to stimulate farmers to plant more trees than what they receive. This situation underscores the importance of the impact of government support on the sustainability of forest plantation, which is recommended for future research especially on the design of PES policy. From our current data, we find that households have not replanted trees, but have instead grown food crops or left the land fallow after the trees died from unexpected problems, such as extreme weather. This phenomenon may nullify the statement by Godoy (1992) that outside support or assistance could act as bait that induces farmers to cultivate forest on their own. It also sheds light on the importance of monitoring and the incentive needed to achieve the sustainability of the scheme.

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CHAPTER 3

WHAT DO FARMERS WANT FROM FOREST PLANTATION SCHEME? A CHOICE EXPERIMENT TO ANALYZE WILLINGNESS TO ACCEPT AND CONTRACT PREFERENCES

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Abstract

Forests play an important role in the mountainous area of northern Vietnam, they are providing not only complementary source of income for poor households but also ecological benefits to the downstream area. Government has been active in supporting household forest plantation and conservation through the conventional programs providing tree seedlings and cash compensation as well as through the introduction of Payment for Forest Ecosystem Services (PFES). However, the pilot PFES scheme has not taken account of farmers' opportunity cost of alternative land use or preferences. Our article sheds light on the cost efficiency and reasons behind participation of local farmers, which are very fundamental for the success of the policy given the limited resources and voluntarism nature of the scheme. Choice experiment is used to estimate the willingness to accept to plant and conserve forest and to investigate different attributes of forest plantation contract that encourage farmers to participate in the program. The results revealed that farmers are not only concerned about the amount of subsidy but also pay attention to limitation of timber harvest, forest maintenance frequency and the level of punishment in case of contract violation. The willingness to accept to plant forest is higher than the previous government subsidy but is still far lower than the forgone income of cash crops cultivation. This finding underscores the fact that encouraging farmers to plant forest is not as costly as the opportunity cost of the land. Even though the local farmers tend to associate forestry more with monetary benefits, our findings have confirmed that there is room for a more stringent forest conservation program as long as the farmers are adequately compensated.

3.1 Introduction

Forests play an important role as a complementary source of income for poor households in the mountainous area of northern Vietnam. The government has supported household forest plantation for economic development (poverty alleviation) and environmental conservation for decades. In 2008 Vietnam implemented a pilot project on payments for forest environmental services (PFES) in Lam Dong and Son La provinces where the payment streams from ecosystem services beneficiaries, i.e. commercial hydropower, water production and tourism businesses, were transferred to the service providers including local farming households and communities as a reward for their forest protection (Winrock International, 2011). The payment was based on forest quality and threat level of the forest, not the opportunity cost of alternative land use accrued to farmers. At the same time, the policy tended to overlook other aspects of the program that targeted the interests of local farmers and induced more participation.

Our article sheds light on the cost efficiency and reasons behind participation of local farmers in the forest plantation programs, which are very fundamental for the success of the PES policy given the limited resources and voluntarism nature of the scheme. Forgone income from agriculture is not always a reliable factor in predicting farmers' participation in forest conservation for several reasons. First, there is uncertainty about the costs, yields and prices relating to tree plantation (Shaikh et al., 2007; Stavin, 1999). This uncertainty is especially important for planting forests, as the benefits accrue in the very distant future or several decades after the investment. Second, there may be non pecuniary benefits or other private benefits and costs related to forest plantation that farmers may take into account for reaching a decision. Our study aims to elicit the willingness to accept (WTA) of farmers to plant and conserve forest in their private area as well as to investigate the different attributes of forest plantation scheme that encourage farmers to participate in the program. It examines whether the farmers in developing countries are concerned only with money when it comes to forest conservation program and whether there is heterogeneity in contract preferences among farmers. Our findings provide insightful information on farmers' behavior and preferences which could contribute to the PFES related policy improvement in Vietnam in the future.

The analysis is based on choice experiment (CE), a stated preference method that is able to incorporate nonmarket values, risk attitude as well as unobservable benefits or costs

incurred for substituting agricultural activities with forest plantation. Several studies on agri-environmental scheme underscore the importance of looking at social acceptability (Espinosa-Goded, 2010; Grosjean and Kontoleon, 2009; Horne, 2006; Ruto and Garrod, 2009) and heterogeneity of farmer's preferences (Broch and Vedel, 2012; Hudson and Lusk, 2004) when determining the factors affecting farmers' participation. Most of these choice experiment studies are conducted in developed countries, except for the study on the sustainability of sloping land conversion program in China (Grosjean and Kontoleon, 2009). Therefore, our study also contributes to the very limited research in developing countries on the trade-off between environmental conservation and economic development. The remainder of the paper is organized as follows; Section 3.2 describes the study area; The conceptual framework, design of the choice experiment, econometric model and data collection are presented in Section 3.3; Section 3.4 reports and discusses the results; and Section 3.5 provides conclusions.

3.2 Study area

The study area is the mountainous district of Da Bac, the largest district of Hoa Binh province located in the northwestern region of Vietnam. Da Bac district is the largest district in the province and is located at the highest altitude above sea level (560 meters). In addition, it has the lowest population density in the province (66 persons per square km) (Hoa Binh Statistical office, 2011). The majority of the population is comprised of ethnic groups, which are the Tay, the Muong, and the Dao. The study area in Da Bac district has diversified economic activities due to its proximity to Ha Noi, which is about 100 km away, as well as its varied geography which includes the Hoa Binh reservoir in the south and a steep mountainous area in the north. Over two-thirds of the area is covered by natural forests (39%) and production forests (28%). Agricultural area, including paddy field, is merely 7% of the total area and nearly one-fifth of the area is identified as unused land. Rice is grown as a subsistence crop in irrigated paddy fields of the lowlands while the main crops cultivated in the uplands are maize, cassava, and arrow root. In general, households also have small scale livestock farming for home consumption and income generation. Fishery and aquaculture are practiced in the communes located near the reservoir. In Da Bac district, forest land has been allocated to individual households since 1994 (Tran et al., 2013) under the 1993 Land Law. Households received a Land Use Certificate (also known

as a 'Redbook') as proof that its holder has the legal rights to exchange, transfer, lease, inherit, and mortgage the land use right for the purpose of forestry for 50 years.

3.3 Methodology

3.3.1 Conceptual framework

This study applies the concept of agri-environmental scheme which gives farmers incentives to carry out environmentally beneficial activities on their land. We ask farmers to consider whether they want to participate in the voluntary forest plantation program and receive compensation (subsidy) from government in return. Choice experiment (CE) is employed to collect preference data from respondents in a hypothetical situation. The aim of CE is to place the decision maker in a certain frame of mind to compare a number of alternatives, each described in terms of some number of attributes (Adamowicz et al., 1998). In our case, the hypothetical baseline and contract attributes are stimuli and the individual's choice is the elicited response. According to Bennett and Birol (2010), the advantage of using CE rather than other stated preference technique is that it can examine the trade-off between different contract attributes, both quantitative and qualitative. Theoretically, the CE approach is based on consumer theory (Lancaster, 1966) which states that consumption decisions are determined by utility derived from the separable attributes of a good rather than the good per se.

3.3.2 Hypothetical baseline

Our study employs a hypothetical baseline to examine what households would do if circumstances changed and farmers were confronted with a new program (Whittington and Adamowicz, 2011). The respondents are informed that they would be allocated one hectare of land per household in the steep slope area, located about one km away from the respondent's house. We pose this baseline due to the fact that there is an inequality among farmers in terms of land holdings. This baseline is plausible from farmers' perspective since it is in line with the past forest land allocation in the study area. The size and location of the land are given to respondents to minimize the bias that may occur from the discrepancy of judgment towards the land and hence the value that respondents place on program participation. To underline the importance of the voluntary aspect of the program and to ensure that the farmers understand the questions and consider them seriously, we begin by asking the respondents about what they would do with this plot of land and its

reason. We then provide them with basic information about the new forest plantation program that the government would like to propose. This information is important as it minimizes the extent of farmers' own interpretation on information that is not explicitly mentioned, and it contains three main components. First, the government will provide all the establishment costs of forest plantation including seedlings, fertilizer and labor compensation to participants. This aspect is critical since these initial costs of forest plantation are found to be different among farmers and would confound the valuation of WTA, as farmers with a higher initial cost may give a higher WTA and vice versa. Second, the program will have the duration of ten years, and the third aspect is that the choice of tree will suit the local condition. This is quite important because some farmers were not satisfied with past government programs that offered the tree species that were not suitable to the local conditions and consequently a substantial number of trees have died. To capture the preference on tree species, the respondents are asked about the choice of trees they prefer to grow before starting with the choice tasks.

3.3.3 Attributes and attribute levels

After defining the setting of the proposed forest plantation program, the next important stage is to select the attributes and their levels. These are initially identified from the literature and prior experience of forest plantation support programs in the study area. We then further examine the relevance of these attributes through focus group discussions to ensure that the chosen attributes accommodate farmers' preferences and the levels do not seem unrealistic from their perspective. At the same time, we also take into consideration policy concerns and potential improvement in the future when choosing the attributes. The list of attributes and their levels are shown in Table 3.1. Due to the concern on cognitive complexity of the questions, we assign only two different levels to each attribute except for the subsidy level which has three different levels.

There are two sources of monetary benefits from participating in the program. The first is through the sale of planted trees, and this attribute comprises two levels. One of them is a conservation oriented policy where the participant is not allowed to harvest any timber products except for use in house construction and with a maximum allocation of ten cubic meters for the whole period. Another level is a production or commercial oriented policy where the participant is allowed to harvest up to 50% of matured timber products. However, the participant is free to harvest any non-timber forest products under both levels. This policy is included to examine farmers' preference beyond the current practice

where farmers are free to harvest timber. The second source of pecuniary benefit is the subsidy per hectare per year which has three levels ranging from 500,000 VND (USD 25) to 1,500,000 VND (USD 75). Establishing the appropriate level of subsidy is a crucial and challenging task which requires careful considerations. On the one hand, setting the subsidy too high would result in all respondents wanting to participate in the program and hence overestimating the WTA. In addition, a proposed subsidy that is far higher than the past government offers would lead to unrealistic policy implications. On the other hand, if the subsidy is too low, there will be no one participating in the program which would result in bias in estimation. To identify an appropriate range of subsidy, we set the figure with previous programs as a reference point and then use the survey pretests with local people to find the minimum amount that is acceptable among a diverse group of respondents.

Table 3.1 Attributes examined in the choice experiment

Attribute	Description	Levels
Harvesting policy	All participants can harvest non-timber forest products. The difference between the two levels is the extent to which participant can harvest timber products.	1. Participant cannot harvest timber except for the volume used for house construction (up to 10 m^3) 2. Participant can harvest 50% of timber
Frequency of forest maintenance	How often is participant obliged to maintain the forest per year throughout the contract period.	1. Once a month 2. Once every three months
Punishment	The severity of punishment in case of contract violation.	1. Contract would be terminated and participant has to return all the payment received 2. Pay a fine of 100,000 VND per time of violation
Subsidy	The amount of cash participant receives per ha per year	1. 500,000 VND (USD 25) 2. 1,000,000 VND (USD 50) 3. 1,500,000 VND (USD 75)
Frequency of subsidy payment	The frequency of subsidy payment to participant per contract year. In case of two times per year, half of the amount will be provided on mid-year and another half at the end of the year.	1. One time per year 2. Two times per year

The next attribute is the obligation to maintain forest which includes two options of once a month or once every three months. The next attribute lists the punishment when the contract is violated. There is one level with a relatively strong punishment where the

contract would be terminated and the participant is obliged to return all the payment they have received, including the initial cost of forest establishment. Another level of punishment is weaker, as participant only needs to pay a fine of 100,000 VND (approximately USD 5) per time of violation. The final attribute reflects how frequent the subsidy will be delivered to the participant. This aspect of the contract is included to check whether the farmers prefer the more frequent cash flow to the conventional once a year payment.

3.3.4 Experimental design

In our case, the use of a generic title for alternatives, or unlabeled experiment (Hensher et al., 2005), is considered to be more suitable since the specific title of the contract is not meaningful for our research goal. After identifying the attributes and associated levels, we generate different combinations of these levels called treatment combinations or choice profiles. We employ the full factorial design in which all possible treatment combinations are included. There are four attributes with two levels, and one attribute with three levels, making it a total of 48 profiles (2x2x2x2x3). Following the recommendation of Street et al. (2005) for an efficient design, we construct 24 pairs from 48 combinations, and there are at least three attributes that differ in each pair. Then, 24 pairs of alternatives are randomly formed into three groups in which eight different choice sets will be shown, one by one, to each respondent. According to Hess et al. (2012), there is no evidence of respondent fatigue for answering up to 16 choice sets, and our design falls within this limit. Nonetheless, we also checked for respondents' fatigue and their comprehension of the questions during pretest and found that respondents had no difficulties in answering the choice scenarios. Three different groups (blocks) of choice sets are randomly distributed in each village to ensure that there is no bias in responses of choice sets by location.

3.3.5 Questionnaire development

There are eight different choice cards in one group with each card representing a choice set as shown in Figure 3.1. The respondents are asked to choose one option, either contract A or B, or they can choose not to participate in the program at all. This opt-out option is included to reflect the real situation of demand for goods and services. The actual choice cards contain simplified local language (Vietnamese) combined with pictures and are shown to the respondent while the enumerator is providing the explanation. The follow-up question of why the respondent chooses a particular choice is asked for each choice set to ensure that the respondent understands the task correctly. Prior to the choice questions, we

ask the respondents to rank the attributes in the order of importance towards a successful forest plantation program. This ranking aims to make the respondents start thinking about the forest plantation program. The response can also be used to check the consistency of the choice answers later on. After finishing all the eight choice tasks, the respondent are asked to rate the feasibility of the hypothetical scenario and the choice questions. The reason for choosing not to participate in the program is investigated as well.

Card code: D

D1

Which contract would you choose? Only one choice!!

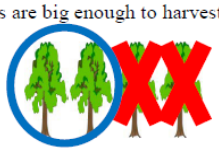
Attribute	Contract A	Contract B	
Timber harvesting policy In general household can harvest other forest products such as firewood, bamboo shoot, medicinal plant etc. 	Farmer is allowed to harvest commercial wood **ONLY for house construction** (up to 10 cubic meter) 	Farmer is allowed to harvest **50%** (half) of commercial wood when the timbers are big enough to harvest 	
Frequency of maintaining of forest until the end of contract (monitor for illegal logging, fire, diseases, cattles destroying trees)	Once a month	Once in every 3 months	I do not want any of the contracts. I prefer to use the land for something else.
Punishment if rules are violated (for example, when you cut more trees than the limit or if you don't maintain the forest as mentioned in the contract)	Contract would be terminated. Have to return all the money back	Pay fine of 100,000 vnd per time of violation	
Subsidy amount (will be provided from the second year of the contract)	**500,000** VND per year	**1 ,000,000** VND per year	
Frequency of delivering subsidy	**Two times per year** (half of the amount on mid-year and another half at the end of the year)	**One time** (at the end of contract year)	
Please choose one	☐	☐	☐

Figure 3.1 Example of a choice set

3.3.6 Econometric framework

The specification of choice model is based on the random utility theory (McFadden, 1974) where the utility, U, of a household i on a good j can be written in the form of a deterministic component (V) and a stochastic term (ε):

$$U_{ij} = V_{ij} + \varepsilon_{ij} \equiv \beta_i' x_{ij} + \varepsilon_{ij}$$

where V depends on the observable variables x_{ij} that include attributes of alternatives, household socio-economic characteristics as well as factors related to the decision context, β_i is a vector of coefficients of these variables for household i representing the household's

preferences, and ε_{ij} is a random term that is i.i.d. extreme value type 1. According to the theory, a household will choose an alternative k from a set of competing alternatives C when the indirect utility of k is greater than the indirect utility of any alternative, j. The probability of choosing k can be expressed as

$$\Pr(k|C) = Pr\left[(V_{ik} + \varepsilon_{ik}) > \left(V_{ij} + \varepsilon_{ij}\right)\right] = Pr\left[(\beta_i' x_{ik} + \varepsilon_{ik}) > \left(\beta_i' x_{ij} + \varepsilon_{ij}\right)\right], \forall j \neq k; j, k \in C$$

Our objective is to identify and estimate the β vector associated with the explanatory variables for the choice made. To estimate the preference parameter vector β, we use random parameter logit (RPL) model, also known as mixed logit model. Conditional on parameter β_i, the probability that household i chooses a specific alternative k in a choice task n (which has the sequence n=1, ..., N) from the three alternatives (contract A, contract B or no participation) is

$$Pr(ik|\beta_i) = \frac{\exp(\beta_i' x_{ik})}{\sum_j^J exp\left(\beta_i' x_{ij}\right)}$$

However, the researcher does not know β_i and therefore cannot condition on β. Following Train (2009), the unconditional choice probability is the integral of Pr (ik) over all possible β_i . Then the probability of choosing alternative k under RPL model becomes

$$\Pr(ik) = \int \left(\prod_{n=1}^{N} \left[\frac{exp(\beta_i' x_{ik})}{\sum_j^J exp\left(\beta_i' x_{ij}\right)} \right] \right) f(\beta) d\beta$$

where $f(\beta)$ is identified as a normal distribution function for β with mean b and covariance matrix W. The model is not subject to the independence of irrelevant alternatives (IIA) condition. It utilizes the repeated observations taken from each respondent, by making preference parameters constant over choice task within individual household but not among different households. This type of specification is more likely to enhance the explanatory power of the model (Broch and Vedel, 2012) than using conditional logit that requires IIA property and assumes homogenous preference across respondents. The choice probability does not have a closed form solution, thus it will be approximated through simulation. The parameters are estimated by maximizing the simulated likelihood function across sampled households.

