

# Institutional Arrangements for Composting and Compost Use in Ho Chi Minh City, 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.

## **Abstract**

The staggering levels of growth and development resulting in a more populous and affluent society that Vietnam is experiencing have resulted in greater levels of consumption and environmental damage from agricultural intensification (over-use of chemical fertilizers) and solid waste pollution. A traditional method touted as a modern solution is organic solid waste recycling and composting. This thesis seeks to determine the potential of compost use in Ho Chi Minh City, Vietnam based on a decentralized community-based composting scheme. In recent decades, in Vietnam and other developing countries, there has been an emphasis on large-scale, mechanized composting processes using mixed waste as the input material and technologies that are inappropriate for use in a developing country. These processes face high operational costs and a lower quality final product, leading to more problems than they promise to cure. This study examines three institutional models currently advocated in the literature to manage organic waste in developing countries: decentralization, privatization, public-private partnerships. This thesis focuses on how to redefine the manner in which organic waste is composted and concludes in favour of small-scale community-based composting. A small-scale community-based model currently in use in Quy Nhon, in central Vietnam is examined to determine its applicability in Ho Chi Minh City, Vietnam. The major contribution of this thesis is the use of institutional models (community-based management, decentralization, privatization, and public-private partnerships) to further understand the system of composting using municipal solid waste in developing countries. This understanding is used to present a framework that outlines the necessary institutional change to facilitate the development of initiatives that would manage organic solid waste.

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And finally, a big thank you to my parents for guiding me through this journey.

## **Dedication**

I dedicate this thesis to my parents. In honour of my father, Dr. Yousif A. Yousif and in memory of my mother, Kifah Algudady.

It is because of their struggle for freedom and a better way of life for their children that I am able to write this dedication in my thesis. I love you both and I miss you mom.

## Table of Contents

List of Figures .....	ix
List of Tables .....	x
Abbreviations .....	xi
Chapter 1 Introduction .....	1
1.1 Defining the Research Problem.....	3
1.1.1 Urban and Peri-urban Agriculture and Food Security .....	3
1.1.2 Solid Waste .....	5
1.1.3 Urban Governance.....	6
1.2 Research Statement and Objectives .....	7
1.3 Research Framework.....	8
1.4 Contribution of the Thesis.....	10
1.5 Thesis Structure.....	11
Chapter 2 The Governance of Solid Waste: Literature Review .....	13
2.1 Introduction.....	13
2.2 Urban Management and Governance .....	13
2.2.1 Community-based Management.....	16
2.2.2 The Challenges of Decentralization .....	19
2.2.3 The Impact of Privatization on Solid Waste Management Systems .....	21
2.2.4 Public-Private Partnerships .....	24
2.3 Population Growth and Urbanization, Agriculture and Solid Waste Management .....	25
2.3.1 Population Growth and Urbanization .....	25
2.3.2 Urban and Peri-urban Agriculture and Food .....	27
2.3.3 Solid Waste Management in Developing Countries.....	30
Chapter 3 Research Methodology .....	39
3.1 Introduction.....	39

3.2 Research Purpose .....	39
3.3 Conducting Research in Vietnam .....	39
3.4 Research Phases and Data Collection Methods.....	40
3.4.1 Secondary Data.....	41
3.4.2 Primary Data.....	41
3.4.3 Data Analysis.....	43
3.5 Limitations.....	43
Chapter 4 Regional and Local Context.....	45
4.1 Introduction.....	45
4.2 Environment in Vietnam .....	47
4.3 Ho Chi Minh City.....	48
4.4 Agricultural Sector.....	51
4.4.1 The Changing Face of Agriculture.....	51
4.4.2 The Link Between Waste and Urban and Peri-urban Agriculture .....	53
4.5 Development Context .....	55
4.6 Context for the Use of Compost in Urban and Peri-urban Agriculture in HCMC .....	56
4.6.1 Decentralization in HCMC .....	57
4.6.2 Impact of Equitization, Public-private Partnerships and Community-based Composting in HCMC.....	58
Chapter 5 Solid Waste and Agricultural Systems of HCMC: Findings and Discussion .....	61
5.1 Introduction.....	61
5.2 Solid Waste Management in Vietnam .....	62
5.3 Solid Waste Management in HCMC.....	62
5.3.1 The History of Solid Waste Management in Vietnam and HCMC.....	66
5.3.2 Institutional Organization and Management.....	70
5.3.3 Collection and Transportation.....	76
5.3.4 Disposal.....	78

5.3.5 Recycling .....	79
5.3.6 Composting.....	80
5.4 Solid Waste Management in Quy Nhon.....	88
5.4.1 Large-scale Composting in Quy Nhon .....	90
5.4.2 Use of Compost by HCMC Farmers .....	91
Chapter 6 Conclusion and Recommendations.....	96
6.1 Changes and Implications of the marketization reforms on HCMC’s Municipal Solid Waste System.....	97
6.2 Partnerships and Institutional Frameworks Necessary for the Support of a Composting Program in HCMC.....	99
6.3 Potential Compost Use in Urban and Peri-urban HCMC.....	102
6.4 Recommendations .....	104
6.5 Filling the Gap: Spatial Linkages.....	105
 Bibliography .....	 106
 Appendices.....	 120
Appendix A - Interviews .....	120
Appendix B - Interview Questions for Solid Waste Officials .....	122
Appendix C - Farmer Survey .....	123
Appendix D - Photographs.....	124



## List of Figures

Figure 1 - Dimensions of the Analysis of Composting and Compost Use in HCMC.....	9
Figure 2 - Final Products of Organic Solid Waste.....	33
Figure 3 - Map of Vietnam .....	46
Figure 4 - Map of HCMC.....	49
Figure 5 - Map of Cu Chi District, HCMC.....	50
Figure 6 - Fertilizer Use in Vietnam from 1961 to 2005 .....	53
Figure 7 - Municipal Solid Waste Collected Per Day in HCMC (1983-2005).....	64
Figure 8 - HCMC Solid Waste Management System.....	72
Figure 9 - Solid Waste Generation in HCMC (2006).....	81
Figure 10 - Organic Waste to Landfill to Biogas and Compost Specialized Plan .....	87

## **List of Tables**

Table 1 - Quantity of Municipal and Commercial Solid Waste Collected Per Day in HCMC from 1983-2005 .....	63
Table 2 - Regulations Dealing with Waste .....	73
Table 3 - Existing Composting Plants in Vietnam.....	82
Table 4 - Summary of Results from Farmer Survey .....	93

## **List of Abbreviations**

CITENCO – City Environmental Company  
DARD – Department of Agriculture and Rural Development  
DONRE – Department of Natural Resources and Environment  
DOSTE – Department of Science, Technology and Environment  
DPWSC – District Public Works Service Company  
ENDA – Environmental Development Action in the Third World Vietnam  
FAO – Food and Agriculture Organization  
FDI – Foreign Direct Investment  
HCMC – Ho Chi Minh City  
MOSTE – Ministry of Science, Technology and Environment  
NPK – Nitrogen, Phosphorus, Potassium  
PC – People’s Committee  
PPP – Public-Private Partnerships  
SWTE – Solid Waste Treatment Enterprise  
UNCHS – United Nations Centre for Human Settlements  
UNDP – United Nations Development Programme  
UNESCAP – United Nations Economic and Social Commission for Asia and the Pacific  
VND – Vietnamese Dong



# Chapter 1

## Introduction

Cities and towns are marvellous and vital instruments of exchange, vital for the development of economic systems and social organizations.

Freire, 2001, p. xvii

Since human beings have inhabited the earth, they have generated, produced, manufactured, excreted, secreted, discarded, and otherwise disposed of all manner of waste. Among the myriad kinds of rejectamenta, refuse-solid waste has been one of the most abundant, most cumbersome, and potentially most harmful to society. Beginning with ancient civilization, there has always been a refuse problem.

Melosi, 1981, p. 3

Waste problems are said to be the mirror of a society.

Sakurai, 2000

In the last 100 years, population growth and rapid urbanization have resulted in many environmental problems. One of the most significant human alterations to the global environment has been the expansion and intensification of agricultural land particularly throughout the use of synthetic inputs, such as chemical fertilizers. This has led to concerns over the long term sustainability, and health and environmental consequences of the expansion and intensification of agricultural systems. Compounding this problem is the encroachment of cities into the countryside. As a result, the make-up of the global environment has been radically transformed. The intensification of agricultural practices that were meant to cope with significant population growth by providing food security have instigated major challenges to urban and rural planning with regard to food safety, waste

management, and environmental protection (Rigg, 2001). A growing urban population creates significant problems at both ends of the food chain. At one end, a population is reliant on vast amounts of resources, nutrient rich agricultural fields for food, and at the other end, is the solid waste that is created as a result of this increased consumption.

The root of the solid waste problem begins with the over-consumption of resources by humans. A growing urban population concentrates increasing levels of used products and materials that require disposal in or near urban centres. These problems are exacerbated by the changing and often inequitable political measures resulting from incomplete institutional frameworks. Limiting product consumption (the notion of limiting consumerism and the idea of reduce, reuse, and recycle) has not yet advanced to the forefront of public policy in developing countries, a predicament that rests on government reluctance to slow down an economic engine that is powered by consumption.

In this introductory chapter, the scope of the problem outlined above is addressed by linking solid waste management to urban and peri-urban agriculture. A case study of Ho Chi Minh City (HCMC), Vietnam was used to determine, firstly, the potential for the use of compost<sup>1</sup> in urban and peri-urban agriculture and secondly, whether composting can help relieve some of the pressure placed on urban centres dealing with growing and changing amounts of waste. Three key bodies of literature are reviewed to frame the research problem and provide a basis for the case study: urban and peri-urban agriculture, urban solid waste, and urban governance. The conceptual framework which is the basis for this research is then outlined. The chapter ends with the research statement and objectives that oriented the research reported in this thesis, and an outline of the thesis structure.

