Moving Towards Agroecosystem Sustainability: Safe Vegetable Production in Vietnam

By

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Author’s Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

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Abstract

Humanity is facing a series of challenges, including climate change, biodiversity loss, decreasing availability of cheap fossil fuel energy and social inequality that, when taken together, constitute a sustainability crisis. Agricultural systems are vitally important for the survival of humanity and must be moved towards greater sustainability. In Vietnam, the challenges facing the agriculture sector are immediate and pressing. These challenges include the need to improve the livelihoods of millions of smallholder farmers, improve food safety and protect already heavily burdened ecosystems. In response to these challenges, a number of alternative agriculture approaches, including safe vegetable production and organic farming have emerged. While the use of chemical fertilizers and pesticides are not permitted in certified organic agriculture, the requirements for safe vegetable production are not nearly as stringent. Chemical fertilizers and some low toxicity pesticides are allowed in safe vegetable production as long as pesticide residues are below proscribed limits. This research assesses the contributions that safe vegetable production and organic agriculture are making to the development of more sustainable agroecosystems in Vietnam. Organic production is still in early stages of development, with the majority of the projects directed towards production for export. Safe vegetables in contrast are produced primarily for the domestic market and demand is driven by consumer concerns over excessive pesticide use in conventional vegetable production. A sustainability assessment that explores the effect that safe vegetable production is having on eight major criteria for sustainability is applied in Cu Chi District, Ho Chi Minh City. Research methods included semi-structured interviews and group discussions with safe vegetable farmers together with interviews of other key actors from the agricultural sector in Vietnam. Along with the goal of protecting human health, farmers are interested in safe vegetable production because of improved economic returns made possible by reduced inputs and greater market access. While safe vegetable production is contributing to greater agroecosystem sustainability, further improvements are needed in some areas, specifically in the use of agrochemicals. There are encouraging signs in relation to pesticides, with some farmers reducing their pesticide use and moving towards less-toxic pesticides. Further movement towards sustainability could be fostered by a shift to the use of pesticides only as a last resort, a further shift from chemical to organic fertilizers, and improved capacity of farmers to experiment with and adapt safe vegetable production techniques.

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Dedication

I dedicate this book to the farmers of Vietnam who are striving to protect the health of their farms and their communities.

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Glossary of Acronyms

AMESH	Adaptive Methodology for Ecosystem Sustainability and Health
AVRDC	World Vegetable Centre
CIRAD	Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement
CPV	Communist Party of Vietnam
DARD	Department of Agriculture and Rural Development
EU	European Union
EurepGAP	Partnership of agricultural producers and retailers that sets certification standards for Good Agricultural Practices (now called GLOBALGAP)
GAP	Good Agricultural Practices
GTZ	German Technical Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit)
HCMC	Ho Chi Minh City
ICS	Internal Control System
IFOAM	International Federation of Organic Agriculture Movements
IPM	Integrated Pest Management
MARD	Ministry of Agriculture and Rural Development
MRL	Maximum Residue Limit (for pesticides)
ND	Nhuan Duc Commune
NGO	Non-Government Organization
SAP	Structural Adjustment Programme
SIPPO	Swiss Import Promotion Programme
TPT	Tan Phu Trung Commune
USD	United States Dollar
VAC	Integrated garden, pond and animal production system. In Vietnamese *Vuon* = garden, *Ao* = pond, *Chuong* = animal sheds
VND	Vietnam Dong (at time of study 16,100 VND = 1 USD approximately)

Chapter 1: Introduction

1.1 The Challenges Facing Agriculture

In the hubris surrounding the projects of modernization and economic diversification that are transforming agrarian societies, a basic biological fact – that we still need to eat – tends to be overlooked. Over the past 10,000 years agriculture emerged as the primary activity by which humans provide themselves with food (Diamond 1999). Agroecosystems can be conceived as social-ecological systems that combine human actors with other biological and physical elements in the process of food and fibre production (Waltner-Toews 2004). Agroecosystems are nested within the larger agro-food system, which encompasses not only the production of food, but also the processing, transportation and consumption of food. From a social-ecological systems perspective, humans are viewed as fundamentally part of the natural world. We are dependent on nature and our actions affect nature. This is evident when you consider the extent to which we have transformed the landscapes around us for the purposes of food production, with crops and pastures now covering 38 percent of the land area on the Earth (Pimentel and Wilson 2004).

In the past, farmers were able to increase food production through territorial expansion, but population growth leading to land shortages has necessitated a shift to agricultural intensification as the main way in which food production is increased (Szirmai 2005). This process of agricultural intensification uses increased inputs of energy, materials and information as a substitute for land. The inputs of energy into agriculture from non-renewable sources rose dramatically over the last 100 years as labour intensive practices became mechanized and inputs of agrochemicals, particularly synthesized nitrogen fertilizer, increased (Pimentel and Pimentel 1996). Modern agro-food systems use large amounts of oil and natural gas in the production, processing and transportation of food. But what happens when this approach to feeding the world is viewed through the lens of a low energy future?

It is increasingly recognised that world energy supplies, in the form of oil and natural gas, are very close to peaking and will soon start to decline (Deffeyes 2005; Heinberg 2005; Homer-

Dixon 2006). For example, in early 2007 the Commission of the European Communities released its latest energy policy which states that "the days of cheap energy for Europe seem to be over" (EC 2007: 3). Smil (2006) alleges that some of the authors in the peak oil movement tend to paint an overly pessimistic picture of the global oil supply. While there is no consensus on when a exactly the peak in world oil production will occur - most predictions place it sometime within the next 20 years – and what reaching and passing the peak will mean for the societies that are heavily reliant on oil, nobody can argue that fossil fuels are a sustainable energy source. As Smil (2006: 88) himself writes, "modern civilization rests on unsustainable harnessing of the solar inheritance, which cannot be replenished on a civilizational timescale". This poses serious questions as to the prudence of pursuing agricultural research and development activities that further promote the use of fossil fuels.

> Based on the available evidence from the temperate zone, one can argue that what has passed for successful agricultural development, as we know it, is merely a system dislocation associated with the temporary exploitation of hydrocarbons; that even if acceptable energy substitutes are found, the chemical approach to agriculture is collapsing as pests develop resistance and the environment reaches pollution thresholds (Norgaard 1981: 240).

It is widely recognized that there are a number of challenges facing humanity and the way we organize our agro-food systems. Added to the decline of readily available fossil fuels, is the decline of freshwater supplies and the additional challenges of climate change, soil erosion, biodiversity loss and social inequality that promise to make agriculture more difficult in the future. When considered together, these multiple intersecting challenges constitute a sustainability crisis (Gibson et al. 2005).

1.2 Agriculture in Vietnam

The challenges facing the agricultural sector in Vietnam are immediate and pressing. Vietnam is a densely populated country with over 83 million people living on 329,314 square kilometres of land. In the main agricultural areas of the Red River Delta in the north and the Mekong Delta in the south, population densities average 1,218 and 435 people per square kilometre respectively (GSO 2007). In 2005, around half of the economically active

population in Vietnam was employed in agriculture, while the agricultural sector accounted for less than 20 percent of the country's GDP (GSO 2007). Since the reforms of the mid-1980s, economic growth has been rapid but there has also been increasing income inequality, particularly in rural areas (Akram-Lodhi 2005; Taylor 2007).

In Vietnam, a move towards sustainable agriculture will need to bring improvements to the livelihoods of millions of smallholder farmers while at the same time protecting the already heavily burdened natural resource base. The river deltas and coastal areas of Vietnam are at great risk from rising sea levels and extreme storm events caused by climate change (Adger 1999; Preston et al. 2006). The use of agrochemicals has increased substantially since the 1980s and farmers have been found to overuse pesticides, including some that have either been banned or restricted because of their toxicity (FAOSTAT 2004; Nguyen and Tran 1997). The misuse of pesticides is raising concerns among consumers, who are demanding safer food (Moustier et al. 2006; Scott 2005).

To meet the challenges facing the agricultural sector in Vietnam, a number of alternative visions are being promoted, which seek to reduce inputs of non-renewable resources, integrate farm components to make better use of resources and improve the social and economic benefits derived from farming. In many countries it is often development organizations that are the driving force behind the introduction of alternative agriculture approaches, although the government and private sector can also be important actors. These alternative approaches to agriculture include the VAC[1] system of integrated gardens, fishponds and livestock (Le 2003), integrated rice and aquaculture systems (Dey and Prein 2005), integrated pest management (FAO 2001) and agroforestry (Vu and Nguyen 1995). Organic agriculture has also emerged over the past decade in Vietnam (den Braber and Hoang 2007; Firmino 2007; Moustier et al. 2006). Currently the majority of the organic agriculture projects are producing for export markets, but a small number of projects are focussing on the development of the domestic market for organic food.

[1] In Vietnamese, *Vuon* means garden, *Ao* means pond, and *Chuong* means animal sheds.

In the late 1990s another form of alternative agriculture called “safe vegetable production”, started to be practised in Vietnam. Safe vegetables are produced with lower inputs of pesticides in specially zoned areas deemed to be free from soil and water pollutants. Safe vegetable production arose in response to a number of pesticide poisoning cases that were reported in the mass media in Vietnam. With consumers becoming increasingly concerned about the safety and quality of their food, the government outlined temporary regulations on safe vegetable production in 1998 and began to train farmers in safe vegetable production.

1.3 Research Objectives

The aim of this research is to assess the contributions of organic agriculture and safe vegetable production to the development of more sustainable agroecosystems in Vietnam. The research aim is broken down into three specific objectives.

Objective 1: To develop a framework for assessing the contributions of alternative agriculture approaches to agroecosystem sustainability.

Objective 2: To explore the social-ecological changes that led to the emergence of organic agriculture and safe vegetable production in Vietnam.

Objective 3: To conduct a sustainability assessment of safe vegetable production in Cu Chi District on the outskirts of Ho Chi Minh City.

As a starting point, this study is based on the idea that maintaining healthy agroecosystems is one of the most important human activities in regards to our continued survival on the planet. We can live without many of the conveniences of modern life but we cannot live without and adequate food supply for very long. Given the challenges facing humanity, it is necessary to engage in a concerted effort to move along the path towards agricultural sustainability. In order to do this it is necessary to first develop some basis for assessing the sustainability of agricultural systems.

Sustainability is often conceived as resting on the three pillars of economy, society and ecology, with agriculture considered sustainable if it is economically viable, environmentally sound, and socially acceptable (Brown et al. 1987; Conway 1985). Thus, sustainable agriculture should be productive over the long-run without degrading the natural resource base (Altieri 1989). However, as Rigby and Cáceres (2001: 21) note, "the desire for sustainable agriculture is universal, yet agreement on how to progress towards it remains elusive." Apart from the difficulties of translating the concept of sustainability into practice, focussing on the three pillars as discrete entities has hampered innovation in moving toward sustainability (Gibson et al. 2005).

Conceiving of sustainability along traditional disciplinary lines can make things easier to understand, but it is problematic in that it obscures "the linkages, interconnections and interdependencies", which are integral in understanding and fostering sustainability (Gibson et al. 2005: 56). In their book on sustainability assessment, Gibson et al. (2005) move beyond the three pillars of economy, ecology and society, and focus instead on the minimum set of core requirements for moving towards sustainability. These core requirements involve maintaining the integrity of the social-ecological system, sharing resources equitably and using them efficiently to ensure sufficient livelihood opportunities, improving participation in decision making and planning ahead to ensure adaptation to system changes.

This study draws on the ideas of Gibson et al. (2005) from the emerging field of sustainability assessment and integrates these with principles from the literature on agroecology, organic agriculture and sustainable agriculture (Altieri 1989; Altieri and Hecht 1990; Altieri and Nicholls 2005; Conway 1985; Conway 1987; Francis 1988; Gliessman 2004; Pretty et al. 2001) to develop a framework for the assessment of agroecosystem sustainability. While consideration of biophysical aspects is important for understanding farm sustainability, it is also necessary to incorporate into the analysis the socio-economic conditions in which a farm exists. A social-ecological systems approach guides the application of the sustainability assessment, which allows for the interactions between the social and ecological components of agroecosystems to be explored (see for example Kay et al. 1999; Waltner-Toews 2004; Waltner-Toews and Kay 2005; Waltner-Toews et al. 2004).

A system is defined as a "set of interacting elements that form an integrated whole" (De Rosnay 1979). Systems have arbitrarily defined boundaries, are open to flows of energy, material and information and are composed of interacting subsystems (Grzybowski and Slocombe 1988). Systems theories challenge traditional reductionist science by positing that a system is more than the sum of its constituent parts. Therefore, systems cannot simply be understood by studying each individual system component but must be understood by examining the whole (Waltner-Toews et al. 2004). By adopting a systems perspective, this study brings an integrative and interdisciplinary understanding to issues of agroecosystem sustainability in Vietnam.

The sustainability assessment framework is applied in a case study of safe vegetable farmers in the Cu Chi District of Ho Chi Minh City. This area is a focal point for the development of safe vegetables in the south of Vietnam. Many farmers in this area are shifting out of rice production and starting to grow safe vegetables or they are already growing conventional vegetables and they are starting to adopt safe vegetable production practices. The sustainability assessment examines the effect that a shift from conventional vegetable production to safe vegetable production is having on moving the agroecosystems in Cu Chi District towards greater sustainability.

1.4 Contributions of this Study

This research fills the need for detailed case studies that incorporate the ideas from the emerging field of sustainability assessment to investigate the various spheres of human activity, with the ultimate goal of moving humanity along the road towards sustainability. (Gibson 2006; Pope et al. 2004). Agriculture, as the main form of land-use and a major user of fossil fuel energy, is a prime candidate for serious investigation under a sustainability assessment framework. While there is an extensive literature dealing with numerous interpretations of sustainable agriculture, there has been very little if any investigation so far of agricultural activities using the sustainability assessment criteria put forth by Gibson et al. (2005). By marrying the sustainability assessment criteria of Gibson et al. (2005) with the key principles from the agroecology literature, this research seeks to both test and further the

theory around the emerging field of sustainability assessment and generate practical insights for moving safe vegetable production towards greater sustainability.

This thesis provides a multi-dimensional investigation of the sustainability of safe vegetable production around Ho Chi Minh City. Ho Chi Minh City represents the largest urban area in Vietnam, with rapid urbanization and industrialization putting pressure on agricultural land and labour. Hanoi has been the city of geographic focus within Vietnam for several large collaborative projects on peri-urban vegetable production in Southeast Asia and China (MALICA 2007; Moustier 2007; Moustier et al. 2006; SEARUSYN 2006). There has been much less research activity on safe vegetables in Ho Chi Minh City with the research that has taken place focusing more on vegetable supply chains and less on the production issues faced by farmers (Cadilhon et al. 2003; Cadilhon et al. 2005; Cadilhon et al. 2006; 2006). Farmers represent the very basis of the safe vegetable production system and this research places a strong emphasis on their perspectives.

One of the sections of the sustainability assessment focuses on the ability of farmers to engage in safe vegetable production and examines whether there are barriers to production faced by farmers. Part of this involves assessing the ability of farmers to conform to and benefit from the new forms of regulation around safe vegetable production. Conceived broadly, regulation is any attempt to shape social, ecological and economic processes (Vandergeest 2006; Vandergeest and Li 2006).

In researching sustainability it is important to understand the visions of the various actors within the system. It is not always clear to what extent social and ecological concerns lie behind the spread of safe vegetable production or organic agriculture in Vietnam, or to what extent it is being driven purely by the search for greater profits. Organic agriculture for example, started as a holistic farm management approach that stressed the linkages between soils, plants, animals and human communities (Rigby and Cáceres 2001). Globally, the organic food sector has been growing rapidly and organic food is now produced on large monoculture farms and transported around the world, leading some to question the sustainability of this approach (Guthman 2004).

Organic agriculture is just starting in Vietnam and has so far received only scant attention in the academic literature (Camillo 2004; Moustier et al. 2006). One of the main contributions of this research is a review and consolidation of the available information on organic agriculture in Vietnam. As it is early days for organic agriculture in Vietnam, safe vegetable production is used as a case study for testing the sustainability assessment framework. It is assumed that using safe vegetable production as a test case for the sustainability assessment framework will be useful in gaining at least some understanding as to the challenges that farmers might face in undertaking the more involved transition to certified organic production.

1.5 Organization of the Thesis

This thesis is organized into seven chapters. This first chapter has briefly outlined the challenges facing agriculture in Vietnam and set out the research objectives and contributions of this study. Chapter Two reviews the relevant literature on agroecology, sustainable agriculture and sustainability assessment in order to develop the sustainability assessment framework that guides this study. Chapter Three provides a brief introduction to the study sites and outlines the research methods that were employed for data collection. Chapter Four introduces the main agroecological regions of Vietnam and explores the social-ecological changes that led to the emergence of organic agriculture and safe vegetable production in Vietnam. Chapter Five introduces the system of safe vegetable production in Ho Chi Minh City and the two study sites in Cu Chi District and provides a comprehensive picture of the current status of organic agriculture initiatives in Vietnam. Chapter Six presents the results of the sustainability assessment of safe vegetable production in Cu Chi District, Ho Chi Minh City. Chapter Seven concludes this study by examining the complementarities and tensions that exist between safe vegetable production and agroecosystem sustainability. Some reflections on the process of conducting the sustainability assessment are also offered, along with some suggestions for further research.

Chapter 2: Assessing Agroecosystem Sustainability

2.1 Introduction

This chapter reviews the literature relevant to agroecosystems, sustainable agriculture and sustainability assessment in order to develop a framework for assessing the sustainability of safe vegetable production in Vietnam. The chapter begins with an introduction to agriculture as a social-ecological system. The evolution of agriculture is discussed, particularly in relation to smallholder farming systems in developing countries. Woven through this discussion is a narrative on the increasingly important role that energy derived from fossil fuels has come to play in agricultural production. The following section briefly discusses some of the challenges facing world agriculture. Following this, various conceptions of sustainability, sustainable agriculture and sustainability assessment are reviewed, along with some of the main principles derived from the field of agroecology over the past three decades. The ideas drawn from these various literatures feed into the sustainability assessment framework, which is presented at the end of the chapter.

2.2 Agriculture as a Social-Ecological System

The human species has spent the vast majority of its evolutionary history gathering rather than producing food (Simmons 2006). This all began to change around 10,000 years ago when agriculture was "invented" in several different locations on the earth (Diamond 1999). Since then, agriculture has become the primary activity by which humans provide themselves with food and other useful products. Agricultural systems, or agroecosystems, involve human-induced disturbances in ecosystems for the purposes of obtaining products deemed useful to humans. Thus, agroecosystems can be conceived as social-ecological systems that combine human actors with other biological and physical elements in the process of food and fibre production (Waltner-Toews 2004).

Since the "invention" of agriculture and up to the time of the industrial revolution in the 18th Century, much of the human population was engaged in agricultural activities. During this

period, farming activities ran primarily on solar energy captured through photosynthesis (Simmons 2006). Norgaard (1981) conceives of agricultural development occurring as the result of beneficial sequential adaptations between social systems and ecosystems. When a surplus above maintenance needs can be generated, the system can coevolve in such a way that favourable outcomes are realised for the human actors in the system (Norgaard 1981). Under this process of "agricultural coevolution", the ecosystem generally becomes less complex while the opposite is true for the social system (Norgaard 1981: 239). Where favourable conditions for agriculture existed, modest surpluses of food beyond the subsistence needs of farmers could be captured, allowing for the development of towns and cities (Simmons 2006). The fossil fuel era, starting with the exploitation of coal, led to vast changes in agriculture and indeed all aspects of human society.

> Once it was realized that coal was a concentrated source of energy that could be released in controlled conditions, the stage was set for an unprecedented set of leaps in environmental manipulation and, via increased food production, greater surpluses of energy. In effect, the exploitation of coal (followed by oil and gas) has provided immense subsidies to the gathering of solar energy and the capital to invent and construct machines which act as positive feedback loops for myriad activities (Simmons 2006: 308).

The inputs of energy into agriculture from non-renewable sources rose dramatically over the last 100 years as labour intensive practices became mechanized and inputs of agrochemicals, particularly synthesized nitrogen fertilizer, increased (Pimentel and Pimentel 1996). This process started to gain momentum in the latter half of last century, spreading to developing countries during the Green Revolution of the 1960s and 1970s. The Green Revolution combined new crop varieties with increased inputs of agrochemicals and water to raise productivity in many of the best-endowed agricultural regions of the world, particularly in Asia (Evenson and Gollin 2003). While this strategy successfully increased production of the main cereal grains at a rate comparable with the increases in population growth, it appears that productivity gains are now levelling off, while the world population continues to grow (Brown 2004; Conway 1997).

The Green Revolution has been critiqued for failing to account for the externalities of production caused by the increased use of agrochemical inputs that have damaged human and

ecosystem health (Lang 1999; Shiva 1991). Further, the technologies generated during the Green Revolution were inappropriate for the socioeconomic or biophysical situations of all farmers, particularly resource poor farmers living in marginal environments for agriculture (Tripp 2001). Even the International Rice Research Institute (IRRI) in the Philippines, which was heavily involved in the plant breeding work of the Green Revolution, has recognized the need to improve production practices so as to reduce negative environmental effects and make more efficient use of agrochemical inputs (IRRI 2004).

Increasing inputs of fossil fuel energy into agriculture has led to a decline in the number of farmers in the world. Mechanization has replaced human and animal labour, allowing individual farmers to farm much larger areas of land. Nevertheless, agriculture still plays an important role as the main provider of employment in the economies of many developing countries. In the year 2000 there were 2.5 billion people worldwide who depended on agriculture for their livelihoods, representing 42 percent of the world population (See Table 2.1). The majority of the world's farmers live in developing countries where much of the agricultural production occurs on small-scale farms. In Asia, around 52 percent of the farms are less than one hectare in size (Devendra and Thomas 2002). Alamgir and Arora (1991) estimate that smallholders, defined as farmers with farms of less than two hectares in size, accounted for 60-70 percent of farmers in developing countries. These smallholders operate on 25-30 percent of the land area and account for 30-35 percent of the output, indicating their higher relative productivity compared to farmers with larger landholdings.

Table 2.1: Percentage of World Population Employed in Agriculture, 1950-2000

Region / Year	1950	1960	1970	1980	1990	2000
Developed Countries	35.5	26.7	18.0	13.6	10.7	7.6
Developing Countries	79.2	74.0	68.9	63.1	57.6	52.0
World	64.4	58.8	54.1	50.0	46.4	42.4

Source: (FAOSTAT 2006)

Small-scale mixed farms are a durable form of spatial organization in agriculture, existing in all environments where crops can be grown. Smallholders have developed a diversity of systems and techniques to suit the heterogeneous conditions in which they exist (Rosset 1999;

Stevens 1977). For much of the history of agriculture, small farms were largely subsistence enterprises, with the farm family producing for their own consumption (Ruthenberg and Jahnke 1985). This began to change during the industrial revolution, when the growing urban markets required farmers to produce much larger surpluses of food (Heffernan 2000). Over time, economic growth came to be associated with industrialization and a move away from agriculture. It was believed by Marxist and capitalist thinkers alike that greater efficiency in agriculture would free up labour for the industrial sector as the economy underwent a process of structural transformation (Szirmai 2005).

In the 1970s, following years of neglect of the agricultural sectors in developing countries and a bias towards industrialization, there was a renewal of interest in domestic food production and an increased focus on the role of small farms in national development (Szirmai 2005). This was brought on by recognition of the growing income disparities in developing countries, rising food prices and increasing energy costs (Stevens 1977). Unfortunately, this growing interest in supporting smallholders coincided with the imposition of Structural Adjustment Programmes (SAPs) in response to the debt crisis facing many developing countries. The austerity measures imposed on developing countries by these SAPs worsened the conditions for smallholders (Alamgir and Arora 1991). Under SAPs, the increased prices for inputs compared to those received for traditional food crops meant that scarce resources such as fertilizers were diverted for use on cash crops, negatively affecting food security. At the same time, reduced investment in infrastructure further isolated many rural areas. More recently, it has been recognized that the ability of smallholder farmers to produce and compete in the global food system has been undermined by the trade policy regulations dictated by the World Trade Organization and the massive subsidies paid to farmers in developed countries (Rosset 2006).

The marginalization and loss of small-scale producers, combined with land degradation and other externalities caused by unsustainable production, is seen by some as threatening both the livelihood security of rural producers and the food security of vulnerable urban consumers (Pimbert et al. 2001). Rosset (1999: 17) believes the loss of smallholder farmers from rural economies represents “a final triumph of inefficient and ecologically destructive monocultures

over ecologically rational and sustainable farming practices". However, not everyone agrees with this position. In a provocative paper that challenges some of the assumptions about supporting smallholders in developing countries, Rigg (2006) puts forth the case that livelihoods for many in the developing world are increasingly divorced from farming and argues that the best means for promoting pro-poor growth would be to provide them with the skills to allow them to leave farming.

Proponents of small farms claim that they are more productive, more efficient and contribute more to social and economic development than large farms, while at the same time representing a more environmentally friendly or at least a more environmentally benign way of producing food (Altieri 2006; Rosset 1999). Numerous authors have demonstrated that small-scale farms can be more productive than large farms (Berry and Cline 1979; Feder 1985; Rosset 1999). Moreover, small-scale family farms feature prominently in the visions for a more sustainable and equitable future and have found a political voice in the food sovereignty movement (Rosset 2006; Windfuhr and Jonsén 2005). The small farm centred approaches to agriculture that are being promoted by civil society groups and farmer organizations can be seen as a resistance to the forces driving agrarian change in that they represent a vision of the future that sees farmers on the land. Farmer-led resistance to the dispossession caused by the neoliberal economic development model and a reassertion of the right to farm as an act of land stewardship, represents a twenty-first century peasant politics (McMichael 2006).

It is commonly assumed that large farms are more efficient and productive than small farms but this is not borne out in the data. A study by Berry and Cline (1979) brought together empirical evidence from a number of countries to test the relationship between farm size and productivity. They concluded that small farms achieve higher production per unit of land than large farms. This higher productivity of smallholdings results mainly from more intensive land use and the supply of family labour at below average wage rates. As well as achieving greater land productivity, Berry and Cline (1979) also concluded that small farms achieve greater total factor productivity than large farms. Total factor productivity is a measure of the ratio of output to the social cost of all the factors used in production. Numerous other authors have

validated these original findings (Carter 1984; Feder 1985; Rosset 1999). Other authors that have attempted to challenge these findings have found either a weak inverse relationship or a constant relationship between farm size and productivity (Townsend et al. 1998). However, this issue remains contested in the literature (Byres 2004).

Proponents of small-farm agriculture put forth a number of different explanations as to the perceived greater productivity of small farms. The first of these is greater use of multiple cropping, intercropping and the integration of various farm components to make efficient use of space and resources. Small farms are also more likely to produce higher value crops on their land, and to use family labour that is committed to the success of the farm enterprise (Feder 1985). Small farms may also use more inputs per unit area than larger farms, but these are often sourced from within the farm system, such as compost made from manure and crop wastes (Devendra and Thomas 2002; Hecht 1990; Rosset 1999). There has been a trend towards greater specialization in modern farming and the separation of livestock and crop components (Barrett et al. 2001). This disrupts the fertility cycle between crop and livestock components on mixed farms, creating soil fertility problems on cropping land while concentrated livestock waste can lead to water pollution.

Large farms tend to plant monocultures of a limited range of crops, as these are easier to manage with machinery (Rosset 1999). Smaller farms usually have a higher biodiversity per unit area than larger farms and include a wide variety of functional biodiversity as part of their production strategies (Merrick 1990; Rosset 1999). Mixed farming systems that integrate crop, tree and livestock components provide farmers with an opportunity to guard against the risks associated with the production of single crops (Devendra and Thomas 2002; Gliessman 1990). As well as protecting the resource base and making efficient use of energy, water and nutrients, farms with high biodiversity are thought to suffer less from insect pests, diseases and weed problems than farms with a monoculture (Geno and Geno 2001).

2.3 Challenges to World Agriculture

It is widely recognized that there are a number of serious and intersecting challenges facing world agriculture (Brown 2004; Kiers et al. 2008; Pimentel and Wilson 2004). One of the looming challenges is the issue of fossil fuel use in agriculture. By replacing human and animal labour with machines and substituting easy to use chemical fertilizers and pesticides for ecological processes of pest control and soil fertility enhancement, much contemporary agriculture has greatly increased its reliance on non-renewable energy from fossil fuels (Brown 1988; Pimentel and Pimentel 1996). The sustainability of this approach to feeding the world is increasingly uncertain in an age of decreasing availability of cheap fossil fuels.

It is estimated by many petroleum geologists that we have already used up around half of all the conventional oil on earth (Bentley 2002; Campbell and Laherrère 1998; Deffeyes 2005). While there is no consensus on when a peak in world oil production will occur, most predictions place it sometime within the next 20 years and many predictions place it sometime before 2010 (Johnson et al. 2004). This obviously means a large amount of oil is still in the ground, but the remaining oil is harder to get out than the oil we have already used and is subject to decreasing energy returns on the energy invested to access it (Heinberg 2005; Homer-Dixon 2006). Thus oil will become increasingly expensive as demand outstrips supply.

> [C]onventional wisdom erroneously assumes that the last bucket of oil can be pumped from the ground just as quickly as the barrels of oil gushing from wells today. In fact, the rate at which any well - or any country - can produce oil always rises to a maximum and then, when about half the oil is gone, begins falling gradually back to zero. From an economic perspective, when the world runs completely out of oil is thus not directly relevant: what matters is when production begins to taper off. Beyond that point, prices will rise unless demand declines commensurately (Campbell and Laherrère 1998: 78).

Added to the issue of declining available energy supplies are many additional challenges, each serious in their own right, that promise to make agriculture more difficult in the future. These include climate change, loss of farmland, soil erosion, biodiversity loss and water scarcity (Kiers et al. 2008; Lobell et al. 2008; Seckler et al. 1999). The world population continues to grow, leading to increased demands for food, fuel, fibre and water, while decreasing the per capita availability of agricultural land (Pimentel and Wilson 2004). Dietary transitions away from grain-based diets are increasing the demand for meat, fruits and vegetables (Smil 2001).

Consumers are also becoming more health conscious and demanding food with fewer pesticide residues as the growth of the organic food sector attests (Rigby and Cáceres 2001). Our current economic system is based on the premise of continued growth and this creates demands on agriculture to increase productivity and profitability so that farmers' incomes can rise at a level commensurate with other members of society. This requirement is not often met and rural people in developing countries are among the poorest and most food insecure (Cannon 2002).

2.4 Assessing Agroecosystem Sustainability

To meet the challenges facing agriculture, it will be necessary to engage in a concerted effort to move along the path towards sustainability. Sustainable agricultural systems should be productive over the long-run without degrading the natural resource base (Altieri 1989). Interest in sustainability and sustainable development has increased markedly since the publication of the report *Our Common Future* by the World Commission on Environment and Development in 1987. The authors of that report define sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987). Since the publication of this report, there has been a proliferation of academic writing on the subject of sustainability, leading to numerous different definitions of the term.

Sustainability is seen as being a complex and contested concept (Pretty 1998). Bartlett (1998) points out that many of the uses of the term sustainability are contradictory and attempts to formulate a clear and unambiguous definition of sustainability. Bartlett (1998) suggests that if we take sustainable to mean "for an unspecified long period of time", then "population growth and/or growth in the rates of consumption of resources cannot be sustained". In relation to sustaining natural resources, Popp et al. (2001) suggest that that the concept of sustainability needs to be inclusive of multiple services and point out that attention should be given to whether the goal is to maintain the stock or the flow of resources. Over the years, a number of authors have attempted to crystallize the essential elements of sustainability from the literature (Bartlett 1998; Brown et al. 1987). These authors point to a number of common themes in the

literature, including stable human populations, the conservation of natural resources and stable state economies.

Many of the definitions of sustainability arising since the publication of *Our Common Future* are based on the "three pillars" or "triple bottom line" concepts (Pope et al. 2004). In these definitions sustainability is conceived as resting on the three pillars of economy, society and ecology. Thus agriculture is considered sustainable if it is economically viable, environmentally sound, and socially acceptable (Brown et al. 1987; Conway 1985). However, as Rigby and Cáceres (2001: 21) note, "the desire for sustainable agriculture is universal, yet agreement on how to progress towards it remains elusive." Apart from the difficulties of translating the concept of sustainability into practice, focussing on the three pillars as discrete entities has hampered innovation in moving toward sustainability. Gibson et al. (2005: 56) believe that conceiving of sustainability along traditional disciplinary lines can make things easier to understand, but it is problematic in that it obscures "the linkages, interconnections and interdependencies", which are integral in understanding and fostering sustainability.

Emerging out of more than three decades of experience with Environmental Impact Assessment and incorporating the concept of sustainability is the new field of "sustainability assessment" (Gibson et al. 2005) or "assessment for sustainability" (Pope et al. 2004). What is notable about this field is the requirement that projects and programmes are now explicitly assessed on the contributions they make towards sustainability, rather than to minimize or avoid harm caused by the proposed activities. In their book on sustainability assessment, Gibson et al. (2005) move beyond the three pillars of economy, ecology and society, and focus instead on the minimum set of core requirements for moving towards sustainability. These core requirements involve maintaining the integrity of the social-ecological system, sharing resources equitably and using them efficiently to ensure sufficient livelihood opportunities, improving participation in decision making and planning ahead to ensure adaptation to system changes. The goal in sustainability assessment is to search for mutually reinforcing gains in all areas (Gibson et al. 2005).

The broader focus on sustainability over the last 20 years has also led to changes in the nature of agricultural science. The focus in this field has shifted from the maximization of production to seeking a more nuanced understanding of the costs and benefits of agricultural production (Dalgaard et al. 2003). The concept of multifunctionality recognizes the additional goods and services offered by agricultural systems beyond just the production of food and fibre, including such things as landscape preservation, environmental protection and rural employment (Pretty et al. 2001). Beginning in the 1930s, agricultural researchers in both Germany and America started using the term "agroecology" to signify the application of ecological principles within agriculture (Dalgaard et al. 2003). Agroecology has matured over the past 30 years, serving as a counterpoint to the simplifying tendencies inherent in the productionist paradigm of the early stages of the Green Revolution.

