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RESEARCH ARTICLE



Expansion of fruit tree cultivation by different ethnic groups in mountainous areas of Vietnam: key tree species, challenges, and policy support

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ABSTRACT

Growing fruit trees is becoming one of the main agricultural activities for different ethnic groups in mountainous areas of Northwest Vietnam. However, information on, e.g. key tree species and challenges for farmers in growing fruit trees remains unclear. This study selected fruit tree-growing areas in Dien Bien, Yen Bai and Son La provinces of Northwest Vietnam using spatial analysis for semistructured household interviews. Information on fruit tree cultivation types and species, motivations and challenges, and further support needed by farmers to grow fruit trees was gathered through interviews. Support policies enacted between 2010 and 2020 were reviewed. The interviews revealed that the variety of fruit tree species in monoculture or agroforestry farms managed by the Kinh, Thai, and H'mong ethnic groups in the three provinces was likely affected by market access and species promoted by local governments, apart from altitude. Factors such as potential economic returns and incentives offered by support policies motivated farmers to grow fruit trees. However, farmers faced challenges in accessing more stable markets and incentives. Further support needed from local governments included more assistance to farmers to comply with the requirements and apply for incentives and to better access market opportunities.

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Agroforestry; ethnic groups; fruit trees; Northwest Vietnam; support policies

1. Introduction

To jointly tackle the global challenges of poverty, food insecurity and climate change, countries across the world have declared their commitment to the Sustainable Development Goals (SDGs). While aiming to benefit the entire global population, the SDGs, especially SDG1 (Poverty reduction) and SDG2 (Zero hunger), focus on disadvantaged groups such as ethnic minorities, who account for about 15% of the world's poorest individuals (WACC, 2023). Ethnic minorities are defined as groups of people with a nondominant position, at least in terms of population, compared with a dominant ethnic group, and often have their own culture and/or language (UN, 2018).

Ethnic minorities across the world often face similar challenges, such as limited access to basic services (e.g. health or education) and few opportunities for nonagricultural sources of income (UN, 2018). The physical characteristics of areas where they live, which are often remote and rugged mountainous areas, such as in some low- and lower middle-income countries in Asia, exacerbate the cycle of poverty and marginalisation of these groups from the rest of the population (ADB, 2002). Infrastructure development, improvements in basic services and the promotion of sustainable agriculture to improve the livelihoods of ethnic minorities are priority measures in the SDGs (OECD, 2021).

The mountainous areas of lower Mekong countries have been inhabited by diverse ethnic minority groups for centuries (ADB, 2012). For example, the upland areas of Vietnam's northwestern region are home to Thai and H'mong ethnic groups, who cohabit with Kinh, the country's main ethnic group. Kinh makes up

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around 86% of Vietnam's population, while Thai and H'mong make up only 1%–2% of the total population; however, these latter two groups constitute ~26% of the population in the Northwest region (Phung et al., 2016). According to the General Statistics Office of Vietnam, the poverty rate in the Northwest region was about 12.8% in 2022, or 8.6% higher than the national average, and was the highest of all regions in the country (Statista, 2022). Vietnam's Sustainable Development Agenda, introduced in 2017, considers economically poor communities and ethnic minorities as the main target groups (GOV, 2017).

Ethnic groups in Northwest Vietnam are strongly reliant on agriculture for their livelihood, with a few annual crops, mainly cassava, upland rice and maize, representing the main source of income (GEF, 2019; Montgomery et al., 2017; Zimmer et al., 2018). Financial limitations and a lack of knowledge and access to alternative options have constrained these groups from diversifying their income streams (Hoang et al., 2017; Zimmer et al., 2018). Moreover, unsustainable farming practices such as seasonal cropping systems on fragile sloping land in the Northwest region have resulted in multiple issues, including severe soil loss and declining crop yields due to degraded soil fertility (van Noordwijk et al., 2020). Sustainable farming practices such as agroforestry and stronger policy support are needed to halt the increasing level of ecological issues and rural poverty in the region (Simelton et al., 2017).

Agroforestry has been proposed as a sustainable farming practice for upland regions in Southeast Asia (Fox et al., 2014; Hoang et al., 2017; van Noordwijk et al., 2020). It comprises an intentional combination of trees and annual crops or perennial shrubs, with or without livestock (Gassner & Dobie, 2022; Mulia & Nguyen, 2021). Compared with monoculture, agroforestry has the potential to make farmers more economically or climate resilient (Catacutan et al., 2017; van Noordwijk et al., 2020). Vietnam's updated Nationally Determined Contribution submitted to the UNFCCC in 2022 explicitly mentions agroforestry as a measure for land conservation and carbon sequestration (GOV, 2022). There is a relatively large area suitable for the expansion of agroforestry in the Northwest region and across Vietnam (Mulia et al., 2020). When appropriately designed and managed, agroforestry can contribute to most of the 17 SDGs (van Noordwijk et al., 2020) and, in Vietnam, specifically to SDGs 1–3, 5, 6, 8, 10–13, and 15 (Mulia et al., 2022a). In contrast, monoculture practice likely contributes to only two SDGs (SDGs 1 and 10) (Mulia et al., 2022a).

According to a report by the General Statistics Office of Vietnam (GSO, 2018), the area of fruit tree cultivation in several provinces of Northwest Vietnam, especially Dien Bien, Yen Bai and Son La, has substantially increased. For example, the combined area of fruit tree cultivation in the three provinces was 58,464 ha in 2018, a 51% increase compared with that in 2015. However, the factors motivating farmers to grow fruit trees remain unclear. Additionally, limited information exists about the fruit tree cultivation practices employed. This lack of information hampers effective support from local governments or other stakeholders to smallholder farmers. There are several government projects promoting the planting of fruit trees in these three provinces. For example, the project approved through Decision No. 115/QD-UBND aimed at increasing the area of fruit tree cultivation and improving the quality of fruit products and livelihood of farmers in Yen Bai province for the period of 2016–2020. Fruit tree cultivation could potentially generate a substantial income for smallholder farmers in Vietnam (Do et al., 2020; Khanh, 2023; Wataru et al., 2020).

This study investigated the expansion of fruit tree cultivation in selected districts of Dien Bien, Yen Bai, and Son La provinces in Vietnam's Northwest region and had four research questions: (1) What are the kinds of fruit tree cultivation practices adopted by local ethnic groups and the selected fruit tree species? If agroforestry exists, what kinds of agroforestry practices exist? (2) What are the main motivations and challenges to growing fruit trees, according to farmers? (3) How did farmers sell harvested fruit products and whether they could comply with any product quality standards? (4) What local policies support the expansion of smallholder fruit tree cultivation in the three provinces, and what incentives are offered by the support policies?

2. Materials and methods

2.1 Methodological framework

Nguyen et al. (2018) proposed a methodological framework to investigate the extent and drivers of forest cover changes in Vietnam combining spatial analysis, policy review, and household interviews. The spatial

analysis was used to examine historical forest cover changes at the province scale across years, while information derived from policy reviews and household interviews was used to identify the main drivers of forest cover changes. The present study adapted the framework for investigating the expansion of fruit tree cultivation areas in Northwest Vietnam. The household interviews were conducted not only to understand the motivating factors, challenges and support needed by farmers to grow fruit trees but also to characterize their fruit tree cultivation types and key species. The classification of different types of fruit tree agroforestry practices at the study sites followed the approach proposed by Mulia and Nguyen (2021), namely, the practices were classified into fruit trees combined with annual crops, perennial shrubs, annual crops and/or perennial shrubs with understorey crops, or other crops such as fodder grass.

Secondary data from the General Statistics Office of Vietnam only provide information on the total area of fruit tree cultivation at the province level. Therefore, a spatial analysis using available satellite images (year 2015 and 2019) was conducted to select districts within the three provinces (i.e. levels of administrative divisions in Vietnam are provinces, districts, and then communes) that experienced a significant increase in fruit tree cultivation area and communes within these districts for the collection of data for the present study (step 1). A purposive sampling approach was then applied to create a list of farm households in the selected communes for semi-structured interviews (step 2). To investigate the presence of policy support for fruit tree cultivation in the three provinces, policies enacted between 2010 and 2020 to promote agriculture and rural development in the provinces were reviewed (step 3).

2.2 Brief description of the three provinces

Dien Bien, Yen Bai and Son La are three of the six provinces in Vietnam's Northwest region (Figure 1). All three have complex topographies, with high mountains and plateaus. Thai, Kinh and H'mong are the main local ethnic groups. Thai people generally live at an altitude of 500–800 m, H'mong people at higher altitude (>800 m) and Kinh people at lower altitude (<600 m). In 2022, the total population of Dien Bien, Yen Bai and Son La provinces was 512,000, 758,000, and 1.1 million, respectively. The mean annual temperature in these provinces ranges from 21 to 24° C, and the mean annual precipitation ranges from 1200 to

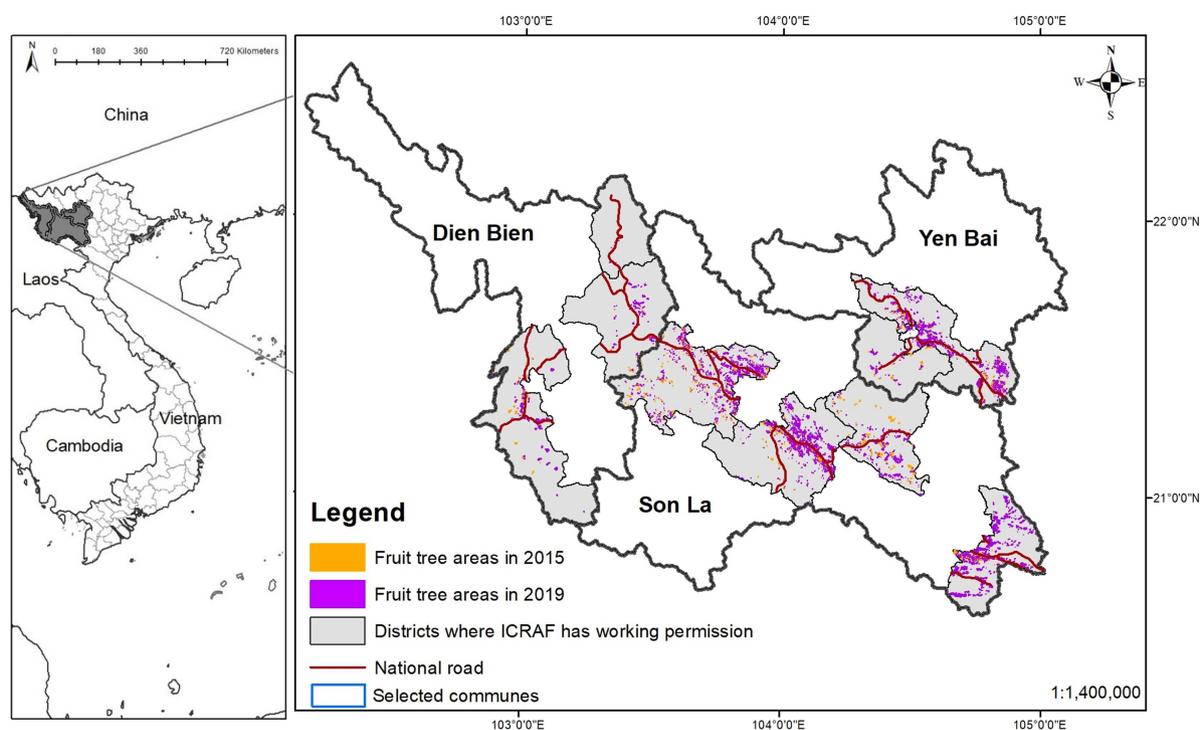


Figure 1. Location of Dien Bien, Yen Bai and Son La provinces in Vietnam's Northwest region, and areas of fruit tree cultivation in the provinces in 2015 and 2019.