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<sup>1</sup> The term 'compost' in this thesis refers to the soil conditioner processed from organic solid waste.

## **1.1 Defining the Research Problem**

### **1.1.1 Urban and Peri-urban Agriculture and Food Security**

Although urban and peri-urban agriculture in many parts of the world is performed as a kind of informal sector activity on lands not zoned as agricultural, the forms of agriculture referred to in my analysis in Ho Chi Minh City are conventionally on land zoned as agricultural. However, industrial activities are fast encroaching on these lands and conversion of land use zoning to non-agricultural uses is increasingly common. These same areas are also progressing through the process of urbanization (Hubbard & Onumah, 2001). Given the enormous amount of food required to feed a growing city, urban and peri-urban agriculture is perceived to be a means to provide the food required without entirely putting further strain on resources and polluting the environment. Nelson (1996) contends that as cities grow, their ecological footprint can be reduced in a variety of ways using urban and peri-urban agriculture. These include the urban and peri-urban farmers that convert municipal organic waste into a useful soil conditioner, such as compost. Also include, farmers that contribute to the greening of a city by farming available open land, and the fact that less food has to be transported into the city contributes to sustainability and has a positive environmental impact. In addition to supplying food to growing cities, urban and peri-urban agriculture may provide relief to migrant agricultural labourers by engaging them in the activities they know best and providing a means to earn an income, especially when they cannot find other jobs in the early stages of migration.

From 1700 to 1980 the total area of cultivated land globally increased more than four-fold (466%) (Matson, 1997). Also, 10 to 15% of the earth's land surface is estimated to be occupied by row crop agriculture and 6 to 8% is used primarily as pasture land (Vitousek et al., 1997). In Asia for the past 30 years, agriculture has been transformed in order to keep up with population growth. Mono-cropping and increased use of synthetic inputs are two examples of this transformation. The intensification of agriculture with the use of synthetic

inputs such as chemical fertilizers has increased rapidly (FAO, 2006). In the early 1960s developing countries (including China) accounted for 14% of world fertilizer consumption. By the early 1970s their share had increased to 20%. By the late 1980s, the developing countries' share of the total, which had more than doubled since the early 70s, had reached 42% (FAO, 1989). By the 21<sup>st</sup> century their share reached 63% (FAO, 2003).

Matson (1997) reveals that it is apparent that agricultural expansion and intensification can have harmful environmental consequences. These consequences include erosion, poor soil fertility, and reduced biodiversity; damaging regional consequences, such as pollution of ground water and eutrophication of rivers and lakes; and destructive global consequences, including impacts on atmospheric elements and climate through the release of organic carbon from rocks, organisms and soils in the form of CO<sub>2</sub>.

In Vietnam and other Southeast Asian countries, the increase in use of synthetic inputs (see Appendix D, Photo 1), coupled with an increasingly affluent and health conscious population, have resulted in growing concerns over food safety and, thus, demands for 'safe' vegetables. This term refers to vegetables produced using more sustainable cultivation methods, safe water and soil, and limited application of agrochemical inputs. To meet this demand for safe vegetables, farmers utilize more environmentally friendly methods of production and cultivation, including organic inputs such as compost, as an alternative to chemical inputs (Moustier et al., 2006).

However, the recent history of Vietnam shows that prior to reaching this stage of demand for safe and more organic vegetables, national food security needed to first be met. Serious food shortages during the post war<sup>2</sup> rehabilitation and pre *doi moi* reform periods (1975-

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<sup>2</sup> The war in question refers to the 1960s and 70s militarized conflict between the Democratic Republic of Vietnam (communist North) and the Republic of Vietnam (the South supported by the United States). From this point onwards in this thesis, this conflict will be referred to as the 'war'.



1986) revealed that the level of agricultural system intensification mentioned above was a necessary factor in the establishment of national food security. According to official statistics, in 1976 Vietnam's national rice production fell from approximately 12 million tonnes to 10.6 million tonnes in one year. In 1978, production was even less, at 9.79 million tonnes. While this was not an overtly dramatic decrease, the decline in production caused economic problems for Vietnam, which were compounded in December 1978 by a cessation of trade with China after Vietnam's invasion of Cambodia, and extreme typhoon rains that destroyed the crops of several provinces. By 1980, annual per capita rice production had fallen to 157 kilograms in northern Vietnam, and both the Mekong and Red River deltas were producing less rice per capita than they had at the end of the war in 1975 (Raymond, 2003). However, today Vietnam is a leading international exporter of rice, coffee, tea, and rubber.

This transformation to a major producer of foodstuff was an important factor distinguishing the period of fast growth in the decade of the 1990s from the period of economic crisis in the 1980s (Rigg, 1997). While growth in food production kept pace with population growth in Vietnam since 1989, an increase in purchasing power among the Vietnamese population allowed for an increase in and diversification of food consumption (Le et al., 2003). Yet this translated into higher levels of solid waste.

### **1.1.2 Solid Waste**

Solid waste management is one of the most costly urban services. On average, for most developing countries it absorbs 20 to 50% of city revenues and up to a percentage point of the gross national product (Cointreau, 1982; Cointreau-Levine, 1994). Poor institutional programs and strategies in the developing world exacerbate this problem as many residents are unwilling or unable to pay for waste management services, especially if these are of dubious quality. The uncontrolled dumping and proliferation of refuse in streets and waterways creates a serious health problem. The impact of poor waste management

practices on the natural environment (land, water, air) is now finally being understood and acknowledged in developing countries. In developing countries, the recent change in composition and quantity of waste produced by a growing and more affluent population has had a direct negative impact on public health and the natural environment.

In developing countries, the proportion of organics in the waste stream can account for as much as 70% (Srinivas, 2001). This high proportion of organics in the waste stream creates a potentially attractive scenario for composting. Composting can reduce waste disposal costs and the negative impacts indicated earlier while producing a marketable soil conditioner for agricultural use. Conventional composting initiatives and projects using urban solid waste have been well documented in the developing world. Their successes and mostly failures continue to raise questions as to the compatibility of such projects in developing countries. Cities seeking an alternative to conventional large-scale composting projects have sought small-scale community-based initiatives. While community-based composting is not new, it is only within the past few years that the concept has taken off globally (Bhuiyan, 2005).

### **1.1.3 Urban Governance**

In the major cities of developing countries, between a third and two thirds of the solid waste generated goes uncollected, piling up on streets and in drains, contributing to flooding and the spread of disease (Furedy, 1992). All the challenges and complexities facing mega cities in developing countries create a condition that results in poor solid waste management practices. Typically, solid waste management systems of developing countries are marked by mismanagement and continuous institutional disorganization and fragmentation.

“By their very nature, urban dilemmas are almost always multisectoral and city management has to be studied from a variety of angles and disciplines” (Stren, 1996, p. 393). Cities in developing countries face a number of challenges in their attempt to provide

good governance. The World Bank (1992) defines governance as “the manner in which power is exercised in the management of a country’s economic and social resources for development.” This definition of governance essentially emphasizes the importance of strong leadership (the manner in which states manage and use, or misuse power) and political empowerment in the management of solid waste. However, as Onibokun and Kumuyi (1999) and Mahadevia (2001) point out, this has not been the case in India, or in other parts of Asia and in parts of Africa. For example, Onibokun and Kumuyi (1999) emphasize organization, transparency, accountability, creditability, and stability of government in the management of solid wastes.

In this increasingly global world, Freire (2001) argues that cities in developing countries have to be managed in an attractive manner for businesses and foreign investment in order to generate income and employment opportunities for their citizens. This type of management in turn is presumed to provide a good livelihood for the local population generating enough resources to finance infrastructure and social needs, and to take care of the poor. It is the chance or opportunity for upward mobility that provides the attraction for rural migrants. However, living conditions for the newly arrived migrants can be considered to be below an acceptable level. Cities overwhelmed with this constant influx have frequently been unable to keep up with the provision of basic services including waste collection, processing, and disposal.

## **1.2 Research Statement and Objectives**

In 2006, the residents of Ho Chi Minh City (HCMC) generated over 2 million tonnes of municipal solid waste. Alongside growing population and urbanization levels in HCMC, levels of waste are expected to increase significantly in the next few years, placing further strain on existing infrastructure and resources already under stress. Relatively little attention is devoted to the sustainable management of organic waste which can account for as much as 70% in the waste streams of many cities in developing countries. While there

are many types of municipal solid waste (organic and inorganic, hazardous and non-hazardous), the focus of this study is on organic waste. This thesis examines the municipal solid waste management system of HCMC in order to determine the potential use of compost in urban and peri-urban agriculture. Through primary and secondary sources, my study seeks to identify the role a city, community, and private/informal sector can play in the management of organic solid waste and the production of compost. This is examined in relation to management priorities, policy regulations, as well as technical, economic and logistic constraints.

