forests

MDPI

Article

Adoption of Agroforestry in Northwest Viet Nam: What Roles Do Social and Cultural Norms Play?

Mai Phuong Nguyen [1,*], Tim Pagella [2], Delia C. Catacutan [3], Tan Quang Nguyen [1] and Fergus Sinclair [2,4]

[1] World Agroforestry, ICRAF Viet Nam, Ha Noi 100000, Vietnam; N.QuangTan@cgiar.org
[2] School of Natural Sciences, Bangor University, Bangor, Gwynedd LL57 2DG, UK; t.pagella@bangor.ac.uk (T.P.); F.Sinclair@cgiar.org (F.S.)
[3] World Agroforestry, ICRAF Southeast Asia, P.O. Box 161, Bogor 16115, Indonesia; D.C.Catacutan@cgiar.org
[4] World Agroforestry, Headquarter Office, P.O. Box 30677, Nairobi 00100, Kenya
* Correspondence: n.maiphuong@cgiar.org

Abstract: This article presents research about the influences of social and cultural norms on the adoption of agroforestry in the northwest mountainous region of Viet Nam. The farming systems practiced by various ethnic groups in the northwest mainly occur on sloping land, which extends over 70% of the land area in the region. Decades of intensive monoculture of annual crops has resulted in severe soil erosion, contributing to soil degradation and decline in crop yields. Integrating agroforestry practices on sloping land has the potential to halt and reverse soil degradation and improve local livelihoods, but its adoption is conditioned by the diverse social and cultural norms of different ethnic groups. This research applies knowledge-based system methods in order to understand local opportunities, preferences, and constraints influencing the adoption of agroforestry practices, using a purposive, gender-balanced sample of sixty farmers from six villages across three provinces in the northwest region comprising people from Kinh, Thai and H'mong ethnic groups. Our results show that although farmers from all groups are aware of the economic and ecological benefits of trees for soil conservation in general, they have different perceptions about the benefits of particular agroforestry practices. Behavioural norms controlling agroforestry adoption vary amongst ethnic groups, and farmers' individual social and cultural preferences influence their aspirations and adoption decisions. We conclude that developing appropriate agricultural interventions in a culturally rich environment such as northwest Viet Nam requires understanding of the context-specific needs and interests of socially and culturally disaggregated populations. Policies supporting agroforestry are more likely to contribute to more sustainable livelihoods and ecological benefits where they are tailored to the requirements of different ethnic groups.

Keywords: agroforestry; adoption; perception; behavioural controls; ethnic minorities; Viet Nam

Citation: Nguyen, M.P.; Pagella, T.; Catacutan, D.C.; Nguyen, T.Q.; Sinclair, F. Adoption of Agroforestry in Northwest Viet Nam: What Roles Do Social and Cultural Norms Play? *Forests* **2021**, *12*, 493. https://doi.org/10.3390/f12040493

Academic Editors: Mi Sun Park and Himlal Baral

Received: 10 March 2021
Accepted: 12 April 2021
Published: 16 April 2021

1. Introduction

Agroforestry is where trees interact with agriculture and farmers manage interactions with the aim of achieving net economic and ecological gains [1,2]. "Agroforestry", therefore, is a broad term used to describe a wide range of practices at a range of scales [3]. At its simplest, agroforestry is a set of practices that combine woody components and agricultural crops and/or livestock, but this often involves quite complex interactions between people and trees, requiring systems analysis to understand why people adopt particular practices [4]. Based on spatial and temporal arrangements, agroforestry practices are defined as either simultaneous or sequential and in relation to the juxtaposition of tree and crop components. In the simultaneous practices, all components are intercropped at the same time, while in sequential practices, components occupy land at different times [5]. Sequential practices have varying degrees of overlap between the crop and tree components. Concomitant systems overlap in the beginning (such as in taungya systems), and

superimposed systems have overlaps between components only at certain times (such as the temporary grazing of orchards) [6].

Under the pressure of population increase and global demand for food without further damaging the environmental resources, smallholder farming needs to change the way it is conducted [7]. Agroforestry provides a broad set of regulating ecosystem service benefits at both plot and landscape levels. Agroforestry provides benefits to soil health by increasing soil biodiversity, increasing the supply of nutrients, and reducing soil loss compared to monoculture agricultural systems [8,9]. Contour-based cropping systems reduced soil loss by 30–60% in the first year, and up to 72–98% by the third year in Thai Lan [10]. Adding trees into agroecosystems is critical for addressing climate change by slowing deforestation [11,12]. A good example is shaded agroforestry systems, with a number of studies highlighting their value to adapt to climate change [13,14].

Agroforestry can contribute to improving food security through the provision of fodder, fruit, and the use of fertiliser trees [15], or planting trees on farms in multi-strata and intercropping practices [16]. Agroforestry plays an important role in improving food quantity and nutrient provision by diversifying food products [17,18].

In Viet Nam, agroforestry has been present for a long time with many different forms across the country, but there has not been widespread adoption. Extant practices fall into several categories including traditional models of (i) forest–garden–fishpond–livestock or garden–fishpond–livestock without forests in the lowland; and (ii) home gardens with fruit trees, perennial tree-based alley cropping systems at field level on higher land [19]. Given the need for effective soil stabilisation in farming systems in the northwest, the integration of trees using agroforestry has significant potential. However, realising this potential requires moving beyond understanding the biophysical pre-requisites for agroforestry expansion to incorporate better knowledge of the key social factors that may influence adoption [20].

Intensive monoculture of food crops on steep sloping land in northwest Vietnam (which accounts for about 70% of the area of the northwest region) has resulted in significant environmental problems. This includes soil erosion, decline in soil quality, and loss of biodiversity [21,22]. Consequently, many of these smallholder farming systems now face economic uncertainty because increasing costs for fertiliser and seedlings may force farmers to reconsider their cultivation practices to find more sustainable options.

About 3.4 million people live in the northwest provinces of Viet Nam, in culturally diverse communities made up of nearly 30 ethnic groups [23]. In this region, there is a strong link between ethnicity and topography [24], with different ethnic groups associated with different elevations. The main ethnic group occupying lowland areas (below around 600 m) is the Kinh. Although Kinh is the most common ethnic group in Viet Nam, making up 88% of the national population, they are only the second largest group in the northwest, accounting for 26% of the region's population in 2015 [23]. The Thai group is the third most common ethnic minority of the country (accounting for about 2% of the total population), but the largest group in the northwest (28% of the population in 2015) [23]. Thai people in this region generally live in the middle altitudinal zone (around 600–800 m). The Hmong are the third most common ethnic minority in the northwest (14% of the population in 2015) [23], and generally live at higher altitudes (approximately above 800 m).

Agroforestry adoption is not just a "copy and paste" process; it is highly dependent on the biophysical, socio-economic context of the households [25]. Farmers will primarily adopt tree species based on their own needs [26], therefore understanding farmers' knowledge, interests and challenges is essential in order to provide appropriate support that meets their actual needs and capacities. The research reported here aimed to acquire information about local opportunities, preferences and constraints influencing the adoption of agroforestry practices and how they vary amongst ethnic groups and thus can be used to tailor agroforestry options to suit local contexts [27].

2. Materials and Methods

2.1. Theoretical Framework

Participatory approaches developed in the 1990s were viewed as a paradigm shift in research and development, providing tools to capture the views of local people and moving away from top-down prescriptions [28]. Earlier participatory approaches were, however, often applied without critically thinking about the issues of social barriers to farmers' decision-making. Several theories have been applied to understand farmers' behaviours. For example, the "Diffusion of innovation" theory [29] looks into how and why a technology is adopted and spread. Value–belief–norm theory [30] provides an approach to analyse social supports for the environmental movement. The theory of planned behaviour [31] is a conceptual framework that has often been used to explore the social dimensions of technology acceptance and adoption [32–35] and forms the basis for the methods in use in this paper. The key aspects of this theory are briefly discussed here.

2.1.1. Social Norms

Social norms are the expectations from a community on individuals to perform a behaviour in a specific situation. Social norms interact with social relationships to influence a farmer's adoption decision through, for example, their neighbours' adoption patterns, social expectation, and pressure or social status that may result from engaging in an activity. Current recommendations suggest that analysis of these norms should be incorporated in best practice adoption studies [36]. Adjusting agricultural intervention to socio-cultural factors can improve how farmers value innovations and their motivation to adopt them [37]. This has led to a major paradigm shift to support local innovation where farmers adapt practices to suit their local circumstances rather than the widespread promotion of prefabricated technology packages [27].

2.1.2. Farmer Capacity to Adopt

A farmer's capacity to adopt agroforestry is defined by both biophysical and socio-economic conditions. Biophysical conditions are derived from understanding of the ecological conditions of the farm, including characteristics such as soil type, slope [38], farm size [39], or the geographical context of the plots [40]. On the other hand, socio-economic factors include: market incentives, household preferences [38], economic benefits of land tenure and available time [41], the amount of social capital and human capital (including knowledge), and the influence of local and national policies [42].

Applying the theory of planned behaviour [31], willingness to adopt is influenced by personal beliefs and attitudes, social norms, and perceived behavioural controls. Farmers' attitudes encompass how personal beliefs act on behaviour, which can be negative, positive, or neutral. Farmers' attitude towards adoption is strongly correlated with farmers' perceived behavioural control (how they perceive the level of difficulty in adopting) and their self-belief in the capacity to adopt and then maintain the practice [43]. For example, farmers' attitudes towards agroforestry were strongly related to the level of access to information and extension support in Bangladesh [44].