3.3.7 Estimation procedure

The model contains variables related to five contract attributes (HARVEST, MAINTAIN, PUNISH, FREQUENCY, SUBSIDY) which are assumed to be random parameters and

have normal distribution except for the subsidy attribute that is assigned to be a fixed parameter.[13] The model also includes an alternative specific constant (ASC) which takes the value of one when the household chooses either contract A or B or zero otherwise. The function of ASC is to capture all other attributes that are unobservable or omitted from the model. In addition, we include in the model household specific characteristics which are shown in the literature to be the determinants of farmer participation in agri-environmental programs (Espinosa-Goded, 2010; Grosjean and Kontoleon, 2009; Ruto and Garrod, 2009; Zbinden and Lee, 2005). These variables include socioeconomic indicators of households such as: (1) age of household head (AGE = 1 if household head's age is equal to or less than 55 years old), (2) education attainment of household head (EDUC = 1 if household head has high school certificate or higher level of education), (3) annual household income per capita in VND (INCOME), and (4) number of household members aged 18-60 years old who are able to work (ACTIVES). In addition to the profile of household, access to the main road (ROAD = 1) is also considered important for the decision to participate in the program. The previous participation in the government forest plantation program (PASTSUPPORT = 1) is included as this factor can influence the perception of farmers on joining another government program. The type of trees that farmers wish to plant is hypothesized to influence the participation since some farmers do not want to participate if the seedlings provided are not suitable for the climatic or soil conditions. Two main types of trees (ACACIA and BAMBOO) are included in the model. These household specific variables are entered into the choice model by interacting with ASC to generate variation within the choice set. The estimation of such interaction terms examines which household characteristics affect the likelihood of participating in the proposed program. The RPL model is estimated using 500 Halton draws in order to obtain consistent estimates.

The RPL model allows us to identify the determinants of participating in the program as a function of contract attributes and household socio-economic factors. We can also estimate the marginal willingness to accept (or implicit price) associated with changes in contract attributes. Suppose the estimated subsidy parameter is $\beta_{subsidy}$ and the parameter of an attribute has mean β_{att} and standard deviation σ_{att}. Then the implicit price of the attribute would have the mean of $\beta_{att}/\beta_{subsidy}$ and the standard deviation of $\sigma_{att}/\beta_{subsidy}$ (Hensher et

[13] The variable is treated as random parameter means that the coefficient is assumed to vary across individuals. On the contrary, fixed parameter means that the coefficient is assumed to be the same for every observation (Hensher et al., 2005).

al., 2005). More importantly, the minimum willingness to accept (total consumer surplus) for farmers to participate in the program can be estimated by

$$WTA = -(V^0 - V^1)/\beta_{subsidy}$$

where V^0 is the indirect utility associated with the status quo of no program and V^1 is the indirect utility obtained from participating in the program.

3.3.8 Sampling and data collection

Two rounds of household survey were conducted from November to December 2011 and from August to September 2012 in Da Bac district, Hoa Binh province. A two-stage cluster sampling procedure was employed where a village-level sampling frame was constructed based on the number of households per village. At the first stage, 20 villages were randomly selected using the Probability Proportionate to Size method (Carletto, 1999), resulting in larger villages having a higher probability to be selected. Then, 15 households were randomly selected in each of the selected villages using village level household lists. For the two villages that did not have a household list, the random walk method (Henry et al., 2003) was used to select the sampled households. In total, the dataset consists of 300 households which are representative at the district and village levels. For the second round survey, nine households were missing due to unavoidable reasons such as sickness, death and relocation. Apart from the choice questions, the questionnaire covered a wide range of topics ranging from demographic, socio-economic data, food security, social capital, land use, land tenure, agricultural production, forest protection and production activities, and benefits from previous government programs.

3.4 Results and discussion

3.4.1 Household characteristics

Table 3.2 reports the descriptive statistics of all households as well as the subsamples of households who chose to participate in at least one choice occasion and those who provided negative answers to all of the choice occasions. The analysis of variance (ANOVA) test is conducted to determine whether the means between the two groups are statistically different or not. Average age of household heads is about 44 years old and there is no significant difference between the groups. Almost all the household heads (92%) are men and the percentage of male household heads in the participating group is

significantly higher than in the non-participation group. Nearly four-fifth (79%) of all household heads has secondary education or higher and there is no significant difference between subsamples. Average household size is the same between groups, so is the case with land area where the two groups have an average area of 0.47 ha per capita. About 80% of all households experienced food shortage in the past 12 months with no difference in food security status between subgroups. Average per capita income of all the households is about 5.8 million VND (USD 275)[14] per year and there is no significant difference between groups. However, the share of non-farm and forest income is significantly higher for participating group (43.8%) than non-participating group (32.8%). The proportion is also higher in the participating group even if we consider only the income from forest (10.9% compared to 6.5%). This implies that households who have enjoyed greater earnings from alternative sources are more willing to participate in the forest plantation scheme than those who have earned less from non-farm activities. The road access data reveal that households in participating group have poorer access (32.8%) than households who do not want to participate in the program (43.8%), which may indicate that households with poor access to market need more assistance from the government. It is also possible that having limited market access leads to lower opportunity costs of labor and hence they are more likely to join the forest program. The current involvement in forestry also varies with a greater proportion of household (94.0%) in participating group being currently active in forest plantation than the non-participating group (81.0%). Along the same line, households who have received the support for forest plantation in the past are more willing to participate in the program.

[14] 2012 average exchange rate: USD 1= VND 20,899 (Vietcom Bank)

Table 3.2 Household characteristics by decision to participate in the program

Characteristics	Participating (n=229)	Non-participating (n=62)	All (n=291)
Age of household head	44.3	45.5	44.5
Gender of household head: % Male	94.0%*	87.0%*	92.0%
Education: secondary school or higher	79.0%	82.3%	79.7%
Household size	4.4	4.4	4.4
Land area per capita (hectare)	0.47	0.47	0.47
Food security status: % households experienced food shortage	81.0%	74.0%	80.0%
Income per year per capita (in thousand VND)	5,808	5,528	5,748
Share of non-farm and forest income	43.8%**	32.8%**	41.5%
Share of forest income	10.9%*	6.5%*	10.0%
Access to road	34%**	48%**	37%
Planting forest currently	94.0%***	81.0%***	91.0%
Received support in the past	83.0%***	65.0%***	79.0%

Note: ***, **, * denote 1%, 5% and 10% level of error probability from one-way ANOVA; n= number of observation

On the reasons why farmers do not want to participate in any of the contracts, low subsidy amount is the most cited response at 33.9%. Lack of labor and household head being too old are the second most likely reason (24.2%) for not participating. Low level of trust in government is interestingly the third most given response (17.7%). This was due to some problems in the previous programs such as uncertainty in subsidy payment and seedlings that were not suitable for local conditions. Other economic-related reasons include the low income from forestry (12.9%) and the high risk involved (4.8%) due to the extreme weather in the mountainous area and benefits from forestry are accrued in the long term.

3.4.2 Ranking of attributes

Results of attribute ranking are reported in Table 3.3. The desire to earn more income from forest products is the most important facet of the program according to the participating households. However, the amount of subsidy is considered the most important factor for

non-participating group (35.5%). This is consistent with the finding that inadequate subsidy is the most common response for not choosing any contracts. Maintenance of forest is ranked as the second and third most important attribute for participating and non-participating groups respectively. Frequency of subsidy payment and punishment in case of contract violation are relatively less important for both groups.

Table 3.3 Attributes that promote the success of a forest plantation program

Attribute	Attribute is chosen as the first rank (%)		
	All (n=290)	Participating (n=228)	Non-participating (n=62)
Opportunity to use or sell products for income	45.5	50.4	27.4
Amount of subsidy from the government	26.6	24.1	35.5
Forest must be regularly maintained by farmers	25.2	37.1	21.9
Frequency of subsidy payment	7.2	5.3	14.5
Punishment in case of contract violation	3.1	2.2	6.5

Note: n= number of observation

3.4.3 Choice of land use

Farmers have been asked hypothetically what they would do with the land if they were allocated one. The answers from participating and non-participating households are shown in Table 3.4. Result from Pearson's Chi-square test is statistically significant (*p*-value = 0.00) which reveals that the choice of land use and intention to participate in the program are dependent on one another. Overall, most households want to plant forest (67.4%) if they were allocated an extra piece of land, suggesting that local farmers are inclined to plant forest even without any assistance offered. As expected, the proportion of households who want to plant forest is higher for the participating group (71.2%) than the non-participating group (53.2%). The rest of the households who do not want to participate in the program prefer to use the land for cultivating food crops or other income generating activities such as raising livestock or leasing the land for a fee.

Table 3.4 Choices of land use by intention to participate in the program

Activity	Choices of land use (%)		
	All (n=291)	Participating (n=229)	Non-participating (n=62)
Forest plantation	67.4	71.2	53.2
Food crop cultivation	23.4	21.0	32.3
Decision depends on land quality	4.8	5.7	1.6
Others	4.5	2.2	12.9

Note: n= number of observation

3.4.4 Results from choice model

Table 3.5 presents the coefficient estimates of the RPL model for the pooled sample of households as well as the subsamples according to the type of tree households want to grow. Acacia and bamboo are selected as they are the main species that farmers prefer to grow. All the three models are statistically significant with a p-value of zero. The pseudo-R^2 in all models is higher than 0.5, indicating that the explanatory power of the model is quite high.[15] The diagnostics of multicollinearity among explanatory variables show that there is no collinearity problem, as the largest variance inflation factor (VIF) of all variables is less than ten (Kutner et al., 2005) and the condition number is 15.95 which is less than the cut-off value of 30 (Belsley et al., 2005). The coefficients of contract attributes are highly significant and have the expected signs for all the models except for the frequency of subsidy payment which is not significant. The positive coefficients of harvesting policy, maintenance and punishment suggest that farmers prefer a more production oriented, less labor demanding and weaker punishment contract. Insignificant coefficient of payment frequency indicates that households are indifferent in how often they receive the subsidy. The ASC is negative and significant for only the pooled model, reflecting that in general without presenting the attributes of the contract, farmers are reluctant to sign up for the program. As expected, the amount of subsidy is positive and significant which means that farmers favor the higher subsidy amount per year.

[15] Hensher et al. (2005; p. 337-339) shows the direct empirical relationship between the pseudo-R^2 and R^2 of a linear regression model. Pseudo-R^2 of 0.5 can be translated as an R^2 of about 0.9.

Table 3.5 Coefficient estimates of RPL model by type of tree farmers want to grow

Choice parameters	Pooled data		Acacia		Bamboo	
	Coeff.	s.d.	Coeff.	s.d.	Coeff.	s.d.
ASC (constant)	-7.2127*** (1.9184)	8.4693*** (0.9505)	-0.6918 (1.8131)	5.6563*** (1.1861)	-1.744 (6.7569)	8.3035*** (1.8979)
Harvesting policy	4.5287*** (0.4216)	2.0510*** (0.2206)	3.8677*** (0.5967)	1.5778*** (0.2710)	5.6567*** (1.0967)	3.0330*** (0.6506)
Maintenance frequency	0.2135** (0.0830)	0.4142*** (0.1361)	0.2884** (0.1345)	0.4317* (0.2473)	0.3762** (0.1885)	0.6498** (0.2955)
Punishment	0.9413*** (0.1123)	0.6608*** (0.1254)	1.1083*** (0.2516)	0.8641*** (0.2224)	1.0547*** (0.2588)	0.6197*** (0.2275)
Subsidy amount	0.0021*** (0.0002)	-	0.0022*** (0.0004)	-	0.0019*** (0.0005)	-
Subsidy payment frequency	0.0738 (0.0935)	0.0273 (0.1700)	0.0790 (0.1493)	0.1038 (0.2399)	0.1937 (0.2186)	0.0032 (0.3183)
Interactions with ASC						
Age	1.4419 (1.1349)	-	1.2346 (1.6123)	-	-0.3225 (5.4921)	-
Education	-0.2498 (0.8439)	-	-0.8712 (1.2295)	-	-1.5925 (1.8952)	-
Income	0.000002 (0.00007)	-	0.00006 (0.00008)	-	0.00002 (0.0002)	-
Share of non-farm and forest income	2.5656* (1.4210)	-	-1.5307 (2.1928)	-	3.4525 (2.5581)	-
Active members	-0.2523 (0.3232)	-	-0.2636 (0.4719)	-	-1.4913 (1.0671)	-
Past support	4.1162*** (1.0011)	-	3.1279* (1.7766)	-	7.0749** (2.8864)	-
Access to road	-3.5416*** (0.8506)	-	-4.0071*** (1.2138)	-	-4.9010** (2.3618)	-
Bamboo	2.0107** (0.9897)	-	-	-	-	-
Acacia	4.9173*** (1.0554)	-	-	-	-	-
Pseudo R^2	0.5598		0.5539		0.5819	
Log likelihood	-863.7568		-300.4167		-195.7684	
AIC	1676.5140		636.8333		427.5368	
BIC	1904.5410		739.4305		523.8807	
No. of observations	6,984		2,208		1,560	

Notes: Coeff. = coefficient estimates; s.d.= standard deviation; all parentheses denote standard errors. ***, **, * denote 1%, 5% and 10% level of error probability respectively.

The results also exhibit preference heterogeneity around the mean as demonstrated by the significant standard deviations of all the contract attributes. There is large variation within two parameters, ASC and maintenance frequency, as indicated by their high standard deviations. Such variation in maintenance frequency exists because approximately 30% of the households prefer a higher maintenance frequency in contrast to the preference of the majority. Nearly 20% of the households have a positive ASC parameter estimate, indicating that they are willing to participate in the program even without knowing the contract attributes.

The next set of results is the measures of marginal WTA or implicit price of each of the contract attributes as reported in Table 3.6. The table shows both the mean and standard deviation of WTA for attributes that are statistically significant from the RPL model estimation. The mean WTA of ASC shows that the minimum average compensation required for farmers to participate in the program without any other attributes is 3,434,619 VND (USD 164.34) per hectare per year. However, farmers are also willing to forgo some amount of money if there are changes to the attribute levels of the contract. Harvesting policy is the most important attribute that households consider when they decide which contract to choose, as shown by the highest amount of implicit price. Households are willing to forgo 2,156,524 VND per hectare per year on average if the contracts allow them to harvest half of the timber, compared to a total ban on timber harvest. There is variation of mean WTA on harvesting policy between acacia and bamboo where farmers who want to grow bamboo are willing to forgo almost twice of the subsidy in order to harvest half of the timber, compared to those who want to grow acacia. This reflects that farmers place a higher value on bamboo harvest than acacia. The severity of punishment in case of contract violation comes as the second biggest concern, with households willing to give up 448,238 VND to have a less strict rule of punishment. Households on average are also willing to forgo 101,667 VND per year if they are allowed to maintain their forest less often and those who prefer to grow bamboo are willing to give up more than the acacia households.

Table 3.6 Marginal willingness to accept by attributes (VND/year/household)

Variable	Pooled data		Acacia		Bamboo	
	Mean WTA	s.d.	Mean WTA	s.d.	Mean WTA	s.d.
ASC	-3,434,619 (-164.34)	4,033,000 (192.98)	-	-	-	-
Harvesting policy	2,156,524 (103.19)	976,667 (46.73)	1,758,045 (84.12)	717,182 (34.32)	2,977,211 (142.46)	1,596,316 (76.38)
Punishment	448,238 (21.45)	314,667 (15.06)	503,773 (24.11)	392,773 (18.79)	555,105 (26.56)	326,158 (15.61)
Maintenance frequency	101,667 (4.86)	197,238 (9.44)	131,091 (6.27)	196,227 (9.39)	198,000 (9.47)	342,000 (16.36)

Note: Numbers in brackets report value in USD; USD 1= 20,899 VND (average exchange rate in 2012, source: Vietcom Bank); s.d. = standard deviation.