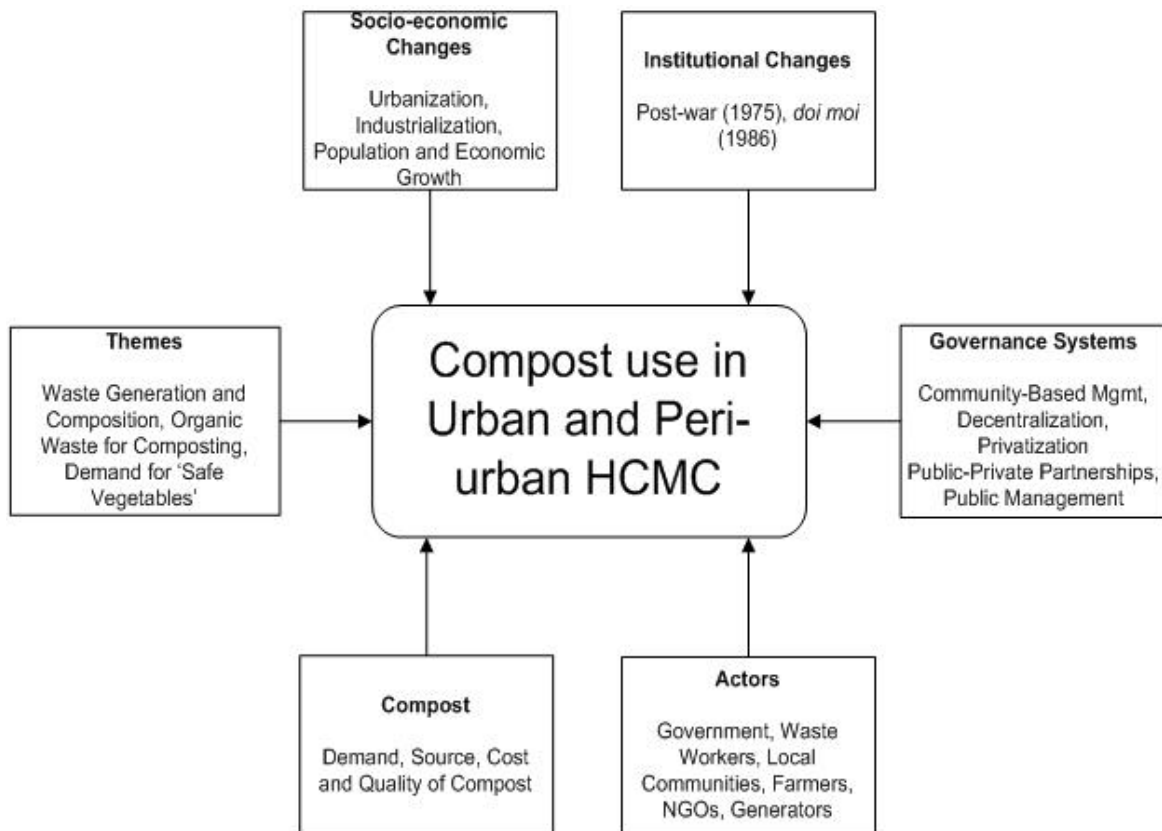
To determine the likelihood of compost use in urban and peri-urban agriculture the following objectives are established:

- To identify the implications of the increasing marketization of the economy on HCMC's municipal solid waste system;
- To evaluate the institutional models, including decentralization, privatization, public-private partnerships and community-based management, that are necessary for a composting program in HCMC; and
- To determine the potential of compost use in urban and peri-urban agriculture HCMC based on the above objectives and HCMC's current solid waste management system.

### **1.3 Research Framework**

In the solid waste and agricultural literature (see Mosler et al., 2006; Furedy, 1992), there is much cautious optimism with regard to the value of urban and peri-urban agriculture as one means for dealing with urban solid waste. However, to implement this strategy there are many challenges that first need to be overcome. Lardinois and Furedy (1999a) argue that the effectiveness of composting programs could be improved by good governance, successful source separation and the development of a strong market for compost.

In HCMC, the factors that influence the use of compost in urban and peri-urban agriculture include the various institutional, economic, and political changes that have occurred in the past 30 years (Figure 1). Good governance is also a factor in the quest for improved solid waste management services and compost use in urban and peri-urban agriculture. While still controversial, decentralization and privatization is perceived as a specific action that governments in developing countries can take and have taken to achieve success in solid waste management. Public-private partnerships arise from privatization. These actions are further examined in chapter 4, with specific examples provided. The actors in the solid waste management and agricultural system that play a major role in composting and compost use include the various government official and policy makers, solid waste workers, local communities, farmers, NGOs and the generators of waste.



**Figure 1 - Dimensions of the Analysis of Composting and Compost Use in HCMC**

#### **1.4 Contribution of the Thesis**

This thesis provides three main contributions to current literature on composting municipal solid waste in developing countries and HCMC. The first is an important empirical contribution building on the limited literature on solid waste management systems in HCMC. This provides a characterization of the current institutional model in place to manage solid waste. Although HCMC is Vietnam's commercial capital and largest city, the majority of solid waste related research has been conducted in other parts of the country (see Byer et al., 2006 and Nguyen, 2005 for a waste audit study conducted in Da Nang and Ha Long; DiGregorio, 1994 for a look at Hanoi's informal waste workers; Gray-Donald, 2001 for a study on using education to improve waste management in Hanoi; and Richardson, 2003 for a look at three community-based initiatives in Hanoi). This thesis advances knowledge on the evolution of Southeast Asia's large cities as personified by HCMC in regards to their waste management system and its interface with agriculture. Using both a waste management and agricultural perspective, this thesis highlights the significant population growth and rapid urbanization experienced in HCMC. This creates an interesting case where the two perspectives are examined together exploring the potential for composting and compost use.

The second contribution is to the literature on institutional models necessary for composting municipal solid waste. The current literature on community-based management (see Asomani-Boateng, 1997), decentralization (see World Bank, 2000 and Burki et al., 1999), privatization (see Brune et al., 2003 and Cointreau-Levine, 1994) and public-private partnerships (see Massoud & El-Fadel, 2002) have independently embraced the models and the range of benefits they promise to provide without acknowledgement of other models that might be of use. This thesis complements the above literature to a certain extent and determines that components of the four models can be used in the development of a successful composting program. However, this thesis does not recommend that one of

these models be used to the exclusion of the other models. For example, a community-based management program will achieve additional success by incorporating components of decentralization (increased authority at the lower level of government) or privatization (efficiency).

The third contribution of this thesis is to provide additional evidence to the literature regarding the challenges to composting solid waste and the use of compost in developing countries. Over the past two decades the amount of solid waste generated and collected in HCMC has increased dramatically, posing a number of processing and disposal problems. The majority of waste collected is unprocessed and the landfills/dumps are filling up rapidly. Taking into consideration that organics make up a significant portion of the waste stream, composting offers a practical option for alleviating the HCMC's waste collection, processing and disposal problems, and for mitigating pollution. However, as this thesis will show, composting in HCMC and Vietnam has been fraught with a number of institutional, operational, and financial problems.

### **1.5 Thesis Structure**

This thesis is organized in six chapters. This introductory chapter provides a background to the agricultural and solid waste management problem in developing countries. The first chapter also sets out the research agenda and questions of the study. The second chapter reviews the main themes, theories and research traditions drawn upon for this study. These include urbanization, community-based management, decentralization, privatization and public-private partnerships. Chapter three outlines the methods used for data collection and analysis. The fourth chapter sets the case study context and provides justification for the selection of Vietnam as the study site. Chapter five provides the case study results and discussion. The concluding chapter provides recommendations based on the results of the potential use of compost in urban and peri-urban agriculture and is a critical reflection on

the research experience, highlighting the main insights from the study and suggestions for future research.



## **Chapter 2**

### **The Governance of Solid Waste: Literature Review**

#### **2.1 Introduction**

To clarify a number of issues in the governance of solid waste, the following underlying questions are addressed in this section: what are the necessary features of a good governance system, what are the problems hindering the attainment of good governance, and what actions are needed in order to address these problems?

This chapter outlines the conceptual approach used in this study. It provides a rationale for the choice of approach and explains how governance, community-based and decentralization approaches were used to analyze the research. The review of literature consists of two main sections. The first section discusses the governance and urban management of cities. Within the scope of governance and urban management is community-based organizations and decentralization, which includes the concepts of privatization and public-private partnerships. The second section looks at the trends of population growth and rapid urbanization. These trends explain the pressure for agricultural intensification and current solid waste management practices in developing countries.

#### **2.2 Urban Management and Governance**

This section examines the issues that cities in developing countries have to contend with in order to improve urban management and governance. Rapid urbanization in developing countries is usually accompanied by a general decline in the capacity of the government at the regional and local level due to unprecedented and unpredictable growth. Municipal authorities lose their traditional roles by having to deal with the spontaneous change to the social environment, and the supply and maintenance of basic community services and

facilities suffer as well (Harper, 2000). As a result, the local environment is radically transformed, including basic urban services not being able to keep up with the demand for sanitation and solid waste management.

Perceived as service providers, local governments in developing countries are seen to have limited resources to be able to effectively and efficiently provide environmental and public services. Also, the inability of local governments to properly consult communities and make use of all available resources within the community is seen as a major factor in their inability to provide services at an adequate and acceptable level. Additionally, Rayp and Van De Sijpe (2007) find that high efficiency in municipal governments is a result of good governance. Hence, when governments strengthen the rule of law and safeguard political stability they can in addition expect to reduce inefficiency. In essence the roles and responsibilities of local governments are standard and seem easy to perform. They are meant to establish policies and regulations which can be used to support approaches of solid waste integration and management. With the establishment of sound policies and regulations, programs that deal specifically with solid waste are then developed with the local government acting as the facilitator. Bond and Hulme (1999) contend that as a by-product of governance and by acting as facilitators, local governments provide support, access to available information, infrastructure and technical expertise to the relevant stakeholders (such as the private sector, NGOs and local communities).

