# Characteristics of Home Garden and Its Improvement through Vanilla Introduction in Central Vietnam

**Vu Tuan Minh**

# Characteristics of home garden and its improvement through Vanilla introduction in Central Vietnam

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**Vu Tuan Minh**

**Laboratory of Terrestrial Ecosystems Management**

**Graduate School of Global Environmental Studies**

**Kyoto University**

**Japan**

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Vu Tuan Minh

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## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ANOVA | Analysis of variance |
| ALWSO | A Luoi's Weather Station Office |
| BSBAL | Branch of the Statistic Board of A Luoi district |
| CARD | Centre for Agricultural-Forestry Research and Development |
| GDP | Gross Domestic Product |
| GPS | Global Positioning System |
| GSO | General Statistics Office of Vietnam |
| FAO | Food and Agriculture Organization |
| HHCPC | Hong Ha Commune People's Committee |
| HTWSO | Huong Tra's Weather Station Office |
| JICA | Japan International Cooperation Agency |
| NCCCA | North Central and Central Coast Area |
| SD | Standard Deviation |
| SPSS | Statistical Package for the Social Sciences |
| TTHPPC | Thua Thien Hue Provincial People's Committee |
| TTHSO | Thua Thien Hue Statistical Office |
| USD | United States Dollar |
| VASS | Vietnamese Academy of Social Sciences |
| VND | Vietnamese Dong |

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# EXECUTIVE SUMMARY

Vietnam is an agriculture-based country, agriculture and rural areas has developed in the context of the positive impact of the abundance of labor force of rural areas and fluvial deltas and that is very fundamental advantages. There are about over 70% of the 90 million people living in the rural area and is involved directly or indirectly in agriculture. Agriculture constitutes over 20% of the GDP of the country. Since 2011, in the whole country, there are 9,071 communes with 80,904 villages and hamlets. Rural areas have 15.3 million households with approximately 32 million people in working age, increased 11.4% of household numbers and 4.5% of the workforce compared to the 2006. Agriculture is essential to sustainable and equitable development in Vietnam.

In central Vietnam, crop production provides more than 67% of agricultural annual income, of which perennial production gives over 7.0%, vegetable production gives about 16.7% and food crop production (rice, cassava, corn, sweet potato) gives 76.3%. However, many of poor rural areas in this region earn their living on small farm, where basic grain production is a central component of their livelihood. Field site became smaller caused by population developed; especially on upland sides with scatter and narrow cultivated land is a persistent problem one that led to impoverishment and stagnation of agriculture productivity. These are lead to designing and implementing actions in rural community assistance for livelihood improvement of local people, it is necessary to have a site-specific identification on natural conditions, social conditions and agro-economic conditions on cropping system characteristics. Setting Hong Ha commune located in mountainous area as our study area, we focused on the following three objectives; 1) to characterize the situation of home garden practice with various crop usage and their contribution to house hold income, 2) to investigate vanilla growth, productions and processing performance by farmers 3) to identify/assess product quality (vanilla cured pod).

Findings of the study in Thua Thien Hue province, central Vietnam show that major household income source is generated from agriculture production including annual crops

cultivation, perennial crop cultivation, animal husbandry, agro-forestry and fishery. To creating strong changes in agriculture production, the household income and improve local people's livelihood; the issue of field land, high yield variety and home garden productions have special strategic importance. Always to attach great importance to promote the cash crop contributing to home garden system towards building a small-scale commodity agriculture, diversity and balance development sustainability; step by step to facilitate the improvement of livelihood, striving to increase the value added in home garden product reached the family home needs. To linked household development with building the new ability model; better address the relationship between home garden practice and new cash varieties, contributing to the home garden cropping system. It is necessary to have an investigation for field base station on land used and crop systems or crop varieties and so on.

Vanilla as well known a cash crop in the world and it is still very new in Vietnam and firstly introduced to farmer at Hong Ha commune, Thua Thien Hue province in 2006 under support from JICA foundation. Since vanilla production has not yet been widely practiced in Vietnam, it was necessary to find the source of seedling vines from other producing regions outside the country. According to the accessibility and the similarity in natural environment, we selected the mountainous part of South Sulawesi province, Indonesia, which is one of the well-known vanilla production regions in Southeast Asia. Hence in 2007, the study was undertaken in Hong Ha commune state with in order to examine the potential growth and returns from production and processing of vanilla in the study area as well as identify the constraints in production and processing of vanilla and to suggest appropriate techniques or typical skill.

In Hong Ha commune, vanillas (*Vanilla planifolia*) grow well and they are suitable with those local ecological systems and vanilla is particularly suitable as an additional crop on diversified home garden site, and can be easily integrated into the system of organic tree and trees canopy in home garden. Developing home garden system along mountainous village and vanilla production lines is also feasible. This activity has been enhancing the farmers' capacity of implementing the new plant trial such as farmers themselves measure some growth figures, bending, fertilizing/mulching or processing vanillas pod… Observation on growth and yield attributes such as vine length, number of node per vine, intermodal length, number of

beans per vine, bean size, and yield etc. reveal that performance of vanillas as well. It is also observed if that good management practices are adopted, vanillas perform better at full bearing stages of the plant. This proved that vanilla can be popularized as a cost effective source planting of materials. However, vanilla growing farmers are facing several problems in cultivation such as irrigating and pollinating of vanilla.

In addition, one of the main finding that vanilla has suitable with some kinds of host tree and need organic decomposed materials mulching under the good shading condition (40-60%) of home garden canopy. Therefore, this motivated the researcher to study the improvement of vanilla with regard to combined materials of host tree and organic matter to suggest appropriate measures.

# Chapter 1. INTRODUCTION

## 1.1. Study background

Vietnam is an agriculture-based country with over 70% of the 90 million people living in the rural area and engaged directly or indirectly in agriculture. Agriculture constitutes over 20% of the GDP of the country (GSO, 2012). Agriculture, which is an important source of foreign exchange, ensures food security for the country and is a large input for industry. Farming systems have an important position in Vietnamese agriculture, they are well known as comprised of four land use types which are closely linked; and home gardens, the area for annual food crop cultivation, fields which serve as communal farmland, and area for shifting cultivation (Hanoi University of Agriculture, 2011).

The home garden can be defined as a farming system that combines different physical, social and economic functions on the land around the family home (Nguyen, 1992); it is a part of the land used for cultivation and is usually fenced (VASS, 2005). Home gardens are sometimes called backyards or kitchen gardens. These gardens have an established tradition and offer great potential for improving household food security and alleviating micronutrient deficiencies. Gardening can enhance food security in several ways, most importantly through direct access to a diversity of nutritionally rich food, an increase in purchasing power by savings on food bills and income from sales of garden products, and the fallback of food provision during seasonally lean periods (FAO, 2010). This type of garden has been traditionally used by villagers and land ownership is transferred by inheritance or sale (Nguyen and Nguyen, 1985). Many types of home garden systems in Asia have been recorded in terms of their structure, combination and function (Kumar and Nair, 2004; Mohri *et al*., 2013). Indonesia, Sri Lanka and Vietnam have home garden systems called *Pekarangan*, *Kandyan* and *VAC*, respectively. These three systems differ in the structure of their horizontal zoning and vertical stratification. While the *Pekarangan* and *Kandyan* represent complex horizontal zoning and vertical stratification at height with a high diversity of species, resulting in intimate plant associations in a virtually closed canopy structure, the *VAC* system has a simpler vertical structure. *VAC* stands for *Vuon*, *Ao* and *Chuong* in Vietnamese, which can be translated

as ‘garden’, ‘pond’ and ‘livestock pen’. It originated in the Red River delta and midlands of northern Vietnam and uses land for various agri-aquacultural activities in domestic dwellings (Nguyen, 1992). However, systematic studies of *VAC* or home gardens are completely lacking. In the lowlands and uplands of central Vietnam, *VAC* and home gardening are also practiced as farming activities, but very few field-based studies on the link between diverse plant species and their contribution to family needs have been conducted.

Central Vietnam is located in a disaster-prone region as floods, typhoons and other natural disaster often seriously affect agricultural production and livelihood of households. Disaster resilience of the vulnerable people in the region will be enhanced through various livelihood activities such as livestock and crop production. Crop production plays an important role in terms of food production and farmers’ income. It helps to maintain food security and socio-economic stability. In central Vietnam, crop production provides more than 67% of agricultural annual income, of which perennial production gives over 7.0%, vegetable production gives about 16.7% and food crop production (rice, cassava, corn, sweet potato) gives 76.3% (GSO, 2012). Similarly, in Thua Thien Hue province in central Vietnam, upland farmers rely mainly on farming production for a living while off-farm activities are hardly developed. They are dependent on locally available food resources for their crops. Generally, food supplies are seasonal and inadequate to meet their livelihood maintenance throughout the year.

Cash crop plays an important role in sustaining and preserving the confidence of family income in agricultural practices. Moreover, diversified production through utilization of cropping system at an appropriate scale will lead the households toward higher resilience against various risks of unfavorable natural factors. The natural suitability of the crops, agronomy practices and further visions on marketability of the products must be taken into account and examined through trials and monitoring.

In upland area, Hong Ha commune, Thua Thien Hue province, home garden under the socioeconomic and geographic conditions of the land use forms, has a crucial element for not only daily food, but also other income sources of household. This type of garden has been traditionally used by villagers and land ownership is transferred by

inheritance or sale (Nguyen, 1985). The farmers grow mainly fruit trees and annual crops except cereals in home garden. Many farmers planting their crops but not intensively in terms of labor input because they have not found the valuable crops in their garden. Some new crops have been introduced to Hong Ha farmers such as coffee (2002), pepper (2003) and dragon fruit (2003) but they did not show remarkable success, although these crops are valuable cash crops in the other places such as A Luoi and Nam Dong town, especially in Central Highland Region.

From 2006, Hue University and Kyoto University have established collaboration in research and education that focuses on building community capacity to cope up with natural disasters and improve the livelihoods of local people. One of the new crops introduced to farmers in central Vietnam is vanilla plant which was first grown in Hong Ha and Huong Van commune of Thua Thien Hue province in 2007.

Vanilla has been developed in some tropical countries such as in Madagascar, Tanzania, India, Indonesia and South China. This plant produces pods to process vanillin for food consumption in these countries. In the upland area of central Vietnam home to ethnic minorities group, vanilla is recognised as a commercial food crop to improve the income of the local people.

In agricultural production systems, the plants are grown not only on farmlands, but also mountains, fields and home gardens; of which, farm homes lifestyle are closely linked to the home garden with indigenous knowledge in management. Under the upland conditions of Hong Ha commune, vanilla plants in the garden grow and seem to be adapted to the environment and climate of this region with strong length vine and yearly flower. Having been introduced only since 2007, vanilla plant is still very new to Vietnam in both scientific data and market. There is a need to initially investigate and evaluate the characteristics of home garden and its improvement through vanilla plant (*vanilla planifolia*) introduction in central Vietnam.

### 1.2. Objectives of the thesis

The objectives of the thesis are;

- To characterize the situation of home garden practice with various crop usage and their contribution to house hold income (chapter 3);

- To investigate production and processing performance of vanilla by farmers (chapter 4);

- To evaluate the possibility of vanilla production in home gardens for improving the livelihood (chapter 5).

### 1.3. Location of the study area

This study is carried out in Hong Ha commune, A Luoi district, central Vietnam, which consist of mountainous areas and plain areas, focusing on part of the mountainous and midland zones, covering about 40 km$^2$ (Fig. 1.1).

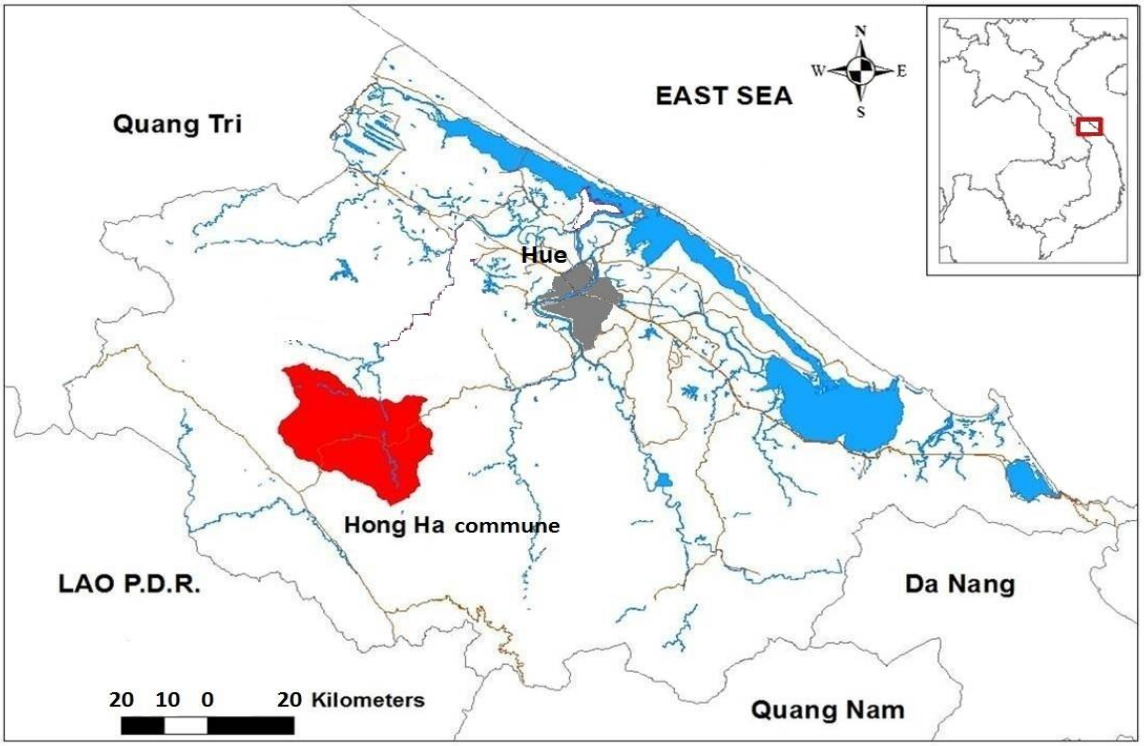



**Fig. 1.1. Location of the study area**

### 1.4. Structure of the thesis

This study is presented in five chapters. The thesis begins, in chapter 1, by tracing study background of home gardens in farmlands system in central Vietnam and vanilla contributing as a cash crop, location of the study, and objectives of the thesis have been clearly indicated. The main features of the study area are outlined in Chapter 2. Chapter 3 presents characteristics of home garden practice in upland area of central Vietnam. Chapter 4 presents vanilla growth performance in upland villages. Chapter 5 summarizes the result of the study and brings out the way to improve livelihood and recommendations to improve vanilla production.

