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**ECONOMIC APPRAISAL AND AGRO-BIODIVERSITY DEVELOPMENT OF  
URBAN AGRICULTURE IN HUE CITY, VIETNAM**

DIPLOMA THESIS

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## Statement

I hereby declare that I have compiled my diploma thesis entitled “Economic appraisal and agro-biodiversity development of urban agriculture in Hue city, Vietnam” by myself and have used all the resources mentioned in the references.

In Prague, 24 April 2013

.....

Signature

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## Abstract

Home gardens play an important role in household strategies as they contribute to their livelihood sustainability. They are a typical example of farming systems documented in urban or peri-urban areas. Vietnam has been witnessing fast economic development during the last twenty years and its cities now experience huge migration of population at rural-urban gradient. Together with personal income growth and increasing number of tourists, there is a growing demand for food, both in terms of quantity and quality. The position of urban and peri-urban agriculture can thus shift from subsistence to market-oriented production and improve household cash security. The aim of the research is (i) to understand the impact of home gardens on household economy in Hue City, (ii) to document cultivated plants and their uses, and, (iii) to assess the attitudes of urban farmers towards new challenges including market potentials or urban threats. Data were collected from July to August 2012 among 99 farmers, who were involved in planting home garden higher-added value crops in Hue City and surrounding suburbs, via direct observations and questionnaire filling. Results show that farmers grow fruits and vegetables primarily for income generation and keep lower part of their production for subsistence. From 30 most frequently documented crop species, majority were predominantly market oriented (i.e. *Musa balbisiana*, *Citrus grandis* and *Citrus paradise*). Surprisingly, farmers are not planning to manage enhancement of their home garden production in the future. They perceive negative influences hindering future development of urban agriculture particularly in price fluctuation and pollution. Local authorities could support urban farmers by developing a food system plan adapted to Hue City's challenges. It can be concluded that increasing demand for food cannot be considered as a driving factor for changes in the structure or market orientation of home gardens in peri-urban and urban areas of Hue city.

## Key words

Peri-urban agriculture, home gardens, commercialization, ethnobotany, Vietnam

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## **Introduction**

Home gardens traditionally represent a subsistence oriented farming system, which significantly participate to worldwide food supplies. Since generations, households combine through small-scale cultivation various efforts to be nutritionally better off. In many developing regions and especially among poorer populations of urban or peri-urban areas, home gardens offer increasingly more advantages as they are a source of fresh food for own consumption but also a possible source of additional income. Since the 1980's, home gardens have been witnessing extended interest particularly in those dynamically growing regions. They were newly perceived by different actors as specific tools for poverty alleviation by addressing economic and nutritive deficiency in low or middle income societies.

Vietnam represents a suitable example for the socioeconomic assessment of home gardens among countries with rapid socioeconomic development. The Vietnamese economy was in majority based on agriculture and has quite suddenly developed a thriving export-oriented manufacturing sector. Economic reforms and accession to WTO in 2007 combined with cheap labor force has led to an influx of foreign investment and subsequently triggered the economic miracle that has rocketed Vietnam from one of the five poorest countries in the world in 1985 to an average per capita income of over 1,000 USD in 2010. Though many Vietnamese still face severe poverty, the country as a whole now stands at the limit of middle-income status. Although industrialization pursues, the declining agricultural sector still plays an important role with a large percentage of the population still being reliant on farming. Furthermore, urban population already represents 30% of Vietnamese population. It increases annually by 3% is expected to continue as cities attract economic activities and thus concentrate livelihood opportunities, services and better infrastructure than rural areas. In addition to the increasing migration at the rural-urban gradient, Vietnam is a new destination for international visitors and shows a 10% average growth rate in tourism. Coastal cities such as Hue rapidly became favorite destinations for tourists travelling from the north to the south or vice versa.



The steady increase of urban population and the overall increase of life standards are affecting urban agriculture, which stresses the importance of home gardens' deep analysis as urban farming is central to many residents' household economy. Home gardens as a specific urban and peri-urban farming system play a significant role in enhancing food and cash security of involved farmers but also benefit to other inhabitants by addressing the multiplying demand for food. However, in the actual vibrant globalization process, complex socioeconomic changes affect traditional ways of life. In consequence, those thousand year old farming systems are subject to the influence of various factors and require special attention as their position in the household livelihood strategies may be changing in both agro-biodiversity and socioeconomic patterns.

## Literature review

Urban agriculture has an old history all over the developing world. The origin of home gardening is related to fishing communities living in Southeast Asia from 13<sup>th</sup> to 9<sup>th</sup> millennium B.C. (Wiersum, 2006). Cities of Morocco, Peru, China, Kenya, Mali, Brazil or Nigeria are nowadays reputed for producing fresh vegetables and livestock for the city market. Nevertheless, urban agriculture has been for long forgotten and even fought by urban managers, especially in Latin America and Africa, because it was considered as an illegal activity inherited from old times (UNDP, 1996).

Home gardens as non negligible farming systems became an interesting topic since the 1980's. It had recently benefited from an emerging awareness of its potential to alleviate hunger and economic and environmental crises in metropolises. With worsening of urban problems due to civil strife and population growth, some countries like Zaire, Peru or Vietnam saw the urban farming activities and its production rose (Egal et al, 2001). As large-scale agriculture and distribution systems as well as urban food supply were disrupted, people focused on their own production and developed farming activities without any official support or recognition. The home gardens thus gained even more cultural value (Trinh et al., 2003). More recently, the role of agriculture in rapidly developing cities has been analysed in cooperation with urban planners and public decision-makers (Bryant, 1997; Bontje, 2001; van Veenhuizen, 2006). Development of urban areas puts pressure both on those actors and home gardening farmers over the future coexistence of traditional farming activities and modern urbanization forces, so that all together, they form a sustainable system (Monédiaire, 1999; Kumar and Nair, 2006; Sullivan and Lovell, 2006). Meeting today's needs without compromising the ability of future generations to satisfy their needs is a key issue in all land use activities today.

Home gardens are one of the main components of a larger concept: the urban agriculture, which was defined as "agriculture located within a city or on its periphery, the product of which are at least partly destined for the city, and for which alternative

agricultural and non-agricultural uses of resources are possible” (Moustier and Mbaye, 1999). Home gardens are both the most common and the most varied urban agricultural system across all continents. They are characterized by combined cultivation of trees and crops around the homestead. Mixed cropping is very suitable in tropical climates and most of world home gardens can be found in humid or subhumid tropics (Nair, 1989). They are known as *Talun-Kebun* or *Pekarangan* in Indonesia, *Shamba* and *Chagga* in East Africa, *Huertos Familiares* in Central America and as *Vuon Nha* in Vietnam (Nair, 1993). Apart from home gardening, urban agriculture also designates container or soilless horticulture, animal husbandry and agroforestry practiced within city borders. Usually, urban areas are differentiated from rural areas by national laws and regulations defining cities as particular entities, which may vary from one country to other. The purpose of home gardening was primarily outlined as the food supply for family consumption, respectively for its nutritional benefits as well as for barter with neighbours (Brownringg, 1985; Fernandes and Nair, 1986). On the other hand, a substantial number of urban households involved in home gardening orientate at least part of their production to markets (Ellis and Sumberg, 1998; Maxwell, 2003; Zezza and Tasciotti, 2010).

Urban agriculture produces all kinds of horticultural crops and species, depending mainly on local tastes, nutrition and religious habits.<sup>1</sup> Home gardens, by their small size and mainly family-oriented consumption, produce generally food plants (food crops and fruit trees) consisting mainly of perishables (Kumar and Nair, 2006). In developing countries but also in developed countries, home gardeners usually grow vegetables (Bricas and Seck, 2004; Temple and Moustier, 2004). Production of fruit and vegetable allows urban residents to improve their living standards. On one hand, through year-round production of nutritional food, the home garden encourages household food security. On the other hand, selling or exchange of non-staple crops brings additional income to the household in terms of cash or in-kind products. Farmers can choose to grow high-value crops or specialty market crops (Kumar and Nair, 2006). The intensive

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<sup>1</sup> Large fruit of good color and taste are often given as presents and even more demanded during special occasions such as National Holidays and Tet-the Vietnamese New Year.

production of cash-crops refers to market gardening and involves also related non-agricultural activities (UNDP, 1996). For instance, street food and family-owned restaurants are a typical service all around Vietnam and in Asia in general. Often, women cook directly on the pavement or circulate through the city with a cooking trolley. These independent outlets are mostly located in crowded parts of cities and are available at any time of the day. The offered food is in majority produced and processed within the households.

Fresh products or food generated in urban areas can also be sold in small household-owned grocery shops or supply other restaurants of the cities and vibrant markets. According to the Vietnamese Ministry of Trade, there are about 8,000 traditional wet markets in Vietnam and hundreds of thousands of small private shops spread all over the country. Household-owned shops and wet markets are still the most popular destinations for consumers in Vietnam especially for the purchase of food. Modern retail outlets such as hyper or supermarkets currently have a market share of only 6% for fresh fruit and vegetables (Mergenthaler et al, 2008). Outside of Ho Chi Minh City and Hanoi, food distribution heavily relies on the traditional channels. Producers sell their production directly or via a middleman on open-air or enclosed traditional wet markets, particularly in the greater proportion of the country where western-type shops do not exist.

Economic growth, trade liberalization and widening market access assure that even small agricultural production can be highly profitable and offer employment opportunities. Urbanization and commercialization of the rural sector made home gardening a serious activity for urban or suburban dwellers, because domestic but also international demand for fruits and vegetables is rising (Weinberger and Lumpkin, 2007). Vietnamese governmental policy is to open the market, what means new opportunities for the population even in the agricultural sector. Similarly, Chinese authorities have liberalized agricultural sector by allocating land on a family basis and limiting tariff restrictions on fruits and vegetables. Concretely, they eliminated low

procurement prices, what subsequently lead to the importance of those products as leading class of Chinese food export products (Lu, 1998).

In fact, some home gardens already shift to market-oriented systems in Vietnam and elsewhere. On the international level, exports of fruit and vegetable are rising and are projected to rise faster than traditionally traded commodities, such as coffee, tea or cotton. This international shifting could motivate crop diversification and more attention towards horticultural production. For Vietnam and its important fruit and vegetable production, it means a pertinent potential of non-traditional crops' export. Home gardens could play an important role by supplying that kind of production to the international market, with a significant impact both on national and household level (Weinberger and Lumpkin, 2007). With increasing commercialization of horticultural food plants from home gardens, many farmers choose to grow cash crops (Abdoellah et al., 2006; Kumar and Nair, 2006; Yamada and Osaqui, 2006). Number of studies has been released about home gardens' commercialization problematic especially in South-East Asia, Africa or South America. Families in Thailand grow orchids on their veranda and make important profit. In Latin America, chillies are widely grown at home. Those examples are only little part of a wider concept known as market garden already cited before, in which crops are chosen to be cultivated because the farmer is located next to a market and seeks profit. Those urban farmers are often among the wealthier farmers (UNDP, 1996). They form the capacity of cities to feed themselves. For that purpose, agricultural zones within or neighbouring cities must increase their productivity to meet the growing demand for food (Aubry et al., 2012).

Urban managers and state policy makers intensified their support to urban agricultural activities with growing urban problems. In Latin America, it received wide support as a social welfare programme. Moreover, since 1995 exists the Latin American Urban Agriculture Network to promote urban farming. With the involvement of developed countries, technologies and methods spread all over the world and effectively influenced the development of urban agriculture. For instance, US support permitted export of urban flowers, vegetables and grapes from Columbia and Brazil (UNDP, 1996). In Vietnam was established a national programme with the objective to increase

productivity and sustainability of home gardens. The Vietnamese Gardeners Association is promoting a process of mixed cropping, also known as VAC, based on the combination of crops with improved nutrition, nourishing the soil and providing cash. It results in a very sustainable cyclical system, in which output of one cultivated plant represent input into different specie, combining farm and household waste. UNICEF, partly in charge for the programme, estimated that income of VAC farmers is three to ten times higher than that of monoculture farmers (Marsch, 1996; UNDP, 1996, Watson and Eyzaguirre, 2002). Asian countries generally have a long tradition of urban agriculture and early recognition of the benefits of recycling waste. In Singapore, authorities have planned to recycle wastes into green areas, concentrating on livestock production and vegetable growing in the logic that organic wastes feed land crops. Also, by using composts from agricultural wastes such as banana leaves and straw, the intensive cultivation of mushrooms has been possible in urban areas. Similarly, Colombo and other cities in Sri Lanka have promoted the use of urban wastes on vacant land with the intention to produce nutritious food on small-scale. In Indonesia, the Ministry of Research and Technology financed environmental studies about small-scale composting for soil improvement. Other examples surely do exist but the research about agricultural waste and its uses in the urban context must be extended to at least regional level and deepened. In the case of market-oriented urban agriculture, farmers tend to grow monocrops and overuse fertilizer and insecticides. Because of the cash it provides, farmers seek the overproduction and this can lead to environmental damages, especially soil contamination. Moreover, food may become unsafe and gardens may loose their natural fertility (UNDP, 1996).

Urban farmers can range from poorest dwellers to developed agribusinesses, but no precise data are available regarding their number. Several authors already highlighted the need to estimate more systematically the magnitude of urban agriculture (Nugent, 2001; Egal et al., 2001). The UNDP has released a global overview of urban agriculture facts and figures, but their sources rely on “estimates by the Urban Agriculture Network based on the authors’ experiences and observations and extrapolation from data” (1996). According to them, 800 million people are embraced by urban agriculture. FAO

contrarily evaluates their number at 100 million (1996). Until now, only case study quantifications are accessible. Among them, Christanty estimated that 70% of all households in the Philippines are engaged in home gardening (1990). In their study of Kampala (Uganda), Maxwell and Zziwa estimated that 36% of the population was involved in urban agriculture (1992). According to the UNDP, 80% of families in Libreville (Congo), 68% of urban dwellers in six Tanzanian cities, 45% in Lusaka (Zambia), 37% in Maputo (Mozambique), 36% in Ouagadougou (Burkina Faso), 35% in Yaounde (Cameroon) are involved in urban agriculture (UNDP, 1996). Recently Zezza and Tasciotti conducted a cross-country research comparing urban agriculture data from 15 developing or transition countries (2010). From those case studies appear general differences between home gardens from different developing regions. For instance Asian urban agriculture is more effective than in Africa or, similarly, urban farmers from Latin America sell more of their production on markets than in Africa (Maxwell, 2003; UNDP, 1996). But urban farming in Africa has shown the most dramatic expansion compared to other developing regions. The result is that it has been the most surveyed during the past decade.