The late-modern concept of governance as defined by the UNDP (1997, p. 2-3) explains that “it is the exercise of economic, political and administrative authority to manage a country’s affairs at all levels. It comprises the mechanisms, processes and institutions, through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences.” In addition, the Asian Development Bank’s concept of governance also emphasizes participatory and engagement processes (ADB,

1995). Governance more specifically refers to the partnerships and exchanges that occur among a range of actors, central and local governments, the private sector, NGOs, and community organizations, for decision-making. Additionally, the promotion of partnerships between government, business and social organizations for service delivery is indicated by the shift from government to governance (Mwangi, 2000).

Mungai (1998) argues that solid waste initiatives that focus on community-based management and social development can provide outcomes that are sustainable. Mungai (1998) also makes it clear that these initiatives do not come easily. If a culture of cooperation and enforcement mechanisms are lacking, changing the attitudes and behaviour of people in developing countries can be a challenging task (Thomas-Hope, 1998). Although there is some awareness of waste management problems, greater appreciation of solid waste management issues (such as waste prevention and reduction) is needed at all levels of society (Betts, 1984). The involvement of parties outside of government is also an essential factor to achieve the sustainable management of solid waste (Thomas-Hope, 1998).

However, the ease with which governments are able to make the transition from having complete control of the provision of public services to a co-operative (shared) role is questioned. Douglass (1992) in a review of urban poverty and environmental management in Asia, concluded that governments have been unsuccessful in assisting the poor to better manage their local environments. He argued that community-based environmental management can be an avenue for addressing environmental deterioration, although he is concerned that governments rarely encourage such initiatives. His analysis is reiterated by the UNCHS, which remarks that “in most cities in Africa, Asia, and Latin America, the individual, household and community efforts that have such a central role in building cities and developing services have long been ignored by governments, banks, and aid agencies”

(UNCHS, 1996, p. 425). Overall, urban governance in a waste management and Asian context needs to be examined further to determine the extent to which it responds to the challenges of population growth and rapid urbanization. Because much of this discussion has been at the theoretical stage, there is also a need to operationalize some of these new concepts with reference to a set of definite relationships.

### **2.2.1 Community-based Management**

This section examines the role that the community plays in solid waste management. The role played by the community often goes beyond the acknowledgment of the needs of the local area and building forms of intervention and involvement to resolve the problems at hand (Manikutty, 1998). Ta (1996) argues that community-based management allows for interaction between the local authorities and communities to share information, to promote and encourage new approaches, to bring about regular payment for services to control the quality of these services, and to prepare the social base for new urban services. As a result of this type of interaction, the needs of neglected neighbourhoods emerge, with solutions proposed and developed (Ta, 1996). Community-based solid waste collection and processing is considered the most appropriate approach to increase private sector participation in areas where neither a commercialized utility nor private businesses could operate cost-effectively (Richardson, 2003). Community-based and public-private partnerships in the waste management system come in many different shapes and sizes. For example, in the case of a community-based composting operation, the government will provide the land used to site the plant free of charge and the community group in turn will collect and turn organic waste into compost. Profits are made through collection fees and the sale of compost.

There is a wide range of literature examining the application of community-based approaches to the management of environmental services and solid waste management (Bhuiyan, 2005; Asomani-Boateng, 2007; Zurbrügg et al., 2005). In Bangladesh for instance

the management of solid waste, as carried out by the local government, is far from adequate. Bhuiyan (2005, p. 90) argues that the inadequate services provided by the state “have propelled the growth of community initiatives for the management of solid waste.” While other developing countries have implemented community-based solid waste management projects, Bangladesh appears to be unique for the sheer number of community-based initiatives put into practice (Zurbrügg et al., 2005). Zurbrügg et al., (2005) contend that community-based solid waste management initiatives emerge through the influence of social organization and communication.

In a Hanoi based study, Richardson (2003) compares three community-based solid waste management initiatives and finds that the success of solid waste management services lies in the involvement of local communities as the main stakeholders and decision-makers. The three community-based initiatives initially began as a result of the local environment becoming increasingly polluted with solid waste. The main goal of the initiatives is the timely and proper collection of household waste and litter in public areas, and not on composting programs. Richardson (2003) determines that although each community-based program is organized and run by the community, they are still accountable to local government.

In Bangalore, India’s community-based solid waste management program, Beall (1997) determines that although the government and communities in the city were working together in various solid waste management schemes, ultimately the work did not lead to equitable partnerships and reinforced structural inequalities because the government ultimately made the final decisions. Nevertheless, there is an argument for decentralized community-based composting systems which is based on experience in Dhaka, Bangladesh. The experiences in Dhaka were able to show that a decentralized community-based composting system (Zurbrügg et al., 2005): is cheaper to run, due to its labour intensive

nature, when compared to a centralized system; is well suited for a developing city's waste stream, climate, and social and economic conditions; is more cost effective due to readily available local materials and the use of low-cost technology; can improve a community's participation in solid waste source separation; is a way to reduce the volume of solid waste at the household level more effectively; and can enhance income and job opportunities for the poor, socially deprived informal workers<sup>3</sup> and small entrepreneurs of the city.

Sinha and Enayetullah (2007) note that the decentralized community-based composting model operating in Dhaka, developed by Waste Concern (a solid waste management NGO based out of Dhaka, Bangladesh), is currently also practiced in Matale, Sri Lanka and Quy Nhon, Vietnam. The model is comprised of two important factors, which define its innovative nature. First, the private sector company in partnership with the community has enriched the processed compost with nutrients – nitrogen, phosphorus, potassium (NPK) – making it more marketable. The proceeds from the sale of the compost/fertilizer make up 70% of the total revenue of the projects. Second, communities participate in household collection and they share the cost of waste collection by paying a monthly fee based on their economic status. Each household in the community contributes in the form of a waste collection fee, accounting for 30% of the projects' revenue, helping to financially sustain the project with a second source of revenue. The success of a community-based program depends largely on identifying and addressing the community's needs, while the sustainability of the project depends on their involvement in the cost recovery/cost sharing process.

On the other hand, centralized systems, which can be exclusive of communities, have led to social strife, ineffective economic and resource management. This type of situation detrimental to both the health of the environment and well being of local users (Larson,

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<sup>3</sup> Informal solid waste workers are sometimes referred to as scavengers. They are part of the informal sector as there are no administrative or financial control and monitoring mechanisms that control their activities.

2001; Perrett, 2008). According to Gershberg (1998), one reason is that because of the failure of governments to react to local urban service needs (i.e. waste management services), local services are often considered inappropriate by the communities that are supposed to benefit from them. Current thinking asserts that local communities need to be included and feel part of the planning process.

Korten (1986, p. 4) examines the deficiencies in centralized approaches to adapt to what he describes as “local variety” in community life, or the “substantial variety in natural and social ecologies and in individual preferences.” He goes on to remark that “with their broadly distributed decision process, community management systems have nearly unlimited potential” (Korten, 1986, p. 4). The subsequent section looks at this potential using the concept of decentralization. Specifically, it determines the importance of establishing a legally sanctioned structure of decentralized governance within which the community-based organizations can then play a role to help foster a composting program in HCMC.

### **2.2.2 The Challenges of Decentralization**

This section examines the concept of decentralization and its impact on the governance of urban systems. Decentralization is not an event but a process. The motivations for government decentralization have been attributed to the dissatisfaction with the results of centralization, and the acknowledgment that development is a complex and multifaceted process, which cannot be administered effectively at the central level (Rondinelli & Nellis, 1986). In particular, Cohen & Peterson (1999) emphasize the widely held belief that central governments lack sufficient capacity to provide an adequate level of public service. According to the UNDP, decentralization is the devolution of power and authority to local governments with the “central purpose of creating an enabling environment in which all can enjoy long healthy and creative lives” (UNDP, 2000).

A trend in governance worldwide and promoted by the World Bank, decentralization gradually emerged as a development strategy in the late 1980s and early 1990s (Bardhan, 2002; Schmidt, 1990). It was believed at the time that a better system of cooperation and support was needed between the various levels of government. A number of studies linked especially to the rise of new institutional economies have converged on the importance of institutions and agents at the local level for carrying out all manner of public services (Ostrom, 1990; Gershberg, 1998; Putnam, 1993).

The gains from moving government closer to the people are perceived to be the most important advantages to decentralization (White & Smoke, 2005). Burki et al., (1999) also contend “that decentralization can increase the efficiency and responsiveness of government.” This is the efficiency argument that drives the thinking of most decision-makers. When preferences among voters are diverse and local governments have the responsibility for delivering those services that do not have major external effects, the potential benefits include better public services, accountability and transparency on the part of government officials, more willingness to pay for services, and development from below (ADB, 1995; Jacobsen, 2004).

Reforms for decentralization are broad in nature, and their target is not only improvements in municipal service delivery but also overall urban governance including administration. Accordingly, decentralization, in some places, may help to improve the level of environmental services (Memon et al., 2006). However, it is also possible that it may deteriorate the level if the proper institutional reforms are not implemented and the direct link between improvements in the service delivery and decentralization is not established (Klugman, 1994; Memon et al., 2006).



Many Asian countries have implemented or started to implement reforms to promote decentralization to improve the effectiveness of urban environmental management (Memon et al., 2006). Japan for example is pursuing further decentralization of local governments for revenue generation and expenditure based on intergovernmental relations (Saito, 2003). In Indonesia, fiscal decentralization has its basis in law on regional administration and financial balance between the central government and the various regions (Sidik, 2003). In Pakistan, the current government in its decentralization scheme has restructured the local government system to suit local situations. However, in this case, decentralization of local governments has had a negative impact on provision of water and sanitation services in Sindh Province by not taking into consideration policies already in place meant to manage urban services (Memon et al., 2006). In India, constitutional amendments provide more powers to the local governments (Brillantes & Cuachon, 2002). However, Gershberg (1998) contends that despite its long standing presence little is known about the impact that decentralization reform policies have had on the provision of services in the urban sector.