# Chapter 2. CHARACTERISTICS OF THE STUDY AREA

This chapter provides descriptive background of the study area. The main feature of the natural and social agro-economic characteristics in central Vietnam are presented and linked to cropping system and livelihood activities of households.

## 2.1. Materials used

In order to understand the contextual background of study area, desk study was mainly applied to overview the relevant documents. Field trips to these study sites were organized to observe and discuss with relevant community staff and stake-holders. The secondary data was collected from various sources such as annual reports by local governments (District People's Committee, Commune People's Committee); reports from professional organizations such as General Land Administration Office, Thua Thien Hue Statistical Office and General Statistical Office of Vietnam (Statistic Year Book). The review of documents also partly contributed to next steps of research such as designing questionnaire and interviews.

## 2.2. Natural conditions and socio-agronomical condition of central Vietnam

Central Vietnam is one of six socio-economic regions of Vietnam, officially called Central Coastal Region which is divided into North Central Coastal Region (NCCR) and South Central Coastal Region (Fig. 2.1), and known as one of the most disaster prone areas in the country. Annual frequency of typhoons in the whole region in the period 1951-2010 was 7 and 8 events, respectively. Typhoons bring heavy rains and high tides which accelerate floods, discourage livelihoods of local people and agricultural production (Duc, 2012).

According to GSO 2012, in the region, most of the population live in the rural area with about 76% of total populations depended on agriculture activities. Agriculture, forestry and fishery sector accounted for 16-18% of GDP.


**Fig. 2.1. Vietnam regional map**

(Source: Viet Sciences 2013)

Amount of 2.42 million households live in rural area, accounting for 66% in the total households country-wide, including: agricultural production with 2.21 million households (61%); forestry production with nearly 0.3 million households (1%); fishery production (5%) with approximately 1.75 million households. In the households, there are totally 18.96 million agriculture labors in the whole country and 4.67 million agriculture labors in central Vietnam. The structure of labor force is categorized into three resources; year round agriculture labors (46%), agriculture labors who are also engaged in non-agriculture activities (32%) and non-agriculture labors who are sometimes involved in agriculture activities (22%).

In terms of numbers of households employed at agriculture production in 2012, almost of agriculture or nationwide are occupied by annual crop production, which includes all of crops cultivated in a year such. The proportion of land used by size under 0.2 ha and 0.5 ha are tended to be higher than 0.5 – 2 ha or over 2 ha (Table 2.1).

**Table 2.1. Structure of household by size of each kind of land used in agriculture production of whole country and North Central Coastal Region**

| Type of land use | Institutions | Total (household) | Under 0.2 ha (%) | From 0.2 to under 0.5 ha (%) | From 0.5 to under 2 ha (%) | From 2 ha and over (%) |
|---|---|---|---|---|---|---|
| **Agriculture production** | Whole country | 11,948,261 | 34.7 | 34.3 | 24.8 | 6.2 |
| | NCCR | 3,006,663 | 36.3 | 41.7 | 19.1 | 2.9 |
| **Annual crop** | Whole country | 10,355,941 | 39.6 | 26.0 | 20.3 | 4.0 |
| | NCCR | 2,864,371 | 38.4 | 43.5 | 16.4 | 1.8 |
| **Paddy** | Whole country | 9,271,194 | 50.0 | 34.8 | 12.9 | 2.3 |
| | NCCR | 2,561,883 | 53.4 | 39.0 | 7.4 | 0.2 |

(Source: GSO 2012)

The most outstanding feature of NCCR is high proportion of agriculture production land used by size smaller than 0.5 ha compared to the whole country on average. This means that, in NCCR, there are many small pieces of agriculture land used, of which the paddy land has the highest proportion of land used by size under 0.2 ha and 0.5 ha, more than 92%. Before 1994, each member in household received 500 $m^2$ to 1000 $m^2$ as their property (Land law NĐ64/CP, 1993). After 1994, the land resource was no longer available because of the population growth, so new households or young generations have land smaller.

## 2.3. Thua Thien Hue province

### 2.3.1. Geography and climate

Thua Thien Hue province is located in North Central Region Vietnam encompasses 5,054.99 $km^2$ along with Northwest to Southeast at the latitude $15^0$59’30”-$16^0$44’30” North and longitude $107^0$00’56”-$108^0$12’57” East.

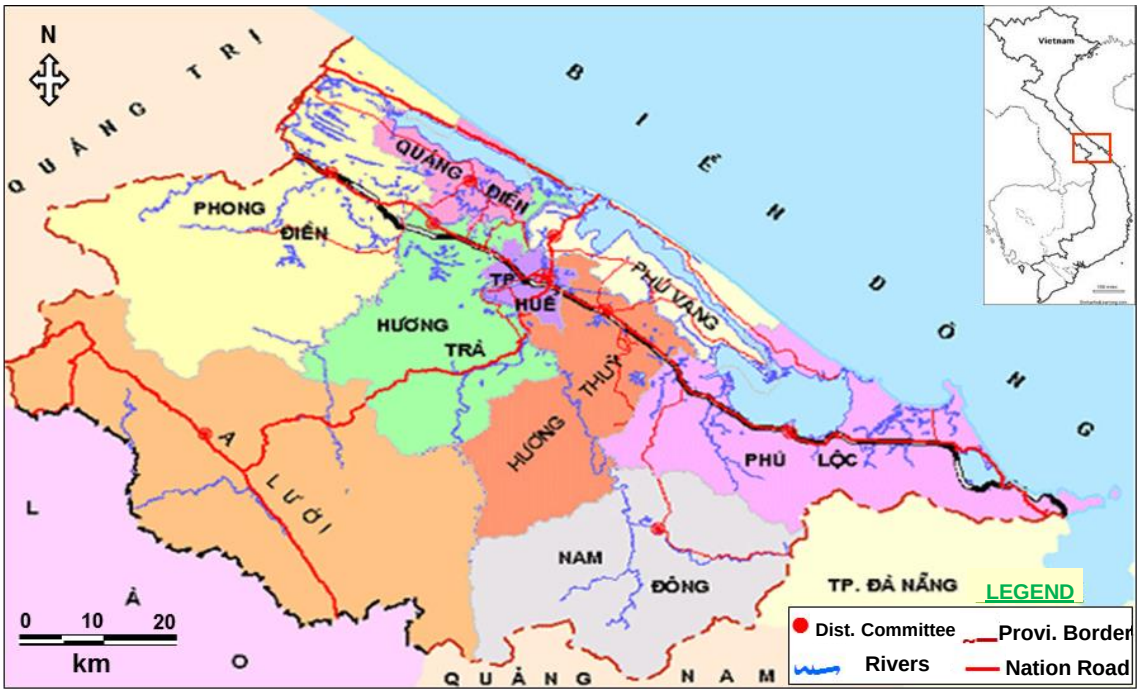



**Fig. 2.2. Administrative map of Thua Thien Hue province**

(Source: General Land Administration Office, 2013)

Thua Thien Hue province is contiguous to Quang Tri province in the North and Quang Nam province, and Da Nang city in the South, Laos country from West, and the Eastern Sea in the East. Thua Thien Hue province has around 120 communes, 20 wards belonging to Hue city and 8 districts, namely Phong Dien, Quang Dien, Huong Tra, A Luoi, Phu Vang, Huong Thuy, Phu Loc and Nam Dong, of which A Luoi and Nam Dong are mountainous areas (Fig. 2.2).

Thua Thien Hue province is well known by the diversity of natural conditions and is comprised of three major agro-ecological zones; mountainous, midland and lagoon zones. Under tropical monsoon climate, Thua Thien Hue province has very distinctive of dry season and rainy season being one of the provinces that usually record the highest annual rainfall in Vietnam (TTHPPC 2005).

In recent years (2010 – 2012), the average annual precipitation was 3700 mm. In the rainy season, from October to November, 1941mm of total precipitation was recorded,

while that in the dry season from April to May, was 92 mm totally. The average humidity was about 88% and the average humidity in the dry seasons from May to July was about 78 – 79% and from October to January of the next year was 93 – 95% in the rainy season. The mean air temperature was 24.9$^0$C; it reached the highest from April to July was 39$^0$C, while lowest temperature was 14$^0$C during December and February (Figure 2.3).

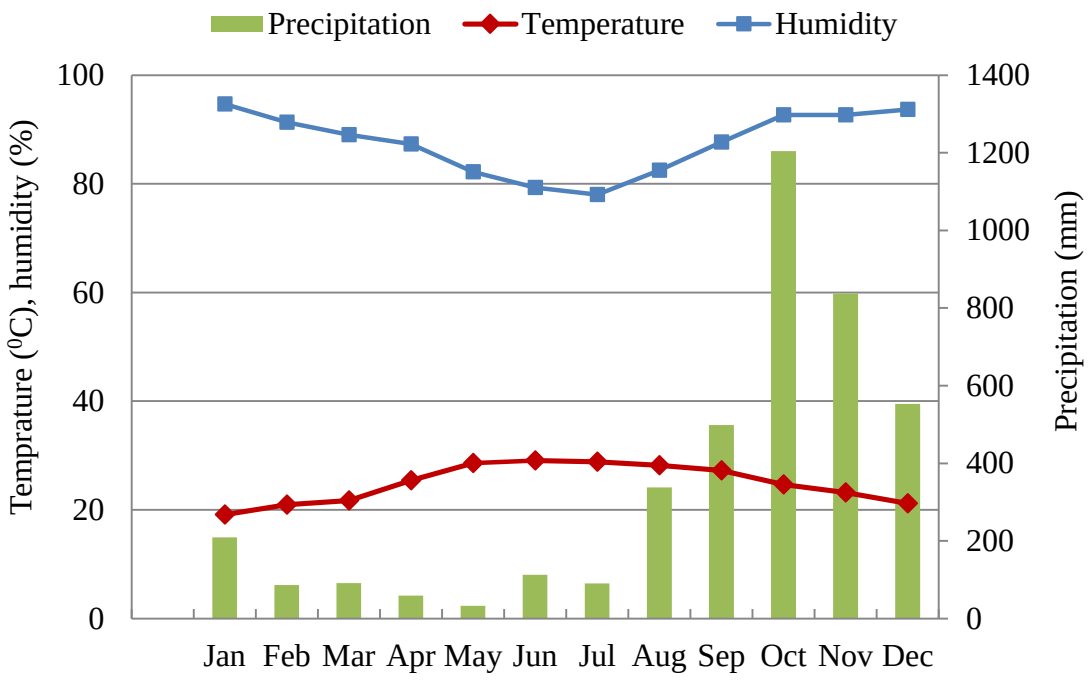



**Fig. 2.3. Mean monthly precipitation, air temperature and humidity in Thua Thien Hue province from 2010 to 2012**

(Source: TTHSO 2013)

### 2.3.2. Agriculture and socio-economics

Thua Thien Hue province encompasses about 506,300 ha natural land with a population of about 1.13 million, of which 84,000 ha (17%) is used for agriculture. The economy depends largely on agriculture, which employs over 64% of the population. In 2012, gross value of agriculture production attained about 21.2% of whole GDP in the province in which annual crop production accounted for 66% of total gross value of agriculture (TTHSO 2013).

**Table 2.2. Structure of household by size of each kind of land used in agriculture production of Thua Thien Hue province**

| Type of land use | Total (household) | Under 0.2 ha (%) | From 0.2 to under 0.5 ha (%) | From 0.5 to under 2 ha (%) | From 2 ha and over (%) |
|---|---|---|---|---|---|
| Agriculture production | 103,664 | 31.87 | 41.63 | 23.87 | 2.63 |
| Annual crop | 95,758 | 31.91 | 45.36 | 21.88 | 0.85 |
| Paddy | 86,361 | 40.87 | 43.25 | 15.51 | 0.37 |

(Source: TTHSO 2012)

There are 103,664 agriculture households, including annual crop households which account for great majority with 95,758 households and 86,361 households have paddy cultivation (Table 2.2). The household with small scale production (under 0.5 ha) account for about 73% of total agricultural land used, of which the dominant proportion concentrate on paddy land.

**Table 2.3. Output value per ha of cultivated-aquaculture land and cultivated land during 2008 – 2011**

(Unit: Million VND)

| **Type of land use** | **Institutions** | **2008** | **2009** | **2010** | **2011** |
|---|---|---|---|---|---|
| Cultivated & aquaculture land | NCCR | 38.74 | 41.76 | 49.22 | 61.04 |
| | Thua Thien Hue province | 44.23 | 46.39 | 51.07 | 65.16 |
| Cultivated land only | NCCR | 36.89 | 39.24 | 46.31 | 57.31 |
| | Thua Thien Hue province | 40.28 | 41.82 | 47.24 | 61.02 |

(Source: TTHSO 2012)

The output value per hectare of agricultural land has increased year by year and provincial output value per hectare is higher than average regional output value per hectare (Table 2.3) because processing and storage in Thua Thien Hue province have gathered together and they purchased facilities farmer's products quickly with higher value.

## 2.4. Location, demography and land use in A Luoi district

A Luoi district is one of the two mountainous districts of Thua Thien Hue province. A Luoi district located face to Phong Dien districts and Quang Tri province in the North; Quang Nam province in the South; The People's Democratic Republic of Lao in the West; Huong Tra, Huong Thuy and Nam Dong district in the East (Figure 2.2). The population and population density of A Luoi district were 45,190 inhabitants and 37 persons per $km^2$ in 2012, respectively (TTHPPC 2013). The total area of A Luoi district is about 122,464 ha in which only 6,129 ha (5 %) is used for agriculture, and 107,868 ha (88 %) for forestry (BSBAL).