2.1.3. Farmer Perceptions

Farmers' adoption decisions regarding agroforestry practices are influenced by the degree of difficulty associated with acquiring accurate information about the benefits of such innovations [32,42], alongside perceptions of risks and barriers associated with tree planting [45] or knowledge of agroforestry techniques. The selection of tree species for agroforestry adoption highly depends on farmers' attitude or knowledge concerning the impact of trees on food, soil, water and crops from their experiences and observation [46].

2.1.4. Perceived Behavioural Controls

Perceived behavioural control is the personal perception of the difficulty involved in performing a specific behaviour [31]. High financial cost and lack of knowledge on

tree management techniques are commonly perceived challenges of planting trees on farms [47]. Limited skills and techniques were highlighted in studies in Pakistan [48], while the unavailability of capital and quality seed were identified in Rwanda [49,50].

Social and cultural values maintain a strong link with ethnicity because different ethnic groups have their own religions, beliefs, values, and resources which influence their attitudes, social norms, and behavioural controls related to agricultural innovation [51]. If communities are viewed as homogenous groups, the result may be that only the voices of a small number of powerful people are included, and thus the design of interventions may not be appropriate for those who are supposed to be empowered [52].

In this study, we explore how social factors influence pathways to adoption for agroforestry practices designed to stabilise soils and support local livelihoods for different ethnic groups in northwest Viet Nam. This includes: (i) identifying and understanding the social factors including personal attitude, subjective norms and behavioural controls towards farmers' willingness to adopt agroforestry (and whether this varies with ethnicity); (ii) recording preferences for different forms of agroforestry systems; and (iii) identifying potential constraints to the adoption of agroforestry from three main ethnic groups, the Kinh, Thai, and H'mong.

This study contributes to the existing global literature in understanding cultural and ethnicity aspects of local ecological knowledge on agroforestry and other land uses [53–56]. Scaling up agroforestry adoption need to be adapted to fine-scale variation in ecological and social contexts, including local needs [57]. Adoption is more likely to happen when farmers have knowledge, labour, and secure land tenure [58,59]. Social factors including farmers' preferences, attitude, cultural or social constraints, and local knowledge strongly influence farmers' adoption decisions [60]. These factors can be categorised as farmers' capacity to adopt and farmers' willingness to adopt [61].

Farmers' capacity and willingness are two key elements for agroforestry adoption (Figure 1), based on the theory of planned behaviour [31] and the practical evaluation of agroforestry adoption [61]. This study hypothesises that agroforestry adoption will occur when farmers have both the capacity and willingness to adopt agroforestry.

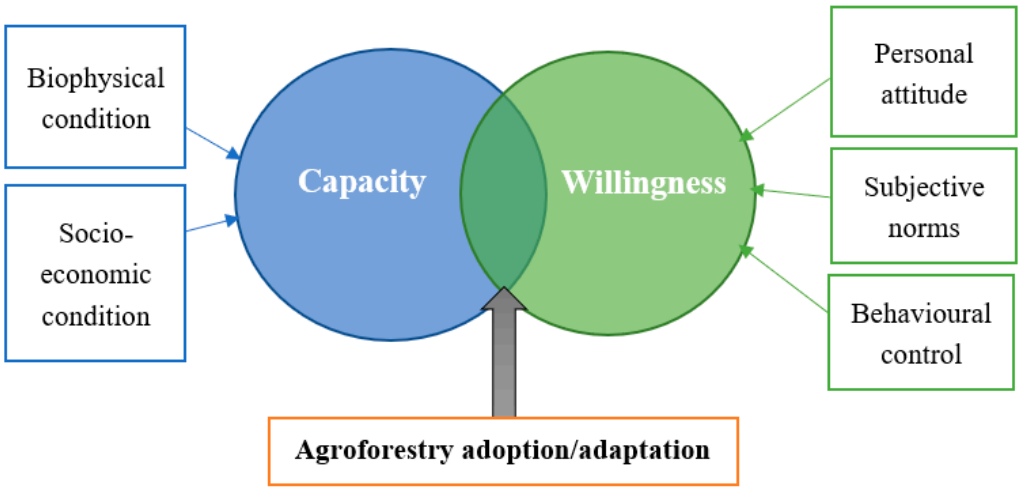

Figure 1. Farmer's capacity and willingness for pathways towards agroforestry adoption (adapted from Ajzen [31] and Mills et al. [61]).

2.2. Data Acquisition Methods

Data used in this study were collected from two surveys in 2016 and in 2017 in the northwest region of Viet Nam. Households covered in the surveys were in the sites of the Agroforestry for Livelihoods of Smallholder Famers in Northwest Viet Nam (AFLi) project, which is representative of the ecological landscape and social–cultural dynamic of the northwest region.

The surveys are described briefly below.

2.2.1. Survey 1 (2016): Adoption Capacity Survey

The first survey explored farmers' agroforestry adoption preferences. This involved a purposive sampling of current adopters and non-adopters of agroforestry. The first group was current adopters, consisting of two sub-groups: (1) farmers who worked with the AFLi project, called "project adopters" (n = 166); and (2) farmers who adopted agroforestry but were not involved in the AFLi project, called "spontaneous adopters" (n = 7). The second group consisted of farmers who had not adopted agroforestry on their farms, classified as non-adopters (n = 56). Questions in the first survey were designed to understand the capacity of farmers to adopt agroforestry, and their perceptions of the degree to which their biophysical context (elevation, cultivation, traditional practice) and social–economic conditions (finance, labour, knowledge) affected their capacity to adopt agroforestry systems (for non-adopters) or expand these systems (for adopters).

2.2.2. Survey 2 (2017): In-Depth Household Survey

The second survey was an in-depth household survey which focused on acquiring farmers' local ecological knowledge regarding tree planting following a knowledge-based systems approach [62,63]. Indigenous knowledge is culturally specific [64]; therefore, this survey looked at how local knowledge was shaped by attitudes and perceptions, as well as behavioural controls towards agroforestry adoption and hence farmers' preferences with regard to potential agroforestry options and the degree to which these were influenced by their ethnicity. This survey used key informant interviews of six commune representatives, combined with farmer focus group discussions and semi-structured interviews. One focus group discussion was conducted in each village, with the same farmers participating in the semi-structured interviews.

Key informant interviews were designed to understand the overall context of the communes, including the distribution of ethnic groups across elevations, socio-economic contexts of three ethnic groups, supporting policies of tree planting, and agroforestry development.

Farmer focus group discussions aimed to understand village history, culture, tradition, cultivation practices, agroforestry opportunities, and constraints using village map sketching, historic mapping, faming calendars, and strength–opportunity–weakness–threats analysis (SWOT).

Finally, semi-structured interviews with fifty-eight farmers (50% female) were used to explore their knowledge about agroforestry management and obtain a deeper understanding about agroforestry management, the values of trees, social norms related to tree planting, farmers' attitude on the benefits of agroforestry, and preferences relating to agroforestry adoption. The interviews were conducted together with farm visits. Farmers were again purposively selected for these interviews. All interviewees were agroforestry adopters who were currently not involved in the AFLi project (to avoid influence from project training). We consulted six village leaders to choose farmers implementing agroforestry practices by themselves. The total number of farmers interviewed was 58, with 10 farmers invited per village representing the minimum number of agroforestry adopters per village across the study sites. This was gender-balanced; thus, equal numbers of men and women were interviewed. Two villages were selected for each ethnic group (Kinh, Thai and H'mong), amounting to six villages in total (Figure 2).

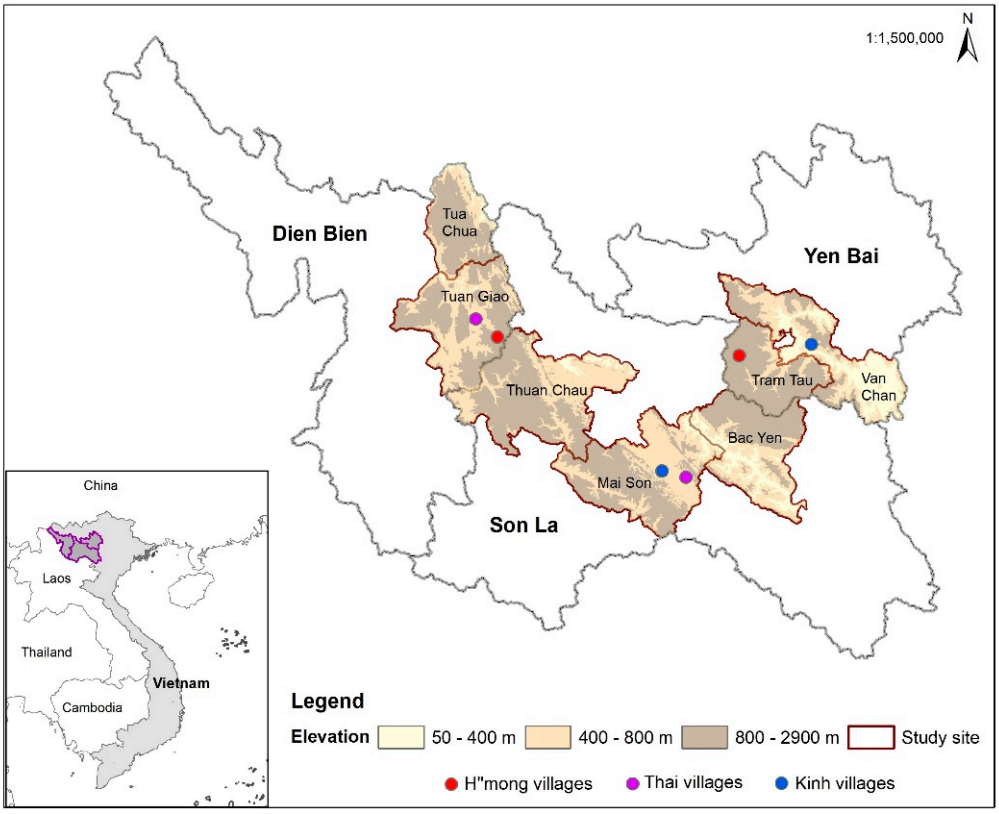

Figure 2. Map of the study villages within the Agroforestry for Livelihoods of Smallholder Famers in Northwest Viet Nam (AFLi) project site in northwest Viet Nam.