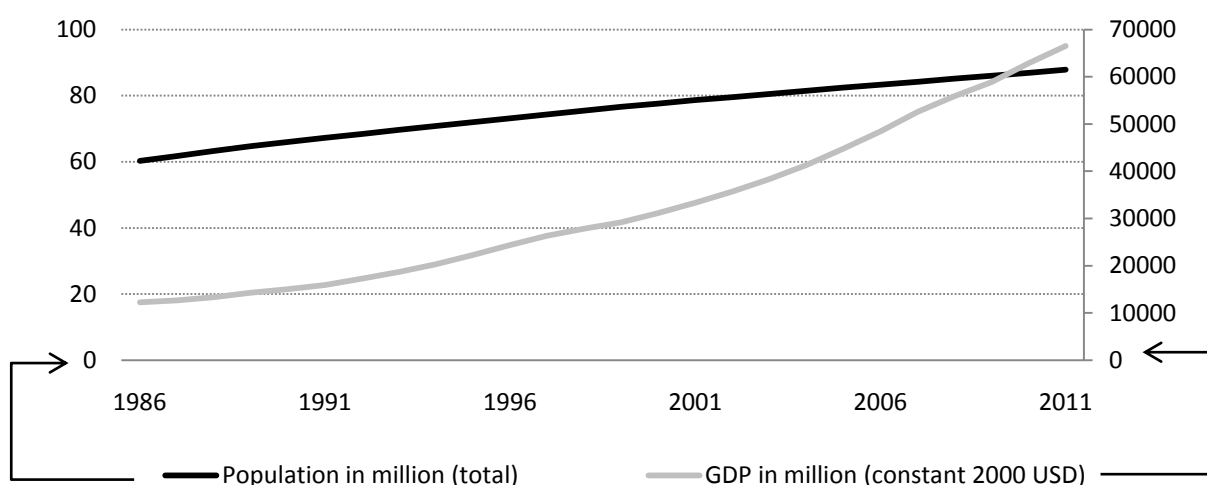
Vietnam has witnessed an important socioeconomic evolution for the past twenty years. Since the beginning of 1990's, the Vietnamese population and GDP rose steadily (see Figure 1) and predictions go on those trends.<sup>2</sup> As a member of COMECON, it was bound to the Soviet market and did not benefit from world trade liberalization until the fall of the Soviet Union and especially, until wide reforms came into force and born fruits.<sup>3</sup> Vietnamese authorities became more inspired by the East Asian development models and launched a deep transformation of the centrally planned economy towards a socialist market oriented system. Those reforms significantly contributed to what is Vietnamese economy now. The introduction of private ownership of land and business gave people access to markets and to welfare thank to their individual entrepreneurship. Also, improved trade policies based on progressive trade liberalisation aimed at Vietnam's greater international economic integration. Besides its accession to the World

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<sup>2</sup> The average economic growth rate is approaching 10% per year.

<sup>3</sup> The reforms also known as Doi Moi were adopted in 1986

Trade Organization in January 2007, Vietnam has become a member of many free trade agreements since 1995. It is now seeking to establish a bilateral free trade agreement with Chile and a regional one including Pacific countries. Talks about other agreements are scheduled especially with the EU and with Russia (Vietnam Investment Review, 2010). Besides the reduction in tariffs for Vietnamese exports (but also imports), these agreements count also with a progressive liberalisation of trade in services. Their main advantage is that they promote and attract foreign investment and lay down the basis for further negotiations to facilitate trade among the members.

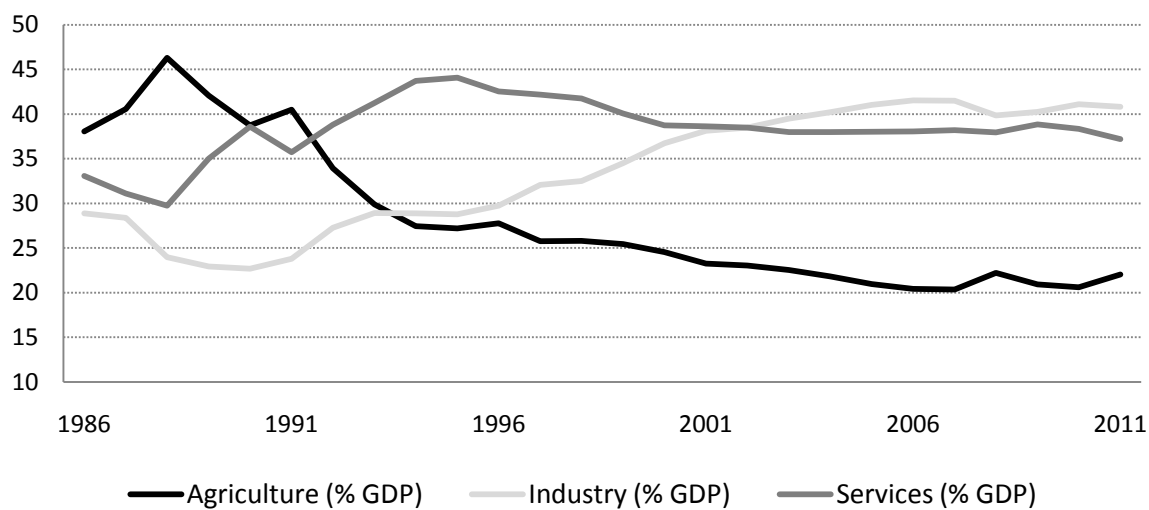


**Figure 1 Evolution of Vietnamese total population and GDP, 1986-2011, World DataBank**

As a matter of fact, fruits and vegetables are not the first Vietnamese export commodities. Instead, since the country is industrialized, it exports mainly textiles, leather including footwear, wearing apparel, chemicals, motor vehicles, manufactures and electronics. Nevertheless, Vietnamese exports of fruit and vegetable have grown vigorously since the early 1990s. The significant export-fruits are pineapple, banana, mango, litchi, watermelon, longan, dragon fruit, and rambutan. Exported vegetables include baby cucumbers, potatoes, onions, tomatoes, beans, cauliflowers and chili. Until September 2012, Vietnam's exports of fruit and vegetable kept rising to some markets. That going to Japan went up by 16%, to the United States by 39%, to Taiwan by 19%, to Thailand by 40%, to Singapore by 22%, and to Canada by 13%. China remains Vietnam's



major fruit and vegetable importer, responsible for revenue of 154 million USD, what is 50% more compared to the same period last year, accounting for 29.5% of Vietnam’s export of those commodities. Among top fruit and vegetable importers from Vietnam, Japan ranked second at 39 million USD, 8% of Vietnam’s fruit and vegetable export value; followed by the United States (27 million USD, 39%). The above top-three largest accounted for 42% of the Vietnam’s total fruit and vegetable export value.<sup>4</sup> Despite the volume of agricultural production and trade are apparently significant, the share of Vietnamese agricultural sector is decreasing in the long-term on the GDP generation as seen on Figure 2.



**Figure 2 Evolution of Vietnamese GDP by sector, 1986-2011, World DataBank**

The socioeconomic development combined with relatively more political openness and support of cultural diversity strongly influences the Vietnamese society. Since the new millennium, it has to deal with metamorphosis of the traditional way of life (Beresford, 2008). But despite those deep changes, Vietnam remains a country of traditions, where

<sup>4</sup> [http://www.vietrade.gov.vn/en/index.php?option=com\\_content&view=article&id=1620:vietnams-fruit-and-vegetable-products-export-in-first-9-months-of-2012&catid=270:vietnam-industry-news&Itemid=232](http://www.vietrade.gov.vn/en/index.php?option=com_content&view=article&id=1620:vietnams-fruit-and-vegetable-products-export-in-first-9-months-of-2012&catid=270:vietnam-industry-news&Itemid=232) “

over half of the population, i.e. 45 million people, work in agriculture. Often, and it is the case for home gardens, It implies that small-scale agricultural production has not been fully utilized and that there is an important potential both in terms of quantity and quality improvements. However in that subject, publications focus more on ethnobotanical aspects, such as in situ conservation, than on socioeconomic features of home gardens (Trinh et al, 2003). But according to Trinh, home gardens, home ponds and home husbandry accounted for 30% of the total agricultural production in Vietnam in 1997, which is a non-negligent value (1998).

## Objectives

Hue City is experiencing important demographic expansion linked besides all with its touristic attractiveness. Demand for food and level of life standards are rising, which has multiple effects on economic situation of households, especially the poorer ones. This study focuses on urban households' involvement in agriculture, concretely via home gardening, not on urban agriculture in general. Home gardens could represent one of the main tools of livelihood improvement strategies in actual changing processes (Wiersum, 2006).

In order to assess the economic and agro-biodiversity development of urban agriculture in central Vietnam, the first objective of this study is to (i) generally understand the impact of urban agriculture on household economy in Hue City.

One of the opportunities for urban farmers is to tackle the increasing demand for food. In this regard, the research focuses on (ii) the behaviour of home gardeners whether they do adapt their producing habits to such opportunities. Also, the study aims to identify the challenges affecting those attitudes.

Furthermore, the research seeks to (iii) document cultivated plants and their use categories.

## Methodology

### 1. Study area

The data collection took place inside and in direct proximity of Hue City, which is the capital of Thua Tien-Hue province situated in central Vietnam. The province covers an area of 5,033 km<sup>2</sup> and the population equals to 1.1 million people. The density is 219 persons per km<sup>2</sup> (General Statistic Office of Vietnam (GSoV), 2011). The population density is relatively low compared to other major cities in the region of central Vietnam (Da Nang: 740 persons per km<sup>2</sup>) because the province encompasses mountainous areas bordering Lao with sporadic population.

The annual average precipitation in the study area ranges between 2,500 and 3,500 mm. About 70% falls during the rainy season peak from September to December. Floods and erosion characterize the rainy season, implying social, economic and environmental consequences. Frequent torrential rain could cause human, but also ethno-botanical losses due to the extended flat territory in the long coastline and also the lack of suitable water management infrastructure, as it happened in 1999. At the heart of the water system is the Perfume River (Sông Hương or Hương Giang) (Trai et al. 2001; Tuan et al. 2003; Villegas 2004).

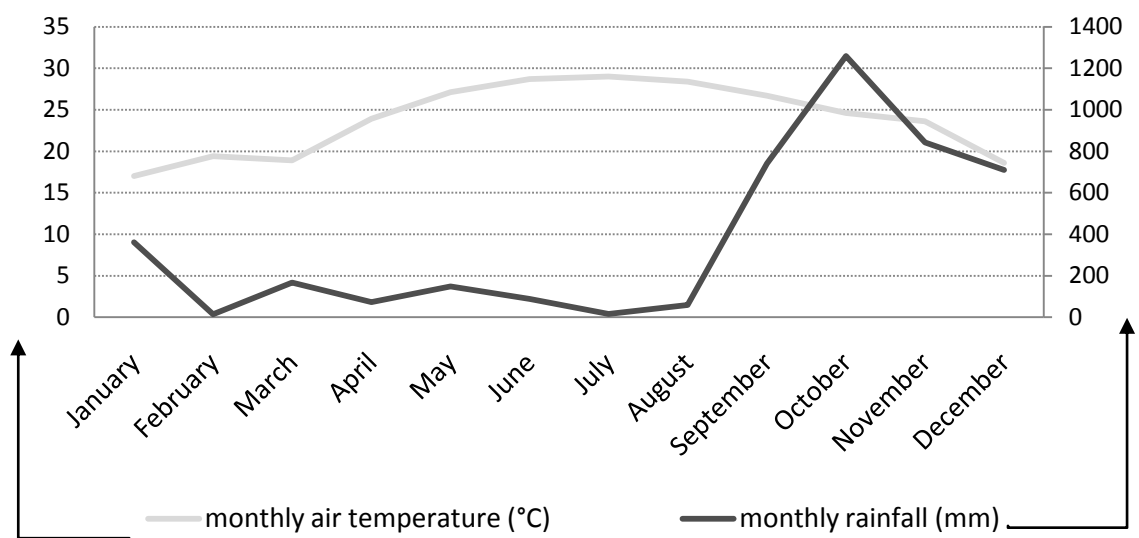
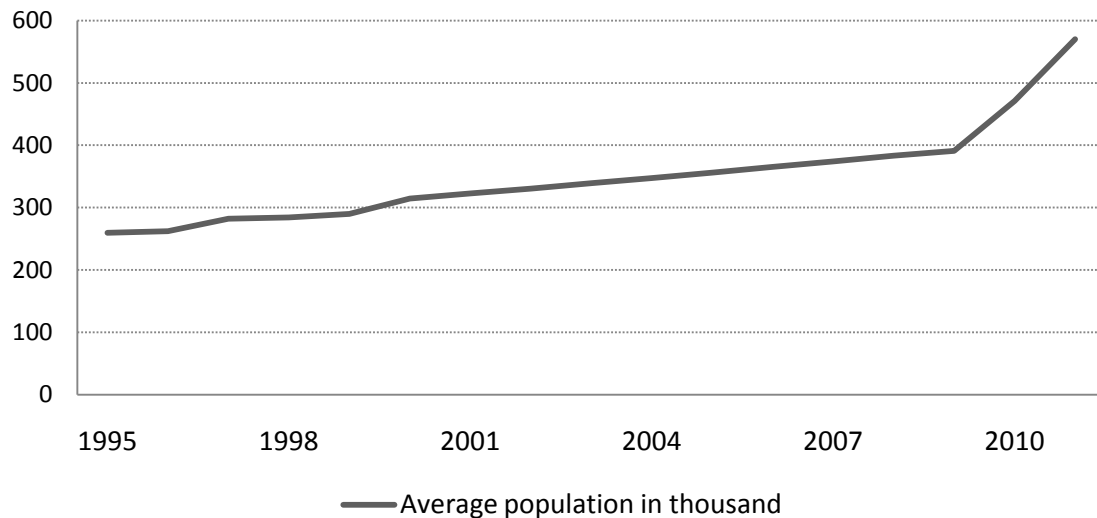


Figure 3 Average temperature and rainfall, 2011, GSoV

The province has few bigger towns along the coast, where the population growth is significantly increasing (Figure 3). Hue, the imperial capital of the last Nguyen dynasty, has been witnessing a very dynamic development thank to its tourist attractiveness<sup>5</sup> and its key position between Hanoi and Ho Chi Minh City. Despite of very destructive fights during the peak of the Vietnam War (1965-1973), which seriously damaged the north of the province, all visited areas during the research have benefited from satisfactory social and transport infrastructure. This supports stable and rapid economic development of the province, particularly in industry and services. Nevertheless, agriculture still plays a major role in family income generation.



**Figure 4 Evolution of urban population in Thua Thien Hue province, 1995-2010, GSoV**

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<sup>5</sup> Hue is part of the UNESCO world heritage since 1993.