## 2.5. Hong Ha Commune

### 2.5.1. Geographical and social conditions and seasonal feature

Hong Ha Commune is located in the upper Bo River Basin in Thua Thien Hue Province, within 40 km and about 1.5 hours away from both Hue City and the A Luoi District center (Fig. 2.4). The commune has five villages with a total population of 1,577 composed of four ethnic groups (Hong Ha Commune Office, 2012). Each village is composed of different ethnic groups. The Ta Oi group generally occupies the higher land, the Co Tu group occupies the lower land, and several other groups are mixed in with them. All five villages, Can Tom, Can Sam, Pa Hy, Pa Rinh and A Rom, are located along the valley and surrounded by undulating hills with elevations ranging between 100 and 200 m (Nguyen and Nguyen, 2007). These villages are located within 6 km west-to-east and 3 km north-to-south of each other in the foothills of the mountain region (Le *et al*., 2001).

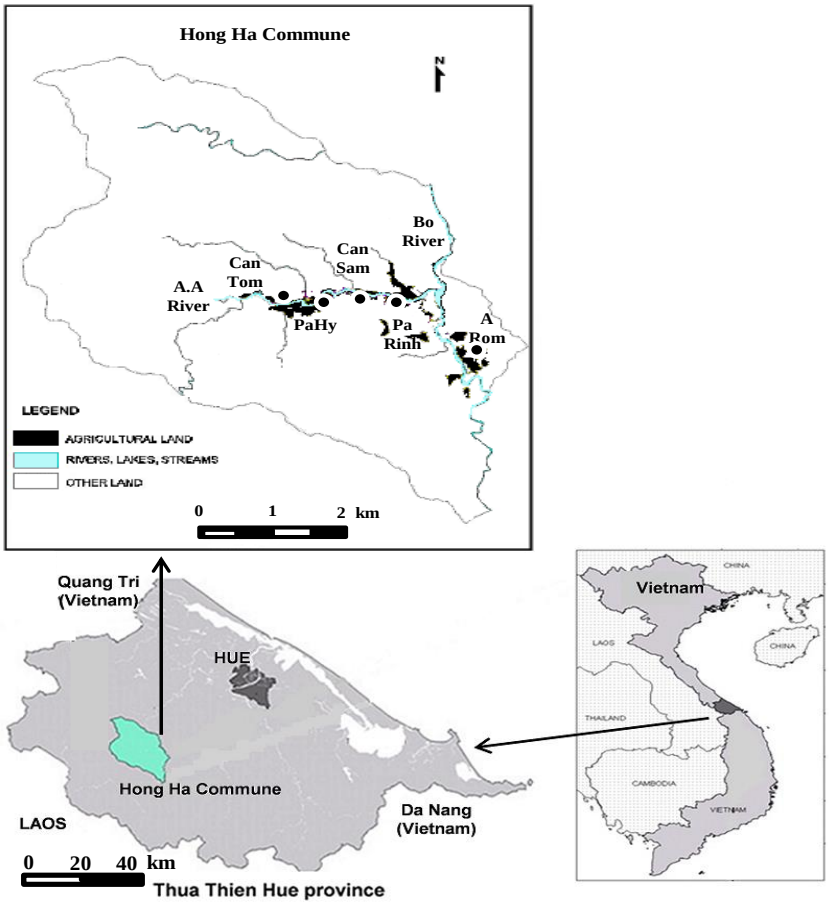



**Fig. 2.4. Location of the study site.**

(Source: General Land Administration Office, 2013)

Can Tom village is located on the top of a hill and has the highest elevation. Can Sam, Pa Hy, and Pa Rinh are located on the middle of the slope with intermediate elevation (middle-slope villages). A Rom is located at the lowest part of the sloping hill region (foothill village).

Hong Ha has a tropical monsoon climate where the dry and wet seasons are sharply separated. The dry season includes spring and summer, and runs from January to August, while the rainy season is from September to January. Because prolonged heavy rainfall events occur from September to November, with more than 70% of the total annual precipitation, floods usually occur during this time (Nguyen and Nguyen, 2007). The average annual rainfall is around 2,700 mm and the average temperature is about $23^0$C (Le *et al*., 2001).

### 2.5.2. Agronomical condition and livelihood of household

The total area of Hong Ha commune is 14,048 ha, including forestry land (13,260 ha), agricultural land (299 ha) and non-agricultural land (487 ha). The cultivated area covers approximately 517 ha (agriculture crops and forestry crop). The agricultural land is situated along the fluvial area and terraces mainly for lowland rice, cassava and corn, as well as on the hills where slash-and-burn cultivation of upland rice and cassava, and acacia hybrid plantation (*Acacia mangium x A. auriculiformis*) are practiced. The cultivated area of annual crops covers approximately 239 ha, among which 28.5 ha are used for lowland and upland rice, 174 ha for cassava and 19.6 ha for corn (Hong Ha Commune Office, 2012).

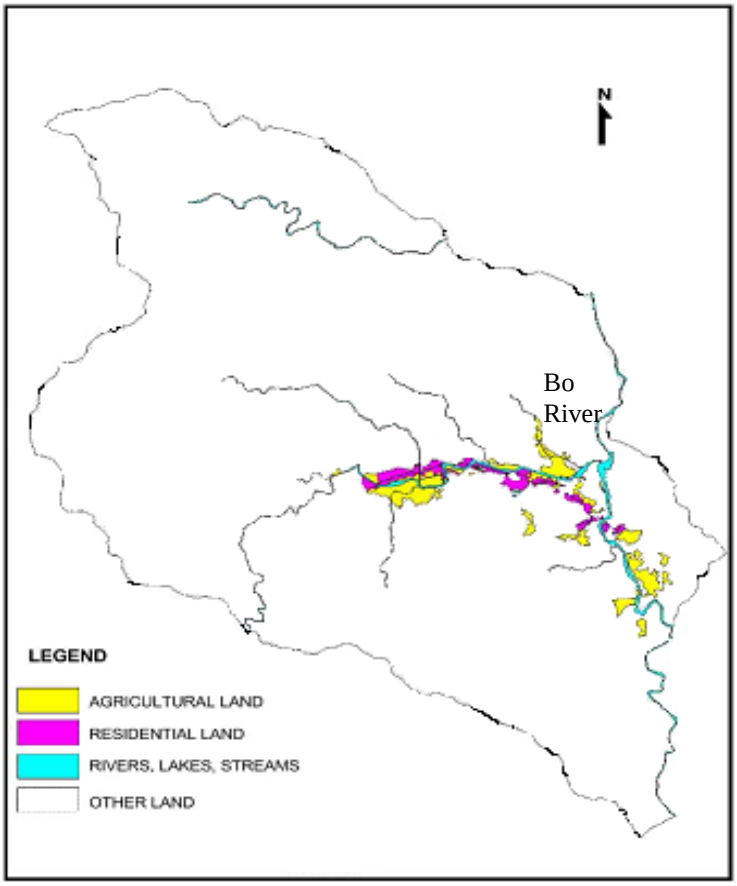



**Fig. 2.5. A distribution map of agricultural land and residential land in Hong Ha commune**

(Source: GLAO, 2013)

**Table 2.4. Population, average income, and food productivity in Hong Ha commune in 2010 – 2012**

| | 2010 | 2011 | 2012 |
|---|---|---|---|
| Population (persons) | 1,541 | 1,577 | 1,603 |
| Ave. Income/person/year (million VND) | 7.3 | 7.6 | 7.8 |
| Food productivity per capita* (kg/person/year) | 234.0 | 248.1 | 267 |

* Includes staple crop

(Source: HHPCO, HVPCO 2013)

In recent years, agriculture production of Hong Ha commune has contributed more to the average income per person. The food productivity per capita from 2010 to 2012 increased from 234 to 267 kg/person/year in Hong Ha commune (Table 2.4).

In Hong Ha commune, rice yield attained 4.6 ton/ha, which is much lower than an average yield of the province, 6 to 7 ton/ha (or higher in some other areas). Besides, crops providing subsidiary food for human and animal feed in the commune such as cassava, corn and sweet potatoes are also grown commonly in the commune. The productivity higher tends to for rice and cassava (Table 2.5).

**Table 2.5. Area, yield and productivity of major staple crops cultivated in Hong Ha commune in 2012**

| | Rice | Cassava | Corn | Sweet potato |
|---|---|---|---|---|
| Area (ha) | 28.5 | 174.2 | 19.6 | 2.3 |
| Yield (ton/ha) | 4.6 | 4.5 | 2.7 | 3.5 |
| Total production (ton) | 134.0 | 784.0 | 53.0 | 8.0 |

(Source: HHPCO, HVPCO 2013)

In Hong Ha commune, the dominant land use is forest (acacia and rubber) greatly related to the economy. Besides, cassavas have also significantly met financial demand of local people. Growing cassavas reduce or maintain the dependence on forest resource. Almost all households in the commune cultivate locally annual crops such as vegetables in home garden with total of 3.8 ha. However, the productivity of these crops is still low due to lack of technique and the harvested product is mainly used for home consumption, so there is no cash crop (HHPCO 2013).

# Chapter 3. HOME GARDEN PRACTICE IN UPLAND AREA OF CENTRAL VIETNAM


## Summary

A total of 95 households from five mountainous villages in Hong Ha Commune, A Luoi District, Thua Thien Hue Province, Vietnam were surveyed to investigate the function and significance of home garden practices in their livelihood. The results showed that the average home garden size was about 1000m$^2$ with 30% of the households having fish ponds. Using this land resource, households were enjoyed in various cultivation activities. The main source of income from home gardens was derived from products from annual and perennial crops, which were primarily used for daily consumption and occasionally for cash income. The dominant seasonal crops, such as taro, *Sauropus androgynus* L., papaya, *Piper lolot*, lemongrass and sweet potato, were grown and harvested all year round while others crops were harvested in the rainy season. Perennial crops were normally harvested during the dry season when few annual crops were harvested. In addition, perennial crops also function well as wind breaks, provide shade for the garden, supply organic matter to the soil and act as host trees for plant vines to cling to. The contribution of home gardens to income was more significant for poor households. Thus, home gardens not only ensured food security for families but also contributed cash income to improve the livelihood of households in this area.



**Keywords:** Canopy stratification, Cash crop, Perennial crop, Annual crop.


## 3.1. Introduction

In Vietnam, approximately 83% of the people in mountainous regions depend on agriculture for their livelihood. They face increasing difficulties in meeting their daily subsistence needs (Nguyen and Thai, 1999). Hillside villages that depend on a combination of paddy and shifting cultivation are confronted with problems of food security; more than two-thirds of households do not produce sufficient grain to meet their needs annually (Tran and Le, 2009).

As rice production falls short of consumption needs, maize and cassava are required to cover basic nutritional needs (Kono and Rambo, 2004). At the same time, the agro-resources on which the economic welfare of the mountain people depends have been severely degraded, with consequent reduction in productivity per unit area (Tran and Le, 2009). The green landscape in which the villages are located is maintained by large agroforestry sites, including village communal forests, paddy fields, maize fields and small scale home gardens (Tran, 2003). Combinations of these land uses provide resources to improve the livelihoods of local people. This chapter focuses on the home garden practices of villagers and their contribution to the livelihood of an ethnic minority community.

The present paper focuses on the home garden practices of villagers and their contribution to the livelihood of an ethnic minority community. The home garden can be defined as a farming system that combines different physical, social and economic functions on the land around the family home (Nguyen, 1992); it is a part of the land used for cultivation and is usually fenced (VASS, 2005). Home gardens are sometimes called backyards or kitchen gardens. These gardens have an established tradition and offer a great potential for improving household food security and alleviating micronutrient deficiencies. Gardening can enhance food security in several ways, mainly through direct access to a diversity of nutritionally rich food, an increase in purchasing power by savings on food bills and income from sales of garden products, and the fallback of food provision during seasonally lean periods (FAO, 2010). This type of garden has been traditionally used by villagers and land ownership is transferred by inheritance or sale (Nguyen and Nguyen, 1985). Many types of home garden systems in Asia have been recorded in terms of their structure, combination and function (Kumar and Nair, 2004; Mohri *et al*., 2013). Indonesia, Sri Lanka and Vietnam have home garden systems called *Pekarangan*, *Kandyan* and *VAC*, respectively. These three systems differ in the structure of their horizontal zoning and vertical stratification. While *Pekarangan* and *Kandyan* represent complex horizontal zoning and vertical stratification at height with a large diversity of species, resulting in intimate plant associations in a virtually closed canopy structure, the *VAC* system has a simpler vertical structure. *VAC* stands for *Vuon*, *Ao* and *Chuong* in Vietnamese, which can be translated as ‘garden’, ‘pond’ and ‘livestock pen’. It

originated in the Red River delta and midlands of northern Vietnam and uses land for various agri-aquacultural activities in domestic dwellings (Nguyen, 1992). However, systematic studies on *VAC* or home gardens are completely lacking. In the lowlands and uplands of central Vietnam, *VAC* and home gardening are also practiced as farming activities, although very few field-based studies on the link between diverse plant species and their contribution to family needs have been conducted.

According to TTHPPC (2005), 87% of the communities in the mountains of Thua Thien Hue Province are dominated by ethnic minorities who have fewer income opportunities than lowlanders. The Hong Ha Commune Office (2010) reported a typical example of the livelihood of ethnic minorities in this region. The median monthly income of farmers was 500,000–700,000 VND (25–35USD), providing limited cash for family needs. Although their livelihood is based on self-sufficient production of food including rice, various vegetables and forest resources, the products from home gardens offer a valuable source of income as well as diverse food crops. Home gardens also enable for villagers to save their income (Le *et al*., 2001). Although the home garden output might not be sold because neighbors have adapted the same system goods may be exchanged among them (Nguyen and Nguyen, 2007). To improve the livelihood of villagers, the functions of the home garden could be enhance to achieve this objective, the current status of the home garden should be analyzed. The present study focuses on three aspects that an essential for the improvement of the home garden: land and water resources; home garden practices in terms of crop varieties, crop products and their consumption; and the contribution of the home garden to the household's livelihood.