Agroecology is defined as the "application of ecological concepts and principles to the design and management of sustainable agroecosystems" (Altieri and Nicholls 2005: 30). This ecologically-integrated farming paradigm aims for greater efficiency in agriculture by reducing non-renewable inputs and realigning production to smaller-scale, biodiverse and localized farming systems (Lang and Heasman 2004). Small-scale farms are seen as better suited to this form of knowledge-intensive agriculture, because management is site-specific and demands an intimate knowledge of the local ecology (Altieri and Hecht 1990). Agroecological researchers recognize that for agricultural development to be applicable to small-scale farms in developing countries, an integration of scientific and traditional knowledge for the design of new production systems is needed. As Gliessman (1990: 16) writes:

> An agroecological focus on small farm development goes beyond crop yields, delving deeply into the complex set of factors that make up the agroecosystem. Local, indigenous agroecosystems that have evolved under the diverse and often limiting conditions facing small farmers are adapted to this set of factors. They have evolved through time as reduced external-input systems, with greater reliance on renewable resources and an ecologically based management strategy. A Research focus that can take advantage of this knowledge and experience can permit us to explore the multiple bases upon which sustainability rests.

Agroecology seeks to make the best use of the goods and services offered by nature while internalizing the externalities of modern farming to reduce pollution and waste. It does this by designing farm systems that mimic the structure and functions of natural ecosystems so that nutrients, water and energy are cycled within the farm system and biological pest control mechanisms are enhanced (Altieri and Hecht 1990; Altieri and Nicholls 2005; Gliessman 2004). The assemblage of functional biodiversity and the functional integration of system components are key to designing agroecosystems that are able to benefit from these ecological services (Altieri and Nicholls 2005). Francis (1988) considers renewable resources that are available on-farm, such as rainfall, nutrients in the soil strata, biological nitrogen fixation and biological pest control, to be the basis on which to grow a sustainable agricultural system. Pretty (2000) identifies a number of changes that can be made on farm for improving sustainability, including better use of locally available natural resources and non-renewable inputs and external technologies, diversification of the farm system and the intensification of productive microenvironments on the farm. On the socioeconomic side, Pretty (2000) suggests that access to affordable finance, building human capital through participatory processes and continuous learning programmes and adding value to farm production through direct or organized marketing can all lead towards greater farm sustainability.

In order to investigate the contribution that a shift to safe vegetable production is having on the agroecosystems in southern Vietnam, a sustainability assessment framework was developed (See Table 2.2). This framework incorporates the broad sustainability assessment criteria of Gibson et al. (2005) with principles from the literature on agroecology, organic agriculture and sustainable agriculture (Altieri 1989; Altieri and Hecht 1990; Altieri and Nicholls 2005; Conway 1985; Conway 1987; Francis 1988; Gliessman 2004; Pretty et al. 2001). The eight sustainability criteria of Gibson et al. (2005) are in the left hand column, while the list of requirements to be met for moving towards sustainability derived from the literature on agroecology and sustainable agriculture are found in the right hand column. Many of these requirements for sustainability are very similar to those put forth by Van Cauwenbergh et al. (2007), although they frame their assessment using a three pillars approach and restrict the evaluation to within the farm boundaries (except for energy balance).

Table 2.2: Sustainability Assessment Framework

Sustainability Assessment	
Social-Ecological System Integrity	• Are the human actors well nourished and disease free? • Are soil and water quantity and quality maintained or enhanced? • Is biodiversity maintained? (including agrobiodiversity).
Resource Maintenance and Efficiency	• Are the agroecosystems designed to mimic the structure and functions of natural ecosystems? (the system runs primarily on sunlight, rainfall and internally cycled nutrients). • Are system components integrated to make efficient use of inputs of natural, human and financial capital? • Does waste from one activity become the input for another activity? • Is the use of non-renewable resources minimized? (reduction in the use of chemical fertilizers, pesticides and fossil fuels). • Is water used efficiently?
Livelihood Sufficiency and Opportunity	• Is system productivity maintained or increased? • Is profitability maintained or increased? • Is market access maintained or improved?
Intragenerational Equity	• Are farmers from all socio-economic classes and both genders able to use the new approach or are there barriers to adoption for certain segments of society? • Can farmers earn a living commensurate with other sectors of society?
Intergenerational Equity	• Are the needs of future generations being considered and provided for? • Are any significant negative effects displaced to the future?
Social-Ecological Civility and Democratic Governance	• Is understanding for nature and other humans encouraged? • Is there reciprocal information and influence exchange between actors or do some actors dominate in a command and control arrangement? • Are social networks strengthened? • Are farmers spreading these approaches amongst themselves?
Precaution and Adaptation	• Are production strategies diversified to reduce risk? • Are participatory research, development and extension methods used to facilitate active learning and encourage experimentation among farmers?
Immediate and Long-Term Integration	• Are mutually supportive gains in all areas being realised in all areas?

Many of the principles from the agroecology literature deal with the functioning of the biophysical components of farm systems. While consideration of the biophysical aspects at the farm level is important for understanding agroecosystem sustainability, it is also necessary to incorporate into the analysis the broader socioeconomic conditions in which a farm exists and to consider possible future events that may affect the system. It is therefore necessary to view

agroecosystems from different spatial and temporal scales and from the multiple perspectives of the actors in the system. The different actors of importance in Vietnamese agroecosystems, from the level of individual organisms to the international stage, are presented in a shell diagram in Figure 2.1.

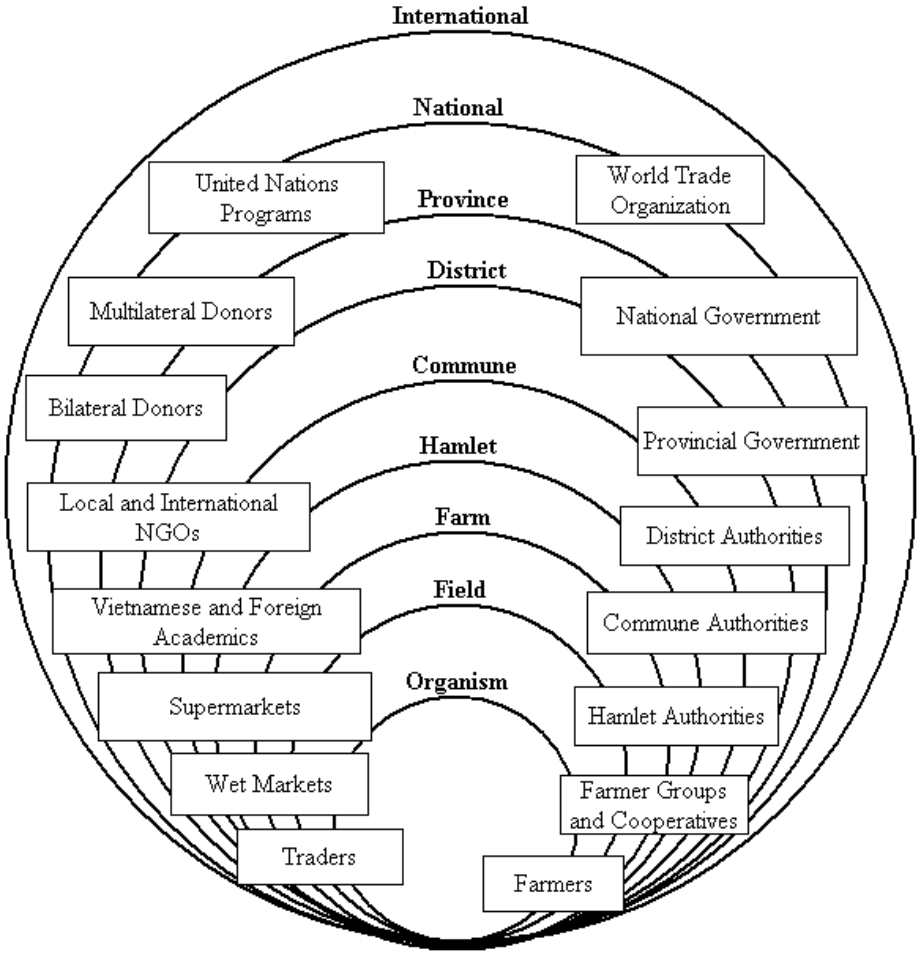


Figure 2.1: Shell Diagram Depicting Multiple Perspectives at Various Scales

Individual farmers are likely to be particularly interested in the livelihood opportunities and quality of life afforded them by their farming system, with profitability likely to be more important than productivity alone. From a broader social perspective, the equitability of production is of interest. Gibson et al. (2005: 104) acknowledge that difficulties arise in

determining what is fair for future generations and point out that the "requirement for intergenerational equity is, perhaps more clearly than the other sustainability prerequisites, a matter of applied moral choice where the interests of the unrepresented must be served". It is impossible for us to know what future generations would prefer, but at a minimum we should strive to maintain social-ecological system integrity and resource availability (Gibson et al. 2005).

The power relations that exist between the various actors in the agro-food system are important to understand in researching sustainability. Writing on organic production in China, Thiers (2005) outlines the contradictions that exist between the market and ecology and between the control and empowerment of farmers when production for the international market is organized by powerful government officials and trading companies who are able to capture much of the organic price premium at the expense of farmers. Given that Vietnam is also in transition from a centrally planned to a market economy, local political elites may also be able to control the development agenda.

It will be vital that farmers are supported in developing their adaptive capacity if they are to meet the challenges facing agriculture and improve the sustainability of the agroecosystems they manage. Adaptive capacity in a social-ecological system is the ability to maintain or improve system conditions in the face of environmental change (Gallopin 2006). Sustainable agriculture that is promoted using participatory research and extension approaches is thought to facilitate farmer learning and experimentation and can improve the adaptive capacity of farmers (Hagmann and Chuma 2002). In reviewing extension policy in Asia, Sulaiman and Hall (2005) suggest that while training continues to be an important part of the role of extension services, they should also focus on facilitating farmer innovation and strengthening linkages between farmers and other agencies. Research on the adaptive capacity of farmers in responding to climate change is also gaining in prominence (Smit and Pilifosova 2001).

2.5 Summary

In this chapter a review of the literature on agroecosystems, sustainable agriculture and sustainability assessment was conducted. The literature review started with an introduction to the evolution of agriculture, focussing on smallholder faming systems in developing countries. The use of fossil fuel energy in agriculture has increased substantially over the last 100 years as farm mechanization increased and Green Revolution technologies requiring the use of chemical fertilizer and pesticides spread. It is widely recognized that there are a number of serious and intersecting challenges facing world agriculture. Added to the issue of declining available energy supplies are the additional challenges of climate change, loss of farmland, soil erosion, biodiversity loss and water scarcity. To meet these challenges, it will be necessary to engage in a concerted effort to move along the path towards sustainability. Insights from the emerging field of sustainability assessment were combined with principles from the literature on agroecology and sustainable agriculture to develop a framework for assessing the sustainability of safe vegetable production in Vietnam.

Chapter 3: Research Methods

3.1 Introduction

This chapter outlines the research framework and research methods that were used for this study. This study progressed through three stages: (1) study design, (2) fieldwork, and (3) analysis of data and thesis writing. The first stage of the study involved identification of the topic, the development of a research proposal and a preliminary literature review. This stage of the research lasted from September 2006 to April 2007. The fieldwork was conducted in Vietnam between May and August of 2007, with funding provided by the multi-university collaborative research project "Challenges of the Agrarian Transition in Southeast Asia" (ChATSEA). The final stage of data analysis and thesis writing took place from September 2007 to April 2008. As the research is exploratory and inductive, there was in practice some overlap between all three stages, with the literature review continuing throughout the length of the study and some initial data analysis occurring during the fieldwork stage.

A social-ecological systems approach was chosen to guide this study so that the interactions between the social and ecological components of agroecosystems in Vietnam might be explored. The first section of this chapter details the research framework, including issues of researcher positionality. Following this is a brief introduction to the study sites in Cu Chi District on the outskirts of Ho Chi Minh City in southern Vietnam. The rationale for choosing these sites is also discussed. Data for the systems analysis were gathered from a wide variety of actors involved in the safe vegetable agro-food system around Ho Chi Minh City. The various research methods used in this study, along with the strategies employed for data crosschecking and data analysis are also discussed. The chapter concludes with a brief discussion of some of the limitations of this study.

3.2 Research Framework

This research uses a social-ecological systems approach to assess the sustainability of safe vegetable production in southern Vietnam (Kay et al. 1999; Waltner-Toews 2004; Waltner-

Toews and Kay 2005; Waltner-Toews et al. 2004). A system is defined as a "set of interacting elements that form an integrated whole" (De Rosnay 1979). Systems can range from relatively simple systems composed of a relatively few elements, to complex systems. Social-ecological systems fall into this latter category. When systems are composed of human actors with other biological and physical elements, the picture can quickly become complex. As Waltner-Toews (2004: 62) says, there is not one perfect description of a system, but rather "there are only various approximations of the mess we live in".

Systems methodologies for describing and exploring this "mess we live in" have evolved over the last half century from the general systems theory of Ludwig von Bertalanffy, to include the concepts of self-organization and complexity (Grzybowski and Slocombe 1988; Kay et al. 1999). Systems have arbitrarily defined boundaries, are open to flows of energy, material and information and are composed of interacting subsystems (Grzybowski and Slocombe 1988). Complex systems are organized in hierarchies or holarchies, where each part is nested within a whole, which is further nested within another whole. Holarchies are distinct from traditional hierarchies in that they exhibit a reciprocal flow of power between levels rather than being strictly top-down (Kay et al. 1999).

Systems theories challenge traditional reductionist science by positing that a system is more than the sum of its constituent parts. Therefore, systems cannot simply be understood by studying each individual system component but must be understood by examining the whole (Waltner-Toews et al. 2004). Complex system theories have highlighted the unpredictable changes that can occur in a social-ecological system, which throws into question our assumptions about controlling and precisely managing complex systems (Kay et al. 1999). Under these conditions, the task of natural resource managers is not to reduce complexity and uncertainty, but rather to react with good judgement to the surprises that face them (Sayer and Campbell 2004). The new understanding emerging from the work on complex systems is pointing to the need for interdisciplinary knowledge, participatory learning and adaptive management for moving us along the path towards greater sustainability.

3.2.1 The Diamond Schematic

Complex systems cannot adequately be described by a single model or from a single perspective, but should instead be described using a variety of models, narratives and rich-pictures (Waltner-Toews et al. 2004). The diamond schematic developed by Kay et al. (1999), is a useful heuristic for researchers and practitioners interested in developing an understanding of the interactions between components in a social-ecological system and the future visions of human actors in the system for moving toward greater sustainability. Figure 3.1 presents a simplified version of the diamond schematic.

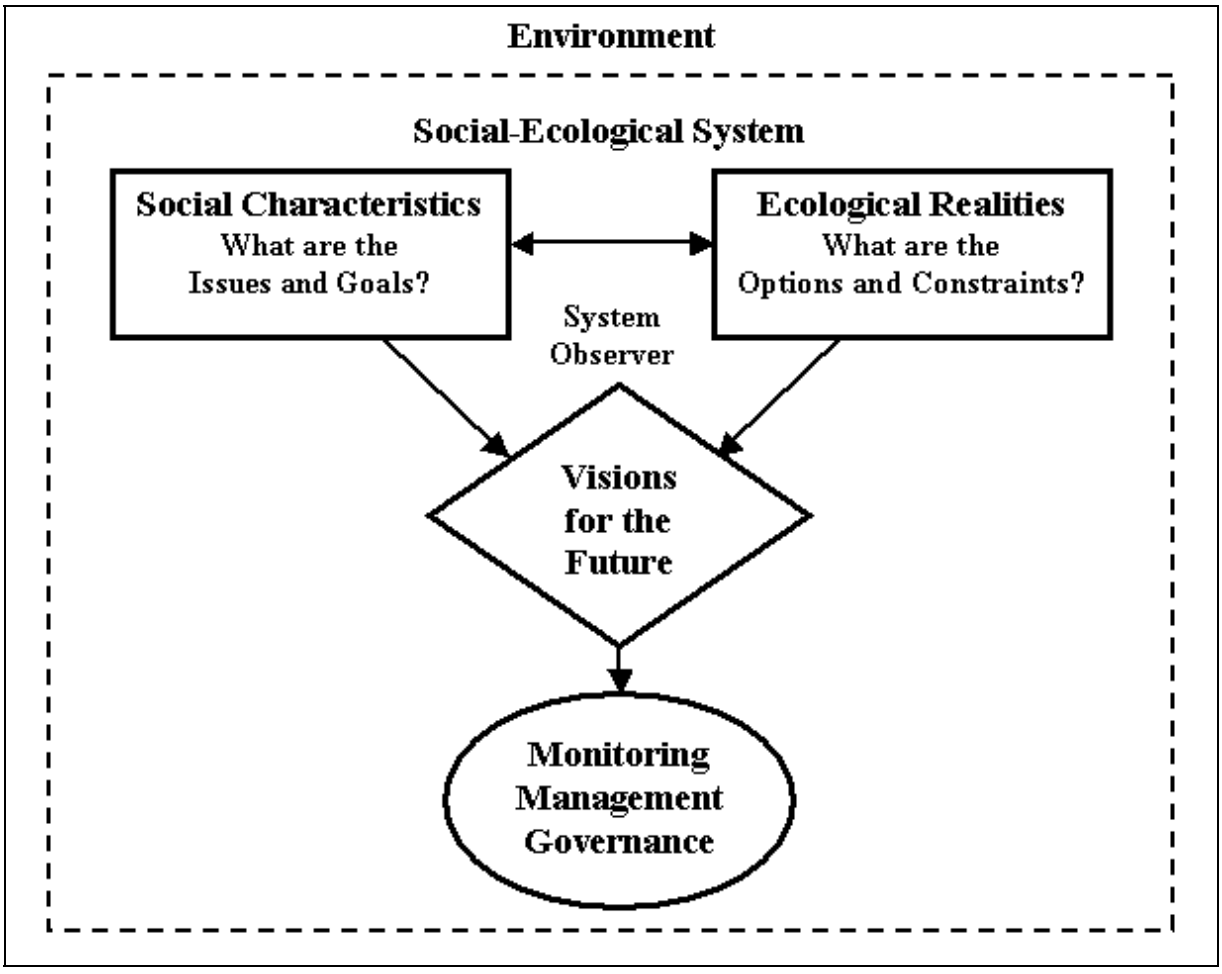


Figure 3.1: The Diamond Schematic for Exploring Social-Ecological Systems
Source: (adapted from Kay et al. 1999)

A social-ecological system is composed of the issues and goals of the human actors, including the system observer, along with the ecological options and constraints. Together these frame the visions for the future or "multiple possible pathways for development" (Kay et al. 1999: 721). In the context of this study, safe vegetable production is considered to be one of the pathways to development being explored by actors in the system. The diamond schematic was further developed into the Adaptive Methodology for Ecosystem Sustainability and Health (AMESH) (Waltner-Toews 2004; Waltner-Toews and Kay 2005; Waltner-Toews et al. 2004). The AMESH approach is more applicable to a participatory team-based research process but elements of the methodology inform this study, particularly the use of group discussions with farmers to generate insight into the challenges and opportunities for safe vegetable production.

3.2.2 Reflexivity: The System Researcher

The version of the diamond schematic presented in Figure 3.1 includes the system observer as part of the system. This is done purposely to remind the reader that this study is not objective and value-free science, but rather it contains the values and preferences of the various human actors in the system, including those of the system researcher. In the "hard" branch of agroecology, which focuses on the ecological, economic and agronomic aspects of social-ecological systems, the position of the scientist is thought to be external to the system being studied. However, in the more integrative "soft systems" approach to agroecology, which considers both ecological and social aspects, all the actors including scientists and researchers are seen as being intimately and subjectively involved in the food system (Dalgaard et al. 2003).

As the system researcher, my values and preferences are made explicit here. I grew up around the organically managed food gardens of my parents and grandparents and came to value the fresh fruit and vegetables that could be produced as part of small-scale homegarden systems. I have since become a dedicated organic gardener. After graduating from my undergraduate degree, I spent two years working with farmers in Southeast Asia promoting low external input sustainable agriculture approaches based on agroecological principles. I believe that sustainable agricultural systems should run primarily on solar energy, with nutrient and water

cycling occurring as much as possible within the farm system. Agriculture that relies primarily on inputs of energy from fossil fuels and nutrients from outside the farm system is not a sustainable production strategy. For this reason I see a return to local food systems as the way of the future, where farms and the human societies they support are re-coupled at a bioregional scale. This will require far less energy for the transport of food and will potentially allow organic wastes to be recycled back into production systems.

3.3 Institutional Support

Prior to arriving in Vietnam for the fieldwork stage of my research, my supervisor Dr Steffanie Scott contacted Dr Pham Van Hien of the Post Graduate Office at Nong Lam University to arrange institutional and supervisory support in Vietnam. During my four-month stay in Vietnam I was hosted at Nong Lam University in Thu Duc District, Ho Chi Minh City. Nong Lam is one of the main agriculture and forestry universities in Vietnam and it provided a supportive environment for conducting this research project. This was in no small part due to the work of Dr Pham Van Hien in obtaining permission from the relevant authorities to allow me to conduct this research and to the excellent research assistance provided by Mr Nguyen Duy Nang. The good standing of Nong Lam University amongst farmers and government officials became obvious when conducting research in the field. Many of the government officials interviewed as part of this research were alumni from Nong Lam University, while farmers favourably mentioned the previous research efforts emanating from this institution.

3.4 The Study Sites

The main study site chosen for this research project were Tan Phu Trung and Nhuan Duc Communes in Cu Chi District, Ho Chi Minh City. Prior to my arrival in Vietnam I had not yet selected any study sites but I had in mind an area with a concentration of farmers practicing safe vegetable production. The site also had to be reasonably close to Nong Lam University to facilitate transportation. During the first week of my stay in Vietnam, Dr Pham Van Hien organized a meeting with the director of the Ho Chi Minh City Agricultural Extension Centre

to discuss possible research sites around the city. During this meeting the director and the head extension officer suggested that Cu Chi District would be a good location for the study, as this is one of the main areas where farmers are growing safe vegetables around Ho Chi Minh City. Further, they suggested that a comparison between two communes in Cu Chi District would provide useful insight into the experiences of farmers growing safe vegetables. Together we settled on Tan Phu Trung Commune and Nhuan Duc Commune as the primary research sites within Cu Chi District.

At the outset of the research there appeared to be a number of interesting differences between these two communes that justified their selection as study sites. Tan Phu Trung Commune is close to the main highway and market in the town centre of Cu Chi. Farmers in this area have a long tradition of vegetable production and have been growing safe vegetables since the mid 1990s. Nhuan Duc Commune is located further from the market and transportation infrastructure linking the farmers of Tan Phu Trung Commune with the city. Farmers in Nhuan Duc have largely been rice and livestock producers, and have only been shifting to vegetable production in recent years. Safe vegetable production has only been occurring in Nhuan Duc Commune since 2006, following a promotion and training campaign by the Government of Ho Chi Minh City.

3.5 Data Collection

Data for the systems analysis were gathered from a wide variety of actors involved in the agro-food system of Vietnam, particularly from those with direct experience of safe vegetable production around Ho Chi Minh City. The challenges and opportunities presented by safe vegetable production were explored with 20 farmers in each commune using semi-structured interviews. A group discussion was also held in each commune to explore some of the issues relating to the training and support of farmers, input costs and the potential effects of climate change on agriculture. A total of 21 farmers participated in the two group discussions. Interviews were also conducted in person, by telephone and by email with 34 key informants in the agro-food system in Vietnam. A summary of the research methods used in this study can be found in Table 3.1. These methods are discussed in greater detail below.

Table 3.1: Summary of Research Methods

Research Method	Purpose	Sample Size
Semi-Structured Interviews with Farmers	To collect qualitative and quantitative data on household and farm variables and to explore the challenges and opportunities presented by safe vegetable production.	A total of 20 farmers in Tan Phu Trung Commune and 20 farmers in Nhuan Duc Commune were interviewed.
Group Discussions with Farmers	To explore some of the issues relating to training, financial support for farmers, rising input costs and the effects of climate change.	One discussion was held with 10 farmers in Tan Phu Trung Commune and another held with 11 farmers in Nhuan Duc Commune.
Key Informant Interviews	To understand the perceptions of sustainable agriculture, the history and direction of safe vegetable production and the challenges facing the agriculture sector in Vietnam.	A total of 34 key informants were interviewed, including academics, NGO staff, Government officials, representatives from farmer organizations, and staff from agricultural trading companies.
Participant Observation	To gain an understanding of the agricultural activities in the study sites.	Extensive field visits across Cu Chi District.
Secondary Data	To gain additional information and for crosschecking data from other sources.	Maps, training manuals, Government reports and statistics.

3.5.1 Sampling

Participants were selected for this study using purposive sampling. The goal in purposive sampling is not to achieve a representative sample of the general population, but rather to select participants based on particular characteristics of interest in the study. Information can then be gathered from a range of people within the study area and a rich picture of the local situation can be generated. Purposive sampling has two principle aims: (1) to ensure that the main groups of actors of relevance to the study are represented, and (2) to ensure that a diversity of actors within each of the main groups is selected to allow for an exploration of the influence of the key characteristic on these various actors (Ritchie et al. 2003a).

The main characteristic of the farmers selected for this study was experience with the safe vegetable production system in Cu Chi District. I had no sampling frame available from which to select farmers that fit the characteristics that I required, so instead I had to rely on key contact people in Cu Chi District, or "gatekeepers" to help identify farmers for the study. A form of purposive sampling called snowball sampling was then used to identify further

participants. Snowball sampling involves asking the people who have already been interviewed by the researcher to identify other potential interviewees who fit certain selection criteria (Ritchie et al. 2003a).

After I had obtained permission to conduct the research it was decided that the best approach to getting an entry into the research sites was through the introduction of the agricultural extension centre of Ho Chi Minh City. My research assistant and I accompanied the head technician from the extension centre on a visit to Cu Chi so that he could introduce us to some key contact people involved in the safe vegetable production system. On this initial field visit to Tan Phu Trung and Nhuan Duc Communes we met with the heads of the safe vegetable cooperatives in their respective communes. These people turned out to be invaluable in helping us contact farmers involved in safe vegetable production and inviting them along for interviews. From these initial points of contact we were able to reach 40 farmers for individual interviews and a further 21 farmers for group discussions. Within the group of 20 farmers from each commune selected for interview, a diversity of farmers was sought based on the location of their hamlet within the commune and their membership or lack of membership in safe vegetable cooperatives and safe vegetable groups (See Table 3.2).

One of the risks of snowball sampling is that the researcher will not gather enough diversity of perspective when starting from a few initial contacts or gatekeepers. This was potentially problematic in this study as the initial contacts I had made in each commune were the leaders of the safe vegetable cooperatives. I could have ended up just interviewing 40 farmers from the safe vegetable cooperative and missing out on the perspectives from those on the "outside". To counteract this possibility I kept a tally of interviews already completed and used this to identify other groups of actors who were under-represented. I then sought out further interviews to "fill the gaps". I wanted to interview farmers from across the commune and not just in the more established safe vegetable growing areas, such as Dinh Hamlet in Tan Phu Trung Commune. I also wanted to interview farmers who were growing safe vegetables but not necessarily part of a safe vegetable cooperative or group. By asking farmers and commune officials, we were able to identify and interview a small number of farmers who were growing safe vegetables and selling individually to the market.

The biggest challenge I encountered when selecting farmers for this study was finding enough female farmers who were willing to be interviewed. As an all male research team, it was hard for us to engage female farmers in the research process. Ideally I would have liked half of the farmers I interviewed to be female, but I did not even come close to achieving this goal. I had limited success finding female participants in Tan Phu Trung Commune, where six female farmers participated in the group discussion and two female farmers participated in semi-structured interviews, but I had no success interviewing female farmers in Nhuan Duc Commune, where the opinions I gathered were exclusively those of male farmers. Females are actively involved in safe vegetable production, where it is often a husband and wife team growing vegetables together on a small plot of land. Female farmers were sometimes present during the interviews and would occasionally participate in the discussion, but they mostly deferred to their husbands, particularly on technical issues relating to fertilizer and pesticide application.

Table 3.2: Key Characteristics of Farmers Interviewed in this Study

Location	Member of Safe Vegetable Cooperative	Member of Safe Vegetable Group	Member of Cooperative and Group	Not Member of Cooperative or Group
Tan Phu Trung Commune				
Dinh Hamlet		7	5	
Cay Da Hamlet		2		
Ben Do 1 Hamlet		2		1
Giong Sao Hamlet		1		1
Xom Dong Hamlet		1		
Nhuan Duc Commune				
Bau Tron Hamlet	3		3	
Bau Tran Hamlet	3		3	
Bau Cap Hamlet		3	2	
Nga Tu Hamlet				3
Total Interviews	**6**	**16**	**13**	**5**

A similar snowball sampling technique was also used for finding key informants in the agricultural sector in Vietnam to interview. Prior to arrival in Vietnam I had conducted a search for potential interviewees using the Internet. However, sending out emails from Canada

to potential interviewees in Vietnam returned disappointing results, with very few people responding to these requests for an interview. A small number of people did respond to my emails, and from these initial contacts I was able to reach a larger group of people working within the agriculture sector in Vietnam. The personal introduction from earlier interviewees played a key role in opening the doors to further interviews. Eventually I was able to interview 34 key informants from a range of different occupational groups in both Hanoi and HCMC. A summary of the key informants interviewed for this study can be found in Table 3.3.

Table 3.3: Summary of Key Informant Interviews

Occupational Category	Number of Interviews
Vietnamese Academics	7
Vietnamese NGO Staff	2
International Advisors and Researchers	8
Staff of Agricultural Trading Companies	4
Officials with the Department of Agriculture in HCMC	4
Officials with the Department of Health in HCMC	1
Officials with the Department of Agriculture in Cu Chi District	2
Officials with Farmer Cooperatives and Groups in Cu Chi District	6
Total Interviews	**34**

3.5.2 Semi-Structured Interviews with Farmers and Key Informants

Interviews are a commonly used research technique that allow for the collection of a rich and varied data (Kitchin and Tate 2000). The semi-structured interviews used in this study were designed to combine structure with flexibility (Legard et al. 2003). The challenges and opportunities presented by safe vegetable production were explored with 20 farmers in each of the two communes using semi-structured interviews. A further 34 semi-structured interviews were conducted with key informants from the agro-food system across Vietnam. The list of questions that were used to guide these interviews can be found in Appendix A.

During farmer interviews, the list of questions was followed in a relatively structured manner to allow for the collection of a certain amount of comparable data on farm inputs and farm management practices. However, when a novel or unexpected issue was raised during the

course of the interview there was enough flexibility in the approach to allow for additional questions to be raised. The key informant interviews were based more on a set of guiding questions that were adapted to suit the particularities of each interview and were applied in a much more flexible manner to suit the broader range of people being interviewed. The issues around language and interpretation are discussed later in this chapter in the section dealing with research limitations.

3.5.3 Group Discussions

In a group discussion, data is generated from the interactions between participants (Finch and Lewis 2003). A group discussion is more than a collection of individual interviews, but should rather be understood as a synergistic process where the group works together to generate ideas and insights (Finch and Lewis 2003). Focus groups and group discussions are considered synonymous. Despite the profusion of group methods, Kitzinger and Barbour (1999: 4) suggest that "any group discussion may be called a 'focus group' as long as the researcher is actively encouraging of, and attentive to, the group interaction." Morgan (1988: 17) notes that the "comparative strength of focus groups as an interview technique clearly lies in the ability to observe interactions on a topic." This interaction between participants in a group discussion replaces the interaction between the interviewer and interviewee and leads to more emphasis being placed on the participants own viewpoints (Morgan 1988).

Two group discussions, one in Tan Phu Trung Commune with 10 safe vegetable farmers and another in Nhuan Duc Commune with 11 safe vegetable farmers, were held to explore some of the issues relating to the training and support of farmers, the challenges of rising input costs and the potential effect of climate change on agriculture. My supervisor in Vietnam, Dr Pham Van Hien, facilitated these group discussions, while my research assistant interpreted and helped in the recording of the discussion. As the literature on group discussions suggests, attention was given to the ways in which participants interacted during the group discussion.

The group discussion started with the farmers constructing a timeline of the agricultural development activities and changes experienced in the commune. This was followed by a

participatory diagramming exercise where farmers were asked to create a diagram showing the agricultural organizations and their relative "closeness" to farmers. Closeness in this context refers to how closely these organizations collaborate with farmers on safe vegetable production activities. Next a SWOT analysis of the strengths, weaknesses, opportunities and threats around safe vegetable production was conducted. Following this exercise some further discussion questions were posed, dealing with the cost of farm inputs and the challenges of climate change. The outline of the group discussion and a list of the guiding questions can be found in Appendix A.

3.5.4 Participant Observation

Although a detailed ethnographic study was impossible due to time and language constraints, elements of participant observation were used to gain greater insight into the local realities of the study sites (Nachmias and Nachmias 1976). In participant observation the researcher observes events and gathers data while participating in the activities taking place (Kitchin and Tate 2000). In the context of this study, participant observation involved actively recording the patterns of land use and economic development occurring within Cu Chi District whilst on numerous field visits to interview farmers. Another important element in shaping my understanding of Vietnamese culture and society more generally, was the insights gained from living on the Nong Lam University campus in a semi-rural district of Ho Chi Minh City for a period of four months. During this time I engaged in many informal discussions with Vietnamese students and academics during the course of routine activities such as eating meals, playing sport or travelling on the bus.

3.5.5 Crosschecking Data

Triangulation was used to ensure the validity of the data collected in this study. Triangulation involves collecting data from a number of different sources and in a number of different ways, and then crosschecking to ensure that the results match up (Chambers 1994). As Lewis and Ritchie (2003: 275) point out, triangulation "assumes that the use of different sources of information will improve the clarity, or precision, of a research finding". In a practical sense this meant asking the same questions of a number of different actors to see if their version of

events is similar, and gathering the same information in a number of different ways, for example through the use of interviews, group discussions and observation. The results were also crosschecked against those reported in secondary sources where these were available.

3.6 Data Analysis

Once the raw data has been collected they must be organized and analysed if any conclusions are to be drawn from the study. Data analysis can be thought of as "the interplay between researchers and data" (Strauss and Corbin 1988: 12). Data analysis is also "a continuous and interactive process" (Ritchie et al. 2003b: 219). In practice, the first stages of data analysis started while I was still in the field conducting interviews. This initial data analysis involved the open coding of my field notes and interview transcripts in order to identify emerging themes. Open coding is an "analytic process through which concepts are identified and their properties and dimensions are discovered in the data" (Strauss and Corbin 1988: 101). After the major themes or categories had been identified, axial coding was used to uncover relationships between the themes and add depth and structure (Strauss and Corbin 1988). This involved combining some narrow themes together or breaking broad themes into sub-themes (Neuman 2000). Finally, during the thesis writing stage, selective coding was used to refine the initial data analysis and fill in poorly developed areas (Strauss and Corbin 1988). By progressively coding the data as described above, the theory was allowed to "emerge from the data" (Strauss and Corbin 1988: 12).