2.3. Study Site

The study was conducted in the AFLi project sites in Yen Bai, Son La and Dien Bien of the northwest region of Viet Nam. The northwest of Viet Nam (21–23° N and 103–105° E) is one of eight eco-regions in Viet Nam. It is the most mountainous, remote, and poorest area of Viet Nam. Forest cover accounts for about half of the area, although the region is prone to severe deforestation, land degradation, and soil erosion. Extreme weather such as landslides, droughts, frost, and hailstorms significantly affect agricultural production and the economic development of the region. Key agricultural products of three provinces include annual crops such as rice (*Oryza sativa* L.), soybean (*Glycine max* (L.) Merr.), sugarcane (*Saccharum barberi* Jeswiet), amomum (*Amomum villosum* Lour.), perennial crops such as Shan tea (*Camellia sinensis* (L.) Kuntze), Arabica coffee (*Coffea arabica* L.), macadamia (*Macadamia* spp.). Popular fruit trees include H'mong apple—son tra *(Docynia indica* (Colebr. ex Wall.) Decne), plum (*Prunus salicina* Lindl.), peach (*Prunus persica* (L.) Batsch), mango (*Mangifera indica* L.) orange (*Citrus sinensis* (L.) Osbeck), longan (*Dimocarpus longan* Lour.). Common timber trees in three provinces consist of acacia (*Acacia mangium* Willd.), manglietia (*Manglietia conifera* (Dandy) V.S.Kumar), melia (*Melia azedarach* L.), teak (*Tectona grandis* L.f.), cinnamon (*Cinnamomum verum* J.Presl), pine (*Pinus* spp.), leucaena (*Leucaena leucocephala* (Lam.) de Wit), cassia (*Cassia siamea* Lam), vernicia (*Vernicia montana* Lour.). Wild peanut (*Arachis pintoi* Krapov. & W.C.Greg), peanut (*Arachis hypogaea* L.) or soybean (*Glycine max* (L.) Merr.) are often cultivated to improve soil fertility [65–67].

Six villages representing the biophysical conditions and ethnicity within project sites were selected, with two villages per ethnic group. These six villages are described below and shown in Figure 2.

- Kinh ethnic group: Van Thi 3 village in Van Chan district, Yen Bai and Tan Que village in Co Noi commune, Mai Son district, Son La.

- Thai ethnic group: Na Ban village in Mai Son district, Son La and Giang village in Tuan Giao district, Dien Bien.
- H'mong ethnic group: Hua Xa A village in Tuan Giao district, Dien Bien and Sang Pao village in Tram Tau district, Yen Bai.

2.4. Analytical Method

In this paper, qualitative data analysis was used as the key analytical method to provide insight about farmers' perceptions about agroforestry adoption and how this affects their decisions, through looking at the reasons and supporting farmers' explanations of their adoption decisions [68].

Qualitative data analysis has been widely used in the literature regarding planned behaviour [31], which is a cognitive process involving subjective norms, perceived behavioural control, and attitudes, as well as in the acquisition and analysis of local agroecological knowledge [62,63].

Textual analysis of interview transcripts was the main tool used in the paper to analyse and describe the actors involved, their subjective norms, perceived behavioural control, and attitude. In addition, illustrations are provided through the use of matrix, chart, and figure formats for both descriptive and explanatory purposes.

3. Results

3.1. Farmer Capacity to Adopt Agroforestry

3.1.1. Farmers' Perceptions of Biophysical Conditions Required for Agroforestry Expansion

Biophysical attributes include factors defining the suitability of an agroforestry practice such as elevation, rainfall, temperature, slope, and soil type. Elevation is an important biophysical condition linked to ethnic groups in northwest Viet Nam, with the H'mong group inhabiting areas over 800 m above sea level (asl), the Thai at 400–800 masl, and the Kinh below 400 masl. Farming practices and choice of tree-crops differ by elevation and ethnic group (Table 1).

Table 1. Farming characteristics of three ethnic groups.

Ethnic Group	Range of Elevation (masl)	Traditional Cultivation Techniques	Suitable and Preferred Tree Crops
Kinh	0–600	Intensive cultivation and intercropping	Tea Longan, mango, plum, pomelo Cffee, macadamia
Thai	400–800	Partly shifting cultivation	Plum, mango, longan manglietia, melia Shan tea, coffee
H'mong	>800	Shifting cultivation	son tra Pine

3.1.2. Socio-Economic Conditions

Socio-economic attributes include financial capacity, size of landholding, distance of farm to market, education, and knowledge, awareness, and proficiency with techniques (Table 2). The Kinh are lowland migrants that settled in the lower part of the region under the post-war migration policy of the Vietnamese government. The Kinh have advantages in terms of language, enabling easy access to education, technology, market information, and other productive resources. The Thai live just above the Kinh communities. They are also able to speak the Vietnamese language and have reasonable access to information and technology. In contrast, the H'mong live in high-elevation areas that are often far from the main roads and local markets. The H'mong have sparse access to external information and government support because of their social distance from other communities in Viet Nam, which is exacerbated by language barriers. Today, many H'mong farmers are still practicing shifting cultivation with short fallow periods, while some, possessing less land, have already shifted to sedentary farming. Poverty is manifest in the economic status and

educational level of households, which influence the way farmers learn new techniques. Land holding influences the availability of land to be used under agroforestry. The Kinh people have long been using agroforestry as a traditional practice, while the H'mong people rarely did so in the past.

Table 2. Typical social characteristics of three main ethnic groups in northwest Viet Nam.

Ethnic Group	Poverty	Distance to Market	Distance to the Field *	Education	Average Land Holding
Kinh	Low	0–2 km	<1 km	High school, university	<1 ha
Thai	Medium	0–3 km	1–3 km	High school	1–3 ha
H'mong	High	5–10 km	3–6 km	Primary school	2–5 ha

* distance to field represents the distance from the homestead to their fields.

3.1.3. Farmer Willingness to Adopt Agroforestry

(1) Farmers' Attitude to Benefits from Agroforestry Adoption

Although farmers from all groups were aware of the benefits of using trees in soil conservation, they had different perceptions on the benefits of specific agroforestry practices, which was likely to influence the types of agroforestry adopted (see Figure 3). All groups stated that agroforestry practices had some provisioning function relating to income generation but had differing needs in relation to regulating functions. The H'mong group were interested in increased land, labour and fertiliser use efficiency, while the Thai highlighted soil erosion reduction, and the Kinh were motivated by the idea of soil fertility improvement. This study suggests that farmers' specific social circumstances influence their aspirations and constraints related to adopting agroforestry interventions. When it comes to tree planning, H'mong farmers have myriad considerations even with increased demand for fuelwood and timber for house construction—first is to save time walking from and to their farms and homes; second is their limited family labour; and third is the high-cost of fertilisers. Meanwhile, Thai farmers think that timber and firewood, food for humans and animals (buffalo and cow), and soil erosion mitigation are important benefits that can be derived from agroforestry. Most Thai households have confined animals, so fodder grasses in agroforestry practices are useful to augment their cut-and-carry animal feeding strategies. However, reluctance to adopt agroforestry also grew from concerns that trees grow slowly, affecting cash flow. Finally, apart from income, Kinh farmers think that agroforestry is an efficient strategy to address having a limited size of land holding. Having more access to technical information from local extension workers, the Kinh are more willing to intercrop various tree species, especially in home-gardens. In Tan Que district, Son La province, many Kinh farmers are already intercropping peanuts and beans with perennials to improve soil fertility and optimise land productivity.