The results of ASC interacted variables reveal the determining factors for participation. Age, education, income and labor force are not statistically significant. The share of non-farm (including forest) income is positively significant only for the pooled model. It could be interpreted that farmers who are more successful with non-farm activities expect more benefits from forest plantation, hence are more willing to join the program. Previous experience of receiving support for forest plantation is positively significant for all the models, indicating that households who have participated in the government programs before wish to join the program again. Households who have easy access to market are less likely to participate in the program as shown by the negative and highly significant road access variable. Finally, type of tree is positive and significant which suggests households think that suitable tree choice is a factor contributing to the success of the program.

Our main goal is to estimate the minimum WTA to plant forest which is shown in Table 3.7. Based on the results from RPL model where different attributes have been analyzed, total WTA is estimated by forming certain type of contract. We estimate two contract scenarios, taking into consideration the types of contract that could contribute to PES policy development. The first is the conservation oriented contract which forbids any timber harvest, requires monthly forest maintenance and any violation would lead to contract termination and return of previous payment to the government. The result reveals that on average the households are willing to accept 3,943,930 VND per hectare per year for participation in this type of contract. On the other hand, under the production oriented

scenario, households are even willing to pay on average 1,573,519 VND per hectare per year if the contract allows them to harvest 50% of timber, maintain forest once every three months, and only requires them to pay a fine, not contract termination, in case of contract violation. Our estimated WTA is higher than previous study of Bui and Hong (2008) which has average WTA of 190,000 VND per ha per year[16] as well as the compensation in piloted PFES policy which has a range from 130,000 to 280,000 VND per hectare per year (McElwee, 2012). However, the range of WTA estimates within the 95% confidence interval is quite large, reflecting a large variance of WTA across households.

Table 3.7 Estimates of total WTA (VND/hectare/year)

Contract scenario	Mean WTA	95 % confidence interval	
		Lower	Upper
***Conservation oriented*:** Timber harvest is forbidden, participants have to maintain forest at least once a month, contract would be terminated if violated	3,943,930 (USD 188.7)	473,418 (USD 22.7)	9,541,812 (USD 456.6)
Production oriented: 50% of timber can be harvested, participants have to maintain forest at least once in every three months, fine payment when contract is violated	-1,573,519 (USD -75.3)	-4,946,730 (USD -236.7)	3,867,062 (USD 185.0)

Note: average exchange rate for 2012 USD 1 = 20,899 VND (Vietcom Bank)

3.4.5 Comparative analysis

It is interesting to compare the monetary benefits farmers would obtain between participating and not participating in the forest plantation contracts. We examine the net present values (NPVs) of ten years benefit streams for conservation oriented contracts with two species of tree and for maize cultivation which is considered the most profitable agricultural activity in the study area. The result is reported in Table 3.8 with varying discount rates of 5%, 10% and 15%.[17] It is obvious that on average the net profit from growing maize is far more substantial than signing up for the government forest programs, even more than double the upper level of WTA. The question arises as to why many farmers still choose to plant forest under the proposed program instead of using the land for cash crop cultivation. One plausible explanation is that some farmers may perceive other

[16] To be able to compare with our estimate, the value is adjusted to 2012 constant price. The average WTA by the time of study is 155,000 per ha per year.

[17] To establish the mid-point of discount rate, we use Vietnamese average inflation rate from 1999-2012 which is approximately 7% (World Bank, 2012) plus opportunity cost of capital at 3% . Then we plus and minus 5% from the mid-point to set the range of discount rates.

benefits that do not show up in market transactions (Shaikh et al., 2007). Under the research setting where farmers are given extra piece of land, they may prefer to enter contract with government to have assured annual payment that can reduce risk from income variability or they may perceive environmental services from forest such as improvement in soil quality. Another reason is that market access for some households is too restricted for cash crops production, leaving them with no better option than receiving subsidy to plant forest. This factor is confirmed by the negative coefficient of road access in the RPL model as well as the result from ANOVA test showing that households who want to participate in the program have significantly poorer road access than those who do not.

Table 3.8 NPVs of 10-year benefit from maize cultivation and conservation contract

Discount rate (%)	Maize cultivation	Conservation contract		
		Acacia plantation	Bamboo plantation	Acacia plantation with upper level WTA
5%	154,428	23,933	7,238	75,603
10%	123,891	17,656	5,136	57,619
15%	101,938	13,324	3,708	44,994

Note: The unit is thousand VND per ha; NPV for maize is calculated from the annual gross margins of 19.4 million VND per ha per year which is comparable to the data in Yen Chau district which is 20.4 million VND per ha per year (Saint-Macary et al., 2013). However, we assumed that cost of fertilizer increases by 5% every year.

3.5 Conclusions

This study utilizes choice experiment to elicit the willingness to accept to plant forest and examine the contract attributes that affect farmers' preference and participation in the program. It contributes to a handful of research on choice experiment application in developing countries in the field of forest conservation scheme. The findings can inform policy makers on what types of forest conservation contracts are more attractive to local farmers, which is very useful for PFES policy implementation where voluntary participation is the key to the success of the policy. Hypothetical baseline and choice scenarios of five different attributes were applied through face-to-face interviews. Our results reveal that nearly two-third of the households want to plant forest if they were provided the extra piece of land and almost four-fifth of the households want to participate in at least one of the contracts. In our case where there are households who want to participate and who reject the program, indicating that the choice tasks are realistic and

respondents understood and took the choice decision seriously. The results from RPL model estimation reject the hypothesis that farmers are only concerned about the amount of subsidy from the government. These households also pay attention to how much they can harvest the timber, how often they need to maintain the forest and how strict the punishment is in case of contract violation. However, as harvesting policy has the highest marginal willingness to accept compared to the other attributes, farmers still tend to focus more on the potential pecuniary benefits from the program.

There exists variation in the willingness to participate among different types of households. Those with a higher share of non-farm income and past experience of receiving support for forest plantation tend to be more interested in the program. Households who have market access to sell the products prefer not to join the program since they want to harvest all the planted forest without any restrictions from the government. Therefore, targeting the households in the remote villages where the road access is relatively poor may lead to a higher participation rate. Alternatively, the government would have to invest more resources to encourage farmers in the less remote villages to participate in the forest conservation program.

Our results reveal that, surprisingly, farmers are even willing to pay to participate in a contract that allows up to 50% of timber harvest, does not demand a high maintenance frequency and has relatively weak regulations. However, if policy makers aim to implement the scheme that is more stringent for environmental protection, then a higher payment could be offered to encourage farmers to participate. It is evident that the willingness to accept for a conservation oriented contract is higher than the previous subsidy and the payment in the pilot PFES project, however, the result from our comparative analysis reveal that the subsidy is still far lower than the forgone income of cash crops cultivation. The reason could be that some farmers may perceive other benefits that do not show up in market transactions (Shaikh et al., 2007), such as the risk reduction from assured annual payment or environmental services from forest that could improve soil quality and so on. Imperfect credit and insurance market for crop production as well as limited market access for timber product could also lower farmers' WTA to plant forest. The finding underscores the fact that encouraging farmers to plant and conserve forest is not as costly as the opportunity cost of the land. Even though the local farmers tend to associate forestry more with monetary benefits, our findings have confirmed that there is

room for a more stringent forest conservation program as long as the farmers are adequately compensated.

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CHAPTER 4

TRANSACTION COSTS OF FARMERS' PARTICIPATION IN FOREST MANAGEMENT: POLICY IMPLICATIONS ON PAYMENTS FOR ENVIRONMENTAL SERVICES SCHEMES IN VIETNAM

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Abstract

Recent research on payments for environmental services (PES) has observed that high transaction costs (TCs) are incurred through the implementation of PES schemes and farmer participation. TCs incurred by households are considered to be an obstacle to the participation and efficiency of the policy. This study aims to understand transactions related to previous forest plantation programs and to estimate the actual TCs incurred by farmers who participated in these programs in a mountainous area of northwestern Vietnam. It also examines determinants of household TCs to test a hypothesis whether the amount of TCs vary according to household characteristics. Results show that average TCs are not likely to be a constraint for participation since they are about 200,000 VND (USD 10) per household per contract, equivalent to about two days of wages. However, TCs amount to more than one-third of program benefits, which is relatively high compared to programs in developed countries. This implies that rather than aiming to reduce TCs, an appropriate agenda for policy improvement is to balance the level of TCs with program benefits to enhance the overall attractiveness of afforestation programs for smallholder farmers. Regression analysis indicates that household characteristics do not play a major role in determining the level of TCs. Only education, gender, and perception towards programs have significant effects on the magnitude of TCs.

4.1 Introduction

Recent research on payments for environmental services (PES) has observed that high transaction costs (TCs) are incurred through the implementation of PES schemes and farmer participation (e.g., Dunn, 2011; FAO, 2007; To et al., 2012). TCs incurred in setting up and managing PES schemes are central to their sustainability. Many studies have reported that TCs are a significant factor in farmers' decision to participate. Some studies find that higher TCs are likely to be greater obstacles to the participation of poor households in PES schemes than the households' own capacity and resources (Behera and Engel, 2004; Engel, 2008; Locatelli et al., 2008; Wunder, 2008). Several studies find that participation decisions are highly influenced by fixed TCs (Goetz, 1992; Key et al., 2000; Kranton, 1996; Ouma et al., 2010). Omano (1998) shows that tension between TCs and participation in specialized farming may contribute to smallholders' disregard for more income through greater specialization. Studies on agri-environmental schemes (AES)[18] also claim that TCs do matter for farmers' decision to participate in such schemes (Falconer, 2000; Mettepenningen et al., 2009; Van Huylenbroeck et al., 2005). The concern over households' TCs is also related to the efficiency of implementation of agricultural policies (e.g., Buchl and Flury, 2005; Rørstad et al., 2007) and nature conservation practices (e.g., Falconer and Saunders, 2002; Mburu et al., 2003). The issue of high TCs, which can be an obstacle to farmers' participation and efficiency of the program, is acknowledged by the European Commission who introduced the compensation of TCs in calculating agri-environmental payments since 2005. To minimize a potential constraint from high TCs through participation in PES schemes, it is of importance to calculate the actual TCs incurred by farmers. However, few studies have empirically estimated farmers' TCs (Buchl and Flury, 2005; Falconer, 2000; Mburu et al., 2003; Falconer and Saunders, 2002; Vatn et al., 2002; Rørstad et al., 2007; Mettepenningen et al., 2009). Instead, most studies tend to observe patterns of participation without determining which factors cause participation or non-participation (Engel et al., 2008).

This article contributes to the literature on PES by investigating TCs incurred by smallholder farmers who participated in forest management schemes in a mountainous area of northwestern Vietnam. In September 2010, the government of Vietnam decreed the policy of payment for forest environmental services, which gave payments to service

[18] AES is based on long-term, voluntary contracts between farmers and the government, whereby the exchange of certain environmental management and compensation fee are exchanged.

providers for forest protection activity. Studying TCs on past forest management schemes have policy implications for PES implementation and design of regulations and guidelines in the future. Our study aims to understand the processes and transactions related to past forest plantation programs and to estimate TCs incurred by farmers who participated in these programs. Another objective of this study is to examine determinants of household TCs to test whether the amount of TCs vary according to household characteristics. There are only a handful of studies that have empirically investigated factors determining the level of TCs of farmers' participation in forest management programs (e.g., Adhikari and Lovett, 2006; Arifin, 2006; Meshack et al., 2006). Lastly, we review some studies on TCs of farmers participating in community-based schemes to compare the levels of commitment required in individual versus community-based participation.

In current studies, focus is given to TCs involved in the implementation and monitoring of PES schemes. Recommendations to reduce TCs have been biased towards the adoption of community-based management as cost-saving alternatives (e.g., Jundal and Kerr, 2007; Meshack et al., 2006). By reducing the number of providers into group entities, TCs incurred by buyers or intermediaries of ecosystem services are substantially reduced. However, some studies have shown that time spent by participants in group meetings, planning, and decision making is the source of most TCs, which is a disadvantage of community-based programs. Community-based forest management may lower TCs incurred by the buyer or government, but a large portion of these costs is transferred to and taken up by members of the community or groups. Such a transfer is cost-efficient (i.e., it reduces the sum of transaction costs incurred by principal and agents) if the local group has information advantages over the principal, i.e., the buyer of the environmental service. This has been argued by Zeller (1998) and Sharma and Zeller (1998) for the case of microfinance institutions that transfer the functions of screening and monitoring borrowers to local solidarity credit groups who take out loans under joint liability for repayment of the loan lent to the group. We aim to understand differences in the level of TCs between individual and community-based forest management through a literature review and key stakeholder interviews. The remainder of this paper is structured as follows: Section 4.2 describes the study area and forest plantation support programs; Section 4.3 contains the methodology, including data collection and econometric estimation strategy; Section 4.4 reports the results with discussions; and Section 4.5 provides conclusions.

4.2 Study area

The study area is the mountainous district of Da Bac, the largest district in Hoa Binh province. The district is located in northwestern Vietnam, with the highest altitude reaching 560 meters above sea level. Its population density is 66 persons per sq. km. in 2010, which was the lowest in the province (Hoa Binh Statistical Office, 2011) and was approximately one-fifth of the average population density of the entire country. The study area has diversified economic activities due to its proximity to Ha Noi – about 100 km away – and various types of geographical conditions – the south is adjacent to the Hoa Binh reservoir, whereas the north is steep and mountainous. Forest occupies about two-thirds of district, with natural forest accounting for 39% and production forest for 28% of the total area. Agriculture, including paddy field, accounts for merely 7% of the total area, whereas nearly one-fifth of the total area is identified as unused land. Rice is grown as a subsistence crop in irrigated paddy fields in the lowlands. The main crops cultivated in the uplands are maize, cassava, and arrow root. In general, households also have small scale livestock farming for home consumption and income generation. Fishery and aquaculture are practiced in the communes located near the reservoir. In Da Bac district, forest land has been allocated to individual households since 1994 according to the 1993 Land Law (Tran et al., 2013). Households receive the land use certificate, also known as the 'Redbook' given the appearance of the certificate, as proof that its holder has the legal rights to exchange, transfer, lease, inherit, and mortgage the land use right over the designated land for the purpose of forestry for 50 years.[19]

Forest plantation support programs

In the past, several government programs have been implemented to provide support for forest plantation even though the main purposes of these programs differ. The most well-known and most participated in program is the resettlement program, known as Program 747, for households that were relocated from the Hoa Binh dam construction site and its reservoir area. Although a main goal of this program was to stabilize socio-economic development for resettled households, the support of forest plantation is another element of the program. In particular, investment in short term growing trees, such as bamboo, was supported by the provision of bamboo seedlings and cash for compensating labor costs for

[19] The period of land use right of agricultural land for planting annual and perennial crops is 20 years.

a period of three years. The amount of support varies among different communes. The program also provided training on techniques of tree plantation and maintenance.

Another important program was the Five-Million-Hectare-Reforestation Program (also known as Program 661), which has the main goal of supporting forest plantation at the national level. The program began in 1998, after the start of Program 747, and initially offered loans to companies for reforestation with the purpose of forest protection. The program evolved to include the provision of direct support to plantations established by households since 2006 (Sikor, 2011). The program was planned and implemented through several hundred local projects designed and carried out by localities after being approved by higher level authorities. The government provided a broad framework and indicated a set of policies. Thus, local authorities were given a high degree of freedom to design activities (MARD, 2000).

Households in the study area have received support from Program 661 through projects executed by the district-level office of Agriculture and Rural Development and State Forest Enterprise (SFE). For individual farmers, there are two types of support according to the purpose of forest plantation, namely, protection and production. Our analysis focuses only on the production forest component of the program, which provided tree seedlings and cash as a compensation for labor. The forestry department at the provincial level specified the type of trees and technical design of the plantation, such as how many trees per hectare and the distance between each tree. The program provided support mainly for acacia and other slow growing trees and had a maximum total value of support of 2 to 3 million VND (approximately USD 95 to 144) per hectare, depending on the type of seedling. The allocation of the support can be categorized as seedling and labor costs, which were granted to farmers directly, and administrative costs which accounted for 5-7% of the total value of support deducted by local officers. The payment for labor compensation was not fixed, but instead was contingent on the quality and survival rate of the trees. As a worst case scenario, farmers would not receive the labor compensation if the percentage of tree cover is lower than 50% of the designated number of trees per hectare. If farmers maintained trees well, so that tree coverage is more than 85%, farmers would receive the full amount of labor compensation one year from the beginning of the contract. Table 4.1 summarizes the details of both programs. In addition to these two main programs, there were other forest plantation programs implemented in the study area;

however, because only a few households participated in these programs, they are not considered in this study.