3.7 Research Limitations

Any research process will involve challenges and complications, especially when the context is foreign to the researcher (Scott et al. 2006). When the researcher is unfamiliar with local protocols, even organizing permission to conduct research can be an exercise in frustration. Fortunately, as already mentioned, I had excellent institutional support and research assistance during my stay in Vietnam, which helped to smooth and expedite the process of gaining permission to conduct research. However, I still encountered a number of challenges or limitations during my fieldwork.

The first of these limitations was language. During the entire set of farmer interviews and for many of the key informant interviews I had to work with a Vietnamese research assistant who acted as an interpreter. This was the only possible approach available for to me for conducting interviews, due to my very limited ability to speak Vietnamese. While I attempted to learn as much Vietnamese as possible before and during my stay in Vietnam, I was still a long way off being able to work without an interpreter. However, even having a limited understanding of the language helped me on several occasions to pick up on key words that had been mentioned and to ask for further clarification if I felt that the translation had not covered the full depth and breadth of the answer provided. For the most part, working with an interpreter worked adequately for my research purposes. There are undoubtedly subtleties of response that I missed, but this is to be expected when working in a cross-cultural context.

Another limitation encountered during this study was a lack of time in which to cover all of the research activities I might have wished. While I am happy with the number of interviews that I was able to conduct during my four months of fieldwork, there were a few other research opportunities that never materialised as I simply ran out of time. Late in the research period I identified some of the supermarkets as key players in conducting training with farmers on safe vegetable production. I never received a response to my requests to these companies requesting an interview and my research assistant and supervisor in Vietnam were similarly unsuccessful in their attempts to obtain interviews with these companies. I had also hoped to attend some of the training sessions with farmers that were being conducted by the agricultural extension centre. Unfortunately a suitable opportunity never presented itself during the period of my fieldwork.

3.8 Summary

This chapter discusses the research framework and research methods used in this study. Issues of sampling, data analysis and some of the limitations and challenges experienced during the fieldwork stage of this study were also discussed. The next chapter introduces the main agroecological regions of Vietnam and explores the social-ecological changes that have led to the emergence of organic agriculture and safe vegetable production in Vietnam.

Chapter 4: Agroecosystems in Vietnam

4.1 Introduction

This chapter introduces the main agroecological regions of Vietnam and discusses some of the pertinent social, cultural and economic changes that have occurred in recent decades, particularly those changes relating to the agricultural sector. There has been a continuing decline in the number of farmers in the world, yet agriculture continues to play an important role as the main provider of employment in many developing countries. Vietnam is no exception, with 53% of the economically active population estimated to be engaged in agricultural activities in 2005 (GSO 2007). Clearly, Vietnam's agricultural sector is of great importance for the livelihoods of a large part of the population, yet this sector is under stress due to a number of changes that have occurred over the past three decades.

Vietnam has experienced rapid economic growth following reforms in the mid 1980s, but there is evidence of increasing income inequality, particularly in rural areas (Akram-Lodhi 2005; Taylor 2007). In the peri-urban areas of Vietnam, the lure of more remunerative work in cities and industrial zones is proving a strong draw for many young people, leading to labour shortages back on the farms. There are a number of other challenges facing the agriculture sector in Vietnam, notably the heavy use of agrochemicals. The need to increase rural incomes coupled with health concerns over excessive agrochemical use has led to the emergence of various alternative agricultural approaches such as safe vegetable production and organic agriculture.

4.2 The Agroecological Regions of Vietnam

Vietnam is a long and narrow country stretched out on a north-south axis, with 3,200 kilometres of coastline (Kelly et al. 2001). The country can be divided into eight regions, each of which contains a number of provinces (See Map 4.1). In total there are 59 provinces in Vietnam and five municipalities. These municipalities include Can Tho and Ho Chi Minh City in the southern part of the country, Da Nang in the centre, and Hai Phong and Hanoi in the

north. For administrative purposes the country's 64 provinces and municipalities are subdivided into districts, which in turn are further subdivided into precincts and communes (See Table 4.1). Precincts are the more urbanized areas of districts, whereas communes are generally the more rural areas of a district. Precincts are further subdivided into wards and communes are subdivided into hamlets. Government authorities also exist at the provincial, district and precinct/commune levels. All three levels of local administration have an elected representative body, the People's Council, and an executive body, the People's Committee (Wescott 2003).

Table 4.1: Land Area, Administrative Units and Population Characteristics of Vietnam

Characteristics	Red River Delta	North East	North West	North Central Coast	South Central Coast	Central High-lands	South East	Mekong River Delta	Vietnam Total
Area (Km^2)	14,813	63,630	37,337	51,511	33,069	54,474	34,743	39,739	329,315
Provinces (#)	11	11	4	6	6	5	8	13	64
Urban Districts (#)	14	0	0	0	6	0	19	4	43
Rural Districts (#)	86	95	31	72	54	49	54	100	541
Precincts (#)	284	131	24	89	124	60	353	154	1,219
Communes (#)	1,863	1,845	544	1,644	700	557	630	1,286	9,069
Population (000s)	18,039	9,358	2,566	10,620	7,050	4,759	13,460	17,268	83,120
Rural Population (%)	75	81	86	86	70	72	46	79	73
Pop Density (Pers/Km^2)	1,218	147	69	206	213	87	387	435	252

Source: (GSO 2007)

4.2.1 Agro-Climatic Zones

The eight regions of Vietnam can also be conceived as agro-climatic zones (See Table 4.2). Vietnam covers 16 parallels of latitude, with climatic conditions ranging from the warm moist tropics in the South to moist subtropics in the North (Kelly et al. 2001). Rice is the most important crop in Vietnam, and is produced in all of the agro-climatic zones. The North East and the North West are sparsely populated mountainous regions bordering Laos and China. The Red River Delta is the country's most densely populated region and contains the capital city of Hanoi. This region is important agriculturally and produces a small surplus of rice, enough to feed the capital city and to cover part of the rice deficit in the North East and North West regions (Goletti and Minot 1997).

Map 4.1: The Main Agroecological Regions of Vietnam

Table 4.2: Major Agro-Climatic Zones of Vietnam

Agro-Climatic Characteristics	Red River Delta	North East	North West	North Central Coast	South Central Coast	Central High-lands	South East	Mekong River Delta
Annual Precipitation (mm)	2400	2200-2400	2200-2400	1800-2000	1400	1800-2200	1600-2200	1600-2400
Lowest Temperature (^{0}C)	12-18	8-15	8-15	14-16	20-22	15-18	22-23	22-25
Area of Cereals 1995-2005 (% Country Total)	16	9	3	10	5	4	7	46
Value of Agricultural Output 1995-2005 (% Country Total)	19	8	2	9	6	10	11	36
Forest in 2005 (% Country Total)	1	23	12	19	10	24	8	3
Rice Surplus	Yes	No	No	No	No	No	No	Yes

Source: (Goletti and Minot 1997; GSO 2007)

The North Central and South Central Coasts of Vietnam are rice deficit areas and have population densities slightly below the national average. The Central Highlands are mountainous and sparsely populated, bordering Cambodia. The South East region contains the country's largest urban centre, Ho Chi Minh City, and is the third most important agricultural region in the country. The Mekong River Delta in the far south of Vietnam has the second highest population density in the country and is the main agricultural region in terms of the value of output. All of the rice that is exported from Vietnam is grown in the Mekong Delta (Goletti and Minot 1997).

4.2.2 Farming Systems

While rice is the major crop grown in Vietnam, many other agricultural crops are grown, including other field crops such as corn, soybeans, and peanuts. Due to the large climatic variations across the country, many varieties of temperate and tropical fruits and vegetables can be grown. Plantations of rubber, coffee and tea can be found in the Southeast and the Central Highlands and aquaculture is important in the Mekong Delta and along the coast. In the rural and peri-urban areas of Vietnam, many of the houses are surrounded by a homegarden. These homegarden systems, which feature various combinations of fishponds,

vegetable gardens, fruit trees and animal production areas, have been traditionally used as a source of subsistence production. The integrated systems of gardens, fishponds and livestock are also known as the VAC system. In Vietnamese, *Vuon* means garden, *Ao* means pond, and *Chuong* means animal sheds. The VAC system has been the focus of a substantial amount of research and development, aimed at improving the productivity and profitability of these systems (Le 2003).

Homegardens are found across Vietnam, exhibiting a diversity of structure. They often feature fruit trees in the South, vegetables, ponds and covered livestock pens in Central Vietnam and the Red River Delta and forest trees in the mountainous areas of the North (Trinh et al. 2003). On a trip to Dalat in the Central Highlands, many of the homegardens were observed to contain fruit trees along with cash crops of tea or coffee. In a survey of 116 homegardens across four sites in Vietnam, Trinh et al. (2003) found that the average size of homegardens followed a geographical gradient from south to north, with the largest homegardens being found in the Mekong River Delta (average size of 0.75 ha) and the smallest found in the Red River Delta (average size of 0.14 ha). At Thuan An District on the outskirts of Ho Chi Minh City, the average homegarden size was 0.28 ha. These authors also found that although Vietnamese homegardens have traditionally been an important source of subsistence production, they are becoming increasingly commercialized, with homegardens providing 13-54 percent of the total income for a family (Trinh et al. 2003).

> [Homegardens] hold a singular place in the culture of the Vietnamese people, and reflect their pride in a rich gardening tradition. The cultural value attached to home gardens has been reinforced by their important contribution to household food security over the past 50 years. During the successive wars with France and the United States, when large scale agriculture and distribution systems were often disrupted, home gardens filled major gaps in the food supply (Trinh et al. 2003: 319).

Following the reunification of the country in 1975 and the introduction of a system of collective farming, homegardens remained the only plot of land where farmers had control over production decisions. This encouraged diversification and intensification of production to help meet family subsistence needs during these times of persistent food shortage, with homegardens often being much more productive than the collective farms (Trinh et al. 2003).

4.3 Social, Political and Economic Changes

Vietnam has seen much turmoil and socio-economic transition over the latter part of the 20th Century. Some of the main events in this transition, particularly those relating to agriculture can be found in Table 4.3. Vietnam was a colony of France for almost 100 years, before achieving independence in 1954. At this time the country was divided into two states, the socialist Democratic Republic of Vietnam in the North and the Republic of Vietnam in the South. Under the rules of the Geneva Accords of 1954, national elections were to be held to vote in a government for a unified Vietnam. However, the South Vietnamese Government, fearing a communist victory, refused to agree on a timetable for the vote and the country was soon plunged into war. A great deal of damage was caused to the social and ecological systems of Vietnam during this period (Luong 2003). When the war ended in 1975, much of the agricultural land in the South was damaged or abandoned, the population having fled to the main cities. The country was facing food shortages and had the imposing task of rebuilding the national infrastructure.

Vietnam is governed by a joint party-government structure. The Communist Party of Vietnam (CPV) was formed in 1930 and set out to establish a unified force for achieving independence from colonial rule (Wescott 2003). The CPV ruled North Vietnam following independence from the French in 1954 and have been in charge of the whole country following reunification in 1975. Under this one party system, every citizen over the age of 18 can vote to elect the 500 members to the National Assembly. These members in turn elect the President of the State and the Prime Minister. Prior to 1992 most of the decision-making was carried out by the CPV and not by government agencies (Wescott 2003). There has been a growing separation between the party and the state following the adoption of a new constitution in 1992, which created a "state structure more appropriate for a mixed economy" (Painter 2003: 262). As well as specifying the functions and responsibilities of the government, the judiciary and the National Assembly, the 1992 constitution recognized individual ownership rights and increased the legitimacy of the private sector (Wescott 2003). The 1992 constitution "signifies the growing importance of the idea of 'rule by law' in the organization and conduct of state affairs" (Painter 2003: 262).

Table 4.3: Historical Events Relating to Agriculture in Vietnam

Year	Historical Timeline
1858	French troops to Vietnam, start of colonial period – canal building, introduction of capitalist markets, plantation agriculture and private landlords.
1946	War of independence from France.
1954	Independence from France, country divided into Democratic Republic of Vietnam in North and Republic of Vietnam in South; redistribution of land in the North.
1960s & 1970s	War between North Vietnam (backed by communist allies) and South Vietnam (backed by anti-communist coalition led by USA) – massive bombing and defoliation campaign destroys agricultural infrastructure, crops and forests, migration to cities.
1975	End of war and reunification of country as Socialist Republic of Vietnam - cutbacks in Soviet and Chinese aid, hostile relations with the West.
1978	Collectivization of agriculture in the South and introduction of green revolution technologies to the collectives in the North.
1979	Invasion of Cambodia and border war with China; economy under great strain, falling agricultural outputs in the North and South of Vietnam.
1981	Instruction 100 – shift from collective agriculture to system of production contracts.
1986	Sixth Party Congress and passage of the *Doi Moi* reforms.
1988	Resolution 10 – legalized ownership of livestock and farm implements; land assigned to cooperatives on long-term leases.
1989	Withdrawal of Vietnamese troops from Cambodia; end of Soviet aid and moves to normalize relations with the West.
1993	Land Law – allowance of long-term tradable leases for land.

Source: (Adger et al. 2001; Luong 2003; Luttrell 2001; Quinn-Judge 2006)

Following reunification, the CPV attempted to rebuild the country's food supply through the collectivization of agriculture in the South and the introduction of green revolution technologies to the collectives in the North (Castella et al. 2005; Quinn-Judge 2006). Under the system of collectivization, which had been operating in the North since the 1960s, land was held in common and people were organized into work teams (Quinn-Judge 2006). Village level collectives organized the distribution of external inputs and the outputs of production (Adger et al. 2001). These changes were unpopular in the South and agricultural outputs fell during the late 1970s, a time when the country could least afford it. In late 1978, Vietnam invaded neighbouring Cambodia in response to border incursions by the Khmer Rouge. China, a patron of the Khmer Rouge, attacked Vietnam in retaliation. The war with China was bloody and short lived, but Vietnam's occupation of Cambodia continued until 1989, draining resources from Vietnam's economy (Quinn-Judge 2006).

The falling agricultural output of the late 1970s led to some initial reforms, but these were mostly applied in a piecemeal fashion (Luong 2003). In 1981, Instruction 100 allowed for a system of household contracts in agriculture (Adger et al. 2001). Cooperatives could now engage individual households in short-term contracts, with households able to retain any surplus above specific production targets (Luong 2003). At the Sixth Party Congress in 1986, formal moves towards a market-oriented form of socialism were initiated. This process became known as *Doi Moi*, meaning "change for the new" (Luttrell 2001). In 1988, Resolution 10 legalized ownership of livestock and farm implements, with land assigned to cooperatives on long-term leases. This was followed by the Land Law of 1993 that allowed households to directly apply for long-term tradable leases for land (Adger et al. 2001).

4.4 Challenges to Agriculture in Vietnam

The *Doi Moi* reforms appear to have paid off in terms of the economic development of the country. Between 1990 and 2005 the agricultural sector grew erratically but at a respectable annual average rate of almost 4 percent (See Figure 4.1). Over the same period, growth in the industrial and service sectors averaged 10.4 and 7.3 percent respectively (GSO 2007).

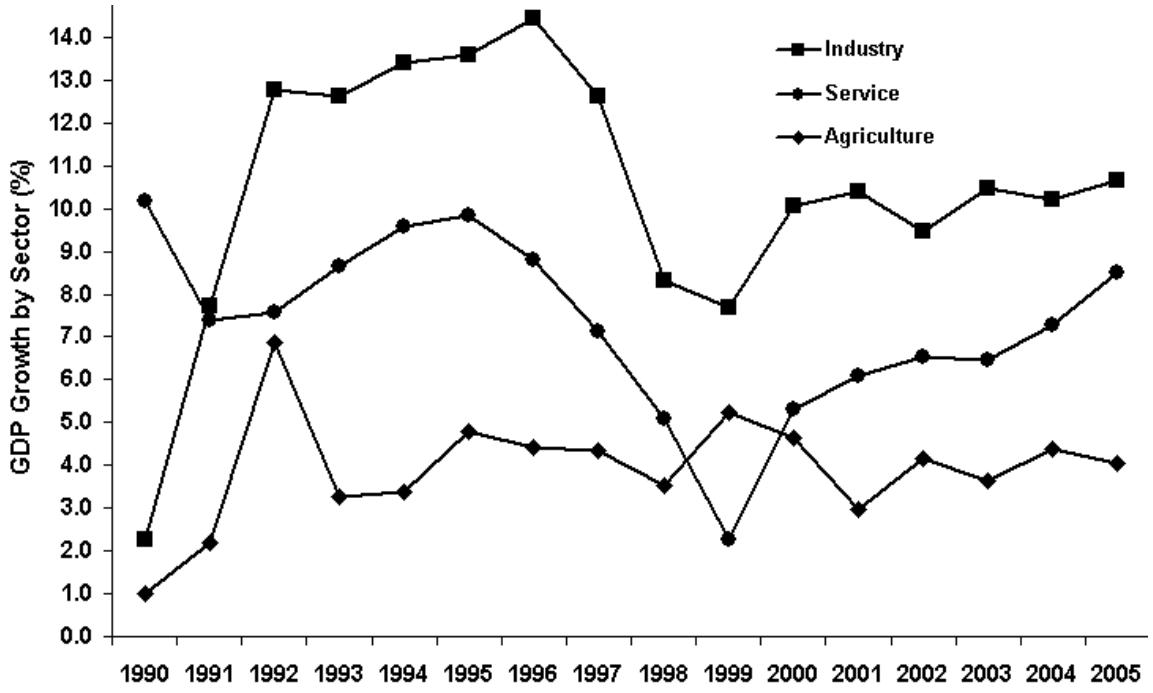


Figure 4.1: Economic Growth by Sector from 1990-2005

Vietnam was relatively insulated from the Asian financial crisis of 1997-98, and while growth rates in the industrial and service sectors fell briefly at this time, agricultural growth increased slightly. The growth of the agricultural sector transformed Vietnam from a food importing country to one of the world's top three rice exporters (Goletti and Minot 1997). Despite the impressive economic growth that has been experienced in Vietnam, there are a number of challenges facing the agriculture sector, particularly the issue of economic inequality between farmers and other segments of the population and the inappropriate use of agrochemicals.

4.4.1 Economic Inequality

In 1990, agriculture accounted for almost 32 percent of GDP, industry accounted for 25 percent and the service sector accounted for 43 percent. By 2005, the contribution of agriculture to total GDP had decreased to less than 20 percent, with the industrial and service sectors contributing around 40 percent each. At the same time, 53 percent of the economically active population continued to be employed in agriculture (GSO 2007). These numbers alone indicate that farmers are unlikely to be benefiting equally from the economic growth occurring in Vietnam. This assertion is also backed up by a number of other studies. Rural wages are lower than urban wages and poverty has declined more slowly in rural areas (Taylor 2007). There is also growing inequality between groups of farmers. Akram-Lodhi (2005: 107) found "the emergence of a stratum of rich peasants with relatively larger landholdings, relatively larger quantities of capital stock, relatively greater recourse to hired labour-power, and larger yields per unit of land".

4.4.2 Increasing Agrochemical Use

Another one of the main challenges facing the agriculture sector is the increasing use of agrochemicals. Following the reunification of Vietnam, the government controlled the use and import of agrochemicals (Phan 2005). However, following the market reforms of the late 1980s, the use of agrochemicals increased substantially as production decisions were placed back in the hands of farmers. Figure 4.2 shows the dramatic increase in fertilizer use that occurred during the 1990s, particularly for nitrogen-based fertilizers. Nitrogen fertilizer levels

in excess of economic optimum were found by Pham et al. (1995) in nearly all of the areas they studied in Vietnam, particularly in vegetable growing areas.

Compared to the data on fertilizer use, the available data on pesticide import and use in Vietnam are rather incomplete. Figure 4.3 shows pesticide imports and pesticide use in Vietnam during the 1990s and early into the new millennium. The available data on pesticide imports suggest that yearly imports have increased substantially from around 14,000 tonnes in 1990 to over 45,000 tonnes in 2004 (Do 2005). The data on pesticide use only cover the years from 1994-2001 (FAOSTAT 2004). These data come from the archived version of the FAOSTAT website and the new FAOSTAT website does not have updated data on pesticides listed yet. These data show a substantial increase in fertilizer use between 1994 and 1997 before dropping back down again to around 20,000 tonnes per year.

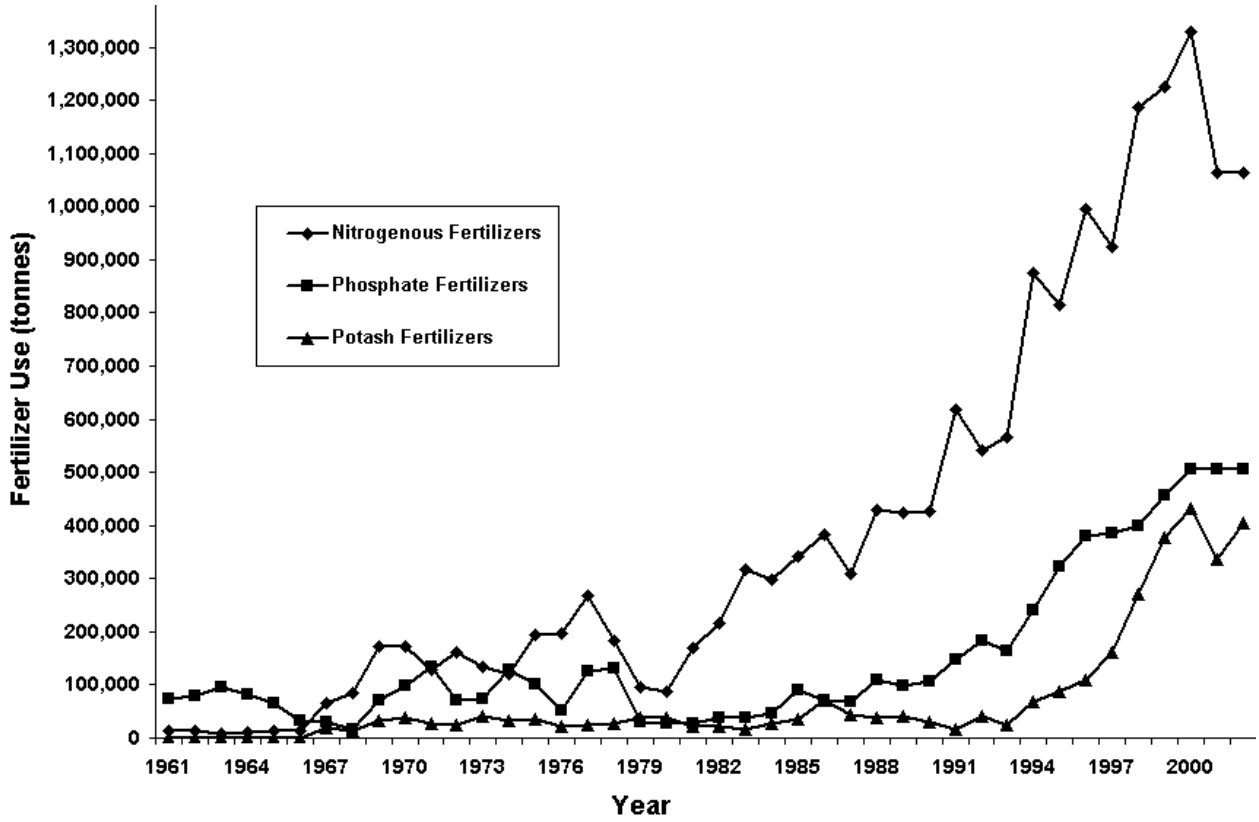


Figure 4.2: Fertilizer Use in Vietnam, 1961-2002
Source: (FAOSTAT 2004)

The increased use and misuse of pesticides is particularly worrying for human and environmental health. Pham et al. (1995: 385) found that with market liberalization "there has been a greater tendency towards the application of cheaper, more hazardous pesticides and less conformity to the guidelines issues by the Plant Protection Department". A study by Nguyen and Tran (1997) found that farmers in the Mekong Delta overuse pesticides, including several products that have either been banned or restricted because of their toxicity. Further, it was found that even if farmers can read the pesticide labels, they do not always follow the instructions or use protective clothing, resulting in pesticide exposure and poisonings. It has also been found that while poorer farmers apply lesser amounts of pesticides than better off farmers, they use more toxic pesticides (Meisner 2003).

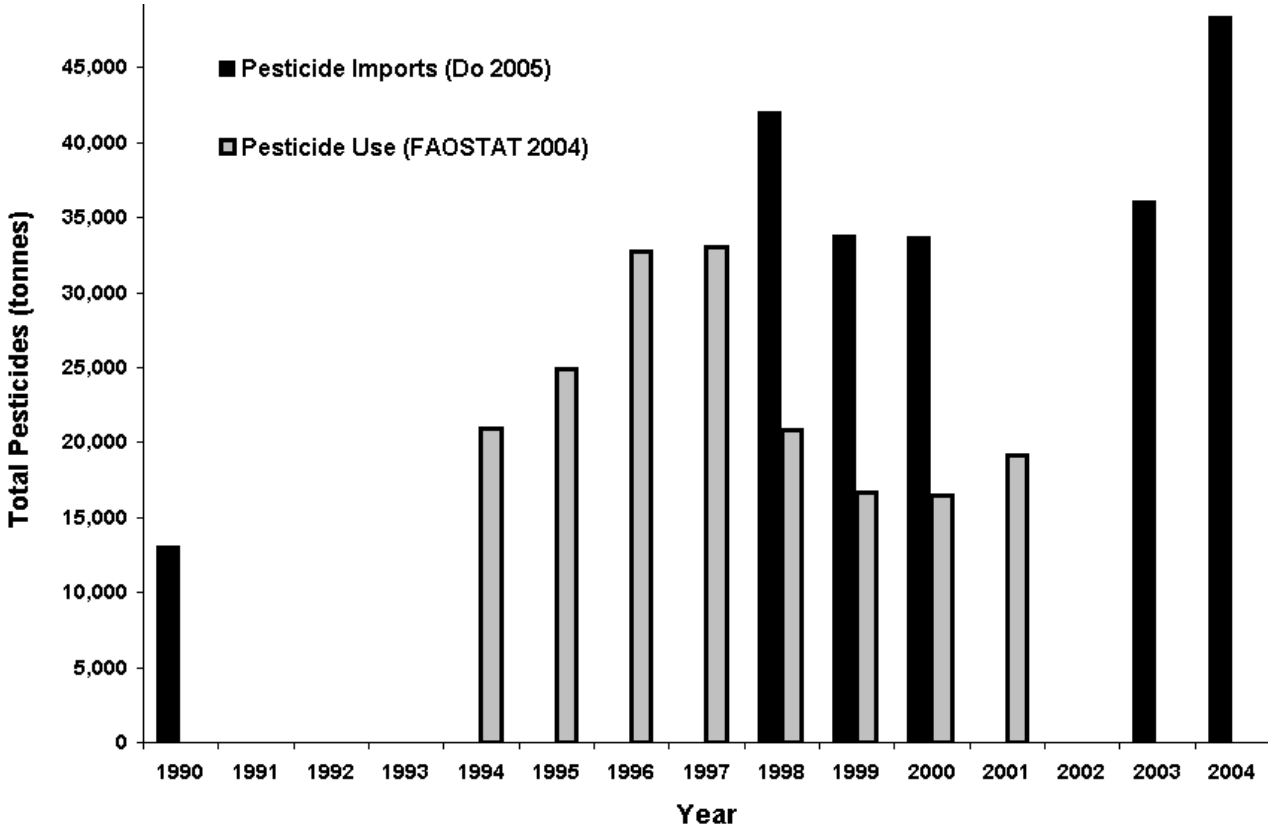


Figure 4.3: Pesticide Imports and Pesticide Use in Vietnam, 1990-2004
Source: (Do 2005; FAOSTAT 2004)

4.5 Summary

In this chapter the main agroecological regions of Vietnam were introduced. Also discussed were the main social, cultural and economic changes that have affected the agricultural sector in Vietnam in recent decades. While the transition from a centrally planned to market economy has led to impressive economic growth in Vietnam, there are a number of challenges facing the agriculture sector. These include the issue of economic inequality between farmers and other sectors of society and the increasing use of agrochemicals. The next chapter introduces safe vegetable production and organic agriculture in Vietnam, both of which can be seen as emerging in response to the challenges facing the agriculture sector.

Chapter 5: Safe Vegetable Production and Organic Agriculture in Vietnam

5.1 Introduction

This chapter introduces two of the alternative agriculture approaches to have emerged in Vietnam during the 1990s, namely safe vegetable production and organic agriculture. The chapter begins with a short comparison of the two approaches, before discussing the current status of safe vegetable production in Ho Chi Minh City. Following this, the reader is introduced to safe vegetable production in the two study sites of Tan Phu Trung and Nhuan Duc Communes in Cu Chi District. This section discusses the characteristics of safe vegetable farmers in the study sites and the reasons for growing safe vegetables. The second half of the chapter discusses the current status and future directions of organic agriculture in Vietnam.

5.2 Safe Vegetable Production and Organic Agriculture in Vietnam

The challenges of economic inequality and increasing agrochemical use as described in the previous chapter have led in part to the emergence of safe vegetable production and organic agriculture in Vietnam. It appears that in the case of Vietnam, safe vegetable production and organic agriculture are primarily being driven by economic and health reasons. On one hand there is a push to develop higher value crops in order for farmers to be able to raise their living standards, while on the other hand there is substantial concern over the health effects of inappropriate and excessive pesticide use.

While similar in some regards, there are a number of important differences between safe vegetable production and organic agriculture. The requirements for safe vegetable production are not nearly as stringent as organic production, with chemical fertilizers and some low toxicity pesticides allowed in safe vegetable production. The main differences between safe vegetable production and organic agriculture can be found in Table 5.1. There is a great deal of consumer confusion between the terms “safe” and “organic” when it comes to vegetables,

even though there are different names in Vietnamese[2] (Moustier et al. 2006). These terms are also often confused in the local press (Viet Nam News 2006b; Viet Nam News 2007a).

Table 5.1: Comparison of Safe Vegetable Production and Organic Agriculture

Criteria	Safe Vegetables	Organic Agriculture
Use of chemical insecticides, fungicides and herbicides	Permitted; with restrictions on the most toxic classes	Not permitted
Use of chemical fertilizers	Permitted; nitrate content of vegetables below a MRL	Not permitted
Use of genetically modified organisms	Permitted; although they are not yet commonly used.	Not permitted
Use of seed treated with fungicides	Permitted	No chemical treatment
Soil conservation	Not considered	Integral part of production
Use of non-renewable resources (fossil fuels, mineral fertilizers)	Not considered	Minimal use
Conservation of biodiversity	Not considered	Requirement in some organic standards

5.3 The Emergence of Safe Vegetable Production in Vietnam

It appears that health concerns are the primary reason why safe vegetables emerged in Vietnam, although economic reasons are also important. The standard of living has increased and people are becoming more concerned about their health. Vegetable consumption has increased along with the increasing incomes over the past decade. However, it is vegetables that cause the greatest concern for consumers in terms of food safety (Moustier et al. 2006). There were a large number of food poisoning cases in Vietnam throughout the 1990s and consumers became concerned about the quality and safety of their food, particularly vegetables (Luis and Firmino 2007; Moustier et al. 2006). Phan et al. (2005: 5) report that in 1995 there were 13,000 cases of food poisoning in the Mekong Delta alone, resulting in 354 deaths. Figuié (2003) reports that for 90 percent of respondents interviewed in Hanoi, vegetables were the food that gave them the greatest concerns over quality, with pesticide residues the cause for concern for the majority of the respondents.

[2] Safe vegetables are known as “rau an toàn” while organic vegetables are known as “rau hữu cơ”.

In April 1998 the Ministry of Agriculture and Rural Development (MARD) issued "Temporary Regulations for the Production of Safe Vegetables" (MARD 1998). These temporary regulations have subsequently been finalized and were released in January 2007 as the "Regulations for the Management and Certification of Safe Vegetable Production" (MARD 2007b). Among other things, these regulations specify the required quality for safe vegetables. These are spelled out in tables listing the Maximum Residual Levels (MRLs) for permitted pesticides, nitrate and heavy metals, along with the allowable levels of bacterial pathogens in harvested vegetables. Vegetable farmers around the major cities of Hanoi and Ho Chi Minh City received training on safe vegetable production in an attempt to reduce pesticide residues in vegetables and improve food safety.

5.4 Safe Vegetable Production in Ho Chi Minh City

Ho Chi Minh City (formerly Saigon) is the largest city in Vietnam, with a population of more than six million people in 2004 (See Table 5.2). The core of the city, located 80 km from the coast on the Saigon River, started as a trading post in the 17th Century and grew in size with the arrival of the French in the 1860s (Gainsborough 2003). The city is now the commercial centre of the country and is one of five municipalities that are under direct central management, giving it the same administrative status as a province (See Map 5.1).

The administrative boundaries of Ho Chi Minh City encompass 209,501 ha of land (2,095 Km^2), comprised of 19 urban districts and 5 rural districts (Statistical Office of HCMC 2004). According to the Department of Agriculture and Rural Development (DARD), slightly less than half of the land area in Ho Chi Minh City is covered in urban development, with another 35,500 ha of forests and 79,534 ha used for agriculture. Rice is grown on approximately 50,000 ha of the city's agricultural land, with the remaining 29,534 ha of agricultural land used for fruit orchards, industrial crops, field crops, vegetables and grazing land for livestock. Data on the conversion of agricultural land to urban and industrial uses in Ho Chi Minh City have proved difficult to track down, but within the agricultural sector there has been a shift out of rice production and into higher value crops and livestock products in recent years.