## 2. Data collection

The fieldwork took place at the end of the dry season from July to September 2012, i.e. before the eastern tropical monsoon came. Data were collected in 99 chosen households located inside Hue or in vicinal villages at an average distance of 5.5 km from Hue. Among the seven districts forming the Thua Thien–Hue province, the study area covered three of them: Hue as a distinct municipality, Huong Thuy and Huong Tra (Figure 5). The sample dispersion between them can be seen on Table 1. Distribution of semi-structured questionnaires and direct observations were the main field methods applied. Questionnaires were composed by 24 questions (mixing multiple choices, free listing and likert scale questions) and prepared in advance before the practical part of the study. Then, they were translated to Vietnamese directly in Hue with the help of local research team (students of Hue University of Agriculture and Forestry – HUAF and agents from Agriculture, Fisheries and Forestry Extension Centre – AFFEC). The questionnaire in English can be found in Annexes.

**Table 1 Communal distribution of respondents**

<b>District</b>	<b>Thanh Phe Hue</b>		<b>Huong Tra</b>		<b>Huong Thuy</b>	
<b>Commune</b>	Phu Vi Da	1	Long Ho Ha	2	Thuy Thanh	4
	Phu Cat	1	Huong Ho	9	Thuy Van	5
	Xuan Phu	2	Giap Kien (Huong Toan)	26		
	Trieu Son Tay (Phuong An Hoa)	6	Huong An	4		
	Thuy Bieu	32				
	Kim Long	7				
	<b>Total of respondents</b>	<b>49</b>		<b>41</b>		<b>9</b>

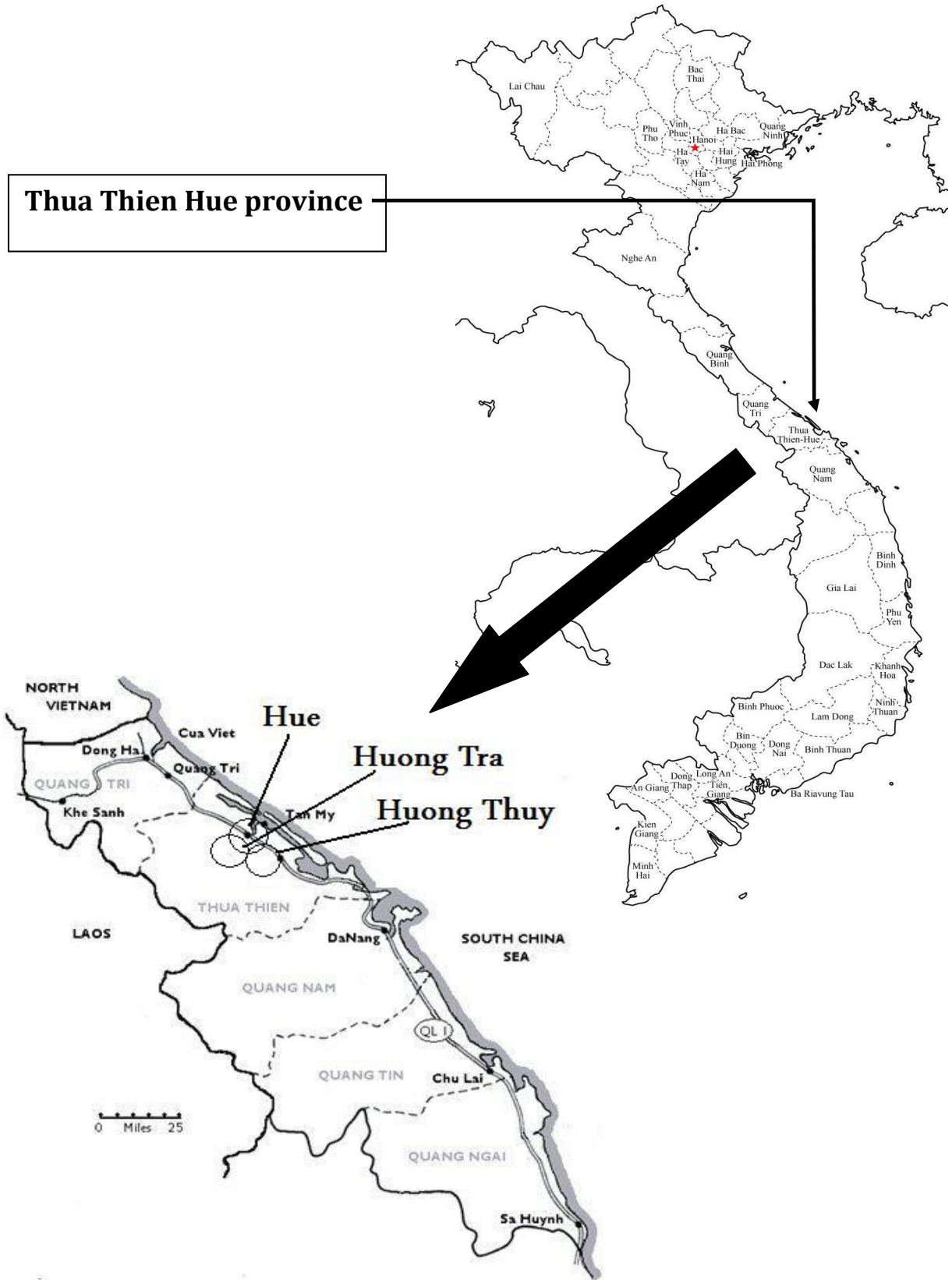


Figure 5 Administrative map of Vietnam, map of data collection areas

Farmers (44 females, 55 males) were visited individually during the day time and only once directly on their plots. Every respondent (from 18 to 81 years old) was introduced into the research theme by accompanying local staff and gently asked for cooperation.

- Firstly, names (vernacular and botanical) and data on number of crop species were obtained and any changes in number, species composition, categories of use and commercialization of the harvest were documented. This part was dedicated to in-depth home garden analysis.
- Secondly, demographic and socioeconomic indicators of the household and its members were obtained, such as age, number of dependent members, labour force, income and expenditures composition etc. This part of research permitted to find differences and correlations between families and home garden's specifics.
- Finally, future expectations of the farmers were documented along with their fears in order to determine long-term trends in local home gardening.



**Figure 6 Data collection in Hue**



### 3. Data analysis

In order to react on the objectives stated, different methods of analysis were applied. All data were entered into MS Office Excel® and STATISTICA ©StatSoft 10.0 for further statistical overview via usual descriptive indicators and regression model. Each surveyed household was firstly described from the demographic point of view. The purpose was to highlight the socio-demographic structure of the family by the identification of its members (age, gender, level of education) and of their labour force utilization by comparing breadwinners (defined as household members from 15 to 60 years old) and dependent members (other members, i.e. children and elderly). Only household members living under the family roof were included. From the economic point of view, household income/expenditure composition, cash-flow balance, supply vs. needs balance, level of indebtedness/investments were under focus. For the analysis of collected data and information about home gardens and cultivated species, usual descriptive indicators were employed regarding yields, subsistence or cash orientation and if, selling modalities (including selling place, margin and means of selling). In addition, the whole farm production system was described highlighting the characteristics of all land holdings, their size and quality of soil, specific material and human requirements for their running.

Multiple linear regression analysis and correlation tests were applied in order to measure the dependency of households on home gardens by identifying significant factors influencing the commercialization process of cultivated plants. For that purpose, several variables summarized in Table 2 have been chosen to depict that process.

**Table 2 Variables used in commercialization process**

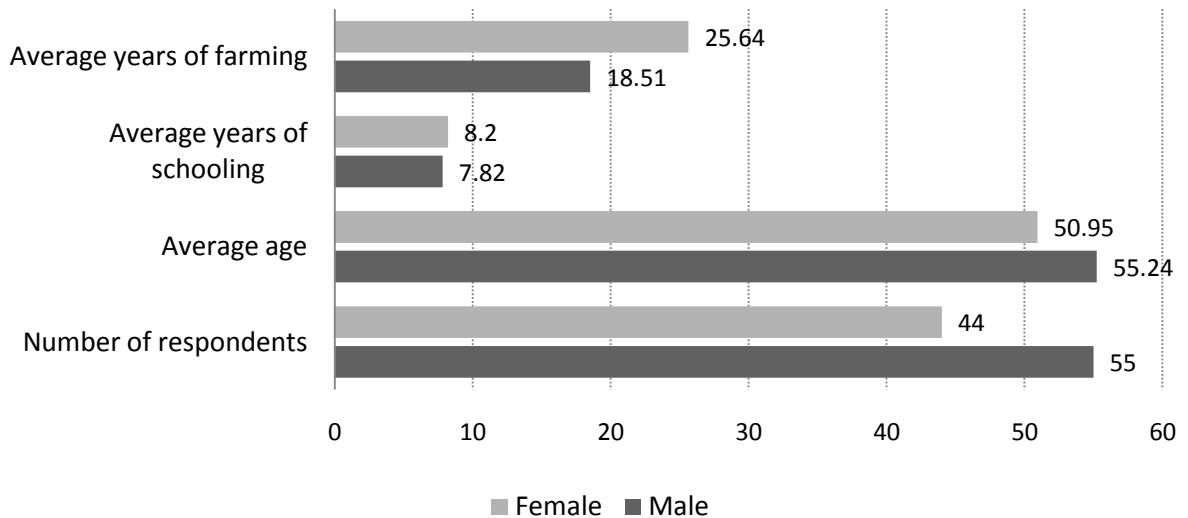
<i>Variable name</i>	<i>Dependent variable</i>	
Y <sub>1</sub>	Share of home gardens on total household income	Percentage of gross income generated from home gardens.

<i>Independent variables</i>		
X <sub>1</sub>	Household income	All cash inflows from particular household activities per one year in Vietnamese song (VND).
X <sub>2</sub>	Dependency ratio	Number of household members non breadwinners divided by the number of breadwinners
X <sub>3</sub>	Distance from Hue	Distance of home gardens from the city borderline in km.
X <sub>4</sub>	Respondent's experience with home gardening	Number of years that respondents actively participate in home garden activities.
X <sub>5</sub>	Financial satisfaction	Self evaluation scoring satisfied 1, satisfied but budget at balance 2, not satisfied 3

## Results

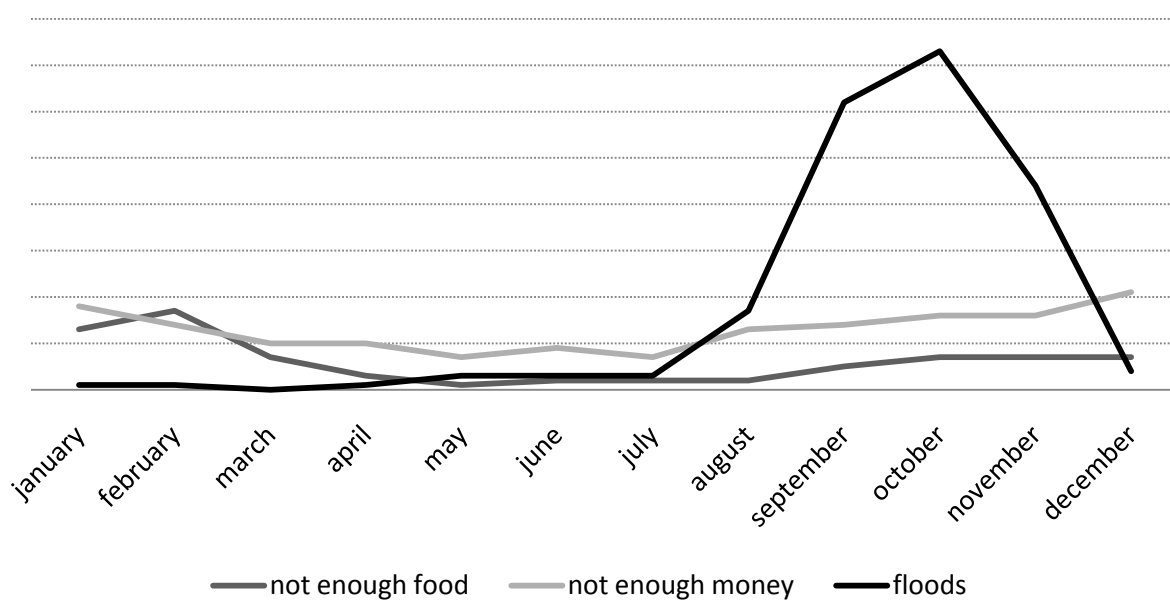
### 1. Socio-demographic description of households

Our sample group of 99 farmers was mostly composed by men (55) and slightly less by women (44). Male respondents were on average 4 years older than women. On the contrary, female respondents were studying and farming a longer period than men. See figure 7 for exact values. Every household counted on average 3 members. Surveyed families had a typical structure of Vietnamese households, i.e. grand parents, parents and children living together. The average number of household breadwinners was 2. The dependency ratio was estimated at 1.5. On average, men dedicated to home garden activities 3.8 hours per day, whereas women 3.07. A significant part of respondents had an off-farm job (mostly carpenter or mason for 35 male respondents, small business or tailor for 28 female respondents).



**Figure 7 Respondent socio-demographic overview by gender, age, schooling and farming years**

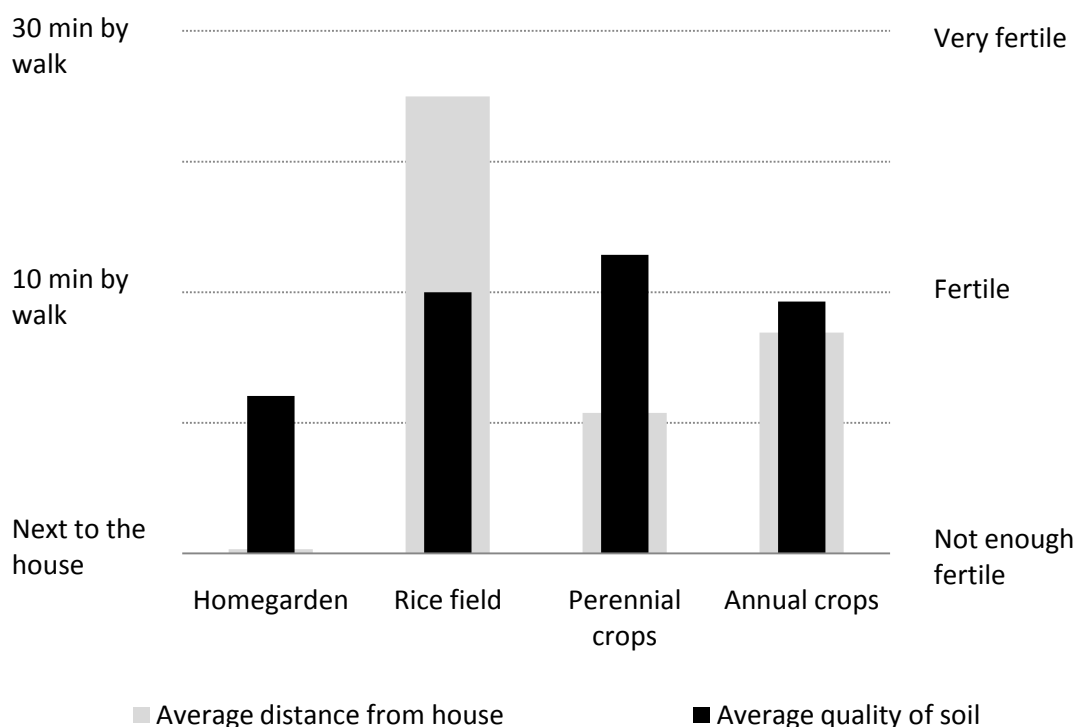
Chronological analysis of main problems faced by households reveals that they suffer from various difficulties during the year. More than 70% of respondents listed floods as their most frequent problem from September to November. During this period, but also all over the year, around 10% of surveyed households were running out of money. Their number increases during the rainy season. Few months of financial struggle result in a clear peak visible in February, where almost 20% of households claim a shortage of food. From March to December, food is no more a problem because of continuous harvest of cultivated plants.