Table 4.1 Details of the two forest plantation programs

Name of the program	Goal	Description of the program	Target group
Resettlement program (Program 747)	-To stabilize the socioeconomic development in the resettled area from the construction of the Hoa Binh dam	-The provision of material, cash, and training for forest plantation (especially bamboo) and other infrastructure or material support for livelihood improvements according to local needs	-Households who have resettled as a consequence of the construction of the Hoa Binh dam
Five-Million-Hectare-Reforestation Program (Program 661)	-To increase forest cover to more than 40% of the total area -To create employment and increase income to eliminate hunger and poverty - To supply enough raw material for forest product processing industries	-The provision of material, cash, and training for forest plantation (e.g., acacia and chinaberry)	-Any households who owns forest land

Note: For Program 661, we consider only the component of the program related to production forest.

4.3 Methodology

4.3.1 Conceptual framework

Transaction costs are originally defined by Coase (1960) as the costs of carrying out a transaction by means of an exchange on the open market. However, to conduct an empirical analysis of private TCs from forest plantation programs, we adapt this definition of TCs and define them as costs that arise from organizing the transfer of goods and services between two agents. We focus on the transfer of support (material, cash, etc.) from the government in the exchange of forest cover provided by farmers. Literature on private TCs distinguishes the following three categories (e.g., Mburu et al., 2003; Mettepenningen et al., 2009; Van Huylenbroeck et al., 2005). The first category of TCs consist of search

and information costs, which arise *ex-ante* to the transaction and include the costs of looking for information for forest plantation programs and costs related to making the decision to join the programs. The second category is *ex-ante* negotiation costs, or in our case application costs since real negotiation on contract terms between the government and farmers does not exist in the programs. Application costs cover the costs of fulfilling preliminary conditions to be able to participate in the program, such as contacting government officers or following a specific training. The third category of TCs occur *ex-post* to the transaction and comprise of costs that farmers incur as a result of monitoring and enforcement required by the government, such as accompanying control officers to the field when the forest needs to be inspected.

According to Williamson (1996), apart from the behavior of farmers and the institutional arrangement in which the transaction takes place, the level of TCs also depends upon the attributes of the transaction. These attributes include asset specificity, uncertainty, and transaction frequency. Asset specificity is defined as the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrificing productive value: higher levels of asset specificity imply higher TCs (Williamson, 1996). The level of asset specificity of the forest plantation programs can be evaluated based on the sources of asset specificity. These sources are site specificity, temporal specificity, specific physical assets, human capital, brand name specificity, and dedicated assets (Williamson, 1996). High uncertainty due to unanticipated changes in the environment and opportunistic behavior from one of the partners increases TCs (Van Huylenbroeck et al., 2005). Lastly, TCs are reduced if transactions are repeated over time because of reduced efforts to search for information, apply, and monitor (Mettepenningen and Van Huylenbroeck, 2009).

Figure 4.1 shows the conceptual framework. We also apply this framework to a qualitative review of the levels of TCs incurred in individual versus community-based participation in forest management.

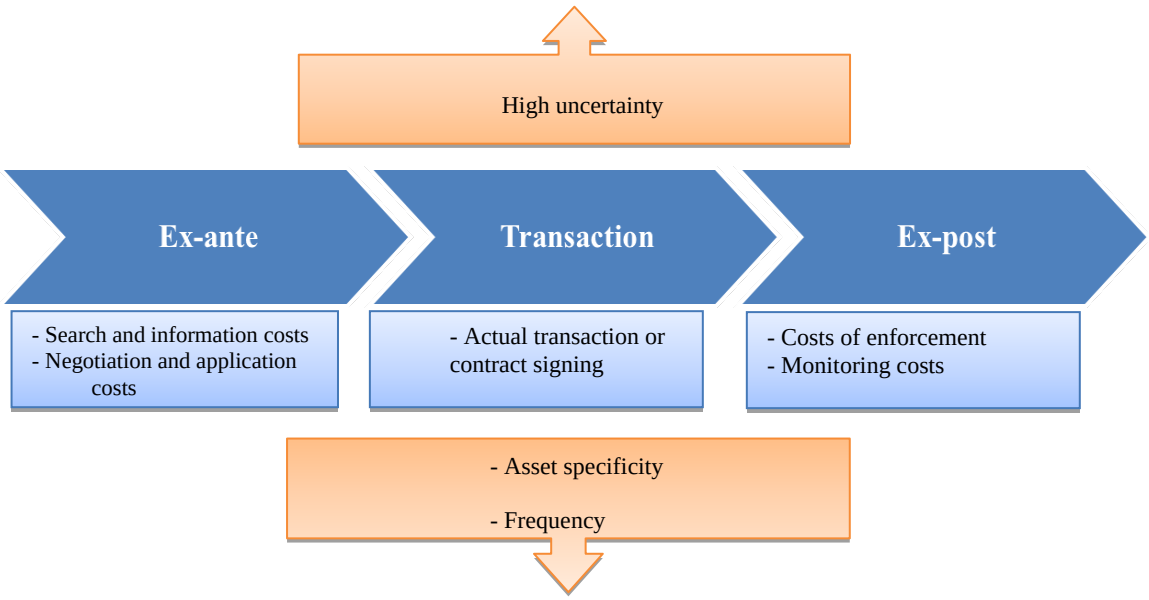

Figure 4.1 Conceptual framework

4.3.2 Sampling and data collection

Two household survey rounds were conducted in November and December 2011 and from August to September 2012 in Da Bac district, Hoa Binh province. A two-stage cluster sampling procedure was employed. In the first stage, 20 villages were randomly selected using the Probability Proportionate to Size method (Carletto, 1999). Therefore, larger villages have a higher probability of being selected. In the second stage, 15 households were randomly selected in each of the previously selected villages using village level household lists. There were two villages that did not have a list, so the random walk method (Henry et al., 2003) was used to select households. In total, the dataset consists of 300 households and is representative at the district and village levels. For the second survey round, nine households could not be interviewed due to unavoidable reasons, such as sickness, death, and relocation. Apart from questions about time and cost spent on each transaction as well as benefits and perceptions towards forest plantation programs, the questionnaire covered a wide range of topics, such as demographic and socio-economic information, food security status, social capital indicators, land use, land tenure, agricultural production, and forest plantation activities.

A starting point to analyze TCs is to examine transactions for each household who participated in a forest plantation program. We asked household heads about the most recent programs that they participated in since details on transactions are easier to recall and therefore the data is more reliable and complete. Respondents were asked about the activities that they have done related to participation in the program and how much time

and money were spent for each activity. Such activities are clearly distinguished from production activities, such as forest planting and maintaining processes. A list of activities is first obtained from focus group discussions in the villages that are not included in our sample villages. The participants were selected by village head on a basis that the group members comprise of different genders and ages. Activities are then categorized into three types as mentioned above. The first type is the search and information gathering activity, which consists of participation in village meetings by household heads or representatives to obtain information about the program, decision making process, and any other activities before signing the contract.[20] The second type of application activities includes contract signing, learning about the technical aspect of tree growing, or attending trainings, or receiving tree seedlings. The last type of monitoring and enforcement activities consists of accompanying officers for evaluating the plot during the forest establishment period (cleaning the weed, preparing the land, and growing trees), maintenance period, and the period until the payments have been received, as well as transactions that occur when farmers receive the payment.

One challenge of estimating private TCs is the monetization of time inputs reported by farmers. Studies that estimate private TCs have used the opportunity cost of labor, such as the market wage rate (e.g., Mburu et al., 2003; Mettepenningen et al., 2009; OECD, 2005) or household farm income (Falconer and Saunders, 2002); however, wage rates for labor in rural areas in many developing countries may not accurately reflect the opportunity cost of labor because the labor market is not perfectly competitive (Gittinger, 1984). To estimate TCs incurred from time spent in participating in the program, we use an average wage rate multiplied by the reported time. However, the possibilities of working outside of the farm are not the same for each farmer since they depend on the location of the village in terms of its distance to the closest town where it is easier to find a job, such as factory work. Another factor is the quality of road access to the village, which is considered to be a barrier for finding a job due to lack of market access, especially for local small-scale businesses (e.g., toothpick production). Therefore, we adjust the value of TCs based on the assumed varying opportunity costs of labor according to location and road access. This adjustment is indicated by conversion factors which are shown in Table 4.2. Here, the opportunity costs of labor for farmers in remote villages with poor quality roads are only a fraction of the local average market wage rate (83,000 VND per day), as compared to

[20] The term 'signing the contract' in this case indicates the action where participants give their signatures to the officers when they receive the tree seedlings.

villages closer to the center of the district where it is assumed that the opportunity costs of labor are equal to the market wage rate.

Table 4.2 Value of time input by location and road quality factors

Village type	Conversion factor	Value of time input
Villages near the town (district center)	1	Labor days of transaction x 83,000 VND
Remote villages with good road access	0.5	Labor days of transaction x 83,000 VND x 0.5
Remote villages with poor road access	0.2	Labor days of transaction x 83,000 VND x 0.2

4.3.3 Estimation strategy

We use regression analysis to investigate whether the level of TCs differs across households due to household and program characteristics, focusing on differences in incentives created for participants to bear TCs. Our regression analysis is limited to Program 747 and Program 661 since they are the main programs that provide support for forest plantation in the study area. In addition, because these two programs are more recent, households are able to remember the details of these programs' activities better than other programs. However, there are 49 cases of missing data on household TCs due to the fact that some household members could not recall the details of activities undertaken when they participated in the program. Using analysis of variance (ANOVA), we investigate whether respondents with missing data on TCs differ systematically from those who could recall data on TCs for a number of pertinent socio-economic characteristics, such as education, duration of residence, per capita income, etc. We find that there are no significant differences between the two comparison groups for all variables, indicating that there is no systematic bias in missing responses. Therefore, we conclude that respondents with missing information can be dropped from the analysis without generating biased results (Osborne, 2013).

To examine factors determining total TCs incurred by households, ordinary least square (OLS) regression is used. Total TCs are computed as the sum of fixed cost TCs (i.e., TCs that do not vary with the size of the forest plantation) and variable TCs (i.e., TCs that do increase with the size of forest plantation, e.g., the costs of visiting and inspecting several large plots are higher compared to that for one small plot). Explanatory variables are selected based on previous studies on factors influencing private transactions, taking

into account the attributes of the transaction (conditions of asset specificity, level of uncertainty, and frequency), nature of the programs, and local context. Table 4.3 presents descriptions of the dependent variable and explanatory variables, their descriptive statistics, and expected signs. The dependent variable is the reported total TCs of participating in a forest plantation program. We only consider TCs for the most recent program, even though some households participated in several programs.

We want to test whether household demographic characteristics influence the level of TCs (Mburu et al., 2003; Mettepenningen and Van Huylenbroeck, 2009). The duration of residence (RESIDENCE) in the villages is hypothesized to have a positive relationship with the level of TCs, since households who are more settled in the village tend to be more active in participating in community affairs. Having a male household head (MALEHEAD) is expected to entail higher TCs since they have more time to participate in programs than female household heads who have to take on more responsibilities in the household. Higher educated household heads (EDUC) tend to contribute more to village meetings and are thus expected to bear higher TCs. The availability of household labor force (ACTIVES) is hypothesized to have a positive impact on TCs since household heads are better able to set aside time for participating in the program if there is enough labor in the household. The effect of wealth (INCOMEPC) is expected to be the same as the effect of labor availability. Social capital indicators (MEMORG and TRUST) are expected to have a positive influence on the magnitude of participation (Mburu et al., 2003). Higher levels of trust among villagers may reduce TCs from perceiving less need to be active in meetings to protect their individual rights or from spending less time on the decision to participate in the program because of a lower prospect of failure (such as from a lower incidence of timber stealing among villagers). Falconer (2000), Mettepenningen and Van Huylenbroeck (2009), and OECD (2005) indicate that farm size is an important factor influencing TCs because of the fixed cost nature of TCs. We hypothesize that farmers with larger areas of forest plantation (FORESTAREA) tend to bear higher variable TCs due to the need to spend more time for monitoring and enforcement activities. To examine the variable cost aspect of TCs, the square of forest land area (FORESTAREASQ) is included in the model to test whether total TCs increase or decline at the margin. Along the same line, the distance between the forest plot and household (DISTANCE) can increase monitoring costs, especially if the frequency of monitoring is high. Farmers with more land tenure security (REDBOOK), measured by having a forest land use right certificate, are

hypothesized to be more motivated to participate in the program and thus are hypothesized to incur higher TCs (Mburu et al., 2003). Farmers' perceptions of the program being beneficial may also encourage households to participate more in meetings and thus may have a positive relationship with TCs. We also examine if Program 747 (PROG 747) entails higher TCs than Program 661 to test the hypothesis that a higher frequency of cash distributions leads to higher TCs incurred by farmers.

Table 4.3 Variables in the regression analysis and their descriptive statistics

Variable	Description	Mean	s.d.	Expected sign
Dependent variable				
TC	Total TCs of participating in a forest plantation program (thousand VND/household)	196.8	189.9	N/A
Explanatory variable				
RESIDENCE	Duration of household residence in the village (in years)	38.7	13.6	+
MALEHEAD	Gender of the household head (male = 1, female = 0)	0.9	0.2	+
EDUC	If the household head has a high school certificate (yes = 1, no = 0)	0.5	0.5	+
ACTIVES	Number of non-disabled adults living in the household aged 18-60	3.2	1.2	+
INCOMEPC	Annual household income per capita, excluding income from forest (in thousand VND)	6,760.4	7547.8	+
MEMORG	Number of local organizations in which any household member is a member of	2.3	1.4	+
TRUST	If the household head trusts others in the village in general (yes = 1, no = 0)	0.4	0.5	+/-
FORESTAREA	Area of forest land (square meter)	13,254	13,937	+
FORESTAREASQ	The square of area of forest land (million square meter^2)	369	924	-
DISTANCE	Walking time from house to forest plot (in minutes)	36.9	36.7	+
REDBOOK	If the household has Redbook for forest land at the time of plantation (yes = 1, no = 0)	0.5	0.5	+
BENEFICIAL	If the household head considers that the program is beneficial for the household (yes = 1, no = 0)	0.9	0.3	+
PROG747	If the household participated in Program 747 (yes=1, no=0)	0.7	0.5	+/-

Note: s.d. = standard deviation; N/A = not applicable

4.3.4 Qualitative synthesis

We rely on qualitative synthesis in our literature review to assist in understanding differences in the level of TCs between individual- and community-based participation in forest management programs. The method can provide analytical depth and contextualization to this particular objective. We used inductive analysis to summarize the collective conclusions of the studies reviewed. To complement the findings, key stakeholders were interviewed to provide additional perspectives.

4.4 Results and discussion

4.4.1 Farmers' transaction costs of participating in forest plantation programs

Regarding the extent of asset specificity of forest plantation programs, it is considered that forest plantation programs have low asset specificity. The programs have small site and temporal specificity since planting forest in our study area can be easily replaced by other agricultural activities, such as growing maize or cassava. The programs do not require very specific human capital since farmers do not need to invest much time in learning how to grow or maintain the forest or attending a training session on the specification and technique of forest plantation. In addition, participants are not obliged to invest in any specific physical assets to join the program. This low level of asset specificity indicates that TCs incurred by farmers will not be high enough to hinder participation by smallholder farmers. The level of uncertainty is considered to be moderate since some farmers claimed that trees died from extreme weather and some did not receive the full amount of cash compensation. Even though the programs have a low frequency of transactions, the level of TCs is not deemed to be higher due to this factor since the transactions are not very complicated. Moreover, farmers have already learned about how such programs are implemented given the history of similar programs in the study area.

We find that household TCs mainly come from the opportunity cost of time spent on activities related to the programs. This can be partially explained by the decentralized nature of the programs: the programs were implemented at the village level and therefore farmers did not need to spend money and time on transportation. The TCs of participating in forest plantation programs are reported in Table 4.4. On average, the total TCs for

participating in a forest plantation program is 196,800 VND (USD 9.42)[21] per household per contract. This is relatively low since it is equivalent to about two days of wage labor (the average wage rate is 83,000 VND per day). TCs per hectare are 588,300 VND (USD 28.15), which is approximately one-tenth of the input costs for maize cultivation (6 million VND per hectare). The high standard deviation of TCs, especially for unit TCs, indicates a large variation in TCs across households. Overall, there is no significant difference in total or per hectare TCs between both programs. TCs from monitoring and enforcement are the greatest for both programs, accounting for almost half of all TCs. Thus, the extent of farmer involvement is less important in the process of information receiving and decision making compared to monitoring activities. Nearly 70% of total TCs arise from fixed costs. Variable costs of monitoring and enforcement are about three-fourths of monitoring costs. Comparing the two programs, each of the costs is not significantly different from one another, indicating that the transactions are more or less the same for both programs. The average benefit from the programs, which is the sum of the value of tree seedlings and cash compensation, is about 2.27 million VND (USD 108.7) per household per contract. Total TCs account for about one-third of the benefits farmers received from the programs. This is rather high compared to other related agricultural policies. For example, the share of private TCs per compensation is just 4.5 to 5% in a direct payment scheme to farmers for ecological compensation in Switzerland (OECD, 2005). For other agri-environmental programs in Europe, this share is 12% (Kumm and Drake, 1998 cited in Falconer, 2000), 13% (Rørstad et al., 2007), 21.4% (Falconer and Saunders, 2002), and 25.4% (Mettepenningen et al., 2009)). This can be explained by the fact that the monetary benefits from the two programs examined in our study are relatively low compared to the agri-environmental programs in developed countries.