### 3.2. Study Area and methods

Hong Ha Commune is located in the upper Bo River Basin in Thua Thien Hue Province, within 35 km and about1.5 hours away from both Hue City and the A Luoi District center (Fig. 1). The commune consists of five villages with a total population of 1517 composed of four ethnic groups (Hong Ha Commune Office, 2012). Each village harbors different ethnic groups. The Ta Oi group generally occupies the higher land, the Co Tu group occupies the lower land, and several other groups are mixed in with them. All five

villages, Can Tom, Can Sam, Pa Hy, Pa Rinh and A Rom, are located along the valley and surrounded by undulating hills with elevations ranging between 100 and 200m (Nguyen and Nguyen, 2007). These villages are located within 6 km West-to-East and 3 km North-to-South of each other in the foothills of the mountain region (Le *et al*., 2001). Can Tom village is located on the top of a hill and has the highest elevation. Can Sam, Pa Hy, and Pa Rinh are located on the middle of the slope with intermediate elevation (middle-slope villages). A Rom is located in the lowest part of the sloping hill region (foothill village).

Hong Ha has a tropical monsoon climate where the dry and wet seasons are sharply separated. The dry season includes spring and summer, and runs from January to August, while the rainy season occurs from September to January. Since prolonged heavy rainfall events occur from September to November, with more than 70% of the total annual precipitation, floods are usually observed during this time (Nguyen and Nguyen, 2007). The average annual rainfall is around 2,700 mm and the average temperature is about 23°C (Le *et al*., 2001). The agricultural land is situated along the fluvial area and terraces mainly for lowland rice, cassava and maize, as well as on the hills where slash-and-burn cultivation of upland rice and cassava, and acacia hybrid plantations (*Acacia mangium x A. auriculiformis*) are observed. The cultivated area covers approximately 239 ha, among which 28.5 ha are used for lowland and upland rice, 174 ha for cassava and 19.6 ha for maize (Hong Ha Commune Office, 2012).


**Fig. 3.2. Five villages in Hong Ha commune**

We conducted a field survey in September 2012. The information on cultivation was collected from the statistical book by the People's Committee Office and the other data were collected from interviews. Among the five villages in the commune, 30% of each village's households were randomly selected for questionnaire survey, counting 95 out of the 309 households in total, to collect detailed information on home garden practices such as location, size, cropping patterns, consumption and income. During of the questionnaire survey, we also conducted on observation survey on the home garden practices such as plant composition and arrangements of crops. The data collected from the surveys were statistically analyzed using the Statistical Package for the Social Sciences (SPSS) software and the Statistix for Windows software for Tukey (HSD) comparison of means.

## 3.3. Results and discussion

### 3.3.1. Land situation and water resource

All the households had home gardens around their houses. The home garden size in Hong Ha varied from 130 to 15,000 $m^2$ with a median of approximately 1,000 $m^2$. In ninety percent of the households, the size of the gardens was less than 5,000 $m^2$ (Table 3.1), while the studies of Vietnamese home gardens from different ecological and geographical regions also showed that in the other areas regions size variation of units ranged from about 500 to 3200 $m^2$ in the northernmost or from 2000 to 22000 $m^2$ in the southernmost ones (Trinh *et al.*, 2003).

**Table 3.1. Distribution of home garden sizes in Hong Ha**

| Land size ($m^2$) | No. of households (n=95) | Percentage (%) |
|---|---|---|
| 100 – 1,000 | 51 | 54 |
| 1,000 – 5,000 | 34 | 36 |
| 5,000 – 10,000 | 7 | 7 |
| 10,000 – 15,000 | 3 | 3 |

Sixty-seven percent of the households obtained water for their home gardens from community reservoir systems. The remaining households depended on rain water. About 30% of the households had fish ponds in the home garden to keep water not only for raising fish, but also for garden irrigation and living activities. The average pond size was about 22.4 $m^2$. The pond size, also calculated by Trinh *et al.* (2003), was 1500 $m^2$ at the southernmost site and 220 $m^2$ in the northernmost site.

### 3.3.2. Vegetable and staple crop cultivation

The natural and planted vegetation in home gardens consisted of vegetables (Table 3.2), staple crops (Table 3.3), fruit trees and industrial crops (Table 3.4), mainly based on their physiology and usage. The vegetables included leafy vegetables, fruit vegetables, flavor vegetables and other vegetables such as bamboo shoot, winged yam, and green jackfruit. Banana is also ranked in the category of fruit vegetables, as the villagers mostly use flowers of planted bananas, and obtain banana fruits from natural plants in the forest, which are diploid banana species. Although bamboo, papaya, and jackfruit are perennial crops and sweet potato is a tuber crop, they are considered as vegetables since not only mature but young shoots, fruits and tubers are typically consumed as vegetables. Planting of vegetable crops varied among the crop categories (Table 3.2). Leafy vegetables and fruit vegetables were relatively common in Hong Ha's gardens. Taro, hot pepper and pumpkin were the main crops based on their percentage of occurrence in 56%, 54% and 52% of the gardens, respectively. Taro was also reported as a major crop for foods in the Javanese home gardens and Kandyan home gardens (Mohri *et al.*, 2013), while hot pepper was also grown in 75% of the gardens in Northeast Thailand (Miyagawa *and Kochan.*, 1990*)*.

The farmers in Hong Ha Commune, according to our observations, adapted a specific schedule for planting various kinds of vegetables for household consumption. Sixteen species were grown year round for consumption, such as taro, sweet leaf, papaya, lemongrass, *Piper lolot*, sweet potato, and bamboo shoots, and 14 species were cultivated from January and harvested.

**Table 3.2. Vegetables in home gardens and their percentage of occurrence.**

| No | Crop | Scientific name | Crop Calendar | | | | | | | | | | | | (%)* | Purpose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Leafy vegetables** | | | J | F | M | A | M | J | Jl | A | S | O | N | D | | |
| 1 | Taro | *Colocasia esculenta* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 56 | Home |
| 2 | Brassica family | *Cruciferaceae* | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | 46 | Home&Sale |
| 3 | Amaranth | *Amaranthus* sp. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | 42 | Home |
| 4 | Sweet leaf | *Sauropus androgynus* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 36 | Home |
| 5 | Water convolvulus | *Ipomoea aquatica* F. | ■ | ■ | ■ | | | | | | | | | ■ | 33 | Home&Sale |
| 6 | Sweet potato leaf | *Ipomoea batatas* | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 19 | Home |
| 7 | Centella | *Centella asiatica* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 15 | Home |
| 8 | Ceylon spinach | *Basella alba* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 9 | Home |
| **Fruit vegetables** | | | | | | | | | | | | | | | | |
| 9 | Hot Pepper | *Capsicum annuum* L.;*C.frutescens* | ■ | ■ | ■ | ■ | ■ | | | | | | | | 54 | Home |
| 10 | Pumpkin | *Cucurbita pepo* L. | ■ | ■ | ■ | ■ | | | | | | | | | 52 | Home |
| 11 | Papaya | *Carica papaya* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 37 | Home |
| 12 | Gourd | *Lagenaria vulgaris* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | 36 | Home |
| 13 | Angled Luffa | *Luffa cylindrical* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | 34 | Home |
| 14 | Eggplant | *Solanum melongena* | ■ | ■ | ■ | ■ | ■ | | | | | | | | 20 | Home |
| 15 | Banana for flower | *Musa paradisiaca* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 19 | Home |
| 16 | Bitter gourd | *Momordica charantia* L. | ■ | ■ | ■ | ■ | | | | | | | | | 12 | Home |
| 17 | Chayote | *Sechium edule* Sw. | | | | ■ | ■ | ■ | ■ | ■ | | | | | 2 | Home |
| 18 | Tomato | *Lycopersicum esculentum* Mill | ■ | ■ | ■ | ■ | ■ | | | | | | | | 1 | Home |
| **Flavor vegetables** | | | | | | | | | | | | | | | | |
| 19 | Lemon grass | *Cymbopogon citratus* Stapf. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 51 | Home |
| 20 | Piper lolot | *Piper lolot* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 47 | Home |
| 21 | Ginger | *Zingiber offcinale* Rosc. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 23 | Home |
| 22 | Turmeric | *Curcuma domestica* Var. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 11 | Home |
| 23 | Galangal | *Alpinia galangal* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 2 | Home |
| 24 | Coriander | *Coriandrum sativum* L. | ■ | ■ | ■ | ■ | | | | | | | | | 2 | Home |
| 25 | Basil | *Ocimum* spp. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 2 | Home |
| 26 | Onion, garlic | *Allium* spp. | ■ | ■ | ■ | | | | | | | | | ■ | 1 | Home |
| 27 | Water cress | *Enhydra fluctuans* | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 1 | Home |
| **Others vegetables** | | | | | | | | | | | | | | | | |
| 28 | Sweet Potato | *Ipomoea batatas* | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 43 | Home |
| 29 | Bamboo shoot | *Bambusa* spp. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 39 | Home&Sale |
| 30 | Green Jackfruit | *Artocarpus heterophyllus* Lamk | ■ | ■ | ■ | | | | | | | | | | 38 | Home |
| 31 | Winged yam | *Dioscorea alata* | | | | ■ | ■ | ■ | ■ | | | | | | 2 | Home |

* Percentage of households growing each crop.

Thus, the crops in the home garden were grown over a long period of time for harvest potential. From the harvest of the home garden, 96% of the vegetables were used for home consumption and 4% for sale, including bamboo shoots, taro, the *Brassica* family and papaya.

**Table 3.3. Staple crops in home gardens and their percentage of occurrence.**

| No | Crop | Scientific name | Crop Calendar | | | | | | | | | | | | (%)* | Purpose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | J | F | M | A | M | J | Jl | A | S | O | N | D | | |
| 1 | Cassava | *Manihotesculenta* | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | 79 | Home&Sale |
| 2 | Maize | *Zea mays* L. | ■ | ■ | ■ | ■ | ■ | | | | | | | | 36 | Home |
| 3 | Sweet potato | *Impomoeabatatas*L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 12 | Home |

* Percentage of households growing each crop.

Staple crops included cassava, maize and sweet potato tubers from the farms and home gardens. Twenty four percent of the households used the harvest for home consumption only, 39% for sale only and 37% for both. Hybrid cassava (KM-94, KM-98) and hybrid maize remained the most important cash crops in home gardens of Hong Ha Commune (Le *et al*., 2001). After the crops were introduced to farmers in some villages in 2000, they spread quickly through farmer migration throughout the commune. One of the most important benefits of cassava production is that the products become trading commodities, due to the presence of tapioca powder factories in the urban area about 40 km Northeast of the commune.

The farmers used both local and hybrid varieties of maize. The hybrid variety was more common because of its higher yield. The farmers usually practiced mixed planting of maize with sweet potato or *Centella* vegetables in part of the garden that was not shaded by tall trees such as fruit trees, bamboo, acacia, and *Wrightia*. The farmers started to transplant maize in January and February, and harvested it in April and May, while

continuing to take care of the other crops. Additionally, maize was grown commonly in the garden under rain-fed conditions with minimal or without application of fertilizer.

### 3.3.3. Perennial crop cultivation

Various perennial crops consisting of 33 species of fruit trees and industrial crops were grown in home gardens (Table 3.4), both for cash sale (13%) and subsistence consumption (87%). Fruit crops such as jackfruit, mango, pomelo, orange, pineapple and guava were generally grown close to the house on flatter land, but were also often planted around fishponds. These crops were common crops, with their percentage of occurrence exceeding 50% of home gardens. In addition, other newly introduced trees, such as *Wrightia*, acacia hybrid and jatropha, were planted behind the house. Near the base of these trees, many kinds of flavor vegetables were grown, such as ginger, turmeric, galangal, lemongrass, *P. lolot*, and basils.

In about 64% of the households, had small numbers of industrial crops were planted in the home garden a little farther from the house on flatter land. Seven industrial species for home consumption were grown in home gardens such as pepper, coffee, cinnamon, rubber, tea, sugarcane and vanilla. Rubbers' latex was used as a suitable material to mend a puncture for households. Tea and pepper, the most and the second most common among the industrial crops, were grown by 52% and 24% of the households, respectively.

As a favorable found of the home garden, leaf litter was the main agent for soil improvement in the garden and the fallen stems and dried branches of many fruit trees were used as fuel. The practice of planting trees such as bamboo and tea around the home as a fence was common. These trees act as a windbreak at the beginning of the rainy season when storms are often hazardous, and provide good shading in the summer. Customarily, the perennial plants close to a fence are mainly used by one household, although the neighbors can share the benefits from them.