**Figure 8 Household problems monthly comparison, n=93**

In majority of cases, surveyed households were in possession of different plots than solely a home garden. 55 respondents listed having a rice field, 35 a field with annual crops, 18 a field with perennial crops and 7 a fishpond. The size of the rice field was clearly the biggest of all plots with a mean of 3,036 m<sup>2</sup>. Fields with perennial crops were slightly bigger than fields with annual crops (1,414 m<sup>2</sup> and 1,191 m<sup>2</sup> respectively). The average size of fishponds was 224 m<sup>2</sup>. Only one respondent declared to have a forest area of 50 m<sup>2</sup>.

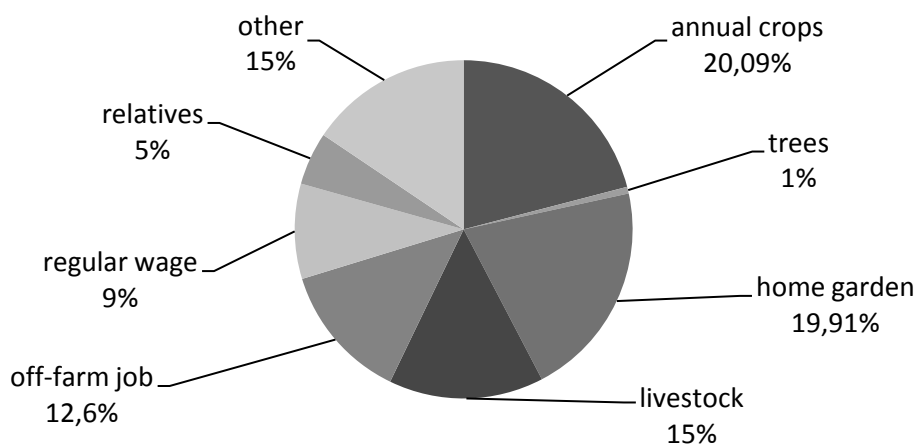
Those plots were compared to the home garden by their quality of soil and distance from the family house. The rice field was generally located out of the commune in the green belts around the town, on a flat and wide area. Fields with annual crops (staple production) are closer to the house and those with perennial crops even closer. But only the home garden and the drying place are directly surrounding the house. In comparison with other plots, home gardens have the lowest quality of soil.



**Figure 9 Household land holdings compared by average quality of soil and distance from house, n=96**

## 2. Economic description of households

Surveyed households earned on average 37.5 million VND per year.<sup>6</sup> The revenue from annual crops represented its most important part (20.09%) and revenue from home garden activities weighted a slightly smaller share (19.91%). In addition, livestock and off-farm job (mainly small family business, either small grocery or machinery maintenance, tailoring etc.) covered a quarter of total income (15% and 12.6% respectively). The next major part of the income composition was the result of governmental policies, especially delivery of war and elderly pensions (“other”), which represented almost 15% of the household revenue. Regular wage (from jobs such as teacher or government employee) counted for 9% of total income and money received from relatives for 5%. Minor part of income came from trees cultivation (only one respondent).

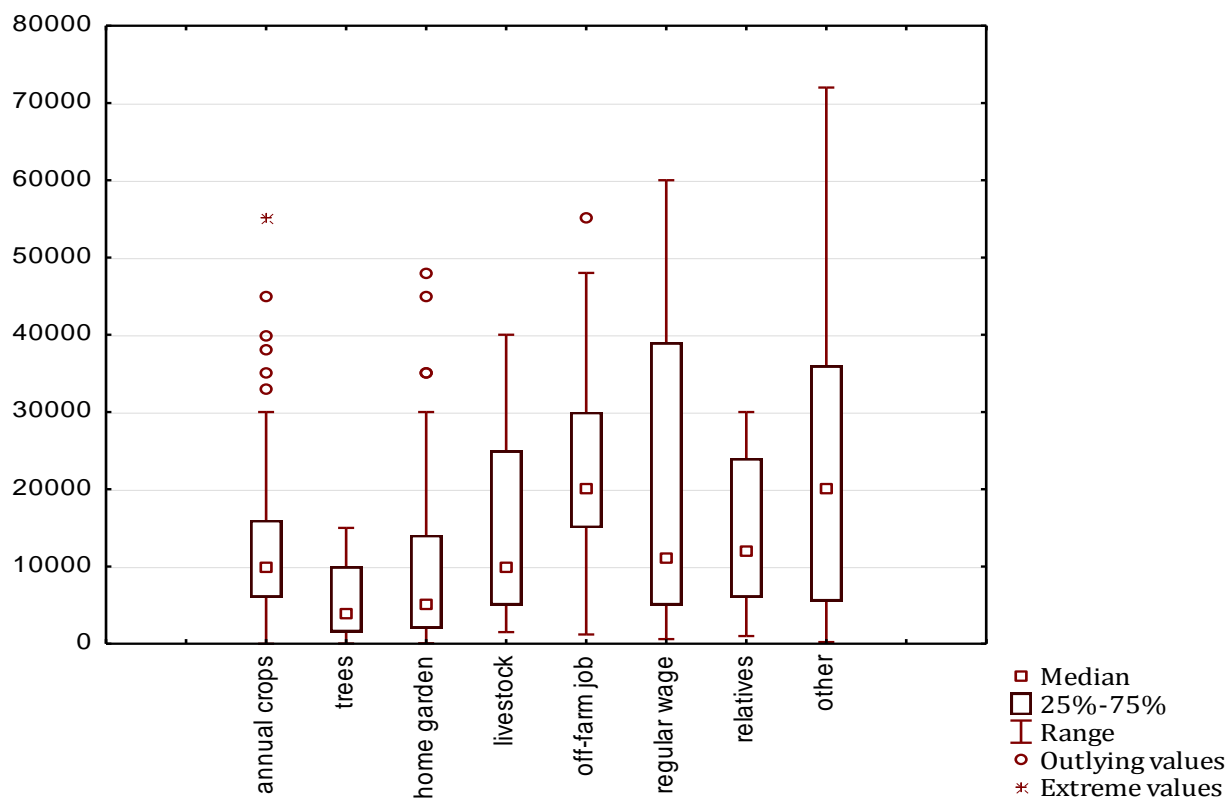


**Figure 10 Household income composition, n=95**

Further details on income amounts of those categories may be found on Figure 11. The range varies significantly in the category of regular wage and other (pensions). The income from annual crops and home garden has many outlying values. Nevertheless, the

<sup>6</sup> 37.5 million VND equals approx. 1,800 USD.

sample was indeed quite consistent in those latter cases, as the boxes defining values between 25% and 75% of respondents are quite small.



**Figure 11 Box plot with income distribution in thousand VND**

On the other hand, surveyed households spent on average 43 million VND per year.<sup>7</sup> Household charges consisting of electricity and water fees, food, house equipment, firewood and other sub-categories counted for the half of all household expenditures. Its second largest share (18%) was represented by education as it is not free in Vietnam and scholar fees often represent a significant investment for families.<sup>8</sup> The inputs into farm activities consisting of fertilizer, seeds, fuel, fodder, farm equipment and transport covered some 15% of all household expenditures. Finally, other expenditures such as ceremonial gifts or extra taxes counted for 7% of total household expenses. Healthcare and credit linked costs both counted for 5%.

<sup>7</sup> 43 million VND equals approx. 2,000 USD.

<sup>8</sup> 16 respondents quoted education as a major investment, 3 cited house fixing and 2 hospital fees.

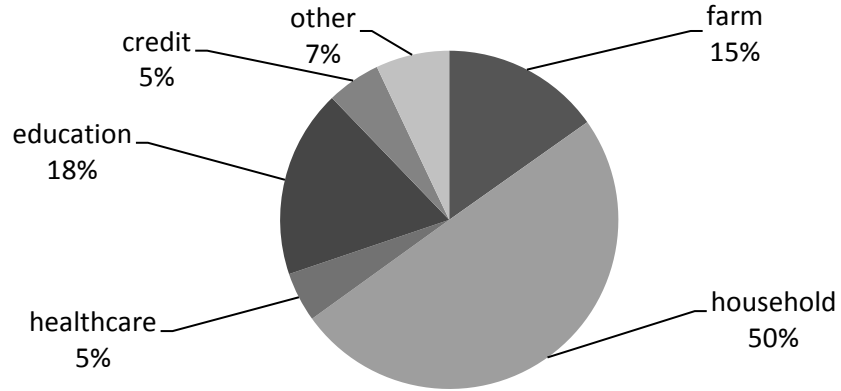


Figure 12 Household expenditures composition, n=95

Further details on expenditure amounts of those categories may be found on Figure 13.

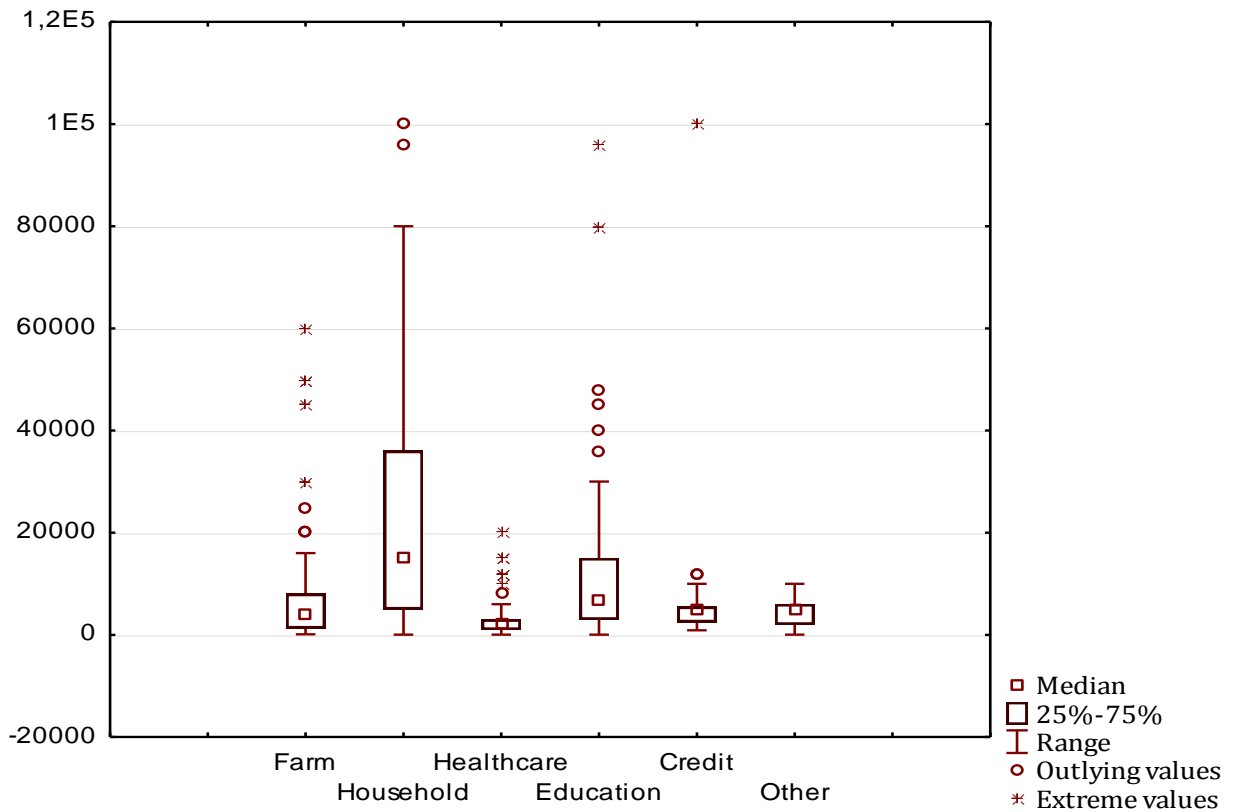
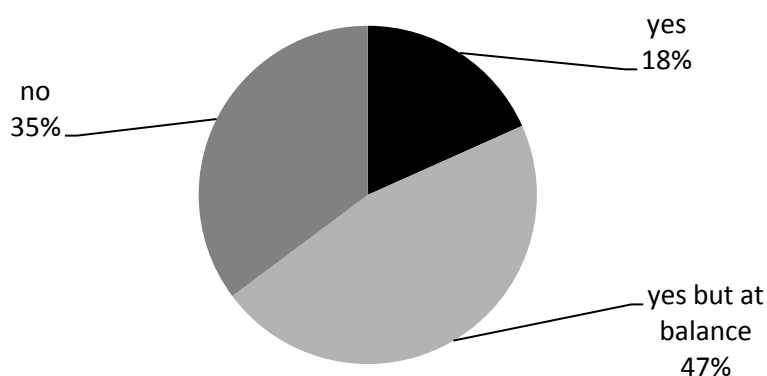


Figure 13 Box plot with expenditures distribution in thousand VND



According to results obtained above, households spent on average 5.5 millions VND more than they earned within a year. It is reflected in respondents' financial satisfaction, where almost half of them listed that their household incomes and outcomes were rather at balance, and other 35% clearly stated they had difficulties to pay for their needs. Only 18% of surveyed households were satisfied with their financial situation.



**Figure 14 Respondents financial satisfaction, n=71**

17 respondents declared having currently a credit. Majority of them obtained it from a bank while 3 respondents from a cooperative or the people's committee. The loan amount reached on average 19.9 million VND<sup>9</sup> for an average period of 2.9 years (minimum 1 year, maximum 5 years). 16 respondents specified their credit was dedicated to educational purposes of their children, especially school fees. Other listed purposes were house construction or its fixing and hospital fees.