[21] The average exchange rate in 2012 is USD 1= VND 20,899 (Vietcom Bank).

Table 4.4 Farmers' transaction costs and benefits from forest plantation programs

Category	Program 747 (n=114)		Program 661 (n=48)		All (n=162)	
	Mean	% of fixed cost	Mean	% of fixed cost	Mean	% of fixed cost
Search and information costs	54.4 (66.1)	100 (0)	55.7 (59.1)	100 (0)	54.8 (63.9)	100 (0)
Application costs	55.7 (77.8)	100 (0)	54.8 (53.4)	100 (0)	55.4 (71.3)	100 (0)
Monitor and enforcement costs	83.3 (99.6)	26.4 (24.1)	83.7 (98.5)	24.5 (26.7)	83.4 (99.0)	25.8 (24.8)
Total transaction costs	195.9 (197.4)	67.9 (15.7)	198.9 (172.8)	69.0 (17.7)	196.8 (189.9)	68.3 (16.3)
Transaction costs per hectare	593.8 (1,226.4)	-	575.4 (1,056.6)	-	588.3 (1,175.4)	-
Benefits of the program	2,403.7 (5,750.0)	-	1,961.5 (2,234.7)	-	2,272.7 (4,970.3)	-
Transaction costs as % of benefit	34.7 (59.9)	-	40.5 (63.3)	-	36.4 (60.8)	-

Note: Standard deviations are shown in parenthesis; n = the number of observations; The unit is thousand VND/household/contract.

4.4.2 Determinants of household transaction costs

Table 4.5 presents the coefficient estimates of the regression analysis. Diagnostics of multicollinearity among explanatory variables indicate that there is no collinearity problem since the largest variance inflation factor (VIF) of all variables is less than ten (Kutner et al., 2005) and the condition number is 23.7 which is less than the cut-off value of 30 (Belsley et al., 2005). The duration of residence is negative and significant, indicating that households with longer establishment in the village are less active in participation in the administrative process. This does not support our hypothesis and is also contrary to Mburu et al. (2003). We had expected that older household heads would be more involved in meetings used to disseminate information about the programs. In the study area, longer established households are less active in meetings and spend less time in the application procedure compared to younger households. This result may be driven by improved access to information that households with longer residence have. They have to spend less time in meetings to gather the same amount of information as compared to newer, in-coming

households who are less embedded in the political gossip of the village and have less information from key informants. Education is positive and significant, which supports our hypothesis that more educated households are more active in taking up the role of disseminating information and helping clarify regulations or technical explanation to others. Gender is negative and significant, rejecting the hypothesis that female household head have less time for participation and indicating that female household heads tend to be more active and spend more time in transactions. Labor availability has the expected sign but is not significant, implying that farmers' time spent in all the processes for program participating may not be large enough to sacrifice work on the farm. Income per capita has a negative sign, suggesting that wealthier households bear smaller TCs, although the variable is not significant. Both social capital indicators are not statistically significant, which may be explained by the nature of the programs which require a low level of co-management from farmers.

Table 4.5 Estimated coefficients from ordinary least square regression analysis

Variable	Coefficient estimate	
	Coefficient	P-value
Dependent variable: Total transaction costs		
RESIDENCE	-3.4388***	0.001
EDUC	133.4091***	0.000
MALEHEAD	-147.925***	0.000
ACTIVES	0.9651	0.936
INCOMEPC	-0.0009	0.596
MEMORG	-6.9643	0.507
TRUST	17.4334	0.545
FORESTAREA	0.0039*	0.098
FORESTAREASQ	-0. 00000004	0.210
DISTANCE	-0.5632	0.111
REDBOOK	-33.9268	0.257
BENEFICIAL	104.6698***	0.000
PROG747	21.946	0.484
Constant	299.1412***	0.000
Observations	162	
F-statistic (14,147)	6.34***	
R-squared	0.2228	

Note: ***,**, and * indicates significance at 1%, 5% and 10% of error probability, respectively.

In addition, since there is a low incidence of conflict among participants in the programs, the role of social capital in resolving conflicts is presumably of lower importance. The area of planted forest is positive and significant, implying that time spent

on monitoring outcomes or enforcing regulations does depend on the size of the planted area. The square of forest area has a negative sign, which implies that costs decline at the margin; however, the coefficient is not significant so that no effect of this variable could be measured. The distance variable is also not significant. Land tenure security has a negative sign, but is not significant. The insignificant result might be caused to some extent by the fact that some households who do not have a Redbook for their land may join the program with the hope and expectation that they may receive the Redbook by participating in the program. Farmers' perception that the program is beneficial is positive and significant, suggesting that greater expectations of benefiting from the program encourage farmers to participate more and hence incur more TCs. Participating in Program 747 is not found to incur higher TCs compared to participating in Program 661 since the coefficient is not significant. This means that even though Program 747 has a longer period for the whole process, farmers did not bear higher TCs.

4.4.3 Individual versus community participation

To understand differences in TCs between individual and community-based forest management, it is necessary to examine the dynamics of TCs incurred by individual and community participation. Adhikari and Lovett (2006) attempt to quantify the extent of TCs incurred by households in the context of community forestry management in Nepal. According to this study, in general, search and information TCs incurred in community meetings at the early stage of the process are largely fixed, including costs associated with identification, negotiation with potential members, formation of groups, gathering information about the physical attributes of resources, demarcation of resources, and capacity building. The TCs of seeking information regarding potential members may be high (McDowell and Voelker, 2008). Group establishment in a PES-like scheme in Indonesia ranks high in TCs components as observed by Arifin (2006). Similar findings are reported by some leaders of community-based forest management in Hoa Binh. Locating willing and trustworthy members is time consuming in the beginning. However, Adhikari and Lovett (2006) observe that these costs are incurred annually, not just at the beginning of the program, due to the dynamic system of a group. The changes are due to the arrival and migration of group members, splits of households, and other factors.

On the other hand, individual participants have the advantage of not having to go through such processes. Meshack et al. (2006) report that spending long periods in meetings is a typical process of community-based forest management. While individual

participants in Hoa Binh spend some time in meetings with implementing officers, community-based participants require more time in meetings with group members. Transaction incurred during the decision making of agreement and implementation is time-consuming because all members should understand the process and content of the agreement and develop a consensus. It takes time to participate in community meetings in order to make decisions related to members' responsibilities, time schedule, site visits, and what to do with the benefits. Members with different sets of preferences require considerable negotiation to reach a consensus. It is argued that heterogeneity of group members can create obstacles to community resource management because it can make communication and cooperation difficult (Agrawal, 2001; Baland and Platteau, 1999; Behera and Engel, 2004). On a study of well cooperation in small groups in India, Aggarwal (2000) observes that the costs of negotiating are higher in groups where heterogeneity among members in endowments and needs is high. Similar finding regarding negative effects of group heterogeneity is hypothesized by Zeller (1998) and Sharma and Zeller (1997) for repayment rates for loans given to solidarity groups.

The TCs of monitoring often include costs incurred during the enforcement of an agreement, monitoring the forest area, and conflict management. Monitoring is essential for institutional maintenance. Community-based forest management has the option of delegating and rotating labor of planned activities. The larger the group, the more participants are able to divide labor and time. Individual participants do not have this option, which increases their TCs. However, inherent in a group- or community-based system are conflicts and rule violations among members. In Hoa Binh province, these activities consume a considerable amount of time and resources to households participating in community-based programs.

The example in Hoa Binh province highlights the different levels of costs incurred by community/group and individual participation. Each has its own advantages and disadvantages. It is important to have a comparative measurement of TCs of the two participation options. Another important issue to examine is the equality of costs and benefits among group members. Some studies have shown that there is inequality, in that all members contribute equal amount of time and efforts into community activities, but that benefits are unevenly accrued to better-off members (Adhikari and Lovett, 2006; Mburu et al., 2003; Meshack et al., 2006).

4.5 Conclusions

This study has aimed to measure the level and importance of TCs incurred by households who participated in two major forest plantation programs in northwestern Vietnam. Measuring actual TCs is helpful to understand whether TCs could potentially act as a constraint to program participation. Our study has contributed to the knowledge on TCs borne by households in developing countries, since there are a handful of studies that have empirically analyzed actual TCs. The results found that monitoring and enforcement costs are higher than information searching and application activity costs. Average TCs are about 200,000 VND (USD 10) per household per contract, which is equivalent to two days of wage labor. Thus, TCs are not likely to be a constraint for participation in forest management programs like PES, given the same level of farmer involvement and monitoring mechanisms as in past programs. The relatively low TCs are also reflected by the program's low level of asset specificity. It is expected that farmers will bear higher TCs from PES schemes due to greater program complexity and longer periods of implementation. We found a large variation in TCs among households, but there is no evidence that poorer farmers bear the burden of TCs more than wealthier farmers. Even though the absolute value of TCs is low, the share of TCs to program benefits is 35.7%, which is relatively high compared to other programs in developed countries with more complex programs. This implies that the payout ratio of the programs is quite low, and could be increased for the programs to be more widely adopted and to have better efficiency. Hence, rather than aiming to reduce TCs, balancing the level of TCs with benefits to enhance the overall attractiveness of afforestation programs for smallholder farmers is considered to be a more appropriate agenda for policy improvement.

Our findings on the determinants of TCs reveal several insignificant and unexpected effects given that Mburu et al. (2003) claims that factors influencing the level of private TCs depend on local conditions. The case study of forest plantation programs underscores the importance of analyzing how programs are actually implemented when identifying determinants of private TCs. Overall, we find that household characteristics do not have a major role in determining differences in TCs among participants. The household head's education, gender, and perception towards the programs have large effects on the magnitude of TCs. Strengthening social capital may not be effective in influencing the level of TCs if the program is based on a top-down approach with less collaboration from participants regarding program implementation and where there is no significant conflict

among participants and authorities. The policy design should pay particular attention to trade-offs between strict monitoring and enforcement mechanisms and the level of TCs incurred by farmers.

Although it was not possible to empirically measure TCs of farmers engaged in community-based forest management, our study identifies interesting results on the matter. Implications from this study could be further developed by expanding the survey and gathering data from participants in community-based forest management. Further research on the comparison of TCs associated with community- and individual-based management systems will have significant implications for the management of PES project and balance the growing bias towards community-based systems.

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CHAPTER 5

CONCLUSIONS

During the last two decades, Vietnam has transitioned from state-managed forestry to village- and household- managed forestry to develop livelihoods and improve the environment. Several measures have been implemented to alleviate forest degradation, including forest land allocation and forest plantation programs. The current and growing international interest of civil society and governments in the acknowledgement of forest environmental services has become mainstream: Vietnam is among several countries who appreciate the need for payment or compensation to local communities for forest values through the PES mechanism. Encouraging local households to participate as environmental services providers is very crucial to achieve successful PES policies. This dissertation aims to understand farmers' behavior on forest management and their experiences with forest policies that are necessary for determining effective incentives that can bring about changes in behavior related to forest conservation practice in a mountainous area. In spite of a number of studies examining the impacts of forest policies in the northern Vietnam, there is limited research on incentive and forest management at the household level. A household level analysis could provide insightful information and policy implications for PES, especially for improved participation and cost efficiency.

The research is mainly based on comprehensive data on forest production, socioeconomic indicators, and government participation in afforestation programs which were collected from 300 representative households in the mountainous area of Da Bac district, Hoa Binh Province in northwestern Vietnam. The first study, contained in Chapter 2, on household adoption of forest plantation examines why farmers planted forest under the current incentive scheme taking several aspects of forest plantation into account. Results from a gross margin analysis indicate that planting forest yields far less profit compared to growing a cash crop like maize, even when accounting for monetary support received from the government. Government policies, namely, forest land allocation and forest plantation programs, are the main reasons why the majority of households still plant forest, even though it is less profitable. From a benefit viewpoint, planting forest is another way to generate income whereby farmers can reap benefits regularly from non-timber forest products. Results from a Heckman sample selection estimation indicate that more

educated and wealthier households invest less in forest. These results contradict those in other adoption studies, which tend to find that more knowledge and money lead to more environmentally-friendly activities. This finding supports the above argument that farmers may view forests as an income generating business without considering its environmental or non-monetary benefits and that better educated farmers may be more able to realize that participating in afforestation programs implies losing money compared to growing maize.

Even though support from the government can encourage farmers to plant forest, the regression results revealed that providing tree seedlings and a rather low level of cash compensation under the previous afforestation programs did not effectively encourage farmers to plant more trees or to replant the trees that were destroyed or did not survive from extreme weather. The implication of these results for PES schemes is that a higher monetary incentive is needed to make planting forest attractive in a sustainable manner. The findings also highlight another issue of forest plantation programs: Despite the fact that some transaction costs of participation are fixed, given that the benefit is paid on an area basis only, wealthier households receive more support because they own more land. This underlines the strong linkage between land allocation and forest conservation policies, especially in mountainous areas which suffer from land scarcity. Lack of formal land security is not found to hinder investments in forests, which contradicts expectations and the literature. However, this unexpected finding may be explained by the behavior of households who do not hold formal land security. Such households may expect that their participation will later facilitate the recognition of plot ownership by the local government. Due to the conditions in mountainous areas where forest plots are located outside of the village, the results indicate that the degree of trust among villagers that the planted forests are secured is an important factor promoting forest plantation.

The finding from the first study on adoption of forest plantation indicates that previous incentive schemes are not able to effectively foster forest plantation, even when the purpose of plantation is commercial. The second objective of the study estimates how much money farmers are willing to accept (WTA) to conserve more forest in comparison to their current practices. It sheds light on the cost efficiency and preferences of local farmers on forest conservation programs. The hypothetical baseline assumes that every household is allocated a plot of land of the same size and conditions. This assumption is made to avoid bias from land holding inequality and to explore the potential demand of forest conservation. The use of the stated preference method allows the examination of

farmers' preferences beyond their current practice. Choice experiments estimate the WTA planting and conserving forest and tests the hypothesis of whether the subsidy amount is the only factor that farmers consider when deciding to enter a forest conservation contract with the government. Results show that even though the pecuniary aspects of forests – namely, the subsidy amount and volume of allowable timber harvest – are the most important factors of the program, farmers consider other aspects as well. It is also noteworthy that the freedom to choose the tree species appears to be attractive for farmers who want to participate in forest plantation programs. This implies that the flexibility of the program according to local conditions can attract more potential participants. Another finding is that the degree of the willingness to participate varies among households. Households with a higher share of non-farm income and that have experienced receiving support for forest plantation tend to have more interest in the program. On the other hand, households who have better market access to sell forest products indicate less interest in the program since they prefer to harvest all of the timber without any restrictions from the government.

Results from the WTA estimation shows that on average, farmers are willing to pay to participate in a contract in which they can exploit half of the timber with minimum care and weak regulations. On the other hand, stricter forest conservation contracts demand a subsidy that is greater than that offered in previous afforestation programs and in the pilot PFES policy. However, the result from the comparative analysis reveals that the WTA is far lower than forgone income from cash crops cultivation. This indicates that encouraging farmers to plant and conserve forest is not as costly as the opportunity cost of land. Even though local farmers tend to associate forests with monetary benefits, the results indicate that given the well-functioning land allocation policy, there is room for stricter forest conservation programs as long as farmers are adequately compensated.

The final part of the dissertation analyzes the level and importance of TCs incurred by households who participated in past forest plantation programs. Measuring the actual TCs is helpful to understand whether TCs could potentially act as a constraint to participation in future programs. Results indicate that TCs incurred by households are not likely to be a constraint for participating in future PES programs if farmer involvement and monitoring mechanisms remain the same. There is no evidence that poorer farmers bear a higher burden of TCs than wealthier ones. However, it is expected that farmers will face higher TCs from a PES scheme due to its greater complexity and longer implementation period.

Monitoring and enforcement costs are highest, indicating that farmers are more involved in monitoring activities rather than searching for information and applying. Despite the low absolute level of TCs, they are equivalent to more than one-third of program benefits, which is quite high compared to other agricultural or conservation programs in developed countries where the nature of the programs are more complex.