2000 mm (Do & Mulia, 2018). The rainy season lasts from April to September. However, changes in local weather conditions, such as longer summer seasons, shorter winter seasons, increased annual temperatures, more unpredictable rainfall, more severe droughts, and a higher incidence of cold spells, have occurred (e.g. Do & Bui, 2023). The main soil type in all three provinces is Ferrasol (Pham, 2010), and the average soil layer thickness ranges from 50 cm to 1 m (Nguyen et al., 2020). Annual crops such as maize, upland rice and cassava and perennial crops, including fruit trees (e.g. longan, orange, peach) and coffee shrubs, are commonly grown on agricultural land with 5%–50% slopes (Hoang et al., 2017). The Kinh people usually have smaller agricultural land sizes (<1 ha) than the Thai (1–3 ha) or H'mong (2–5 ha) people do (Nguyen et al., 2021). The main sources of income of different ethnic groups in the provinces are crops and livestock (i.e. cattle, buffalo, or swine), with limited engagement in nonfarm activities, either wage employment or nonfarm self-employment (Ho et al., 2024; Tran, 2015).

2.3 Spatial analysis to select study sites

Landsat 8 satellite images from 2015 (captured in April and May) and Sentinel 2B images from 2019 (captured in December), i.e. the best images available for the analysis for the two different years, were used to identify districts within the three provinces that showed a significant increase in fruit tree cultivation area in the four-year period. The analysis was limited to the nine districts for which the International Centre for Research in Agroforestry (ICRAF) has working permission (shaded area in Figure 1), which comprises three (Dien Bien, Tua Chua, Tuan Giao) of eight districts in Dien Bien province, two (Tram Tau, Van Chan) of nine districts in Yen Bai province and four (Bac Yen, Mai Son, Thuan Chau, Van Ho) of 12 districts in Son La province. The spatial analysis consisted of seven steps (Figure 2) and was conducted by Vietnam's National Institute of Agricultural Planning and Projection (NIAPP). NIAPP applied pre-processing methods to enhance image quality, including atmosphere correction (steps 1–2), and then identified fruit tree cultivation areas using e.g. a collection of photo keys of fruit tree cultivation in Vietnam (steps 3–5). Google Earth satellite images were used to increase the accuracy of the final map (step 6) prior to estimating changes in the fruit tree cultivation area between 2015 and 2019 (step 7). The analysis aimed to identify the locations and areas of fruit tree cultivation but not to classify those locations and areas by fruit tree species.

The spatial analysis identified several districts across the three provinces with a significant increase in fruit tree cultivation area between 2015 and 2019 (Table 1). Four of these districts were selected for the household interviews, namely, Tuan Giao district in Dien Bien province, Mai Son and Tuan Chau districts in Son La province and Van Chan district in Yen Bai province, all of which are geographically close to each other. Van Ho district (Son La province) – the area with the highest recorded increase in cultivation, was excluded from household interviews to optimize time and resource allocation. Two communes in each of the four districts were selected (Table 1), based on altitude (i.e. ethnic groups living at different altitudes) and proximity to a main road, which could determine how farm households sell their agricultural products (Nguyen et al., 2020). The locations of the eight selected communes are indicated in Figure 1.

2.4 Household selection and interviews

Consultations with the leaders of the eight selected communes prior to determining sample size and selecting households for interviews revealed that it is common for households in the communes to have several fruit tree cultivation plots with different types of practices (i.e. monoculture or agroforestry). In addition, many households combine fruit trees with diverse (annual or perennial) crop components. Considering this information and the resources available for the study, a stratified purposive sampling approach (Campbell et al., 2020) was applied whereby each of the eight commune leaders was requested to recommend 10 households whose fruit tree cultivation plots represented the diversity of fruit tree cultivation practices in their commune. The aim was to capture information on the different plots of selected households through interviews and possible visits to the plots (if these were in accessible areas and the interviewed household gave their consent). Of the 80 households recommended by the commune

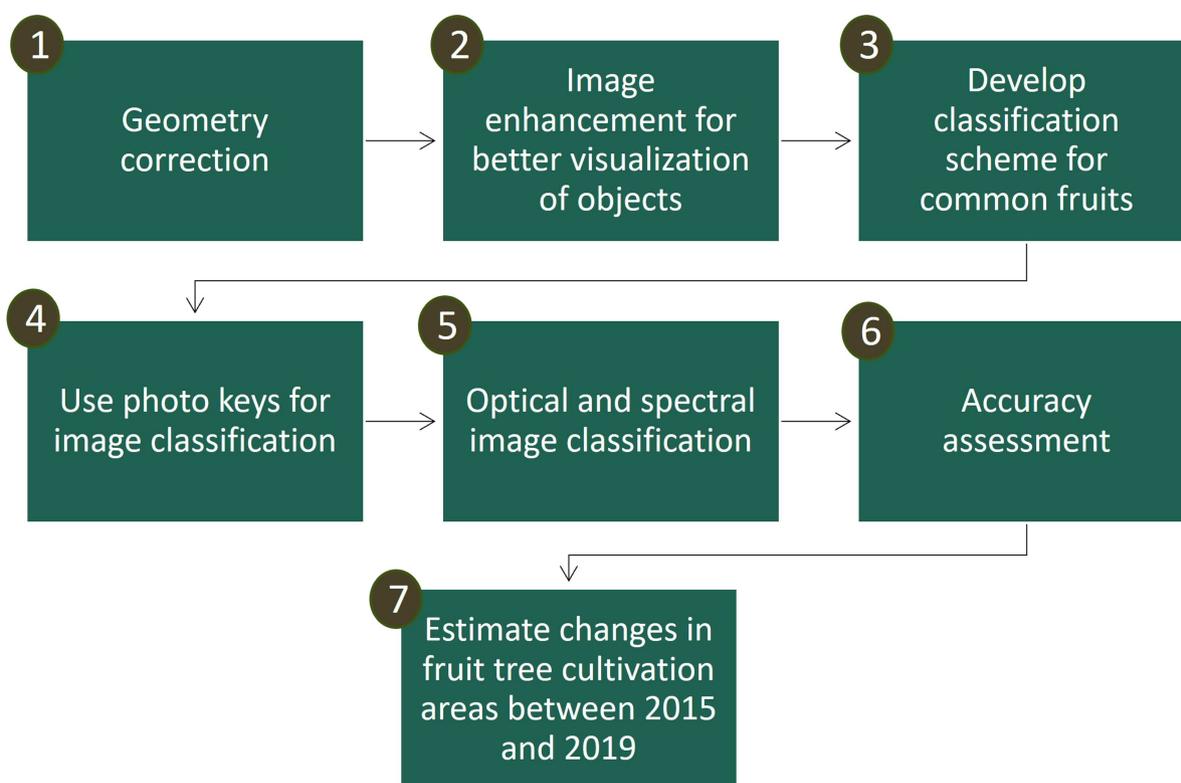


Figure 2. Steps applied in spatial analysis to identify fruit tree cultivation areas in the nine study districts and changes in fruit tree area between 2015 and 2019.

Table 1. Increase in fruit tree cultivation area in the nine selected districts in 2015–2019.

District	Area in 2015 (ha)	Increase 2015–2019 (ha)	Selected communes*	Main ethnic group	Distance to main road** (km)
<i>Dien Bien province</i>					
Dien Bien	448	741			
Tua Chua	0	22			
Tuan Giao [#]	98	505	Quai Nua (6) Toa Tinh (8)	Thai Thai, H'mong	4–5 8–10
<i>Son La province</i>					
Bac Yen	694	207			
Mai Son [#]	1032	1568	Hat Lot (6) Na Bo (8)	Thai Kinh	3–4 8–10
Thuan Chau [#]	880	931	Bo Muoi (10) Long He (10)	Thai H'mong	10–12 > 40
Van Ho	349	2234			
<i>Yen Bai province</i>					
Tram Tau	126	80			
Van Chan [#]	440	1827	Suoi Giang (9) Thuong Bang La (10)	Thai, H'mong Kinh	10–12 2–3
Total	4068	8114 ^{##}			

* The values in brackets are the number of interviewed households in each commune.

** Interdistrict road or asphalt road.

Selected districts for household interviews.

The total area of fruit tree cultivation in the eight selected districts was therefore 12,182 ha in 2019.

leaders, 67 households (18 Kinh, 29 Thai, 20 H'mong) had time and agreed to be interviewed (Table 1). These 67 households managed a total of 144 fruit tree cultivation plots.

In the interviews, a semistructured questionnaire divided into seven sections (available as supplementary material) was used. In Section 1 collected brief personal information of the respondents (e.g. gender, ethnicity), and in Section 2, information of all crop components, type of cultivation practice, and management options implemented in the fruit tree cultivation plots that the selected households managed. Section 3 investigated selling channels and the certification of fruit products. Information about the physical access (e.g. distance from the main road to fruit tree cultivation plots) and climate resilience of

fruit tree cultivation practices that the households managed were gathered through Sections 4 and 5, respectively. This information might indicate challenges that the households encountered in growing fruit trees. Section 6 comprises several open-ended questions to identify factors that motivated the households to grow fruit trees, including cash or in-kind support. The main and present challenges that the households encountered in growing more fruit trees, beyond land availability, were examined in section 7. This final section also investigated the forms of support that the households needed to grow more fruit trees.

Prior to the interviews, the purpose of the study and context of each question in the questionnaire were explained to all the enumerators involved in the interviews. In addition, the enumerators were trained on how to complete the questionnaire, including through interview practices in pairs. The interviews were conducted in the residence or fruit tree cultivation plot of each selected household between July and August 2020. Because several respondents from Thai and H'mong households were not conversant with the Vietnamese language, local interpreters were involved, and the content of the questionnaire was explained to them prior to the interviews.

2.5 Classification of fruit tree agroforestry practices

Fruit tree agroforestry practices in the selected communes were divided into four categories: fruit trees combined with (i) annual crops such as maize, cassava, upland rice or beans; (ii) perennial shrubs such as tea or coffee; (iii) annual crops and/or perennial shrubs with understorey crops such as ginger or taro (called 'complex agroforestry'); or (iv) other crops, e.g. fodder grass. Fruit tree monoculture encompassed one or more fruit tree species but with no other crop component. This classification facilitated the analysis of, e.g. the types of fruit tree cultivation practiced by the different ethnic groups.