(2) Subjective Norms Influencing Agroforestry Adoption

Subjective norms constructed by the beliefs of ethnic groups about others' expectations toward forest protection, tree-growing and agroforestry were revealed in the in-depth interviews and focus group discussions. Farmers hold the same subjective norms, i.e., expectations of their behaviours regarding forest protection. Government reforestation programs supported the establishment of new forest plantations, and natural forest regeneration and protection [69]. In these programs, production forest lands were allocated for farmers to grow timber trees such as *Acacia* spp., *Melia azedarach*, *Manglietia conifera*, *Pinus* spp., and son tra (*Docynia indica*). In turn, households and communities were expected to protect the forest. In Thai villages, however, cultural norms exist wherein community forests are considered "ghost forests" or burial grounds that families come to visit every year. The Thai also believe they have to protect the old wild trees in their village because they are holy and revered for use in traditional ceremonies. When the Kinh migrated to the uplands, they were expected to retain forest patches on hill tops while annual crops, fruit trees or cash crops could be planted in the mid-lower portions of the hill, resulting in a forest–garden–fishpond–livestock system. This comes from a farming design called

"vuon-ao-chuong"-VAC (garden-fishpond-livestock), which literally is the combination of a vegetable garden, fishpond, and livestock recommended by government extension programs. Kinh farmers believe they are expected to adopt the modified VAC practice to help reduce soil erosion and prevent flash floods. All Kinh farmers concurred that they learnt fruit tree management techniques and bought seedlings from their hometown to grow in their new upland environment; 26% of Kinh correspondents indicated that inter-cropping was a traditional technique to address limitations of land holding size. Farmers from all ethnic groups also mentioned that they had been trained and encouraged by local authorities and extension workers to gradually shift from maize/rice cultivation to perennial tree-cropping on slopes. Farmers often choose the most degraded plot with low crop yield to grow trees intercropped in the first few years before later removing annual crops when the tree canopy closes. Today, there are a number of programs for growing avocado, macadamia, son tra (*Docynia indica*), Shan tea (*Camellia sinesis*), and various citrus species that are expected to shift the norm away from annual crop cultivation to tree-based cultivation on sloping lands.

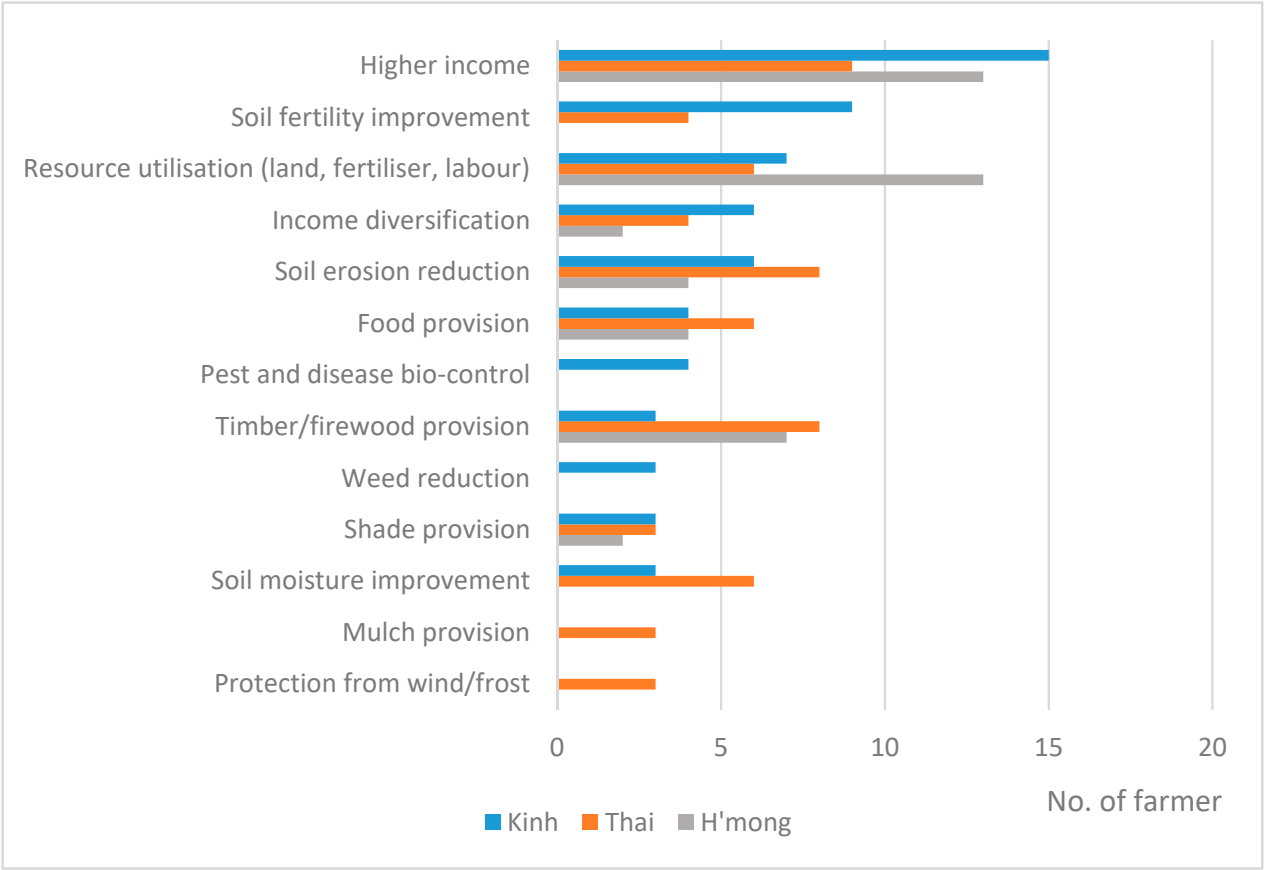

Figure 3. Absolute number of farmers from different ethnic groups mentioning different benefits that can be derived from agroforestry practices.

(3) Behavioural Controls Affecting Agroforestry Adoption

Behavioural controls or challenges to adopting agroforestry varied amongst the three ethnic groups; however, lack of land, labour, and financing are common problems. Most farmers also lacked quality planting materials and market links. Land as a limitation, however, manifests in different ways—the Kinh have smaller farmlands and therefore have nothing to spare for agroforestry. In contrast to the Kinh, the Thai and H'mong have larger landholdings, but prefer to establish agroforestry on plots near their homestead and on fertile soils. In addition, H'mong farmers had concerns about the technical management of agroforestry because of their low access to technical information exacerbated by their lan-

guage barrier with Vietnamese-speaking extension workers. The study also found gender-specific behavioural controls. Most of the concerns about marketing fruit amongst the Thai were from female respondents, while only H'mong men had concerns about market. Both male and female farmers from all ethnic groups were concerned about the technical aspects of agroforestry and expressed a strong desire to learn management techniques.

3.2. Typologies of Agroforestry Adopters and Non-Adopters

Farmer typologies were derived based on criteria identified for the capacity and willingness to adopt agroforestry practices. (Table 3).

Table 3. Farmer characterisations based on capacity and willingness to adopt/scale out agroforestry.

Capacity to Adopt/Scale out Agroforestry	Willingness to Adopt/Scale out Agroforestry	
	Unwilling	**Willing**
Positive capacity	Type 3: Have available land, labour, finance, techniques Do not like to adopt agroforestry (for non-adopter farmers) or only want to maintain current agroforestry adoption (for adopter farmers)	Type 1: Have available land, labour, finance, techniques Have positive attitude towards agroforestry, willing to adopt (for non-adopter farmers) or expand agroforestry (for adopter farmers)
Negative capacity	Type 4: Lack of available land, labour, finance, techniques Do not like to adopt agroforestry (for non-adopter farmers) or only want to maintain current agroforestry adoption (for adopter farmers)	Type 2: Lack of available land, labour, finance, techniques Have positive attitude towards agroforestry, willing to adopt (for non-adopter farmers) or expand agroforestry (for adopter farmers)

We examined the capacity and willingness of non-adopters, wherein more than half (53%), and mostly Thai and Kinh were Type 4 farmers who were unwilling to adopt or expand agroforestry due to limited capacity in land, labour, financing and technical management (Figure 4), and also because of a lack of evidence on agroforestry benefits. Type 3, comprising 14% of non-adopters, mostly belonged to the H'mong ethnic group who expressed a lack of know-how on agroforestry.

Thirty percent of non-adopters had resources and were willing to adopt agroforestry on their farms. Most of these were H'mong, because they saw the benefits of agroforestry from project adopters. One of the techniques they wanted to adopt was planting fruit trees together with grass so that they had more food for cattle in the winter. Cows and buffalos play an important role in H'mong livelihoods because they help farmers in land preparation and the transport of materials between homes and farms. Two H'mong farmers did not have enough land but they were interested in agroforestry and willing to adopt it, whereas none of the Kinh or Thai farmers who lacked land wanted to adopt agroforestry.

The majority of the non-adopters (53%) did not want to adopt agroforestry because of a perceived lack of capacity. Most of these were Thai and Kinh farmers. Only a few H'mong farmers were in this group, primarily because they lacked cultivatable land (which, in this context, meant land that was fertile and less than 10 km from their home). For the Kinh and Thai farmers, they stated that they did not have spare land for agroforestry.

Of those that were unwilling but had capacity (Type 3: 14%), a large proportion were H'mong; the reasons given were a lack of knowledge about agroforestry. For the Kinh and Thai, they had not yet seen the benefits, therefore they were not willing to adopt agroforestry at present.

In Type 4, the number of non-adopters was much higher compared to adopters, clearly because they did not receive direct support from the AFLi project. This is consistent with the impact of low access to information leading to low rates of adoption [70], although in other contexts farmers owning more resources were found to adopt agroforestry more readily [41]. H'mong farmers expressed willingness to adopt agroforestry despite their limited capacity in comparison to the Kinh and Thai, consistent with positive perception being an important factor in agroforestry adoption [71]. The research also shows that ethnicity linked to socio-economic contexts highly influenced agroforestry adoption. For

example, the Thai displayed the highest potential for adopting or expanding agroforestry, which can be linked to the wider range of tree-species suitable in mid-level altitudes and socio-economic factors such as the access to market, seedlings, and information. The choice of agroforestry practices also differed with access to market by the same ethnic group—the H'mong in Dien Bien province were more interested in fruit trees than the Hmong in Yen Bai because of the former's greater access to the highway and local markets. Furthermore, despite having the same farming tradition, the Thai in Son La have less concern about marketing agroforestry products in contrast to those in Dien Bien, whose primary concern is market distance and transportation.