The regression analysis on determinants of TCs reveals that the household head's education, gender, and perception towards afforestation programs have large and significant effects on the magnitude of TCs. Social capital is insignificant for explaining participation in the two programs which were implemented in a top-down fashion with little community involvement. Therefore, strengthening social capital may not be effective in influencing the level of TCs if the program is based on a top-down approach which involves less collaboration from participants regarding program implementation and no significant conflict among participants and authorities. Future policy design should pay attention to the trade-offs between a strict monitoring and enforcement mechanism and the level of TCs incurred by farmers.

As previous afforestation programs are based on a top-down approach, this dissertation contributes to the limited research on the potential demand of and farmers' preferences in forest management. The analysis provides policy implications for a PES scheme where voluntary participation and cost efficiency are crucial for its success. This dissertation also contributes to a small but growing body of literature on choice experiment application to the field of forest conservation schemes in developing countries. In addition, the analysis of TCs borne by households under the forest management scheme can contribute to the limited number of studies that have empirically analyzed private TCs, particularly in developing countries.

A successful transition from a top-down approach to a market-based conservation policy such as a PES scheme calls for the need to understand household behavior and preferences under the local context to ensure effective participation and sustainable management. The results of our research underline the inadequacy of the previous forest plantation subsidy and recommend that given the situation of limited land, higher incentives are needed to make forest conservation attractive in the PES scheme. The findings from the choice experiment study reveal that depending on the type of contract, there exists a potential demand for forest conservation with a small subsidy or even without a subsidy if additional land is allocated. This suggests that policymakers should integrate

land allocation policy with PES policy to achieve cost efficiency. In addition, the CE study indicates that different types of households have different degrees of willingness to participate in the forest conservation programs. A policy recommendation to increase the participation rate is to target the PES campaign to households who have less interest in forest conservation, including households whose livelihoods depend mainly on agricultural production, who have not previously joined forest programs either due to their ineligibility or distrust in local government authorities, and who have limited market access due to poor road conditions. This study finds that the degree of security of the planted forest is a critical factor for the decision to plant forest since the location of forest plots are usually far away from the village and therefore difficult to protect against illegal logging. Strengthening the monitoring mechanism or introducing insurance to reduce the risk of plantation failure is recommended as another option to promote participation.

This dissertation reveals that the amount of incentives that farmers are willing to accept to plant and conserve forest instead of engaging in farming activities is higher than previous subsidies. In mountainous areas where ethnic minorities still live in poverty, a higher subsidy is expected to achieve both environmental conservation and poverty alleviation outcomes. Nevertheless, a critical question arises as to whether a higher subsidy can lead to sustainable household forest management. This question should be addressed by future research by examining longitudinal data on household livelihood and forest management under a PES scheme. It has not been possible to empirically measure TCs of farmers engaged in community-based forest management, where such information would provide interesting results on this matter. The implications on this study could be developed further by expanding the survey and gathering data from participants of community-based forest management. Further research on the comparison of TCs associated with community and individual management is recommended to provide information to policymakers and researchers. Such research may contribute to the realization that community-based systems can create high transaction costs with little benefit for smallholder farmers if they are not implemented well.

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APPENDICES

Appendix A: Baseline household questionnaire, Da Bac District, Hoa Binh Province, Vietnam

1. Identification

	Day	Month	Year	Code
1.1. Date of Interview :			2011	

1.2. Commune name _____ ☐

1.3. Village name _____ ☐

1.4. Household identification number _____
(please write this number on all pages)

1.5. Name of the Household head _____

1.6. Name of respondents
(Name and ID) _____ ☐

1.7 Cell phone number of respondent (or household head)_____

1.8 Ethnic group of the household head
Kinh…… 1
Muong…… 2
Dao……. 3 ☐
Tay……. 4
Thai…… 5
Other (specify)……... 6

1.9 Did your household resettle in this area? Local people=1, Resettled =2

1.10 In which year was your household established ? ☐ year

1.11 Interviewer name and code _____ ☐

1.12 Supervisor name and code _____ ☐

1.13 Date checked by supervisor _____/_____/_____

Signature of the supervisor ☐

Note to the interviewer : A household consist of all people who live under the same roof, eat from the same pot and share expenditures. A person is not considered as a member if she spent more than 3 months away in the past 12 months.

2. Demographic profile

ID	2.1 Name	2.2 Sex 1= Male 2= Female	2.3 Age	2.4 Relation to household head (code 1)	2.5 Marital Status (code 2)	2.6 Can read/ write (code 3)	2.7 Highest class passed (code 4)	2.8 *If > 6 years old* Occupation in the last 12 months (code 5)	
								Primary	Secondary
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									

Code 1 Relation to hh head

Household head.....	1
Spouse	2
Son or daughter or son in law or daughter in law.....	3
Father or mother.....	4
Grandparent.....	5
Grandchild	6
Brother or sister	7
Other relative	8
Other non relative.....	9

Code 2 Marital status

Single ……..	1
Married with spouse permanently present in the household……..	2
Married with the spouse migrant.....	3
Widow / widower	4
Divorced / separated.....	5

Code 3 Read/write

Cannot read or write.	1
Can read only.....	2
Can read and write....	3
Cannot speak ..... national language.....	4

Code 4 Education

Never attended school or not yet attend school.....	0
Attended school but did not finish primary school.....	1
Primary degree	2
Secondary degree.....	3
Vocational diploma	4
High school certificate.....	5
3 year-college degree.....	6
Bachelor (university) degree	7
Master and more.....	8

Code 5 Occupation

Self employed in agriculture	1
Self employed in non-farm enterprise	2
Student/pupile	3
Government employee	4
Salaried worker in non agriculture	5
Daily agricultural labor	6
Daily non agricultural labor	7
Domestic worker	8
Military service.....	9
Unemployed	
Looking for a job.....	10
Doing household chore..	11
Retired.....	12
Disable to work.....	13
Leisure.....	14

3. Housing and utility

	Questions	Response
3.1	What type of toilet does your household have?	
	Flush toilet with septic tank/sewage pipe.....	1
	Double-vault compost latrine, or toilet directly over water.....	2
	No toilet or other type.....	3
3.2	What type of exterior walls does the house have? (Q3.2 - 3.4 Just observe, do not have to ask)	
	Leaves, branches….....	1
	Bamboo….....	2
	Wood….....	3
	Galvanized iron….....	4
	Earth….....	5
	Brick, stone….....	6
	Concrete….....	7
3.3	What type of roofing material is used in your house?	
	Concrete, cement.....	1
	Tile.....	2
	Galvanized iron.....	3
	Wood, bamboo.....	4
	Straw, leaves.....	5
	Canvas, tar paper.....	6
	Fibre cement.....	7
3.4	What type of flooring does the main room have?	
	Earth….....	1
	Bamboo….....	2
	Wood….....	3
	Concrete….....	4
	Brick….....	5
	Concrete with additional covering….....	6
3.5	What type of cooking fuel source is primarily used?	
	Leaves/ grass/ rice husks/ stubble/ straw / thatch stems.....	1
	Wood.....	2
	Coal/ charcoal.....	3
	Kerosene.....	4
	Biogas.....	5
	Bottled gas.....	6
	Electricity.....	7
3.6	What is your primary source of drinking water?	
	River, lake, spring, pond.....	1
	Rain water.....	2
	Public well – open.....	3
	Public well – sealed with pump.....	4
	Public tap.....	5
	Well in residence yard – open.....	6
	Well in residence yard – sealed with pump.....	7
	Outside tap.....	8
	Inside tap.....	9
3.7	Do you have any of the following utilities for your household ?	

	a. Piped water **b**. Electricity **c**. Telephone **d**. Mobile (cell phone)	Yes……..1 No……2 Note: For electricity, piped water If YES, + Own production.....3 + Connected to national authorities.....4
3.8	How much did your household pay **per month** for each utility?	
	a. Piped water **b**. Electricity **c**. Telephone **d**. Mobile (cell phone)	00 VND 00 VND 00 VND 00 VND

4. Assets and credit

4.1 Assets owned (count all members of your household)

Assets type and code	4.1.1. Number owned	4.1.2. Total resale value at the current market price ('000 VND)
1. Buffalo		
2. Pig		
3. Goat		
4. Cattle		
5. Dog		
6. Motor tiller		
7. Plough		
8. Ploughing machine		
9. Motorbike		
10.Car/Pick-up truck		
11.TV&Video player		

4.2 Credit constraint

	Formal organization (VBARD, VBSP, mass organization) Yes=1, No=2	**Informal sources** (private moneylender, shopkeeper, fertilizer dealer, relative, friend/neighbor, etc.) Yes=1, No=2
4.2.1 Did any member in your household apply for a loan from [source] in the last 12 months?		
4.2.2 If your household applied, was the loan granted?		

4.2.3 If the loan was granted, was the household granted the same loan amount as requested?		
4.2.4 If 'No', how many % you granted from the amount you requested?	%	%

Note: if household granted loan more than one source of loan, put the lowest percentage of loan granted.

4.2.5 If household members did not attempt to borrow ('No' in Q.4.2.1), what are the main reasons? (Please rank 3 most important reasons, write '0' if household does not have 3 reasons)

We did not need credit..... 1
Do not have enough information on how to get loan…….. 2
Do not know anyone to borrow from/the relatives don't have money to lend…… 3
The banks/the lenders are too far..... 4
The procedure is too complicated…… 5
No guarantor/no mortgage……... 6
We dislike any borrowing…… 7
We would like to have applied but did not apply because
We felt that we would be rejected because of our characteristics..... 8
Don't want to borrow because the credit is not big enough…….. 9
Interest is too high..... 10
We believe that the government/informal source will not give any loan..... 11
We are afraid that we cannot afford to pay back..... 12
We didn't attempt to borrow because we have already borrowed..... 13

rank	formal	informal
1st		
2nd		
3rd		

4.3 Potential credit access

	4.3.1 Currently, how much does your household owe to…. '000 dong	4.3.2 If you are not currently borrowing from this source, is it possible for you to borrow from..... Yes=1 No=2 (next row)	4.3.3 In case of an emergency (food shortage, sickness), what is **maximum amount** could your household borrow from… '000 dong	4.3.4 For income generating investment purposes, what is **maximum amount** could your household borrow now from… '000 dong
1. VBARD				
2. VBSP				
3. Mass organization				
4. Informal credit group (Ho Hui)				
5. Money lender (in sum)				
6. Shopkeeper/trader (in sum)				
7. Relatives (in sum)				
8. Friends/Neighbour (in sum)				

5. Food security and staple food self-sufficiency

5.1	Did your household experience food shortage in the last 12 months?		
	Often true (happen more than 180 days).....	1	
	Sometimes true (happen less than 180 days).....	2	
	Never true (never happen).....	3 go to Q5.4	
5.2	In the last 12 months, did you or other members of the household ever cut the size of your meal or skip meals **because there was not enough money** for food/or before the harvest.		
	Yes.....	1	
	No.....	2 (go to Q5.4)	
5.3	*Ask only if 5.2= Yes.* How often did this happen?		
	More than 180 days	1	
	Less than 180 days but more than 60 days.....	2	
	Less than 60 days.....	3	
5.4	"We could not afford to eat balanced meals" i.e. the main meals consists of rice and vegetables only (without any animal protein). Was that often, sometimes or never true in the last 12 months.		
	Often true (happen more than 180 days).....	1	
	Sometimes true (happen less than 180 days).....	2	
	Never true (never happen).....	3	

Staple food self-sufficiency

	Rice (all kinds)	Maize	Cassava	Sweet potato
5.5 **How many months** in the last 12 months did your household consume rice, maize, cassava, and sweet potato that you grew or produced at home? *If the farmer doesn't grow or consume any types of these crops, skip to 5.8*	#month	#month	#month	#month
5.6 How much did you consume in a typical month?	kg	kg	kg	Kg
5.7 What was the value of [food] you consumed in a typical month on your own production?	‘000 VND			
5.8 How many kilograms of rice do you usually buy in **one time for home consumption**	Kg			
5.9 And how long can you consume this rice	#month			
5.10 How much do you usually spend on rice per one time of purchase?	‘000 VND			

6. Social capital and access to services and safety nets

6.1 What are the problems/concerns (on economic, social, environment, etc.) that your household is facing at the moment? *Please rank up to 3 most important problems.*

Do not have enough money to buy food or basic needs (including housing)..... 1
Decreasing yield of crop production..... 2
Increasing price of fertilizer and other inputs..... 3
Lowering price of agricultural products..... 4
Do not have enough land for farming..... 5
Do not have enough credits/money to invest on farming, livestock, forest etc..... 6
Problems in farm production (bad weather, disease,etc.)..... 7
Others (please specify)..... 8

	1st
	2nd
	3rd

Interviewer: Do not read the choices. Write '0' if in the remaining box if the respondent does not mention 3 problems. In case of no problem/concern at all, write '0' for every box.

6.2 In case of shock (flood, loss of income, divorce, etc.) or problem such as the ones you mentioned above, is it easy or not to ask for help (any kind of help) from different persons of your network ?

	Relatives	Friends/ Neighbour	Village head	Mass organisation
very easy=1, easy= 2, difficult= 3, very difficult=4				

(Do not know=0)

6.3 Membership in association, group or organization
We would like to ask questions about the associations in which you or household members participate and has membership, including communist party, mass organisation or any other kinds of organisation.

(interviewer, ask the question for <u>each member over 15</u>, to be sure to enter in the table below all the organisation the household participates in. If a member has membership in several organizations, then enter his ID several time in the first column and fill a line for each organization he participates in)

6.3.1 ID of hh member (use ID from family roster)	6.3.2 Type of organization (code 1)	6.3.3 Degree of participation (code 2)	6.3.4 During the past 12 months, did you make contributions to this organization... Yes (in cash or in kind).....1 No.....2

Code 1 type of organization

Mass organisation
Farmer Union..... 1
Women Union..... 2
Youth Union..... 3
Veteran Union..... 4
Fatherland Front..... 5
Eldery Union..... 6

NGO providing services
NGO providing extension service..... 7
NGO providing microfinance services..... 8
Other NGO (family planning, health care, school education, and services for any other social sector)..... 9
VBSP Credit group..... 10
Other formal Credit group..... 11
Other informal credit/finance group.....12
Environmental group..... 13

Agriculture/trade organization
Extension club.....14
Cooperative.....15
Traders association.....16
Professional association.....17
Trade union.....18
Hobby club….....19

Political organization
Communist Party.....20
People's committee.....21
Ethnic committee.....22

Other local groups/organization
Religious group.....23
Cultural association.....24
Parent group.....25
School committee.....26
Health committee.....27
Sport group.....28
Police in the commune.....29

Code 2 degree of participation

Leader.....1
Follow the regulations of Organization.....2
Give help from time to time.....3
Not active.....4

6.4 How many people do you or any member of your household know *personally* and who work (in decision making position) in the following organisations at all administrative levels (i.e. commune, district, province)? (please record only two way relationships)

Type of organisation	6.4.1 How many do you know?	6.4.2 How many are relatives of the household head or the spouse?	6.4.3 Have you ever asked for help from these people that you know? Yes=1 No=2 Not applicable=0
Communist party			
People's committee			
Women Union			
Fatherlands front union			
State Forest Enterprise			
Others (specify)……			

6.5 Please tell me if in general you agree or disagree with the following statements:

Strongly agree..... 1
Agree..... 2
Disagree..... 3
Strongly disagree..... 4

Interviewer, read slowly the following statement to the respondent:

6.5.1 Most people in this village are basically honest and can be trusted. ☐

6.5.2 People are interested only in their own welfare. ☐

6.5.3 If my household has a problem, there is always someone to help me. ☐

6.5.4 If you loose an animal (pig, poultry, or goat) someone in the village would help look for it or would return it to you ☐

6.6 How would you qualify your access to government services listed below on a scale from 1 to 5 ?
(1= do not have access, 2= poor access, 3= fair access, 4= good access,5= very good access)
For education service, if household doesn't have children and don't know about school, write 0

6.6.1 Education/schools		6.6.7 Water distribution for household use	
6.6.2 Health services/clinic		6.6.8 Water distribution for irrigation	
6.6.3 Housing assistance		6.6.9 Agricultural extension	
6.6.4 Job training/employment		6.6.10 Sanitation service	
6.6.5 Credit/finance		6.6.11 Justice/ conflict resolution	
6.6.6 Transportation (road)		6.6.12 Security/ police services	

6.7 Here are listed some services/programs offered by the government,

Name of the service	6.7.1 Do you know about it ? 1= Yes 2= No>> next row	6.7.2 If yes, have you received such support or participate in the program in the last 5 years (since 2007)? Yes = write the year you receive or participate (can be several years if received more than one) No = 0	6.7.3 Amount received in the past 12 months ? '000 VND	6.7.4 If 6.7.2 = 'No'.What are the reason why you did not receive support or participate in the program? (multiple reasons possible) code 1
1. Access to loan with low interest rate				
2. Education tuition exemption and reduction/ free textbooks				
3. Support for agricultural production				
4. Cash transfer				

5.Resettlement program				
6.Reforestation program				
7.Training program			Content of training	
8. Support for electricity				

Code 1: Reasons for not receiving support or not participating government programs

Did not fullfil the criteria/requirement of the program..... 1
Do not have interest to participate in the program/do not need the support..... 2
Do not have time..... 3
Has applied but rejected by the authority/has applied but still waiting..... 4
Village head did not choose my household..... 5
Receive the support long time ago..... 6
Do not have this program/support in the village/commune..... 7
Do not know how to apply..... 8

6.8 Did your household receive poor certificate from commune in.....?

Yes.....1
No.....2
Do not know.....3

…2007? ☐
…2008? ☐
…2009? ☐
…2010? ☐
…2011? ☐

7. Land allocation and land tenure

7.1 Does your household have forestry land?

Yes..... 1
No..... 2 (go to Q. 7.6) ☐

7.2 Has your household received land use certificate (Red Book, Green Book) for forestry land?

Yes..... 1
No..... 2 ☐

7.3 If 'Yes', when did you receive it?.....Year

7.4 If 'No', have your household applied for land use certificate for forestry land?

Yes.....1
No.....2 ☐

7.5 If No, what are the main reasons, why you haven't applied for the certificate? *(multiple answer possible)*

Do not want forestry land.....1 ☐
It would be difficult to obtain certificate.....2
The commune has no land to allocate, do not want to waste ti.....3 ☐
We have applied but are not accepted by commune.....4
Do not know.....5
Fee is too expensive, we cannot afford.....6
Commune hasn't allocated land yet/no need to apply.....7
The plot is too small that it is not worth to apply for RB.....8

For household who has land use certificate either for agricultural land or forestry land.