<sup>9</sup> 19.9 million VND equals approx. 950 USD.

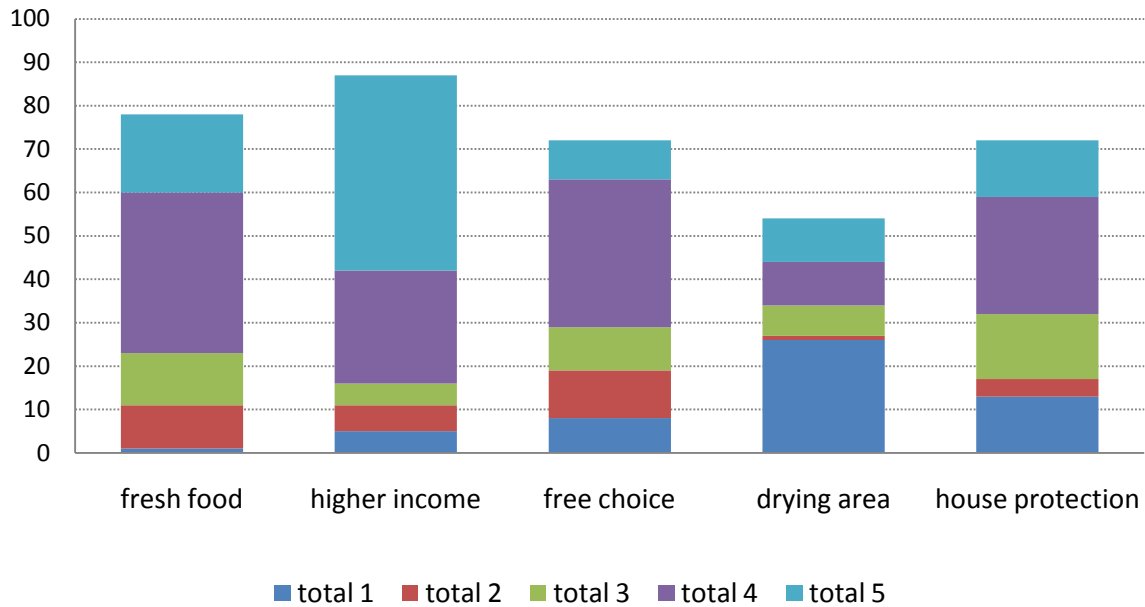
### 3. Screening of home gardens

The respondents' home gardens covered on average 2 sao, respectively almost 1,000 m<sup>2</sup>, while the smallest had 18 m<sup>2</sup> and the biggest 3,000 m<sup>2</sup>. All of those gardens were surrounding the family's residential house and were always located on flat terrains. They were part of family farming system consisting of cultivated fields away from houses. 74% of surveyed households also owned and used an adjacent drying place to the house and the garden, covering on average 56 m<sup>2</sup> and used for the processing of rice or cassava.



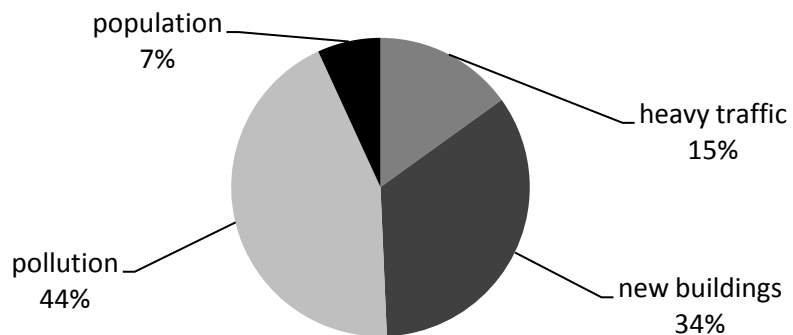
**Figure 15 Drying place surrounded by home garden in Hue, August 2012**

The main reason for running a home garden (measured on a scale of importance from 1 to 5) was that it provides higher income for the household. Secondly, it is a valuable source of fresh food and finally, it serves as house protection from sun or wind. One third of respondents highlighted the fact, that they could freely cultivate whatever desired specie on their home garden. Attributed grades, exact numbers of respondents per category and other reasons of home gardening may be found on Figure 16.



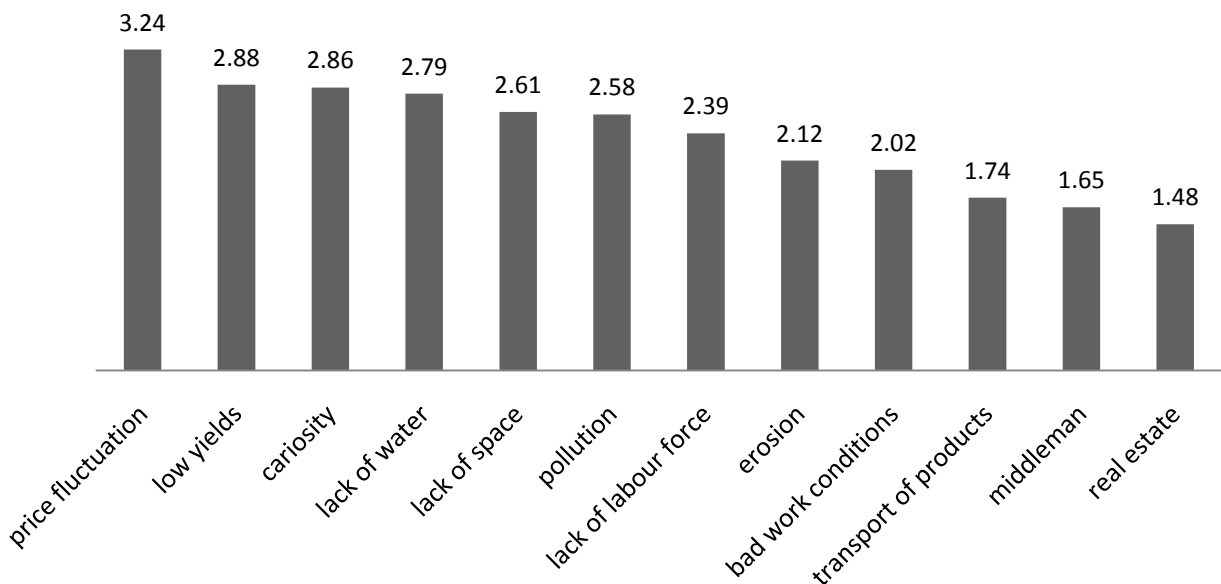
**Figure 16 Reasons for running a home garden by number of respondents and level of importance, n=96. 1= not important, 5= very important**

52 out of 99 respondents answered they were concerned by at least one type of urban pressure. Most of them answered that urban pollution had a negative impact on their home gardening activity (44%), closely followed by the construction of new buildings (34%). Less but not the least important effect of the urban influence on home gardens was the problem of heavy traffic and growth of urban population (15% and 7% respectively).



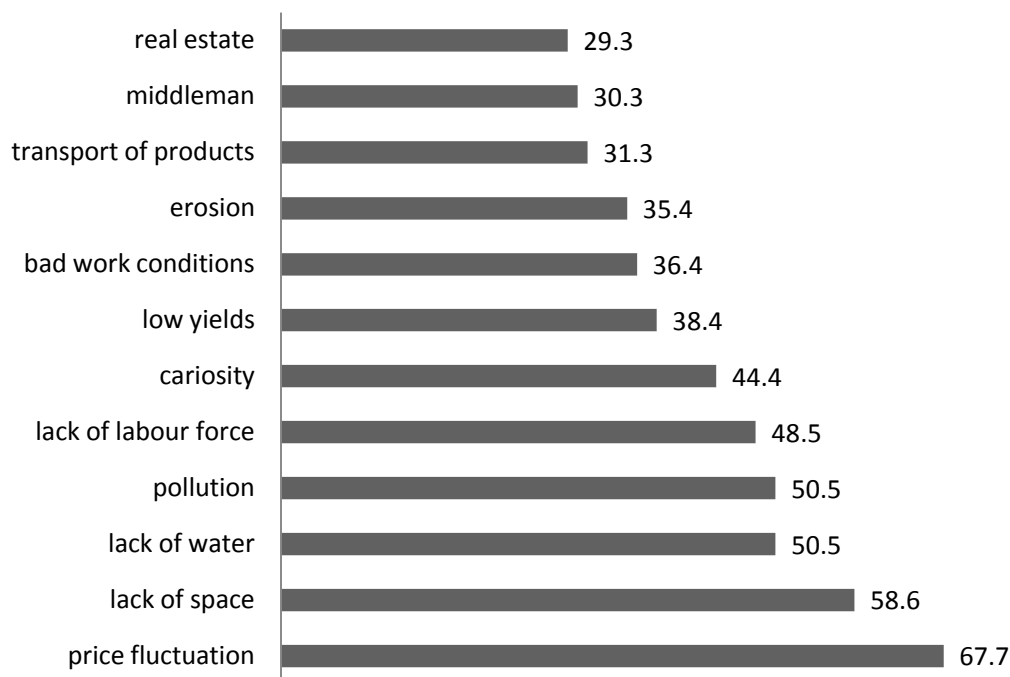
**Figure 17 Urban pressure on home gardens, n=52**

Subjective pressure on household’s agricultural activity was further analyzed through the identification of concrete problems that respondents were facing due to the urban environment. On the level of importance from 1 to 5, 67 out of 85 respondents estimated that price fluctuation was their main problem as they attributed it a mean level of importance of 3.2. Low yields, cariosity and lack of water were the next most important problems faced by respondents. They were all considered as “important” on 2.8 of level of importance.



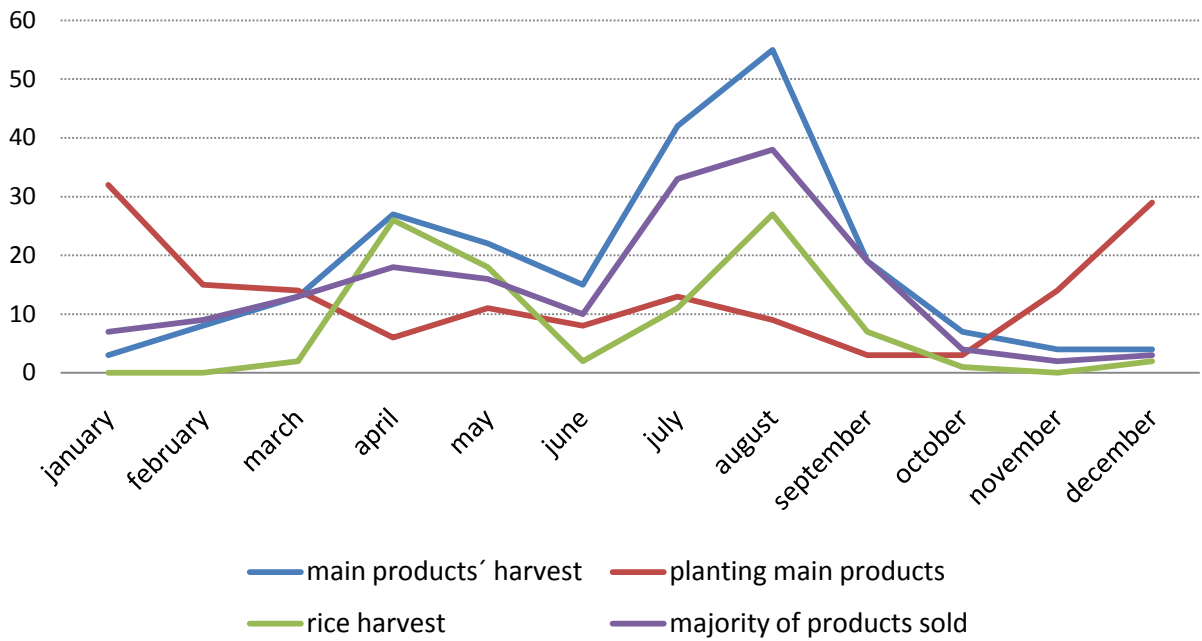
**Figure 18 Concrete urban problems affecting home gardens by level of importance, n=85**

From the point of view of the frequency of encountered urban problems, price fluctuation has been cited by 67.7% of respondents. Following problems were the lack of space, lack of water and pollution with 58.6%, for the first one and 50.5% for both latter respectively. Quite surprisingly according to the previous findings, real estate was identified as a problem for only 29.3% of respondents. For further listed problems, see Figure19.



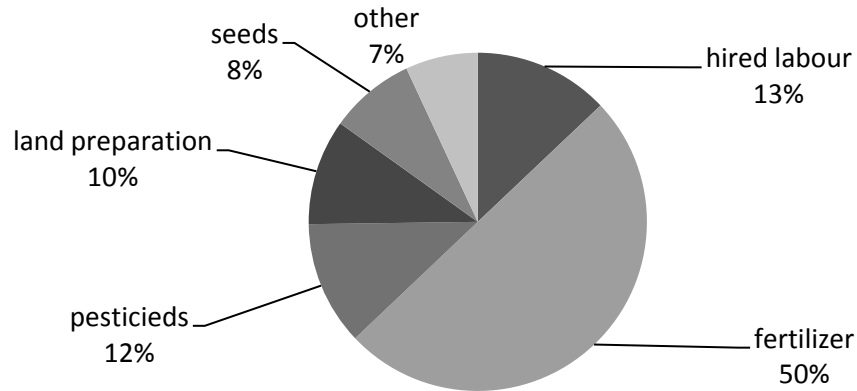
**Figure 19 Frequency of urban problems in % of respondents, n=85**

Regarding the activity of respondents on their home gardens, we differentiated between planting, harvesting and selling of main products. Furthermore a special attention was given to rice harvest, which represents a major activity for households in terms of needed labour force and time. It is also the basic nutriment and important source of income for the family and its shortage often causes serious problems. According to the survey, main products are planted during most of the year with peaks in December and January. Similarly, they are harvested throughout the year with peaks in April and August. The rice harvest occurs twice a year. The first harvest is in April but can be prolonged to May. The second is in August, but can start a bit earlier in July and continue until September. This variation is due to changing weather and especially the precipitation conditions. In majority of cases, households relied mainly on family members and extended kinship networks during the harvest peaks. Children were participating on farm activities during those periods and could even miss school for this reason (Figure 20).