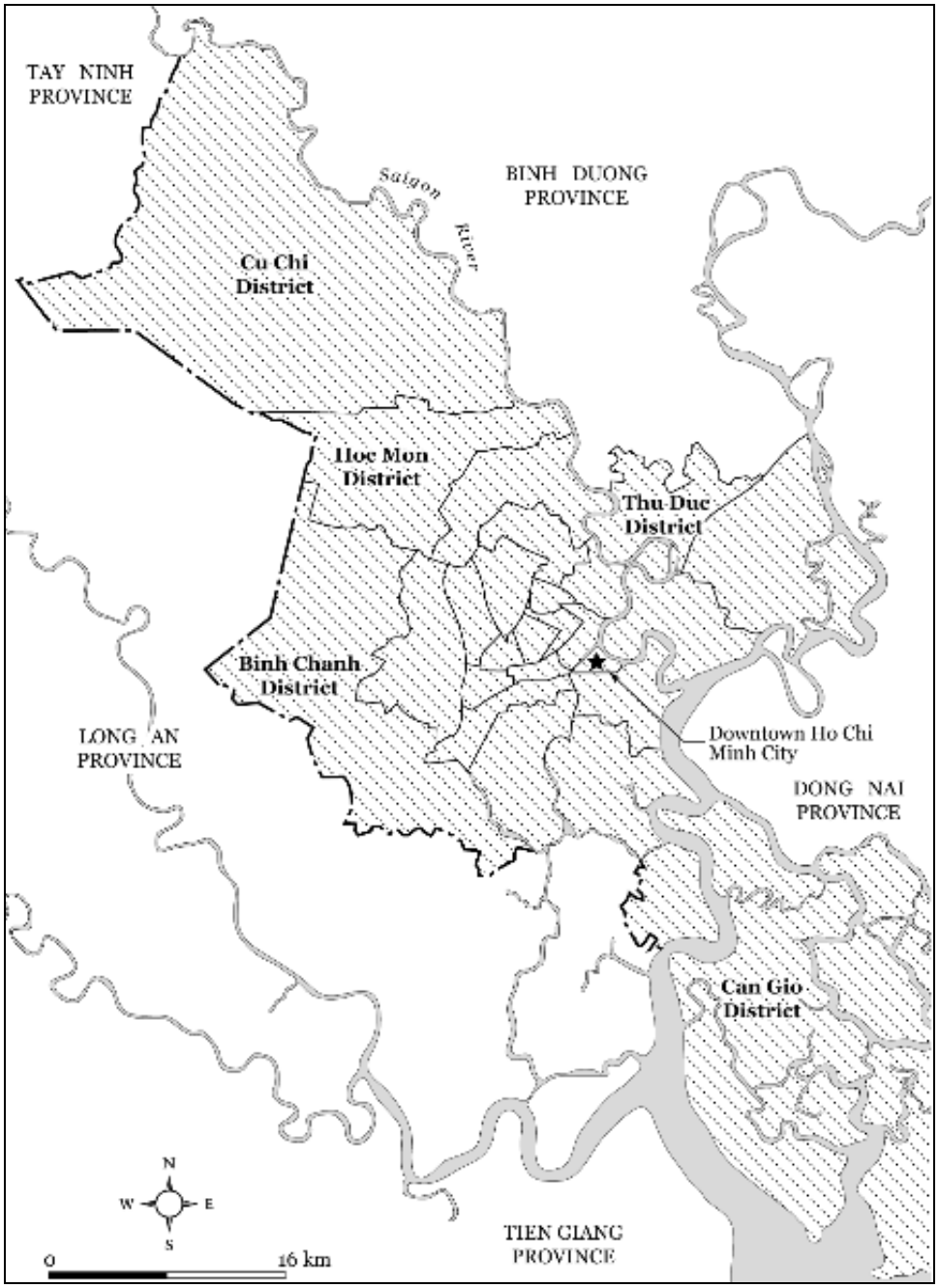
Table 5.2: Administrative Districts and Population in Ho Chi Minh City

District Name	Wards or Communes	Area (Km2)	Population	Population Density (Pop/Km2)	Agricultural Production
Urban Districts	**254**	**494.01**	**5,094,733**	**10,313**	**Some**
District 1	10	7.73	199,247	25,776	No
District 2	11	49.74	123,968	2,492	Yes
District 3	14	4.92	201,425	40,940	No
District 4	15	4.18	182,493	43,659	No
District 5	15	4.27	171,966	40,273	No
District 6	14	7.19	241,902	33,644	No
District 7	10	35.69	156,895	4,396	Yes
District 8	16	19.18	359,194	18,728	No
District 9	13	114.00	199,150	1,747	Yes
District 10	15	5.72	235,442	41,161	No
District 11	16	5.14	229,837	44,715	No
District 12	10	52.78	282,864	5,359	Yes
Binh Tan District	10	51.89	384,889	7,417	Yes
Binh Thanh District	20	20.76	422,875	20,370	No
Go Vap District	12	19.74	443,419	22,463	Yes
Phu Nhuan District	15	4.88	175,668	35,998	No
Tan Binh District	15	22.38	392,521	17,539	No
Tan Phu District	11	16.06	361,747	22,525	No
Thu Duc District	12	47.76	329,231	6,893	Yes
Rural Districts	**63**	**1,601.00**	**968,260**	**605**	**Yes**
Cu Chi District	21	434.50	287,807	662	Yes
Hoc Mon District	12	109.18	243,462	2,230	Yes
Binh Chanh District	16	252.69	298,623	1,182	Yes
Nha Be District	7	100.41	72,271	720	Yes
Can Gio District	7	704.22	66,097	94	Yes
HCMC Total	**317**	**2,095.01**	**6,062,993**	**2,894**	**Mixed Use**

Source: (Statistical Office of HCMC 2004).

The rice crops around Ho Chi Minh City average only three tons per ha, among the lowest rice yields in Vietnam. The reason for these low rice yields is mainly due to poor soils, with grey sandy loams and acid sulphate soils in many areas. There is also a problem with flooding in some of the city's agricultural areas, while other areas suffer from a lack of supplementary irrigation in the dry season. In response to these challenges and the low returns from rice production, there has been a push from the People's Committee of Ho Chi Minh City for

farmers to diversify from rice into higher value products such as vegetables, fruit, flowers, fish, shrimp, frogs, milk and livestock. One of the alternatives taken up by farmers is safe vegetable production, which is currently practiced on just over 3,500 ha in Ho Chi Minh City.



Map 5.1: The Administrative Boundaries of Ho Chi Minh City

5.4.1 Safe Vegetable Production in Cu Chi District

Cu Chi is the second largest district in Ho Chi Minh City and is located along highway 22 in the northwestern corner of the city, about 25 km from the downtown core of District One on the Saigon River. Cu Chi is bordered to the southeast by Hoc Mon District, another one of the main agricultural areas in Ho Chi Minh City. The Anh Ha Canal is the dividing line between Cu Chi and Hoc Mon Districts. There used to be more agricultural land in Hoc Mon District, but the city is expanding rapidly. The roadside is lined with houses and businesses, most often in the same building. Once over the canal the roadside becomes decidedly more rural for a brief period, before the houses and businesses reappear in Tan Phu Trung Commune. The government is aiming to increase the area of safe vegetables in Ho Chi Minh City to 5,700 ha by 2010 (People's Committee of HCMC 2006). Together with Binh Chanh District, Cu Chi and Hoc Mon Districts are projected to account for the all of the increased area for safe vegetable production in Ho Chi Minh City until 2010 (See Table 5.3). It is predicted that the area of safe vegetable production in other districts will actually decline due to urbanization.

Table 5.3: Planned Increase of Safe Vegetables in Ho Chi Minh City from 2006-2010

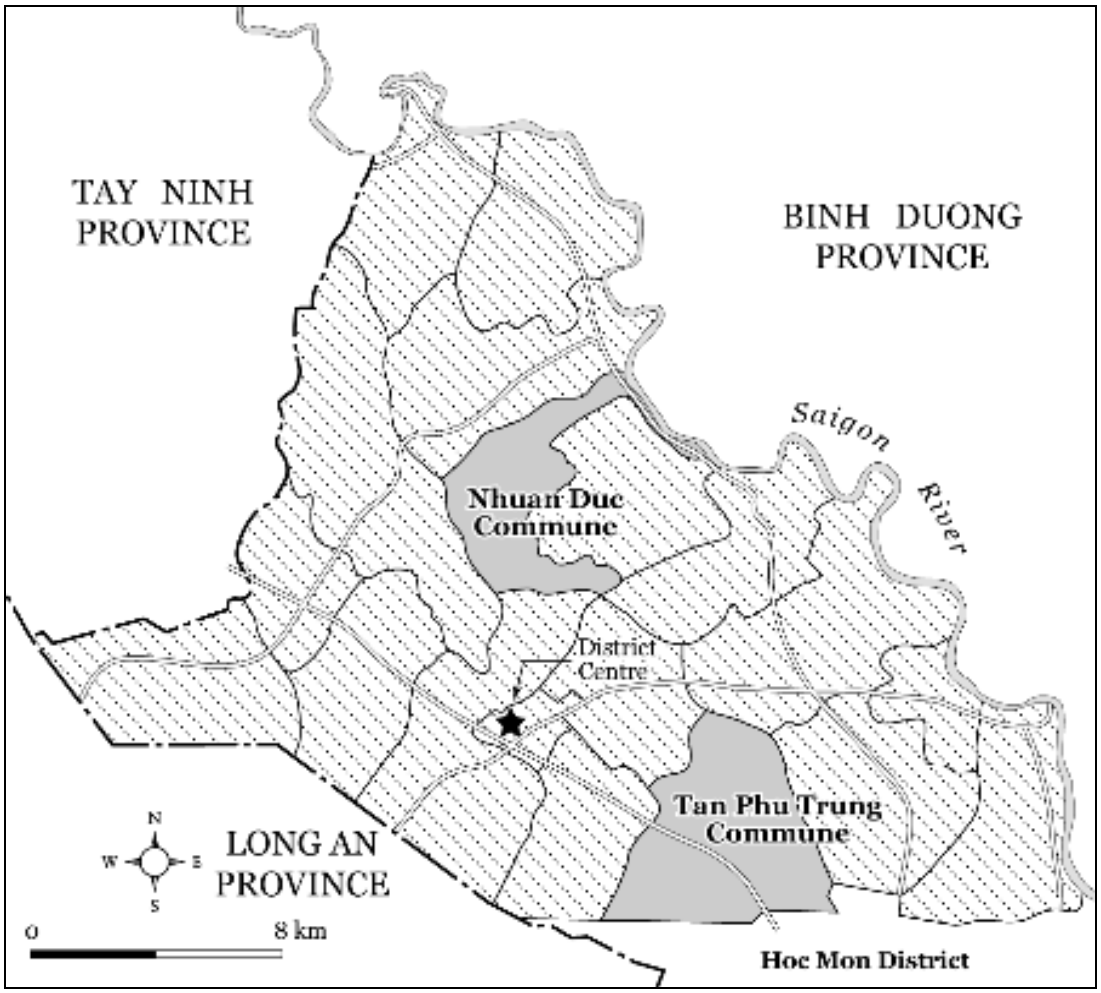
Year	Cu Chi District	Binh Chanh District	Hoc Mon District	Other Districts	Total Area (ha)	Increase (ha/year)
2005	882	813	300	240	2,235	-
2006	1,600	900	400	240	3,140	905
2007	1,970	1,000	500	200	3,670	530
2008	2,470	1,100	650	150	4,370	700
2009	2,950	1,200	750	100	5,000	630
2010	3,400	1,300	900	100	5,700	700

Source: (People's Committee of HCMC 2006)

It is estimated by government agricultural officials that about two thirds of the 21 communes in Cu Chi District have at least some farmers producing safe vegetables. Data on the exact number of safe vegetable farmers and land area proved difficult to obtain. Staff members of the Plant Protection Sub-Department and the Agricultural Extension Centre were unable to provide exact numbers of farmers growing safe vegetables in Cu Chi District. However, these officials were of the opinion that it would be difficult to find any vegetable farmers in Cu Chi District who are not following at least some of the safe vegetable practices.

5.4.2 Safe Vegetable Production in Tan Phu Trung and Nhuan Duc Communes

In Cu Chi District, the greatest focus so far has been placed on promoting safe vegetable production in Tan Phu Trung and Nhuan Duc Communes (See Map 5.2). The estimated number of safe vegetable farmers and the land area devoted to safe vegetable production in each of these communes can be found in Table 5.4 and Table 5.5. The heads of the farmer cooperatives in the respective communes made the estimates of the number of safe vegetable farmers contained in these tables. They were more certain of the number of safe vegetable farmers in the hamlets in which the cooperative members reside, such as Dinh and Cay Da Hamlets in Tan Phu Trung and Bau Cap, Bau Tran and Bau Tron Hamlets in Nhuan Duc.



Map 5.2: Tan Phu Trung and Nhuan Duc Communes in Cu Chi District

Table 5.4: Number of Farmers Growing Safe Vegetables in Tan Phu Trung Commune

Hamlet Name	Safe Vegetable Area	Safe Vegetable Farmers	Notes
Dinh	13 hectares	76	Most cooperative members from here
Cay Da	15 hectares	58	Some cooperative members from here
Xom Dong	Small area	<10	Land-use policies changed, less labour
Bao Hung	None	0	
Lang Cat	None	0	
Trang Bom	None	0	
Ben Do I	3 hectares	10	Land-use policies changed, less labour
Ben Do II	None	0	Land rezoned, production stopped 2001
Gi Ua	None	0	
Lang The	None	0	
Cho	None	0	
Giong Sao	Small area	<10	Started producing in 2001

In Tan Phu Trung Commune there used to be more farmers growing safe vegetables in Ben Do I, Ben Do II and Xom Dong Hamlets, but the government land use policies have changed in these areas, with farmers being encouraged to move out of agriculture to make room for industrial development. The land in Ben Do II was rezoned for industrial use in 2001 and production of safe vegetables stopped completely. Some of this production capacity was replaced in Giong Sao Hamlet, which started producing in 2001. These changes have also meant that many young people are getting work in industrial zones and farmers are finding it hard to get enough labour to grow safe vegetables. As the industrialization of Tan Phu Trung has intensified, there has been a push by the Ho Chi Minh City Government to promote safe vegetable production in Nhuan Duc Commune.

Table 5.5: Number of Farmers Growing Safe Vegetables in Nhuan Duc Commune

Hamlet Name	Safe Vegetable Area	Safe Vegetable Farmers	Notes
Duc Hiep	Unknown	~ 20	
Bau Cap	10 hectares	14	Some cooperative members from here
Bau Chua	Unknown	~ 20	
Bau Tron	30 hectares	38	Some cooperative members from here
Nga Tu	Unknown	~ 20	
Can Ly	Unknown	~ 20	
Bau Tran	60 hectares	45	Some cooperative members from here
Xom Bung	None	0	
Ben Dinh	None	0	

5.4.3 Agricultural Change in Tan Phu Trung and Nhuan Duc Communes

This section provides a description of Tan Phu Trung and Nhuan Duc and introduces some of the agricultural changes that have taken place in these communes over the past 30-40 years. Tan Phu Trung Commune is a triangle shaped area of land covering 3,076 ha on the southern side of Cu Chi District. It is the first commune that one enters when travelling to Cu Chi on the main highway from downtown Ho Chi Minh City. The commune straddles both sides of the main highway and is close to the district centre of Cu Chi. The land around Tan Phu Trung is mostly non-flooding upland soils used for growing mixed crops. Some rice fields can still be found, although many of them are left fallow to be grazed by cows. Other rice fields have been recently converted into acacia plantations and fruit orchards.

There is also evidence of increasing urbanization and industrialization in Tan Phu Trung. Factories line the main highway and many new houses are being built along secondary roads throughout the commune. These transitions are part of an ongoing change in the agricultural landscape of Tan Phu Trung (See Table 5.6). In 1954 following independence from France, Catholics from North Vietnam moved south to escape socialist rule (Jamieson 1995). Some of these Catholic families settled in Tan Phu Trung Commune and started growing a greater variety of vegetables along with the more commonly grown crops of rice, peanuts and traditional tropical vegetables.

After the reunification of the country in 1975, the government introduced vegetable growing groups and a vegetable collective with the intention of coordinating vegetable production in Tan Phu Trung. This experiment was not particularly successful and the collective disbanded in 1989, with the opening of the economy. For a number of years farmers pursued their own strategies for growing and selling crops, but in 1993 the farmers in Dinh Hamlet formed their own vegetable farmers group with the intention of mutually supporting each other in growing and selling vegetables. The concept of safe vegetables was introduced into Tan Phu Trung in 1997, when government agricultural staff began working with a group of farmers in Dinh Hamlet.

Table 5.6: Timeline of Agricultural Change in Tan Phu Trung Commune

Year	Commune History
Before 1970	A few farmers grew vegetables, but most grew rice and other field crops such as cassava, peanuts and sweet potatoes.
1970-1978	More farmers started growing vegetables such as cucumber, bitter gourd, luffa and French beans.
1978	A vegetable growing group was formed in Dinh Hamlet and farmers started to grow leaf vegetables (lettuce, mustard greens, Chinese flowering cabbage, spring onions) along with the other vegetables mentioned above.
1978-1986	Farmers continued growing these vegetables in Dinh Hamlet and more vegetable growing groups were also formed in other hamlets.
1986	The government established a vegetable collective composed of all the hamlet vegetable groups in TPT. The name was "Tan Phu Ba".
1986-1989	Operation of the "Tan Phu Ba" vegetable collective.
1989	The government collective was disbanded because it had ceased to function and the farmers were having trouble selling their vegetables.
1989-1993	Farmers grew any type of crop that they wanted, with rice, peanuts, cabbage, pumpkin and gourds commonly grown.
1993	Farmers themselves established a vegetable growing group in Dinh Hamlet and started to grow cabbage and cauliflower.
1993-1997	Farmers continued to grow vegetables to sell to the local market.
1997	The concept of safe vegetables became more widely publicized in the commune. Farmers established a safe vegetable growing group in Dinh Hamlet with support from DARD.
1997-2003	Five other hamlets in TPT established their own safe vegetable groups.
2003	A larger safe vegetable growing group was formed through the aggregation of the 6 hamlet groups in TPT. In June of the same year the privately run "Tan Phu Trung Safe Vegetable Cooperative" was formed and exists alongside the safe vegetable group.

Nhuan Duc Commune is a crescent shaped area of land covering 2,160 ha in the north central part of Cu Chi District. It is further from the district centre and has a lower population density than Tan Phu Trung. Farm sizes are generally larger and there is less industrial and urban development, although factories are opening amongst the rice fields and rubber plantations. Rice fields are still common in Nhuan Duc Commune, although some are left fallow or used for cattle grazing. Field crops of corn, peanuts and cassava are commonly grown. It is also quite common to see young rubber plantations being developed by smallholders.

Nhuan Duc Commune has a very different history of agricultural development than Tan Phu Trung (See Table 5.7). Prior to 1965, much of the land was still forested and there were few farms and hamlets. During the war the area was under the control of the Viet Cong and it was declared a "free fire" zone, meaning aircraft could bomb the area without needing to first gain permission from central command. Located less than 20 km from Nhuan Duc Commune is the entrance to a vast tunnel complex, referred to as the Cu Chi Tunnels. The Viet Cong and the North Vietnamese army used these tunnels as a supply base and staging ground for raids. It was obviously very dangerous to continue living in Nhuan Duc Commune during the war and most of the inhabitants moved away to other areas.

Table 5.7: Timeline of Agricultural Change in Nhuan Duc Commune

Year	Commune History
Before 1965	The commune was a mix of forest and farmland, with few farmers in the area.
1965-1975	The commune was declared a "free fire" zone under the control of the Viet Cong. No agriculture took place and most farmers moved away to the district centre or to other communes.
1975	End of the war, farmers moved back to the area and resumed farming.
1975-1995	Farmers growing rice and some traditional vegetable varieties (mostly bitter gourds, wax gourds and cucumbers).
1995-2005	More farmers growing vegetables and they start to use black plastic mulch and hybrid vegetable varieties; chillies also grown more widely by farmers.
2005	Safe vegetable growing techniques spread to Nhuan Duc Commune.
July 2006	Farmers established a safe vegetable production group called "Bau Tron".
May 2007	The Nhuan Duc Safe Vegetable Cooperative was established with support from DARD. They have obtained an official tax stamp and they are looking to sign contracts with buyers.

Following the war, people moved back to the area and commenced farming, growing rice and a small number of traditional vegetable varieties. In the mid 1990s farmers started using some new production techniques for growing vegetables and switched to hybrid seeds. Safe vegetable production was only introduced to the area around 2005. Since that time, more farmers have taken up growing safe vegetables and supporting the development of safe vegetables through a farmer run group. In early 2007 the Nhuan Duc Safe Vegetable Cooperative was established.

5.4.4 Characteristics of Safe Vegetable Farmers

There are a number of interesting similarities and differences between the safe vegetable farmers of Tan Phu Trung and Nhuan Duc (See Table 5.8). In Tan Phu Trung the farmers were older than those in Nhuan Duc, with an average age of 51 years compared to 44 years in Nhuan Duc. Farmers in Tan Phu Trung had on average been growing safe vegetable for eight years, while in Nhuan Duc the farmers had only been growing safe vegetable for an average of two years. In both communes the farm households had a similar number of family members (TPT = 4.7, ND = 4.8), with an average of two family members working on the farm.

Table 5.8: Characteristics of Safe Vegetable Farmers

Farmer Characteristics	Farmers in TPT	Farmers in ND
Age of farmers (years)	51 (range 34-59)	44 (range 35-74)
Length of time growing safe vegetables (years)	8 (range 4-10)	2 (range 1-3)
Family members (number of people)	4.7 (range 3-9)	4.8 (range 3-7)
Farm labour (number of people)	2.1 (range 1-4)	2.3 (range 1-6)
Household income from farming activities (%)	71 (range 20-100)	95 (range 70-100)
Household income from safe vegetables (%)	60 (range 20-100)	65 (range 20-100)
Size of homegarden (ha)	0.6 (range 0.01-0.2)	0.16 (range 0.01-0.5)
Size of own farmland (ha)	0.3 (range 0.1-0.8)	0.72 (range 0-3.0)
Size of rented farmland (ha)	0.08 (range 0-1.0)	0.4 (range 0-2.0)
Area of land devoted to safe vegetables (ha)	0.27 (range 0.05-1.3)	0.9 (range 0.01-2.5)
Area of vegetables under shadehouses (ha)	0.03 (range 0-0.1)	0

Farms and homegardens were generally much smaller in Tan Phu Trung compared to those in Nhuan Duc. In Tan Phu Trung farmers devoted an average of 0.27 ha of their farms to safe vegetable production, compared to an average of 0.9 ha in Nhuan Duc. Farm income accounts for the majority of the total household income in both communes. However, it was relatively more important for farmers in Nhuan Duc, accounting on average for 95 percent of their total income, compared to 71 percent of total household income in Tan Phu Trung. Safe vegetable production is the most important component of the farm income for the majority of farmers in both communes, accounting for an average of 60-65 percent of the total household income.

Safe vegetable farmers can be loosely grouped according to the types of vegetables that they grow (See Table 5.9). The farmers in Tan Phu Trung, with their smaller farm sizes, are

mostly specializing in growing many different types of leaf vegetables and herbs on a short-rotation. These leaf vegetables mature in 25-30 days, allowing farmers to grow 8-10 crops per year when time for land preparation is taken into account.

Table 5.9: Safe Vegetables Grown in Tan Phu Trung and Nhuan Duc Communes

Scientific Name	English Name	Vietnamese Name	Farmers TPT (#)	Farmers TPT (%)	Farmers ND (#)	Farmers ND (%)
Leaf Vegetables and Herbs						
Allium fistulosum	spring onion	hành	2	10	0	0
Allium tuberosum	garlic chives	he	4	20	0	0
Amaranthus hybridus	amaranth	rau dên	13	65	0	0
Basella alba	Ceylon spinach	mông toi	11	55	0	0
Brassica juncea	mustard greens	cai xanh	11	55	0	0
Brassica rapa	Chinese cabbage	cai ngot	11	55	0	0
Corchorus olitorius	jute mallow	rau đay	9	45	0	0
Enydra fluctuans	buffalo spinach	ngò ôm	1	5	0	0
Ipomoea aquatica	kang kong	rau muồng	13	65	0	0
Lactuca sativa	lettuce	xà lách	1	5	0	0
Ocimum basilicum	basil	rau quề	3	15	0	0
Oenanthe javanica	water parsley	rau cần	1	5	0	0
Perilla frutescens	perilla	tía tô	4	20	0	0
Fruit and Pod Vegetables						
Benincasa hispida	wax gourd	bí	3	15	8	42
Capsicum annuum	chilli	ớt	1	5	13	68
Cucumis sativus	cucumber	đưa leo	5	25	16	84
Hibiscus esculenta	okra	dâu bap	0	0	1	5
Lagenaria vulgaris	gourd	baù	2	10	15	79
Luffa acutangula	angled luffa	mướp khia	2	10	5	26
Luffa cylindrical	smooth luffa	mướp huong	1	5	4	21
Lycopersicon esculentum	tomato	cà chua	1	5	0	0
Momordica charantia	bitter gourd	khô qua	5	25	14	74
Phaseolus vulgaris	common bean	đậu quê	1	5	0	0
Solanum melongena	eggplant	cà tím	0	0	1	5
Vigna unguiculata	long bean	đậu đũa	1	5	9	47

Some varieties of leaf vegetables are grown under a shadehouse, particularly mustard greens (*Brassica juncea*) and Chinese cabbage (*Brassica rapa*). A smaller number of the farmers in

Tan Phu Trung also grow fruiting and pod bearing vegetables[3] including cucumbers, beans, and numerous types of gourds. In Nhuan Duc all of the farmers are specializing in growing fruit vegetables and none of them grow leaf vegetables or herbs commercially. As such, none of the farmers in Nhuan Duc have invested in building shadehouses. The fruit vegetables are usually grown over a period of three months, allowing farmers to harvest three to four crops per year. Some of the vine crops, such as cucumbers, beans and gourds are grown on a bamboo trellis system that is replaced every three to five crops.

5.4.5 Farmers' Definitions of Safe Vegetables

Safe vegetable farmers in Tan Phu Trung and Nhuan Duc were asked what the term "safe vegetables" meant to them. In both communes 19 out of the 20 interviewed farmers answered this question. Farmers mentioned a broad range of criteria relating to the required product quality for safe vegetables and the production practices for growing safe vegetables (See Table 5.10). These definitions ranged from the very basic, specifying only "the use of less pesticides and less chemical fertilizers" in production, to quite detailed definitions that included reference to the principles of integrated pest management and correct pesticide use.

> Safe vegetables have pesticide residues and chemical fertilizer residues below the maximum allowable limit (nitrate not mentioned specifically). When growing safe vegetables you also need to apply the four truths of integrated pest management. These include the appropriate type of pesticide to use, the appropriate dose to use, the appropriate time to apply the pesticides, and the appropriate time of isolation between spraying pesticides and harvesting vegetables (Male Farmer, Tan Phu Trung).

Some of the definitions provided by farmers were based on the processes of production of safe vegetables. The most commonly cited production processes associated with safe vegetable production were: (a) observing the correct withholding period between spraying pesticides and harvesting vegetables (32 percent of farmers in TPT, 26 percent of farmers in ND) and (b) using only the pesticides allowed by the regulations (37 percent of farmers in TPT, 5 percent of farmers in ND). In addition to these production processes, one quarter of farmers in Tan Phu Trung mentioned the correct application of fertilizer, and one quarter of farmers in Nhuan

[3] In this thesis I use the term "fruit vegetables" to refer to those vegetables for which the main edible product is a fleshy fruit or pod containing seeds.

Duc mentioned using less-toxic pesticides. Other production processes, such as using only clean water from deep wells for irrigation and composting all manure before application, were mentioned by only a small number of farmers.

Table 5.10: Farmers' Definitions of Safe Vegetables

Criteria for Safe Vegetables	Farmers TPT (%)*	Farmers ND (%)*
Production Processes		
Use only pesticides allowed in the regulations	37	5
Use less toxic pesticides	0	26
Apply the correct amount of pesticides	0	11
Observe correct pesticide withholding period	32	26
Use no chemical fertilizer	5	0
Use less chemical fertilizer	11	5
Correct application of fertilizer	26	0
No human manure to be used as fertilizer	5	0
All animal manure to be composted before application	5	0
Use good quality seed	5	0
Use clean well-water	11	0
Vegetable Quality		
Vegetables with no pesticide residues	16	5
Vegetables with less pesticide residues	16	37
Vegetables with pesticide residues below the MRL	32	21
Vegetables with no nitrate content	16	0
Vegetable with less nitrate content	0	5
Vegetables with nitrate content below the maximal tolerance	16	0
Microorganism content below the maximal tolerance	5	5
Heavy metal content below the maximal tolerance	5	0
General Benefits of Production		
Protection of human health	21	42
Protection of environmental health	0	16
Economic benefits (higher prices and lower production costs)	0	11

* Percentage of farmers mentioning each factor.

Farmers also mentioned a number of different criteria relating to the quality of safe vegetables. The required quality for safe vegetable, as outlined in the safe vegetable standards, specify the following four criteria: (1) pesticide residues below the maximal residual level, (2) nitrate content below the maximal tolerance, (3) heavy metal content below the maximal tolerance, and (4) microorganism content below the maximal tolerance. Of these criteria, most

farmers referred to a requirement for lower pesticide residues in their definitions of safe vegetables. Some farmers stated that safe vegetables should have no pesticide residues whatsoever while others mentioned that the vegetables should have less pesticide residues than normal vegetables. Less than one third of farmers in both communes mentioned that pesticide residues should be below a certain maximal residual level as specified in the regulations on safe vegetable production.

Just as there was some confusion around the specifications of pesticides residues on vegetables, so too was there confusion around the allowable nitrate content in vegetables. Some farmers in Tan Phu Trung suggested that safe vegetables should have no nitrate content. This is not possible given that nitrogen is a major plant nutrient. Only five percent of farmers in Nhuan Duc mentioned nitrate at all in their definition of safe vegetables, while in Tan Phu Trung only 15 percent of farmers correctly mentioned that the nitrate content should be below a maximal tolerance. Only a small proportion of farmers mentioned the requirement for safe vegetables to have a microorganism content and heavy metal content below a certain limit.

In their definitions of safe vegetables, farmers in both communes also mentioned some general benefits that could result from the production of safe vegetables, notably the protection of human health, which was mentioned by over 40 percent of farmers in Nhuan Duc Commune and over 20 percent of farmers in Tan Phu Trung Commune. A small number of farmers in Nhuan Duc also mentioned economic benefits and the protection of the environment as important components of safe vegetable production. These benefits were not mentioned by any of the farmers in Tan Phu Trung.

Overall, it appears that the safe vegetable farmers interviewed in Tan Phu Trung Commune have a more comprehensive and sophisticated understanding of safe vegetables than the farmers interviewed in Nhuan Duc Commune. They mentioned a greater number of criteria relating to safe vegetable production and were more likely to correctly mention the criteria contained in the regulations on safe vegetable production. This is probably due to the fact the farmers in Tan Phu Trung Commune had on average been growing safe vegetable for a longer period of time, eight years as compared to an average of two years for the farmers in Nhuan

Duc. Some of the farmers in Tan Phu Trung are exceeding the requirements for safe vegetable production and have eliminated the use of agrochemicals altogether in their production systems. This is discussed further in the following sections on organic agriculture in Vietnam.

5.5 The Emergence of Organic Agriculture in Vietnam

In the late 1990s a small number of organic agriculture initiatives started in Vietnam. These projects primarily involved the production of specialty crops, such as spices and essential oils, destined for export (den Braber and Hoang 2007). There is currently little information available on organic agriculture in Vietnam and the topic has received little attention in the academic literature. Papers by Camillo (2004) and Moustier et al. (2006) are some of the exceptions. As of January 2008, the FAO website devoted to organic agriculture in Vietnam had only one article listed, a news report relating to brown plant hoppers in the Mekong Delta with no direct reference to organic agriculture (FAO 2008). No other information was listed concerning organic agriculture in Vietnam. Similarly on the IFOAM website, the Organic Directory Online lists only two entries for Vietnam. One of these listings is for an international development organization, which has recently ceased activities in Vietnam and the other listing has no contact information available (IFOAM 2008). However, when one begins to search online, reference to organic agriculture can be found in the grey literature such as project reports, newspaper articles and company websites.

One of the objectives of this research was to better understand the reasons for the emergence of organic agriculture and safe vegetable production in Vietnam. The remainder of this chapter presents a consolidation of the available information on organic agriculture in Vietnam. This information is combined with additional data from key informant interviews to develop a comprehensive picture of the current status of organic agriculture in Vietnam. Future directions for organic agriculture in Vietnam are also discussed, particularly in relation to the further development of the domestic market for organic food.

5.5.1 Typology of Organic Farmers in Vietnam

If conceived in the broadest sense, there are three main types of organic farmers in Vietnam. I have named these the traditional organic farmers, the reformed organic farmers and the certified organic farmers. Although it is difficult to get a good estimate of the number of organic farmers in Vietnam, it is safe to say that each of these groups contains a small number of farmers when compared to the vast majority of conventional farmers in Vietnam. An overview of these three groups can be found in Table 5.11 and they are discussed in greater detail below.

Table 5.11: Typology of Organic Farmers in Vietnam

Main Characteristics	Type One Traditional Organic	Type Two Reformed Organic	Type Three Certified Organic
Description	Traditional farmers who have never used agrochemicals on their farms.	Farmers who applied agrochemicals in the past but have stopped after receiving training on ecological farming methods.	Farmers who have received training on organic production methods and use only those inputs and practices allowed by an organic certifying body.
Rationale	Lack of access to agrochemicals. Concern for human or environmental health (?)	Concern for human or environmental health. Economic benefits from reducing input costs.	Concern for human and environmental health. Economic benefits from reducing input costs and from obtaining organic certification.
Organic Awareness	May or may not be aware of organic agriculture as a larger movement.	May or may not be aware of organic agriculture as a larger movement.	Aware of the principles of the organic agriculture movement.
Certification Status	No certification	No organic certification but may have safe vegetable or EurepGAP certification.	Certified organic or in processes of obtaining certification.
Number of Farmers	1,000s to 10,000s (?)	1,000s to 10,000s (?)	1,000-3,000 (?)

The first group of "traditional organic" farmers are those who have never embraced the use of agrochemicals in their production systems and continue to farm using traditional methods, including composting and crop rotations to maintain soil fertility and guard against pests and diseases. This type of organic farmer are also referred to as "organic by default" (Johannsen et al. 2005). In practice these farmers are probably few in number today and are most likely to be found in the mountainous areas of central and northern Vietnam among the ethnic minorities. These farmers most likely use little or no agrochemical inputs because of limited access to them, either through distance from markets or the relatively high cost to purchase, rather than an organic philosophy that shuns the use of agrochemicals for health or environmental reasons. The vast majority of rice growing farmers in the lowlands of Vietnam would also be found to be using at least some chemical fertilizer inputs in an attempt to boost production. If their use of inputs is lower than the average, this is again likely due to economic constraints or an attempt to reduce costs rather than health or environmental concerns.