7.6 Do you think there will be a reallocation of land in your village before the end of the Use Right period.

It is very likely to occur.....1
It is likely to occur.....2
It is unlikely to occur.....3
It will definitely not occur.....4

7.7 What do you think would happen to your land after the end of use right period?

I still can use the same land (but perhaps need to extend certificate).....1
I will have to register for the new plot of land.....2
It is very hard to tell.....3

7.8 Information at plot level

PLOT ID	General information						Acquisition			Land use				
	Type of plot code1	Area m^2 or ha	Use right with RB=1 w/o RB=2	Distance Plot-house in walking minutes	Slope code slope	How do you assess quality of soil? Code2	When did you first acquire this land? Year	Is your household using this land now? Code3	If you leased this plot out, how much would you receive? '000 VND/year	How did you use it in 2011? Code 4		How did you use it in 10 years ago? Code4	Why do you change the land use? Code5	How can you rank your plots on profit that you earned from each plot? (only agricultural land) 1= highest profit 2= second highest 3= third highest .....
										Crop1	Crop2			
1														
2														
3														
4														
5														
6														
7														
8														

Code 1 Type of plot

Protection forest..... 1
Planted forest..... 2
Perennial tree land..... 3
Paddy field irrigated..... 4
Paddy field non irrigated..... 5
Other farming land irrigated..... 6
Other farming land non irrigated... 7
Fish pond..... 8
Land for livestock..... 9
Residential land..... 10
Barren land..... 11
Home vegetable garden..... 12

Code 2 Soil quality

Plant growth:
Vigorous..... 1
Normal..... 2
Stunted..... 3

Code 3 Plot management

Yes..... 1
No,
Plot is leased out (fixed rent).....2
Share tenancy..... 3
Mortgaged out..... 4
Given away, lent out (no payment)..... 5
Borrowing land.....6
Renting land.....7

Code 4 Land Use

Paddy rice..... 1
Upland Rice..... 2
Maize..... 3
Cassava..... 4
Arrow root..... 5
Sweet Potato..... 6
Sugar Cane..... 7
Soybeans..... 8
Peanut..... 9
Sesame..... 10
Vegetables..... 11
Acacia..... 12
Bamboo..... 13
Eucalyptus..... 14
Mango..... 15
Longan..... 16
Other fruit tree..... 17
Fish pond..... 18
Plot not managed by hh.... 19
Fallow..... 20
Melia (Chinaberry)..... 21
Maize+cassava+bamboo.... 22
Other tree..... 23

Code 5

Receive government support..... 1
New crop is more profitable..... 2
Rotate crop to improve soil quality..... 3
Lack of money to plant trees/crops..... 4
No water..... 5
There is buyer/market for this crop..... 6
Trees died..... 7
No labour..... 8

8. Agricultural production

8.1 Net profit of crops at household level in one season in 2010

Amount and expenses on input use		**Unit**	**Paddy Rice (ask for season 1)**	**Upland Rice**	**Maize (ask for season 1)**	**Cassava**	**Arrow root**
8.1.1 What was the ***total cultivated*** area in one season?		m2					
8.1.2 How many crop seasons did you grow?		Number					
Costs							
8.1.3 Seedling							
What kind of seed did you use?		*Name of seed 1*					
What is the quantity you used?		Kg					
Amount you bought?		Kg					
What is the price? (if buying)		'000 VND/kg					
What kind of seed did you use?		*Name of seed 2*					
What is the quantity you used?		Kg					
Amount you bought?		Kg					
What is the price? (if buying)		'000 VND/kg					
8.1.4 Fertilizer							
1. NPK	-Volume	Kg					
	-Price	'000 VND/kg					
	-When did you pay?	Immediately=1 After buying=2					
2. Urea	-Volume	Kg					
	-Price	'000 VND/kg					
	-When did you pay?	Immediately=1 After buying=2					
3. *Potassium (kali)*	-Volume	Kg					
	-Price	'000 VND/kg					
	-When did you pay?	Immediately=1 After buying=2					
4. Phosphate	-Volume	Kg					
	-Price	'000 VND/kg					
	-When did you pay?	Immediately=1 After buying=2					
5.Organic fertilizer	-Volume	Kg					
	-Price	'000 VND/kg					
8.1.5 Pesticide (including hiring sprayer)		'000 VND					
8.1.6 Labor (*notice that man-day= number of days * number of people*)							
- Land preparation	Did you use machine?	Yes=1,No=2					
	Household labor	Man-day					
	Hired	Man-day					

	labor						
- Growing	Household labor	Man-day					
	Hired labor	Man-day					
- Weeding	Household labor	Man-day					
	Hired labor	Man-day					
- Harvesting (including moving back to your house)	Did you use machine?	Yes=1,No=2					
	Household labor	Man-day					
	Hired labor	Man-day					
8.1.7How much did you pay for hired labor (in all processes)		'000 VND					
8.1.8 How much did you pay for renting land?		'000 VND/season					
8.1.9 What was the total cost for hired machinery/transport for all the crops that you grew?		'000 VND					
8.1.10 How much was the interest paid for the loan used for crop cultivation? (also estimate for in-kind payment)		'000 VND					
Revenue *(For rice, use unhusked quantity)*							
8.1.11 What was the total quantity of crop did you harvest in one season?		Kg					
8.1.12 Quantity used for home consumption		%					
8.1.13 Quantity sold		%					
8.1.14 Average selling price		'000 VND/kg					
In case of cassava and arrow root, if farmer cannot answer 8.1.11-.8.1.14 8.1.15 How much did you get from selling your product?		'000 VND					

9. Forest protection and forest production

Ask only households who are currently managing forest land (including both of forest protection and forest production). ***If households are not managing any forest land go to Q 9.18***

**** For forest protection activity***

9.1 Do you participate in forest protection?

Yes = 1

No = 2 **(go to question 9.11)**

9.2 Which year did you start the activity of forest protection?..... (4 digits)

9.3 How many hectares of protection forest do you participate?..... (ha)
9.4 How many people are in your group?.....persons
9.5 How much do you receive to protect the forest from government?.....(‘000VND/ha/month)
9.6 How much did you get from non-timber products in the last 12 months?

Non-timber products	Quantity (kg)	Consumption (kg)	Sold (‘000VND)
9.6.1 Bamboo shoot			
9.6.2 Mushroom			
9.6.3 Jew’s ear			
9.6.4 Medicines			
9.6.5 Fuelwood			
9.6.6 Others (specify).....			

9.7 Why did you participate in forest protection?
.....
.....
.....

9.8 What are the three most difficulties/concerns you are facing in forest protection?

Payment for forest protection is too low.....1
Unsafety because of illegal logging.....2
I have to spend too much time to deal with officers.....3
(for signing contract, officers come to monitor, etc.)
Other (specify).....4

	1st
	2nd
	3rd

9.9 How many days per month does your household spend on forest protecti.....days

**** For forest production***

9.11 What is the total forest area your household have?.....(ha)

9.12 Do you make a contract with a company?
Yes =1
No =2 [ ]

9.13 Costs and revenue from forest production (*if the farmer sign a contract with the company, please skip information about the price of seedling and fertilizer)*

Information	Unit/code	Acacia	Bamboo	Eucalyptus
Establishment period (within the first three years)				
9.13.1 Seedling				
How many trees (including extra growing)?	number			
When did you grow?	time			
Price of seedlings	‘000 VND			
9.13.2 Fertilizer				
Type 1 of fertilizer	name			
+ Volume	Kg			

+ Price		‘000 VND/kg			
Type 2 of fertilizer		name			
+ Volume		Kg			
+ Price		‘000 VND/kg			
Type 3 of fertilizer		name			
+ Volume		Kg			
+ Price		‘000 VND/kg			
9.13.3 Herbicides (including hiring sprayer)		‘000 VND			
9.13.4 Labor (from land preparation to harvest)					
-Land preparation	Household labor	Man-day			
	Hired labor	Man-day			
-Growing	Household labor	Man-day			
	Hired labor	Man-day			
- Weedling	Household labor	Man-day			
	Hired labor	Man-day			
9.13.5 What was the other costs that you spent on the establishment?		‘000 VND			
Operating cost (since 4th year)					
9.13.6 How often do you maintain the forest? (weeding,…)		Time/year			
9.13.7 How many man-days do your household member work on each time?		Man-day			
9.13.8 How many man-days of hired labor?		Man-day			
9.13.9 What was the total cost for hired labour?		‘000 VND			
9.13.10What was the other costs that you spent on maintaining forest?		‘000 VND			
Harvesting (if household has not harvested timber yet, go to ask about non-timber products from question 9.13.18)					
9.13.11 How many man-days did your household member spend for harvesting (if needed)		Man-day			
9.13.12 How many man-days of hired labor?		Man-day			
9.13.13 Cost of hiring labor		‘000VND			
9.13.14 How much did you get from selling timber? (1st sale)		‘000 VND			
9.13.15 When is that?		year			
9.13.16 How much did you get from selling timber? (2nd sale)		‘000 VND			
9.13.17 When is that?		year			
9.13.18 How much did you get from selling non-timber products in one year, on the average?					
1. Bamboo shoot	a. Total harvested quantity	Kg			
	b. Quantity sold	Kg			
	c. Average selling price	‘000VND/kg			
2.Mushroom	a. Total harvested quantity	Kg			
	b. Quantity sold	Kg			
	c. Average selling price	‘000VND/kg			
3. Jew’s ear	a. Total harvested quantity	Kg			

	b. Quantity sold	Kg	
	c. Average selling price	'000VND/kg	
4. Medicinal plant	a. Total harvested quantity	Kg	
	b. Quantity sold	Kg	
	c. Average selling price	'000VND/kg	
5. Fuel wood	a. Total harvested quantity	Kg	
	b. Quantity sold	Kg	
	c. Average selling price	'000VND/kg	
6. Other (specify).....	a. Total harvested quantity	Kg	
	b. Quantity sold	Kg	
	c. Average selling price	'000VND/kg	
9.13.19 Have you received any subsidies/supports from the government?		Cash=1 Loan=2 Rice=3 Seedling=4 Fertilizer=5 No=6	

9.14 List three most difficulties you are facing now in forest production? (*for example: production side, marketing side, and others*)

.....
.....
.....
.....

9.15 What are other benefits you obtain from forest plantation?

Improving soil quality.....1
Trees provide shade and beauty.....2
Forest is good for the environment.....3
(e.g. help improving air quality, reduce soil erosion, improve water quality downstream etc.)
Forest can be considered a saving in case of emergencies or saving for children...4
Other (specify).....5

9.16 What are the reasons why you chose to plant forest? Please rank the three most important reasons.

Hope to earn more income from forestry/use forest products for home consumption..... 1
Government provides support..... 2
Forestry does not need much labor..... 3
Want to have more land/want to keep the land..... 4
Forest is good for soil protection/soil improvement/increasing water quantity..... 5
Other (specify)..... 6

1st
2nd
3rd

9.17 What do you want from following actors in order to support your forest production?

- From central government (higher than provincial level)
.....
.....
.....

- From local government (province, district and commune level)
.....
.....
.....

- From mass organizations and associations
.....
.....
.....

Ask households who are not currently conducting forest plantation.

9.18 Have you ever thought about planting forest? If no, why is that? If yes, what is preventing you from adopting forest plantation?

No	Forestry is not profitable	1		1st
	Do not have land to plant forest	2		2nd
	Do not have enough labor/time to grow/maintain the forest	3		3rd
	Do not know how to do it	4		
	It is too long to get benefits	5		
	Do not have money/credit for initial investment	6		
	It is too risky	7		
	Other (specify)	8		
Yes, but...	Do not have land to plant forest	9		
	Do not have enough labor/time to grow/maintain the forest	10		
	Do not know how to do it	11		
	It is too long to get benefits	12		
	Do not have money/credit for initial investment	13		
	It is too risky e.g. the tree may die before harvesting	14		
	Other (specify)	15		

10. Household income in the last 12 months

	How much did all the member of household earn from the following sources in the last 12 months? (i.e. for crop production: gross revenue – production costs) ‘000 VND
1.Vegetables	
2. Other crops (cotton, sugar cane, etc.): specify_____	
3. Fruit	
4. Livestock	Ask only revenue
5. Fisheries (Capture fish in the nature)	Ask only revenue
6. Aquaculture	Ask only revenue

7. Agricultural trade	
8. Agricultural wage	
9. Non agricultural wage	
10. Non agricultural business (incl. revenue from lending land)	
11. Remittances	
12. Government aid	
13. Others (specify).....	

11. Household expenditure in the last 12 months

11.1 Food expenditure

Item		Response
Food at home		
11.1.1 How much do you spend on average **to purchase** food to consume at home in **one month?**		
Rice .....'000 VND	Food eaten with rice .....'000 VND	
11.1.2 How many months in the last 12 months did your household consume food (rice, maize, cassava, sweet potato, vegetable, live stock, fruit, etc) that you grew or produced at home?		#month
11.1.3 What was the value of the food you consumed in a typical month from your own production? (approximately)		'000 VND
Food outside		
11.1.4 How many times in a month that your household usually have a meal outside home e.g. at the restaurant? (don't count special occasions, e.g. wedding)		#time
11.1.5 How much do you spend for a typical meal?		'000 VND

11.2 Non-Food expenditure

How much did your household spend on the following items during the last 12 months?

Item	Value ('000 VND)
11.2.1 Clothing, including shoes, bags, jewellery	
11.2.2 Personal care items and services (soap, shampoo, toothpaste, cosmetics, detergent, haircut	
11.2.3 Leisure, entertainment and sport (travel, cinema, cultural event, sport equipment, toys, etc.)	
11.2.4 Tax (income tax, tax on a living plot, housing and property tax, etc.)	
11.2.5 Insurance (auto, property, health, etc.)	
11.2. 6 Payment to wedding and funeral	
11.2.7 Others	

11.3 Durable goods

How much did you household spend on the following item **in total** during the last 12 months?

	'000 VND

Read the list of durable goods one by one and take note if household bought the item.

Category	Example
Furniture	Bed, cupboard, wall clock, sofa, table etc.
Electrical appliances	Electric fan, iron, radio, telephone, mobile phone, computer, video/dvd player, camera, television, satellite dish, rice cooker, refrigerators, washing machine, air conditioner, water heater, etc.
Vehicle	Bicycle, motorcycle, car, etc.
Others	Cooking pots, stove, sewing machine, water filter, etc.

11.4 Remittances

11.4.1 *During the last 12 months*, how much have all member of your household provided money or goods to person who are not members of your household? For example, for relatives living elsewhere, child support or alimony, or to friends and neighbors, for holidays, Tet….?

☐ **'000 VND**

11.4.2 In case you also send any food or other goods, what it the total approximate value of the food or goods that you sent ?

☐ **'000 VND**

11.5 Education expenditure

During the last 12 months, how much has your household spent on education (fees, uniforms, textbooks, or other materials) for any of its members?