**Figure 20 Home garden activities monthly schedule, n=96**

The home garden not only needs time and care of household members but also multiple financial inputs. On average, every household invests a total of 4.5 million VND per year into its home garden. Half of it goes to the purchase of fertilizers (on average 2.9 million VND per year). 19 respondents did not differentiate between fertilizer and pesticide costs. Purchase of pesticides to prevent or eliminate plant diseases represents 12% of the home garden budget, while purchase of new seeds counts for 8%. The hire of additional labour force to meet the home garden's care and harvest needs covers 13% of annual investment. Other 10% are dedicated to the preparation of land, which consists of costs linked to the use of either natural (buffalos, fix stable) or mechanical means (agricultural engine insurance, reparation, and petrol) (Figure 21).

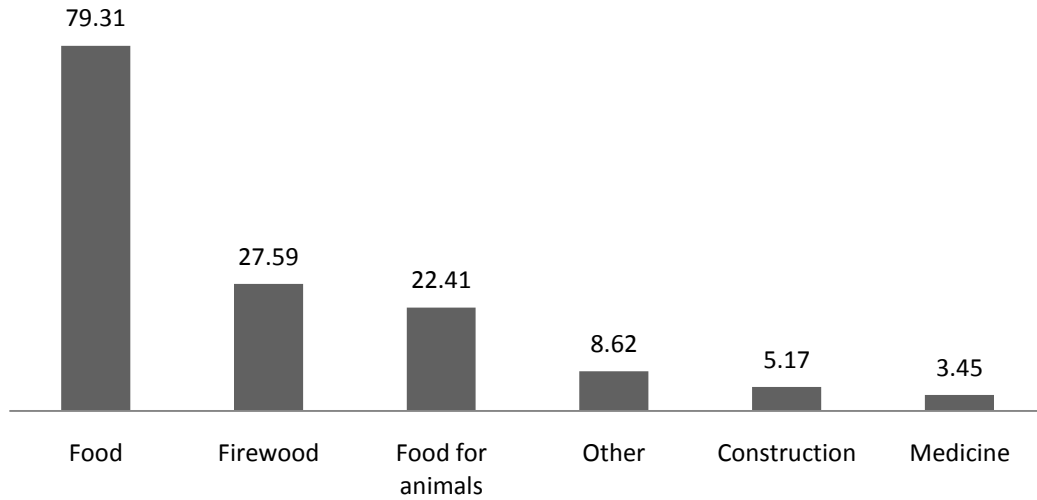


**Figure 21 Home garden cash input composition, n=81**

#### 4. Ethno-botanical screening

Total number of crop species documented in our study area was 58 with an average of 5 species (maximum 15) per each visited home garden.<sup>10</sup> Plant species were used for various purposes. Almost 80% of them served as food, 28% as firewood, 22% as food for animals, 5% as constructing material (*Musa balbisiana*, *Bambusa balcooa*) and 3% as medicine (*Musa balbisiana*, *Piper lolot* C.DC). Remaining 9% represented mainly flowers and high trees with decorative purposes. Some flowers were specially used for the Vietnamese New Year “Tet” (*Prunus persica*, *Ochna integerrima*, *Plumeria obtusa*) (Figure 22). But at least 80% of all species were characterized by multiple uses, usually combining food and food for animal. Farmers choose the species to be grown or to be kept growing in their home gardens according to the utility value of the species (either subsistence use or market orientation).

<sup>10</sup> Their complete list can be found in Annexes



**Figure 22 All species sorted by category of use (%)**

Each home garden had its unique land use according to household preferences. Grown crops consisted mainly of vegetables and fruits, but flowers and medicinal herbs also appeared. Home gardens were organised according to a multicrop method, so that it generates harvest all year-round. This was partly due to the suitable climate and also to the layered differentiation of cultivated species. Gardens were usually operating on four layers: high trees (i.e. *Areca catechu*), low trees and bushes (i.e. *Musa balbisiana*), at ground level (i.e. *Vigna unguiculata sesquipedalis*) and at root level (i.e. *Ipomoea batatas*). All of the surveyed home gardens had very typical soil horticulture. Any of 99 households used a different, modern and improved technique of cultivation such as shallow-bed or hydroponics.

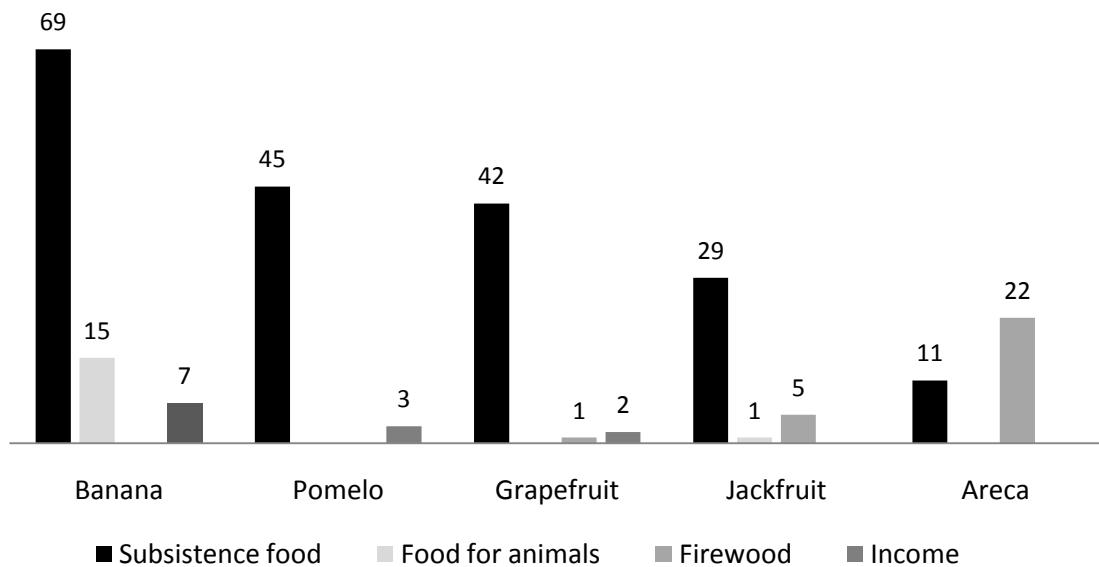
Typical appearance of multicrop layered home garden can be found on Figure 23.





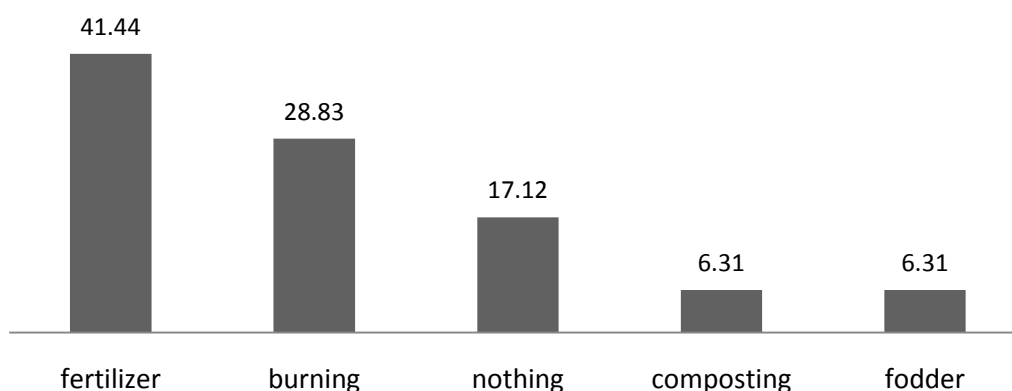
**Figure 23 Typical layered home garden in Hue, August 2012**

On Figure 24 are listed five most frequently documented species with their main category of use. *Musa balbisiana* had the highest multipurpose score (5 categories), followed by *Manihot esculenta crantz*, *Prunus persica* and *Ficus auriculata* (4 categories).



**Figure 24 Category of use of most cited species (%)**

During the cultivation or the harvest of almost every plant species, organic waste appears under different forms, rotten parts or leaves being the most usual ones. Almost half of respondents (48%) declared using agricultural waste as fertilizer and for composting. Similarly 6.3% of respondents used it as fodder for livestock. Burning concerns almost 29% of the sample group and the remaining 17% do not anyhow process it. All together, sustainable procedures of agricultural waste use represent more than non sustainable types of use.



**Figure 25 Agricultural waste by category of use (%), n=84**

## 5. Commercialization features

In order to identify the commercialization character of surveyed home gardens, documented species were defined either as predominantly market or subsistence crops. *Bambusa balcooa* illustrates the issue of interpretation: while 2 households sell 100% of their production to the market, 6 households keep 100% of their production for subsistence. In that case, *Bambusa balcooa* is not considered as predominantly commercialized crop. In that spirit, 24 out of 30 most frequently documented<sup>11</sup> species were intended to be sold on markets. *Citrus sinensis* was the only specie with full market-oriented production.<sup>12</sup> *Citrus reticulata blanco*, *Arachis hypogaea*, *Phrynium placentarium*, *Brassica oleracea capitata*, *Piper betle*, *Allium fistulosum* and *Mangifera*

<sup>11</sup> Those species listed at least by 5 respondents.

<sup>12</sup> Among other documented species, flowers *Ochna integerrima* and *Amaranthus* have also been listed as full market-oriented.

*indica* were at least by 90% intended to market. Majority of families also kept part of the production for subsistence.<sup>13</sup> *Artocarpus heterophyllus*, *Annona squamosa*, *Capsicum frutescens*, *Ficus auriculata* and *Carica papaya* were more than by 80% consumed within the family (Table 3).

**Table 3 Average of listed final destinations (%)**

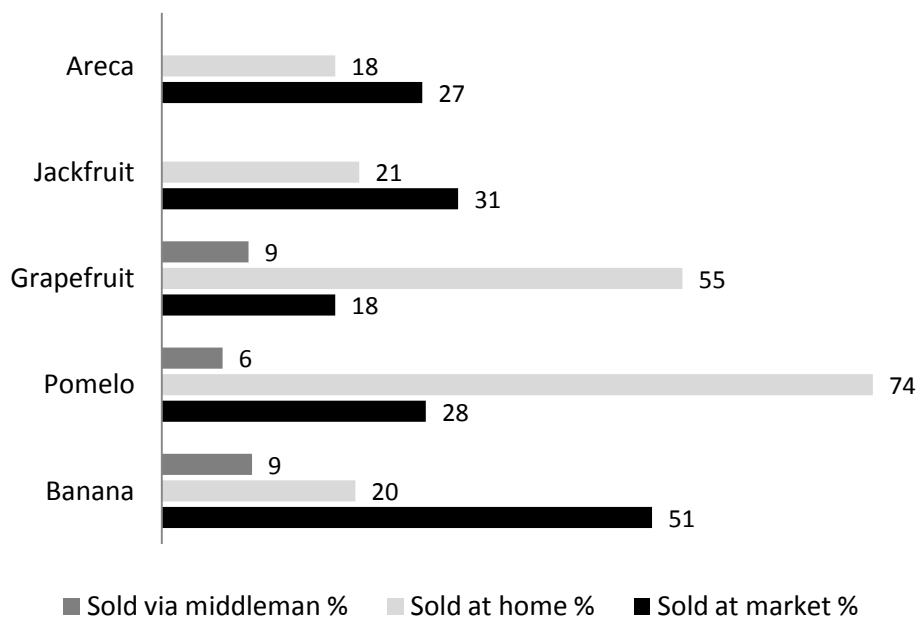
<b>Species name</b>	<b>Respondents (n)</b>	<b>Production destined to market (mean %)</b>	<b>Respondents (n)</b>	<b>Production destined to household (mean %)</b>
<b>Banana</b>	54	80.5	55	50.9
<b>Pomelo</b>	45	85	44	19.9
<b>Grapefruit</b>	38	85.9	40	28.4
<b>Jackfruit</b>	13	51	28	80
<b>Areca</b>	9	72.5	9	65
<b>Tangerine</b>	19	97.2	6	15
<b>Cassava</b>	10	88.3	11	61.7
<b>Sweet potato</b>	8	78.8	6	23.3
<b>Starfruit</b>	6	76.7	9	71.1
<b>Mangosteen</b>	9	65.6	9	34.4
<b>Pineapple</b>	7	71.4	8	48.8
<b>Corn</b>	8	86	6	23.3
<b>Custard apple</b>	2	65	9	85.6
<b>Bamboo</b>	2	100	6	100
<b>Chilli</b>	6	74	5	82.5
<b>Morning glory</b>	7	81.4	8	28.8
<b>Dong leaf</b>	5	92	3	47.5
<b>Fig</b>	2	75	7	78.6
<b>Longbean</b>	4	-	4	-
<b>Mango</b>	3	90	5	80
<b>Sweet orange</b>	7	100	-	-
<b>Cabbage</b>	4	90	4	46.7
<b>Papaya</b>	1	80	6	86.7
<b>Peanut</b>	5	92.5	2	15
<b>Basil</b>	4	77.5	4	47.5

<sup>13</sup> Among other documented species, *Dimocarpus longan*, *Diospyros lotus*, *Dioscorea esculenta* were also used only for family purposes.

<b>Betel</b>	5	90	2	25
<b>Guava</b>	4	70	4	55
<b>Peach</b>	1	80	4	73.3
<b>Pumpkin</b>	5	53.3	5	46.7
<b>Spring onion</b>	5	96	1	20

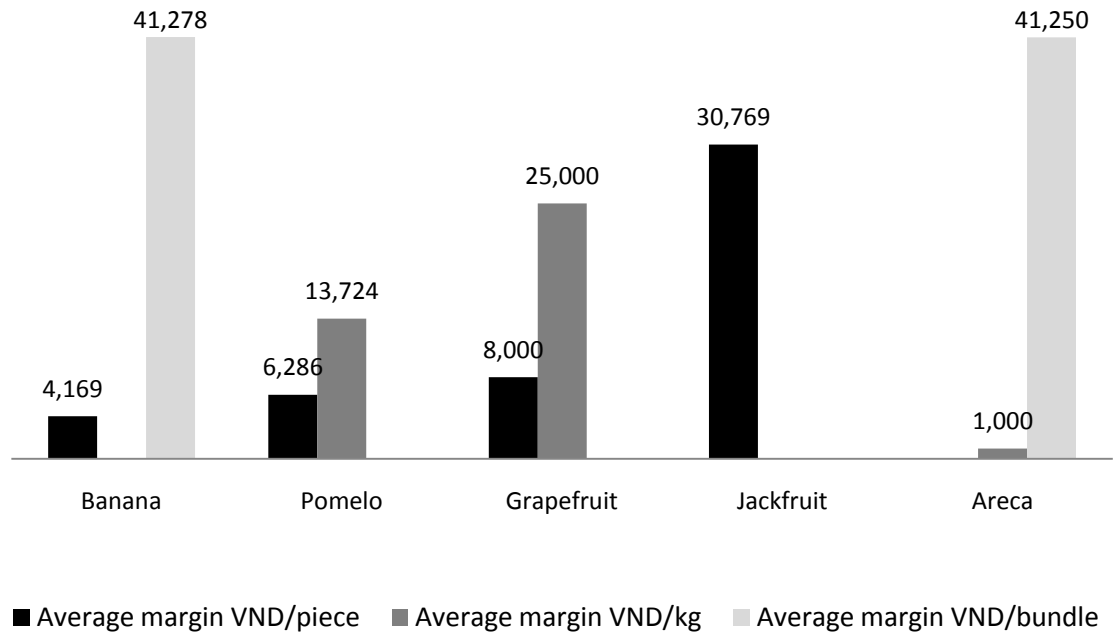
**Interpretation:** from all respondents who cultivate banana, 54 picked “market” as (one of) the final destination of their product and on average 80% of its production goes to the market. 54 respondents picked “family” and on average 50.9% of their production of banana stays within the family. Banana is thus considered as predominantly market-oriented.