2.6 Policy review

The Department of Agriculture and Rural Development in the three provinces were consulted on suitable policies for review. Based on their recommendations and an online investigation using the Google search engine, five relevant policies enacted between 2010 and 2020 were identified for Yen Bai province, four for Dien Bien province and six for Son La province. The policy documents were obtained from several websites, e.g. <https://thuvienphapluat.vn/en/index.aspx>, and were used to identify the main objective of the policies, prioritized fruit tree species, and incentives (cash or in kind) offered to help farmers in the three provinces expand fruit tree cultivation. Detailed information on these different policies is provided in the Appendix.

2.7 Data analysis and statistical tests

The information collected through the household interviews was cross-checked with the enumerators if any missing information or outliers were found. The information was stored in Microsoft Excel for data analysis and visualization. For example, factors motivating farmers to grow fruit trees were illustrated using a spider chart. Statistical tests using data from nonrandom samples and interviews with multiple response questions require adjustments to the standard theoretical sampling distribution (Bilder & Loughin, 2004; Decady & Thomas, 2000; Ecker et al., 2021; Mahieu et al., 2021). In this study, to avoid such complexity, 'standard' statistical tests such as the chi-square test and the Kruskal–Wallis test were applied, and the results were considered indicators of the strength of evidence rather than the truth or false status of the hypotheses. In addition, no inference from sample to population was made. The chi-square statistic (Turney, 2022) was used to test associations between two categorical variables when data could be arranged in a 2 × 2 contingency table, such as between ethnic groups and the type of fruit tree cultivation practice (monoculture or agroforestry) that the participating households managed. The Marascuilo procedure (Wagh & Razvi, 2021) was the post hoc test following a significant result of the chi-square test, with a Bonferroni correction (Hayes, 2024) for multiple pairwise comparisons. The Kruskal–Wallis test (McClenaghan, 2023) was used to compare continuous variables, e.g. distance from fruit tree cultivation plots to the main road,

across ethnic groups. The chi-square and post hoc tests were conducted using Microsoft Excel, and the Kruskal–Wallis using JASP software (<https://jasp-stats.org/>).

3. Results

3.1 Fruit tree cultivation types and species

Each of the three ethnic groups cultivated both fruit tree monoculture and agroforestry practices (Table 2). The most common agroforestry practices were fruit trees combined with annual crops (Figure 3a) or perennial shrubs (Figure 3b). Owing to the relatively high altitude, the coffee variety most commonly grown by the local households was Arabica coffee (*Coffea arabica*). The more complex agroforestry practices in the study communes integrated up to five different fruit tree species, e.g. mango (*Mangifera indica*), longan (*Dimocarpus longan*), pomelo (*Citrus maxima*), lime (*Citrus aurantiifolia*) and plum (*Prunus domestica*), with annual crops, perennial shrubs and/or understory crops such as taro (*Colocasia esculenta*) or ginger (*Zingiber officinale*) (Figure 3c).

The adoption of fruit tree agroforestry practices (calculated as the proportion of agroforestry plots to the total number of fruit tree cultivation plots per group) by Thai households was higher ($p < 0.006$) than that of the other two groups: 75% in Thai, 55% in H'mong and 46% in Kinh households. Among the three ethnic groups, the agroforestry plots were not confined to homestead yards, where local farm households usually cultivate diverse crop species for subsistence and commercial purposes. The average distance (\pm SE) from the residences of the 67 households to their fruit tree agroforestry plots was 0.94 ± 0.15 km, while the average distance to monoculture plots was 0.93 ± 0.20 km.

Table 2. Fruit tree cultivation practices by the different ethnic groups in the eight communes studied and number of fruit tree cultivation plots reported in interviews with selected farm households.

Fruit tree cultivation practice	Ethnicity			Total (plots)
	Kinh	Thai	H'mong	
Monoculture	22	17	16	55
Agroforestry				
-Fruit trees and annual crops	10	15	9	34
-Fruit trees and perennial shrubs	7	19	9	35
-Complex agroforestry	2	13	1	16
-Other agroforestry practices*	0	4	0	4
Total (plots)	41	68	35	144

* With fodder grass.

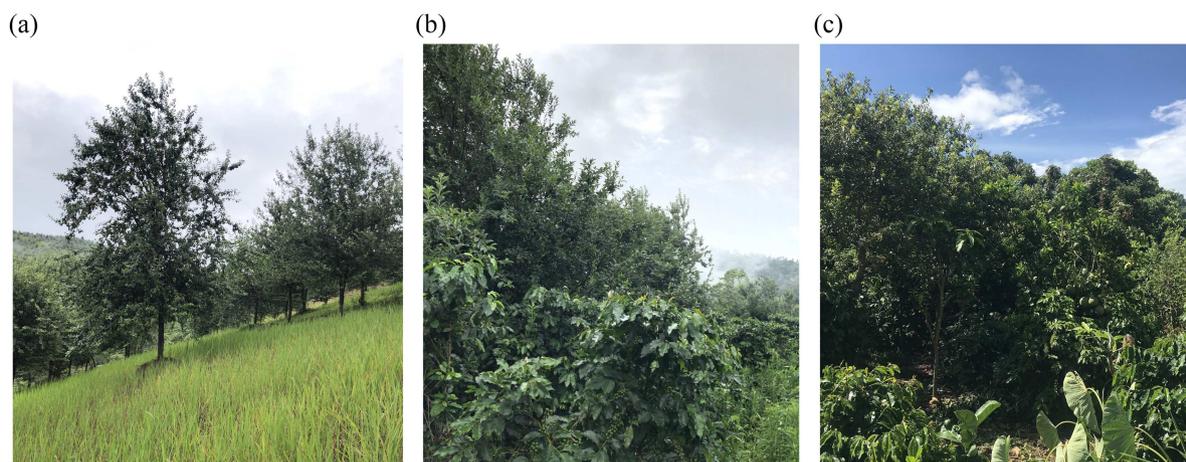


Figure 3. Example of fruit trees combined with (a) upland rice as an annual crop, (b) Arabica coffee as a perennial shrub and (c) Arabica coffee with taro and ginger as understory crops (complex agroforestry) (source of photos: World Agroforestry).

Table 3. The 10 most common fruit tree species grown in the eight communes.

No	Species name:			No. of plots*	No. of plots managed by		
	Vietnamese	English	Scientific		Kinh	Thai	H'mong
1	Xoài	Mango	<i>Mangifera indica</i> L.	52	7	42	3
2	Mận	Plum	<i>Prunus domestica</i> L.	47	3	30	14
3	Nhãn	Longan	<i>Dimocarpus longan</i> Lour.	44	15	29	0
4	Sơn tra	H'mong apple	<i>Docynia indica</i> (Wall.) Decne	26	0	3	23
5	Cam	Orange	<i>Citrus x sinensis</i> (L.) Osbeck	20	20	0	0
6	Đào	Peach	<i>Prunus persica</i> (L.) Stokes	15	0	8	7
7	Chanh	Lime	<i>Citrus aurantiifolia</i> (Christm.) Swingle	13	5	5	3
8	Bưởi	Pomelo	<i>Citrus maxima</i> (Burm.) Merr.	12	4	6	2
9	Bơ	Avocado	<i>Persea americana</i> Mill.	10	4	3	3
10	Mít	Jackfruit	<i>Artocarpus heterophyllus</i> Lam.	5	2	1	2

* Number of cultivation plots in which the species were grown. One plot could have more than one fruit tree species.

Mango, plum, longan, *son tra* (*Docynia indica* (Wall.) Decne) and orange (*Citrus x sinensis*) were the most common fruit tree species in the monoculture or agroforestry plots (Table 3). Among the three ethnic groups, Kinh farmers cultivated mainly orange and longan; H'mong farmers cultivated *son tra* and plum; and Thai farmers cultivated mango, plum and longan. There was no tendency that certain fruit tree species was grown in monoculture or agroforestry. For example, the ten species listed in Table 3 were found both in monocultures and agroforestry systems.

3.2 Factors motivating farmers to grow fruit trees

The factors motivating the interviewed households to grow fruit trees included incentives offered by the local government (i.e. support policies), potential economic returns, and expectations that fruit tree cultivation could be more resilient to climate threats compared with the conventional farming practices with annual crops (Figure 4). The incentives offered were financial assistance to partly cover establishment costs, subsidies for agricultural inputs such as planting materials or fertilizers, or training on fruit tree cultivation techniques. Among the 67 interviewed households, 41 (~60%) obtained information about fruit tree cultivation and offered incentives from local authorities, including agricultural extension staff. The remaining 40% accessed information from other sources, such as neighbors, television or radio. The climate threats mentioned during the interviews were storms, flash floods, cold spells, and droughts. Among the motivating factors that the households mentioned during the interviews, there was no evidence that one factor was considered more motivating than the others in any of the three ethnic groups.

3.3 Challenges and further support needed for growing fruit trees

The interviewed households identified six main challenges to growing more fruit trees, namely, unstable markets, limited financial capital, labour shortages, insufficient knowledge, land scarcity, and climate threats (Table 4). Unstable markets include unstable demand or product prices, and insufficient knowledge encompasses a lack of technical skills in growing fruit trees. Among the six challenges, climate threats were not mentioned by Kinh households (Table 4).

The households mentioned several forms of support needed to grow more fruit trees, namely, agricultural inputs (e.g. seedlings, fertilizers, pesticides), technical guidance, financial assistance, access to more stable markets, and additional labour (Table 5). The financial assistance included access to soft loans with a low interest rate from local banks. Of the 67 participating households, only nine (six Kinh, two Thai, and one H'mong) had access to loans from local banks, and 12 households had loans from other sources, such as farmer associations or relatives. The four forms of support related to farm inputs, technical skill, financial capital, and the market had the same relative importance in the Kinh and Thai households, while H'mong households highlighted farm inputs and technical guidance.