Other criticisms of decentralization refer to the struggle in transferring this theory into practice. Failed implementation essentially stems from poorly planned reform initiatives which do not ensure accountability at the local level administrations, adequate funding, and sufficient practical and technical capacity, which are seen as essential preconditions for shifting power from the center to the local (Larson, 2001; Rondinelli & Nellis, 1986). In a decentralization classification scheme, Rondinelli and Nellis (1986) identify privatization and public-private partnerships as forms of decentralization. These two concepts form the basis of the next two sections.

### **2.2.3 The Impact of Privatization on Solid Waste Management Systems**

Since the 1980s, privatization has been actively embraced by governments of both developed and developing countries (Dinavo, 1995). After extensive privatization efforts

from a number of developed nations (for instance, the United Kingdom under Margaret Thatcher and the United States under Ronald Reagan) many governments of developing countries also set out on privatization schemes. At the time, these nations were attempting to deregulate industry, resource extraction and agriculture in a fight against inflation (Harvey, 2005). Some nations proceeded with privatization schemes on their own while others (mainly developing countries) embarked on privatization as a condition of structural adjustment policies, loans, and programs promoted by the International Monetary Fund and the World Bank (Brune et al., 2003). Overall, “more than 8,000 acts of privatization were completed around the world between 1985 and 1999,” valued at \$1.1 trillion (1985 US dollars) (Brune et al., 2003).

In solid waste management the aim of privatization is to trim down the role that governments play in their national economies and increase the role of the private sector as provider of effective waste services at a lower cost (Dinavo, 1995). Ramamurti (1992, p. 225) argues that privatization “refers to the sale of all or part of a government's equity in state-owned enterprises to the private sector.” This closely resembles the process occurring in Vietnam which involves the transfer of company assets from the government as owner to a private sector receiver. Also, the government does not have to sell all of its equity; it may choose to sell a portion of it to either one or several buyers as it desires.

In context of the neoliberal approach, the participation of the private sector in the management of solid waste is seen as a way to address solid waste concerns in developing countries. Reasons for the cost-effectiveness and efficiency of the private sector in solid waste management include (Cointreau-Levine, 2000): as a result of competition and motivation to maximize profits, the private sector can deliver services at lower cost than the public sector and provide local public funds for investment when in short supply; the private sector is well situated to introduce proven and cost-effective technologies based on its

international experience; the private sector has more flexibility and less bureaucracy in employing and firing staff, paying employees according to performance, and regulating work hours to meet demand; and the private sector is reliable because contracts outlining specific performance measures enable standards of operation to be achieved and penalties to be incurred if services are not provided. However, Batley (1996) states that private initiatives can also include citizens mobilizing to resolve solid waste problems themselves or with the help of private groups.

However, the empirical proof that privatization actually works is weak and largely drawn from experiences in developed countries where institutional frameworks are much different from those in developing countries (Post, 1999). Opponents of privatization and the broader neoliberal agenda in developing countries include environmental groups, researchers, unions, and in many cases, direct customers of the provided privatized service. They argue that without the necessary pre-conditions, privatization will never be successful in a developing country (UNESCAP, 2001). Unfortunately, a number of countries in the developing world do not meet these preconditions and it would be inappropriate to attempt to instil privatization programs (UNESCAP, 2001).

Essentially, a troublesome issue for local authorities in most developing countries is the costly provision of municipal solid waste services. Resources are insufficient, service coverage is low, and indiscriminate dumping is widespread resulting in significant environmental problems. Furthermore, Gandy (1994) argues that considerable inefficiencies occur in the publicly operated services. However, the promotion of private solutions to service delivery problems in solid waste management is being debated. Dinavo (1995) points out privatization has not always succeeded resulting in the creation of huge deficits in government budgets, reducing the autonomy of the public sector, and resulted in increased social costs. A study by Yoshida (2003) of Malaysia's privatized solid waste

management system determined that there is a “strong concern that privatization can result in inefficiency, lower quality of service, additional burden to lower-income groups, and other disadvantages.” Yoshida (2003) and Dadalauri et al., (2006) also find that a privatized solid waste system may result in a monopoly of services resulting in corruption, negligence of public health, inefficiency, and the promotion of unfair competition.

Private solid waste management initiatives are linked to the global political resurgence of market-oriented administrations. For local governments in developing countries, this means in practice the contracting out of waste services to private groups (Cointreau-Levine, 1994). However, Cointreau-Levine and Coad (2000) argue that private sector involvement should be looked at only as a potential opportunity and not a panacea. There are essential questions on whether, and how, to include the private sector in the provision of municipal solid waste services (Cointreau-Levine & Coad, 2000).

#### **2.2.4 Public-Private Partnerships**

The term public-private partnerships refers to any agreement between the private and public sector to provide services to the populace. The waste management literature suggests ways of integrating the activities of the private/informal sector with that of the government in primary waste collection. Although there is no consolidated or established definition of public-private partnerships, all explanations have common characteristics or features (Li & Akintoye, 2003), such as the potential for collaboration, the planning, development and delivery of a set of projects or strategy or operations, and the social partnership (McQuaid, 2000). Massoud and El-Fadel (2002) contend that public-private partnerships entails the transfer and control of a good or a service currently provided by the public sector, in part, to the private sector.

Where public and government funds or expertise are lacking for environmental infrastructure and services, public-private partnerships between governments, NGOs,

community groups and private corporations are formed. Over the years, the concept of partnerships has diversified from the joint ventures between the public and private sector and now includes broader collaboration with civil organizations (Forsyth, 2005). Part of this change and push can be attributed to the United Nations and the Millennium Development Goals need to achieve effective environmental governance.

Forsyth (2005) promotes deliberative public-private partnerships as a means to manage solid waste in the developing countries of Asia. Deliberative partnerships are defined as “partnerships that maximize public debate about the purpose and inclusivity of collaboration between state, civil and market actors” (Forsyth, 2005, p. 429). Partnership refers to the sharing of responsibilities of public functions with private enterprises and/or voluntary organizations. The main objective here is to assemble the initiatives and capacity of organizations working in civil society for social and economic development. Resources are transferred to civil society organizations that enter into an agreement with the government on the basis of an indicative program of work. Government does not intervene with the plans and budgets of the model (Osmani, 2001).

### **2.3 Population Growth and Urbanization, Agriculture and Solid Waste Management**

The ideas to be explored in this section are placed in context to determine the overall patterns of urbanization at a global and regional level, predicting a continuing increase in the proportion of the world’s urban population and, as a consequence, a significant increase of municipal solid waste and greater demand for food in major cities.

#### **2.3.1 Population Growth and Urbanization**

Population growth and rapid urbanization essentially implies significant accumulation of waste (Onibokun and Kumuyi, 1999). In developing countries, over the past three decades, population growth and rapid urbanization have affected solid waste management and particularly the relationship that exists between the urban and rural domain. This

relationship, based on a mutual understanding of roles and responsibilities in the waste economy, is breaking down in scattered metropolitan regions and is creating a solid waste crisis across much of the developing world (Ginsburg, 1991).

According to the United Nations, the world's urban population is expected to grow to 5 billion (from the current 3.3 billion) by 2030 while rural populations are expected to decrease. In North America, Europe and Latin America, the urban population already exceeds the rural population. The urban population in developing countries is expected to double by 2030 from 2 to 4 billion (Cohen, 2004). By the same year, 60% of Asia's population is expected to reside in cities (Mai et al., 2003). A major contribution to urban centres in developing countries is the internal migration of inhabitants from the surrounding rural regions providing the means for development.

In light of this growth, Cohen (2001) sees cities as 'engines of [socio-economic] growth' thereby complementing their ability to provide arenas for the social and economic exchange necessary to create development, productivity and social interaction. The present pattern of globalization now more than ever before makes this possible. Migration to urban centres offers hope for a better life and the promise of opportunities not available in rural regions. It is generally accepted that new jobs and business opportunities, better education, more entertainment and a modern-day cosmopolitan way of life are all features which draw people to the city (Ginsburg, 1991; Moore et al., 2003). However, the slums and shanty towns built up around many of the cities in developing countries reveal the fact that for many people a better life in the city is only a dream.

Ginsburg (1991) notes that cities in Southeast Asia experience a settlement transformation where a large and ever increasing percentage of the population settles in the urban core. Ginsburg (1991, p. 7) contends that the "existence of high-density agricultural regions

adjacent to large urban cores offers an opportunity for a particular form of a mega-urban region to emerge.” Essentially, this is what took place in Southeast Asia during the mid to late twentieth century due to economic development policies. A major city emerged in each country in addition to several secondary cities where commerce is not as significant and government administration is not as influential (Evers & Korff, 2000). The emergence of these mega cities placed considerable strain on the surrounding areas, “spilling into rural villages or towns” (Murakami et al., 2005, p. 251). As cities and their populations in developing countries continue to grow due to natural growth and rural-urban migration, they create unparalleled demands for goods and services, and strain is also placed on the environment and local governments (Breman & Mundle, 1991). These trends, in conjunction with growing per capita incomes in many developing countries, have led to greater demand for food and increasing concentrations of solid in major urban areas. Also, the trends drive up the average cost per tonne of solid waste collection, treatment, and disposal and strain the waste management capacities of many cities and their governments.