The second group of "organic" farmers are those that at some point embraced the use of agrochemicals on their farms but have now stopped after learning about the negative economic, health and environmental effects associated with the excessive use of agrochemicals through a training course or some other avenue. Along with government supported training courses on integrated pest management and safe vegetables, there are a handful of non-government organizations working in Vietnam who explicitly promote ecological farming practices and advocate for farmers to adopt a more organic production approach by reducing or eliminating their use of agrochemicals. An overview of these initiatives can be found in Table 5.12.

Most of the training courses on IPM and safe vegetable production do not strictly rule out the use of agrochemicals, but rather attempt to teach farmers about the safe and appropriate use of agrochemicals. They also demonstrate the economic irrationality of using excessive amounts of chemical fertilizers. When it comes to applying chemical fertilizer, more is not always better and when applied past an optimum amount, farmers are wasting their money. These courses also often contain components on ecological farming practices, such as composting, crop diversity and crop rotations.

As farmers experiment with these ecological farming practices and gain more experience some of them may eventually abandon the use of agrochemicals altogether. I am not claiming that this will happen with every farmer that attends an IPM course, but there are bound to be a number of farmers that do stop using agrochemicals after learning about and experimenting with ecological farming practices on their farms. This was certainly the case with a small number of the safe vegetable farmers that I interviewed in Cu Chi District. These farmers had replaced all chemical fertilizer inputs with composted livestock manure and were using only a small amount of biopesticide sprays such as *Bacillus thurengiensis* (Bt) for crop protection. These biopesticides are allowed for use in organic production in emergency situations. While these farmers were not aware that they were "organic" farmers, and certainly had not sought any form of organic certification, they would likely be able to gain certified organic status with a few minor adjustments to their current practices.

Table 5.12: Ecological Agriculture Initiatives in Vietnam

Organization	Description	Commodity Groups	Location of Projects	Number of Farmers
National IPM Program MARD and FAO Source:(FAO 2001)*	National IPM program has been running since 1992 with support from the FAO, Funding has variously been provided by the governments of Australia, Norway, Denmark and the EC. Training based on Farmer Field Schools (FFS). Many provincial agriculture departments are also training farmers in IPM and safe vegetable production.	Rice, Sweet Potatoes, Cotton, Peanuts, Soybeans, Sugarcane, Vegetables.	Country wide	Over 30,000 farmers from 1999-2001. Probably more than 500,000 farmers trained since1992.
IPM Program Danida Source: (Danida 2007)	Supporting the National IPM Program from 2000-2005. Training of farmer trainers and supporting FFS and Community IPM activities.	Rice and Maize	In 31 provinces across the country	3,500 farm trainers and 356,000 farmers trained on IPM
Vegetable IPM Agricultural Development Denmark Asia (ADDA) and Hanoi	Providing training to farmers on implementing IPM in vegetables through the use of Farmer Field Schools (FFS). Participatory training method in which	Vegetables	Northern Vietnam	Full season training of 9,000 vegetable farmers and

Farmers Union (HNFU) Source: (ADDA 2006)*	farmers select the topics of interest to them. Goal was to optimize the water and fertilizer management, reduce the use of pesticides and produce safer vegetables for consumers. The project ran from 1999-2005.			formation of more than 100 farmer groups.
IPM Training CIDSE Source: (FAO 2001)	Project from 1999-2001 to spread IPM capability in tea. Project from 2002-2003 to improve farmer knowledge of IPM in field crops.	Tea, Rice, Maize, Soybeans, Tea and Potatoes	Tea in Thai Nguyen and Phu Tho and other crops in Bac Kan Province	7,840 farmers
Citrus IPM National Institute of Plant Protection and ACIAR Source: (FAO 2001)	Season long field studies and development of FFS for IPM from 1997-2000. Reduce use of broad spectrum pesticides through introduction of petroleum spray oils	Citrus	Nghe An and Tien Giang Provinces	Unknown
Market Access for the Poor Netherlands Development Organization (SNV) Source: (SNV 2008)*	Promoting improved market access for the poor through the sustainable use of upland areas through agriculture, forestry and the collection of Non-Timber Forest Products (NTFPs). Encourage responsible use of external inputs and promote IPM methods.	Subsistence: Rice, Maize, and Small Livestock. Cash Crops: Mushrooms, Bamboo Shoots, Cardamom, Tea, Longan and Flowers	Son La, Dien Bien, Lai Chau, Thai Nguyen and Ninh Binh in North Vietnam Quang Binh, Quang Tri and Hue in Central Vietnam	Working with policy makers, farm trainers and service providers.
Ecological Agriculture Japan International Volunteer Centre (JVC) Source: (JVC 2006)*	Introduce ecological and organic farming techniques to farmers. Emphasise the use of internal farm inputs, compost making and integrated farming technologies for promoting food security amongst ethnic minorities in the uplands. Projects include integrated rice-fish farming, rice-duck farming and the system of rice intensification (SRI).	Rice, Maize, Fruit, Vegetables, Livestock and Fish	Hoa Binh Province, Northern Vietnam	1,400 households
Ecological Agriculture Social Policy Ecology Research	Facilitates FFS for different upland areas and develops a network of farmers interested in sustainable agriculture and	Crops, Fish and Livestock	Lao Cai, Nghe An, Ha Tinh, Quang Binh	Unknown

Institute (SPERI) Source: (SPERI 2007)*	organic agriculture.		Provinces	
Les Vergers Du Mékong Private Company Source: (Les Vergers Du Mékong 2007)*	French coffee company that established fruit plantations and processing company in Vietnam in 2000. Orchards produce more than six millions tonnes of fruit per year. They do not use chemicals or additives in their products and ensure traceability but are not certified organic.	Fruit, Fruit Juices, Jams, Honey Coffee	Mekong Delta and Central Highlands	Unknown
Sustainable Development of Peri-urban Agriculture in South-East Asia (SUSPER) AVRDC and CIRAD Source: (Moustier 2007)	The SUSPER project ran from 2002-2006, funding from the French Ministry of Foreign Affairs. Goal was to raise capacity of stakeholders involved in peri-urban agriculture by improving profitability. Market analysis and development and testing of technical innovations.	Vegetables, Fish and Frogs	Vegetables in Hanoi, Aquaculture in HCMC (activities also in Phnom Penh & Vientiane)	150 farmers in Hanoi, 100 farmers in HCMC
Markets and Agriculture Linkages for Cities in Asia (MALICA) Centre for Agrarian Systems Research and Development (CASRAD) Source: (MALICA 2007)	Consortium of French and Vietnamese Research Institutes. Main objective is to build the capacity of researchers, students, administrations and private groups in analysing food markets. Research focuses on local production and local market demand, food quality, food behaviour and risk perception amongst consumers.	Rice, Fruit, Vegetables, Meat and Fish	Hanoi and HCMC	Primarily research activities
South and East Asian Rural Urban Synergy (SEARUSYN) The Agricultural Economics Research Institute (LEI) Source: (SEARUSYN 2006)	Main objective was to contribute to the synergy between urban growth and agricultural development in the urban fringe in order to improve the welfare of rural and urban communities. One component was to determine the key constraints and opportunities for environmentally sustainable agriculture.	Fruit and Vegetables	Hanoi in Vietnam and Nanjing in China	Primarily research activities from 2003-2006

* Information on these programmes and projects was also gathered through interviews.

The third group of organic farmers are those that are certified as organic producers, or that are in the process of becoming certified. An overview of the certified organic agriculture initiatives in Vietnam can be found in Table 5.13. These organic initiatives are being developed through a variety of different means and involve a variety of different commodity groups. A few of these projects are being promoted by development organizations, while private trading companies are the driving force behind the rest. The main organic products in Vietnam are spices such as cinnamon, star anise and pepper, fruit, cashews, tea and some vegetables. Organic aquaculture, particularly shrimp farming, is also an important part of the organic industry in Vietnam (Willer and Yussefi 2006).

Vietnam is among the top producers of coffee and rice in the world, but it appears that very little of the production of either of these crops is organically certified. About 20,000 tons of organic coffee is produced worldwide per year, representing about 1.5 percent of the total coffee production (Willer and Yussefi 2006). "In Asia, according to the last organic coffee conference held in Uganda in 2004, East Timor is the largest producer, with 9,000 metric tons of organic green coffee, although it only sells 2000 tons as organic. Unfortunately, data on organic certified land area was not available for this country or for other important countries like Vietnam or Papua New Guinea" (Willer and Yussefi 2006: 57). There is also very little information available on organic rice farming in Vietnam, although reference is made to it in a number of websites and news articles (Finkel 2006; Vien Phu 2003; Viet Nam News 2003).

Certified organic farming is a fairly recent phenomenon in Vietnam. Around 10 years ago a small number of foreign companies started working with local companies and farmers to grow organic crops for export (den Braber and Hoang 2007). Today, around 90 percent of the organic production is destined for export, mainly to Europe and the USA. The local market for organic vegetables is very underdeveloped, with only small amounts of organic vegetables and tea being sold mostly to foreigners or wealthy Vietnamese in Hanoi and Ho Chi Minh City and various five star resorts and restaurants around the country.

The 2006 IFOAM report on trends in world organic agriculture lists Vietnam as having 1,022 farms with an area of 6,475 ha of land certified or in transition (Willer and Yussefi 2006).

These farms represent only 0.07 percent of the total agricultural area of Vietnam. It must be noted that these figures are based on a survey from 2001. These figures are repeated in the 2007 IFOAM report, suggesting that little has changed in Vietnam in terms of organic agriculture projects (Willer and Yussefi 2007). However, according to Koen den Braber, an advisor with the ADDA organic agriculture project and formerly involved with Hanoi Organics and Ecolink Tea Company, there are probably an additional 6,000-7,000 ha of land under organic management that have not been included in the IFOAM report (den Braber and Hoang 2007). The 2007 IFOAM report does list one additional project involving wild harvesting in Vietnam, covering a area of 44 ha (Willer and Yussefi 2007). The commodity being harvested is not mentioned in the report. Interest in organic agriculture is growing, with a number of potential projects on organic cacao and organic bitter tea being discussed by development organizations and companies (den Braber and Hoang 2007).

Table 5.13: Certified Organic Agriculture Initiatives in Vietnam

Organization	Description	Commodity Groups	Location of Projects	Number of Farmers
Hanoi Organics Private Company Source: (Economy and Marketing Department 2003; Karkoviata 2001; Moustier et al. 2006)*	Hanoi Organics started selling boxed vegetables to expatriates in Hanoi in September 1999. Expanded to also sell to restaurants in 2001 and through their own retail shop. Certified by Organic Agricultural Certification Thailand, 2002 and 2003. Certification stopped due to financial difficulties in 2004. Company now only sells Biogrow biofertilizer.	Vegetables, Biofertilizer	Tu Liem District of Hanoi and Chuong My District of Ha Tay Province	Working with 6 farmers in Tu Liem and 32 farmers in Chuong My
Sapro Private Company Source: (Firmino 2007)*	Started selling boxed vegetables in 2004 (Owner is formerly of Hanoi Organics). At the peak they had about 100 customers in total (20-30 customers/week). Stopped selling vegetables about one year ago and now concentrate on landscape gardening services and sales of Biogrow biofertilizer.	Vegetables, Biofertilizer	Hanoi	Working with 10 farmers on 0.36 ha

Organik Dalat Private Company Source: (Nguyen Ba Hung 2007)*	Started with research on organic production and sale of vegetable seedlings in 1997. Began production of vegetables on rented land in 2003, lettuce exported to Taipei. Purchased land outside of Dalat and began full production in October 2006. Farm has modern packaging facilities. Sale of vegetables to local and export markets. EurepGAP certification in August 2005. In process of obtaining organic certification from Naturland of Germany.	Vegetables, Fruit	Dalat, Lam Dong Province	Main farm of 15 ha with 6 ha in production. Working to get EurepGAP certification for 7 other farmers in Dalat so their vegetables can be purchased and processed at Organik.
Organic Tea Farming Project Partnership: International Global Change Institute (IGCI), MARD and TUAF Source: (IGCI 2006; IGCI 2007)*	Project funded by the Asia Development Assistance Facility of NZAID from 2002-2006. Objectives: (1) work with MARD to develop national organic standards; and (2) work with the Mountainous Resources and Environment Centre (MREC) at Thai Nguyen University of Agriculture and Forestry (TUAF) to develop organic production systems.	Tea	Thai Nguyen Province	Initial focus on two communes expanded to include other partners (see Ecolink below). Total of 225 farmers trained in organic methods and 69 aiming for certification.
Ecolink Private Company Source: (Ecolink 2008; IGCI 2007; Luu Minh Ngoc 2006)*	Founded in 2003 with aim of promoting sustainable livelihoods for small-scale tea producers through improved market access. Developing products for local and export markets. Certified by ACET of Italy and ACT of Thailand.	Tea	Thai Nguyen City, Thai Nguyen Province and Bac Ha District, Lao Cai Province	18 farmers in Thai Nguyen, 286 farmers in Lao Cai.
Tradin Organic Private Company (Netherlands) Source: (Tradin Organic 2008)	Importer of organic foods to Europe, North America and Japan. Started joint venture with local company Vinh Phuc Co. in 2000 to source organic products. Certified according to EU, USDA National Organic Program (NOP) and Japanese Agricultural Standards (JAS).	Cashew, Pineapple, Mango and Passion fruit	Southern Vietnam	Unknown number of farmers
Moonflower Private Company	Started in 2004 to commercialise essential oils	Spices and Essential	Yen Bai, Tuyen	Unknown

Source: (Moonflower 2007)	produced in Vietnam. Projects include some reforestation and all production is done according to organic standards, without chemical fertilizers or pesticides. Local supplier for sister company in Belgium. Certified to NOP and EC standards for all stages of production and processing.	Oils	Quang, Lang Son, Nghe An, Long An, Bin Phuoc, Lam Dong, and Dac Nong Provinces	
Natural-Pro Private company Source: (Natural-Pro 2008)	A Vietnamese private company selling essential oils with certification from NOP and Naturland.	Essential Oils	Unknown	Unknown
Organic Shrimp Aquaculture Partnership: Ministry of Fisheries, SIPPO and private growers. Source: (Benguerel 2007; Camillo 2004)*	Organic aquaculture combined with the conservation of mangroves. Project started in 1999, with certification provided by Naturland. The main market is Europe.	Black Tiger Shrimp	Ca Mau Province, Mekong Delta	Around 850-1,200 farmers. Area of around 6,000 ha
Organic Fish Aquaculture Partnership: An Giang Fisheries Association, Binca Seafood Company and GTZ Source: (Finkel 2006; Viet Nam News 2006c)	Pilot project started in 2004, with 70 tons in 2005 and 400 tons in 2006 being exported to Europe. Certification by Naturland of Germany. Farmers are earning approximately 15 percent more than conventional producers. Has led to a spin-off project to produce organic rice as a component of fish feed.	Pangasius Fish (Catfish)	An Giang Province, Mekong Delta	Production on 3 farms
Organic Agriculture Project Partnership: Agricultural Development Denmark Asia (ADDA) and the Vietnamese Farmers Union (VNFU) Source: (ADDA 2007; Viet Nam News 2006a; Viet Nam News 2007b)*	Project running from 2004-2010 to train farmers on organic production techniques and to develop local markets for organic crops. Certification will be sort under the Vietnamese national organic standards once they are operational. The project will also explore export market opportunities, particularly to other countries in the region. Some interest exists from Europe for the Litchis so these may be exported with EU organic certification.	Vegetables, Oranges, Litchis, Rice and Freshwater Fish (Carp and Tilapia)	Vegetables in Bac Ninh, Vinh Phuc and Lao Cai Provinces. Oranges in Tuyen Quang, Litchis in Bac Giang and Fish in Hai Phong Provinces	A total of 117 farmers are participating in the project, approximately 20 farmers in each province.

Fresh Foods Private Company Source: interview*	New company opening its first shop in Hanoi in January 2008. They plan to carry a range of organic products.	Vegetables, Fruit	Hanoi	Sourcing from the ADDA organic project (see above)
Organic Garden at the Vietnam Friendship Village Non-Profit Organization Source: (Berlow 2008; Waltz 2006)	Organic gardening project located on the grounds of a treatment centre for children and war veterans affected by Agent Orange. Running since 2004, products feed the residents with excess products sold in local markets.	Fruit, Vegetables, Livestock and Fish	Ha Tay Province, Northern Vietnam	Around 200 residents and staff members. Garden size is approximately 0.5 ha
Vien Phu Organic Fragrant Rice Private Company Source: (Vien Phu 2003)	Established in 1999. Focussing on the production, processing and marketing of organic rice. Selling domestically and looking for international buyers. Name of organic certifier is not listed on the website.	Rice	Thuan An District, Binh Duong Province	Unknown
Organic Rice Source: (Viet Nam News 2003)	News article mentioning organic or 'clean' rice being grown in the Mekong Delta. Unclear whether this is certified organic.	Rice	Tien Giang Province, Mekong Delta	105 farmers on 115 ha
Organic Coffee Source: (Willer and Yussefi 2006)	Reference is made to Vietnam as a producer of organic coffee in the IFOAM report.	Coffee	Central Highlands	Unknown
Organic Cacao Helvetas Vietnam Source: interview*	Potential project to develop organic cacao production for export to Europe.	Cacao	Southern Vietnam	Still in the planning stage
Organic Bitter Tea Helvetas Vietnam Source: (den Braber and Hoang 2007)	Study conducted for the Cao Bang Bitter Tea Company to assess potential for converting to some organic production. Concluded that there are few technical barriers and recommended conversion to organic in one commune.	Bitter Tea (*Ilex kaushue*)	Cao Bang Province	Feasibility study conducted

* Information on these programmes and projects was also gathered through interviews.

5.6 Organic Agriculture in Vietnam: Three Case Studies

In this section three short case studies are presented to highlight some of the ecological agriculture and organic initiatives presented in Table 5.12 and Table 5.13 above. The cases

presented are: (1) safe vegetable farmers in Cu Chi District, Ho Chi Minh City who have exceeded the requirements for safe vegetable production and have eliminated the use of agrochemicals in their farming systems altogether; (2) the organic agriculture program by Agricultural Development Denmark Asia (ADDA); and (3) the vegetable farm run by Organik Dalat. These cases are chosen because they represent a range of ecological and organic agriculture initiatives in Vietnam, including Vietnamese Government supported IPM projects, an organic farming project supported by an NGO, and a private company producing vegetables for both the domestic and export markets.

5.6.1 Moving Beyond Safe Vegetable Production

While conducting interviews with safe vegetable farmers in Cu Chi District, it became clear that a small number of farmers had in fact exceeded the requirements for safe vegetable production and eliminated the use of agrochemicals in their production systems. One such example was a farming couple from Tan Phu Trung Commune who had eliminated the use of chemical fertilizers on their crops after receiving three months of training on safe vegetable production and IPM. This husband and wife team in their early fifties are professional farmers, with 90 percent of the family income from their farming operation growing leaf vegetables on 0.1 ha and raising cattle on another 0.45 ha. When asked to define safe vegetables, the husband responded that they are grown using clean water from a deep well, with only organic fertilizers for soil improvement and spraying only biopesticides for plant protection. He also mentioned that the correct isolation time between and spraying and harvesting of the crop must be observed. While these farmers were not aware of the concept of certified organic agriculture and would not identify themselves as being organic farmers, they nevertheless represent an important resource for moving the Vietnamese agriculture sector towards greater sustainability.

While only a very small number of safe vegetable farmers who had completely eliminated the use of agrochemicals were encountered during the course of this study, most of the safe vegetable farmers had reduced the application of chemicals fertilizers substantially, replacing these with composted livestock manure. There was also a strong trend towards using only

biopesticides for crop protection. The use of highly dangerous pesticides in the organophosphate and carbamate groups has largely been stopped. While safe vegetable production is expressly not the same as organic vegetable production, it does signify an important trend in Vietnamese agriculture where food quality and food safety are considered important indicators, rather than a singular focus on the quantity of food produced. As a densely populated country with a large proportion of the population reliant on agriculture for their food security, ensuring an adequate food supply will always be an important issue in Vietnam. However, the emerging concern for food quality shows an important maturing of the Vietnamese agricultural sector after the widespread food shortages of the early 1980s.

5.6.2 Organic Agriculture Program by Agricultural Development Denmark Asia

In late 2004, Agricultural Development Denmark Asia (ADDA) and the Vietnamese National Farmers Union (VNFU) commenced a project to train farmers in organic agriculture and to develop the local market for organic crops. The pilot phase of the project involves 117 farmers in six provinces across Northern Vietnam (approximately 20 farmers in each province). The project involves a number of different commodities, with vegetables in Bac Ninh, Vinh Phuc and Lao Cai Provinces, oranges in Tuyen Quang Province, litchis in Bac Giang Province and fish in Hai Phong Province. A farmer field school approach is used for training farmers. Training is run for half a day each week in a study field. Some of the specific challenges encountered are the small size of individual fields that are often scattered in various locations. This can make it difficult to protect the integrity of the organic fields. As much as possible blocks of fields are selected with all farmers in the area growing organically. There have also been some challenges finding enough animal manure for making compost, so other nutrient sources such as green manures are used.

Initially the plan was to obtain certification under the Vietnamese organic standards that have been in development since 2004. The Vietnamese Ministry of Agriculture and Rural Development have developed some organic standards for Vietnam but their status remains unclear. Currently, the standards serve more as a guide to farmers and processors rather than a concrete tool for certification (IGCI 2007). The regulations do allow for private companies to

issue organic certification for products destined for the domestic market, but since the domestic market is so small there are few companies willing to invest in organic certification. Rather than working directly to implement the Vietnamese organic standards, the focus of the project has shifted towards developing the capacity of farmers to produce organic crops in the hope that this will spur interest in organic food from consumers. The project will also explore export market opportunities, particularly to other countries in the region. Some interest exists from Europe for organic litchis so these may be exported with EU organic certification.

For most smallholder farmers in Asia, the cost of an external inspection to obtain organic certification would be prohibitive and so a process of group certification has been developed to help reduce the cost to individual farmers. These group certification systems involve an internal control system (ICS) for the group and a central body responsible for ensuring compliance with the organic standards and marketing the produce (van Elzakker and Rieks 2003). For the moment, the ADDA project is focussing on developing an ICS for the farmers in each project area. This will facilitate the conversion to certified organic agriculture at a future date, as explained by den Braber and Hoang (2007: 19): "With an ICS in place, the external inspection process is then focussed on evaluating the operation of the ICS and the inspection of a sample of farms, not each individual farm". The processing facilities are also inspected as part of the certification process. Group certification has also been used with farmers growing organic tea for the Ecolink Company.

5.6.3 The Vegetable Farm of Organik Dalat

Dr Nguyen Ba Hung was born in the town of Dalat in the central highlands of Vietnam. Dr Hung has been involved in the agriculture sector since 1977 and is the founder of an organic vegetable production company called Organik Dalat. From 1989-1995 he lived in France while studying for his PhD in vegetable genetics. On completion of his studies he moved back to Vietnam to manage a number of agriculture projects before founding his own company in 1997. Initially the company bred vegetable seedlings for sale to other producers around Dalat. Then in 2003 the company commenced production of vegetables on rented land and exported lettuce to Taipei. In August 2005, Organik Dalat became the first farm in Vietnam to obtain

EurepGAP[4] certification, allowing them to export vegetables to Europe. The company is also in the process of obtaining organic certification from Naturland of Germany. From Dalat the vegetables are sent across Vietnam to five star hotels, restaurants, cruise ships and catering companies. Vegetables are also exported to Berlin in Germany. The company previously ran a vegetable box scheme for expatriate families in Ho Chi Minh City, but this was suspended temporarily while the company moved to a new farm.

In 2005 Dr Hung purchased 15 ha of land outside of Dalat and began full production of vegetables in October 2006. There are currently four ha of land under cultivation, including two ha under sealed net houses designed to keep insects out. There is also a double door system on the shadehouses to prevent entry by insects. Pheromone baits along with sticky yellow and blue cards are used to attract and trap any insects that make it inside the net houses. There are a total of 35 workers employed in the company. Around 15 people work in the production of vegetables and another 17 work in the processing factory, with three managers in charge of production, processing and marketing. The company has modern packaging facilities that allow for vacuum cooling and packing of vegetables.

When setting up an organic farm in Vietnam, Dr Hung notes the importance of knowing the history of the land, particularly in relation to herbicides used during the war. His farm was created on an old coffee plantation, surrounded by pine forest and soil tests were conducted to make sure that no pesticide residues were present. The isolated nature of the farm helps to eliminate the risk of pesticide contamination from neighbouring farmers. Unfortunately this model is of limited relevance to other farmers living in the heavily populated areas of Vietnam with small and dispersed parcels of land. Dr Hung stressed the importance of creating groups of farmers from one area who are willing to work together on organic agriculture. Organik Dalat is working to obtain EurepGAP certification for seven other farmers around Dalat City. The company will then be able to package and sell their vegetables. Dr Hung stresses the importance of certification for ensuring the integrity of safe and organic foods in Vietnam.

[4] Now known as GLOBALGAP

5.7 Organic Standards in Vietnam

The Vietnamese Government is continually looking for ways to improve growth rates in the agriculture sector. The export of high quality agricultural products is one avenue being explored. There has been a growing interest from governments across Asia in organic farming over the last decade due to the market opportunities offered by exporting to Europe and North America. This has led to a blossoming of organic standards and certification systems.

> Almost all Asian authorities have taken an interest in organic certification and accreditation as their priority, even though the major constraints in organic farming in Asia are at the level of farm production. The booming of public organic standards and inspection systems makes little contribution to Asian organic growth and, on the contrary, further complicates international harmonization of organic guarantee systems (Panyakul 2003: 23).

The 2007 IFOAM report on trends in world organic agriculture lists Vietnam as being in the process of drafting organic regulations (Willer and Yussefi 2007: 58). In fact this process has been ongoing for a number of years and started in 2002 with a project supported by NZAID that aimed to develop national organic production guidelines (IGCI 2007). An initial draft was produced in 2004 by the New Zealand team. This draft was further developed by a four person advisory committee and presented for discussion at various workshops in December 2005, May 2006 and December 2006. At the one day workshop held by MARD and the VNFU in December 2006, it was agreed that reference to the certification system should be kept separate from the production and processing standards (IGCI 2007). In December 2007 the Ministry of Agriculture and Rural Development issued "National Standards for Organic Production and Product Processing" (MARD 2007a). These standards, which are based on the IFOAM Basic Standards, are intended as a reference for producers, processors and others interested in organic agriculture in Vietnam. As yet the standards do not offer a system for certification of organic products. The Ministry of Agriculture and Rural Development is planning on developing an organic certification system for the local market but a timeframe for this is still to be determined (den Braber and Hoang 2007).

5.8 Future Directions for Organic Agriculture in Vietnam

There has been very little development of the domestic market for organic products in Vietnam despite the fact that there are strong concerns around food safety and food quality, particularly among urban consumers. In fact, the two companies that tried to introduce organic vegetables to consumers in Hanoi have ceased selling vegetables and now concentrate on the sale of biofertilizer, leaving Organik Dalat as the sole trader of organic vegetables in Vietnam. However, a new shop opening in Hanoi in January 2008 is planning to sell organic produce sourced from farmers involved in the organic agriculture project run by ADDA. Most of the focus in the domestic market has been placed on developing safe vegetables and training farmers in IPM techniques. While safe vegetables are not equivalent to organic vegetables, investigating the emergence of safe vegetable production is useful in gaining at least some understanding of the challenges and opportunities that farmers might encounter in undertaking the more involved transition to certified organic production.

Preliminary evidence from interviews with safe vegetable farmers indicates that a small portion of them have actually surpassed the requirements for safe vegetable production. With some further training and fine tuning of their production systems they would be eligible for organic certification. In the lowlands of Vietnam, where farm sizes are often small and the fields controlled by an individual farmer may be spread around in several locations, it will be a significant challenge to prevent cross-contamination from irrigation water and spray drift from neighbouring fields. Setting up groups of farmers to work together on organic production is one possible avenue for overcoming this challenge. These group certification systems can also help to reduce the costs of certification for individual farmers. There are a growing number of organizations and farmers in Vietnam with experience in implementing group certification and internal control systems. Farming organically is a knowledge intensive activity and requires that farmers engage in a process of learning (Johannsen et al. 2005). However, the process of gaining this knowledge through participatory learning methods can lead to the empowerment of smallholder farmers.

Future development in the organic sector will likely continue to be driven by production for export, at least in the short to medium term. Despite the potential of exports for driving

growth in the agriculture sector, attention should also be given to developing the domestic market for organic foods. Given the confusion that currently exists around "safe" and "organic" foods, public education campaigns are needed. Another important step will be to finalize the national standards on organic agriculture and put in place an effective system of certification. This task has been put on hold until sufficient demand is created in the domestic market to justify the expense. In the meantime, organic agriculture initiatives run by development organizations and private entrepreneurs will continue to play an important role in building the capacity for organic production among farmers and creating demand in the domestic market.

5.9 Summary

Safe vegetable production and organic agriculture have emerged in Vietnam over the past decade, particularly in response to health concerns around inappropriate pesticide use. Safe vegetable production is substantially different from organic agriculture, but it could be seen as the first step towards organic agriculture. Preliminary evidence from interviews with safe vegetable farmers indicates that a small portion of them have actually surpassed the requirements for safe vegetable production and with few if any changes to their production practices they would be eligible for organic certification.

The next chapter presents the results of the sustainability assessment of safe vegetable farmers in Cu Chi District of Ho Chi Minh City. As it is early days for organic agriculture in Vietnam, safe vegetable production is used as a case study for testing the sustainability assessment framework. It is assumed that using safe vegetable production as a surrogate for organic production will be useful in gaining at least some understanding of the challenges that farmers might face in undertaking the more involved transition to certified organic production.

Chapter 6: Sustainability Assessment of Safe Vegetable Production

6.1 Introduction

This chapter presents the results of the sustainability assessment of safe vegetable production in Tan Phu Trung and Nhuan Duc Communes in Cu Chi District, Ho Chi Minh City. The chapter is organized according to the eight sustainability criteria outlined in Table 2.2. The first section investigates the role that safe vegetable production is playing in maintaining the integrity of the social-ecological system. The second section looks at the maintenance and efficient use of natural resources in safe vegetable production. The third section explores the role that safe vegetable production is playing in promoting livelihood sufficiency and opportunity for farmers. The contributions of safe vegetable production towards promoting greater equity within and between the generations are then discussed. Following this, the contributions made in promoting civility and democratic governance in social-ecological systems are explored, along with the contributions made towards preparing for and adapting to change. The final section of the chapter deals with the integration and application of all the other principles of sustainability in order to achieve multiple gains.

6.2 Social-Ecological System Integrity

Farmers in Tan Phu Trung and Nhuan Duc Communes are responding to the opportunity presented by the consumer demand for safe vegetables and diversifying their farms from rice, peanut and livestock production to include or to be entirely replaced by safe vegetable production. This first section of the sustainability assessment looks at the influences of safe vegetable production on maintaining the integrity of the social-ecological system in the study sites. Key indicators of social-ecological system integrity include the health of the human actors in the system, soil health, water quality and the conservation of biodiversity.

6.2.1 Human Health

This study did not set out to measure the health and nutritional status of safe vegetable farmers and how this has changed since they started growing safe vegetables. Instead the relationship between safe vegetable production and human health was explored through the interview process. When asked why they grow safe vegetables, farmers in the study sites responded with a variety of reasons, mostly relating to the protection of human health and to the economic benefits that could be derived from growing safe vegetables (See Table 6.1). The following responses illustrate the concern that safe vegetable farmers hold for protecting human health.

> I produce safe vegetables because I want to protect the health of the community. If I use too much pesticide on my vegetables it is not good for the health of the people who eat my products (Female farmer, Tan Phu Trung).
>
> I started growing safe vegetables to protect my health and to improve my income. If my vegetables go to the local market it is difficult to sell them because my vegetables don't look as good as the normal vegetables which have been grown with pesticides and consumers are turned away by the small blemishes on the vegetables. However, I am able to get a better price for my vegetables when I sell them to the safe vegetable production group (Male Farmer, Tan Phu Trung).
>
> I started to grow safe vegetables after I attended the training course held by the plant protection sub-department and learnt the correct techniques for applying pesticides and fertilizers to my vegetables. These techniques are better for my health and for the health of the community, and it also saves me money by reducing my input costs (Male Farmer, Nhuan Duc Commune).

While these responses may seem to be a little scripted, reading like slogans that farmers learned during a government-run training session on safe vegetable production, there was a widespread concern among farmers over the importance of protecting human health. In both communes around half of all the farmers mentioned that protecting the health of farmers and consumers was an important reason for growing safe vegetables. Some of these farmers also mentioned economic or other reasons as being important in their decision to grow safe vegetables. The economic reasons are discussed later in the chapter in the section dealing with livelihood sufficiency and opportunity. A small number of farmers in each commune mentioned that the reason they grow safe vegetables was on the recommendation of the government agricultural staff. Only one farmer mentioned environmental protection as a

reason to grow safe vegetables. Another farmer mentioned pride in being able to sell his vegetables to a supermarket as a motivating factor for growing safe vegetables.

Table 6.1: Farmers' Reasons for Growing Safe Vegetables

Reasons for Growing Safe Vegetables	Farmers TPT (%)	Farmers ND (%)
Health Reasons		
To protect the health of farmers and consumers	53	47
Economic Reasons		
Guaranteed market for their vegetables	47	41
Higher price from safe vegetables	16	35
Higher yields from safe vegetables	5	6
Lower input costs growing safe vegetables	10	18
Get financial support to grow safe vegetables	0	12
Other Reasons		
On the recommendation of the Government	16	6
Pride in selling vegetables to supermarkets	0	6
To protect the environment	0	6

6.2.2 Soil Health

Soil health is dependent on complex interactions between the physical, chemical and biological components of soils and human management decisions. At a bare minimum, there are a couple of principles for maintaining soil health that should be observed. Soil erosion should be minimized to conserve soil, and soil fertility should be maintained to allow for productive and healthy plant growth. Numerous studies could be conducted to explore the effects of safe vegetable production on soil health. The intention in this section is to offer a few observations on the relationship between safe vegetable production and soil health.