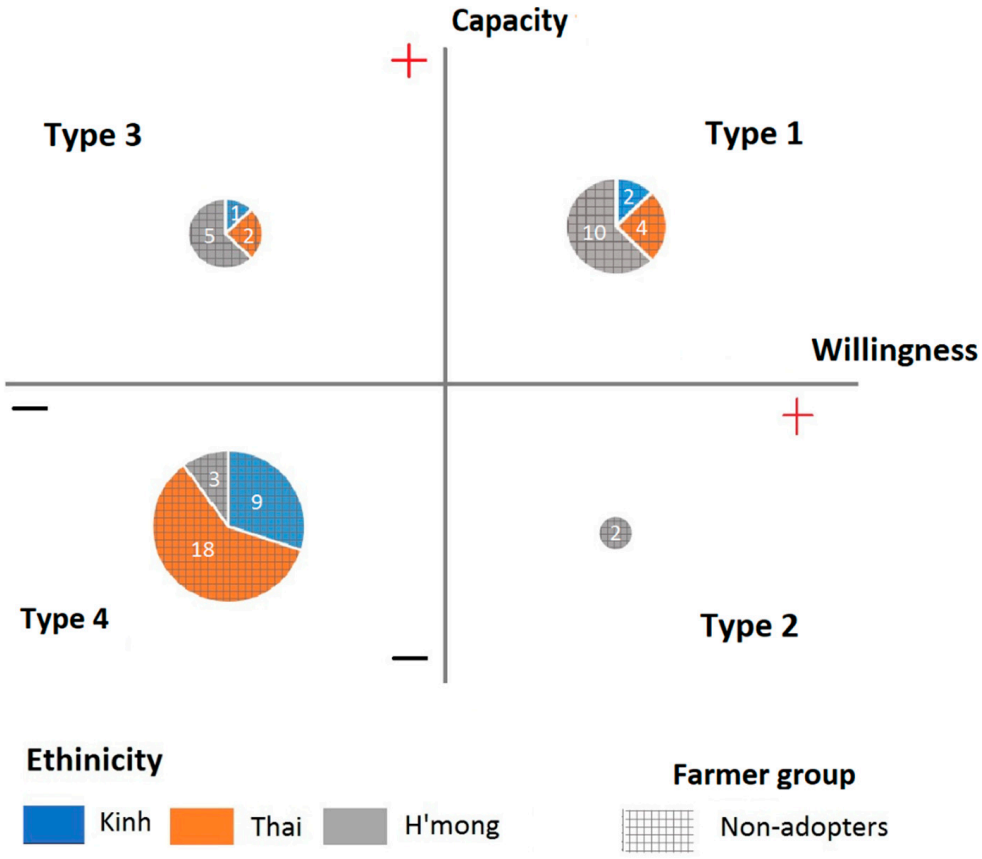

Figure 4. Non-adopter farmers' capacity and willingness to adopt agroforestry (n = 56).

3.3. Preferred Agroforestry Options for Different Ethnic Groups

Based on the understanding of capacity, willingness and motivation relating to agroforestry adoption, farmers were able to identify suitable tree-based options which fitted their local social–ecological context and that were economically viable. Fruit tree intercropping systems were the common interest of all groups because fruits have high selling prices. The other systems were identified based partly on individual farmer motivations for agroforestry. For example, H'mong farmers tended to prefer an annual crop component in their practices to provide food. In contrast, Thai farmers liked to have grass for livestock, and Kinh farmers wanted to improve soil by growing nitrogen-fixing species such as peanut or soybean (Table 4).

Understanding local preferences and motivation to adopt agroforestry helps project teams to modify trials and match them with the local interest. For example, the grass component was removed from practices for H'mong farmers, while peanut/pineapple was added into the practices offered to Kinh farmers. Grass was maintained for the Thai group.

Table 4. Preferred agroforestry options identified by three ethnic groups and local contexts.

Ethnicity		H'mong	Thai	Kinh	
Common System		Mixed Fruits (Peach, Plum, Mango)–Lime/Maize			
By Elevation		High (Above 800 m)	Medium (500–800 m)	Medium (500–800 m)	Low (Below 500 m)
By Location	Dien Bien	Son tra/Rice/Maize/Cassava Coffee/Leucaena /Mixed fruits Coffee/Maize	Cassia /Vernicia /Grass Coffee—Cassia /Leucaena /Longan	N/A	
	Son La	N/A	Fruit trees/Cana/Maize/ Soybean/Cucumber/Pumpkin Macadamia/Coffee/Fruit trees/Grass/ amomum	N/A	Mixed fruit trees/Wild peanut/Peanut/Soybean Pomelo/Guava
	Yen Bai	Shan tea/Rice/Maize/Cassava Son tra/Rice/Maize/Cassava	N/A	Melia /Vernicia /Tea Manglietia /Melia /Vernicia Plum/Pineapple/ Soybean/Peanut Tea/Maize	N/A

(N/A: not applicable).

3.4. Discussion

3.4.1. Ethnicity and Agroforestry Adoption

Results of this research clearly demonstrate that ethnicity associated with specific contexts highly influences agroforestry adoption as well as the relevance of potential designs. The results suggest that the Thai ethnic group had the highest potential for adopting agroforestry and for expanding their current practices in the near future. This is a combination of the advantages of living at medium elevations, which were suitable for more tree species coupled with moderate access to market, seedlings, and information. The Kinh were more technologically advanced and had good access to markets, but their land size was restricted. The H'mong were more isolated and had the most difficult agricultural conditions, although they had the largest land holding sizes.

The number of non-adopters in Group 4 (i.e., those with no capacity and unwillingness to adopt) was much smaller than the number of the adopter group (Figures 4 and 5). Adopter farmers had received training by the project teams about agroforestry benefits. This is consistent with low access to information leading to low rates of adoption [70], although in other contexts farmers owning more resources have been found to adopt agroforestry more readily [41]. In this research, a higher percentage of H'mong farmers were willing to adopt agroforestry compared to Kinh and Thai, although they had more limited resources. However, only the H'mong farmers who had spontaneously adopted wanted to expand their agroforestry practices (Figures 4 and 5). Famers' positive perceptions towards agroforestry is important for adoption [71]; therefore, this brings up a high potential for scaling out agroforestry adoption for the H'mong, who are particularly vulnerable to poverty, climate change, and degraded landscapes.

Farmers' perspectives on benefits from agroforestry generally align with scientific findings about positive impacts of agroforestry such as soil loss reduction [10], improving soil fertility [8,71], providing food and fodder [18,71], and reducing the impact of extreme weather [72], but it was difficult for farmers to recognise some benefits that they could not observe, such as climate resilience or carbon sequestration. People's attitudes to future agroforestry options were also heavily context- and ethnic-specific. For example, H'mong farmers in two different provinces, Dien Bien and Yen Bai, had different preferred options. This can be explained by variations in their access to the highway (i.e., a context variable rather than an ethnic variable). The options that farmers wanted to have in Table 4 were consistent with their motivations to adopt agroforestry in Figure 3, and fits with their context. H'mong famers preferred cash crops or fruit trees with short-term crops for food and high income in a sufficiently short time period (3–4 years). Thai farmers wanted to

have fodder grass for their livestock, and Kinh farmers wanted to have legume plants in their systems. However, it is clear that market factors play an overwhelmingly important role in the choices of farmers and their likelihood of change over the short term [73]. Except for the Thai in Dien Bien and the H'mong in Yen Bai whose fruit trees do not grow well, all three ethnic groups in other areas liked to grow fruit trees with the species dependent on market availability.

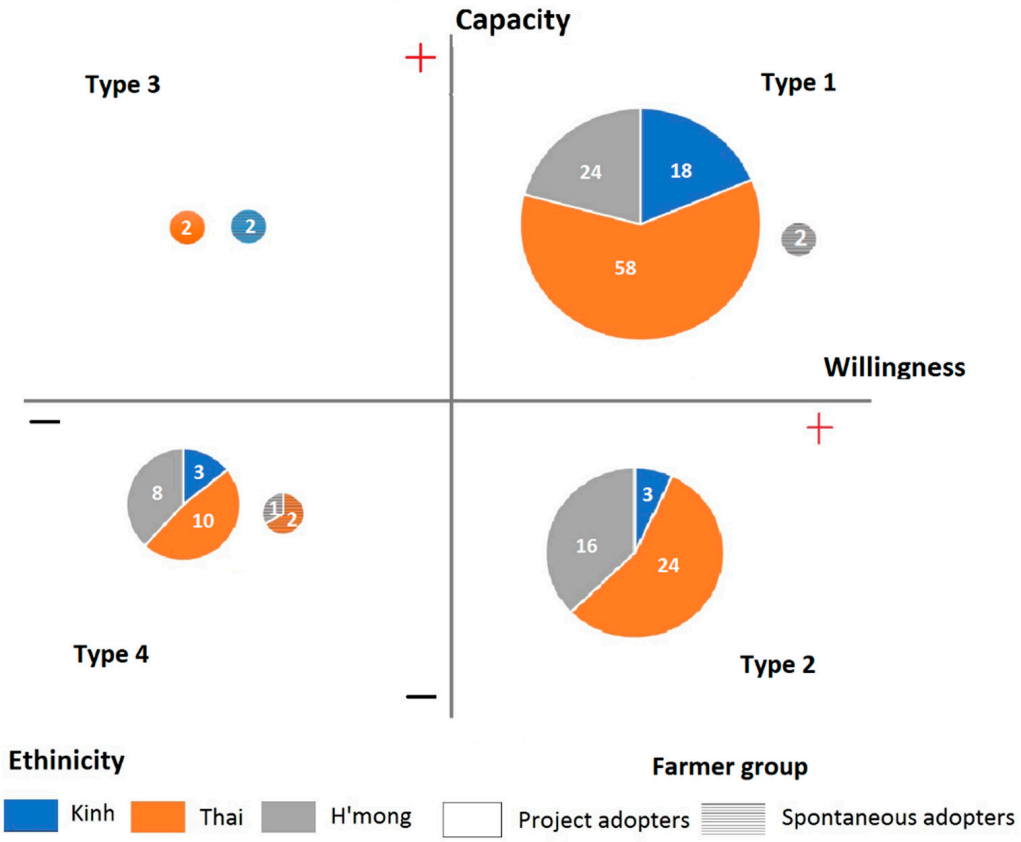

Figure 5. Farmer-adopters' capacity and willingness to scale out agroforestry (project-supported adopters: n = 166; spontaneous adopters: n = 7).