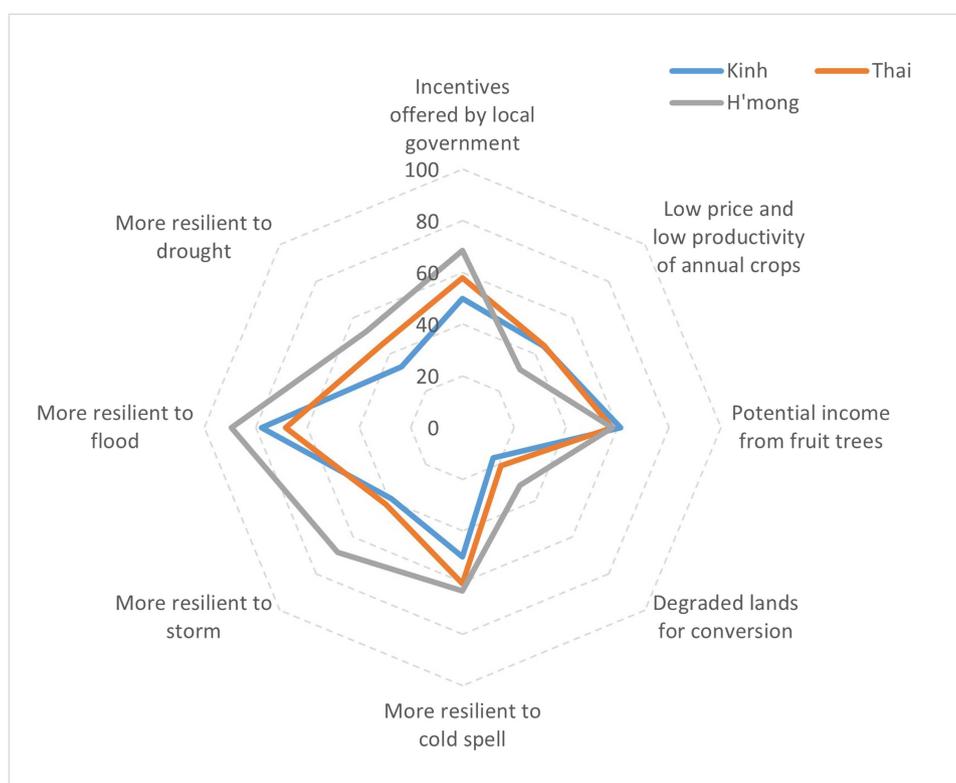


Figure 4. Factors motivating farmers in Northwest Vietnam to grow fruit trees. The axis indicates the percentage of interviewed households by ethnic group who mentioned the factors in interviews.

Table 4. Perceived challenges to growing fruit trees (percentage of households by ethnic group who mentioned the challenges. Percentages with different superscripts within each ethnic group differ significantly according to the Marascuilo Procedure).

	Unstable market	Limited financial capital	Labour shortage	Insufficient knowledge	Land scarcity	Climate threats	Other*
Kinh	50 ^a	50 ^a	6 ^{ab}	11 ^{ab}	17 ^{ab}	0 ^b	33
Thai	34 ^a	41 ^a	17 ^a	14 ^a	3 ^a	10 ^a	10
H'mong	42 ^a	21 ^a	16 ^a	5 ^a	5 ^a	11 ^a	32
All	41	38	14	11	8	8	23

* Other challenges were mentioned by fewer households, e.g. poor-quality seedlings, low soil fertility and difficulty transporting farm inputs or harvested fruit products.

Table 5. Perceived forms of support needed to grow fruit trees (percentage of households by ethnic group who mentioned the support. Percentages with different superscripts within each ethnic group differ significantly according to the Marascuilo Procedure).

	Farm inputs	Technical guidance	Financial assistance	Access to more stable market	Additional labour
Kinh	22 ^{ab}	33 ^{ab}	44 ^a	11 ^{ab}	0 ^b
Thai	45 ^{ab}	55 ^a	34 ^{ab}	7 ^{ab}	3 ^b
H'mong	68 ^a	42 ^{ab}	11 ^{bc}	5 ^{bc}	0 ^c
All	45	45	30	8	2

3.4 Market channels for selling fruit products

The interviewed households sold fresh fruit products either by self-transport to local markets or, more commonly, to traders at the farm gate (Figure 5). However, regardless of ethnic group and distance from the fruit tree cultivation plot to the main road (i.e. nearest was ten meters and farthest four kilometers),

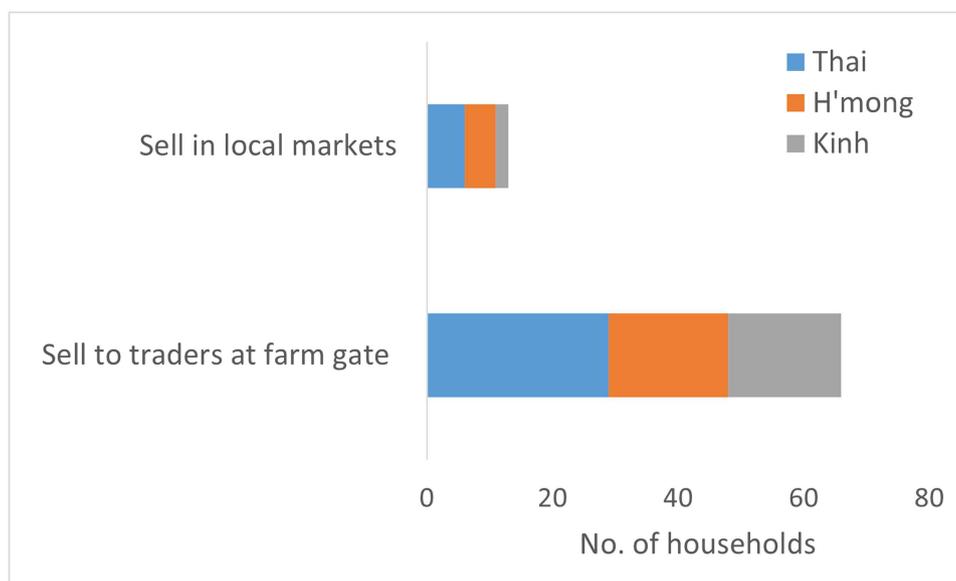


Figure 5. Main channels used by households for selling fruit products. A household could use both channels for fruits from the same or different tree species.

most households sold their products at the farm gate. Only 13 of the 67 interviewed households (~19%) self-transported their fruit products for sale in local markets. The households mentioned that the traders who bought fruit products at the farm gate came from the commune, district or province. About 56% of the households had no information about where the traders sold the fruits, while 40% mentioned other districts, provinces or urban cities such as Hanoi, and two of them mentioned exports to China. There were no product processing facilities in the eight selected communes and the households did not conduct any preliminary processing of harvested fruits. The household interviews also revealed that there was usually no written contract between farmers and traders but only an oral agreement.

3.5 Resilience to climate threats

All three ethnic groups experienced impacts of climate threats on their fruit tree cultivation plots, such as cold spells, storms, or droughts, at least once over the period from 2015 to 2020 (Figure 6). Among those impacted, 53% claimed that fruit trees (in monoculture or agroforestry plots) were more resilient to cold spells than annual crops. About 38% and 46% made a similar claim related to drought and storms, respectively. The five households affected by flash floods claimed that fruit trees were more resilient to that climate threat compared with annual crops. Nine households highlighted that fruit trees were more resilient to those climate threats because of their stronger physical characteristics than annual crops, wide canopies provided shade, and leaf litter helped maintain soil humidity during a prolonged dry season.

3.6 Awareness of product quality standard

Household interviews revealed that only 10 (~15%) of the 67 interviewed households (three Kinh, one Thai and six H'mong) had quality standard certifications for their fruit products. They obtained certification by complying with the Vietnam Good Agricultural Products (VietGAP) standard. The other households mentioned a lack of awareness of any product quality standard (25 households) or relatively small fruit tree cultivation area (10 households) as the main reasons for not applying for certification. Four households mentioned other reasons, e.g. no farm cooperative to help register for certification. The remaining households provided no answer regarding the reason for not applying for certification.

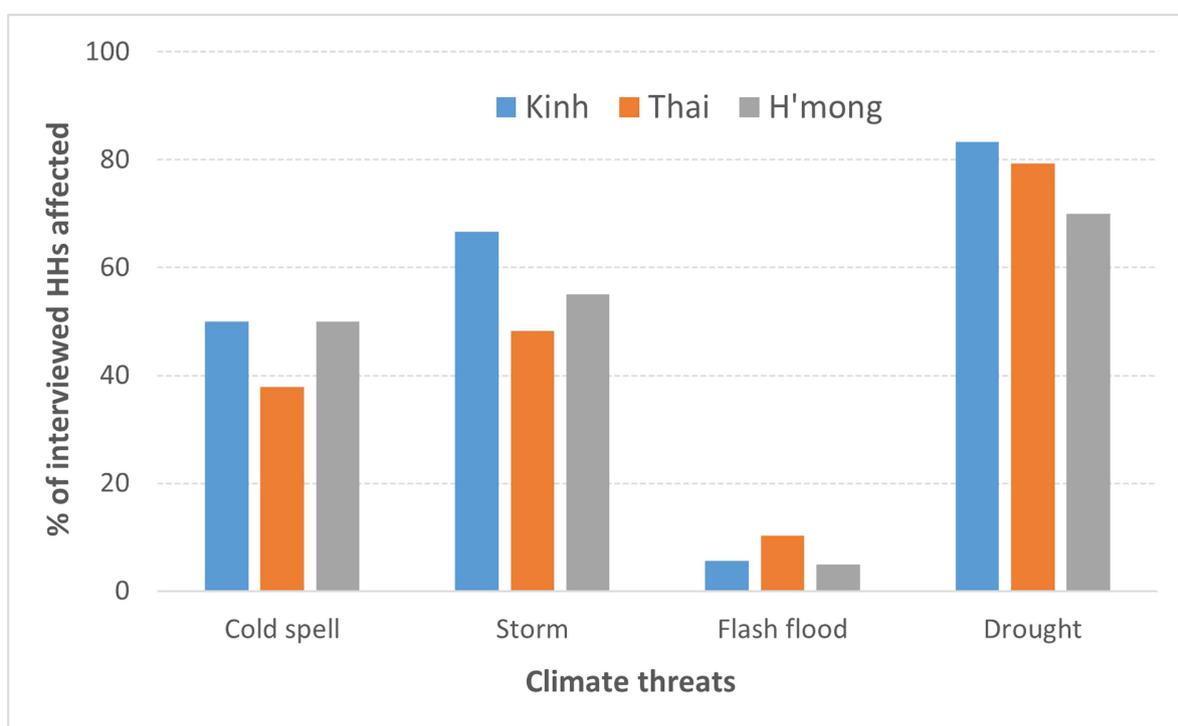


Figure 6. Households (HHs) affected by climate threats at least once over the period from 2015 to 2020.

Table 6. Main objectives, prioritised fruit tree species, and incentives offered by policies supporting expansion of fruit tree cultivation in Dien Bien, Yen Bai and Son La provinces in Northwest Vietnam based on the policy review.

	No. of policies		
	Dien Bien	Yen Bai	Son La
No. of policies reviewed	4	5	6
Main objectives of the policies			
• More fruit tree cultivation for higher production and livelihood improvement of local communities	3	2	4
• Restructuring of the agriculture sector, introduction of technologies for preservation and processing of fruit products	1	3	1
• Promoting the 'One Product One Commune' programme	-	-	1
Fruit tree species mentioned in the policies			
Citrus (e.g. orange, mandarin, pomelo)	3	5	6
<i>Son tra</i>	-	3	3
Longan	2	-	6
Others (e.g. mango, avocado)	-	-	4
No fruit tree species specified	1	-	-
Incentives offered*			
• Cash or in-kind (e.g. planting materials) for individual households or cooperatives to establish new fruit tree plots	-	4	2
• Financial assistance to cover the cost of buying agricultural inputs (e.g. seedlings, fertiliser)	1	1	-
• Other (e.g. assistance for product packaging)	-	1	2
• Not specified	3	-	3

* Some policies offered two different incentives, e.g. financial assistance and training on product packaging.