As has already been mentioned, the soils in Cu Chi are mostly grey sandy loams of low fertility. These types of soils easily leach nutrients and farmers need to add substantial inputs of organic matter to help maintain fertility. Safe vegetable farmers appear to be quite aware of this fact and, as will be discussed in greater detail later in the chapter, most of them apply organic fertilizer and compost to their soils. When asked about good agricultural practices, over one quarter of farmers in both communes explicitly mentioned the need to maintain soil

health and fertility through regular applications of organic matter. In regard to soil erosion, many of the safe vegetable farmers growing leaf vegetables are using shadehouses to break up rainfall impact in the wet season and reduce the erosion on newly worked seedbeds. A mulch of rice husks is also used for this purpose. Likewise, most of the farmers growing fruit vegetables have started using black plastic to cover the raised beds on which they plant vegetables. This black plastic serves multiple purposes by preventing weed growth, protecting the soil surface from erosion and retaining moisture in the subsurface. Unfortunately, this plastic can only be used for around three to four crops before it becomes degraded by sunlight and general wear. At this stage the plastic is discarded and becomes a source of unsightly waste around the farm.

6.2.3 Water Quality

The issue of water quality is also a subject with which this study must deal in only the most cursory manner. Cu Chi district is bordered by the Saigon River and is relatively well provisioned with irrigation canals. There is also a separate reservoir from which water is drawn for irrigation in the dry season. There is currently mixed management of the irrigation systems in Cu Chi District[5]. A state-run company manages the reservoir and the network of concrete lined primary and secondary canals. Farmers pay a small annual fee of around US$5 per hectare to use the water. There are plans to eliminate this fee and decentralize the management of the irrigation systems in the near future. Farmers are already in charge of managing the unlined canals that draw their water directly from the Saigon River.

With increasing urbanization and industrialization on the margins of many cities in Vietnam, there are concerns that the water in irrigation canals has become polluted to such an extent that it poses a danger to human health. While data on water quality in Cu Chi District are scarce, there are examples in the literature from other parts of Vietnam, which indicate that pollution of the water sources has occurred (Pham et al. 1995; Phung and Mol 2004). As a consequence, there is a requirement that safe vegetable farmers use only groundwater for

[5] Personal communication with fellow masters student from the University of Waterloo, Darren Perrett, who is investigating the management of the irrigation systems in Cu Chi District for his thesis.

irrigating their vegetables (van Wijk et al. 2005). While safe vegetable farmers may not be directly responsible for the poor water quality, the requirement to irrigate with groundwater is indicative of problems within the broader social-ecological system. However, if safe vegetable farmers are able to reduce their use of agrochemicals this could only be beneficial in helping to protect water quality.

6.2.4 Biodiversity Conservation

Along with soil and water, the diversity of plant and animal species and varieties used in agricultural production is vitally important for sustainable agriculture. This diversity of plant and animal species and varieties used in agriculture is referred to as agrobiodiversity. At the most utilitarian level, the conservation of agrobiodiversity is important for ensuring a future supply of breeding and planting material adapted to certain biophysical conditions. These could include adaptations to new climatic conditions or resistance to certain diseases or insect pests. Farmers can play an active role in conserving agrobiodiversity by planting a diverse range of crops on their farms and by saving their own seeds. These issues were explored with safe vegetable farmers.

Farmers in both communes generally grow a diversity of vegetable crops, rather than specializing in one species. In Tan Phu Trung farmers on average grew 5.3 different types of vegetables, while in Nhuan Duc farmers grew an average of 4.5 different types of vegetables on their farms (See Table 5.9). Farmers were asked whether they are growing a more diverse range of crops now compared to five years ago (See Table 6.2). In both communes, 19 out of 20 farmers answered this question. One third of farmers in Tan Phu Trung and two thirds of farmers in Nhuan Duc reported that they are growing a greater diversity of crops compared to five years ago. The rest of the farmers in both communes, bar a small number of farmers in Tan Phu Trung who have lower crop diversity, are growing the diversity of crops as they did previously. There are a small number of farmers in Tan Phu Trung who are growing a less diverse range of crops. This is because they have specialized in the production of leaf vegetables and have stopped the production of fruit vegetables in recent years.

Table 6.2: Crop Diversity in the Study Sites

Diversity of Crops	Farmers TPT (%)	Farmers ND (%)
Growing a more diverse range of crops	32	68
Growing the same crops as before	58	32
Growing a less diverse range of crops	10	0

The diversity of crops grown on the farm is only part of the story in conserving agrobiodiversity. The other part of the story concerns the saving of seeds. In Tan Phu Trung, 58 percent of the safe vegetable farmers purchased all of their vegetable seeds from the cooperative or from a local trader, while in Nhuan Duc, 100 percent of the safe vegetable farmers purchased all of their seeds. Thirty seven percent of farmers in Tan Phu Trung reported that they purchased some seeds and also saved some seeds from year to year. The seeds that they save are usually for some of the traditional herb and leaf vegetable crops such as amaranth and jute mallow. Farmers mentioned that very few companies were actually stocking seeds for these plants and thus they had to save these seeds each year. Only one farmer in Tan Phu Trung reported saving all of his own seeds each year. This farmer has a college diploma in agriculture. He initially purchased herb seeds from a company in another province, but now he saves them himself each year.

The following experience of one farmer from Nhuan Duc Commune was fairly typical of the responses given by most farmers when discussing seed saving. This farmer mentioned that he used to grow traditional vegetable varieties and save his own seed. About ten years ago he switched to growing hybrid vegetable varieties in the hope of obtaining greater yields. This meant that he now had to buy the seeds each year from the company. He mentioned that he used to have fewer problems with insect pests and diseases when he was growing traditional varieties. When he first switched to hybrid seed he had healthy plants and a big yield increase, but now the yields have decreased about 30 percent compared to before. He attributed this yield reduction to a decrease in the quality of hybrid vegetable seed. He said the reason for this was that a lot of farmers now buy their seed and the quality of the seed has gone down because the companies now have to produce a lot of seed each year.

6.2.5 Summary of Social-Ecological System Integrity

Improved economic outcomes and the protection of human health emerged as the main reasons why farmers are interested in growing safe vegetables. Only a small proportion of the farmers directly mentioned the protection of ecosystem health as being an important consideration in their decision to produce safe vegetables. Nevertheless, farmers mentioned the importance of maintaining soil health in order to ensure future productivity. No definitive conclusions on the issue of water quality and safe vegetable production could be reached. If safe vegetable farmers are able to reduce their use of agrochemicals then this can only help in protecting water quality. While many farmers have maintained or increased the range of crops that they grow in their farms, very few farmers are actively saving seed as they have changed to growing hybrid vegetable varieties for which they must purchase seed.

6.3 Resource Maintenance and Efficiency

This section of the sustainability assessment will look at whether or not safe vegetable production is contributing to the maintenance of the resource base and the efficient use of resources. The first sub-section will discuss the structure and functions of the agroecosystems and whether or not they run primarily on inputs of sunlight, rainfall and internally cycled nutrients. While this sub-section could also fit under the previous section on social-ecological system integrity, the decision was made to discuss agroecosystem structure and function in this section as the integration of system components relates to the maintenance and efficient use of resources. The extent to which system components are integrated to make efficient use of inputs is also discussed. The following sections discuss the use of fertilizers, pesticides and irrigation water in safe vegetable production.

6.3.1 Agroecosystem Structure and Function

The structure of the agroecosystems in the study sites is fairly typical of small mixed farms in much of Southeast Asia, consisting of a mosaic of rice fields, homegardens, vegetable gardens, fishponds and livestock raising areas (Devendra and Thomas 2002). There are numerous trees growing in the landscape, often growing on field boundaries and acting as

windbreaks. Some homegardens contain elements of multi-strata forest garden structures, but as yet the agroecosystems of Cu Chi have not been extensively redesigned to mimic the structure and function of the forest ecosystems that once dominated this region. The vegetable production systems consist of raised beds that are extensively tilled prior to the planting of each crop. There has been no adoption of zero or reduced tillage to minimize soil disturbance. Furthermore, farmers have started to grow new crop species, such as mustard greens (*Brassica juncea*) and Chinese cabbage (*Brassica rapa*), which are poorly adapted to the local tropical growing conditions, particularly in the wet season. This has necessitated investments in shadehouse technology to create more favourable growing conditions.

The vegetable growing systems do not run primarily on sunlight, rainwater and internally cycled nutrients. Inputs of agrochemicals are still used on the farms, often in amounts far higher than those used for rice or peanut production. However, farmers have adopted some agroecological principles and many are replacing at least some of their chemical fertilizers with composted animal manure, wood ash and rice husks produced on farm or purchased locally from other farmers. In mixed farming, the wastes from one component of the system can become the inputs for another component of system, thereby increasing the cycling of energy and nutrients within the system. The cycling of crop wastes for livestock feed and manure for making compost is one of the keystones of the sustainability of traditional mixed farming systems.

About half of the safe vegetable farmers in Tan Phu Trung and 95 percent of the farmers in Nhuan Duc are still practicing mixed farming, growing crops and raising animals on the same farms. In Tan Phu Trung, half of the safe vegetable farmers have moved away from mixed farming and now specialize in vegetable production. These farmers no longer produce livestock or it is only a very a minor portion of their farm system, involving the raising of poultry for home consumption. For the majority of farmers in Tan Phu Trung who did not raise livestock, the reason cited was the lack of space on their farms and the potential damage that livestock could cause to vegetable crops. Farmers with insufficient access to livestock manure from their own animals had to either buy manure from other farmers in the district who specialize in raising cattle or they need to switch to alternative sources of nutrients,

including commercially produced biofertilizer, wood ash and chemical fertilizer. Fertilizer use is discussed in greater detail in the next sub-section.

6.3.2 Fertilizer Use

Farmers were asked about their fertilizer use when growing safe vegetables and how this has changed over the past five years. Farmers use two main types of fertilizers in producing safe vegetables. These are organic fertilizers and inorganic fertilizers. The organic fertilizers that farmers use include composted livestock manure with rice straw and rice husks, wood ash, and commercially produced biofertilizers made from composted pig manure compressed into pellets and sold in 50kg bags. The main types of inorganic or chemical fertilizers used by farmers include urea, diammonium phosphate (DAP), potassium chloride (KCl), triple superphosphate and compound fertilizers containing various quantities of nitrogen, phosphorous and potassium (NPK). Some farmers also apply lime as a soil amendment to regulate the pH of the soil.

Table 6.3: Recommended Fertilizer Rates for Safe Vegetables

Leaf Vegetables
Composted Manure (15-20 tons/ha/crop)
Superphosphate (1,000 kg/ha/crop)
Urea (1g/L of irrigation water, applied every 7 days)
Foliar fertilizers with micro-nutrients (applied every 7 days)
Fruiting Vegetables*
Composted Manure (30 tons/ha/crop)
Superphosphate (300-500 kg/ha/crop)
NPK (400 kg/ha/crop)
Urea (120 kg/ha/crop)
Potassium Chloride (150 kg/ha/crop)

*For cucumber, pumpkin and gourds. Source: (Agricultural Extension Centre 2006)

The basic fertilizer rates for safe vegetables, taken from the handbook on safe vegetable production issued by the Agricultural Extension Centre of Ho Chi Minh City in 2006, can be found in Table 6.3. These recommended fertilizer rates for fruiting vegetables are three or four times higher than those recommended by Leers (2006) for farmers in the Red River Delta and two to three times higher than the general recommendations for bitter gourds made by the

World Vegetable Centre (Palada and Chang 2003). The head technical officer from the Agricultural Extension Centre said that they determine the recommended fertilizer rates based on a review of the literature and the results of crop trials conducted in the areas where they are promoting safe vegetables. The optimal rates will obviously vary depending on the type of crop and the soil conditions, but they serve as a guide for interpreting the average fertilizer applications as reported by the farmers themselves.

In Tan Phu Trung, the farmers growing leaf vegetables were on average applying the equivalent of 15.4 tons/ha of composted manure for each leaf crop that they grew, right in line with the recommendations from the Agricultural Extension Centre. When reporting their use of chemical fertilizers, farmers did not always differentiate between the various types, often just reporting a figure for NPK use. Very few farmers mentioned using foliar fertilizers. On average, farmers in Tan Phu Trung reported that they applied an average of 402 kg/ha of chemical fertilizers for each crop of leaf vegetables, well below the rates recommended by the agricultural extension centre. In Nhuan Duc, farmers growing fruit vegetables reported applying on average the equivalent of 14.6 tons/ha of composted manure for each fruit crop that they grew. This is less than half the recommended rate of 30 tons/ha/crop. They also reported applying on average 1,297 kg/ha of chemical fertilizers per crop, about 120kg higher than the upper amount recommended by the Agricultural Extension Centre.

Farmers were asked whether or not their application rates of chemical and organic fertilizers on their vegetable crops had changed compared to five years ago. All the farmers in Tan Phu Trung and 19 out of 20 farmers in Nhuan Duc answered this question. The various configurations of the answer to this question can be found in Table 6.4. The main trends to report are that over one third of farmers in Tan Phu Trung and one quarter of farmers in Nhuan Duc report that they are now using less chemical fertilizer and the same amount of organic fertilizer as they did five years ago. Significant numbers of farmers in both communes also reported that they now used more chemical fertilizer and more organic fertilizer (TPT = 25 percent, ND = 16 percent), or that they had made no change in their use of fertilizers over the past five years (TPT = 15 percent, ND = 21 percent).

Table 6.4: Changes in Fertilizer Application Over the Past Five Years

Changes in Fertilizer Application	Farmers TPT (%)	Farmers ND (%)
Same Chemical Fertilizer, Same Organic Fertilizer	15	21
Same Chemical Fertilizer, More Organic Fertilizer	5	5
Same Chemical Fertilizer, Less Organic Fertilizer	5	0
More Chemical Fertilizer, Same Organic Fertilizer	0	16
More Chemical Fertilizer, Less Organic Fertilizer	0	0
More Chemical Fertilizer, More Organic Fertilizer	25	16
Less Chemical Fertilizer, More Organic Fertilizer	0	5
Less Chemical Fertilizer, Same Organic Fertilizer	35	26
Less Chemical Fertilizer, Less Organic Fertilizer	15	11

These results indicate a trend towards a reduction in chemical fertilizer use, with 50 percent of the farmers in Tan Phu Trung and 42 percent of the farmers in Nhuan Duc reporting that they now use less chemical fertilizer compared to five years ago. One quarter of farmers in both communes report that they use the same amount of chemical fertilizer now compared to five years ago and the remainder report that they have increased their use of chemical fertilizer over the past five years (TPT = 25 percent, ND = 32 percent). Likewise, the majority of farmers in both communes report that they use the same amount or increased amounts of organic fertilizer compared to five years ago, with only 20 percent of farmers in Tan Phu Trung and 11 percent of farmers in Nhuan Duc reporting that they have reduced their use of organic fertilizers. Research from the Red River Delta in the north suggests that farmers could further reduce their fertilizer use and still improve their economic returns (Leers 2006).

6.3.3 Pesticide Use

Pesticide is an umbrella term that covers insecticides, fungicides, herbicides, rodenticides and several other categories of plant protection products. Safe vegetable farmers mostly apply insecticides and fungicides, with herbicides and rodenticides rarely used. Most of the safe vegetable farmers in Cu Chi District now understand the principles of integrated pest management and the dangers associated with the overuse of pesticides. As a result they are trying to reduce their pesticide applications to protect their own health and to reduce their input costs. That said, all the farmers reported using at least some pesticides on their

vegetables, even if they were biopesticides. Pesticide application is generally higher in the wet season, when the humid conditions make the vegetables more susceptible to fungal diseases. A small number of farmers reported that they were able to grow their vegetables without applying any pesticides during the dry season.

Farmers in both communes reported using around three different types of pesticides on average (TPT = 2.8, ND = 3.2). Individual farmers reported using from one to six different types of pesticides. The pesticides used by farmers range in toxicity, from highly acutely hazardous to being unlikely to present an acute hazard in normal use. However, it was only two farmers in Nhuan Duc Commune who had not yet had direct training on safe vegetable production who reported that they still used some pesticides that are potentially highly acutely hazardous. Many of the other farmers mentioned that they started using less-toxic pesticides after they had attended training on safe vegetable production. Out of the 40 farmers interviewed, two farmers in Tan Phu Trung and three farmers in Nhuan Duc could not remember any specific pesticide names. The other 35 farmers mentioned using 42 different types of pesticides. A list of the pesticides used by farmers can be found in Appendix B. After returning from the field, no information could be found for nine of the pesticides mentioned by farmers. This is likely due to errors of translation that can easily occur when farmers have to read a pesticide label in English and remember it according to a Vietnamese pronunciation, before it is translated back into English via an interpreter. Wherever possible the original packaging was photographed to enable easy identification of names and active ingredients.

Farmers were asked whether they are using more or less pesticides now than they were five years ago. In Tan Phu Trung, 80 percent of farmers stated that they are now applying less pesticide than five years ago, while 15 percent of farmers are using the same amount. Only five percent of farmers in Tan Phu Trung mentioned that they are now using more pesticides than five years ago. The reason given for this increase in pesticide use was that these farmers had switched from using broad-spectrum pesticides to less-toxic pesticides that target a narrower range of pest species. These farmers felt that the less-toxic pesticides have to be applied more frequently, or several different types have to be applied in order to achieve the

same level of crop protection as the broad-spectrum pesticides provided. Interestingly, many of the other farmers in Tan Phu Trung had also shifted to using these less-toxic pesticides and still reported that they had decreased their use of pesticides.

In Nhuan Duc Commune 90 percent of farmers reported that they had increased their use of pesticides, with only five percent of farmers having decreased their use and the other five percent of farmers reporting that they use the same amount of pesticides as before. For the farmers that reported an increase in pesticide use over the past five years, half of them mentioned that this was because they had switched from using broad-spectrum pesticides to less-toxic pesticides that target a narrower range of pest species. One quarter of the farmers mentioned that they were using more pesticides now because of unfavourable weather conditions that were leading to more outbreaks of insects and diseases, while the other quarter of the farmers mentioned that they were now using more pesticides because they had switched from using traditional vegetable varieties to hybrid varieties that are more susceptible to attack from insects and diseases.

While there are some encouraging signs in relation to pesticide use on vegetables, with some farmers reducing their pesticides usage and moving towards using less-toxic pesticides and even biopesticides, there are still some areas of concern. A number of farmers mentioned that they did not know the names of pesticide that they used, or how much they applied. When these farmers ran out of pesticides they would simply take the empty packet back to the store and buy some more of the same. In some cases the pesticides were labelled in English, making it difficult for farmers to understand the instructions. The use of protective clothing by farmers while spraying appeared to not occur with any frequency. Less than ten minutes after interviewing one farmer who said that he had attended a training session on the safe use of pesticides, I watched as his son sprayed fungicide on their bitter gourd crop. He was using a hand operated backpack sprayer, without any protective clothing or a mask. It was the middle of the day and the strong wind was sending clouds of fungicide billowing away across the field. Several other farmers were observed storing pesticides in a bucket in their front garden, or on low shelves in the house, where they were easily accessible to children or livestock.

6.3.4 Water and Energy Use

The question of whether or not water is used efficiently in safe vegetable production is not an easy one to answer definitively. Some preliminary observations will be offered that could help to guide future investigations in this area. Rice is well known as a water-demanding crop, so the shift to vegetable production may entail lower overall water use. However, as previously mentioned, the water for irrigating safe vegetables is derived from groundwater sources. At this stage it is impossible to say whether or not these groundwater supplies are being used at a sustainable rate.

At the farm level, the groundwater is often pumped to the surface, which entails an expenditure of energy in the form of fuel or electricity. This comes in addition to the already high expenditure of energy for maintaining and operating the existing irrigation and drainage system in Cu Chi (Turral and Malano 2002). In fruit vegetable crops, water is often applied by flooding the small furrows between the crop rows. This system of irrigation can be quite inefficient in delivering water to the crop, as much of the water can be lost through evaporation and seepage. However, these systems have the advantage for smallholders of being easy to construct and they do not require large investments in pipes, sprinklers and drippers. In leaf vegetable crops, watering is done by hand using a hose or with watering cans. This can be a quite time consuming process but again it does not require a large investment in micro-irrigation systems on the farm level.

6.3.5 Summary of Resource Maintenance and Efficiency

The safe vegetable agroecosystems in the study sites have not been extensively redesigned to mimic the structure and function of native ecosystems and they do not run primarily on sunlight, rainwater and internally cycled nutrients. Inputs of chemical fertilizers are still used on the farms, often in amounts far higher than those recommended by the Agricultural Extension Centre. However, there is a trend towards a reduction in chemical fertilizer use, with almost half of all the farmers reporting that they now use less chemical fertilizer compared to five years ago. Farmers have adopted some agroecological principles and many are replacing at least some of their chemical fertilizers with organic fertilizers and many

farmers still practice mixed farming, which allows for the recycling of crop wastes and livestock manure within the farm system. The question of the sustainable use of irrigation water in safe vegetable production is unresolved. Most of the safe vegetable farmers in Cu Chi District now understand the principles of integrated pest management and the dangers associated with the overuse of pesticides. As a result they are trying to reduce their pesticide applications to protect human health and to reduce their input costs. While there are encouraging signs in relation to pesticides, with some farmers reducing their pesticides usage and moving towards using less-toxic pesticides, some relatively toxic pesticides were still applied by a small number of farmers and protective clothing appeared to be infrequently worn.

6.4 Livelihood Sufficiency and Opportunity

This section of the sustainability assessment focuses on the productivity and profitability of safe vegetable production. The issue of market access for safe vegetable farmers is also examined. The role that farmer groups and farmer cooperatives are playing in facilitating market access is also discussed.

6.4.1 System Productivity

One of the conventional measures of success of a cropping system is the overall yield of the crop that can be obtained from a given land area using certain inputs. This study did not set out to comprehensively compare the yields of safe vegetable production to those obtained by conventional approaches to vegetable production. This in itself would be a large undertaking requiring replicated field trials over a number of seasons. Again, however, some observations from the field can be bought to bear on the question of productivity in safe vegetable farming. It is worth noting that as an agronomic system, safe vegetable production does not differ markedly from conventional vegetable production, other than in the restrictions placed on the use of certain pesticides. The recommendations of the Agricultural Extension Centre specify a balanced and targeted application of fertilizers to meet the requirements for healthy and productive crop growth. As such, the safe vegetable guidelines can be considered equivalent to best management practices for vegetable production.

The chief technical officer from the Agricultural Extension Centre of Ho Chi Minh City specifically mentioned that the approach to safe vegetables production that his organization is promoting represents the most productive approach to growing vegetables that they have been able to determine through field trials. In each location where the extension centre plans to promote safe vegetable production, they first conduct field trials to ensure that they are training farmers in the most productive methods of vegetable production. A small number of farmers in both communes mentioned that the system of safe vegetable production that they learned in the training has helped them to improve their vegetable yields. Most farmers however, did not specifically mention yields as a topic of importance, being more concerned with the profitability of the system.

6.4.2 System Profitability

A common method of assessing agricultural profitability is to calculate the gross margin for a certain crop based on the costs of production and the income derived from selling the crop. This sustainability assessment does not use conventional calculations on gross margins to estimate the profitability of safe vegetable production. It would have been very time consuming to gather all the required data on costs of inputs and vegetable prices. In any case, calculations of gross margins for vegetables are available in the handbook on safe vegetable production from the Agricultural Extension Centre of Ho Chi Minh City (Agricultural Extension Centre 2006). Instead, farmers were asked about their perceptions of the profitability of safe vegetable production. After all, it is the farmers' perceptions of the profitability of safe vegetables that will inform their decision making in the future.

Many farmers in both communes mentioned economic reasons as being important in their decision to grow safe vegetables. The most commonly cited economic reason for growing safe vegetables was the perceived guaranteed market that farmers could get once they signed a contract with buyers. In the case of farmers in Nhuan Duc this was more a future hope rather than their current reality, as the cooperative in their commune had yet to sign a contract at the time of the study. Likewise, the incentive of obtaining a higher price for safe vegetables was mentioned by more farmers in Nhuan Duc Commune than in Tan Phu Trung Commune.

Farmers were asked whether or not their farm income has improved as a result of growing safe vegetables. Seventeen of the 20 farmers in both communes answered this question. None of the farmers in either commune thought that their incomes had fallen after they started growing safe vegetables. In Tan Phu Trung, 88 percent of farmers said that their incomes had increased since they started growing safe vegetables, while the remainder said that their income remained the same. In Nhuan Duc Commune, 41 percent of farmers thought that their incomes had increased since they started growing safe vegetables, while 59 percent said that their income remained the same (See Table 6.5).

Table 6.5: Farmers' Perceptions of the Profitability of Safe Vegetable Production

Safe Vegetables and Farm Income	Farmers TPT (%)	Farmers ND (%)
Income has increased since growing safe vegetables	88	41
Income is the same as prior to growing safe vegetables	12	59
Income has decreased since growing safe vegetables	0	0

There was a strong feeling of hope expressed by farmers in Nhuan Duc about future improvements in their incomes once the safe vegetable cooperative was up and running and able to buy their vegetables at a higher price and in guaranteed quantities. It must be remembered that at the time of the interviews, the safe vegetable cooperative in Nhuan Duc was not yet operating and farmers were still selling their products to the wholesale markets for the same price as all other conventional vegetables. The fact that 41 percent of farmers in Nhuan Duc said that they had already seen an improvement in their income indicates that factors other than increased prices or improved market share also play a role in improving the profitability of safe vegetable production.

The reasons that farmers gave for the improvement in their incomes once they started growing safe vegetables can be found in Table 6.6. Increased prices for safe vegetables and a guaranteed market for their produce were the most common reasons that farmers in Tan Phu Trung gave for improvements in their farm incomes once they started growing safe vegetables. Improvements in growing techniques and decreased input use were other reasons mentioned by a smaller number of farmers in both communes. Another reason mentioned by

almost 30 percent of farmers in Nhuan Duc, but by none of the farmers in Tan Phu Trung, was that they had increased the area of vegetables that they were growing and this had contributed to their higher incomes.

Table 6.6: Safe Vegetable Production and Improved Farm Income

Reasons for Improvement in Farm Income	Farmers TPT (%)	Farmers ND (%)
Increased prices for safe vegetables	40	0
Guaranteed market for their produce	40	0
Improvements in growing techniques	13	29
Increased area of vegetables	0	29
Decreased input use	13	14
Reason for increase not mentioned	27	43

The problem of increasing costs for inputs, particularly for fertilizers, was one that worried many of the farmers. In Tan Phu Trung one of the farmers whose income had not improved mentioned that while he gets a higher price for his safe vegetables, his costs of production have gone up in recent years, so overall his income remains about the same. During the group discussions, farmers also mentioned the problems that they face regarding unstable prices and rising costs of production, particularly for fertilizers. In the wet season, when production of vegetables is more difficult due to excess moisture and disease problems, the price of the vegetables is high and farmers can make a good profit. However, in the dry season many more farmers around Ho Chi Minh City and neighbouring provinces grow vegetables and the price drops due to increased production. Unstable prices coupled with increasing costs for fertilizers make for a difficult situation for farmers. Even the cost of manure has doubled in the last two years due to increasing demand, leading some farmers to question for how much longer they can produce vegetables profitably.

> When the price of chemical fertilizer went up in the past we tried to reduce the amount we use and replace it with more compost, but now the price of manure has gone up also. We do not know how we can continue to produce vegetables if this situation persists (Male Farmer, Tan Phu Trung).

The cost of fertilizers, particularly nitrogenous fertilizers, is related to the cost of natural gas (Pimentel and Pimentel 1996). Rising world oil prices can also increase fertilizer prices due to

increasing transportation costs. While increasing energy and fertilizer prices undoubtedly place great strain on the profitability of farmers in the short term, they could also serve as a catalyst for farmers to change to less energy intensive production methods. As already mentioned, research on fertilizer use in vegetables conducted by Leers (2006) in northern Vietnam suggests that many farmers could greatly reduce their fertilizer use while maintaining or increasing their profitability.

6.4.3 Market Access

There are three large wholesale produce markets in Ho Chi Minh City, each receiving agricultural products from different regions (See Figure 6.1). On the eastern side of the city, the Tam Binh wholesale market in Thu Duc District receives produce from Dong Nai and Lam Dong Provinces. Dalat is located in Lam Dong Province in the central highlands and is an important vegetable growing region. In the southwest of Ho Chi Minh City is the Binh Dien wholesale market in Binh Chanh District, which handles produce coming in from the Mekong Delta Provinces. The third wholesale market is the Tan Xuan market, located in the northwest of the city in Hoc Mon District. This market receives produce from Cu Chi District and Tay Ninh Province as well as from Lam Dong Province in the Central Highlands.

In conventional vegetable marketing, farmers either transport their products to one of the wholesale markets, or collectors come to their farms and purchase products for the sellers in the wholesale market. One of the key factors allowing farmers to better access the markets for safe vegetables has been the development of safe vegetable farmer groups and cooperatives. These farmer-led organizations facilitate the sale of safe vegetables by acting as an intermediary between producers and buyers. The buyers of safe vegetables include supermarkets, restaurants and food service companies for schools and factories. The first supermarket opened in Ho Chi Minh City in 1993, followed by several other chains throughout the 1990s (Cadilhon et al. 2006). These supermarkets focus on maintaining quality standards to differentiate their produce from the vegetables sold in the traditional wet markets. Cadilhon et al. (2006) estimate that only about two percent of vegetables are sold through modern supply chains in Ho Chi Minh City.

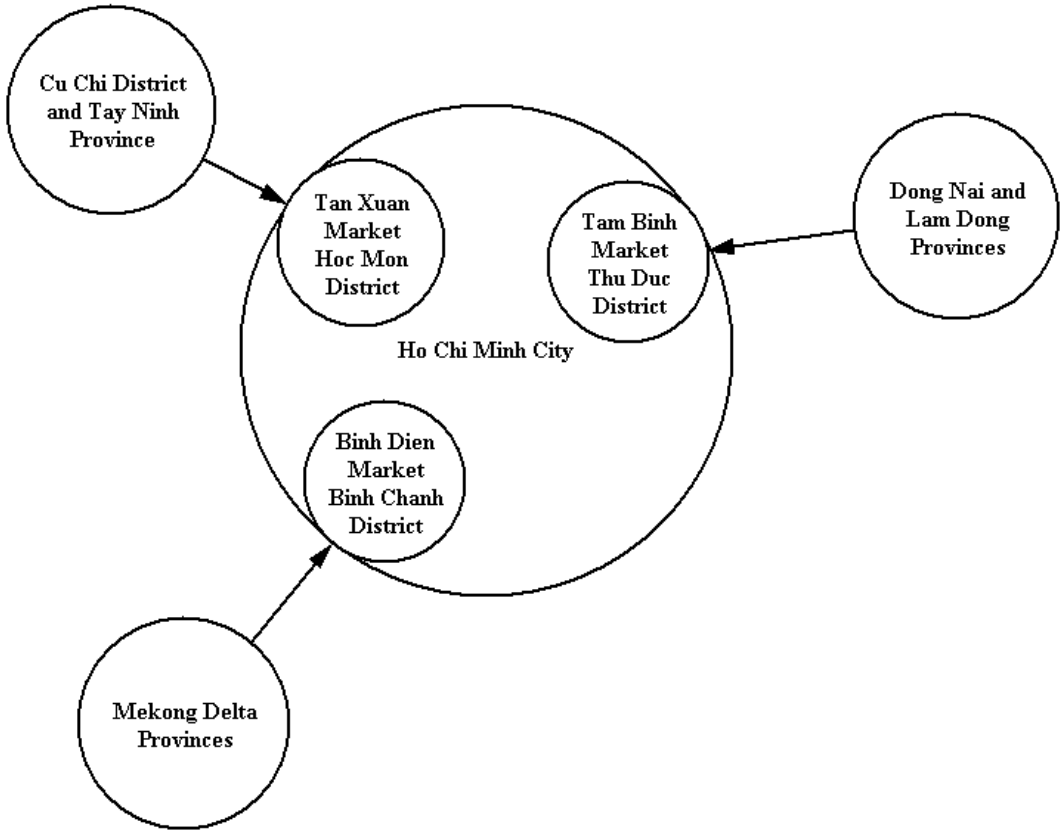


Figure 6.1: Wholesale Markets in Ho Chi Minh City

Safe vegetable groups often started out as production support groups for farmers who were growing vegetables. Farmers in these groups were able to access inputs at a reduced rate from input supply companies and the groups were a venue for information sharing. The marketing function of the groups became more important as supermarkets and other buyers started to become more interested in safe vegetables, requiring farmers to coordinate their production to a greater extent. The main difference between the safe vegetable farmer groups and the safe vegetable cooperatives is the official tax stamp that cooperatives can get from the government to allow them to issue tax receipts to the companies with which they deal. However, the safe vegetable farmer group in Tan Phu Trung existed prior to the establishment of the safe vegetable cooperative and they have already built up a long-term partnership with Coop-Mart. Coop-Mart belongs to the Vietnamese Federation of Trade Cooperatives and is the largest local supermarket chain in southern Vietnam (Cadilhon et al. 2006).

In Tan Phu Trung Commune, the safe vegetable cooperative was formed in October 2003. The main purpose of the cooperative is to coordinate the production of vegetables among the farmers so that they can achieve the stable output required by the buyers. The Tan Phu Trung safe vegetable cooperative has had 29 permanent members since the time of establishment (See Figure 6.2). Each of the founding members contributed a minimum share of 200,000 VND to start the cooperative and no member can own a share greater than 30 percent. There are three people on the cooperative executive committee and they are elected to the position every three years. Any profits from the cooperative are shared between the regular members. The cooperative also gets a seven percent lower price on production inputs from input supply companies. The cooperative enters into a contract with members to supply inputs of seed, fertilizer and pesticides and to purchase their vegetables. Along with the regular members, up to 300 other farming families are contracted to grow vegetables for the cooperative, although they do not benefit from any profits made by the cooperative.

The structure of the recently formed safe vegetable cooperative in Nhuan Duc is similar to the cooperative in Tan Phu Trung. The Nhuan Duc safe vegetable cooperative started in May 2007 with 39 regular members. A seven person executive committee is charged with overseeing the operations of the cooperative. In reality, most of the responsibility for management of the cooperative currently falls onto the shoulders of the chair of the cooperative. As yet, the safe vegetable cooperative in Tan Phu Trung has not contracted out production to any other farmers as they are still in the process of attracting buyers.