Farmers adopt tree species and modify how they adopt them based on their own needs [74]. Various adaptations were observed from the survey, such as planting one or double grass strips between tree rows, and growing trees at different spacings and densities. This was quite similar to the adoption patterns in Nepal [71], where farmers in the lowlands did not opt to grow fodder trees with paddy rice, but upland farmers integrated fodder trees with rainfed crops to feed livestock, which then provide manure to fertilise crops. Unlike the farmers planting trees to improve soil fertility in Malawi [75] or for fuel and timber in Ethiopia [76], most farmers in northwest Vietnam wanted high-value fruit trees suitable for their biophysical condition.

The complexity and diversity of agroforestry adoption makes it difficult to monitor and evaluate the benefits of agroforestry accrued to adopters and non-adopters. The long-term nature of trees makes this even more challenging, because farmers intercrop tree and crops for the first few years but may focus entirely on the trees after a few years once they have become productive. Attitudes to adoption may change when the context changes (such as project support and market availability); our observations represent farmers attitudes at the time we conducted our survey, although this will include their accumulated experience.

3.4.2. How Farmers Transition from Being Non-Adopters to Adopters

Previously, adopters have been classified as "real adopters", "testers" or "pseudo adopters" depending on the permanency of their use of particular practices [8] conditioned by how farmers may have benefited from projects socially or materially beyond what they derive from the agroforestry practices that they may be using. Therefore, the adopters might implement the technologies just because of the incentives from a project rather than the intrinsic value of the practice. In this study, it is unclear how permanently the farmers in the project adopter group will use agroforestry practices, although 61% expressed a capacity and willingness to adopt agroforestry. On the other hand, non-adopter farmers who want to adopt agroforestry might be more committed because they are willing to do it on their own without any support. This requires further research to track adoption and adaptation over long periods of time, encompassing the entire length of agroforestry rotations.

The social condition that enables the scaling out of diversified farming systems requires changes in people's aspirations and actions [77]. In order to scale out agroforestry adoption, it is necessary to shift farmers from other types into Type 1 (have capacity and willingness to adopt) from both adopters and non-adopters. Moving from Type 2 to Type 1 requires them to improve their capacity factors, such as labour, finance, or land, which is quite difficult and dependent on external support. The most feasible option is to increase their access to social capital in order to hire more labour or rent more land. Moving from Type 3 to Type 1 requires a change in farmers' attitudes and perceptions, addressing behavioural controls constraining agroforestry adoption. Farmers can change by themselves if they see the success from project agroforestry trials, or learn from neighbours, friends, and social media. This is sustainable because farmers combine the new information and techniques with their indigenous knowledge to generate locally adapted practice, consistent with farmers adopting agroforestry in Malawi [78]. Successful agroforestry trials should be promoted widely through different channels which farmers can easily access. The proportion of Type 4 farmers who are adopters is much smaller than the non-adopters, meaning that more farmers wanted to continue adopting after some time working with the project.

3.4.3. Policy Implications for Scaling out Agroforestry

Policy plays an important role in the widespread adoption of agroforestry [79]. This study suggests that for the effective adoption of agroforestry, government policy must respond to the needs at farmer level and fit into their specific contexts, which is consistent with recommendations from various authors [80]. Findings from this study show that addressing perceived behaviour controls enables the conditions for farmers to adopt agroforestry. Strong correlation often exists between farmers' intention to adopt or maintain agroforestry and their behavioural controls [43], but behavioural controls vary amongst ethnic groups and are related to their contexts, which differ from one community to another [81]. Therefore, policies from governmental or development projects should be tailored to different ethnicities in different locations and modified in light of their local knowledge and practices. This research also revealed that men and women often appeared to have different concerns towards agroforestry adoption. For example, Thai women were concerned about the market for fruits, while H'mong men wanted to learn more about agroforestry techniques. Effective policies will, therefore, need to be based on a clear understanding of the needs of men and women. Further research on gender would help shed light on design principles for scaling out agroforestry. Furthermore, understanding different motivation for agroforestry adoption and the preferred options of different farmers could help policy makers and development projects design best-fit agroforestry practices for specific contexts. If an option does not fit with their existing practices, farmers are unlikely to be willing to adopt it [80].

4. Conclusions

This research has revealed contrasting social contexts for agroforestry adoption amongst three ethnic groups in northwest Viet Nam, the Kinh, Thai, and H'mong. Non-adopter and adopter farmers were categorised into four groups with different levels of capacity and willingness to adopt agroforestry. Farmers' behavioural controls constraining the adoption of agroforestry also varied among the three ethnic groups and were influenced by their location, accessibility to market, and different cultivation traditions. Most farmers lacked access to high-quality tree seedlings and connections to markets. Kinh and Thai farmers in lowland areas were concerned about climate change and the high cost of managing agroforestry and preferred high-value fruit trees. H'mong people, in contrast, were more concerned about the efficiency of using fertiliser and labour and accessing required financial resources to support the purchase of seedlings and fertilisers. This understanding contributes to selecting which agroforestry interventions are most likely to be suitable for different ethnic groups, and what supporting policies are required to enable adoption.

Author Contributions: Conceptualisation, D.C.C., T.P., M.P.N., T.Q.N. and F.S.; Methodology, D.C.C., M.P.N. and T.P.; Software, M.P.N.; Validation, T.P. and M.P.N.; Formal analysis: M.P.N.; Investigation: M.P.N.; Resources: D.C.C. and F.S.; Data curation, M.P.N.; Writing—original draft preparation, M.P.N. and T.P.; Writing—review and editing, T.P., D.C.C., T.Q.N. and F.S.; Visualization: M.P.N.; Supervision: T.P., D.C.C. and F.S.; Project Administration: M.P.N.; Funding acquisition, D.C.C. and F.S. All authors have read and agreed to the published version of the manuscript.

Funding: The study was supported by the AFLi project funded by ACIAR (Australian Centre for International Agricultural Research) and FTA (CGIAR Research Program on Forest, Trees and Agroforestry).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and the research was approved by Bangor University Ethical Review Committee and follows World Agroforestry's Policy Guidelines Series on Research Ethics (2014). In particular all participation in the research was voluntary, and all information, including any confidential personal data, was anonymised and stored in appropriately secure facilities, following current World Agroforestry protocols.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy.

Acknowledgments: We thank the survey respondents for sharing their information and our ICRAF colleagues Vu Thi Hanh, Pham Huu Thuong, Nguyen Van Thach, Do Van Hung, the master's student Marika Simelson, and the intern Nguyen Tuan Anh for their contributions in farmer interviews, farmer rankings, and focus group discussions.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Lundgren, B.O.; Raintree, J.B. Sustained Agroforestry. In *Agricultural Research for Development: Potentials and Challenges in Asia*; Nestel, B., Ed.; International Service for National Agricultural Research (ISNAR): The Hague, The Neithelands, 1983.
2. Nair, P.K.R. Definition and concepts of agroforestry. In *An Introduction to Agroforestry*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 1993.
3. De Foresta, H.; Temu, A.; Boulanger, D.; Feuilly, H.; Gauthier, M. *Towards the Assessment of Trees Outside Forests: A Thematic Report Prepared in the Framework of the Global Forest Resources Assessment*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2013.
4. Sinclair, F.L. A general classification of agroforestry practice. *Agrofor. Syst.* **1999**, *46*, 161–180. [CrossRef]
5. Sánchez, P.A.; Woomer, P.L.; Palm, C.A. Agroforestry approaches or rehabilitating degraded lands after tropical deforestation. In *Proceedings of the JIRCAS International Symposium Series (Japan)*; Ibrahim, M., Beer, J., Eds.; CATIE: Turrialba, Costa Rica, 1994.
6. Somarriba, E.; Kass, D.; Ibrahim, M. Definition and classification of agroforestry system. In *Agroforestry Prototypes for Belize*; CATIE/GTZ: Turrialba, Costa Rica, 1998.
7. Pretty, J.; Bharucha, Z.P. Sustainable intensification in agricultural systems. *Ann. Bot.* **2014**, *114*, 1571–1596. [CrossRef] [PubMed]