3.7 Policies supporting expansion of fruit tree cultivation

Most of the 15 policies reviewed were designed to support the expansion of fruit tree cultivation for the purpose of higher production, livelihood improvement in local communities or restructuring of the agriculture sector (Table 6). Policies supporting restructuring highlighted the need to develop local fruit processing industries. Citrus fruits (e.g. orange, mandarin, pomelo), longan and *son tra* were the main fruit tree species mentioned in the policies.

The policies offered two types of incentives (cash or in kind) to individual households or cooperatives (Table 6). For example, Policy Decision No. 27/2015/QD-UBND for Yen Bai province provided one-time financial assistance of up to VND 20 million (equivalent to USD 851 at an exchange rate of VND 23,500 per USD) per hectare for individual households interested in developing citrus cultivation and up to VND 6 million (USD 255) for individual households interested in developing *son tra* cultivation.

4. Discussion

4.1 Selection of fruit tree species and cultivation practice by ethnic group

Apart from potential income, the selection of fruit tree species by the three ethnic groups was likely affected by the altitude at which they live and by the species mentioned in support policies. For example, orange was popular among the interviewed Kinh households in Yen Bai and Son La provinces because it can grow at lower altitudes (Orwa et al., 2009) and because most of the policies introduced in these provinces provide financial assistance for individual households interested in growing citrus species. Thai and H'mong households cultivated plum because plum is suitable for growing at relatively high altitudes (Bonney et al., 2016). Although no policy explicitly mentioned plum as an option for fruit tree species, several policies (e.g. Decision No. 1006/2016/QD-BNN-TT for Son La province and Decision No. 610/2017/QD-UBND for Dien Bien province) provided support for any fruit tree species.

H'mong farmers in the three selected provinces also cultivated *son tra*, which can grow at high altitudes (Muchugi et al., 2021). Several policies (e.g. Decision No. 2412/2016/QD-UBND for Yen Bai province and Resolution No. 37/2017/NQ-HDND for Son La province) supported the expansion of *son tra* cultivation. Sociocultural factors might also have influenced selection of fruit tree species by different ethnic groups. For example, H'mong people are known to use *son tra* fruits for foods and are skilful in making wine from these fruits to generate income (VNN, 2016). They also believe that *son tra* fruits have medicinal benefits, such as reducing high blood pressure and cholesterol levels (Mamo, 2015). However, sociocultural factors were outside the scope of the present study.

The percentage of fruit tree agroforestry plots managed by Thai households was much higher than that managed by H'mong and Kinh households. A previous study investigating the adoption of agroforestry practices in general in Northwest Vietnam (Nguyen et al., 2021), which also involved the Kinh, Thai and H'mong ethnic groups, mentioned the possible effects of altitude and landholding size on the choice of cropping system. Compared with the high altitude at which most H'mong households reside, the moderate altitude (500–800 m) where most Thai households reside is likely more suitable for agroforestry, partly because of the more accessible market and seedling sources of different crop species (Nguyen et al., 2021). That study also found that the average landholding size of Kinh households was smaller (<1 ha per household) than that of Thai (1–3 ha) and H'mong (2–5 ha) households. This trend was confirmed in the present study, where the average landholding size of Kinh households was smaller (1.6 ± 0.2 ha per household) than that of the other two ethnic groups (2.9 ± 0.3 ha for Thai households, 2.9 ± 0.6 ha for H'mong households). Fruit tree agroforestry was not widely adopted by Kinh farmers, likely because they had relatively little land. H'mong farmers had much larger landholdings, but as mentioned earlier, they resided at high altitudes and in steep sloping areas, which are more challenging for more complex farming practices.

Some studies have demonstrated good potential of fruit tree-based agroforestry in generating a more stable income for farm households in Northwest Vietnam (e.g. Do et al., 2020). Fruit tree-based agroforestry combined with contour planting on steep and fragile sloping land, a typical biophysical characteristic of agricultural lands in Northwest Vietnam, could substantially reduce soil and nutrient losses through natural terrace formation (Do et al., 2023). Through a comprehensive literature review, Octavia et al. (2023) concluded that agroforestry practices, including those integrating fruit trees, have an important role in maintaining soil fertility and community livelihood, including in upland areas. In another study, Yousefi et al. (2024) highlighted that, compared with monoculture practices, cover cropping can help enhance ecosystem services such as soil biodiversity and nutrient cycling while reducing water runoff. Therefore, agroforestry and cover cropping could help address issues related to soil degradation and poverty in

Northwest Vietnam. Furthermore, agroforestry could potentially enhance the adaptation of smallholder farmers to climate change, for example, through different ecological services that agroforestry tree species could generate (Do & Bui, 2023; Nguyen et al., 2020).

Nguyen et al. (2020) reported that, among 25 different tree species found in selected coffee agroforestry systems in Northwest Vietnam, local farmers considered *Leucaena leucocephala*, longan, mango, plum, peach, and jackfruit as those providing more ecological services, including climate regulation, wind control, and frost control. Five fruit tree species (i.e. longan, mango, plum, peach, and jackfruit) were also found in the fruit tree cultivation plots managed by the farm households interviewed in the present study. Further studies are needed to investigate which fruit tree agroforestry systems managed by different ethnic groups are more resilient to climate threats. The present study was not designed to investigate factors motivating local farmers to select fruit tree agroforestry over fruit tree monoculture, including the possible influence of activities by ICRAF. ICRAF has promoted agroforestry practices in three of the eight communities selected for this study, namely, Quai Nua and Toa Tinh, in the Tuan Giao district of Dien Bien Province, and Hat Lot commune in the Mai Son district of Son La province.

4.2 Main constraints to growing fruit trees and accessing support from local policies

The challenges to growing fruit trees mentioned by Kinh, Thai, and H'mong households interviewed in this study have been raised previously by ethnic groups in other mountainous areas of Vietnam, although the context was tree planting in general (Do & Mulia, 2018; Mulia et al., 2016; Simelton et al., 2017). For example, Tay households in Bac Kan province of Northeast Vietnam identified a lack of technical know-how, unstable markets, limited financial capital, land scarcity and poor-quality seedlings (Do & Mulia, 2018). Kinh households in Northcentral Vietnam highlighted a lack of knowledge, financial limitations, unstable markets, a scarcity of quality seedlings and climate threats (Mulia et al., 2016). Relatively similar constraints on smallholder tree planting have been reported for other Asian countries (e.g. Mulia et al., 2022b; Nouman et al., 2008). For example, farm households in northern Cambodia mentioned financial limitations, a lack of knowledge, lack of quality seedlings, shortage of water for irrigation and land scarcity as their main challenges (Mulia et al., 2022b). However, the ethnic groups in those studies did not identify labour shortage as a constraint. In the present study, there were nine households who identified labour shortage as a challenge to growing fruit trees. They mentioned health issues or old age as the main reason.

All three ethnic groups interviewed in this study identified limited financial capital as one of the main constraints, indicating that the incentives offered by existing policies have motivated farmers to grow fruit trees, but apparently did not cover all the establishment or production costs. Some policies (e.g. Resolution No. 30a/2008/NQ-CP) provided free seedlings of several fruit tree species, such as mango, orange, or pomelo, but farmers still needed to cover the labour costs for land preparation and tree planting. These costs likely increase with altitude because of the more challenging biophysical conditions. In addition, the poverty level of farm households in Northwest Vietnam has been reported to increase with altitude (Nguyen et al., 2021).

Additionally, based on informal discussions with the leaders of the selected communes, further assistance is needed for farm households to better understand and apply for the incentives available. For example, to qualify for a one-time cash incentive, households or cooperatives need to produce a document showing their fruit tree planting plan, including a sketch of farm design, and submit this document for approval by local authorities. Farmers need more assistance in producing such documents, particularly those who live in remote areas, such as Thai and H'mong farmers, and those without affiliation with a cooperative. Farmers living in more remote areas usually have a higher illiteracy rate and speak a local language instead of Vietnamese (Dao, 2020). This might explain why, out of the 67 participating households, only 34% and 10% have received in-kind and cash incentives from the support policies, respectively. In addition, as mentioned earlier, only 10 of the 67 households (~15%) had access to loans from local banks. Other households, without support from local policies or loans from local banks, mentioned that they borrowed some money from their relatives. The fact that the interviewed households could not optimally draw benefits from the incentives offered by the support policies also calls for further studies investigating the effectiveness of policy implementation.

All three ethnic groups interviewed were motivated by the capacity of fruit tree cultivation to generate higher income than common annual crops. However, during the interviews, all also reported unstable market demand and prices for fruit products, likely because of their strong reliance on traders who bought fruit products at the farm gate. Only 34% of the interviewed households knew about the presence of local cooperatives, which could facilitate the selling of fruit products. Even fewer, only about 23% of the interviewed households, were members of a cooperative. Existing policies with restructuring of the agricultural sector as their main objective highlight the need to develop agro-enterprises to process and preserve agricultural products. Such enterprises might help farmers access more stable markets or diversify their income sources with nonfarm jobs (Nguyen & Nguyen, 2021). Another option to reduce the impact of market uncertainty is to encourage smallholder farmers to practice fruit tree-based agroforestry, which can diversify on-farm sources of income through different crop components combined with fruit trees (Catacutan et al., 2017). Since unstable markets substantially affect income that farmers could derive from growing fruit trees, further studies investigating factors affecting market instability are also needed.

The other main constraint mentioned by the interviewed households was a lack of technical know-how on growing fruit trees. As mentioned earlier, about 60% of the interviewed households obtained information about fruit tree cultivation and offered incentives from local authorities, including agricultural extension staff. However, the staff might not have provided species-specific guidance on how to grow fruit trees. Local extension staff need to use suitable communication channels for disseminating new knowledge, e.g. visual and audio training materials, which are usually more effective for ethnic groups with a relatively high illiteracy rate (Do & Mulia, 2018). In addition, extension staff should be able to communicate in the local language. Le et al. (2024) highlighted that digital extension services could be considered for smallholder farmers, including those in Vietnam, to better access reliable and up-to-date information. However, the authors also underscored that the effectiveness of such services will depend on assistance and/or subsidies from the public and private sector, access for women and youth, and capacity development for key stakeholders.

This study did not investigate gendered perspectives on motivating and constraining factors for farmers to grow fruit trees, although men and women might highlight different factors due to, e.g. agricultural task allocation within the family or their access to and control over family resources. However, previous studies about challenges for tree planting in general (Catacutan & Naz, 2015; Mulia et al., 2016) have found that Vietnamese men and women had relatively similar views. For example, men and women in a study in Northcentral Vietnam considered a lack of knowledge as the main constraint to tree planting, followed by limited financial capital, unstable markets and seedling scarcity (Mulia et al., 2016). In addition, the present study was not designed to generate, e.g. species-specific information regarding factors motivating farmers to grow fruit trees or investigate, e.g. the relationships between the demographic profiles of the interviewed households and the motivating factors, which also calls for further studies. As mentioned earlier, the current study only gathered brief demographic information of interviewed households (a summary is available as a supplementary material).