### **2.3.2 Urban and Peri-urban Agriculture and Food**

The urban and peri-urban agricultural areas of developing countries, particularly in Southeast Asia, that are reviewed in this section consist of a system of complex and regional arrangements of agricultural, farming and horticultural land uses (see Appendix D, Photo 2). The terms *urban and peri-urban agriculture*, *urban and peri-urban farming* and *urban and peri-urban food production* are used interchangeably in the literature. As a result, urban and peri-urban agricultural systems can vary in intensity, size and the type of production. It can be anything from “aquaculture in tanks, ponds, rivers, and coastal bays to livestock raised in backyards and to vegetables and other crops grown on roof tops, in backyards, in vacant lots of industrial estates, along canals, on the grounds of institutions, on roadsides and in many suburban small farms” (Smit & Nasr, 1992, p.141-2).

Smit and Nasr (1992, p. 141) define urban agriculture as “food and fuel grown within the daily rhythm of the city or town.” According to the FAO (1999, p. 4), urban and peri-urban agriculture is “perceived as agriculture practices within and around cities which compete for resources (land, water, energy, labour) that could also serve other purposes to satisfy the requirements of the urban population.” McGregor et al. (2006) define the peri-urban area as “areas around cities and towns characterized by rapid demographic, economic, environmental, social and cultural interactions and changes” (p. 232). In addition, Ginsburg (1991) contends argues that the peri-urban area in Asia is dominated by wet-paddy cultivation, and central cities, fringe areas of those cities, suburbs, satellite towns, and extensive intervening regions of dense population. Also, urban and peri-urban areas surrounding and in cities are within a daily commute of the city core. However, from the city core, peri-urban areas in some parts of Asia can stretch for up to thirty kilometres (Ginsburg, 1991). McGregor et al. (2006) explain the interactions between urban and rural areas as changing due to rapid urban population growth and expansion of the built-up area, technological change, and local and global economic restructuring.

As well, development and economic growth has created changes in the agricultural system worldwide. These changes pose challenges to safe and sustainable farming practices. The agricultural industry, while providing an accessible, cheap and bountiful supply of food, has adapted practices that affect social and environmental health. Kriflik (2006) argues that current food production methods are not sustainable, resulting in environmental damage that is as much a risk to population health as that posed by a virus or disease. The modern industrial agricultural and food system threaten biodiversity, soil fertility and safety, and water pollution with the over-use of water, pesticides, chemical fertilizers, and antibiotics (Warnock, 1987).



In addition to environmental problems, Sawio (1994) claims that possibly the leading challenge in relation to urbanization in developing countries is that of food security and how to feed the urban populace. Hubbard and Onumah (2001, p. 433) go further, claiming that “with their expanding population and sprawl, developing cities are increasingly dependent on distant food supply sources, including imported food. As a result transport and handling costs make up an increasing part of food costs to the urban consumer (usually more than half the retail price).” Mougeot (1994) reports that by 1980, nearly 50% of all food consumed by people in the cities of developing countries was imported from other countries.

Despite the urbanization trends in Asia, more than half of the economically active population is still involved in agriculture, and agricultural employment is particularly important for the livelihoods of the poor. In addition, in all developing Asian economies agriculture remains a major sector. In India for example, it accounts for 22% of GDP (2003), and 58% of the economically active population engages in agricultural activities. These figures are even larger if the value generated through downstream processing is included. Agriculture also serves as a shock absorber and safety net by providing employment in the face of large economic shocks, such as the financial crisis in 1997 (Hubbard & Onumah, 2001).

Urban and peri-urban agriculture, in comparison with rural agriculture, contributes a smaller proportion of the domestic food supplies (Ellis & Sumberg, 1998). However, urban and peri-urban agriculture has an important complementary function. A significant potential benefit of urban and peri-urban agriculture lies in the all-encompassing ecological and environmental effects it can have (Smit & Nasr, 1992; Midmore & Jansen, 2003). Along with being an important source of income for the urban poor farmer, and a source of agricultural goods for the urban poor, urban and peri-urban agriculture is an important user

of urban organic solid waste for compost and fertilizer. The organic fraction of municipal solid waste can provide nutrients and organic matter for farmers in the urban and peri-urban areas (Eaton & Hilhorst, 2003). For example, Nelson (2006) finds that in Cuba, agriculture is largely based on ecological production, including the use of organic solid wastes. However, ecological agricultural production using municipal solid waste is being challenged by a change in composition of waste and decrease in sound composting initiatives.

### **2.3.3 Solid Waste Management in Developing Countries**

The management of urban solid waste is a global problem. Traditional solid waste management practices in developing countries such as landfilling waste is relatively harmful to human and ecological health (Maclaren, 1995). In the case of landfills, adverse effects include groundwater contamination (by leachate), landfill gas (methane) emissions, increased traffic flow, depreciation of neighbouring property values, lowered aesthetics, litter, and pests. Several ideas and models are being proposed in the literature as a way to curb solid waste management problems in cities of the developing world. Rathi (2006), for example, finds that community participation in Mumbai's waste management system provides a cost effective manner to collecting, processing and disposing of wastes. On the other hand, NIUA (1999) finds that in Rajkot, India it is actually more cost effective with the participation of the private sector.

The total amount of municipal solid waste generated around the world in 1997 was approximately 500 million tonnes, with an estimated annual growth rate of 3.2-4.5% in developed nations and 2-3% in developing nations (Suo Cheng et al., 2001). In 1998, the urban areas of Asia produced a daily total of approximately 760,000 tonnes of municipal solid waste. This is anticipated to rise to 1.8 million tonnes by 2025. To manage this amount of waste municipal governments spend 20-50% of their operating budgets on solid waste management, they are generally only able to collect 60-70% of the solid waste generated in

cities of developing countries leaving a significant amount untreated in the open environment (Cointreau-Levine, 1994; Cointreau, 1982). The collection and transportation phases are usually the most expensive components of the solid waste system (Jindal et al., 1998).

Although the urban waste management problem seems to occur on a localized level, it also depends on cultural and social phenomena that go beyond the local space. The worldwide problem of solid waste makes waste management a central issue. It is therefore essential to understand how the issue of waste has evolved around the world. In recent decades, the evolution of lifestyles and product manufacturing has led to a continuously increasing amount of waste, an amount exceeding that which can be naturally degraded in landfills or open dumps. Also, the intense urbanization and population growth in developing countries has led to households in more impoverished areas receiving under-serviced waste collection. If a large fraction of solid waste is organic in nature, composting may be one of the sustainable ways to manage it.

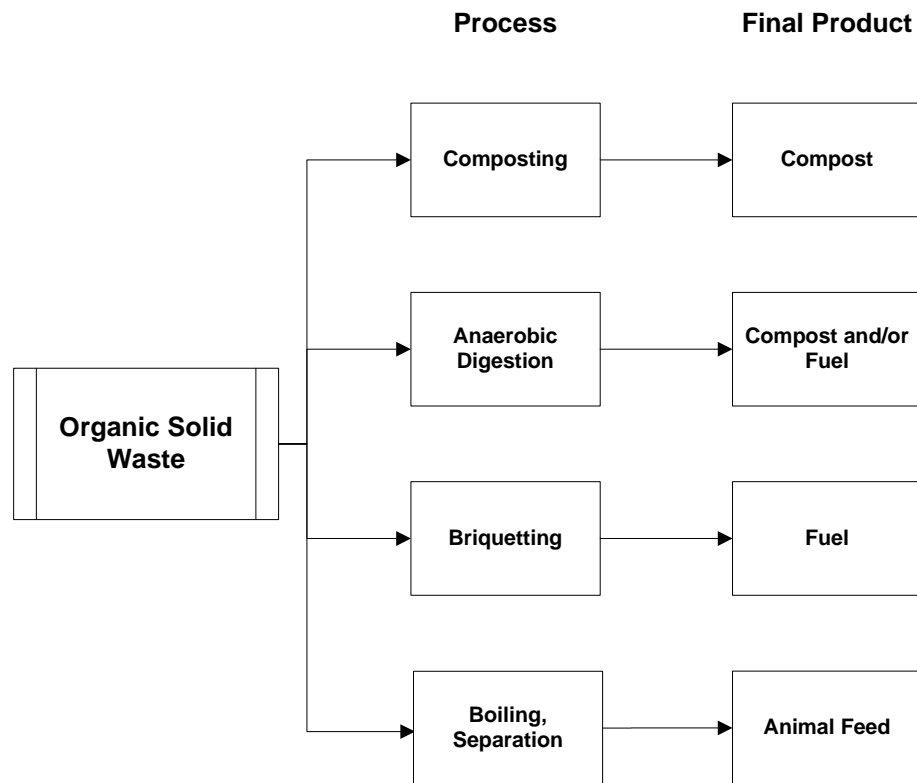
#### 2.3.3.1 Sustainable Waste Management

Sustainable solid waste management systems aim to meet the waste management needs of all residents, including the poor (Shubeler, 1996). Jindal et al., (1998) identify the need for solid waste management to achieve “a more hygienic, safe and pollution-free environment; cleaner and more comfortable living conditions, and a higher standard of living; reduction in diseases; and optimization of resources.” van de Klundert and Anschutz (2001) suggest utilizing several differing approaches to curb the generation of and improve the management of waste based on a city’s present situation. This utilization of varying approaches, which is a form of good governance in solid waste management, is dependent on the integration of the four pillars of sustainability: environmental, economic, social and governmental/administrative dimensions (UN, 2005).