Farmers were asked why they chose to join a safe vegetable group or a safe vegetable cooperative. The majority of farmers said that the main reason they joined was to be able to gain improved market access for their vegetables. For farmers in Nhuan Duc Commune this reason for joining the cooperative was more of a future hope, as the farmers were not yet getting higher prices for their vegetables. At the time the fieldwork was conducted the cooperative had only just been formed and was yet to sign any contracts with buyers. Another reason given for joining the cooperative was to be able to access training and support on growing safe vegetables. Members of the groups and cooperatives can apply for low interest

loans from the government for capital investment in their farms. Almost a quarter of farmers in both communes mentioned that they joined on the recommendation of the government.

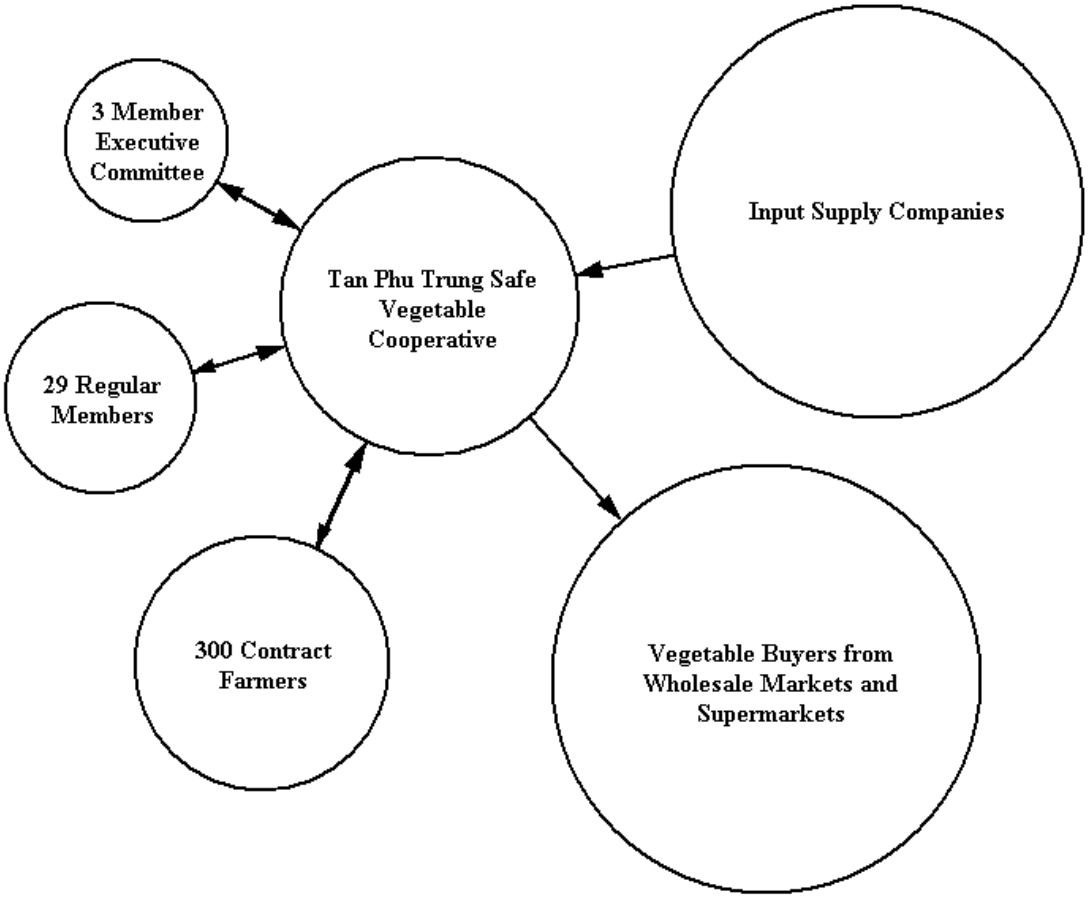


Figure 6.2: Structure of the Tan Phu Trung Safe Vegetable Cooperative

Despite the perceived benefits of joining a safe vegetable group or cooperative, 10 percent of the farmers interviewed in Tan Phu Trung and 15 percent of the farmers interviewed in Nhuan Duc were not members of a group or cooperative. One of the farmers was a member of the group in Tan Phu Trung for four years before he left in 2004. He was seen in the community as being a good farmer and he was recommended by the local farming committee to join the group. However, he said that when he joined the group he was unable to sell all of his products to the group, especially his leaf vegetables, and sometimes he had to throw away half

of his crop. He now sells his produce to the Tan Xuan wholesale market in Hoc Mon District. When asked why he could not sell some of the produce to the group and some to the wholesale market, he said that he would then have to spend too much time transporting his produce to two different locations. He also said that the group selects the best vegetables to sell and he would have to spend a lot of time sorting the vegetables. Since he stopped growing for the group, he did not change his farming practices and he is still growing safe vegetables even though they are not marketed as such. He still follows the procedures for growing safe vegetables because it saves him money on input costs for fertilizers and pesticides.

6.4.4 Summary of Livelihood Sufficiency and Opportunity

While safe vegetable production is considered to be a high yielding approach to growing vegetables by the Agricultural Extension Centre, most farmers did not specifically mention yields as a topic of importance, being more concerned with the profitability of the system. This in itself is an encouraging sign as a singular focus on achieving greater crop yields often lies behind the "more is better" approach that some farmers use in applying agrochemicals. Rising fertilizer prices could also serve as a catalyst for farmers to change to less energy intensive production methods. All of the farmers thought that safe vegetable production had at least enabled them to maintain the profitability of their farming system, while many believed that their farm profitability had increased since they started growing safe vegetables. For many farmers, joining a safe vegetable group or cooperative has been key to gaining improved market access for their vegetables. However, some farmers who have had training on safe vegetable production continue to sell to the wholesale markets. This strategy reduces the labour requirements for the harvesting and grading of vegetables and farmers are able to sell all of their vegetables to the wholesale markets, including those of a lower grade.

6.5 Intragenerational Equity

This section of the sustainability assessment looks at the influence that safe vegetable production is having on equity, both for farmers as a group, and between farmers and other members of society. The assessment will focus on two main areas. The first of these areas looks at the ability of farmers to participate in safe vegetable production. The main question of

concern is whether farmers of all socio-economic classes and both genders are able to participate in safe vegetable production, or whether there are barriers for certain segments of society. The second area looks at the effect that safe vegetable production is having on reducing income inequality between farmers and other segments of society.

6.5.1 Farmer Participation in Safe Vegetable Production

Rural landlessness has been increasing in Vietnam, more than doubling between 1993 and 2002, by which time 18.9 percent of rural households did not have any agricultural land (Akram-Lodhi 2005). It goes without saying that if you are a landless peasant then you will find it very difficult to participate in agricultural production of any sort, other than to hire out your services to other farmers or to rent land for the purposes of farming. For those farmers that do have access to land, are there any barriers to the adoption of safe vegetable production?

First, let us consider some general spatial and biophysical aspects of producing safe vegetables, such as farm size, farm location and agroecological conditions on the farm. From interviews and field observations it seems that having a small farm does not appear to be a barrier to producing safe vegetables. Many of the farmers in Tan Phu Trung had farms of only 0.1 ha in size, and some farmers were growing safe vegetables commercially on small plots of land within their homegardens. In fact, the Vietnamese government actively encourages farmers with a limited land area to change from producing rice to higher value crops such as safe vegetables.

Farm location is an important aspect to consider when discussing a shift from growing rice, which is easily stored and transported, to growing vegetables, some types of which can spoil within a day of harvesting and can be easily damaged during transportation to market. As a consequence of this, most of the safe vegetable farmers in Vietnam are clustered around the major cities, where the largest demand for vegetables is concentrated. However, this is not universally true as the case of Dalat City in the central highlands illustrates. This major vegetable growing region is located over 250 km away from Ho Chi Minh City, where most of

the vegetables from Dalat are sold. The agro-climatic conditions in Dalat are conducive to growing vegetables year round, including many temperate vegetable species that would not thrive in the tropical lowlands. Even in the lowlands, remoteness from major markets does not preclude safe vegetable production on a small scale for local consumption.

One issue that can hamper vegetable production in the rice growing lowlands, particularly in the wet season, is flooding. This problem was even mentioned by a number of safe vegetable farmers in Tan Phu Trung. Most of the irrigation and drainage systems in Vietnam have traditionally been designed for rice production. This can lead to excessive moisture in some low-lying areas during the wet season, which is damaging to many vegetable crops. However, some vegetable species such as kang kong (*Ipomoea aquatica*) and taro (*Colocasia esculenta*) can be grown in wet soil conditions. The other alternative, which some farmers in Cu Chi still practice, is to grow one crop of rice in the wet season followed by one or two vegetable crops in the dry season.

Based on the interviews with farmers, it appears that there are few major barriers to the adoption of safe vegetable production. It most be noted however, that most of these interviews were with safe vegetable farmers or with farmers who were already growing vegetables but were not yet certified as safe vegetable farmers. The opinions of female farmers are also under represented, as discussed in Chapter Three. The farmers were asked to describe the main problems they faced in growing safe vegetables (See Table 6.7). These problems in growing safe vegetables, as perceived by safe vegetable farmers, give some indication of the barriers that other farmers might face in starting to grow safe vegetables.

There was quite a big difference of opinion between the farmers in Tan Phu Trung and Nhuan Duc as to the main problems in safe vegetable production. The only problems on which there was much agreement by farmers in both communes were to do with the capital and labour requirements for growing safe vegetables. A lack of capital for growing safe vegetables was particularly seen as an issue in Nhuan Duc Commune. It is debatable whether or not a lack of capital is a problem unique to safe vegetable production, or whether this is a problem associated with any method of vegetable production, or indeed with any form of agricultural

production. The nature of agricultural production means that farmers have to invest money for inputs such as seed and fertilizer at the start of the season and then they must wait until the crop is harvested until they see a return on their labours and investments. With rice cropping, farmers must wait from between three and six months before they can sell their crop. With vegetable crops, the return on investment can be as short as 25 days for leaf vegetable crops or at most three months for some fruit vegetable crops. Indeed many farmers commented that this regular income was a favourable aspect of vegetable production and one that had helped to improve their standard of living.

Table 6.7: Problems Encountered by Farmers in Safe Vegetable Production

Problems in Safe Vegetable Production	Farmers TPT (%)	Farmers ND (%)
Lack of capital	21	67
Increased production; difficult to sell all produce in dry season	42	6
Rain damage on crops in wet season and/or flooding	16	0
Increasing insect and disease problems	16	0
Changes in land-use zoning by the Government	5	0
Lack of labour, increased labour cost	16	22
Unstable prices when selling to local market	0	67
Need technical support on production practices	0	28
No problems growing safe vegetables	21	0

When comparing the capital required for safe vegetable production and conventional vegetable production, one can assume that the requirements are similar. With lower inputs of fertilizer and pesticides, farmers should actually require less capital for safe vegetable production. However, a number of farmers mentioned that the newer less-toxic pesticides and biopesticides that they are required to use in safe vegetable production are more costly than the older broad-spectrum pesticides. There is also the issue of major capital investments required to produce safe vegetables, such as sinking a well for obtaining groundwater and building a shadehouse. These expenses could prove prohibitive for some farmers. With this in mind, the Ho Chi Minh City government is making low interest loans available to safe vegetable farmers. It must be noted however, that a shadehouse is not a requirement for all safe vegetable production, only for certain species of leaf vegetables, and these can easily be

grown in smaller moveable net tunnels which require a much more modest investment than a full size shadehouse.

The issue of a lack of labour or an increase in labour costs for safe vegetable production as compared to conventional vegetable production is perhaps more clear-cut than the issue of capital, although they are clearly related. Safe vegetable farmers mentioned that there was one area for which they required greater labour compared to when they were growing conventional vegetables. This increased labour requirement in safe vegetable production comes at the harvesting and sorting stage, so as to meet the quality requirements of the buyers for vegetables of uniform size and appearance. When selling to the wholesale market, farmers did not need to spend as much time sorting vegetables. Some farmers with larger land holdings mentioned that for safe vegetable production they needed to hire skilled labourers who understood the principles of safe vegetable production, and this entailed a higher cost. From the perspective of the labourers, this could be seen as an advantage if they are able to sufficiently raise their skill levels to meet this opportunity.

Aside from issues of labour and capital, the other main issue mentioned by farmers in Nhuan Duc Commune was unstable prices when selling vegetables to the local market. This in itself is not directly attributable to safe vegetable production, and in fact this issue can be solved once farmers are able to engage in contracts with supermarkets and other buyers to sell their produce at guaranteed prices. However, almost half of the farmers in Tan Phu Trung mentioned the problem of not being able to sell all of their produce to the cooperative or group, particularly in the dry season when there is an increased production of vegetables. This problem highlights the need for multiple marketing channels for safe vegetables, even if this means that some of the excess safe vegetables must be sold at a lower price in the wholesale markets. From the perspective of consumers, the sale of excess safe vegetables into the wholesale markets could be seen as a positive occurrence, one that helps to lift the safety standards of the whole vegetable supply system.

The need for training and technical support for growing safe vegetables was mentioned by one third of farmers in Nhuan Duc Commune. None of the farmers in Tan Phu Trung mentioned

the need for more training or technical support, although some farmers mentioned that they had increasing problems with insect pests and diseases. Overall, the farmers in Tan Phu Trung have been growing safe vegetables for much longer than the farmers in Nhuan Duc and felt better trained and more experienced to deal with the production requirements of safe vegetables. In fact, over 20 percent of the farmers in Tan Phu Trung said that they had no problems at all in growing safe vegetables.

6.5.2 Farmer Livelihoods

Across Vietnam, rural incomes are half those of urban incomes and poverty has declined more slowly in rural areas (Taylor 2007). From the discussion in earlier sections of this chapter it appears that safe vegetable production is helping many farmers to improve their incomes. However, without conducting a detailed comparison of the incomes earned by workers in all sectors of society, it is difficult to say with any certainty whether or not safe vegetable production is helping farmers to keep pace with other members of society.

Two approaches were used in this research to try to assess how farmer livelihoods are fairing compared to other sectors of society. The first approach was to ask farmers how their living standards have changed over the last five years. The second approach for assessing the influence that safe vegetable production is having on farmer livelihoods was to ask farmers whether or not they wanted their children to become farmers also. The answers to this question give some sense of the value that farmers themselves place on farming as an occupation and the prospects that they believe it holds for their children in the future.

Farmers in the study sites were asked how their living standard has changed over the past five years (See Table 6.8). All of the 20 farmers in Nhuan Duc and 19 of the 20 farmers in Tan Phu Trung answered this question. The majority of farmers in both communes said that their living standard was better now compared to five years ago. In Nhuan Duc Commune, 90 percent of farmers thought that their living standard has improved compared to five years ago.

Table 6.8: Changes in Living Standards in the Study Sites

Changes in Living Standards	Farmers TPT (%)	Farmers ND (%)
Better now compared to five years ago	58	90
Same living standard as five years ago	37	0
Worse now compared to five years ago	5	10

The reasons that farmers gave for improvements in their living standard are presented in Table 6.9. The main reason for improvement given in both communes was the greater ease with which farmers are now able to sell their produce. This was relatively more important in Tan Phu Trung than in Nhuan Duc, where farmers gave a wider variety of reasons for improvement in living standards, including improvement in growing techniques and improvements in rural infrastructure, such as roads, electricity and irrigation systems.

Table 6.9: Reasons for Improvements in Living Standards

Reasons for Improvement in Living Standards	Farmers TPT (%)	Farmers ND (%)
Children have grown-up and are earning income off-farm	45	6
Easier to sell their produce	91	28
Growing an increased area of vegetables	9	17
Improved growing techniques	0	28
Improved infrastructure (roads, electricity, irrigation)	0	22

In Tan Phu Trung almost 40 percent of farmers said that their living standard remained the same as five years ago. Some of the farmers who said that their living standard was the same as before still mentioned that they now had better access to food and that it was easier to sell their produce now. Two of the farmers in Tan Phu Trung who mentioned that their living standard had not improved said that the reason for this was that now more farmers were growing safe vegetables and it is more difficult to sell all of their produce to buyers. A small number of farmers in both communes mentioned that they had seen a decline in their living standards over the past five years. Reasons for a decrease in living standards included increasing costs of inputs and difficulty in selling all of their produce because more farmers are growing safe vegetables. One of the farmers in Nhuan Duc mentioned that he used to raise

poultry but had to switch to growing safe vegetables because of avian influenza and as a result of this his income has decreased.

The opinions of farmers as to whether or not they wanted their children to follow in their footsteps and also become farmers were very mixed. Some of the farmers have older children who are already working off-farm in numerous occupations. Indeed for some farmers the extra support that their children provided was a key to helping them improve their standard of living. A number of the farmers had children, particularly their sons, who had followed in the footsteps of their parents and were continuing to farm. Among the farmers with young children, there was a strong feeling that the children should study hard to keep their options for future employment open. Many farmers said that it was up to their children to decide on their future occupation once they had finished their schooling, with farming seen as a fallback option if they cannot find other employment. There was a strong sentiment among many farmers who mentioned that they did not want their children to continue to farm because farming makes for a hard life.

> My children are still studying in high school. I encourage them to keep studying for as long as possible. I do not want my children to become farmers like me because life as a farmer is hard (Male Farmer, Tan Phu Trung)

> I will not my let children become farmers. I want to raise them with good educations so that they can get work outside of the farm. I want my daughter to be a doctor (Male Farmer, Tan Phu Trung).

These sentiments must not be seen as an indictment of safe vegetable production per se, but rather they serve as an indication of the prevailing attitudes about farming as an occupation, even among farmers themselves. It must be remembered that the average age of the farmers interviewed for this study was almost 48 years and the youngest farmer interviewed was 29 years of age. During the course of this fieldwork, farmers and government officials frequently mentioned that all the young people in Cu Chi were leaving the farm to work in other industries. This does not bode well for the future of farming in Vietnam.

6.5.3 Summary of Intragenerational Equity

There appear to be few major barriers to the adoption of safe vegetable production, although farmers did mention a number of difficulties that they encountered while growing safe vegetables. Many of these challenges are not specific to safe vegetable production per se, but could equally apply to vegetable production in general. Some farmers indicated that safe vegetable production requires more labour for harvesting and sorting vegetables so as to meet the quality requirements of buyers. Growing some safe vegetables crops may require large capital investments for sinking a well or building a shadehouses. While these expenses could prove prohibitive for some farmers there are ways around these constraints. The majority of farmers in both communes thought that their living standards were better now compared to five years ago, although some farmers reported no change in their living standards and a small proportion of the farmers thought that their living standards had decreased. The opinions of farmers as to whether or not they wanted their children to follow in their footsteps and also become farmers were very mixed, although many farmers said that they wanted their children to pursue their studies and keep their future career options open.

6.6 Intergenerational Equity

Just as it is hard to say conclusively whether or not safe vegetable production is leading to greater equity amongst the current generation, so too is it difficult to draw any firm conclusions about the effect that safe vegetable production is having on the "opportunities and capabilities of future generations to live sustainably" (Gibson 2006: 174). However, some broad trends can be sketched, which highlight areas of progress and areas of concern. These issues will be discussed in greater detail in the final chapter of this thesis, so they are only briefly mentioned here. The extent to which safe vegetable production is focussed on protecting human health must be seen as a positive outcome for future generations. By seeking to reduce inputs of toxic pesticides into the food system, safe vegetable production must be seen as a step towards sustainability. However, the continued use of relatively high inputs of non-renewable energy in the form of fertilizers suggests that there is still some progress to be made towards sustainability. Also, the need to protect ecosystems was not frequently mentioned by farmers.

6.7 Social-Ecological Civility and Democratic Governance

This section of the sustainability assessment looks at the role that safe vegetable production is playing in promoting social-ecological civility and democratic governance. In particular, the effect that safe vegetable production is having on spreading a culture of understanding and respect for humans and nature is examined. The influence of safe vegetable production on strengthening social networks and promoting information exchanges among the various actors in the system is also examined.

6.7.1 Respect for Humans and Nature

Safe vegetable production arose from concerns about the negative effects that residues of toxic pesticides on conventional vegetables were having on human health. As has already been discussed, the importance of producing safe vegetables for the purpose of protecting human health was a central theme running through many of the farmer interviews. This is clearly a message that farmers have embraced. Any mention of the necessity to protect the health of ecosystems was much less common from farmers. Many farmers were concerned with maintaining the fertility of the soils on their farms by applying organic fertilizers. This is not surprising as it has a direct influence on their farm production. Several farmers also mentioned the importance of protecting the soil and the forage plants on their farms from becoming contaminated with pesticide residues. In their definitions of safe vegetable production, 16 percent of farmers in Nhuan Duc also mentioned the general notion of the protection of the environment as an important consideration. However, beyond these brief mentions, there was little explicit concern voiced by farmers on the importance of protecting ecosystem health.

6.7.2 Social Networks and Information Exchange

Safe vegetable production is a classic top-down program of agricultural development. This was not an alternative cropping system developed by farmers, but rather it was conceived by the central government with assistance from international donors and then the concept was extended to farmers through training workshops held by various agencies under the provincial agriculture departments. Various incentives have been used to promote safe vegetable production, including low interest loans and promises of higher yields, lower input costs,

better health, higher prices and improved market access. The vast majority of farmers in both communes first heard about safe vegetable production from government agricultural staff or through a training course. Smaller numbers of farmers first heard about safe vegetable production through the media or through other farmers.

Despite the fact that safe vegetable production was initially a top-down agricultural development scheme, many farmers have embraced the idea and are sharing the concept with other farmers in their communities. Two thirds of the farmers in Tan Phu Trung and three quarters of the farmers in Nhuan Duc mentioned that they share information about safe vegetable production with neighbouring farmers or other members of their communities. Many farmers also mentioned the safe vegetable farmer groups and cooperatives as an important forum for information exchange on safe vegetable production. Many of the safe vegetable farmers in Tan Phu Trung, including some of the group leaders, are members of the Catholic Church. This potentially represents another layer of social capital among safe vegetable farmers. The extension service in Ho Chi Minh City also appears to be reasonably responsive to the needs of farmers. Commune-level extension agents gather requests from farmers on their training requirements and report this information back to the district office and head office in Ho Chi Minh City.

6.7.3 Summary of Social-Ecological Civility and Democratic Governance

Safe vegetable production is clearly playing a role in promoting a concern for protecting human health. Concern with protecting ecosystem health was much less commonly voiced by farmers, although several farmers mentioned the importance of keeping the soil and plants on their farms free from pesticide residues. Despite the fact that safe vegetable production was initially a top-down agricultural development scheme, many farmers have embraced the idea and are sharing the concept with other farmers in their communities.

6.8 Precaution and Adaptation

This section of the sustainability assessment looks at the extent to which safe vegetable production is helping farmers to plan for and adapt to change. Firstly, the effect that safe

vegetable production is having on the diversification of production strategies at the farm level is explored. Following this, the training and extension system for promoting safe vegetable production is discussed, particularly the influence this system is having on facilitating active learning and encouraging farmer experimentation. Lastly, the system of testing and enforcement in safe vegetable production is discussed.

6.8.1 Diversification of Production

In the literature on agroecology, a diversity of production strategies is thought to reduce the risk faced by smallholders (Altieri and Nicholls 2005; Francis 1988). The reasoning is that when a diversity of crops are grown and a diversity of animals are raised, the likelihood of system-wide failure is reduced. For example, a farmer growing only rice might lose much of his or her crop to an outbreak of insects, but still derive some income from the sale of fruit and livestock products. As already discussed, safe vegetable production has led to greater crop diversity for about one third of farmers in Tan Phu Trung and over two thirds of farmers in Nhuan Duc.

Safe vegetable production occupies a central role as a farm income generation strategy for most of the farmers interviewed in this study. On average, farmers in Tan Phu Trung derived 71 percent of their household income from farming activities, with safe vegetable production accounting for 60 percent of household income. This indicates that while farmers in Tan Phu Trung obtain about one third of their household income from off-farm activities, many of them specialize in safe vegetable production on their farms. Only half of the farmers interviewed in Tan Phu Trung raised livestock and only 10 percent of them still grew rice, with these activities accounting for a small proportion of total farm income on average.

In Nhuan Duc, farmers on average derived 95 percent of their household income from farming activities, with safe vegetable production accounting for 65 percent of household income. Almost all of the farmers in Nhuan Duc also raised livestock on their farms and half of the farmers still grew rice, either for sale or for home consumption. It appears that farmers in Tan Phu Trung are more likely to specialize in safe vegetable production, supplementing this with

off-farm income as a form of risk insurance, while for farmers in Nhuan Duc safe vegetable production represents a diversification of their farm production strategies, with livestock and rice production remaining important income streams for many farmers.

6.8.2 Training, Extension and Farmer Experimentation

The Agricultural Extension Centre and the Plant Protection Sub-Department, both agencies within DARD, are responsible for training farmers in Ho Chi Minh City on safe vegetable production (See Table 6.10). To promote safe vegetable production, the Agricultural Extension Centre organizes meetings with farmers to discuss the critical issues around the management of soil and water resources and the correct procedures for pesticide application. Following this initial meeting, volunteer farmers work with the Agricultural Extension Centre to test out some of the new vegetable growing techniques on their farms and adapt the techniques to the agroecological and climatic conditions of the area. When successful techniques have been developed and tested, demonstration plots are established to show other farmers the new techniques. The Agricultural Extension Centre focuses on growing techniques, fertilizer use and new vegetable varieties, while the Plant Protection Sub-Department focuses on the safe use of pesticides and principles of IPM. Since 2005, DARD has also been training farmers in Nhuan Duc Commune on the EurepGAP standards. Some of the buyers of safe vegetables, such as Metro Supermarket have also been providing training to farmers on vegetable quality standards and post-harvest processing of vegetables.

Table 6.10: Training Courses Attended by Farmers

Type of Training	Duration of Training	Farmers TPT (%)	Farmers ND (%)
Safe Vegetable Production	3-24 days	85	85
IPM for Vegetables	3-24 days	60	55
IPM for Rice	4 days	0	25
EurepGAP (Good Agricultural Practices)	16 days	0	65
Vegetable Quality Standards	1-2 days	10	10

The farmers in Nhuan Duc had on average attended more training courses than the farmers in Tan Phu Trung. In Nhuan Duc 85 percent of the farmers had attended two or more training

sessions, compared to only 55 percent of farmers in Tan Phu Trung who had done so. The training courses range in duration from a short course held over a few days, to a longer farmer field school in which participants attend a training session one or two days per week over a period of three to four months. These longer training sessions give the farmers the chance to observe changes in the field over a whole growing season and are much more likely to facilitate active learning and experimentation among farmers. A small number of farmers mentioned that they actively experiment with different growing techniques and reducing their fertilizer application. However, many farmers mentioned that they just followed the recommendations contained in the training documents. There was a feeling from farmers that they needed to follow the advice given by the government agricultural officers or they might not meet the quality and safety requirements for safe vegetables.

6.8.3 Testing and Enforcement in the Safe Vegetable System

The Plant Protection Sub-Department of DARD is responsible for pesticide residue testing in samples of vegetables taken from farmers' fields and from the wholesale markets around Ho Chi Minh City. They use a quick test that can return a result after about half an hour. This test is used for the two most toxic groups of pesticides, the organophosphate and carbamate groups, and it indicates whether the residues are above or below the MRL, but does not give an absolute quantity of pesticide residue per weight of vegetable. They do not use the quick test for other types of pesticides yet. They do the quick test at a random selection of farms at harvest time and from the wholesale markets. They also take some samples for pesticide quantity testing, but this method takes 24-48 hours to return a result and by that time the vegetable could already be sold to the consumers. Some of the buyers of safe vegetables, such as supermarkets, are also reported to test vegetable samples from the cooperatives.

Officials from DARD reported that the quick test has been used to test vegetable samples from farms and markets since 2002. When they first started testing they were finding that about 10 percent of the vegetable samples had residues of organophosphates or carbamate pesticides that were over the MRL. By 2006 this was reduced to just over one percent of samples. In contrast, around seven percent of the samples from vegetables coming into Ho Chi Minh City

from other provinces were testing above the MRL for organophosphates or carbamates in 2006.

In general it would seem that the efforts directed towards promoting safe vegetable production in Ho Chi Minh City are resulting in a safer food supply. However, there are still concerns that the system of testing and enforcement is weak. Apart from the fact that only two groups of pesticides are routinely tested for, albeit the most toxic ones, testing for nitrate, heavy metal content and bacterial pathogens seems to be rarely carried out. Another major problem is one of enforcement. The Plant Protection Sub-Department does not yet have any authority to remove contaminated vegetables from the food supply. At present, all they can do when they encounter a farmer who has vegetables with pesticide residues above the MRL is to remind them of the need to wait longer between spraying and harvesting. Similarly in the wholesale market, they can only advise traders to be more careful in future as to where they purchase their vegetables but they cannot prevent the contaminated vegetables from being sold.

There is no enforceable penalty yet for farmers who continue to over apply toxic pesticides on their vegetables. Officials from DARD mentioned that they are still waiting for a directive from MARD as to how to deal with this issue. The officials mentioned that if they were going to prosecute farmers in the court, then they would need to have evidence as to the actual amount of pesticide residues in the vegetables and this would entail using a more rigorous, costly and time consuming method of pesticide residue testing. At this stage if the Plant Protection Sub-Department detects vegetables from another province with pesticide residues over the MRL, all they can do is send a letter to the Plant Protection Sub-Department of that province to notify them of the problem. Currently, around 70 percent of the vegetables consumed in Ho Chi Minh City come from neighbouring provinces. Officials from DARD were of the opinion that the best approach would be to establish a safe vegetable project that links the nine provinces around Ho Chi Minh City so that they can all follow common procedures. There are also plans to run a similar project in the provinces around Hanoi.

6.8.4 Summary of Precaution and Adaptation

Safe vegetable production occupies a central role as a farm income generation strategy for most of the farmers interviewed in this study. Farmers in Tan Phu Trung are more likely to specialize in safe vegetable production, supplementing this with off-farm income as a form of risk insurance, while for farmers in Nhuan Duc Commune safe vegetable production represents a diversification of their farm production strategies. Most farmers reported that they had attended at least one training course on safe vegetable production or integrated pest management. While the efforts directed towards promoting safe vegetable production in Ho Chi Minh City seem to be resulting in a safer food supply, the system of testing and enforcement of safe vegetables remains weak.

6.9 Immediate and Long-Term Integration

This final section of the chapter looks at the immediate and long-term integration of all the other sustainability criteria. The requirement here being that all sustainability principles are applied together in order to achieve "mutually supportive benefits and multiple gains" (Gibson 2006: 174). The immediate gains from safe vegetable production are beneficial, but further progress is needed to maintain this progress into the future. An overview of the progress towards sustainability can be found in Table 6.11. This section of the chapter also serves as a summary of the sustainability assessment of safe vegetable production.

Safe vegetable farmers in the study areas are responding to the opportunity presented by demand for food safety and converting much of their farms to the production of safe vegetables. In the process, many of them are realising greater economic returns while at the same time helping to protect human health. Indeed, improved economic outcomes and the protection of human health emerged as the main reasons why farmers are interested in growing safe vegetables. Only a small proportion of the farmers directly mentioned the protection of ecosystem health as being an important consideration in their decision to produce safe vegetables. Nevertheless, farmers mentioned the importance of maintaining soil health in order to ensure future productivity.

Table 6.11: Summary of the Sustainability Assessment of Safe Vegetable Production

Sustainability Assessment	
Social-Ecological System Integrity	• Influences on health not measured directly but protecting human health is a driving concern behind the promotion of safe vegetables. • Farmers are actively managing to improve soil quality. • Questions around the quality of water for irrigating safe vegetables are unresolved. • A greater diversity of vegetables is being grown, but they are mostly hybrid varieties with little or no seed saving by farmers.
Resource Maintenance and Efficiency	• Agroecosystems have not been redesigned to mimic the structure and functions of natural ecosystems. • Some recycling of livestock manure and crop wastes into compost. • There has been some reduction in the use of agrochemicals, but many farmers still apply large amounts of chemical fertilizers. • Groundwater is used for irrigation; aquifer recharge rates unknown.
Livelihood Sufficiency and Opportunity	• System is at least as productive as conventional vegetable production. • Profitability is maintained or improved for many farmers. • Market access is improved for many safe vegetable farmers when they sell to farmer groups and cooperatives.
Intragenerational Equity	• Farmers from all socioeconomic classes and genders are able to engage in safe vegetable production. • The living standards of many farmers have improved, but some have seen stagnation and others a decline over the last five years. • Farming is not seen as a particularly favourable career choice and many young people have left farming for work in other industries.
Intergenerational Equity	• The focus on protecting human health is a positive step toward protecting the interests of future generations. • The use of chemical fertilizers, which are based on non-renewable fossil fuels, remains relatively high for some farmers.
Social-Ecological Civility and Democratic Governance	• Safe vegetable production, while initially a top-down approach, has garnered broad-based support from farmers because it has helped them improve their economic situations. • Government agricultural extension services seem reasonably responsive to the needs of farmers. • Social networks around vegetable production and marketing have emerged and farmers are sharing information on safe vegetable production amongst themselves.
Precaution and Adaptation	• Safe vegetable production is a form of farm diversification for many farmers with mixed crop and livestock operations. Other farmers specialize in safe vegetable production but supplement their income with off-farm income generation activities. • Most farmers have received some form of training on safe vegetable production and integrated pest management.
Immediate and Long-Term Integration	• Mutually supportive gains in protecting human health and improving farmer livelihoods are being realised.

With respect to the use of agrochemical inputs for safe vegetable production, there is a trend towards a reduction in chemical fertilizer use, with around half of the farmers in both communes reporting that they now use less chemical fertilizer than five years ago. However, many farmers in Nhuan Duc in particular are still applying more chemical fertilizer than is recommended in the safe vegetable production guidelines. Farmers who have maintained some livestock production are better placed to recycle nutrients within the farm system. When farm products are sold it represents a loss of nutrients from the system.

There are encouraging signs in relation to pesticide use on safe vegetables, with some farmers reducing their pesticide use and moving toward using less-toxic pesticides. The spraying of pesticides, albeit using pesticides of a reduced toxicity and with less frequency, still seemed to be the first choice of pest management strategy for many farmers. Some integrated pest management strategies were observed in use on safe vegetable farms, but they need to be given much more prominence.