**Table 3.4. Perennial crops in home gardens and their percentage of occurrence.**

| No | Crop | Scientific name | Harvesting time | | | | | | | | | | | | (%)* | Purpose |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Fruit trees** | | J | F | M | A | M | J | Jl | A | S | O | N | D | | |
| 1 | Jackfruit | *Artocarpus heterophyllus* Lamk. | | | | ■ | ■ | ■ | ■ | | | | | | 78 | Home |
| 2 | Mango | *Mangifera indica* | | | | ■ | ■ | ■ | | | | | | | 62 | Home |
| 3 | Pomelo | *Citrus grandis* | | | | | | | | ■ | ■ | ■ | | | 60 | Home&Sale |
| 4 | Orange | *Citrus aurantium* ssp. | | | | ■ | ■ | ■ | ■ | | | | | | 59 | Home&Sale |
| 5 | Pineapple | *Ananas comous* L. | | | | | ■ | ■ | ■ | ■ | | | | | 53 | Home |
| 6 | Guava | *Psidium guyava* L. | | | | | ■ | ■ | ■ | ■ | | | ■ | ■ | 51 | Home&Sale |
| 7 | Longan | *Euphoria longana* Lamk. | | | | ■ | ■ | | | | | | | | 46 | Home |
| 8 | Lemon | *Citrus limonia* | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | 45 | Home |
| 9 | Banana | *Musa* spp. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 45 | Home |
| 10 | Papaya | *Carica papaya* L. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 37 | Home |
| 11 | Custard-apple | *Annona muricata* L. | | | | | ■ | ■ | ■ | | | | | | 23 | Home |
| 12 | Carambola | *Averrhoa carambola L.* | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | 22 | Home |
| 13 | Star-apple | *Chrysophyllum cainito* L. | ■ | ■ | ■ | | | | | | | | | | 22 | Home&Sale |
| 14 | Dragon fruit | *Hylocereus undatus* Britt. | | | | | | | ■ | ■ | | | | | 18 | Home |
| 15 | Areca nut | *Areca catechu* L. | | | | | | | | | ■ | ■ | ■ | | 17 | Home |
| 16 | Persimmon | *Diospyros kaki* Thun. | | | | | | | | ■ | ■ | ■ | | | 14 | Home |
| 17 | Tangerine | *Citrus reticulata* | | | | | ■ | ■ | | | | | | | 5 | Home |
| 18 | Sapodila | *Achras sapota* L. | | | | | ■ | ■ | | | | | | | 5 | Home |
| 19 | Coconut | *Cocos nucifera* L. | | | | | ■ | ■ | ■ | ■ | | | | | 5 | Home |
| 20 | Muricate custard-apple | *Annona squamosa* | | | | | | ■ | ■ | ■ | | | | | 4 | Home |
| 21 | Rambutan | *Nephelium lappaceum* L. | | | | | ■ | ■ | | | | | | | 4 | Home |
| 22 | Avocado | *Persea gratissima* Gaertn. | | | | | | ■ | ■ | ■ | | | | | 3 | Home |
| 23 | Calabura | *Muntigia calabura* L. | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | 2 | Home |
| 24 | Mulberry | *Morus alba* L. | | | | | | | ■ | ■ | ■ | | | | 2 | Home |
| 25 | Jambose | *Syzygium jambos* L. | | | | | ■ | ■ | | | | | | | 2 | Home |
| 26 | False mango | *Spondias cytherea* | | | | | | | | ■ | ■ | ■ | ■ | ■ | 1 | Home |
| | **Industrial crops** | | | | | | | | | | | | | | | |
| 27 | Tea | *Camellia sinesis* | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 52 | Home |
| 28 | Pepper | *Piper nigrum* L. | | | | | | | ■ | ■ | ■ | | | | 24 | Home |
| 29 | Coffee | *Coffea* sp. | | | | | | ■ | ■ | ■ | | | | | 9 | Home |
| 30 | Vanilla | *Vanilla planifolia* | | | | | | | | | ■ | ■ | ■ | | 6 | Home&Sale |
| 31 | Rubber | *Hevea brasilliensis* | | | | ■ | ■ | | | | | | | | 5 | Home |
| 32 | Cinnamon | *Cinnamomum* L. | | | | ■ | ■ | ■ | ■ | | | | | | 3 | Home |
| 33 | Sugarcane | *Saccharum* L. | | | ■ | ■ | ■ | ■ | ■ | | | | | | 2 | Home |

* Percentage of households growing each crop.

### 3.3.4. Agronomic practices and structure of home gardens

Presently, in Hong Ha Commune, chemical fertilizers and pesticides are commonly used for crops and all the farmers understand their effectiveness. About 99% of the interviewed farmers expressed a preference for using chemical fertilizer combined with organic fertilizer because this practice led to a higher crop yield. However, the results revealed that the organic compost produced in the households was mostly brought to paddy fields. It was also applied in home gardens only in combine with chemical fertilizers, while no one used only compost or chemical fertilizers. This observation covered which counts 15% of the gardens in the commune, including 4% for vegetables only, 6% for fruits only and 5% for either vegetables or fruit trees in the dry season. All the chemical fertilizers remaining after application to paddy or maize fields were preserved. Approximately 93% of the farmers did not apply pesticides to crops in their gardens, which may result in lower productivity because of insect damage.

The harvest time of perennial crops in the home gardens indicated that their output tended to offset the distribution of the harvest season for vegetables (Table 3.4). The results revealed that the products of 22 species of fruit trees were harvested in the dry season, due to the considerable drought risk in the dry season during which several vegetable crops could not provide a harvest. Thus, the combination of perennial and annual crops in the garden enabled to satisfy families' needs for fresh foods to supplement a low income.

From the agronomic viewpoint, the advantages of mixed cropping were noted in this study base on previous studies. The land was used effectively; for example, the space was multi-layered, and the upper layer was occupied effectively by large fruit trees, while the lower layer was occupied by smaller fruit trees and other crops. Furthermore, vine crops such as pepper, dragon fruit and vanilla were able to coil up the stems of the tall crops, and even creeping crops like the *Cucurbita* family, thus using all possible space above the ground in a unit area (Tanaka and Watabe, 1981).

The canopy stratification in the home garden consisted of three layers in relation to plant height (Photo 1). The first layer included of plants with height ranging from 0.5 to 2 m, which accounted for 56% of the garden crops. The second layer included trees

with a height of 2 to 4 m, with the lowest percentage of 12%. The third layer included trees taller than 4 m accounting for 32% of the garden crop. The plants in the upper layer were fruit-bearing trees such as mango, jackfruit, longan, guava, star apple, coconut, avocado, carambola, areca nut and other trees such as *Wrightia* (*muc*), bamboo, and acacia. The second layer consisted of fruit-bearing trees such as the citrus family (pomelo, lemon, orange, tangerine), papaya, banana, sapodilla, custard apple, muricate custard apple, and persimmon, and industrial crops such as coffee, cinnamon, tea, rubber, sugarcane, and pepper and vanilla with support trees. Several leafy, fruit and flavor vegetables were grown under the canopies of these fruit trees.

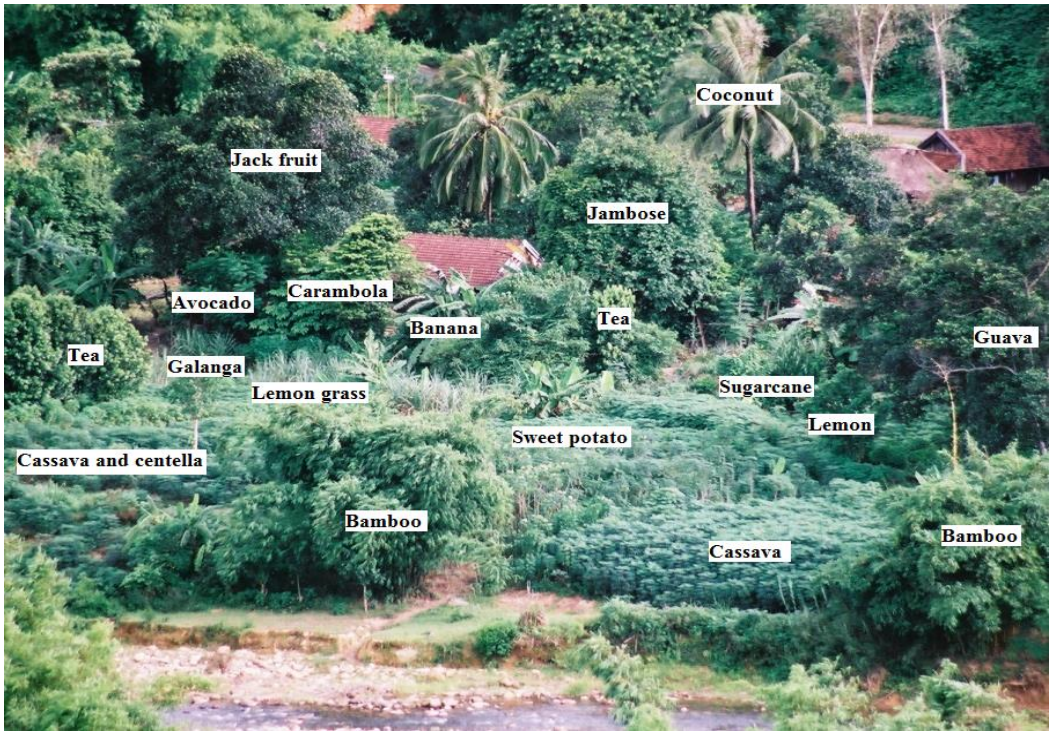



**Photo 1. Mixed cropping with the space was multi-layered in the garden**

The multilayered plant canopies or combined ponds in home gardens enable to regulate the climate on a local scale because the dense vertical plant species control the microclimatic conditions by influencing ecological factors such as soil moisture and erodibility, solar radiation, wind speed and ambient temperature (Gebauer, 2005; Jose and Shanmugaratnam, 1993; Millat-e-Mustafa *et al.*, 1994; Salam *et al.*, 1995).

### 3.3. 5. Contribution of home garden products to household income

The results of the study indicated that home gardens play a key role in providing nutritional and food security to households by ensuring a steady supply of annual and perennial crops. Annual crops contribute to nutrition in various forms, such as staple crops and seasonal crops (leafy, fruit or flavor and tuber vegetables), and supply a less profitable product, while perennial crops play a pivotal role in providing nutrition from fruits during the dry season and also offer more profitable products such as jackfruit, mango, pomelo, orange, lemon, and banana.

**Table 3.5. Income from the home garden in household economics.**

| Household Category* | Percentage of households (%) | Average total income (VND/year) | Average income from garden (VND/year) | Average garden size ($m^2$) | Contribution of income (%) |
|---|---|---|---|---|---|
| Poor | 28 | 4,800,000 | 2,400,000[a] | 1,100[a] | 50.0 |
| Near poor | 15 | 6,000,000 | 1,836,000[a] | 1,200[a] | 30.6 |
| Medium | 48 | 8,400.000 | 2,311,000[a] | 2,300[a] | 27.5 |
| Fair | 8 | 10,000.000 | 1,438,000[a] | 3,500[a] | 14.4 |

* Based on the Vietnamese government's old standard (2010).
The same letter in a column indicates no statistical difference by Tukey at $p < 0.05$.

As mentioned previously, the combination of annual and perennial crops in the home garden have important functions in providing diversification of daily food products as well as economic commodities. According to the Vietnamese government's old standard in 2010, the total income of farm households was classified into four categories, according to the income levels. The contribution of home garden income to the total income was highest in poor households, although the size of the home garden was larger in medium and fair households (Table 3.5). This was because the latter benefited from varied sources of income such as small-scale businesses, pensions, and activities in the forest or shifting cultivation areas. These results indicated that the home garden is more significant for poor households.

As seen in the commune database, the annual income of farmers in Hong Ha Commune was not sufficient to meet family needs. Paddy fields provided 8 to 10 months of food for home consumption, shifting cultivation areas and reforestation areas all support foods such as cassava, maize and non-timber forest products for 5 months of home consumption, and almost all the green fresh foods are supplies by home gardens, especially in the offseason of these crops. This type of land use fundamentally originated from the living and planting needs of individual families, and its actual practices widely varied among the households, depending on their physical and economic conditions. Farmers with sufficient resources could fully utilize different types of land for diverse production, while the others depended mainly on home garden practices because of the limited land area and lack of labor.

The government has promoted the utilization of home gardens for livelihood improvement, by organizing training courses from different aspects such as introduction of new crops, fishes and animals, soil improvement, and post-harvest processing. The training organizations have also supplied seeds and varieties of coffee, orange, pomelo, longan, dragon fruit, sapodilla and avocado, which were received by 63 of the surveyed 95 households.

# Chapter 4. INTRODUCTION OF VANILLA IN MOUNTAINOUS VILLAGE IN CENTRAL VIETNAM


## Summary

The study examined the growth performance of a new cash crop in central Vietnam to improve livelihoods. As a new cash crop, *Vanilla planifolia* was first planted in Thua Thien Hue province in 2006 with the participation of Hong Ha farmers. The study conducted farm trials in four villages belonging to the commune with the second planted is about 59 host trees in 2007 and then access 164 host trees up to 2013. Between 2007 and 2013, vanilla proved to be suitable cash crop, allowing farmers to use their land effectively, to diversify their gardens, and to develop a new source of income. Vanilla grew quickly on appropriate host trees in humus soil with compost fertilization and sufficient shading. Vine length and the number of leaves increased to an average of 4.71 m and about 75 leaves, respectively. Vanillas could bear flowers every year, farmers cared for them well, in addition to controlling the shading level and managing the garden canopy at the beginning of January. The farmers' pollination skill must be improved to increase the probability of fruiting. The fruiting rate was 33.1%, the longest fruit was 16.4 cm, and the widest had a diameter of 1.3 cm. Mature fruits were picked and processed, and could be classified by a private standard for Thua Thien Hue province devised by researchers. This activity allowed farmers to develop new cultivation techniques for their gardens and increase their confidence in producing vanilla products.



**Key words:** Cured pod, Flower bunch, Host tree, Pollination, *Vanilla planifolia*, Vine.


## 4.1. Introduction

*Vanilla* (Orchidaceae) is a genus of more than 100 recorded species of evergreen vines found in tropical and subtropical regions (Uchida, 2011). Cultivated vanilla is widely distributed across the tropics of Central and South America, Asia, and west Africa. The three species of commercial importance are *Vanilla planifolia*, *Vanilla pompon*, and *Vanilla tahitiensis* (Martins, 2009). Vanilla is the world's third most expensive spice after

saffron and cardamom. *Vanilla planifolia* (fragrant vanilla), which yields the popular, commercial, flavoring agent vanillin, is native to Mexico, although it is now grown widely throughout the tropics. Ninety five percent of vanilla beans are produced from this species (Uchida, 2011).

Global annual production of vanilla is estimated to be 2000–2300 tons, 65–85% of which is grown in Madagascar (Shriver, 2013). Indonesia is a distant second, producing an average of 150 tons annually. Other major vanilla-producing countries include Mexico, China, Papua New Guinea, and the islands of the West Indies. In Africa, Uganda and Tanzania have increased vanilla production in recent years to approximately 150 tons.

Vanillas contain an unique oil that is valuable in producing food (such as cakes, candies, ice cream, tea, and wine), medicine, and other products (Dexin, 2009). About 6 kg of green fruits produce 1 kg of processed pods (Parthasarathy *et al*., 2005). The price of processed vanilla pods was 200 USD/kg in 2001. When crops failed in 2003, the price rose to 500 USD/kg in 2004 (Sharon, 2008). By 2005–2007, those prices strongly dipped to 25 USD/kg and as low as 7.5 USD/kg before recovering to 12 USD/kg in recent years (Fuavao, 2012*)*. Because farmers can get 300–600 kg of processed vanilla fruits per hectare with care, vanilla crops can yield 3600–7200 USD/ha.

Hong Ha is a mountainous commune in A Luoi district, Thua Thien Hue province, Vietnam (Fig. 2.4). It is 40 km southwest of Hue city and conveniently situated for transportation and business growth, aiding economic development and stability. A characteristic of upland homes in Thua Thien Hue province, including Hong Ha commune, is the large (1000 $m^2$) median size of gardens compared to lowland homes. However, the populace has not exploited these home gardens for cash crops. For example, 96% of vegetables in home gardens are used for personal consumption, as are 87% of perennial crops (Minh et al, 2014). In order to improve livelihood and to mitigate the impact of storms, floods, and drought to income source in farming, farmers in this area could diversify their garden uses by introducing high-value products that do not require extensive land and inputs, such as vanilla.