In addition, sustainable development requires effective management of outputs as well as inputs, and action now, rather than leaving problems for the next generation, which has often been the habit in the past. Historically, humans have spent much more effort attending to inputs than to outputs. The outputs of development are pollution and waste. In practice, especially developing countries, decision-makers seek trade-offs between economic growth, food production and employment generation on the one hand, and expenditure of scarce resources on environmental management on the other (Barrow, 2005).

#### 2.3.3.2 Organic Solid Waste Management

The agricultural use of decomposed organic matter from municipal solid waste can be traced back to the origins of town garbage dumps in India (for instance, use of Calcutta's waste for farming was envisaged at the time an official garbage dump was set up in the 1860s) (Ghosh & Furedy, 1984). Much of the waste in developing countries is ideal for conversion into organic compost and animal feed, and can be used to create fuel (Figure 2). In developing countries, the use of food waste from restaurants, wet markets and hotels as feed for animal farms is well known. The use of organic waste to create fuel is also well known. However, economic factors favour composting in those countries where high food production is of great importance (Lardinois & Furedy, 1999b). In the poorest countries, very simple screening and maturing can produce good results within the economic realities which the populations face. With wet market waste, little screening or sorting is necessary. In a combined study, an audit of household, hotel and market waste in Vietnam and Laos found that the "high percentages of compostable waste found in the market, hotel and household waste streams suggest that composting is a promising option for managing waste from these sources" (Byer et al., 2006, p. 471). The waste audit also revealed that the "waste from fruit and vegetable vendors is almost entirely compostable and would probably produce high-quality compost without the cost and effort of source separation" (Byer et al., 2006, p. 472).



**Figure 2 - Final Products of Organic Solid Waste**

While some proponents of municipal solid waste composting argue that sales of the finished product can offset operating costs to the point of making composting facilities economical, others argue that scant evidence can be found to confirm this, even in the developed world (Renkow & Rubin, 1998). Nevertheless, communities are motivated to explore municipal solid waste composting due to the difficulty of siting a new landfill (Nguyen & Maclaren, 2007). The process of siting a new landfill takes place over an extended period and involves significant outlays of time and energy on the part of public officials and concerned citizens. Additionally, determining the location of a new landfill is often a very troublesome process that gives rise to considerable public turmoil. Hypothetically, if a community perceives municipal solid waste composting to be more environmentally 'friendly' and/or less damaging to local property values than land disposal,

it may be easier to install a composting facility than a new landfill (Renkow & Rubin, 1998). Also, small-scale composting operations require less land for the plant and generally create less impact on the surrounding environment. On the other hand, composting in developing countries on a large-scale has long been seen as an initiative doomed for failure (Oluwande, 1984; Hoornweg et al., 1999; Zurbrügg et al., 2005). Section 2.3.3.4 discusses large-scale and small-scale composting in more depth.

Even though health risks from the reuse of organic urban waste in urban and peri-urban agriculture are often considered minimal, human toxicity due to high concentration of heavy metals can sometimes occur in produce from urban and peri-urban sources (e.g. in Hanoi) (Midmore & Jansen, 2003). A higher heavy metal count in compost can severely limit the potential soil fertility benefits of the product.

Other key factors to consider in organic solid waste management include: the need for and the feasibility of source separation in order to produce higher quality compost; the cost of waste transportation and processing; the availability and cost of land for a composting site; the avoided costs of disposal; and the availability of revenue sources from selling the compost product or recovering recyclables (Byer et al., 2006). Source separation is perhaps one of the more important factors that needs to be considered.

#### 2.3.3.3 Source Separation

Source separation involves separating wastes into various groups at the household level, i.e. organic waste in one garbage bin, and inorganic waste in another garbage bin. Source separated organic waste is most favourable in a composting operation. However, source separation is easier said than done. With source separation a number of questions arise. Is the overall goal a change in mentality or is the goal the behavioural change of a community? It is possible to achieve results without changing mentalities, but this requires some form of direct persuasion in the form of regulations and enforcement. And is there a

need for source separation or can waste be alternatively mixed together and separated at a later period? The location and life span of a landfill usually determines the extent of source separation and composting activities. A landfill with a long life span and that is expected to operate for a considerable period may be a problem for any future programs of source separation and composting plants because simply dumping waste in the landfill is cheaper than separating and composting the organic portion (Nguyen, 2005). A city with landfill and disposal space constraints can be seen as a way of forcing city officials to seek an alternative to the management of solid waste. Lardinois and Furedy (1999b) report that the majority of large cities in Asia are short of dumping land. The lack of space for landfills in Asia is the main motivation for implementing formalized waste diversion programs, which are not very common in developing countries.

A typical waste diversion program includes source separation. However, the absence of municipal solid waste source separation increases inefficiencies in the recycling system because materials become contaminated and dispersed (Jindal et al., 1998). Recycling through source separation has been found to provide more materials that are of better quality compared to waste picked out of mixed waste streams (Furedy, 1992). However, source separation of organic waste is a somewhat new topic compared to, for example, studies on the informal sector and recycling industries. Academic research on the theories behind domestic solid waste sorting is lacking. One study of source separation, albeit from the European experience found that the main motivation for source separation in Belgium was environmental awareness (Smeesters et al., 1998). A city's inability to properly introduce and manage a source separation program was attributed to the community's lack of environmental awareness. Nowadays, recycling programs throughout Europe and parts of North America are mandatory for that same reason. In order to develop environmental awareness and improve waste practices, policy makers enact policies that force the desired change (Smeesters et al., 1998). In Manila, for example, solid waste management policies

and legislation have been recently updated, outlining clear landfilling guidelines and standards, waste minimization, recycling, and reuse, and promoting source separation initiatives (van Buuren & Tran, 2007). The source separation initiatives along with improved enforcement have resulted in an increase of composting operations in Manila.

The importance of source separation directly relates to the quality of compost, which is perhaps the most important factor in the marketing and use of compost. Quality varies according to the degree of source separation of organics from the waste stream and the care taken in the composting process. Source separation, the first stage in a sustainable, well-managed composting program, as stated above relies heavily on the support of city residents (Thomas-Hope, 1998).

Source separation can be viewed as a community-based approach<sup>4</sup> to improvements in solid waste management, because it requires the direct involvement of the community in the task (Furedy, 1992). Participating in such a program can repeatedly remind those involved that they are protecting the environment (Smeesters et al., 1998), thus altering one's mentality. However, further education is necessary. In Hanoi, for example, emphasis is placed upon community action and educational programs aimed at improving awareness of solid waste related problems, like recycling and source separation at the household level (Gray-Donald, 2001). Gray-Donald (2001) finds that public cooperation, an essential ingredient in source separation initiatives, is a product of public education. Furedy et al., (1997) comes to a similar conclusion when discussing source separation efforts in Bangalore.

#### 2.3.3.4 Large and Small-scale Composting

There is widespread documentation of problems of large-scale centralized composting projects in the waste management literature (Hoornweg et al., 1999; Asomani-Boateng,

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<sup>4</sup> In developed countries, such as Canada, source separation is a municipal or city-wide scheme.



2007; Gonzalez & Morales, 2002). In addition, large-scale centralized composting approaches have also been condemned in the literature (Gershberg, 1998; White & Smoke, 2005). Large-scale centralized composting plants have become an example of a technology that is wholly unsuitable for use in developing countries. According to UNEP (1996), in the past 30 years, the majority of large-scale centralized composting plants in developing countries have closed or operate at less than 30% of capacity. These types of plants have been closed due to high maintenance and production costs, lack of trained personnel and inappropriate technology characterized by imported mechanical and electrical parts which are too expensive to replace or too difficult to maintain, and other financial constraints (Oluwande, 1984; Zurbrügg et al., 2005; Hoornweg et al., 1999).

Large-scale composting plants, with the single purpose of compost production, often produce a product with a value that does not justify the high transportation costs of dispersing and using it. Due to these extra costs the price of compost is high and not affordable to farmers. If a composting plant is truly justifiable on the basis of a proven market demand for the product, there should be no problem in getting the private sector to own and operate the facility. Depending on the risk and if it is too high for the private sector to “accept long-term ownership and operation, it is likely that the risk is also too great for the public sector” (Cointreau, 1982). This opens the door for small-scale composting initiatives. Contributing to the rise of small-scale composting programs is the fact that they require only a small investment to operate, and thus a return on investment can be seen in the short term (Zurbrügg et al., 2005). These programs also involve organizing and ensuring community participation in collection of solid waste and in the building of awareness amongst citizens at the local level to initiate dialogue with the local governments on municipal services and compliment/supplement their efforts in this regard.

Outlined above are a number of case studies that outline various waste management practices, specifically organic waste management for the production of compost, in developing countries. However, this thesis will be an important addition to the limited literature on organic waste composting in Vietnam. This thesis builds on the research that emphasizes decentralized, community-based solid waste management. The literature review also reveals an important gap in the literature on new strategies to manage organic solid wastes in developing countries for the benefit of urban and peri-urban agriculture. Specifically, despite the numerous composting initiatives in developing countries, little is known about how they operate and the necessary institutional conditions for success. Research that addresses this gap may be able to suggest ways in which composting initiatives may be more effective in helping to manage the solid waste problem and at the same time provide increased food security to urbanizing cities.

## **Chapter 3**

### **Research Methodology**

#### **3.1 Introduction**

This chapter explains the methods used to address the research objectives outlined in chapter 1. The field research included observations, semi-structured interviews, and a survey to determine the potential for compost use in HCMC, based on the experiences in Quy Nhon, Vietnam.