4.3 Challenges for farmers in meeting product quality standards

In 2018, the Vietnamese government launched VietGAP to promote a set of standards for 'safe' and sustainable agricultural production in the country. A lot of technical training on VietGAP have since been provided for local extension workers and smallholder farmers across Vietnam (ADB, 2023). However, many smallholder farmers still find it difficult to comply with all the requirements of VietGAP, which sets standards for soil management, water use and postharvest management, in addition to chemical (e.g. fertilizer, pesticide) inputs (ADB, 2023). The present study showed that many households in Northwest Vietnam are still unaware of VietGAP or any product quality standard, despite the implementation of several policies (e.g. Plan No. 2982/2018/KH-UBND for Dien Bien province) targeting safe agricultural production. This lack of awareness about product quality standards may also reflect a need to improve agricultural extension services in Vietnam, especially in relatively remote areas of the country. There is an increasing need for safe agricultural production in Asia, including Vietnam, following strong concerns about food safety (Babajani et al., 2023; Ngo et al., 2020; Thanh et al., 2019).

Market incentives (i.e. higher price or better access to markets) can stimulate farmers to apply for certification in terms of safe agricultural practices or product quality standards such as VietGAP (ADB, 2023). Studies in the Northeast China and Mekong River Delta regions of Vietnam have shown that agricultural products certified with VietGAP can better penetrate domestic and export markets (Ngo & Le, 2022; Tran & Goto, 2019). However, studies on smallholder farmers in the Central Highlands region of the country have reported the opposite, and those farmers stopped adhering to VietGAP (NNVN, 2016). Other stimulating factors include the presence of farmer cooperatives, which can help their members apply for support measures. In addition, the public and private sectors can collaborate to develop more manageable standards for smallholder farmers and set associated market incentives (ADB, 2023).

Meeting the VietGAP standards involves a registration and certification process that is considered unaffordable for many smallholder farmers in Vietnam (Hoang, 2018). In addition, the certificate is valid for only two years. There is also a need for reliable quality control after the initial external controls and issuance of certificates by the government (Hoang, 2018; Thai & Pensupar, 2015). In many cases, farmers' cooperatives conduct quality control by themselves without external authentication and with no sanction from the local government in cases of noncompliance.

5. Conclusions

Each of the three ethnic groups (Kinh, Thai, and H'mong) in the selected communes of Vietnam's Northwest region cultivated fruit trees in monoculture and agroforestry practices. Mango, plum, longan, H'mong apple, and orange are the most common fruit tree species in monoculture or agroforestry plots. The potential economic return, incentives offered by the local government, and expectation that fruit tree cultivation practices could be more resilient to climate threats than conventional farming practices with annual crops motivated the interviewed households from the different ethnic groups to grow fruit trees. However, the households also reported that the market for their fruit products has been unstable and that most of them sold their fruit products at the farm gate. In addition, only a few of them have received incentives from the local government (34% and 10% of the households for in-kind and cash incentives, respectively). Other challenges for the interviewed households to grow fruit trees included labour shortages, insufficient knowledge of appropriate fruit tree planting techniques, land scarcity, and climate threats. The households identified subsidies for farm inputs and financial assistance, including better access to loans from local banks, technical guidance, and access to more stable markets, as the forms of supports needed to grow more fruit trees. The local governments in the three provinces studied (Yen Bai, Son La and Dien Bien) have introduced multiple policies to support the expansion of fruit tree cultivation in these provinces. However, farmers need more assistance to better understand and avail of the incentives offered by the policies. Furthermore, policies targeting 'safe' agricultural production have been issued by the local government in the study areas, but farmers lacked awareness and capacity to meet product quality standards such as VietGAP. All these findings clearly call for further studies investigating, e.g. factors affecting market instability and the effectiveness of the implementation of current policies. On the other hand, local governments need to, e.g. provide further assistance for farm households to better understand and apply for the offered incentives, improve extension services to increase farmers' technical know-how on growing fruit trees including those living in relatively remote areas, provide more guidance for farmers to comply with product quality standards such as VietGAP, and accelerate the development of agro-enterprises for processed agricultural products, which could help farmers access more stable markets. The findings from this study can have wider applications in other mountainous areas of Vietnam or in other countries, e.g. Southeast Asia, which have similar biophysical and socioeconomic characteristics.

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The authors report that there are no competing interests to declare.

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Data availability statement

Data available on request from the authors.

References

- ADB. (2002). Indigenous people/ethnic minorities and poverty reduction in Cambodia. Manila, the Philippines, (p. 53). <https://www.adb.org/sites/default/files/publication/28021/indigenous-peoples-cambodia.pdf>
- ADB. (2012). Greater Mekong sub-region: Atlas of the environment (2nd edition), *Manila, the Philippines* (p. 310). <https://www.adb.org/sites/default/files/publication/30074/gms-atlas-environment-2nd-edition.pdf>
- ADB. (2023). Imperatives for improvement of food safety in fruit and vegetable value chains in Vietnam. *Manila, the Philippines*, 56, <https://doi.org/10.22617/TCS230009-2>
- Babajani, A., Muehlberger, S., Feuerbacher, A., & Wieck, C. (2023). Drivers and challenges of large-scale conversion policies to organic and agro-chemical free agriculture in South Asia. *International Journal of Agricultural Sustainability*, 21(1), 24. <https://doi.org/10.1080/14735903.2023.2262372>
- Bilder, C. R., & Loughin, T. M. (2004). Testing for marginal independence between two categorical variables with multiple responses. *Biometrics*, 60(1), 241–248. <https://doi.org/10.1111/j.0006-341X.2004.00147.x>
- Bonney, L. B., Nicetic, O., Collins, R., Le, A. Q., Thi, H. D., Thanh, T. H., The, A. D., Nguyen, T. T. H., & Van, H. P. (2016). Tam Hoa plums (*Prunus Salicina*) in the maize-based system in the North-West highlands of Vietnam. *Acta Horticulturae*, 1128, 103–109. <https://doi.org/10.17660/ActaHortic.2016.1128.14>
- Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: complex or simple? Research case examples. *Journal of Research in Nursing*, 25(8), 652–661. <https://doi.org/10.1177/1744987120927206>
- Catacutan, D. C., & Naz, F. (2015). Gender roles, decision-making and challenges to agroforestry adoption in Northwest Vietnam. *International Forestry Review*, 17, 22–32. <https://doi.org/10.1505/146554815816086381>
- Catacutan, D. C., van Noordwijk, M., Nguyen, H. T., Öborn, I., & Mercado, A. R. (2017). Agroforestry: Contribution to food security and climate-change adaptation and mitigation in Southeast Asia. World Agroforestry Centre Southeast Asia Regional Program and ASEAN-Swiss Partnership on Social Forestry and Climate Change, *Jakarta, Indonesia*, 30, 30. <https://doi.org/10.5716/cifor-icraf/BK.25114>
- Dao, T. (2020). Assuring learning rights of ethnic minority people in Vietnam - Situation and solutions. Accessed 26 February 2024. https://www.tapchiconsan.org.vn/web/english/culture-society/-/asset_publisher/nl7yCFQ01T3T/content/assuring-learning-rights-of-ethnic-minority-people-in-vietnam-situation-and-solutions
- Decady, Y. J., & Thomas, D. R. (2000). A simple test of association for contingency tables with multiple column responses. *Biometrics*, 56(3), 893–896. <https://doi.org/10.1111/j.0006-341X.2000.00893.x>
- Do, V. H., La, N., Bergkvist, G., Dahlin, A. S., Mulia, R., Nguyen, V. T., & Öborn, I. (2023). Agroforestry with contour planting of grass contributes to terrace formation and conservation of soil and nutrients on sloping land. *Agriculture, Ecosystems & Environment*, 345, 108323. <https://doi.org/10.1016/j.agee.2022.108323>
- Do, V. H., La, N., Mulia, R., Bergkvist, G., Dahlin, A. S., Nguyen, V. T., Pham, H. T., & Öborn, I. (2020). Fruit tree-based agroforestry systems for smallholder farmers in Northwest Vietnam—A quantitative and qualitative assessment. *Land*, 9, 451. <https://doi.org/10.3390/land9110451>
- Do, T. H., & Mulia, R. (2018). Constraints to smallholder tree planting in the northern mountainous region of Vietnam: A need to extend technical knowledge and skills. *International Forestry Review*, 20, 43–52. <https://doi.org/10.1505/146554818822824246>