The mean to reach the final consumer differs from specie to specie in harmony with local habits and market opportunities. While majority of *Citrus paradisi* or *Citrus grandis* production is sold at home (55% and 74% respectively), *Musa balbisiana*, *Artocarpus heterophyllus* and *Areca catechu* are usually sold via direct selling on open markets (51%, 31% and 27% respectively). For a minor part of production, middleman links the producer and the consumer.



**Figure 26 Selling place for 5 most frequently listed species (%)**

The selling margin differs from specie to specie in accordance with market value of the product. In August 2012, *Musa balbisiana* and *Areca catechu* had the highest margin per unit (bundle in this case) reaching more than 41,000 VND.



**Figure 27 Average margin in VND for the 5 most frequently listed species**

Finally, a multiple linear regression model was used to understand the home garden commercialization features. The purpose was to determine significant factors playing a certain role in the dependency of households on home gardens (measured by the share of home garden income on total household income).

**Table 4 Regression analysis of household dependency on home gardens**

<b>Independent variables</b>	<b>coefficients b*</b>	<b>significance (p-value)</b>
<b>total income</b>	-0.31	0.077
<b>dependency ratio</b>	-0.05	0.757
<b>distance from Hue</b>	-0.08	0.609
<b>farming years</b>	-0.01	0.978

<b>financial satisfaction</b>	0.03	0.831
<b>market species</b>	-0.17	0.380
Regression	n=45	
R=	0.36805047	
Standard error	26.730756574	

No statistically significant variable influencing the home garden commercialization has been discovered (p-value higher than 0.05 in all cases). This regression model could explain barely 37% of the analysis (R=0.3428) with 26.66% of range of error. Nevertheless, it turns out that all independent variables except one (financial satisfaction) are negatively correlated to the regressed variable (negative coefficient b\*). In Table 5 can be seen correlations between independent variables, which indicate e.g. that total income increases with higher dependency ratio (breadwinners are under pressure to earn more money because their number is exceeded by dependent members) what is reflected in a better financial satisfaction. On the contrary, the total income decreases in households located further from Hue and in those with lower number of market species cultivated.

**Table 5 Correlation matrix of variables influencing commercialization**

	<b>total income</b>	<b>dependency ratio</b>	<b>distance from Hue</b>	<b>farming years</b>	<b>financial satisfaction</b>	<b>market species</b>
<b>total income</b>	1.00	0.34	-0.22	0.00	0.27	-0.07
<b>dependency ratio</b>	0.34	1.00	-0.01	-0.27	0.05	-0.04
<b>distance from Hue</b>	-0.22	-0.01	1.00	0.02	-0.19	0.17
<b>farming years</b>	0.00	-0.27	0.02	1.00	0.09	-0.54
<b>financial satisfaction</b>	0.27	0.05	-0.19	0.09	1.00	0.04
<b>market species</b>	-0.07	-0.04	0.17	-0.54	0.04	1.00

## 6. Future expectations

Finally, respondents were asked about opinions concerning the future of their home garden. 32 respondents stated they want to keep the same specie composition in the future, whereas 36 stated he/she was planning to develop cultivation of new species. Eleven respondents cited concretely *Citrus reticulata blanco* as the targeted specie. *Citrus paradisi*, *Citrus sinensis*, *Citrus grandis*, *Mangifera indica* or *Psidium gujava* were also listed as desired. Another 7 respondents declared to be willing to enlarge their home garden area. Finally, 6 respondents stated they had no particular plan concerning the future of their home garden and 1 respondent even declared that he will quit farming. On Table 6 can be found detailed recapitulation of specie cultivation history and intentions.

The reasons/benefits to grow new species or increase yields were classified either as economic and/or as practical. Most of commercialized species such as *Citrus reticulata blanco*, *Citrus paradisi* or *Acacia auriculiformis* were listed as desirable in the future because of economic benefit for households. Other reasons for cultivation of different species were behind their practical characteristics. On one hand, desired species are considered as tasty and families stated to generally wish to consume more fresh fruits or vegetables as they try to compose their food of healthier products. On the other hand, respondents highlighted that their cultivation is not very demanding and provides high yields (especially in the case of fruit trees).

**Table 6 Long term plant cultivation overview**

Common name	Citations (n)	Cultivation (n)		
		10 years ago	5 years ago	In 5 years
<b>Banana</b>	74	57	69	69
<b>Pomelo</b>	47	43	46	46
<b>Grapefruit</b>	44	38	39	41
<b>Jackfruit</b>	29	28	23	21
<b>Areca</b>	22	17	19	20
<b>Tangerine</b>	22	9	20	19
<b>Cassava</b>	19	11	12	13
<b>Sweet potato</b>	12	8	8	8

<b>Starfruit</b>	11	10	9	11
<b>Mangosteen</b>	10	9	9	9
<b>Pineapple</b>	10	5	9	8
<b>Corn</b>	9	8	8	8
<b>Custard apple</b>	9	4	7	8
<b>Bamboo</b>	8	4	7	7
<b>Chilli</b>	8	6	8	8
<b>Morning glory</b>	8	7	8	7
<b>Dong leaf</b>	7	5	6	5
<b>Fig</b>	7	5	4	7
<b>Longbean</b>	7	4	4	4
<b>Mango</b>	7	4	6	6
<b>Sweet orange</b>	7	3	6	6
<b>Cabbage</b>	6	6	6	6
<b>Papaya</b>	6	2	4	4
<b>Peanut</b>	6	5	5	5
<b>Basil</b>	5	5	5	5
<b>Betel</b>	5	4	5	5
<b>Guava</b>	5	5	5	5
<b>Peach</b>	5	1	5	5
<b>Pumpkin</b>	5	3	5	5
<b>Spring onion</b>	5	5	5	5

Almost 30% of respondents consider their home garden as part of the heritage they would leave to their children. Because of that, they try, intentionally or not, to transfer their own home gardening skills. 22% of respondents clearly stated their children were taught familial gardening habits particularly in the field of agricultural techniques and cropping time-management. Concretely, children were learning by working with their parents during their free time. Younger children were planting, weeding or harvesting easily accessible species, usually those cultivated at ground level. They were also involved in some basic manual processing procedures, such as peeling or cutting. Older children with stronger physical condition were helping with other crops and other linked activities.



## Discussion

Despite of the two decades of intensive economic growth, Vietnam still faces social, economical and environmental issues. Home gardens are affected by structural changes associated with socio-professional transformations of farmers and rural-urban interface (Wiersum, 2006). They are however able to adjust to these socioeconomic changes (Peyre et al., 2006). In our study, a total of 58 species were documented in 99 surveyed households of Hue City and in surrounding suburbs. Similar research was conducted by Vlková et al. in 2008 within villages of Phong My commune (Thua Thien Hue province). Their survey of rural home gardens identified between 51 and 57 species (2011). As home gardens are reputed to have a high biodiversity in all over the world (Kumar and Nair, 2004), our results support that there are no significant differences of specie composition between rural and urban home gardens (in Thua Thien Hue province). But this study did not compare benefits of horticultural production between rural and urban farmers.

Species diversity was on average 5.01 specie per surveyed home garden, ranging from 1 to 15. That value is very low compared to similar studies. Home gardens of Java count usually 20 to 40 crops within urban areas (UNDP, 1996). Trinh et al. listed on average 50.3 specie per home garden in south lowlands of Vietnam, in the Thuan An district situated in the suburbs of Ho Chi Minh City (2003). There, the minimal number of species in surveyed home gardens was 36 and the maximal 78.<sup>14</sup> This important difference is due to the fact that this research was aimed at higher-added value crops. Respondents then cited only the most important species either in terms of number of individuals planted or in terms of major economic impact. Also, many species and especially those for traditional medicine, spices or decorative flowers were not even mentioned by respondents. This can also imply that farmers neglect the cultivation of some plants, which grow passively as it is the case of *Piper lolot* C.DC. (Schmidt et al., 2008). The home

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<sup>14</sup> In their study, Trinh et al. compared the specie richness in northern, central and southern Vietnam. The average number of species per home garden was equal to 38.6 in northern Vietnam. In comparison, southern home gardens located in tropical areas counted on average 53.9 species per home garden. This wide national disparity is influenced by the natural conditions and agricultural habits characteristic of each region.

garden species composition is the result of deliberate selection and reflects personal preferences of its owner towards particular subsistence and livelihood needs/strategies. That may be the reason why home gardens have not been included into wider development projects, because those usually seek “replicable models” (Kumar and Nair, 2006).

Vietnamese as other home gardens are shifting to market-oriented production (Michon and Mary, 1994; Trinh et al., 2003; Abdoellah et al., 2006; Kumar and Nair, 2006; Vlková, 2011).<sup>15</sup> It turned out that home garden production in Hue was mainly market-oriented although primary role of home gardens is traditionally to support food security (Brownrigg, 1985; Fernandes and Nair, 1986; Torres, 1988; Wickramasinghe, 1995). But in some countries, especially the poorer ones, urban farming is predominantly subsistence oriented. Farmers tend to grow essential staple crops and are highly dependent on their home garden. In Mozambique, urban dwellers even grow perishables in public spaces if they do not have their own land (Egal et al., 2001). The share of home garden on total income generation is therefore lower as they consume most of the production (Egal et al., 2001; Wiersum, 2006; Zezza and Tasciotti, 2010). This study did not focus on the impact of urban agricultural production on low-income consumers. It seems, there is no benefit for them in terms of price, because urban farming does not produce cheaper products. The only way poor households can benefit from urban agriculture is by selling own production (Egal et al., 2001).

As in other studies, urban farmers from Hue prefer to grow commercial species (Shalaby, 1991; Padoch and De Jong, 1991; Egal et al., 2001). Concretely they plant mainly perishables (Zezza and Tasciotti, 2010). Most of commercialized species such as *Citrus reticulata blanco*, *Citrus paradisi* or *Acacia auriculiformis* were listed as desirable in the future essentially because of economic benefit for households. The market demand for those products is rising, and farmers wish to react on that. In our study, surveyed households earned about 40% of their total income from crop activities (20% from home

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<sup>15</sup> But some authors predict that bad economic conditions, accompanied by conflicts and world price fluctuations of raw commodities, seem to take back home gardens to subsistence (Egal et al., 2001).

gardening).<sup>16</sup> Zezza and Tasciotti found in a similar research that only 13% of income came from urban agriculture; however their research was conducted in rural remote areas (2010). On the other hand, Trinh et al. reported 54% of home garden share on total income of households from Ho Chi Minh City suburbs, which indicate there is a positive correlation between urban location and home garden commercialization (2003). In our study, this correlation was also positive, but statistical significance was not proved.

Home gardens are considered to have a major resilient position in household farming system (Buchmann, 2009). Commercialization of urban farming is seen as positive for urban dwellers (Weiberger and Genova, 2005). One of the primary economic aspects of home gardens is their ability to secure household cash security. They diminish negative fluctuations of household income (Wickramasinghe, 1995).

Urban production of fruits and vegetables has a comparative advantage in terms of distance to market access. Furthermore shortage in added-value generation is limited as urban farmers can sell their production themselves. Moreover, demand for fresh products is rising in the non-tropical regions because of the year-round desire for off-season products, exotic fruit and vegetables. That implies many advantages for urban farmers and calls towards higher commercialization of their production and by that mean, towards a more cash crop oriented cultivation. As suggests our study from Vietnam, crop management is very important and high value crops should be emphasized in urban areas, where there is no possibility to increase cultivating area. Farmers should rather focus on sustainable but intensive-oriented home garden care.<sup>17</sup> As a matter of fact, the CGIAR<sup>18</sup> recently identified high value crops as a system priority (Weinberger and Lumpkin, 2007). It might particularly fit into the global efforts to fight hunger and poverty, as stated by the very first Millennium Development Goal. From 2015, their validity will expire and international community is already preparing the next set of goals with similar objectives, but via slightly different approaches. One of

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<sup>16</sup> Margins listed in Figure 26 may vary during the year due to seasonal fluctuations. Also, those values may be in reality different in the Vietnamese typical selling process, where sellers and customers try to bargain.

<sup>17</sup> After an official incentive to higher added value crops cultivation in Java, a research reported that intensive urban horticulture cultivation produces 3 to 6 times more nutritional intake than multicrop rice production (UNDP, 1996).

<sup>18</sup> Consultative Group on International Agricultural Research

them could be the insistence on development of local small scale farming systems and especially urban farming.

State authorities try to influence small-scale cultivation through subvention driven politics as it is the case for cassava or acacia. Official home garden programs also influence traditional agro-biodiversity (Kehlenbeck and Maass, 2006). Trinh et al. noticed that home garden commercialization did not lead to loss of biodiversity (2003). In the case of Vietnam, research has yet focused on impact of urban agriculture on biodiversity or farmers, like in this study, but there is a need for future development of research from the other way: effects on market. Data about importance of urban production for urban markets are missing. However, in several Southern African cities, the share of vegetables grown in urban and peri-urban areas have been estimated such as in Windhoek (20%), Gaborone (30%), Lilongwe (up to 50%) and in Dar es Salaam (for some products up to 90%) (Egal et al., 2001).

As the surveyed home gardens were located in the city of Hue or in its neighbourhoods, we expected that respondents could identify some specific pressure effects linked to that urban vicinity. Half of our respondents stated facing problems linked to pollution, 38 to low yields and 35 to erosion. In terms of soil fertility, home gardens received the worst grade among all household land holdings. That may be the reason behind the fact, that purchase of fertilizers and pesticides represents a 62% burden among all home garden expenses. Use of chemicals is not only financially demanding, but also environmentally harming. A study conducted by Anku et al. highlights this issue by warning about “the potentially harmful impact on human health of growing vegetables in the urban environment... through the potential plant uptake of industrial pollutants in the soil, water, or air” (1998). Managing urbanization is a looming issue in developing countries. Farmers should for instance be aware of the fact, that mixed cropping can represent an effective use of limited area and that it reduces risks of climate and disease threats. The differentiation of plants is encouraging the garden system and its sustainability. They are actually providing shelter, shade and nutrition to each other in perfect logic of the VAC method.