For many farmers, safe vegetable production is leading to improved farm incomes, particularly for those farmers in Tan Phu Trung who are able to increase their market access by selling their produce through a safe vegetable group or cooperative. While farmers in Nhuan Duc Commune have not yet negotiated any contracts with buyers of safe vegetables, almost half of them already report that their farm income has improved due to lower input costs, improved production techniques and an increase in the area of vegetables grown on their farms. It must be noted however, that some farmers mentioned that their living standard had not improved in recent years. Reasons for a decrease in living standard included increasing costs of inputs and difficulty in selling all of their produce because more farmers are growing safe vegetables, particularly in the dry season.

This issue of excess supply seems to counteract the proclamation by DARD that only 30 percent of the total vegetable demand in Ho Chi Minh City is produced within the borders of the city. Plans are underway to more than double the area of safe vegetable production within the city limits by 2010. However, the complaints by farmers that they could not sell all of their production to safe vegetable buyers has more to do with issues of vegetable quality and

appearance than excess production. Some farmers mentioned an increased labour requirement in safe vegetable production for harvesting and sorting the produce, so as to meet the quality requirements of the buyers for vegetables of uniform size and appearance. After sorting, farmers get stuck with some vegetables that are smaller or misshapen whereas in the past they used to transport everything to the wholesale produce market. This highlights the need for multiple marketing channels for safe vegetables, even if this means that some of the excess safe vegetables must be sold at a lower price in the wholesale markets. From the perspective of consumers, the sale of excess safe vegetables into the wholesale markets could be seen as a positive occurrence, one that helps to lift the standards of the whole vegetable supply system.

It appears that there are few major barriers to the adoption of safe vegetable production once farmers have received some training and technical support. Farmers and government officials frequently mentioned that all the young people in Cu Chi were leaving the farm to work in other industries. A lack of farm labour poses a challenge to safe vegetable production and does not bode well for the future of farming in Vietnam. The next chapter concludes this study by offering some reflections on the process of conducting the sustainability assessment and some suggestions for moving safe vegetable production further along the path towards sustainability.

Chapter 7: Conclusions

7.1 Introduction

This chapter presents some conclusions to the issues raised by the sustainability assessment of safe vegetable production. The chapter begins by briefly exploring the role that safe vegetable production is playing in the agrarian transition in Vietnam. Next some reflections on the process of conducting the sustainability assessment are offered. In the following section the areas of tension between safe vegetable production and sustainable agriculture are discussed and suggestions made for ways in which safe vegetable production could be moved further along the path towards sustainability. The chapter concludes with some recommendations for further research.

7.2 Safe Vegetable Production and the Agrarian Transition

Safe vegetable production is one part of the agrarian transition that is underway in Southeast Asia. The agrarian transition has been defined as "the transformation of societies from primarily non-urban populations dependant upon agricultural production and organized through rural social structures, to predominantly urbanized, industrialized and market-based societies" (ChATSEA 2002). Safe vegetable farmers in the study sites have to greater and lesser extents expanded their non-farm income generation activities along with their farming activities. Their farm production has moved from subsistence and semi-subsistence production to what Rigg (2005) terms a "pluriactive" agrarian type, combining subsistence and commercial production with various non-farm income generation activities.

A generalized pattern of the transition from mixed crop production to safe vegetable production can be discerned for farmers in both Tan Phu Trung and Nhuan Duc (See Table 7.1). From the 1950s to the 1970s, most farmers were growing rice alone, or rice and mixed crops, including a small number of traditional vegetable varieties. Farmers mostly grew these vegetables for home consumption and saved their own seed. In the late 1980s and early 1990s farmers started to shift to commercial vegetable production and began using hybrid vegetable

seed and applying more fertilizers and pesticides. Then in the late 1990s there was another shift towards safe vegetable production, although this shift only occurred around 2005 in Nhuan Duc Commune. When growing safe vegetables, most farmers still use purchased hybrid seeds but they start reducing their use of chemical fertilizers and pesticides.

Table 7.1: Transition from Mixed Farming to Safe Vegetable Production

Farming System	Mixed Farming	Commercial Vegetable Farming	Safe Vegetable Farming
Timeline	1950s-1970s	1980s-1990s	1998-Present
Crops	Rice with or without field crops and limited number of traditional vegetable varieties.	Commercial vegetable production with or without rice and other field crops.	Commercial vegetable production with or without rice for family consumption.
Livestock	Mix of livestock for sale, home consumption and farm work.	Mix of livestock, some farmers with less land raise only poultry.	Mix of livestock, some farmers with less land raise only poultry.
Seeds	Traditional varieties, saved by farmers.	Introduction of hybrid vegetable seeds that have to be purchased.	Mostly hybrid seeds, some traditional varieties still saved.
Fertilizer	Composted livestock manure and limited inputs of chemical fertilizers.	Composted livestock manure and high inputs of chemical fertilizers.	Increased inputs of composted livestock manure and reduced inputs of chemical fertilizers.
Pesticides	Limited inputs of pesticides.	Heavy use of pesticides, often very toxic for humans.	Reduced pesticide use and shift to less toxic biopesticides.

In Figure 7.1 the various possible transitions in farming livelihoods in Cu Chi District are depicted. This diagram deals only with farming livelihoods and does not include off-farm activities other than to show the pool of former farmers who have stopped farming activities altogether. It can be assumed that all of the farmers to a greater or lesser extent engage in some non-farm activities. In the diagram, thick arrows represent major flows of farmers from one livelihood strategy to another, thin arrows represent minor flows and dotted arrows represent potential but unconfirmed flows.

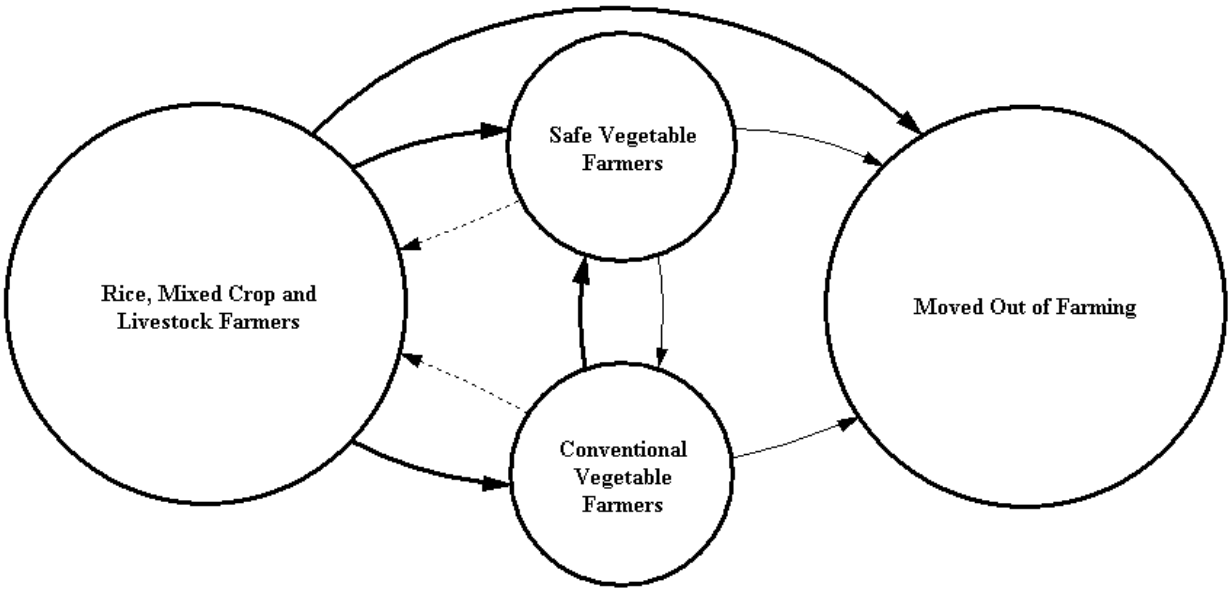


Figure 7.1: Transitions in Farming Livelihoods in Tan Phu Trung and Nhuan Duc

Most of the farmers in the study sites were at one point involved in mixed farming operations growing rice and other crops and raising livestock. While many farmers in the study sites are still practicing mixed farming, some of them started specializing in commercial vegetable production, either following conventional or safe vegetable practices. Many of the conventional vegetable farmers have started producing safe vegetables, but a number of former safe vegetable farmers were also encountered who have returned to conventional vegetable production, although they report to still be following safe vegetable practices even though their products are not marketed as such. Farmers from all categories are moving out of farming and into other sectors of the economy. These transitions may be voluntary, coming in response to increased opportunity in the industrial sector for example, or they can be involuntary, in the case of some safe vegetable farmers who have seen their land rezoned for future industrial parks.

The role that safe vegetable production is playing in the agrarian transition can be viewed from several different angles. Firstly, safe vegetable production can be seen as furthering the integration of farmers into the market economy as they specialize in vegetable production and enter into contracts with buyers. The increased regulations placed on safe vegetable farmers

may force some farmers out of farming and lead to the emergence of a group of professional farmers with larger landholdings and greater market integration. During fieldwork no evidence was found of this process occurring, but up until 2007 the safe vegetable standards were temporary and provided no mechanism for enforcement. The regulations on safe vegetable production have now been formalised and staff from DARD mentioned that they are investigating ways of forcing greater compliance with the regulations. Secondly, safe vegetable production can also be viewed as offering marginal rice farmers and farmers with only very small land areas the opportunity to continue farming through the production of higher value vegetable crops. Many farmers may continue to farm part-time and combine this activity with other non-farm income as can be seen already in Tan Phu Trung Commune. Thus safe vegetable production may lead to the emergence of both professional and part-time farmers as discussed by Rigg (2005). If domestic interest in organic foods grows in Vietnam, some safe vegetable farmers may move beyond safe vegetable production and start producing vegetables organically.

7.3 Reflections on the Sustainability Assessment Framework

By marrying the sustainability assessment criteria of Gibson et al. (2005) with the key principles from the literature on agroecology, sustainable agriculture and organic agriculture (Altieri 1989; Altieri and Hecht 1990; Altieri and Nicholls 2005; Conway 1985; Conway 1987; Francis 1988; Gliessman 2004; Pretty et al. 2001), this research set out to test and further the theory from the emerging field of sustainability assessment. A social-ecological systems approach guides the application of the sustainability assessment, allowing for the interactions between the social and ecological components of agroecosystems to be explored (see for example Kay et al. 1999; Waltner-Toews 2004; Waltner-Toews and Kay 2005; Waltner-Toews et al. 2004).

The first aspect of developing the sustainability assessment framework was distilling the relevant principles from the literature on agroecology and sustainable agriculture and turning these into requirements to be met when moving towards sustainability. The second aspect was deciding where these criteria best fit with the sustainability criteria of Gibson et al. (2005).

The sustainability assessment framework found in Table 2.2 underwent several iterations from the time the research proposal was developed to the thesis writing stage. This process mostly involved some minor adjustments to the ordering of some of the principles and the removal of some principles that were duplicated under several different criteria. These adjustments were made in order to facilitate the flow of the thesis. For example, I initially had the conservation of biodiversity listed under both "Social-Ecological System Integrity" and "Precaution and Adaptation". Likewise, the requirement for diversifying production strategies to reduce risk was initially listed under both "Livelihood Sufficiency and Opportunity" and "Precaution and Adaptation".

Many of the principles distilled from the agroecology literature could potentially fall under several of the sustainability criteria of Gibson et al. (2005). Ultimately I settled on a configuration of the sustainability assessment framework suitable for the purposes of assessing safe vegetable production in Cu Chi District, although it is still sufficiently broad to serve as a basis for the assessment of other agricultural activities and approaches. The process of reworking the framework is indicative of the interconnected and interdependent nature of many of the sustainability criteria. Gibson (2006) has pointed out that there is no need to follow the particular formation contained in the book and that practical applications of the sustainability assessment criteria will need to address issues of aggregation and comparison.

I want to reflect briefly on the criteria of "Intergenerational Equity" as I found this to be the most problematic of all the sustainability criteria to assess, particularly when it comes to the issue of using non-renewable resources. It seems to me that humanity has enough trouble ensuring equitable access to resources and opportunities for the current generation, let alone thinking about the future generations. This problem lies at the very heart of the concept of sustainability and it is the one that we most urgently need to come to terms with. While it may be very hard to come to any concrete conclusions on the issue of intergenerational equity, this criterion remains vitally important as a reminder of the need to plan for the future.

I will now reflect on the process of conducting a sustainability assessment as an individual researcher. Having gone through this process of collecting and analysing the data and

examining the results using the sustainability assessment framework, I have come to the conclusion that working individually on such an endeavour is not the ideal way to proceed. Deciding on which agroecological principles to include in the framework and which areas to focus on for data collection to a large degree reflected my individual areas of interest and expertise. A large part of my focus in this assessment was placed on the area dealing with resource maintenance and efficiency, particularly of non-renewable inputs. Another researcher might have chosen to include a list of different requirements within the sustainability assessment. Water is as important, if not more so, than inputs of fertilizer for agricultural production, but this area was underplayed in my research. While the sustainability criteria of Gibson et al. (2005) did force me to think broadly about relationships between the various criteria, I did at times find myself placing more attention on the areas in which I have background training, namely in ecology and agricultural science.

This tendency of researchers and experts to favour the areas of their disciplinary training could be overcome by conducting these sustainability assessments as part of a more broad based and participatory process, where the areas of focus are negotiated by the participants. Indeed this seems to be the approach favoured by Gibson et al. (2005) in sustainability assessment and by Waltner-Toews and Kay (2005) the adaptive methodology for ecosystem sustainability and health (AMESH). This is not to say that individual researchers have no role in conducting sustainability assessments, but their role may be best viewed as that of a facilitator. If I were to use this approach in the future, I would engage the farmers in a process of group discussion whereby they generate the areas of focus for the sustainability assessment.

Despite the misgivings discussed above in regards to applying this sustainability assessment as an individual researcher, it was still a valuable tool that yielded numerous insights into the agroecosystems of the study sites and the ways in which safe vegetable production could be moved further towards sustainability. The sustainability assessment framework developed as part of this research would have utility in assessing other agricultural programmes and projects with modest adjustments made to account for the specifics of each case. The following section outlines areas for improvement in safe vegetable production and discusses ways for moving further towards agroecosystem sustainability.

7.4 Moving Safe Vegetable Production Towards Sustainability

Safe vegetable production is helping many farmers to improve their economic situations while at the same time helping to protect human health. However, there are several areas of tension between safe vegetable production and sustainability. These areas of tensions are briefly summarised and suggestions are made for how they may be overcome, with the goal of moving safe vegetable production further towards sustainability. Recommendations are also made for a training program on safe vegetable production that could help farmers meet more of the sustainability principles outlined in the sustainability assessment framework.

Safe vegetable farmers are aware of the need to protect against soil erosion and maintain soil fertility. They employ a range of measures for reducing soil erosion, including the use of mulches on the soil surface and shadehouses made of large-weave mesh that reduces rainfall impact on the soil below. They also apply large quantities of composted livestock manure to add nutrients and improve the soil structure. Many farmers cover the soil surface with black plastic to prevent weed growth but the old plastic becomes an unsightly waste around the farm. One possible alternative to the black plastic would be the use of biodegradable weed mats, several types of which are available for use by organic farmers in North America.

While many farmers have reduced their use of chemical fertilizers since receiving training on safe vegetable production, many of them still apply amounts of chemical fertilizers in excess of the recommendations of the Agricultural Extension Centre of Ho Chi Minh City (Agricultural Extension Centre 2006). These recommendations in themselves specify very high inputs of chemical fertilizer for growing safe vegetables. Greater progress in further reducing chemical fertilizer use in safe vegetable production is needed. As oil and natural gas becomes more expensive, the costs of agrochemicals will continue to rise. This will likely force farmers to reduce their applications of chemical fertilizers and replace them with locally available organic fertilizers and soil amendments. Attention should also be placed on other measures for maintaining healthy soils, such as the use of crop rotations and nitrogen-fixing green manure crops. Even in the short term it is likely that farmers could reduce their use of chemical fertilizers and still improve the economic returns from their vegetable growing

(Leers 2006). Schemes to turn municipal organic waste into compost for use in peri-urban agriculture should be investigated further[6].

While there are some encouraging signs in relation to pesticide use, with some farmers reducing their pesticides usage and moving towards using less toxic pesticides, improvements are still needed. Some relatively toxic pesticides were still applied by some farmers and protective clothing appeared to be infrequently worn. Further attention to the issues of safe application and storage of pesticides is needed. Although many farmers have had training on safe vegetable production and integrated pest management, the use of pesticides, even if they are of a low toxicity, appeared to be their first line of defence against pests rather than the option of last resort as promoted in integrated pest management. More effort should be directed to further reducing the use of pesticides in safe vegetable production and replacing these with various ecological pest management techniques such as the use of traps, crop rotations and the promotion of natural predators. The experiences gained by the pioneering organic vegetable farmers in Vietnam will be beneficial in this regard.

The question of sustainable use of irrigation water in safe vegetable production is unresolved. Water availability may become an issue as patterns of climate and regional water use change. Further, groundwater should be tested to ensure pesticide and nitrate contamination is not occurring. Given the frequently cited concern regarding labour availability and the time required for watering crops, investment in micro-irrigation systems may prove worthwhile in the future to reduce both labour and water inputs.

At this stage the vast majority of vegetables produced in Vietnam are destined for the domestic market. It appears that in the case of safe vegetable production for the domestic market, there are few barriers to adoption, even for smallholders once they have received appropriate training. However, strengthening of the system of testing and enforcement is needed to improve consumer confidence in safe vegetables. For farmers, accessing foreign markets is more problematic than growing for the domestic market and requires the observance of even stricter rules on pesticide use and greater attention to issues of quality

[6] Dave Yousif, a fellow Masters student at the University of Waterloo, is investigating this subject for his thesis.

control. However, there are plans afoot to train more farmers to produce vegetables according to the more stringent EurepGAP standards and to encourage export. Exporting vegetables will presumably allow the farmers or other actors in the food system to realise larger profits, but this will also involve great expenditures of fossil fuels for processing and transportation and could thus be considered a step backward for sustainability.

The idea of maintaining or re-growing local food systems is rapidly gaining ground in many developed countries as the realities of climate change and high oil prices become evident to the general public. Initiatives that promote local food, such as farmers' markets, community gardens, backyard gardening and community-supported agriculture are growing in popularity and receive regular press coverage (See for example Early 2008; Vidal 2008; Xuereb 2006). Aside from the people's movements and NGOs promoting food sovereignty in developing countries, the ideas of national or regional self-sufficiency in food and subsistence agriculture have fallen out of favour in the recent era of economic liberalization and free trade. For many developing countries, the trade of agricultural products has been seen as the primary means for generating national income (Szirmai 2005). This has manifested in a bias towards export-oriented agriculture producing cash crops at the expense of national, regional and local food security. This may all be about to change. Rapidly rising prices for cereals in 2007-2008 has led to some countries, including Vietnam and India, to restrict their exports of rice in order to conserve domestic supplies and maintain affordable prices (Beaumont 2008).

In thinking about further progression toward agricultural sustainability, the work of Norgaard (1981) is enlightening. Norgaard (1981) points to four ways in which a surplus can be generated in an agroecosystem, including through (1) favourable changes in the environment; (2) generation of new knowledge about how to interact with the agroecosystem components; (3) new inputs into the system (or the removal of a loss from the system); or (4) a redistribution of power among the human actors in the system. In the original text, Norgaard (1981: 241) refers to the first point as "exogenous changes in the ecosystem which are favourable to man". However, if the social system and ecosystem are considered to be linked in one system, then it would be more useful to restate this point as "favourable changes in the environment", where the environment refers to that which is external to the system but with

which the system interacts through exchanges of energy, material and information. Not all of the processes identified by Norgaard for generating surplus in the system will lead towards sustainability, particularly if – when viewed from a broader spatial scale or over a longer timeframe – they involve "this generation living at the expense of the next or one region or group living at the expense of others" (Norgaard 1981: 240).

In order to move towards sustainability, it would seem then that the removal of transfers out of a system, the redistribution of power among actors in a system, and the generation of knowledge about a system, would be the best paths to travel. In the case of safe vegetable production in Vietnam this would mean reducing losses of nutrients and energy from the system, securing more favourable prices for farmers through negotiations with buyers and further supporting farmers with training that facilitates their active learning and experimentation on safe vegetable production. The removal of transfers of energy and nutrients out of the system implies a reinforcement of more localized food systems where energy and nutrients can be more easily cycled within the system. Practically, this means that when crops or livestock products are sold off-farm, that all wastes such as municipal organic waste and sewage are recycled back to farms as compost or cycled through bio-digesters to produce energy and liquid fertilizer. Farmers and their representatives also need to be empowered to negotiate with safe vegetable buyers in order to ensure that they are receiving fair prices for their produce. This could be achieved by training farmer representatives, such as safe vegetable cooperative managers, in effective communication and negotiation strategies for dealing with safe vegetable buyers.

Providing training to farmers in a way that enables them to become active experimenters will be particularly beneficial in helping to move safe vegetable production towards greater sustainability. The government agencies responsible for training farmers in safe vegetable production should pay greater attention to facilitating farmer learning about agroecosystem properties and processes and to promoting active farmer experimentation with safe vegetable production techniques. This would be best achieved by conducting on-farm experiential training over one or several growing seasons to allow farmers to observe ecological processes and experiment with the application of ecological pest management strategies and soil fertility

enhancement measures. The messages about protecting human health have already been adopted by most safe vegetable farmers. Training sessions should start to also focus on the importance of protecting ecosystem health and conserving resources for future generations. Topics for further exploration could include ecological pest management techniques, seed saving and the use of locally adapted vegetable varieties, crop rotations, companion planting and the use of green manure crops. Instead of feeling constrained by the legislation on safe vegetable production, farmers need to be encouraged to experiment with new production techniques and conservation measures that further the progression towards agroecosystem sustainability.

This research also uncovered and touched on some sustainability issues that go beyond safe vegetable production and have broader implications for the sustainability of farming in Vietnam. These issues include growing rural landlessness, income inequality between urban and rural people, the loss of traditional crop cultivars, specialization in farming systems and a loss of diversity and resilience, and the exodus of young people from farming. Many of these issues have no ready solutions and the intention here is only to draw attention to these issues and the need for future research and action in these areas.

7.5 Future Research

As briefly mentioned in the previous section, future research involving sustainability assessment of agricultural projects or programs could usefully include the participation of the actors in the system in specifying the various areas of focus under the broad sustainability criteria. Participatory research with farmers is also needed on various aspects relating to farm production, including developing methods of ecological pest management and alternative soil management strategies. The issue of water quality in the peri-urban zones around Vietnam needs urgent investigation to quantify the problem and address the sources of pollution. Studies are also needed to determine whether the use of groundwater for irrigation is leading to depletion of the aquifers. Many developing countries still have vibrant local food systems intact even though their central governments have not placed a strong policy emphasis in this area. Exciting opportunities exist for further studies on how the challenges facing world

agriculture are helping to reshape the debates around food sovereignty, food security and subsistence agriculture in developing countries, particularly in light of the current food crisis.

7.6 Summary

The challenges facing world agriculture are complex and interconnected. Humanity needs to urgently start addressing these challenges, particularly the twin issues of fossil fuel decline and climate change, if we are to maintain some semblance of the civilizations we have worked so hard to create. The move towards safe vegetable production in Vietnam is a small step along the road to greater sustainability, but many more steps need to be taken. While many of the farmers interviewed for this study mentioned that their livelihoods have improved over recent years, the exodus of young people from the farm to the factory points to a belief that greater opportunities lie elsewhere. Perhaps, as the Government of Vietnam is hoping, greater investment in mechanization will reduce the problem of labour shortages on the farm. However, the durability of this solution is questionable in an era of rapidly rising energy costs. As the energy crisis bites further, there is likely to be a return to land-based livelihoods. Countries with skilful and knowledgeable farmers who have protected their agricultural lands will have a better chance of riding out the coming storms and transitioning towards more sustainable agroecosystems in the future.

Appendix A – Interview Questions

Recording Form for Semi-Structured Interviews with Farmers

Interview Number:
Location:

1. Household Characteristics
1.1 Name:
1.2 Age:
1.3 Gender: M / F
1.4 Ethnicity:
1.5 How many people are in your household?
1.6 What is your level of education?
1.7 Does anyone in your household have formal agricultural training?
1.8 Are you a member of a farmer cooperative? Why/why not?
1.9 How many years have you lived in this commune?
1.10 Do you plan to stay in this commune? Why/why not?
1.11 Do your children plan to continue farming? Why/why not?
1.12 What proportion of your household income is from farm and non-farm sources?
1.13 How has your living standard changed from 5 years ago?
1.14 How many people work on your farm?

2. Farm Characteristics
2.1 How much land do you have? (homegarden, own farm and rented land)
2.2 What crops do you grow on your land? (type, number per year, area of shadehouse)
2.3 Do you grow a greater diversity of crops now compared to 5 years ago? Why/why not?
2.4 Do you ever save your own seeds? Why/why not?
2.5 How much fertilizer do you use to grow these crops?
2.6 Do you use more or less fertilizer than 5 years ago? Why/why not?
2.7 How much pesticide do you use to grow these crops?
2.8 Do you use more or less pesticides than 5 years ago? Why/why not?
2.9 What animals do you raise on your land?
2.10 What plans do you have for your farm in the future?

3. Sustainable Agriculture
3.1 What do you think are “good agricultural practices”?
3.2 What does “safe vegetables” mean to you?
3.3 How long have you been growing “safe vegetables”?
3.4 Why did you start growing “safe vegetables”?
3.5 How did you learn about “safe vegetables”?
3.6 Has your farm income improved since you started growing “safe vegetables”?
3.7 Have you been telling your neighbours about growing “safe vegetables”?
3.8 Are there any problems growing “safe vegetables”?

Recording Form for Semi-Structured Interviews with Key Informants

Interview Number:
Location:

About Your Organization

1.1 What is the full name of your organization?
1.2 What is your position in the organization?
1.3 How long have you been in this position?
1.4 What are the vision, mission and goals of your organization?
1.5 What are the roles and responsibilities of your organization?
1.6 What is the structure of your organization?
1.7 How many staff in your organization?

Sustainable Agriculture

2.1 What does the term "sustainable agriculture" mean to you?
2.2 What does the term "organic agriculture" mean to you?
2.3 What does the term "safe vegetables" mean to you?
2.4 What type of sustainable agriculture is your organization is promoting?
2.5 What goals do you hope to achieve by promoting sustainable agriculture?
2.6 In which regions are you promoting sustainable agriculture?
2.7 How many farmers are participating?
2.8 What types of crops and livestock are being produced?
2.9 What method of extension is used to spread sustainable agriculture to farmers?
2.10 Is active farmer experimentation encouraged by this extension method? If so, how?
2.11 Does your extension approach build on farmers' existing knowledge?
2.12 Are farmers spreading these approaches amongst themselves?
2.13 What has been the result of your sustainable agriculture program?

Challenges to Agriculture

3.1 What are the main challenges facing the agricultural sector in Vietnam?
3.2 How do you think these challenges can be overcome?
3.3 What are the specific challenges that you have found in your target areas?
3.4 How do you think these challenges can be overcome?

Agriculture and Climate Change

4.1 Do you perceive climate change to be a challenge to agriculture in Vietnam?
4.2 Is your organization doing anything to prepare farmers for the challenges of climate change? If so, please describe these activities.

Energy Supplies and Agriculture

5.1 Do you perceive declining energy supplies to be a challenge to agriculture in Vietnam?
5.2 Is your organization doing anything to prepare farmers for the challenges of declining energy supplies? If so, please describe these activities.

Group Discussion Questions for Farmers

Location:
Number of farmers attending:

Outline of the Group Discussion

1. Timeline of agricultural development and change in the commune.
2. Venn institutional diagram of organizations collaborating with farmers.
3. SWOT analysis of the strengths, weaknesses, opportunities and threats around safe vegetable production.

Extra Topics for Discussion

1. Why do you grow “safe vegetables”?
2. Do you experience any problems growing “safe vegetables”? (field level problems)
3. How can these problems be solved?
4. What are the main challenges you face as farmers? (social level problems)
5. What solutions do you suggest to solve these challenges?
6. Have you noticed any changes in the rainfall in your area?
7. Have you noticed any changes in the temperature in your area?
8. Have you noticed any changes in the length or timing of the wet and dry seasons?
9. Have you noticed any changes in the type and number of pests in your area?
10. Have you changed your farming practices to adapt to these changes? How?
11. Have you ever heard of “climate change”?
12. If yes, how did you hear about it?
13. Has the cost of pesticides been increasing?
14. Has the cost of fertilizer been increasing?
15. If yes, what have you been doing about these increased costs?

Appendix B – Pesticides Used By Farmers

List of Insecticides Used by Safe Vegetable Farmers in Cu Chi District

Name of Insecticide	Active Element	Chemical Class	Toxicity Group*	Target Pest	Crop Type	Farmers TPT (#)	Farmers ND (#)
Abamectin, Phumai, Tap Ky, Vibamec	Avermectin B1a 80% Avermectin B1b 20%	Bacterium	U	Mites	Leaf, fruit & tuber veg	11	9
Ammate 150 SC	Indoxacarb	Oxadiazines	III	Leaf-eating insects	Leaf & fruit vegetables	0	6
Apfara 25 WDG	Thiamethoxam 95%	Nitroguanidine	Not listed	Leaf & sap-feeding insects	Leaf & fruit vegetables	1	0
Atbron 5 EC	Chlorfluazuron 94%	Chitin synthesis inhibitor	U	Leaf-eating insects	Leaf vegetables	1	0
Confidor 100 SL, Vicondor 50 EC	Imidacloprid 96%	Chloro-nicotinyl	II	Sap-sucking insects	Leaf & fruit vegetables	0	3
Dầu Khoáng DS 98.8 EC	Petroleum Spray Oil	Mineral Oil	U	Sap-sucking insect & mites	Leaf, fruit & tuber veg	1	0
Dipel	*Bacillus thuringiensis* var. kurstaki	Bacterium	U	Leaf-eating insects	Leaf, fruit & tuber veg	6	7
Dogent 88 WP	Acetamiprid 20 g/kg + Fipronil 780 g/kg	Chloro-nicotinyl + Pyrazole	II	Leaf & sap-feeding insects	Leaf & fruit vegetables	0	1
Dragon 585 EC	Chlorpyrifos-ethyl 53% + Cypermethrin 5.5%	Organo-phosphorus + Pyrethroid	II	Insects & nematodes	Leaf, fruit & tuber vegetables	1	0
Furadan	Carbofuran	Carbamate	Ib	Insects, mites & nematodes	Leaf, fruit & tuber veg	0	1
Garlic Biopesticide	Garlic Oil	Botanical	U	Leaf & sap-feeding insects	Leaf, fruit & tuber veg	2	0
Kuraba WP	Avermectin 0.1% + *Bacillus thuringiensis* var. kurstaki 1.9%	Bacterium	U	Leaf-eating insects & mites	Leaf, fruit & tuber vegetables	1	0
Lannate	Methomyl	Carbamate	Ib	Insects & mites	Leaf, fruit & tuber veg	0	1
Mimic 20F	Tebufenozide 99.6%	Diacylhydrazine	U	Leaf-eating insects	Leaf & fruit vegetables	1	0
Neem Biopesticide	Azadirachtin	Botanical	U	Leaf & sap-feeding insects	Leaf, fruit & tuber veg	1	0
Pesta 5 SL	Eucalyptol 70%	Botanical	U	Leaf-eating insects	Leaf & fruit vegetables	3	0
Polytrin P 440 EC	Cypermethrin 40 g/L + Profenofos 400 g/L	Pyrethroid + Organo-phosphorus	II	Leaf & sap-feeding insects	Leaf, fruit & tuber veg	1	0
Regent	Fipronil 95%	Pyrazole	II	Leaf & sap-feeding insects	Leaf & fruit vegetables	1	5
SecSaigon	Cypermethrin 90%	Pyrethroid	II	Leaf & sap-feeding insects	Leaf, fruit & tuber veg	2	0
Success 25 SC	Spinosad 96.4%	Bacterium	U	Leaf-eating insects	Leaf, fruit & tuber veg	0	1
Vironone 2 EC	Rotenone	Botanical	II	Leaf & sap-feeding insects	Leaf, fruit & tuber veg	1	0
Vovinam 2.5 EC	Lambda-cyhalothrin 81%	Pyrethroid	II	Leaf & sap-feeding insects	Fruit & tuber veg	1	0

List of Fungicides Used by Safe Vegetable Farmers in Cu Chi District

Name of Fungicide	Active Element	Chemical Class	Toxicity Group*	Target Pest	Crop Type	Farmers TPT (#)	Farmers ND (#)
COC 85 WP	Copper Oxychloride	Inorganic Copper	III	Anthracnose, rust, leaf spot	Leaf, fruit & tuber veg	2	1
Kasumin 2L	Kasugamycin 70%	Aminoglycoside	U	Rot, leaf spot & leaf mould	Fruit & tuber veg	0	1
Mancozeb 80 WP	Manganese Ethylene 85%	Dithiocarbamate	U	Mildew, leaf spot & fruit rot	Fruit & tuber veg	0	2
Mataxyl 25 WP	Metalaxyl 95%	Benzenoid	III	Mildew, white chalk, leaf spot	Leaf, fruit & tuber veg	0	2
Ridomil MZ 72 WP	Manganese Ethylene 64% + Metalaxyl 8%	Dithiocarbamate + Benzenoid	III	Mildew, white chalk, leaf spot & fruit rot	Leaf, fruit & tuber vegetables	4	7
Score 250 EC	Difenoconazole 96%	Conazole	III	Smut, white chalk, leaf spot & fruit rot	Fruit & tuber vegetables	3	0
Tilt Super 300 EC	Difenoconazole 150g/L + Propiconazole 150g/L	Conazole	II	Smut, white chalk, leaf spot & fruit rot	Fruit & tuber vegetables	1	0
V-cin 5 L	Validamycin A 40%	Carbohydrate	U	Damping off diseases	Leaf, fruit & tuber veg	1	0
Vicarben	Carbendazim 98%	Benzimidazole	U	Many fungal pathogens	Leaf, fruit & tuber veg	0	1

(*WHO Pesticide Classification: Ia = Extremely Hazardous, Ib = Highly Hazardous, II = Moderately Hazardous, III = Slightly Hazardous, U = Unlikely to present acute hazard in normal use).

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