Vanilla is easy to be planted and cultivated. It needs no chemical fertilizers and does not harm the host trees to which it clings for support, which means it does not occupy much space to grow and can increase the production potential per unit area. Women, children, and the elderly can care for the plants. In Hong Ha, vanilla is planted with host trees in organic cultivation systems. *Holarrhena antidysenterica*, *Sterculia lychnophora*, and Jack fruit (*Artocapus heterophyllus*) are especially recommended as host trees. *Jatropha curcas* trees are also suitable (Cach, 2010). As a part of trials for livelihood improvement in the community, a team from Hue University of Agriculture and Forestry and Kyoto University introduced vanilla to Hong Ha in 2006, and monitored the performances of the crop and farmer's responses. Farmers volunteer to care the plants and regularly share information to improve practices. Thanks to this activity, farmers enhance their livelihood and confidence when the vanilla sets fruit. Although vanilla has demonstrated potential in this village, no quantitative data on its growth and best practices have been collected. With these data, we could better understand vanilla growth performance of different management techniques on production. Thus, this study aimed to investigate the performance of vanilla plants and to evaluate its suitability as an additional home garden crop in a mountainous village in central Vietnam.

## 4.2. Material and methods

In 2007, vanilla cuttings were brought to Hong Ha commune 1 week after removal from the parent plants in Central Sulawesi, Indonesia. A group of eight farmers experienced in home garden management was organized under the supervision of researchers and the leaders of four villages belonging to the commune. These villages represented three different topographies: top-slope hillside, mid-slope hillside, and foot-slope hillside. In the initial meeting, we introduced the plant to the farmers by explaining its characteristics and how to plant it. A total of 60 cuttings were distributed (5–10 plants per farmer), and their planting was demonstrated and supervised in each farmer's garden (Table 4.1). A combination of survey records, field observations, and measurements was used to track farmer practices, fruit processing, and vanilla growth performance. Interviews of eight

pilot households were also conducted to collect data on organic matter applied, the timing and amounts of watering, tools and labor needs.

Based on Naturland (2002), Giridharand Ravishankar (2004), and Neelannavar (2006), the main characteristics of growth performance for vanilla were selected and studied from 2007 to 2012. In 2010, five vanilla plants were randomly sampled per household, and vine length and node length of each plant was measured with a measuring tape every 3 months. The flowering time of each plant was monitored; one bunch was selected and number of flowers per bunch, the rate of fruiting, and pod growth performance (width and length) were monitored in every 10 days. Flowering was observed on entire host trees at three pilot households, one each in Can Tom, Pa Rinh, and A Rom villages, selected to represent the commune landscape.

Harvested fruits have no aroma and are valueless in retail market. To develop the aroma and bring into marketable products, curing should commence within a week of harvest. A standard method of curing starts with blanching, by which plants are killed by transferring them to a bamboo basket and immersing them in hot water (65–70°C). Then, killed fruits are transferred immediately to a sweating box lined with a blanket for 36–48 hours. A suitable sunny time for sun drying over wooden boards on a blanket is proved to be from noon to 3 pm. Later on, pods are transferred to the sweating box. The next step, conditioning (slow drying), occurs in a well-aerated room maintained at around 30–35°C. Cured pods are graded based on length. The data on cured pod productivity were collected from eight households.

## 4.3. Result and discussion

### 4.3.1. *Vanilla transplanting method*

During the 5 years of this study, the number of host trees in each household increased considerably (Table 4.1). In Hong Ha, host trees could be easily planted with vanilla vines in August and September. The growers chose vanilla plants that were healthy and productive and usually trimmed them after the flowering season. They also found that trimming encouraged the growth of new shoots, rejuvenated the plants, and improved its

overall health. The cut shoots were re-planted to the host tree. With this agronomic characteristic the growers could also sell their cutting vine to other farmers from surrounding areas.

**Table 4.1. Numbers of host trees for vanilla plants in Hong Ha commune in 2007 and 2013.**

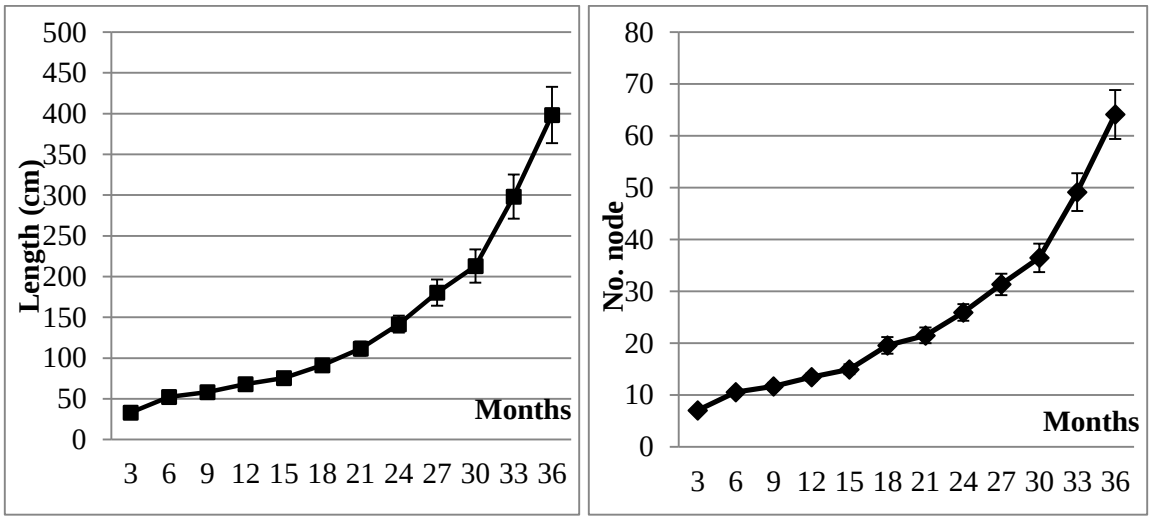
| Household | Village | Host trees in 2007 | Host trees in 2013 |
|---|---|---|---|
| KV | Can Tom | 5 | 8 |
| TA | Can Sam | 7 | 13 |
| TO | Pa Rinh | 7 | 21 |
| DE | Pa Rinh | 10 | 58 |
| NA | Pa Rinh | 5 | 16 |
| KT | Pa Rinh | 10 | 15 |
| OI | A Rom | 5 | 10 |
| QT | A Rom | 10 | 23 |
| Total | | 59 | 164 |

The cuttings were about 30–50 cm each to ensure that the propagated vine had 4–6 nodes. The cuttings were left in the shade for several days to allow the wounds to heal and fungal infection was prevented with 0.5% lime solution. These practices were adapted by the growers using local techniques for orchid species. Previous recommendations specified that cuttings should be about 60–80 cm each and be treated with 3% copper oxychloride to prevent fungi (Parthasarathy *et al.*, 2005; Alexander *et al.* 2009). Finally, seedlings were transplanted to host trees in the garden. To avoid stagnant water, dry trash or dry grass was heaped at the base of the host trees and plants were watered. With these practices the growers can manage the input of organic matter and making compost fertilizing into their garden as well.

4.3.2. Results of Vanillas growth performance

*4.3.2.1. Vanilla performance: growth and physiology*

After the flowering season, the growers practiced the following technique to facilitate vegetative growth and fixed a formatting vine. When the vines attained a height of 1–1.5 m, the growth was trailed downward very close to the ground (within 20–30 cm), then covered with soil mixed with organic matter (trash and litter) to encourage rooting. Excess length was coiled back up to cling to host trees. Support trees were pruned at a convenient height for easy trailing of vines. By this method, the vanilla plant was continually cut and transplanted to expand into the space available in the home garden.




** Forty vanilla plants were randomly sampled per eight households*

**Fig. 4.1. Growth performance of vanilla from 2007 to 2009.**

In the first year, the vanilla performances were not different from subsequent year in terms of vine length and number of nodes (Fig. 4.1), because the growth rate was still low. In addition, farmer skill was still limited, as this was their first time planting vanilla. Twelve months after planting, the average vine was 68.2 cm long, with 13 nodes of 5.1 cm length each.

In the third year after planting, the vanillas grow much better than in the first year and second year because the growers had learned to choose suitable host trees and their

skill in managing vanillas had improved each season, improved growth was evident in vine length and node number (Fig. 4.1). The reasons included suitable weather that year and practices learned by the growers, such as heaping moderate amounts of organic materials (trash and litter) at the plant's base, keeping the soil moist during the dry season, fertilizing with compost (decomposed crop residues), and adjusting to an appropriate shade level (40–60%). The vines averaged 398.5 cm in length, 64.1 leaves, and a node length of 6.2 cm after 3 years. Vine length increased 257 cm over the second year; similarly, the number of nodes increased by 38. This increase in length was very promising, similar to the report by Sujatha and Bhat (2010) from India during peak growth.

Because a node bears only one leaf, the numbers of nodes and leaves are the same. Fig. 4.1 shows that the number of nodes increased relatively quickly in 24 month-old vanilla and increased every season. In particular, in the third year, vine length increased about 100 cm every 2 months from summer to winter (months 30–36) because the weather was favorable with regular rainfall. Sujatha and Bhat (2010) noted that irrigation and rainfall are most important for vanilla during the summer; because vanilla can absorb the ambient humid by both aerial root and terrestrial roots itself.

During summer, it is very dry and hot (Fig. 4.2), therefore, vanillas without shade normally dry out the leaves and vines. Although the growers tried to supply water, they did not succeed during the first year, as evidenced by the slow growth (Fig. 3). The canopy trees in the garden were important for managing shade to control the sunlight and moisture of the vanilla plants. The sunlight intensity around 2300 – 2600 lux and moisture at 80% were fit for vanilla (Cach, 2010). Thus, growth improved in the second and third years, as the growers began to properly manage the shade.

In generally, after three years vanillas grown quickly (471.1 cm of vine length, 75.3 nodes, and 6.3 cm node length after 3 years) and plants bear many flowers (4–8 bunches/plant, 14–15 flowers/bunch) and yield fruits. These results agreed with those reported by Bhat and Sudharshan (2002), Parthasarathy *et al.* (2005), Jannice (2011), and Hailemichael G. *et al.* (2012) for vine length and flowering performance.

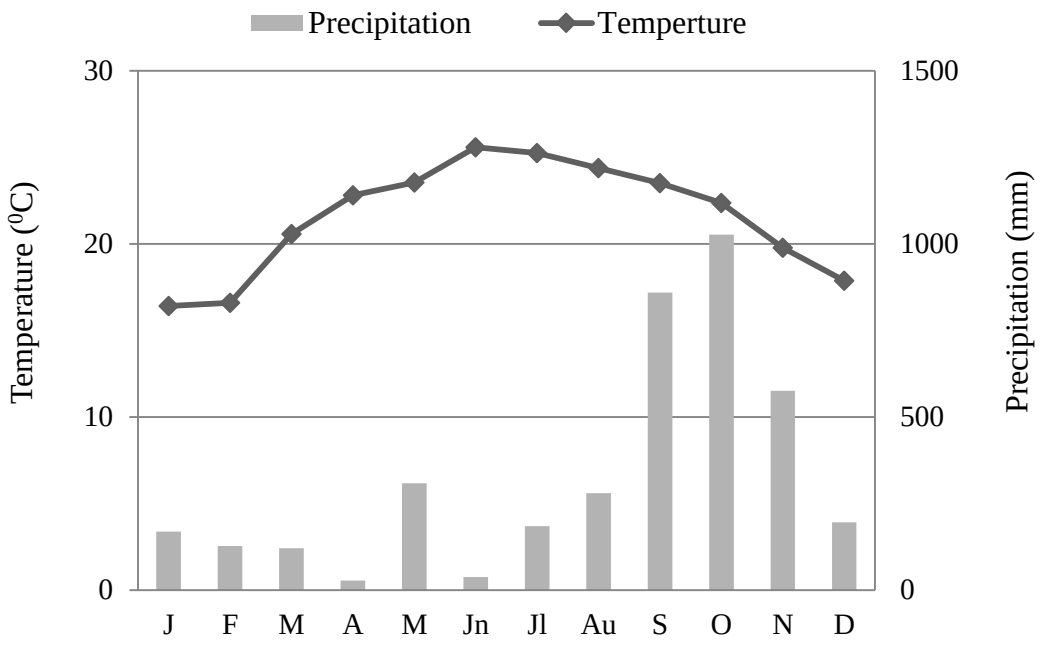



**Fig. 4.2. Average monthly rainfall and air temperature in 2007 – 2009.**
(*Source*: Aluoi's Weather Station Office, 2013)

*4.3.2.2. Vanilla performance: flowering and fruiting*

In Hong Ha commune, the flowering season lasted from late January to April, but vines mainly flourish for 1–2 months. In this season, vanillas bear both inflorescence buds and new vegetative buds. Because these buds are very similar and occur simultaneously, they are difficult to distinguish. The inflorescence bud could be clearly identified when the tip split into two or three oval parts around 10 days after bud development. The number of inflorescence buds per plant is a direct predictor of yield because most of the inflorescence buds could give the fruits after pollination. The vines produced 81% inflorescence buds and 19% vine buds during this season (Table 4.2a). This flower percentage greatly surpassed the rates reported (27.2%) by Havkin-Frenkll and Belanger (2010) and it is also reported that by the fifth year after planting, this figure reached 97.0%, and heavy flowering in one year was generally followed by reduced flowering in the following year.

**Table 4.2a. Vanilla flowering bud performance in 2010.**

| Household | Host tree with budding vanillas | Total buds | Flower buds | Flower bud rate (%) |
|---|---|---|---|---|
| QT | 6 | 38 | 30 | 79 |
| DE | 5 | 43 | 39 | 91 |
| KV | 3 | 15 | 11 | 73 |
| **Average** | | | | **81** |

The flowers open in the morning and close before noon. Pollination must be done when the flowers are maximally open. From the initiation of the inflorescence bud to the first flower took 14.3 days, with another 3 days to bear the first fruit (Table 4.2b). Vanilla cannot self-pollinate because the *rostellum* prevents the stigma from coming into direct contact with pollen grains (Rain, 2005). Hence, artificial hand pollination is necessary by pushing back the *rostellum* with a toothpick or bamboo splinter. One of the most important skills of the growers is to identify the maturing pollen and quickly push on the stigma. In Hong Ha, a skilled farmer can pollinate one flower in a minute. Generally flowering and pollination continued for about 3–5 weeks, with the best time for pollination from 9 am to 10:30 am.