In our case, managing agricultural waste represents an example of wise practice among farmers emerged from concerns about healthy aspects of their cultivation. Most of them used agricultural waste as organic fertilizer.<sup>19</sup> One third of respondents stated they would use a biogas station primarily for its fertilizer benefits.<sup>20</sup> Even if the organic agriculture still does not play an important role in cropping methods of households, it could be a serious opportunity for them to focus on that especially as the demand for that kind of production is rapidly increasing (Reardon et al., 1999; Weinberger and Lumpkin, 2007; Yussefi & Willer, 2003). Our study from Hue suggests, that farmers are advised to teach their children sustainable farming methods insisting on environmental consciousness (Mazumdar and Mazumdar, 2012). Organic farming is now a well researched topic for development of small scale agriculture and environmental protection. With the institutional support, this form of farming could diversify household income (Blanc, 2009).

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<sup>19</sup> Farmers are perhaps obliged to do so as fertilizers represent the biggest cash burden of home garden inputs.

<sup>20</sup> Other benefits represent saving household costs linked to lighting, cooking etc.

## Conclusion

The research led in Hue gives an insight into socioeconomic features of urban and peri-urban agriculture in Central Vietnam. Surveyed households run home gardens combining subsistence and market-orientation. Despite the fact that market-oriented gardening prevails, home garden commercialization represents only a supplementary source of income (20%-share of total income). Major part of household revenue is generated from other land holdings (i.e. annual crop fields) and from off-farm activities (i.e. regular employment, pensions). Despite the commonly shared idea of low inputs into home gardening, survey participants dedicate important amounts into fertilizer and pesticide purchases (62%-share of total home garden inputs). On the other hand, labour costs are minor due to the involvement of extended kinship network.

Nevertheless home gardens represent a great development potential for urban dwellers within forceful urban industry. For entrepreneurial individuals, they offer wide opportunities of self-realization and welfare satisfaction. However farmer's attitudes towards home gardens are negatively affected by regular floods and by pollution (i.e. bad soil quality) and price fluctuation linked to urban environment. A large share of respondents declares not to be financially satisfied, even though they witness benefits of urban commercialization at household level. Paradoxically, only few farmers are willing to cultivate new cash crops, and do prevail those, who do not have any plans for future development of their garden production.

Cultivated species diversity contributes to food and cash security of households, as well as a balance between ecological preservation and economic sustainability of gardens. Farmers dispose of all necessary means to choose garden's plant composition. During this study, 58 species were documented within typical layered multicrop home gardens. Predominantly cultivated fruits and vegetables were used as food (80%), firewood (28) and fodder (22%), while 80% of them served as multipurpose.

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Appendix 1 List of documented species

Common Name	Botanical Name	Vernacular name	Citations (n)
<b>Banana</b>	<i>Musa Balbisiana</i>	Chuoi	74
<b>Pomelo</b>	<i>Citrus Grandis</i>	Thanh tra	47
<b>Grapefruit</b>	<i>Citrus Paradisi</i>	bưởi	44
<b>Jackfruit</b>	<i>Artocarpus Heterophyllus</i>	Mít, Chay	29
<b>Areca</b>	<i>Areca Catechu L.</i>	Cau	22
<b>Tangerine</b>	<i>Citrus Reticulata Blanco</i>	Quýt	22
<b>Cassava</b>	<i>Manihot Esculenta Crantz</i>	Sắn	19
<b>Sweet Potato</b>	<i>Ipomoea Batatas</i>	Khoai lang	12
<b>Starfruit</b>	<i>Averrhoa Carambola</i>	Khê	11
<b>Mangosteen</b>	<i>Garcinia Mangostana L.</i>	mãng cụt	10
<b>Pineapple</b>	<i>Ananas Comosus</i>	Dứa	10
<b>Corn</b>	<i>Zea Mays</i>	bắp	9
<b>Custard Apple</b>	<i>Annona Squamosa</i>	Na	9
<b>Bamboo</b>	<i>Bambusa Balcooa</i>	Tre	8
<b>Chilli</b>	<i>Capsicum Frutescens</i>	Ot	8
<b>Morning Glory</b>	<i>Ipomoea Aquatica</i>	Rau Muong	8
<b>Dong Leaf</b>	<i>Phrynium Placentarium</i>	Lá dong	7
<b>Fig</b>	<i>Ficus Auriculata</i>	Va	7
<b>Longbean</b>	<i>Vigna Unguiculata</i> <i>Sesquipedalis</i>	Dau dua	7
<b>Mango</b>	<i>Mangifera Indica</i>	Xoai	7
<b>Sweet Orange</b>	<i>Citrus Sinensis</i>	Cam	7
<b>Cabbage</b>	<i>Brassica Oleracea Capitata</i>	cải bắp	6
<b>Papaya</b>	<i>Carica Papaya</i>	đu đủ	6
<b>Peanut</b>	<i>Arachis Hypogaea</i>	đậu phộng	6
<b>Basella</b>	<i>Basella Rubra</i>	Mồng tơi	5
<b>Betel</b>	<i>Piper Betle</i>	Trau	5
<b>Guava</b>	<i>Psidium Gujava</i>	Ôi	5
<b>Peach</b>	<i>Prunus Persica</i>	đào	5
<b>Pumpkin</b>	<i>Cucumis Maxima</i>	bí đỏ	5
<b>Spring Onion</b>	<i>Allium Fistulosum</i>	hành (onion)	5
<b>Ochna</b>	<i>Ochna Integerrima</i>	Hoa mai	4
<b>Integerrima</b>			
<b>Eggplant</b>	<i>Solanum Melongena</i>	cà tím	4
<b>Veggie</b>			4
<b>Star Apple</b>	<i>Chrysophyllum Cainito</i>	vú sữa	3
<b>Water Melon</b>	<i>Citrullus Lanatus</i>	dưa hấu	3

<b>Cucumber</b>	<i>Cucumis Sativus</i>	dưa chuột	3
<b>Lemon</b>	<i>Citrus Aurantiifolia</i>	chanh	3
<b>La Lot</b>	<i>Piper Lolot C.DC.</i>	Lá lốt	3
<b>Strawberry</b>	<i>Fragaria X Ananassa</i>	dâu	2
<b>Dragonfruit</b>	<i>Hylocereus Undatus</i>	thanh long	2
<b>Lemongrass</b>	<i>Cymbopogon Citratus</i>	Sa	2
<b>Hibiscus</b>	<i>Hibiscus Spp.</i>	dâm bụt	2
<b>Longan</b>	<i>Dimocarpus Longan</i>	nhãn	1
<b>Kiwi</b>	<i>Actinidia X</i>	quả kiwi	1
<b>Diospyros</b>	<i>Diospyros Kaki</i>	cây hồng	1
<b>Litchi</b>	<i>Litchi Chinensis</i>	cây vải	1
<b>Khaya Senegalensis</b>	<i>Melia Azedarach</i>	sau dong	1
<b>Bonsai</b>			1
<b>Orchid</b>	<i>Orchis X</i>	cây lan	1
<b>Ming</b>	<i>Santalum X</i>		1
<b>Paperflower</b>			1
<b>Yam</b>	<i>Dioscorea Esculenta</i>	khoai tu	1
<b>Plumeria</b>	<i>Plumeria Obtusa</i>	hoa dai	1
<b>Amaranthus</b>	<i>Amaranthus Tricolor</i>	rau đen	1
<b>Coconut</b>	<i>Cocos Nucifera</i>	dua	1
<b>Salad</b>		xả lách	1
<b>Lettuce</b>	<i>Lactuca Sativa</i>	rau diếp	1
<b>Acacia</b>	<i>Acacia Auriculiformis</i>	cây keo	1

**Appendix 2 Questionnaire: Homegardens in Hue, central Vietnam**

**Please, write as clearly as possible (big characters).**

**1. Please, fill in the information about you (if you are a household head, not necessarily house-owner):**

What is your gender?	When were you born?	For how many years did you visit school?	For how long have you run your farm?	Write down your most time-consuming activities	Do you have any off-farm job?	Estimate the time you participate on your homegarden activities?	City/village of residence
	Year		Years	Maximum 3		Hours/day Or Days/year	

**2. Now write down the people who live together in your house.**

**Note: Family = people who live in the same house as farmer (children living in different house or spending main part of their time at the university are not included)**

Nature of relationship (parents, children, other relatives, friends etc.)	What is their gender?	When were they born?	Years of schooling	What is his/her most time-consuming activity?	Do they have an off-farm job?	Estimate the time they participate on your homegarden activities?
						Hours/day or days/year

**3. Did the number of household members changed during the last 10 years?**

- a) no, it remains more or less the same (+/- 2 members)
- b) yes, it has changed as the number of household members increased by \_\_\_\_\_ members
- c) yes, it has changed as the number of household members decreased by \_\_\_\_\_ members

**4. Please, try to estimate your cash income (in thousands VND) per one year from particular activities listed bellow. If you have no income from some activity, write down zero "0". Example bellow helps you to link the income to particular activity. If you have any questions, do not hesitate to ask the interviewer.**

Annual crops	Trees (Plantation)	Home garden	Livestock	Off-farm job	Regular wage	Money from relatives and friends	If other, please specify
(rice, cassava)	(acacia, rubber etc.)			(own business, shop, restaurant etc.)			(government, pension etc.)

**5. And now try to estimate your annual cash expenditures (thousands VND):**

Your farm (fertilizer, seeds, fuel, fodder, farm equipment, transport etc.)	For the household (electricity, energy, firewood, food, water, land, equipment, house repair, transport etc.)	Health care	Education	Paying back for credit	Other (government taxes, gifts to temples etc.)

**6. Overall, are you satisfied with your financial situation?**

- Yes, I can pay for all my needs
- Yes, but incomes and outcomes are rather at balance
- No, I have difficulties to pay for my needs

**7. Do you have any major investment at the present moment? Please, specify. (if for example you are constructing a house or financing your child's studies etc.)**

- Yes
  - No
- If you want, please briefly specify:



**8. Can you specify how much VND/year do you spend for the run of your homegarden?**

	VND
Hired labour	
Fertilizer	
Pesticides	
Land preparation	
Seeds	
Other (please, specify):	

**9. During which months do you feel your household is affected by such events (if yes, mark "X")?**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Not enough food												
Not enough cash/money												
Floods (and other natural hazards)												
Harvesting of main products												
Planting of main products												
Rice harvest												
Off-farm activities receive more interest												
Home garden receive more interest in terms of labour												
Home garden receive more interest in terms of extra care (irrigation, shading, insecticides etc.)												
Majority of homegarden production sold												
Other (please, specify):												

**10. What is the total area of your farm (even if it is not next to your house)? How far in kilometres is it from Hue city?**

**11. Please, write down what is the composition of your farm (field, home garden, orchard...)**

Which plots does your farm have?	Total area in sao	Three main products	Quality of soil	Distance from your house	Slope
			1-not enough fertile 2-enough fertile 3-very fertile	1 – next to house 2 – 10 min walk 3 – 30 min walk 4 – more	1 – flat 2 – moderate 3 – hilly
Rice field		X			
Field with annual crops (cassava, peanuts ...)					
Field with perennial crops (trees, fruits, rubber tree)					
Fish pond/water					
Home garden (vuon)					
Forest (acacia)					
Drying place					
Other (please, specify):					

**12. Can you specify the reasons why are you running a home garden and to rank them according to their importance?(0 if you are not concerned, 1 is not important, 5 is very important)**

Reason	Very important 5	4	3	2	Not important 1	Not concerned
Fresh food production	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Higher income	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Free choice of species you can plant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Drying area

House protection (from sun or wind, shade ...)

Other (please, specify):

**13. Do you face urban pressure on the environment of your homegarden?**

Yes  No

heavy traffic  new buildings  pollution  growing population

Comments or any other feelings:

**14. Do you have a biogas plant?**

Yes. How many years? \_\_\_\_\_  No  No, but I want it  No, but I want it for fertilizer

**15. Your homegarden is situated very near to the city or directly placed in the city area. Can you specify, as a farmer, what are the most serious problems you have to face and to rank them according to their importance? (0 if you are not concerned, 1 is not important, 5 is very important)**

Reason	Very important 5	4	3	2	Not important 1	Not concerned
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of water	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of space	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pollution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bad work conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transport of products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Middlemen problem	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Real estate pressure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Low yields	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Price fluctuation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Erosion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lack of labour force	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Storage (cariosity due to time)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please, specify):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**16. Write down the crop species you plant in your homegarden**

Species name in Vietnamese	Number of individuals or m <sup>2</sup> planted	Period of cultivation (harvest?)	What do you use this species for?	Who is the final consumer of this species?	Who decided to grow this species?	Did you cultivate this species 5 years ago	Did you cultivate this species 10 years ago	Will you cultivate this species in 5 years?	If it's grown for market, indicate the selling place	Margin for 1 individual or kg sold	For what kind of by-products do you reuse materials?	What kind of processing do you use to add value to your product?
	i-individuals  m <sup>2</sup>	y-years  m-months  C-cultivation  H-harvest	A – food  B – medicine  C –constructing material  D – food for animals  E - firewood  F – other, specify	M-Market,  H-Household  in %	M-Market,  F-Family,  N-Neighbours, G-government	Yes=1	Yes=1	Yes=1	M-market,  H-at home, X-middlemen, O-other, specify	VND/i  Or  VND/kg	0 if the specie is not concerned by by-products	for example drying, cutting, peeling, squeezing etc.  0 if the specie is not concerned

17. Do you plan to increase, decrease or leave the same number of plant species in the future comparing to the present situation? (please fill in with a number)

+ ... species                      - ... species                      same number

18. Generally, why would you change the actual number of species cultivated?

market opportunities       food for family       food for animals ....       other, specify:

19. Are there any other species you want to cultivate in the future?

Species name in Vietnamese	Reason of possible cultivation

20. What do you do with your agricultural waste or residuum?

composting       burning       fertilizer       fodder       nothing       other processing

(please, specify):

21. Do you sometimes take your children to your home garden to teach them about its basics?

Yes       No      If yes, why? Do they help you?

22. Does any association/cooperative supports you with your home garden?

No

Yes,

if yes, how?

selling

inputs

selling and inputs       I am a member

other, specify \_\_\_\_\_

23. Do you have a credit or loan directly linked to the running of your home garden?

No

Yes:

Amount:

Interest rate:

Payback period:

Source:

24. Do you have any future expectations and/or opinions about your homegarden? (for example extending area, quit farming, pass to next generation, sell the land etc.)