- Do, T. T. H., & Bui, M. H. (2023). Potential of agroforestry for climate change adaptation in the Northwest mountainous region of Vietnam. *APN Science Bulletin*, 13(1), 50–59. <https://doi.org/10.30852/sb.2023.2147>
- Ecker, F., Francis, J., Olsson, P., & Schipper, K. (2021). Non-random sampling and association tests on realized returns and risk proxies. *Review of Accounting Studies*, 26, 772–814. <https://doi.org/10.1007/s11142-021-09581-0>
- Fox, J., Castella, J. C., Ziegler, A. D., & Westley, S. (2014). Expansion of rubber mono-cropping and its implications for the resilience of ecosystems in the face of climate change in Montane Mainland Southeast Asia. *Global Environmental Research*, 18, 145–150.
- Gassner, A., & Dobie, P. (2022). *Agroforestry: A primer. Design and management principles for people and the environment* (p. 181). CIFOR and ICRAF. <https://doi.org/10.5716/cifor-icraf/BK.25114>
- GEF. (2019). *Climate smart agriculture alternatives for upland production systems in Lao PDR* (p. 208). Global Environment Facility. <https://www.thegef.org/projects-operations/projects/10187>
- GOV (Government of Vietnam). (2017). *The national action plan for the implementation of the 2030 Sustainable Development Agenda* (p. 78). United Nations in Vietnam. <https://vietnam.un.org/en/4123-national-action-plan-implementation-2030-sustainable-development-agenda>
- GOV (Government of Vietnam). (2022). *Nationally Determined Contribution (updated in 2022)* (p. 43). Government of Vietnam. https://unfccc.int/sites/default/files/NDC/2022-11/Viet%20Nam_NDC_2022_Eng.pdf
- GSO (General Statistic Office of Vietnam). (2018). *Statistical yearbook of Vietnam 2018*. General Statistic Office of Vietnam. <https://www.gso.gov.vn/en/data-and-statistics/2019/10/statistical-yearbook-of-vietnam-2018/>
- Hayes, A. (2024). What is the Bonferroni test (correction) and how is it used? Accessed 13 May 2024. <https://www.investopedia.com/terms/b/bonferroni-test.asp>
- Ho, N. N., Lai, P. T., Truong, T. C. A., Hoang, V. H., Do, T. T., & Nguyen, T. (2024). The contribution of livelihood diversification activities to poverty reduction of ethnic minority households: A case study in Son La Province, Vietnam. *Journal of Infrastructure, Policy and Development*, 8(6), 6465. <https://doi.org/10.24294/jipd.v8i6.6465>
- Hoang, G. H. (2018). Farmers' responses to VietGAP: A case study of a policy mechanism for transforming the traditional agri-food system in Vietnam, *Dissertation* (p. 289). Massey University, Palmerston North. <https://mro.massey.ac.nz/server/api/core/bitstreams/6ffbcf60-47e0-4737-95d0-3824193fd7b7/content>
- Hoang, L. T., Roshetko, J. M., Huu, T. P., Pagella, T., & Nguyen, M. P. (2017). Agroforestry - The most resilient farming system for the hilly Northwest of Vietnam. *International Journal of Agricultural Systems*, 5, 1–23. <https://doi.org/10.20956/ijas.v5i1.1166>
- Khanh, K. (2023). Hanoi develops high-value fruit plantations. Accessed 14 December 2024. <https://hanoitimes.vn/hanoi-develops-high-value-fruit-plantations-323206.html>
- Le, T. H. S., Chou, P., Dacuyan, F. B., Nyberg, Y., & Wetterlind, J. (2024). Barriers and enablers of digital extension services' adoption among smallholder farmers: The case of Cambodia, the Philippines and Vietnam. *International Journal of Agricultural Sustainability*, 22(1), 19. <https://doi.org/10.1080/14735903.2024.2368351>
- Mahieu, B., Schlich, P., Visalli, M., & Cardot, H. (2021). A multiple-response chi-square framework for the analysis of free-comment and check-all-that-apply data. *Food Quality and Preference*, 93, 104256. <https://doi.org/10.1016/j.foodqual.2021.104256>
- Mamo, A. E. (2015). The golden apple that offers new livelihoods options to Vietnamese smallholders. Accessed 14 July 2023. <https://humidtropics.cgiar.org/the-golden-apple-that-offers-new-livelihood-options-to-vietnamese-smallholders/>
- McClenaghan, E. (2023). Kruskal–Wallis test. Accessed 23 March 2024. <https://www.technologynetworks.com/informatics/articles/the-kruskal-wallis-test-370025>
- Montgomery, S. C., Martin, R. J., Guppy, C., Wright, G. C., & Tighe, M. K. (2017). Farmer knowledge and perception of production constraints in Northwest Cambodia. *Journal of Rural Studies*, 56, 12–20. <https://doi.org/10.1016/j.jrurstud.2017.09.003>
- Muchugi, A., Pham, H. T., Alercia, A., Hai, P. H., Hendre, P., Jamnadass, R., Cerutti, A. L., de Martiis, S. C., & Lopez, F. (2021). Key descriptors for *Docynia Indica* (Wall.) Decne. *World Agroforestry, Nairobi and the Food and Agriculture Organization Nairobi, Rome*, 20. <https://openknowledge.fao.org/server/api/core/bitstreams/e40d31fe-9ffc-4e93-9a00-0c6db03d6785/content>
- Mulia, R., Catacutan, D. C., Do, T. H., Dam, V. B., & La, N. (2016). *What prevents tree planting in Vietnam?* (p. 4). World Agroforestry (ICRAF). <https://apps.worldagroforestry.org/downloads/Publications/PDFS/PB16121.pdf>
- Mulia, R., Khou, E. H., Chheang, P., Nguyen, Q. T., Perdana, A., & Pham, T. V. (2022b). Agroforestry practices in Sra-Aem Commune, Northern Cambodia: Selected practices from four villages within the commune, *Project Report*. (p. 27). World Agroforestry (ICRAF).
- Mulia, R., Le, T. T., Tran, N. D., & Simelton, E. (2022a). Policy support for home gardens in Vietnam can link to sustainable development goals. *Agriculture*, 12, 253. <https://doi.org/10.3390/agriculture12020253>
- Mulia, R., Nguyen, D. D., Nguyen, M. P., Steward, P., Pham, V. T., Le, H. A., Rosenstock, T., & Simelton, E. (2020). Enhancing Vietnam's nationally determined contribution with mitigation targets for agroforestry: A technical and economic estimate. *Land*, 9, 528. <https://doi.org/10.3390/land9120528>
- Mulia, R., & Nguyen, M. P. (2021). *Diversity of agroforestry practices in Vietnam* (p. 129). World Agroforestry (ICRAF) Vietnam. <https://www.worldagroforestry.org/blog/2021/03/22/new-book-diversity-agroforestry-practices-viet-nam>
- Ngo, H. M., Liu, R., Moritaka, M., & Fukuda, S. (2020). Urban consumer trust in safe vegetables in Vietnam: The role of brand trust and the impact of consumer worry about vegetable safety. *Food Control*, 108, 106856. <https://doi.org/10.1016/j.foodcont.2019.106856>

- Ngo, T. T. T., & Le, V. T. (2022). Impacts of adopting specialized agricultural programs relying on “good practice” – Empirical evidence from fruit growers in Vietnam. *Open Agriculture*, 7, 39–49. <https://doi.org/10.1515/opag-2022-0069>
- Nguyen, T. H., & Nguyen, D. L. (2021). Sustainable development of agricultural product processing industry in Vietnam. *E3S Web of Conferences*, 258, 04003. <https://doi.org/10.1051/e3sconf/202125804003>
- Nguyen, M. P., Catacutan, D. C., Do, T. H., & Mulia, R. (2018). Drivers of forest changes: Mapping actors and motivations in Bac Kan province, Northeast Viet Nam. In Mulia, R., & Simelton, E. (Eds.), *Towards low-emissions landscapes in Viet Nam. World Agroforestry (ICRAF) Viet Nam* (pp. 23–43). World Agroforestry (ICRAF) Southeast Asia Regional Program. https://www.researchgate.net/publication/335602920_Drivers_of_forest_changes_mapping_actors_and_motivations_in_Bac_Kan_province_Northeast_Viet_Nam
- Nguyen, M. P., Pagella, T., Catacutan, D. C., Nguyen, T. Q., & Sinclair, F. (2021). Adoption of agroforestry in Northwest Viet Nam: What roles do social and cultural norms play? *Forests*, 12, 493. <https://doi.org/10.3390/f12040493>
- Nguyen, M. P., Vaast, P., Pagella, T., & Sinclair, F. (2020). Local knowledge about ecosystem services provided by trees in coffee agroforestry practices in Northwest Vietnam. *Land*, 9, 486. <https://doi.org/10.3390/land9120486>
- NNVN (Nong Nghiep Viet Nam). (2016). VietGAP vegetables: waiting for market (article in Vietnamese). Accessed 3 March 2024. <https://nongnghiep.vn/rau-vietgap-ngap-ruoi-d128901.html>
- Nouman, W., Khan, G. S., Siddiqui, M. T., & Riaz, A. (2008). Farmer's attitude towards agroforestry in district Faisalabad. *Pakistan Journal of Agricultural Sciences*, 45, 60–64.
- Octavia, D., Murniati, Suharti, S., Hani, A., Mindawati, N., Suratman, Swestiani, D., Junaedi, A., Undaharta, N. K. E., Santosa, P. B., Wahyuningtyas, R. S., & Faubiany, V. (2023). Smart agroforestry for sustaining soil fertility and community livelihood. *Forest Science and Technology*, 19(4), 315–328. <https://doi.org/10.1080/21580103.2023.2269970>
- OECD. (2021). Women and SDG 2 – Promoting sustainable agriculture, *Gender and the environment: Building evidence and policies to achieve the SDGs* (p. 319). OECD. <https://doi.org/10.1787/35ec6754-en>
- Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., & Anthony, S. (2009). Citrus Sinensis. Accessed 28 March 2024. https://apps.worldagroforestry.org/treedb/AFTPDFS/Citrus_sinensis.PDF
- Pham, Q. H. (2010). Carbon in Vietnamese soils and experiences to improve carbon stock in soil. In Z. S. Chen, & F. Agus (Eds.), *Proceedings of the international workshop on evaluation and sustainable management of soil carbon sequestration in Asian countries* (pp. 175–186). Institute for Agricultural Environment. <https://www.naro.affrc.go.jp/archive/niaes/marco/bogor2010/proceedings/13.pdf>
- Phung, D. T., Nguyen, V. C., Nguyen, C. T., Nguyen, T. N., & Ta, T. K. V. (2016). *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* (p. 220). UNDP. <https://www.UNDP.org/sites/g/files/zskgke326/files/migration/vn/Final-report-on-the-Overview-of-socio-economic-status-of-53-ethnic-minorities-E.pdf>
- Simelton, E. S., Catacutan, D. C., Dao, T. C., Dam, B. V., & Le, T. D. (2017). Factors constraining and enabling agroforestry adoption in Viet Nam: A multi-level policy analysis. *Agroforestry Systems*, 91, 51–67. <https://doi.org/10.1007/s10457-016-9906-2>
- Statista. (2022). Poverty rate in Vietnam in 2022 by region. Accessed 27 March 2024. <https://www.statista.com/statistics/1240092/vietnam-poverty-rate-by-region/>
- Thanh, M. H., Shakur, S., & Do, K. H. P. (2019). Consumer concern about food safety in Hanoi. *Vietnam Food Control*, 98, 238–244. <https://doi.org/10.1016/j.foodcont.2018.11.031>
- Thái, T. N., & Pensupar, K. (2015). Factors affecting consumers' decision to purchase Vietgap vegetables in Hanoi, Vietnam. *Full Paper Proceeding BESSH-2015*, 24(3), 54–64 <https://academicfora.com/wp-content/uploads/2016/01/BCS-1215-147.pdf>
- Tran, D., & Goto, D. (2019). Impacts of sustainability certification on farm income: Evidence from small-scale specialty green tea farmers in Vietnam. *Food Policy*, 83, 70–82. <https://doi.org/10.1016/j.foodpol.2018.11.006>
- Tran, T. Q. (2015). Nonfarm employment and household income among ethnic minorities in Vietnam. *Economic Research-Ekonomska Istraživanja*, 28(1), 703–716. <https://doi.org/10.1080/1331677X.2015.1087872>
- Turney, S. (2020). Chi-Square (X²) tests: types, formula & examples. Accessed 8 June 2024. <https://www.scribbr.com/statistics/chi-square-tests/>
- UN. (2018). Indigenous peoples and ethnic minorities: Marginalization is the norm, *The report on the world social situation 2018* (pp. 97–108). United Nations. <https://doi.org/10.18356/14642ccc-en>
- van Noordwijk, M., Ekadinata, A., Leimona, B., Catacutan, D., Martini, E., Tata, H. L., Öborn, I., Hairiah, K., Wangpakapattanawong, P., Mulia, R., Dewi, S., Rahayu, S., & Zulkarnain, T. (2020). Agroforestry options for degraded landscapes in Southeast Asia. In J. C. Dagar, S. R. Gupta, & D. Teketay (Eds.), *Agroforestry for degraded landscapes* (pp. 307–347). Springer. https://doi.org/10.1007/978-981-15-4136-0_11
- VNN (Vietnam News). (2016). H'mông apple helps minority escape poverty. Accessed 14 July 2023. <https://vietnamnews.vn/society/344996/h-mong-apple-helps-minority-escape-poverty.html>
- WACC (World Association for Christian Communication). (2023). What do the SDGs mean for the world's indigenous peoples? what-do-the-sdgs-mean-for-the-worlds-indigenous-peoples/. Accessed 5 February 2024.
- Wagh, S. T., & Razvi, N. A. (2016). Marascuilo method of multiple comparisons (an analytical study of Caesarean section delivery). *International Journal of Medical Research*, 3(4), 1137–1140.