8. Nerlich, K.; Graeff-Hönninger, S.; Claupein, W. Agroforestry in Europe: A review of the disappearance of traditional systems and development of modern agroforestry practices, with emphasis on experiences in Germany. *Agrofor. Syst.* **2013**, *87*, 475–492. [CrossRef]
9. Torralba, M.; Fagerholm, N.; Burgess, P.J.; Moreno, G.; Plieninger, T. Do European agroforestry systems enhance biodiversity and ecosystem services? A meta-analysis. *Agric. Ecosyst. Environ.* **2016**, 150–161. [CrossRef]
10. Hilger, T.; Keil, A.; Lippe, M.; Panomtaranichagul, M.; Saint-Macary, C.; Zeller, M.; Pansak, W.; Vu Dinh, T.; Cadisch, G. Soil Conservation on Sloping Land: Technical Options and Adoption Constraints. In *Sustainable Land Use and Rural Development in Southeast Asia: Innovations and Policies for Mountainous Areas*; Fröhlich, H.L., Schreinemachers, P., Stahr, K., Clemens, G., Eds.; Springer: Dordrecht, The Netherlands, 2012; pp. 229–279.
11. Swinton, S.M.; Lupi, F.; Robertson, G.P.; Hamilton, S.K. Ecosystem services and agriculture: Cultivating agricultural ecosystems for diverse benefits. *Ecol. Econ.* **2007**, *64*, 245–252. [CrossRef]
12. Bucheli, V.J.P.; Bokelmann, W. Agroforestry systems for biodiversity and ecosystem services: The case of the sibundoy valley in the colombian province of putumayo. *Int. J. Biodivers. Sci. Ecosyst. Serv. Manag.* **2017**, *13*, 380–397. [CrossRef]
13. Philpott, S.M.; Lin, B.B.; Jha, S.; Brines, S.J. A multi-scale assessment of hurricane impacts on agricultural landscapes based on land use and topographic features. *Agric. Ecosyst. Environ.* **2008**, *128*, 12–20. [CrossRef]
14. Lin, B.B. Resilience in Agriculture through Crop Diversification: Adaptive Management for Environmental Change. *Bioscience* **2011**, *61*, 183–193. [CrossRef]
15. Kiptot, E.; Franzel, S.; Degrande, A. Gender, agroforestry and food security in Africa. *Curr. Opin. Environ. Sustain.* **2014**, *6*, 104–109. [CrossRef]
16. Mbow, C.; Van Noordwijk, M.; Luedeling, E.; Neufeldt, H.; Minang, P.A.; Kowero, G. Agroforestry solutions to address food security and climate change challenges in Africa. *Curr. Opin. Environ. Sustain.* **2014**, *6*, 61–67. [CrossRef]
17. Place, F.; Roothaert, R.; Maina, L.; Franzel, S.; Sinja, J.; Wanjiku, J. Leguminous trees help to raise milk yields. *Appropr. Technol.* **2010**, *37*, 47–49.
18. Maliki, R.; Cornet, D.; Floquet, A.; Sinsin, B. Agronomic and economic performance of yambased systems with shrubby and herbaceous legumes adapted by smallholders. *Outlook Agric.* **2012**, *41*, 171–178. [CrossRef]
19. Nguyen, T.H.; Catacutan, D.C. History of agroforestry research and development in Vietnam: A review of literature. In *Proceedings of the Realizing the Potential of Agroforestry in Vietnam*; Catacutan, D.C., Bui, N., Bo, N.V., Hop, B.T.H., Eds.; World Agroforestry Centre: Nairobi, Kenya, 2012; pp. 15–16.
20. Irshad, M.; Khan, A.; Inoue, M.; Ashraf, M.; Sher, H. Identifying factors affecting agroforestry system in Swat, Pakistan. *African J. Agric. Res.* **2011**, *6*, 2586–2593. [CrossRef]
21. Wezel, A.; Steinmüller, N.; Friederichsen, J.R. Slope position effects on soil fertility and crop productivity and implications for soil conservation in upland northwest Vietnam. *Agric. Ecosyst. Environ.* **2002**, *91*, 113–126. [CrossRef]
22. Schweizer, S.A.; Fischer, H.; Häring, V.; Stahr, K. Soil structure breakdown following land use change from forest to maize in Northwest Vietnam. *Soil Tillage Res.* **2017**, *166*, 10–17. [CrossRef]
23. Tung, P.D.; Cuong, N.V.; Thinh, N.C.; Nhung, N.T.; Van, T.T.K. *Report Ethnic Minorities and Sustainable Development Goals: Who Will be Left Behind? Results from Analyses of the Survey on the Socio-Economic Situation of 53 Ethnic Minorities in 2015*; Report; UNDP: Hanoi, Vietnam, 2016; pp. 83–88. Available online: https://www.google.com.hk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwifv8PY84HwAhWaeN4KHWFUBWkQFjABegQIBRAD&url=https%3A%2F%2Fwww.vn.undp.org%2Fcontent%2Fdam%2Fvietnam%2Fdocs%2FPublications%2FFinal%2520report%2520on%2520the%2520Overview%2520of%2520socio-economic%2520status%2520of%252053%2520ethnic%2520minorities%2520E.pdf&usg=AOvVaw0Nsj5LO1MLWfIOZBsj0Qgm (accessed on 16 April 2021).
24. Michaud, J.; Turner, S.; Roche, Y. Mapping ethnic diversity in highland Northern Vietnam. *GeoJournal* **2002**, *57*, 305–323. [CrossRef]
25. Kiptot, E.; Hebinck, P.; Franzel, S.; Richards, P. Adopters, testers or pseudo-adopters? Dynamics of the use of improved tree fallows by farmers in western Kenya. *Agric. Syst.* **2007**, *94*, 509–519. [CrossRef]
26. Derero, A.; Coe, R.; Muthuri, C.; Hadgu, K.M.; Sinclair, F. Farmer-led approaches to increasing tree diversity in fields and farmed landscapes in Ethiopia. *Agrofor. Syst.* **2020**, 1–18. [CrossRef]
27. Sinclair, F.; Coe, R.I.C. The options by context approach: A paradidm shift in agronomy. *Exp. Agric.* **2019**, *55*, 1–13. [CrossRef]
28. Chambers, R. The origins and practice of participatory rural appraisal. *World Dev.* **1994**. [CrossRef]
29. Rogers, E.M. *Diffusion of Innovations*, 5th ed.; Free Press: New York, NY, USA, 2003; ISBN 9780743222099.
30. Stern, P.C.; Dietz, T.; Abel, T.; Guagnano, G.A.; Kalof, L. A value-belief-norm theory of support for social movements: The case of environmentalism. *Hum. Ecol. Rev.* **1999**, *6*, 81–97.
31. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**. [CrossRef]
32. Rodriguez, J.M.; Molnar, J.J.; Fazio, R.A.; Sydnor, E.; Lowe, M.J. Barriers to adoption of sustainable agriculture practices: Change agent perspectives. *Renew. Agric. Food Syst.* **2009**. [CrossRef]
33. Läpple, D.; Kelley, H. Understanding the uptake of organic farming: Accounting for heterogeneities among Irish farmers. *Ecol. Econ.* **2013**, *88*, 11–19. [CrossRef]
34. Lalani, B.; Dorward, P.; Holloway, G.; Wauters, E. Smallholder farmers' motivations for using Conservation Agriculture and the roles of yield, labour and soil fertility in decision making. *Agric. Syst.* **2016**, *146*, 80–90. [CrossRef]