☐ **'000 VND**

11.6 Health expenditure

During the last 12 months, how much has your household spent on health, such as fees for visits to doctors, health clinics, or traditional practitioners, or to pay for medicines or other materials?

☐ **'000 VND**

12. Perceptions on sustainable livelihood

12.1 Are you satisfied with the current living condition? and the reason why? *If 'Do not know', write '99'.*

Yes =1
No=2 ☐

because……
……

12.2 How do you think your living condition would be in the next 20 years?

It would be the same like this….1
It would be better……2
It would be worse ……...3 ☐

Reasons why do you think so
…….....
.....

12.3 How do you think your community would be in the next 20 years?

It would be the same like this….1
It would be better……2
It would be worse ……...3

Reasons why do you think so
…….....
.....

12.4 What kind of supports do you need from the government in order to improve the livelihood in your community?
…….....

I would like to ask some questions concerning forest plantation in your community.

12.5 Do you think forest is important for your livelihood? For example, it would benefit agriculture production and environment?

Yes……1
No…….2

12.6 Do you know that planting forest will also provide benefits to other people especially the hydropower dam at the downstream will get benefits from improving water flow and decreasing in sedimentation?

Yes, I know…….1
No, I don't know…….2

12.7 Do you agree that the forest area in the community should be increased ?

Agree…….1
Disagree…….2

If 'Disagree', could you give the reason……

Appendix B: The second household survey, Da Bac district, Hoa Binh Province, Vietnam 2012

Note for enumerator: Enumerator shall ask ONLY the household head or spouse who are in the decision making position. If the household head or spouse are not available, the enumerator shall proceed to the next household or wait until the respondent is available.

1. Identification

1.1. Date of Interview : **Day** [ ][ ] **Month** [ ][ ] **Year** [1][2]

Code

1.2. Commune name_____ [ ]

1.3. Village name_____ [ ]

1.4. Household identication number [ ]

1.5. Name of the Household head_____
(enumerator confirm whether it is the same household from the first survey)

1.6. Name of respondent_____

1.7 Gender of respondent: Male = 1, Female = 2 [ ]

1.8 Cellphone number of respondent_____

1.9 Interviewer name and code_____ [ ]

---

2. Choice experiment on voluntary forest plantation program

2.1. Does your household **currently** own planted forest/forestry land?
Yes = 1 No = 2 [ ]

2.2 Have you planted forest so far?
Yes, in my own forestry land……..1
Yes, in my own land but not in forestry land……..2
Yes, but not in my own land/in the rental land…….……..3
No……....4 [ ]

*Note to enumerator: Ask **EVERY household**, no matter what they have planted forest land or not*

2.3 Question about the importance of forest plantation program characteristics (Enumerator uses buttons or peanuts to help farmer to answer this question)

Instruction

We want you to think about what is important for the successful forest plantation program. In this case, successful forest plantation program means that the program will provide benefit to farmer and at the same time help farmer to maintain good quality forest which would also have environmental benefits such as reducing soil erosion and land slide problems. We are not talking about your past experience. You may think about the new program that you never had before.

We propose five aspects of the forest plantation program for you to consider as follow.

Aspect	Rank	Point
(1) Opportunity to use and sell forest products for income (example of forest products: commercial wood, bamboo shoot, mushroom, etc)		
(2) Frequency of subsidy payment (you may prefer receiving the money more often, for example, every 3 months or every 6 months)		
(3) Amount of cash that government provides to support forest production/conservation		
(4) Monitoring and punishment if the rules are violated		
(5) Forest must be maintained more often by farmer to make sure that the forest is healthy and no one cut the trees illegally		
Total	**-**	**100**

First, please consider which attribute is the most important. Then, which one is the second most important and continue until the least important (put number 5).

After the farmer has ranked all the attributes, the enumerator shall confirm again for the ranking.

Next, tell the farmer that if they had 100 points to assign to these five aspects to demonstrate their relative importance of successful/desirable forest plantation program, how would he/she do that?

It does not mean that every aspect needs to have points assigned to it. If the farmer thinks the attribute is not important to them at all, the point would be 0.

Enumerator shall confirm whether the points correspond with the ranking or not. If not, ask the farmer again for clarification or check if there are misunderstanding.

Questions on choices

Instruction

For the next questions, we want you to imagine the following hypothetical situations. The situation is not for real and since we are researchers from the university, not the government officers, we cannot promise that anything will happen after this research. However, we would like you to think about the questions seriously because the result from this research might benefit the process of policy making in the future.

Hypothetical scenario

Suppose the government will allocate 1 hectare of land in the sloppy land located about 1 km from your house where you can decide what to do with this land, that is, you can choose to plant forest OR plant crops like cassava or maize OR any other activities.

Note for enumerator: remind the farmer that government provides ONLY land NOT inputs (like seedlings, fertilizer or anything else)

Please imagine this situation and answer the following questions.

2.4 What would you like to do with this land? (choose only one option that you would like to do the most)

Plant cash crops (like maize, cassava, etc.)…….……..……. 1
Plant wood trees…….…… 2
Plant perennial crops (like tea, fruit trees, etc)……... 3
Lease to somebody else to earn money……. 4
Other activities (specify)…… 5

2.5 Could you also give the reason for the answer in 2.4?

Want to earn more income……..... 1
Can use the products for home consumption or feeding livestock 2
To prevent soil erosion..... 3
Do not have labor/time to grow anything……..... 4
Do not have capital/credit to grow anything……..... 5
Others (specify)…….....….... 6

Next, suppose the government also wants to initiate the program to support forest plantation. The program is not compulsory. You can decide whether your household wants to participate or not.

The details of the program are as follows.

1. The government will be responsible for all the establishment cost of the forest plantation (including seedlings, fertilizer and labor cost) if you choose to participate in the program.
2. If you decide to participate, the program would have the duration of 10 years.
3. You can choose the choice of tree that is suitable to local conditions.

What we want you to do is relatively simple. We will show you 8 cards that describe possible contracts, which are contract A and contact B and the choice not to participate in any contracts. We want you to evaluate each scenario and tell us which contract would you be most likely to participate?

Keep in mind that you have a full right to use the land for something else if you decide *not to* participate in any of the contracts.

There are no right and wrong answers. We are not from the government, please feel free to state your opinion.

2.6 Before we show you the cards, if you were to participate in the program, what kind of tree would you like to grow?

Bamboo..... 1
Acacia..... 2
Ironwood (Lim)..... 3
Bo de..... 4
Mo..... 5
Others (specify)..... 6

2.7 Choice answers

Code for choice card.....

No. of card	Contract A	Contract B	Not participate	Degree of certainty of answers 1=least certain, 5 = most certain	Why did you choose this choice?
Card 1				1 2 3 4 5	
Card 2				1 2 3 4 5	
Card 3				1 2 3 4 5	
Card 4				1 2 3 4 5	
Card 5				1 2 3 4 5	
Card 6				1 2 3 4 5	
Card 7				1 2 3 4 5	
Card 8				1 2 3 4 5	

Note for interviewers: If the respondent chose 'contract' for any of the 8 cards, go to Q 2.10

2.8 In case you choose ‘I do not want any contracts for all scenarios’, please tell us why do you NOT want any contract?

The subsidy amount is too low……..1 (ask Q 2.9) ☐

(Answer)……..……..2

2. 9 In case you answer ‘the subsidy amount is too low’, what is the minimum amount that you are willing to accept to plant forest?.....’000 vnd per year

2.10 Evaluate the questionnaire with the help of the following statements.

Question	Answer
2.10.1 Amount of time to think about the answer (not include the time of explaining)	Less than 20 minutes = 1 20- 30 minutes = 2 More than 30 minutes = 3
2.10.2 Did you understand the scenario and choice tasks	1 2 3 4 5 1= did not understand, 5 = fully understand
2.10.3 Do you think the scenario and choice tasks are feasible (or likely to happen in the future)?	1 2 3 4 5 1= impossible, 5 = most likely to happen
2.10.4 If you think the scenario is impossible, could you give the reason?	....

For household who own forest land, ask Q2.11. For household who does not have the forest land, ask Q2.13

2.11 If you chose to participate in any of the contract, are you willing to make such contracts with government **on your own forest land** (in case you can decide how much land you would like to allocate under the contract)?

Yes = 1, No = 2 ☐

2.12 Could you explain why? (Ask for both 'Yes' and 'No' answer)

To earn more income/can harvest products for home consumption……. 1 ☐
We have grown something (e.g. bamboo) already, we do not want to clear the land to grow something else..... 2
Others (specify)…….....…. 3

2.13 Since your household does not have the forest land, are you willing to use your cropland for planting forest under the contract (in case you can decide how much land you would like to allocate under the contract)?

Yes=1, No=2 ☐

2.14 Could you explain why? (Ask for both 'Yes' and 'No' answer)

We have to grow food crop for home consumption…….. 1 ☐
Land is fully cultivated, cannot grow forest.....…….. 2
Others (specify)…….....…. 3

3. Forest production activities *(Ask only household who has planted forest, if the household has not planted forest, go to section 4)*

Costs and revenue from forest production

Information	Unit/code	Acacia	Bamboo	Other tree (specify)
Establishment period (within the first three years)				
Seedling				
3.1 How many trees (including extra growing)?	number			
3.2 Area planted	Sq.m			
3.3 When did you grow?	year			
3.4 How many minutes walk from your house to your forest plot? or how many kilometer?	minute			
3.5 Price of seedlings that the farmer actually paid	'000 VND/seedlings			
3.6 Did you plant for est before or after receiving Redbook?	Before = 1 After = 2			
3.7 Have you planted any cash crop (e.g. cassava) in the same plot with trees?	Yes, but only at the beginning=1 Yes, we are planting it continuously=2 No=3			
Fertilizer				
3.8 Name of fertilizer	name			
3.9 Volume of fertilizer used	Kg			

3.10 Price of fertilizer		‘000 VND/kg			
3.11 Herbicides (including hiring sprayer)		‘000 VND			
Labor					
3.12 Land preparation at the beginning	Household labor	Man-day			
	Hired labor	Man-day			
3.13 Growing at the beginning	Household labor	Man-day			
	Hired labor	Man-day			
3.14 Cleaning the weed (count for the first three years)	Household labor	Man-day			
	Hired labor	Man-day			
3.15 What was the other costs that you spent on the first 3 years?		‘000 VND			
Operating cost (since 4th year)					
3.16 How often do you maintain the forest? (weedling, monitoring the forest for stolen timber,..)		Time/year			
3.17 How many man-days do your household members work on each time for maintaining the forest?		Man-day			
Harvesting					
3.18 Have you harvested the timber so far?		Yes = 1, No = 2			
3.19 How many man-days did your household member spend for harvesting (if needed)		Man-day			
3.20 How many man-days of hired labor for harvesting?		Man-day			
3.21 Cost of hiring labor for harvesting		‘000VND			
3.22 How much did you get from selling the timber for the last time?		‘000 VND			
3.23 In which year?		year			
3.24 [For bamboo], how much did you get on average from selling the timber per one time of harvesting?		‘000 VND			
3.25 [For bamboo], how often do you harvest the timber?		Per year			
3. 26[For bamboo], how many trees did you cut per typical month?		tree			
3.27 Have you received any supports from the government to plant these trees? (e.g. cash, free seedlings, cheap seedlings, loan, etc.)		- No = 0 - Prog 661 = 1 - Government program but not 661 = 2 -Friend/Neighbor = 3			

4. Participation in the government programs

4.1 Do you know about any government program that has supported forest plantation or/and forest protection? (Explain: government has provided free seedlings, fertilizer ,cash and so on to support tree plantation or provided cash to protect forest)

Yes=1, No=2 (go to section 5)

4.2 If 'Yes', could you tell the name of program that you know? Note: if the respondent does not know the name of the program, write down the explanation that he/she knows.

Name of the program	**Since when have you know about it? (Year or important events)**
1	
2	
3	
4	

4.3 Have you ever participated in any programs that has supported forest plantation or/and forest protection before?

Yes = 1, No = 2 (go to section 5)

Details of the program participated	Program 661 (forest production)	Program 747	Program 135	Program 327	Forest protection as a group	If you don't know the name of the program, please explain what did you receive
4.4 Do you think the program was successful or beneficial for you? Yes=1, No=2						
4.5 What did you NOT LIKE the most about the program? 1. Not enough financial support 2. Government provided inappropriate seedling which was not suitable to local conditions 3. Did not have police/ranger to monitor the forest to prevent stealing timber/illegal logging 4.Did not have enough information on how to grow or maintain forest 5. Others (specify).....						
4.6 What did you LIKE the most about the program? 1. Receiving money/materials from government 2. Obtaining Redbook for the land 3. Able to harvest timber for home						

consumption or selling 4. Others (specify).....						

4.7 What kind of supports did you get from program 661 (forest production) or the program you mentioned that you do not know the name? Ask for the whole period of receiving the support (At least the household received seedlings and cash!!)

Year	Type of support Cash=1 Seedlings=2 Fertilizer=3 Rice=4 Others (specify)	How much did you receive?
1.		
2.		
3.		

5. Transaction costs of participation in forest plantation programs

5.1 When did you sign the contract under the program 661 (put the vietnamese name of the contract)? .....Year

5.2 I would like to ask you about activities you have done related to program 661

Activity	**Time spent** (estimate by hour. 1day = 8 hours)	**Cost incurred** (e.g. travel cost)
BEFORE signing the contract		
How did you know about the program ?		
5.2.1 Village meeting to inform about program 661		
5.2.2 Making decision (discussion with family, neighbor, etc.)		
5.2.3 Other activities before signing the contract (e.g. preparing documents) (specify activities).....		
5.2.4 Contract signing (have to go to commune office? If it is far from house, did farmer have cost for travelling? How long did it take to sign contract?)		
AFTER signing the contract		
5.2.5 Learning about the technical design of plantation with the government officers		
5.2.6 Receiving the seedlings (where did you receive the seedlings? did you have to go far away?)		
5.2.7 Attend to officers for coming to check the plot for the growing period		
(1) when finished removing weed or shrub		
(2) when finished land preparation		
(3) when finished growing the trees		

5.2.8 Attend to officers for coming to check the plot for the maintenance period (after the first month)		
(1) How many times did the officer come to check your plot after growing until receiving payment?.....time		
(2) How long did it take to attend to officer per time of visit? including your travel time to the plot.		
5.2.9 Receiving the payment (including the time of officer checking the plot before paying. where did you receive the money?)		
5.2.10 Other activities after receiving payment (Has the officer come to check your plot after receiving money?)		

5.2.11 Overall, were you satisfied with **the activities you have interacted with the government officers** under 661 program (as mentioned in above table)?

1 2 3 4 5 ☐

1= least satisfied, 5 = most satisfied

5.2.12 If you were not satisfied with any activities, please specify what they are and why you were not satisfied.

Activities you were not satisfied

.....

Why?.....

6. Food security and road access

Note to enumerator: Ask for the normal situation not the situation when they had bad weather or natural disaster.

Question	Code	Doi Moi (1986)	10 years ago (2002)	Past 12 months
6.1 Does your household have enough rice to eat all year long?	Yes = 1, No =2			
6.2 Does your household have enough chicken or pork (luxury food) for your celebration on wedding or Tet holidays?	Yes = 1, No =2			
6.3 Were you and your household members hungry for at least 1 month out of 12 months	Yes = 1, No =2			
6.4 Did your household have access to the main road that the truck can come?	No access=0 Poor access=1 Very good access=5			

Appendix C: Gross margin analysis of forest plantation

In our sample, 266 households have planted forest which account for 88.7% of all households. Among households who have planted forest, 170 households (63.3%) have harvested timber products at least one time. Regarding costs and benefits of bamboo plantation, the price per tree is 20,000 VND. One stem of bamboo multiplies to 25 stems after 3 years of growing. Generally, farmer harvests bamboo shoot on the fourth year of growing and one group of bamboo can produce 2 kg of bamboo shoot per year. The price of bamboo shoot is 3,800 VND per kg. For acacia, timber can be harvested after 7 years and the price depends on the perimeter of the timber. Timber with a perimeter of more than 50 cm is estimated to account for half of the plantation and another half is smaller timber. The price of the big and small timber is approximately 600,000 VND per m^3 and 400,000 VND per m^3 respectively. It is calculated that for the timber length of 5 meter, 10 trees would account for 1 m^3 for big size timber and 25 trees would account for 1 m^3 for small size timber. The market price of 1,000 VND is used for the value of firewood. Value of support for forest is estimated from the average value of seeds and cash provided to farmers.

AUTHOR'S DECLARATION

I hereby declare that this doctoral thesis is a result of my personal work and that no other than the indicated aids have been used for its completion. All quotations and statements that have been used are indicated. I did not accept assistance from any commercial agency or consulting firm. Furthermore, I assure that the work has not been used, neither completely nor in parts, for achieving any other academic degree.

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