- Wataru, Y., Vu, V. T., Pham, V. H., Vu, D. T., & Daisuke, Y. (2020). *On farm demonstration of agroforestry model: Fruit and forage contour cultivation on slope in Muong Gion Commune, Quynh Nhai district, Son La Province, Vietnam* (p. 19). Japan International Cooperation Agency. https://www.jica.go.jp/Resource/project/vietnam/037/materials/ku57pq00002hisx7-att/agroforestry_en.pdf
- Yousefi, M., Dray, A., & Ghazoul, J. (2024). Assessing the effectiveness of cover crops on ecosystem services: a review of the benefits, challenges, and trade-offs. *International Journal of Agricultural Sustainability*, 22(1), 15. <https://doi.org/10.1080/14735903.2024.2335106>
- Zimmer, H. C., Le, H. T., Lo, D., Baynes, J., & Nichols, J. D. (2018). Why do farmers still grow corn on steep slopes in Northwest Vietnam? *Agroforestry Systems*, 92, 1721–1735. <https://doi.org/10.1007/s10457-017-0121-6>

Appendix

Reviewed policies ($n = 15$) supporting fruit tree cultivation in Yen Bai, Son La, and Dien Bien Provinces of Northwest Vietnam enacted over the past decade (2010–2020).

Policy*	Policy title	Supported fruit tree species**	Support provided to farm households	Link to check policy content
Yen Bai province				
1. Decision No. 27/2015/QD-UBND	Policies supporting the development of agricultural, forestry and aquaculture production combined with restructuring of the agriculture sector in the period 2016–2020	Citrus tree species, <i>son tra</i>	<ul style="list-style-type: none"> One-time financial support (20 million VND/ha) for individual farmers to establish new farms of citrus trees (0.5 ha area and above) One-time financial support (10 million VND/ha, maximum 100 million VND/group) for groups of farmers to establish new farms of citrus trees (3 ha area and above) Financial support (6 million VND/ha) for individuals and groups of farmers in Tram Tau and Mu Cang Chai district to establish new farms of <i>son tra</i> One-time subsidy on fruit tree seedlings, fertiliser for farmers who plant fruit trees on 0.2 ha area and above (20 million VND/ha) (for isolated/difficulty communes only) 	https://thuvienphapluat.vn/van-ban/Tai-chinh-nha-nuoc/Quy-et-dinh-27-2015-QD-UBND-ho-tro-san-xuat-nong-lam-nghiep-thuy-san-tai-co-cau-nong-nghiep-Yen-Bai-299609.aspx
2. Decision No. 115/2016/QD-UBND	Project on development of fruit trees in Yen Bai province, period 2016–2020	Citrus tree species	<ul style="list-style-type: none"> One-time financial support (20 million VND/ha) for individual farmers to establish new farms of citrus trees (0.5 ha area and above) in four districts: Tran Yen, Yen Binh, Luc Yen, Van Chan One-time financial support (10 million VND/ha, max. 100 million VND/group) for groups of farmers to establish new farms of citrus trees (3 ha area and above) in four districts: Tran Yen, Yen Binh, Luc Yen, Van Chan 	https://yenbai.gov.vn/nongthonmoi/noidung/vanban/Pages/van-ban-dieu-hanh.aspx?ItemID=91
3. Decision No. 2412/2016/QD-UBND	Project on development of <i>son tra</i> in Tram Tau and Mu Cang Chai districts 2016–2020	<i>Son tra</i>	Financial support for individuals, groups of farmers and communities to plant new <i>son tra</i> trees on forest land and protect forest (<i>son tra</i> fruits will belong to farmer)	http://www.yenbai.gov.vn/noidung/vanban/Pages/van-ban-phap-quy.aspx?ItemID=2447
4. Decision No. 101/2018/QD-UBND	Approval of funding for implementation of the policy to support the development of agricultural, forestry and fishery production associated with restructuring of the agriculture sector in Yen Bai province in 2018	Citrus tree species, <i>son tra</i>	<ul style="list-style-type: none"> One-time financial support (20 million VND/ha) for individual farmers to establish new farms of citrus trees (≥ 0.5 ha area) One-time financial support (10 million VND/ha, maximum 100 million VND/group) for groups of farmers to establish new farms of citrus trees (≥ 3 ha area) Financial support (6 million VND/ha) for individuals and groups of farmers in Tram Tau and Mu Cang Chai district to establish new farms of <i>son tra</i> trees. One-time subsidy on fruit tree seedlings, fertiliser for farmers who plant fruit trees on 0.2 ha area and above (20 million VND/ha) (for isolated/difficulty commune only) 	https://thanhphoyenbai.yenbai.gov.vn/thong-bao/?Userkey=Quy-et-dinh101-QD-UBND-Quy-et-dinh-ve-viec-phe-duyet-kinh-phi-thuc-hien-chinh-sach-ho-tro-&PageIndex=14

Policy*	Policy title	Supported fruit tree species**	Support provided to farm households	Link to check policy content
Yen Bai province				
5. Resolution No. 11/2018/NQ-HDND	Restructuring the agriculture sector in association with building new rural areas in Yen Bai Province until 2020	Citrus, <i>son tra</i>	<ul style="list-style-type: none"> Support to develop key commodity products by region. Support for development of a sustainable market value chain 	https://thuvienphapuat.vn/van-ban/Linh-vuc-khac/Nghi-quyet-11-NQ-HDND-2018-chu-yeu-co-cau-lai-nganh-nong-nghiep-xay-dung-nong-thon-moi-Yen-Bai-404822.aspx
Son La Province				
1. Resolution No. 17/2016/NQ-HDND	Supporting the development of fruit tree and medicinal plant cooperatives in the province for the period 2017–2021.	Citrus, mango, longan, avocado	<ul style="list-style-type: none"> Support up to VND 100 million per cooperative or small-scale enterprise for packaging and creating product logo. Support (maximum 30 million per cooperative) for technical support (also available for individual members of the cooperative). 	https://thuvienphapuat.vn/van-ban/Doanh-nghiep/Nghi-quyet-17-2016-NQ-HDND-chinh-sach-ho-tro-phan-trien-hop-tac-xa-trong-cay-an-qua-cay-duoc-lieu-Son-La-336926.aspx
2. Decision No. 1006/2016/QD-BNN-TT	Plan for implementation of agriculture sector' restructuring for 2014–2015 and 2016–2020	Citrus, longan, mango, other fruit tree	Not specified	https://thuvienphapuat.vn/van-ban/Linh-vuc-khac/Quy-dinh-1006-QD-BNN-TT-2014-tai-co-cau-linh-vuc-trong-trot-2014-2015-va-2016-2020-262625.aspx
3. Resolution No. 28/2017/NQ-HDND	Regulations on support for renovating mixed gardens and planting fruit trees in the province	Citrus, mango, longan, avocado, persimmon	One-time support (200,000 VND/ household) for individual households participating in grafting and renovating fruit orchards	https://vbpl.vn/sonla/Pages/vbpq-toanvan.aspx?itemID=121732
4. Resolution No. 37/2017/NQ-HDND	Approval for fruit tree development project in the province until 2020	Citrus, <i>son tra</i> , longan, other fruit tree species	<ul style="list-style-type: none"> Technical guidance for grafting fruit trees and planting new fruit trees. Support for infrastructure development in concentrated fruit tree-growing areas. 	https://hethongphapluat.com/nghi-quyet-37-nq-hdnd-nam-2017-thong-qua-de-an-phat-trien-cay-an-qua-tren-dia-ban-tinh-son-la-den-nam-2020.html
5. Resolution 80/2018/NQ-HDND	Approval for fruit tree development project in the province until 2020	Citrus, <i>son tra</i> , longan, other fruit tree species	Not specified	https://thuvienphapluat.vn/van-ban/Linh-vuc-khac/Nghi-quyet-80-NQ-HDND-2018-thong-qua-De-an-Phat-trien-cay-an-qua-Son-La-den-2020-387422.aspx
6. Decision No. 1288/2019/QD-UBND	Approval for the project 'One Product One Commune' for the period 2018–2020, with a vision to 2030, in Son La province	Citrus, <i>son tra</i> , longan, other fruit tree species	Not specified	https://thuvienphapluat.vn/van-ban/Thuong-mai/Quy-dinh-1288-QD-UBND-2019-De-an-Moi-xa-mot-san-pham-Son-La-2018-2020-469914.aspx
Dien Bien province				
1. Decision 02/2014/QD-UBND	Support for agriculture, forestry and fishery production in Dien Bien Province	Any fruit tree species	<ul style="list-style-type: none"> Covering 50% of total cost for buying seedlings of fruit trees. Covering 50% of total cost for buying grafted fruit trees. 	https://thuvienphapluat.vn/van-ban/Linh-vuc-khac/Quy-dinh-02-2014-QD-UBND-chinh-sach-ho-tro-san-xuat-nong-lam-nghiep-va-thuy-san-tinh-Dien-Bien-261888.aspx

Dien Bien province

2.	Resolution No. 29/2016/NQ-HDND	Support for improvement of agricultural and forestry production up to 2020, vision to 2025	Macadamia, citrus (orange, mandarin, persimmon), coffee, pineapple, banana	• Not specified	https://thuvienphapluat.vn/van-ban/Tai-nguyen-Moi-truong/Nghi-quyet-29-NQ-HDND-De-an-phat-trien-san-xuat-nong-lam-nghiep-Dien-Bien-2020-2025-2016-330984.aspx
3.	Decision No. 610/2017/QD-UBND	Approval of the plan for improving upland rice, perennial industrial crops and high-value fruit tree species in the period of 2017–2020	Longan, citrus, perennial industrial crops	Not specified	https://lawnet.vn/vb/Quy-dinh-610-QD-UBND-2017-Ke-hoach-chuyen-doi-co-cau-cay-trong-Dien-Bien-2017-2020-57203.html
4.	Plan No. 2982/2018/KH-UBND	Restructuring of the agriculture sector in Dien Bien province until 2020	Grated longan, citrus tree species	Not specified	https://thuvienphapluat.vn/van-ban/Linh-vuc-khac/Ke-hoach-2982-KH-UBND-2018-co-cau-lai-nganh-nong-nghiep-Dien-Bien-2020-402219.aspx

*Sorted by promulgation year, **Fruit tree species explicitly mentioned in the policies.