35. Daxini, A.; O'Donoghue, C.; Ryan, M.; Buckley, C.; Barnes, A.P.; Daly, K. Which factors influence farmers' intentions to adopt nutrient management planning? *J. Environ. Manag.* **2018**, *224*, 350–360. [CrossRef]
36. Liu, T.; Bruins, R.J.F.; Heberling, M.T. Factors influencing farmers' adoption of best management practices: A review and synthesis. *Sustainability* **2018**, *10*, 432. [CrossRef]
37. Warren, C.R.; Burton, R.; Buchanan, O.; Birnie, R.V. Limited adoption of short rotation coppice: The role of farmers' socio-cultural identity in influencing practice. *J. Rural Stud.* **2016**, *45*, 175–183. [CrossRef]
38. Mercer, D.E.; Pattanayak, S.K. Agroforestry Adoption by Smallholders. In *Forests in a Market Economy*; Sills, E.O., Abt, K.L., Eds.; Springer: Dordrecht, The Netherlands, 2003; Volume 72, pp. 283–299.
39. Vanslembrouck, I.; Van Huylenbroeck, G.; Verbeke, W. Determinants of the willingness of Belgian farmers to participate in agri-environmental measures. *J. Agric. Econ.* **2002**, *53*, 489–511. [CrossRef]
40. Wilson, G.A.; Hart, K. Farmer participation in agri-environmental schemes: Towards conservation-oriented thinking? *Sociol. Ruralis* **2001**, *41*, 254–274. [CrossRef]
41. Nyaga, J.; Barrios, E.; Muthuri, C.W.; Öborn, I.; Matiru, V.; Sinclair, F.L. Evaluating factors influencing heterogeneity in agroforestry adoption and practices within smallholder farms in Rift Valley, Kenya. *Agric. Ecosyst. Environ.* **2015**. [CrossRef]
42. Ajayi, O.C.; Place, F. Policy Support for Large-Scale Adoption of Agroforestry Practices: Experience from Africa and Asia. In *Agroforestry—The Future of Global Land Use*; Nair, P.R., Garity, D., Eds.; Springer Science & Business Media: Dordrecht, The Netherlands, 2012; pp. 175–201. ISBN 9789400746763.
43. McGinty, M.M.; Swisher, M.E.; Alavalapati, J. Agroforestry adoption and maintenance: Self-efficacy, attitudes and socio-economic factors. *Agrofor. Syst.* **2008**, *73*, 99–108. [CrossRef]
44. Ghosh, M.K.; Sohel, M.H.; Ara, N.; Zahara, F.T.; Nur, S.B.; Hasan, M.M. Farmers Attitude towards Organic Farming: A Case Study in Chapainawabganj District. *Asian J. Adv. Agric. Res.* **2019**. [CrossRef]
45. Pontara, G. Analysing Farmers' Perceptions towards Agroforestry Adoption in Southern Belize. Master's Thesis, Wageningen University, Wageningen, The Netherlands, 2019.
46. Tadesse, S.A. Views and Attitudes of Local Farmers towards Planting, Growing and Managing Trees in Agroforestry System in Basona Worena District, Ethiopia. *J. Agric. Sci. Food Res.* **2019**, *10*, 1–10. [CrossRef]
47. Oduro, K.A.; Arts, B.; Kyereh, B.; Mohren, G. Farmers' Motivations to Plant and Manage On-Farm Trees in Ghana. *Small-Scale For.* **2018**, *17*, 393–410. [CrossRef]
48. Nouman, W.; Riaz, A. Farmer's attitude towardsagroforestry in district Faisalabad. *Pakistan J. Agric. Sci.* **2008**, *45*, 60–64.
49. Kiyani, P.; Andoh, J.; Lee, Y.; Lee, D.K. Benefits and challenges of agroforestry adoption: A case of Musebeya sector, Nyamagabe District in southern province of Rwanda. *Forest Sci. Technol.* **2017**, *13*, 174–180. [CrossRef]
50. Smith, D.E.; Gassner, A.; Agaba, G.; Nansamba, R.; Sinclair, F. The utility of farmer ranking of tree attributes for selecting companion trees in coffee production systems. *Agrofor. Syst.* **2019**, *93*, 1469–1483. [CrossRef]
51. Inwood, S. Social Forces and Cultural Factors Influencing Farm Transition. *Choices Mag. Food Farm Resour. Issues* **2013**, *28*, 1–5.
52. Chomba, S.W.; Nathan, I.; Minang, P.A.; Sinclair, F. Illusions of empowerment? Questioning policy and practice of community forestry in Kenya. *Ecol. Soc.* **2015**, *28*, 1–5. [CrossRef]
53. Madge, C. Ethnography and agroforestry research: A case study from the Gambia. *Agrofor. Syst.* **1995**, *32*, 127–146. [CrossRef]
54. Xu, J.; Ma, E.T.; Tashi, D.; Fu, Y.; Lu, Z.; Melick, D. Integrating sacred knowledge for conservation: Cultures and landscapes in Southwest China. *Ecol. Soc.* **2005**, *10*. [CrossRef]
55. Weber, R.; Faust, H.; Schippers, B.; Mamar, S.; Sutarto, E.; Kreisel, W. Migration and ethnicity as cultural impact factors on land use change in the rainforest margins of Central Sulawesi, Indonesia. In *Stability of Tropical Rainforest Margins*; Tscharntke, T., Leuschner, C., Zeller, M., Guhardja, E., Bidin, A., Eds.; Springer: Berlin/Heidelberg, Germany, 2007.
56. Ayantunde, A.A.; Briejer, M.; Hiernaux, P.; Udo, H.M.J.; Tabo, R. Botanical knowledge and its differentiation by age, gender and ethnicity in Southwestern Niger. *Hum. Ecol.* **2008**, *36*, 881–889. [CrossRef]
57. Coe, R.; Sinclair, F.; Barrios, E. Scaling up agroforestry requires research "in" rather than "for" development. *Curr. Opin. Environ. Sustain.* **2014**, *6*, 73–77. [CrossRef]
58. Adesina, A.A.; Chianu, J. Determinants of farmers' adoption and adaptation of alley farming technology in Nigeria. *Agrofor. Syst.* **2002**, *55*, 99–112. [CrossRef]
59. Bannister, M.E.; Nair, P.K.R. Agroforestry adoption in Haiti: The importance of household and farm characteristics. *Agrofor. Syst.* **2003**, *57*, 149–157. [CrossRef]
60. Meijer, S.S.; Catacutan, D.; Ajayi, O.C.; Sileshi, G.W.; Nieuwenhuis, M. The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *Int. J. Agric. Sustain.* **2015**, *13*, 40–54. [CrossRef]
61. Mills, J.; Gaskell, P.; Ingram, J.; Dwyer, J.; Reed, M.; Short, C. Engaging farmers in environmental management through a better understanding of behaviour. *Agric. Hum. Values* **2017**, *34*, 283–299. [CrossRef]
62. Sinclair, F.L.; Walker, D.H. Acquiring qualitative knowledge about complex agroecosystems. Part 1: Representation as natural language. *Agric. Syst.* **1998**, *39*, 223–252. [CrossRef]
63. Walker, D.H.; Sinclair, F.L. Acquiring qualitative knowledge about complex agroecosystems. Part 2: Formal representation. *Agric. Syst.* **1998**, *56*, 341–363. [CrossRef]
64. Sillitoe, P. The development of indigenous knowledge: A new applied anthropology. *Curr. Anthropol.* **1998**, *39*, 223–252. [CrossRef]

65. Dien Bien Statistic Office. *Dien Bien Statistical Yearbook 2018*; Statistical Publishing House: Dien Bien, Vietnam, 2019.
66. Son La Statistic Office. *Son La Statistical Yearbook 2018*; Statistical Publishing House: Son La, Vietnam, 2019.
67. Yen Bai Statistic Office. *Yen Bai Statistical Yearbook 2018*; Statistical Publishing House: Yen Bai, Vietnam, 2019.
68. Miles, M.B.; Huberman, A.M. *An Expanded Sourcebook: Qualitative Data Analysis*, 2nd ed.; Sage Publications, Inc.: Thousand Oaks, CA, USA, 1994; ISBN 0803955405.
69. De Jong, W.; Sam, D.D.; Trieu, V.H. *Forest Rehabilitation in Vietnam: Histories, Realities, and Future*; Center for International Forestry Research: Jakarta, Indonesia, 2006; ISBN 979-24-4652-4.
70. Gonzalez Gamboa, V.; Barkmann, J.; Marggraf, R. Social network effects on the adoption of agroforestry species: Preliminary results of a study on differences on adoption patterns in Southern Ecuador. In *Proceedings of the Procedia—Social and Behavioral Sciences*; Elsevier: Amsterdam, The Netherlands, 2010.
71. Neupane, R.P.; Sharma, K.R.; Thapa, G.B. Adoption of agroforestry in the hills of Nepal: A logistic regression analysis. *Agric. Syst.* **2002**, *72*, 177–196. [CrossRef]
72. Hernández-Morcillo, M.; Burgess, P.; Mirck, J.; Pantera, A.; Plieninger, T. Scanning agroforestry-based solutions for climate change mitigation and adaptation in Europe. *Environ. Sci. Policy* **2018**, *80*, 44–52. [CrossRef]
73. Bacon, C.M.; Getz, C.; Kraus, S.; Montenegro, M.; Holland, K. The social dimensions of sustainability and change in diversified farming systems. *Ecol. Soc.* **2012**. [CrossRef]
74. Scherr, S.J. Economic factors in farmer adoption of agroforestry: Patterns observed in Western Kenya. *World Dev.* **1995**, *23*, 787–804. [CrossRef]
75. Coulibaly, J.Y.; Chiputwa, B.; Nakelse, T.; Kundhlande, G. Adoption of agroforestry and the impact on household food security among farmers in Malawi. *Agric. Syst.* **2017**, *155*, 52–69. [CrossRef]
76. Assefa, E.; Hans-Rudolf, B. Farmers' Perception of Land Degradation and Traditional Knowledge in Southern Ethiopia—Resilience and Stability. *Land Degrad. Dev.* **2016**, *27*, 1552–1561. [CrossRef]
77. Kloppenburg, J.; Lezberg, S.; De Master, K.; Stevenson, G.W.; Hendrickson, J. Tasting food, tasting sustainability: Defining the attributes of an alternative food system with competent, ordinary people. *Hum. Organ.* **2000**, 177–186. [CrossRef]
78. Thangata, P.H.; Alavalapati, J.R.R. Agroforestry adoption in southern Malawi: The case of mixed intercropping of Gliricidia sepium and maize. *Agric. Syst.* **2003**, *78*, 57–71. [CrossRef]
79. Place, F.; Ajayi, O.C.; Torquebiau, E.; Detlefsen, G.; Gauthier, M.; Buttoud, G. *Improved Policies for Facilitating the Adoption of Agroforestry. In Agroforestry for Biodiversity and Ecosystem Services—Science and Practice*; Kaonga, M.L., Ed.; IntechOpen: London, UK, 2012; pp. 113–128.
80. Kabwe, G.; Bigsby, H.; Cullen, R. Factors Influencing Adoption of Agroforestry among Smallholder Farmers in Zambia. Ph.D. Thesis, Lincoln University, Oxford, PA, USA, 2010.
81. Rai, A.; Srivastava, A.K.; Singh, M. A socio-economic study on agroforestry in Chhachhrauli block of Yamunanagar District of Haryana. *Indian J. Agrofor.* **2001**, *3*, 148–152.