An important problem was that even if many blossoms were pollinated, shoot development was reduced, and the fruits barely ripened or fell to the ground. The plants were also susceptible to pests and diseases. Therefore, the number of blossoms pollinated depended on the development stage of the plant as well as the water supply.

During the flowering period, there were 4–8 flower bunches per plant at maximum (Table 4.2a) and 14–15 flowers per bunch, with a bunch length of 5.9–6.8 cm (Table 4.3). These results were similar to those reported by Parthasarathy *et al.* (2005) and Bhat and Sudharshan (2002).

**Table 4.2b. Vanilla flowering bud performance in 2010.**

| Household | Flower bud appeared to… | |
|---|---|---|
| | Days to pollination from bud appearance | Days between bud and pod appearance |
| QT | 17.2 | 20.4 |
| DE | 12.6 | 15.4 |
| KV | 13.2 | 16.4 |
| **Average** | **14.3** | **17.4** |

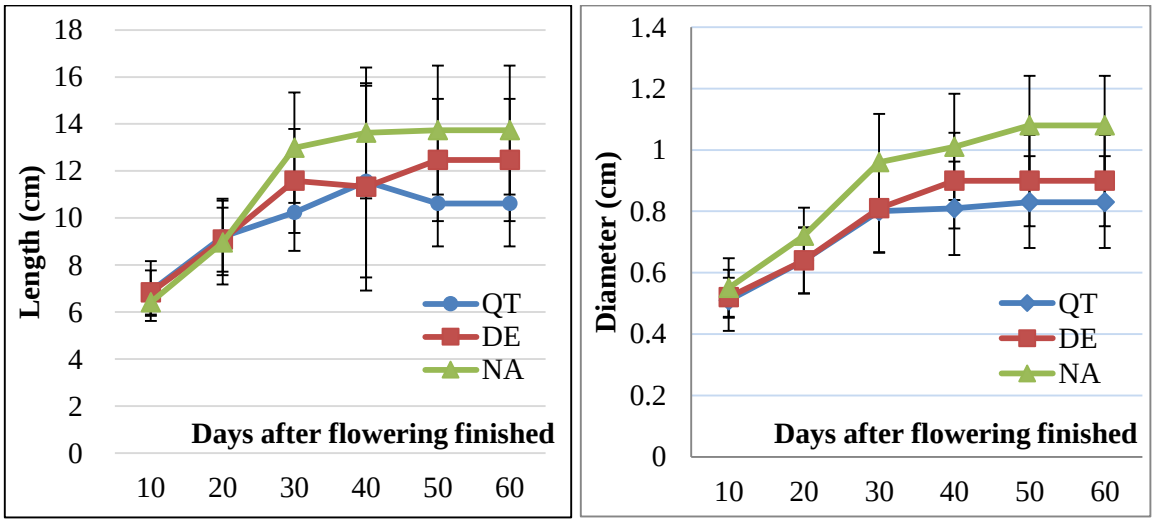
Although the leaves yellowed slightly in summer when shading was light (20–30%), the plants yielded fruit. In summary, proper farming techniques, such as the watering regime and shading level, allowed the vanillas to grow well and fruit. Based on interviews, 30–45 L of water per clump, divided into three watering per week, was a good practice. The time and labor spent to manage the home gardens allowed it to be a subsidiary primary activity of farming. In general, vanillas require minimal watering of about 15 L/clump/week, which could be provided by family members on a flexible schedule.

Even though each bunch produced 14–15 flowers, only five flowers on average bore fruits after artificial pollination (Table 3). Because the plant required a lot of nutrients and water in the dry season, the plant was stunted after the flower season. These results were similar to the report by Rain (2005) that pollination accounts for about one-third of the labor required by each plant. Some growers stated that the investment of skill was best when this ratio of pollinated flowers was maintained. Only successfully pollinated flowers could keep corolla on ovary. Fruits took 8–9 months to mature. The total number of fruits per bunch varied greatly, from 0.5 to 9.2, resulting in fruiting rates of 3.6–61.7%. This variation occurred because some growers lacked the skills to estimate pollen maturation time and to manipulate the *rostellum* to reveal the tip of the stigma.

**Table 4.3. Some indicators of Vanilla bunch in 2010.**

| Household | Bunch length *(cm)* | Total flw/bunch | No. of flw successfully pollinated/bunch | Rate of fruiting (%) |
|---|---|---|---|---|
| QT | 5.9 | 14.9 | 9.2 | 61.7 |
| DE | 6.8 | 15.0 | 5.1 | 34.0 |
| KV | 6.5 | 14.1 | 0.5 | 3.6 |

The green fruits of marketable pods can attain lengths of 10–20 cm and become yellow as they mature. In 2010, marketable green fruits averaged 12.3 cm in length and 0.98 cm in width 2 months after pollination (Fig. 4.3). Fruits grew considerably between 20 and 40 days after pollination. They did not differ significantly among growers.




** Fifteen vanilla plants were randomly sampled per three households*

**Fig. 4.3.Growth performance of Vanilla pods in 2010**

*4.3.2.3. Vanilla performance: fruit harvesting, fruit curing, and pod grading.*

Vanilla pods were ready for harvest 8–9 months after flowering. Harvesting should be done at the appropriate stage because overly mature pods can dehisce, reducing their

market value. Generally, harvesting began in November and ended in December. Because of variation in flower bud initiation, there was no uniformity in fruit development or pod maturity, even within a bunch, and each pod was harvested individually based on its color. Immature dark green pods were not harvested. Slight yellow discoloration at the fruit tip indicated maturity. Vanilla aroma develops through the fermenting and drying procedures of killing, sweating, sun drying, and slow drying. The farmers use methods based on available materials, such as water tanks for killing, drying tool (bamboo baskets) and sweating container (wooden box, carton box), as well as their own experiences (water temperature, conditioning time). Green vanilla pods are flavorless and contain little vanillin, earning only 5–10 USD per kilogram, while cured pods are worth as much as 45–50 USD per kilogram. During processing, fresh fruits lose as much as three fourths of their original weight. The average weight per cured pod was about 1.5 g. After processing the product can be easily shipped to coffee shop or ice cream shop.

**Table 4.4. Pod grading in vanilla-growing households from 2009 to 2012.**

| Household | Year | Total weight (g) | Total fruit (pods) | Highest quality (pods) | Intermediate quality (pods) | Lowest quality (pods) |
|---|---|---|---|---|---|---|
| QT | 2009 | 35 | 21 | 6*(29%)* | 15*(71%)* | 0*(0%)* |
| TO | 2010 | 40 | 40 | 31*(78%)* | 9*(22%)* | 0*(0%)* |
| DE | | 55 | 59 | 26*(44%)* | 27*(46%)* | 6*(10%)* |
| TO | 2011 | 30 | 17 | 10*(59%)* | 7*(41%)* | 0*(0%)* |
| DE | | 160 | 133 | 38*(29%)* | 80*(60%)* | 15*(11%)* |
| NA | | 40 | 14 | 7*(50%)* | 5*(36%)* | 2*(18%)* |
| OI | | 150 | 89 | 18*(20%)* | 71*(80%)* | 0*(0%)* |
| TA | | 180 | 123 | 31*(25%)* | 90*(73%)* | 2*(2%)* |
| TO | 2012 | 140 | 52 | 48*(92%)* | 4*(8%)* | 0*(0%)* |
| **Total** | | **830** | **548** | **215** | **308** | **25** |

*Highest quality: > 15 cm; Intermediate quality: 10 – 15 cm; Lowest quality: < 10 cm*

The commercial value of mature fruits is determined by pod length. Due to limited cultivation techniques of the growers with current development status of vanilla fruit in Hong Ha commune, to evaluate the quality of the fruit after processing, the

authors classified the quality into three categories as follows; If the pod was greater than 15 cm in length and had a uniform dark color, it was categorized highest quality; 10–15-cm-long brown pods were considered intermediate quality and those less than 10 cm in length were of the lowest quality. The results revealed that the amount of cured pods is varying in the different harvested years and also among quality categories (Table 4). A highest yield of cured pod was found for intermediate quality (308 pods) and highest quality (215 pods), and lowest quality (25 pods), respectively. For the variation of the result, the growers who gave reason that; if they pollinate to all of flowers in a bunch, it was varying in the different categories of fruit. Therefore, the setting pollination for flower should 40-50% of flower per bunch has indicated.

**Table 4.5. The situation of flowering management in vanilla households.**

| No. | Household | Year | Gave flower | Pollination | Processing |
|---|---|---|---|---|---|
| 1 | TA | 2009 | O | O | X |
| 2 | QT | | O | O | O |
| 1 | KV | 2010 | O | X | X |
| 2 | TO | | O | O | O |
| 3 | DE | | O | O | O |
| 4 | QT | | O | O | X |
| 1 | KV | 2011 | O | X | X |
| 2 | TO | | O | O | O |
| 3 | DE | | O | O | O |
| 4 | NA | | O | O | O |
| 5 | KT | | O | X | X |
| 6 | OI | | O | O | O |
| 7 | QT | | O | O | X |
| 8 | TA | | O | O | O |
| 1 | TO | 2012 | O | O | O |
| 2 | DE | | O | O | X |
| 3 | OI | | O | O | X |

O: Shows the succeed process X: Shows the failed process

Although there are some standard methods of curing, their modification should be considered according to local and seasonal conditions such as bean size and quality,

weather, and available facilities, while the curing may be done as a household practice to industrial scale, facilitation of appropriate space, equipment, and human resource essential. Four steps of vanilla pod processing have been demonstrated by local people recorded as follows (Fig. 4.4):

1. Killing: Graded beans are transferred to a bamboo basket and immersed in hot water at temperature of 65-70$^0$C for indicate period.
2. Sweating: The treat beans are then transferred immediately to the cardboard box/wooden box lined with blanket, for sweating and kept for 36-48 hours. The temperature initially is to be 48 – 50$^0$C. By then, the beans will attain light brown color and start imparting aroma.
3. Sun drying: Later on, the beans are spread in hot sun (from 12 noon to 3pm) over wooden loft on a clean black blanket. The temperature of the pod, at this time should rise to 50$^0$C. Later on, the bundles are transferred to the sweating box. Sun drying and sweating is continued grade wise.
4. Conditioning (slow drying): The next step involves the spreading of the beans in racks kept in well ventilated room maintained around a temperature of 35$^0$C and relative humidity at 70%.

On the whole, the lesson to be taken care during the curing process should note to know some remember points that recorded as bellows:

- Curing of green fruits is to be commenced within a week of harvest
- Matured, light green of yellow colored fruits are to be harvested individually, avoiding broom harvesting (green fruit and mature fruit harvested together).
- Daily sun drying is to be followed by proper sweating for controlled fermentation. The pods are to be examined every day during sun drying and conditioning for avoiding infection.

  To be kept good aroma of curing pods, the conditioning (slow drying) avoids or escape the place where usually taken smoke such as kitchen's shelves, oven place and cooking fire.

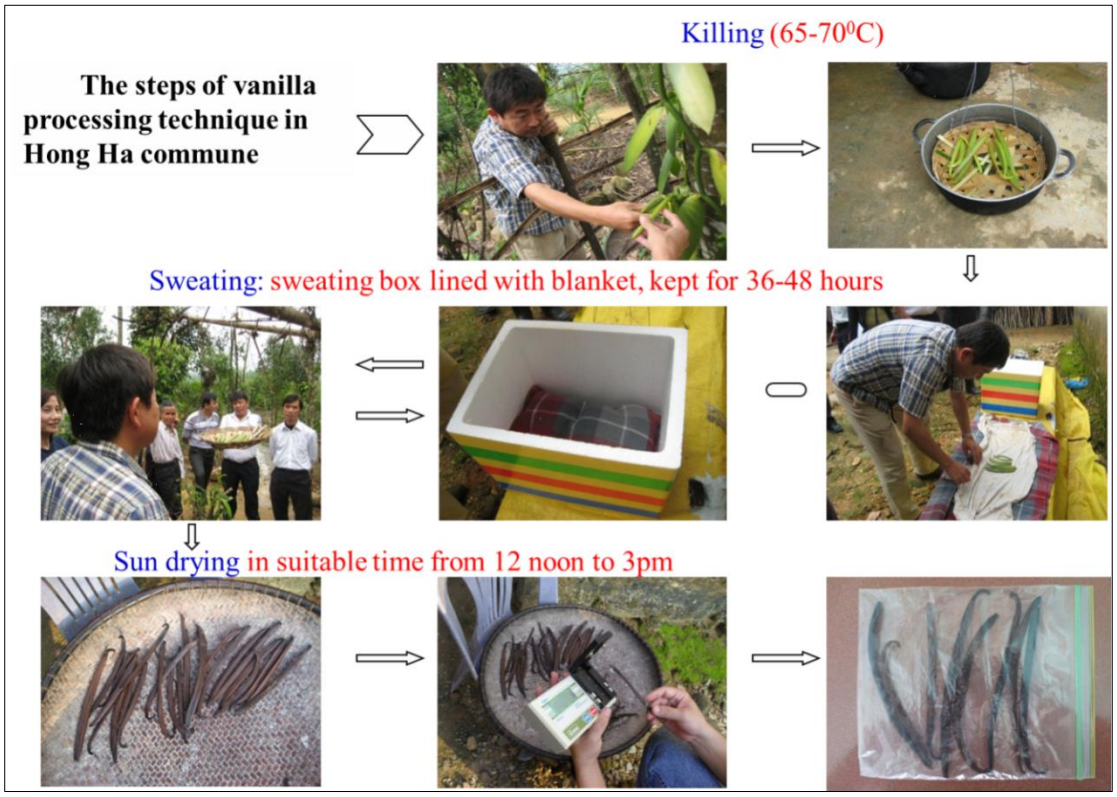



**Fig. 4.4. Production process of vanillas cured pod**

# Chapter 5. SUMMARY AND REMARKS

This chapter summarizes and remarks the main findings induced from chapter 3, chapter 4 and chapter 5. The study has aimed to identify the main role of home garden to livelihood of upland family home through their conventional practices, and also point of view about vanilla plant as a commercial crop composed to home garden practices of local farmers and develop their interests an understanding to the crop; as well as reveal the main results of vanillas trial in experimental farm that way seem to be optimize planting techniques into different field conditions.

**+ Home garden where crops are diversified valuable agricultural product which can be grown under wide range of environment but requires intensive labors inputs and implementing cash crop. Diversification of income sources is the important way to enhance their livelihood to avoid risks or shocks such as flood and typhoon**

The home garden is one of the main components of the village landscape and is used to grow various home-use and cash crops around the house. The home garden practices of farmers in upland villages of central Vietnam are characterized by mixed cropping and numerous different sequences of annual and perennial crops, some plants are used for multiple purpose. The importance of home garden goes far beyond of only a source of income, and they are a life supporting system and may be recognized by their most importance function. This is the result of the home garden practices of local people to maintain and improve their livelihood under local conditions in terms of land and water resources and diverse crop species.

Home gardens could provide jobs during the offseason of crop cultivation in the main field. Home garden systems show that their crop output can contribute efficiently to the total income of the household. With a garden, there is no need to buy any fresh food from outside. Improved home garden practices such as further crop diversification and introduction of high-value crops need to be implemented based on field studies to enhance the villagers' livelihood security. These crops should be adapted to local conditions such as the small land size, harsh climate, scarce water resources in the dry season, pests and drought.

**+ Diversified production through utilization of local natural and social resources at an appropriate scale will lead the community toward higher resilience against various risks; Vanilla is a new variety has seem to be adapted with weather and natural condition in central Vietnam; it also seem to be cash crop and enhance/improve home garden practice.**

Vanilla was particularly suitable as an additional crop in diversified home gardens and could be easily integrated into the existing system of tree cultivation. Developing a home garden system with vanilla production was feasible in this mountainous village. This activity was enhanced by the farmers themselves; for example who measured some growth parameters and developed techniques to bend and fertilize/mulch the vanilla plants.

In Hong Ha commune, vanillas (*Vanilla planifolia*) grow well and were suitable to the local ecological systems. Vanilla management included heaping moderate amounts of organic materials at the plant base, keeping the soil moist during the dry season, compost fertilization, and appropriated shade levels. Under these conditions, vanillas grown quickly and plants bear many flowers, and yield fruits.

Because these farmers had planted vanillas for the first time, their cultivation skills were still limited in vine bending, pollination, and other techniques, so they need additional training. However, the farmers are confident because the vanillas flowered after 3 years and fruits have been harvested every year since, increasing their interest in caring for the vanillas and their gardens. Therefore, enhancing the gardens includes more host trees, improving the curing techniques, and finding national and domestic markets are all worthy goals.

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## Appendix 1. PHOTOS

### 1. Home garden practice in Hong Ha commune

**Appendix 1.1. The house with garden surrounding and scatter field site**

**Appendix 1.2. The house with garden surrounding**

**Appendix 1.3. Home garden with fish pond utilization**

**Appendix 1.4. Home garden with diverse crops species**

**Appendix 1.5. Home garden with diverse crops species**

**Appendix 1.6. Some selling of home garden products**


**Appendix 1.7. Home garden canopy and shade keeping**

**2. Vanilla plant grew naturally seems to be adapted under home garden conditions in Hong Ha commune**

**Appendix 1.8. Vanillas suitable with host tree and home garden canopy shading**

**Appendix 1.9. Flowering**

**Appendix 1.10. Artificial pollination**

**Appendix 1.11. Vanilla pollination training from farmer to farmer**

**Appendix 1.12. Fruiting**

## Appendix 2. SURVEY QUESTIONNAIRES

***Code:*** :……
***Date:*** ……/ 09 / 2012

**I- Investigate general information.**

1. Address: Village…….Hong Ha commune
2. Household mane: ……
3. Classification of household: 1. Poor ☐ 2.Near poor☐ 3. Midle☐ 4. Pretty ☐
4. Housing area: …….. $m^2$

5. Demographic structure:

| Number of family members | Age < 18:…….. | | | | | Age 18 – 60:…… | | | | | Age > 60:……. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Gender | | Edu. Level | | | Gender | | Edu. Level | | | Gender | | Edu. Level | | |
| | Male | Female | Pri. Sch. | Sec. Sch. | Hig. Sch. | Male | Female | Pri. Sch. | Sec. Sch. | Hig. Sch. | Male | Female | Pri. Sch. | Sec. Sch. | Hig. Sch. |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |

**6. How many families labor involved in producing?**

- Main labor: Male: …… Labor Female: …….. Labor
- Semi labor: Male: …… Labor Female: …….. Labor

**7. Income structure from the garden**

- Which income resource from the home garden?

☐ Income from vegetables: …….....VND/year
☐ Income from fruit trees: ..……..... VND/year
☐ Income from industrial crops: ……..... VND/year
☐ Income from fruit crops: ……..……..... VND/year

**8. Training:** □ Yes □ No

- The training session have been involved since 2007 to present:

| **Training course** | **No. of Participants** | **When organization?** | **Who's join?** (Wife, husband,…) | **Whho organized?** | **Where organization?** |
|---|---|---|---|---|---|
| 1. Agriculture | | | | | |
| 2. Gardening | | | | | |
| 3. Agricultural Processing | | | | | |
| 4. Other | | | | | |

**9. Please said that which the training is effective?**

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

**II- Current used of garden.**

1- Total area: ……. $m^2$

2- Classification of land use.

□ Good □ Middle □ Bad □ Very bad

3- Land status.

□ Adjacent areas □ Non-adjacent area

□Plane □ Slope < $10^0$ □ Slope > $10^0$

4- Vegetable plantation:

Area: …… $m^2$

Breed source:

□ Buy □ Keeping □ Importune

5- Fruit plantation.

Area: …… $m^2$

Category of plant:

□ Annual □ Perennial

Breed source:

□ Buy □ Keeping □ Importune

6- Fish pond:

Area: …… $m^2$

Position compared to the house: .....

7- Water sources.

□ Always:

+ Water wells + Irrigation system (canals)

+ Reservoirs + Water tank

+ Water canyon supply

□ Dependent (Rainfall water)

□ Drought:

+ Yes (From …… to ……..)/ Month to month + No

□ Flooding

+ Yes (From …… to ……..)/ Month to month + No

8- Fertilizer applies.

□ Yes □ No

9- Plant protection.

□ Yes □ No

10- Traffic status.

□ Advantages □ Un advantages

11- Assess income from garden.

□ Effective □ Non effective

12- Modification proposal.

□ Capital □ Techniques

□ Policy □ Others:

(…….....……
…….....)

13. Could you please explain the above suggestions on improving the efficiency of garden land use?

.....

.....

**III- The use of garden.**

**1- Vegetable area structure**.

A1: Vegetables: ……$m^2$

A2: Intercropping: ……. $m^2$ (from month….. to month …..)

A3: Seasonal vegetables: …….. $m^2$ (from month….. to month …..)

A4: Extensive culture: ……...$m^2$

**2- Vegetables structure:**

| Category of vegetables | Origin of breed | Stability | Crop | Where planted in the garden | Type of cutivation |
|---|---|---|---|---|---|
| **Leafy vegetables** | | | | | |
| Morning glory | | | | | |
| Euphobia | | | | | |
| Taro | | | | | |
| Brasica family | | | | | |
| Amaranth | | | | | |
| Basela alba | | | | | |
| Rau máCentella | | | | | |
| | | | | | |
| | | | | | |
| **Fruit vegetables** | | | | | |
| Pumkin | | | | | |
| Gourd | | | | | |
| Pepper hot | | | | | |
| Tomato | | | | | |
| Bittle gourd | | | | | |
| Luffa | | | | | |
| Eggplant | | | | | |
| Banana flower | | | | | |
| Edible ficus | | | | | |
| Passion fruit | | | | | |
| GấcMomordica | | | | | |
| | | | | | |
| **Flavourvegettables** | | | | | |
| Ginger | | | | | |
| Saffron | | | | | |
| Citronella | | | | | |
| Piper lolot | | | | | |
| Paederia | | | | | |
| Onion | | | | | |
| | | | | | |
| **Others (Use shoot, tuber, fruit…)** | | | | | |
| Bamboo shoot | | | | | |
| Winger yam | | | | | |
| Sweet Potato | | | | | |
| Diplaziumesculentum | | | | | |
| Green Jackfruit | | | | | |
| | | | | | |

- Fertilizer applies:

□ Yes □ No

Fertilizers (If said YES)

□ N □ P □ K □ NPK □ Organic fertilizer

- Type of use products:

□ Use in the home Percentage of demand: ……..%

□ Sell: The proceeds: …….. (VND/month) OR…….(VND/crop/….$m^2$)

- Use of chemical plant protection.

Spraying:

□ Yes □ No

| Categories | Unit | Crops | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Leafy vegetables | | Fruit vegetables | | Flavour vegetables | | Others (Use shoot, tuber, fruit) | |
| | | Amount | Price | Amount | Price | Amount | Price | Amount | Price |
| *Productions costs* | | | | | | | | | |
| Fertilizers: (N, P, K, DAP NPK, Organic fertilizer) | kg | | | | | | | | |
| Plant protection<br>- Pesticide<br>- Fungicide | | | | | | | | | |
| Breeds | kg | | | | | | | | |
| Othe | | | | | | | | | |
| *Total income* | | | | | | | | | |
| | | | | | | | | | |

**3- Orchard structure:**

| **Trees** | **No. of trees** | **Age of tree** (năm) | **Month for harvest** | **Height** (m) | **Breed source** | **Other purposes** |
|---|---|---|---|---|---|---|
| 1. Jackfruit | | | | | | |
| 2. Lemon | | | | | | |
| 3. Orange | | | | | | |
| 4. Pine Apple | | | | | | |
| 5. Papaya | | | | | | |
| 6. Guava | | | | | | |
| 7. Banana | | | | | | |
| 8. Avocado | | | | | | |
| 9. Mango | | | | | | |
| 10.Pomelo | | | | | | |
| 11. Dragon fruit | | | | | | |
| 12. Longan | | | | | | |
| 13. Cherry fruit | | | | | | |
| 14. Mulberry | | | | | | |
| 15. Custar Apple | | | | | | |
| 16.Soursop | | | | | | |
| 17. Carambola | | | | | | |
| 18. Sapodila | | | | | | |
| 19. Star fruit | | | | | | |
| 20. Ambrella | | | | | | |
| 21. Areca nut | | | | | | |
| 22. Coconut | | | | | | |
| 23. Persimmon | | | | | | |
| 24. Tangerine | | | | | | |
| | | | | | | |
| | | | | | | |

- Fertilizer applies:

□ Yes □ No

Fertilizers (If said YES)

□ N □ P □ K □ NPK □ Organic fertilizer

- Type of use products:

□ Use in the home Percentage of demand: ……..%

□ Sell: The proceeds: ……..(VND/month) OR…….(VND/crop/….$m^2$)

- Use of chemical plant protection.

Spraying:

□ Yes □ No

| Categories | Unit | Crops | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Leafy vegetables | | Fruit vegetables | | Flavour vegetables | | Others (Use shoot, tuber, fruit) | |
| | | Amount | Price | Amount | Price | Amount | Price | Amount | Price |
| *Productions costs* | | | | | | | | | |
| Fertilizers: (N, P, K, DAP NPK, Organic fertilizer) | kg | | | | | | | | |
| Plant protection<br>- Pesticide<br>- Fungicide | | | | | | | | | |
| Breeds | kg | | | | | | | | |
| Othe | | | | | | | | | |
| *Total income* | | | | | | | | | |
| | | | | | | | | | |

**4- Structure of industrial crops – food crops and other crops in home garden**

| **Industrial crops** | | | | |
|---|---|---|---|---|
| Plant | No. of plant | Month for harvest | Where planted in the garden | Breed source |
| 1. hot pepper | | | | |
| 2. Coffe | | | | |
| 3. Cinnamon | | | | |
| 5. Tea | | | | |
| 6. Legume | | | | |
| 7. Ruber | | | | |
| *Other*: Vanilla | | | | |
| | | | | |
| **Food crops** | | | | |
| Plant | Stability | Crop | Where planted in the garden | Breed source |
| a. Casava | | | | |
| b. Corn | | | | |
| c. Rice | | | | |
| d. Tuber of sweet potato | | | | |
| **Others** | | | | |
| Plant | No.of Plant – No. of clump | Month for harvest | Where planted in the garden | Breeds source |
| Bamboo | | | | |
| Cannacea | | | | |
| Acacia | | | | |
| Jatropha | | | | |
| wrightia | | | | |

- Fertilizer applies:

□ Yes □ No

Fertilizers (If said YES)

□ N □ P □ K □ NPK □ Organic fertilizer

- Type of use products:

□ Use in the home  Percentage of demand: ……..%

□ Sell:  The proceeds: ……..(VND/month) OR…….(VND/crop/….$m^2$)

- Use of chemical plant protection.

Spraying:

□ Yes  □ No

| Categories | Unit | **Crops** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Leafy vegetables | | Fruit vegetables | | Flavour vegetables | | Others (Use shoot, tuber, fruit) | |
| | | Amount | Price | Amount | Price | Amount | Price | Amount | Price |
| *Productions costs* | | | | | | | | | |
| Fertilizers: (N, P, K, DAP NPK, Organic fertilizer) | kg | | | | | | | | |
| Plant protection<br>- Pesticide<br>- Fungicide | | | | | | | | | |
| Breeds | kg | | | | | | | | |
| Othe | | | | | | | | | |
| *Total income* | | | | | | | | | |
| | | | | | | | | | |

**5. According to the family, Which kinds of plants are easy to sell and high prices that your home garden is growing?**

| Crops/Products easy to sell | Crops/Products get high price | Note (How sale prices) |
|---|---|---|
| 1 | 1 | |
| 2 | 2 | |
| 3 | 3 | |
| 4 | 4 | |
| 5 | 5 | |

6. Which species before planting, but now no longer growing or grow very little?

Why?……

……

…….

7. Should you add the new plants to grow in your garden?

Why? .....

.....

.....