#### **3.2 Research Purpose**

According to Creswell (1994), qualitative research is descriptive and investigative. Researchers use it to explore a topic when the variables and theory base are known. Research that is descriptive and investigative deals with the questions of what, when and where. This thesis aims to assess the potential for compost use in HCMC within the current solid waste management system. In light of the above, the purpose of this research is, in part, descriptive and the nature of identifying issues is suited more to qualitative measures. Hence, the prescriptive nature of this research focuses on “what is” and suggesting “what should be” (Creswell, 1994). This thesis concludes with a summary of findings and suggestions for the development of a potential composting program in HCMC.

#### **3.3 Conducting Research in Vietnam**

Fieldwork for this study was completed between May 4<sup>th</sup> and August 27<sup>th</sup>, 2007 (approximately 4 months). I received permission to conduct research in Vietnam at two levels. First, the Office of Research Ethics at the University of Waterloo approved my proposal to conduct research in Vietnam. Second, Professor Phan Thi Giac Tam with the Department of Economics at Nong Lam University in HCMC agreed to act my field supervisor.

An important element in conducting research in a foreign culture is developing cultural sensitivity. Before arriving in Vietnam, I attended several meetings held at the University of Waterloo hosted by a Vietnamese master's student. The meetings involved language training and orientation to Vietnamese culture. From these meetings I learned some Vietnamese for basic conversations and a better understanding of Vietnamese culture. Both helped me to establish trust with informants and to conduct my research without offending research participants. In Vietnam, I lived in a guest house at Nong Lam University so that I could interact with students in the Vietnamese culture and lifestyle.

I hired a research assistant to assist with data collection and translation in HCMC for my four month stay. My research assistant, Nguyen Ly, was a young lecturer from the Faculty of Economics at Nong Lam University. A limitation was that she had little to no field work experience and no prior experience working in waste management and composting related projects. However, she was fluent in English and with her support and some patience we were able to overcome language barriers in interviews and informal discussions. Through Nong Lam University I was also able to acquire the necessary government documentation to allow me to conduct research activities in the area. Without this documentation, I would not have had access to the various research participants interviewed and communities studied. Therefore, the assistance of Professor Phan Thi Giac Tam, Nguyen Ly and Nong Lam University was essential.

### **3.4 Research Phases and Data Collection Methods**

Within the fieldwork period, case study research was carried out in HCMC, and for five days in the secondary case study site of Quy Nhon (located on the central coast of Vietnam) and, in the capital, Hanoi, for a little over two weeks. The research was completed in two phases: 1) collection of secondary data, and 2) collection and organization of primary key data from

the field. The following is a description of the data collection methods. A multi-method approach was used to gather data, using secondary and primary sources.

#### **3.4.1 Secondary Data**

The first phase involved the collection of data from over three dozen publications, reports and other documents – from government, NGO, and aid agencies – to refine and focus research activities. This data provided general information regarding solid waste management in developing countries, composting, community-based management, and urban governance. The information was used to identify the various relationships among the varying themes of governance in solid waste management. A number of reports and other documents collected in Vietnam (written in Vietnamese) highlighted historical practices and institutional arrangements. Documents were translated with the help of my research assistant and a document translator.

#### **3.4.2 Primary Data**

The second phase involved 17 semi-structured interviews and informal discussions with research participants that include solid waste and administrative officials, co-operative leaders, NGO leaders and academics (a list of the people interviewed and questions posed to solid waste officials can be found in Appendix A and B, respectively); a survey of 11 HCMC farmers (a copy of the survey can be found in Appendix C); and on-site observations of agricultural operations and of selected elements relating to solid waste management at various composting plants, landfills/dumps, vegetable markets (see Appendix D, Photo 3), transfer stations (see Appendix D, Photo 4), various neighbourhoods, and city streets in general.

Participants were selected as they were directly or indirectly related to my study. Appointments with research participants were scheduled in advance. In all cases I conducted the interviews myself. Average interview length was roughly 2 hours. Interviews

focused on local problems in waste management and agricultural systems (including human resources, facilities, and organization), and the capacity to produce compost for agricultural use. As indicated in Appendix A, a pseudonym was used for six research participants who expressed anonymity.

Data was also collected through a survey of 11 farmers from Cu Chi district in HCMC. I chose to use a survey as I had a clear idea of the types of questions that needed answering, which were closed-ended. The survey questions focused on the demand for compost among farmers of HCMC. Focus was also on the respondents' on-farm activities and their current and historical use of compost, fertilizers, and other inputs. The survey also sought to determine the farmers' level of knowledge of compost and its effects. Various other types of data related to the respondents' background were also collected: gender, marital status, educational level, occupations and family size. Each survey respondent was the head of the household and/or had a lead role in the maintenance of the farming activities.

The survey was conducted in two communes of Cu Chi district in HCMC: Tan Phu Trung and Binh My (see Figure 5). The farmers were selected using purposive sampling based on the criteria and need for a collection of provisional data from a particular population, specifically farmers who would be most likely to be able to use compost in the future. This was partly because they would be close to future composting plants which may be built in urban areas close to major sources of solid waste. Residents of HCMC, who are the generators of waste, were not surveyed directly. Instead, questions pertaining to household waste management practices were directed at solid waste officials. However, there is a considerable value in surveying the residents and is recommended for future research.

Data collected in Quy Nhon and Hanoi were conducted without the use of a research assistant. In Hanoi, those interviewed and consulted spoke fluent English and thus an

interpreter was not needed. The research informants in Hanoi were from various international aid agencies, namely the national agencies GTZ of Germany and BTC of Belgium, and the World Bank. Part of my time in Hanoi was also spent at libraries of the UNDP and FAO, researching documents relevant to my study.

In Quy Nhon, I was working directly with several members of civil society operating in Vietnam; specifically the HCMC based Environmental Development Action in the Third World Vietnam (ENDA), and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). I was able to make contact with ENDA in HCMC through my thesis advisor at the University of Waterloo and field supervisor at Nong Lam University. During my discussions with ENDA in HCMC, I was informed of the community-based composting project commencing in Quy Nhon, to which I was invited to visit.

### **3.4.3 Data Analysis**

This study generated mainly qualitative data. Qualitative data from the interviews, literature reviews, survey and general observations were categorized and coded based on emerging themes. Survey data was also tabulated using spreadsheets. The analysis carried out was descriptive, using frequencies and percentages of the relevant variables to distinguish patterns in the information/data.

### **3.5 Limitations**

Despite my best efforts, the accuracy of some data may have been affected by interviewee discomfort with the lengthy research process or because some interviewees may have perceived the research process to be an evaluation of their personal or their organization's performance. Also, research participants working for the state might have been reluctant to disclose certain pieces of information for fear of presenting disfavour to their government.

Uncovering and accessing historical data on solid waste management in Vietnam and HCMC proved to be a significant challenge. A retired waste management official in HCMC was to be my main source of historical data, but he unfortunately became ill before I could speak with him. Instead, I was forced to rely mainly on data acquired through interviews and discussions with other stakeholders. Also, there was a potential loss of data due to limited translation capacity. Much of the documentation on solid waste management in HCMC is written in Vietnamese. Capacity to translate was limited due to the costly and time consuming nature of translating literature and thus some information remained unavailable to me and therefore was not incorporated into the research.

An unavoidable limitation of the survey methodology was the sample size. It was relatively small based on logistical and practical reasons, that is, lack of time and funding. Another limitation of the survey is that only two of the 11 farmers surveyed were women. Attempts were made to survey male and female farmers equally, however during the sampling period, the availability of female farmers in the study sites was limited.



## **Chapter 4**

### **Regional and Local Context**

#### **4.1 Introduction**

The population of Vietnam is estimated at 85 million. Roughly 73% of the population live in rural areas and work in agriculture, forestry, and the fisheries, while the remaining 27% live in urban areas and are employed in the manufacturing and services industries. Annual urban population growth has been estimated at 4%, almost triple that of the rural population growth rate (O'Rourke, 2004). Situated on the eastern side of the Indo-Chinese peninsula, Vietnam borders Cambodia, Laos and China. With a coast line of more than 3,000 km, Vietnam looks out to the Gulf of Tonkin, the South China Sea and the Gulf of Thailand. After Indonesia, Myanmar and Thailand, Vietnam is the fourth largest Southeast Asian country with an area over 333,000 km<sup>2</sup> and has the third highest population after Indonesia and the Philippines.

Vietnam is a tropical country with a temperate climate in the north and a more humid monsoon climate in the south. The average annual rainfall is 1,678 mm in the north, 2,890 mm in the central regions, and 1,979 mm in the south. This large quantity of rainwater drains to the seas by a multitude of rivers and streams, among these, the most important are the Red River in the north and the Mekong River in the south. Threatening agriculture production in Vietnam are recurring adverse weather effects, including drought, typhoons and floods.



**Figure 3 - Map of Vietnam**

Vietnam is covered by over 7 million hectares of total cropland, which accounts for 22% of the total land area (EarthTrends, 2003). The two largest agricultural regions are the Red River Delta in the North, and the Mekong River Delta in the South. Also, 16 million hectares

of land is designated as forestland. Annually, fisheries on the coast produce approximately 1 million tonnes of fish and 50,000 tonnes of shrimp.

HCMC, with a population of 6.4 million, and Hanoi, with a population of 3.4 million, are the most important urban centres in Vietnam. The 6.4 million pertains to the number of registered HCMC residents. This number could reach as high as 8 million if non-registered and newly immigrated residents are included (Interview 2). In Vietnam, 40% of the population is of working age. This large population provides an abundance of labour power, which serves as an important resource in the country's development and growth. Conversely, this abundance of human power, due to rapid population growth, also puts a strain on the environment and natural resources, as well as on employment, service provision, and living conditions.

#### **4.2 Environment in Vietnam**

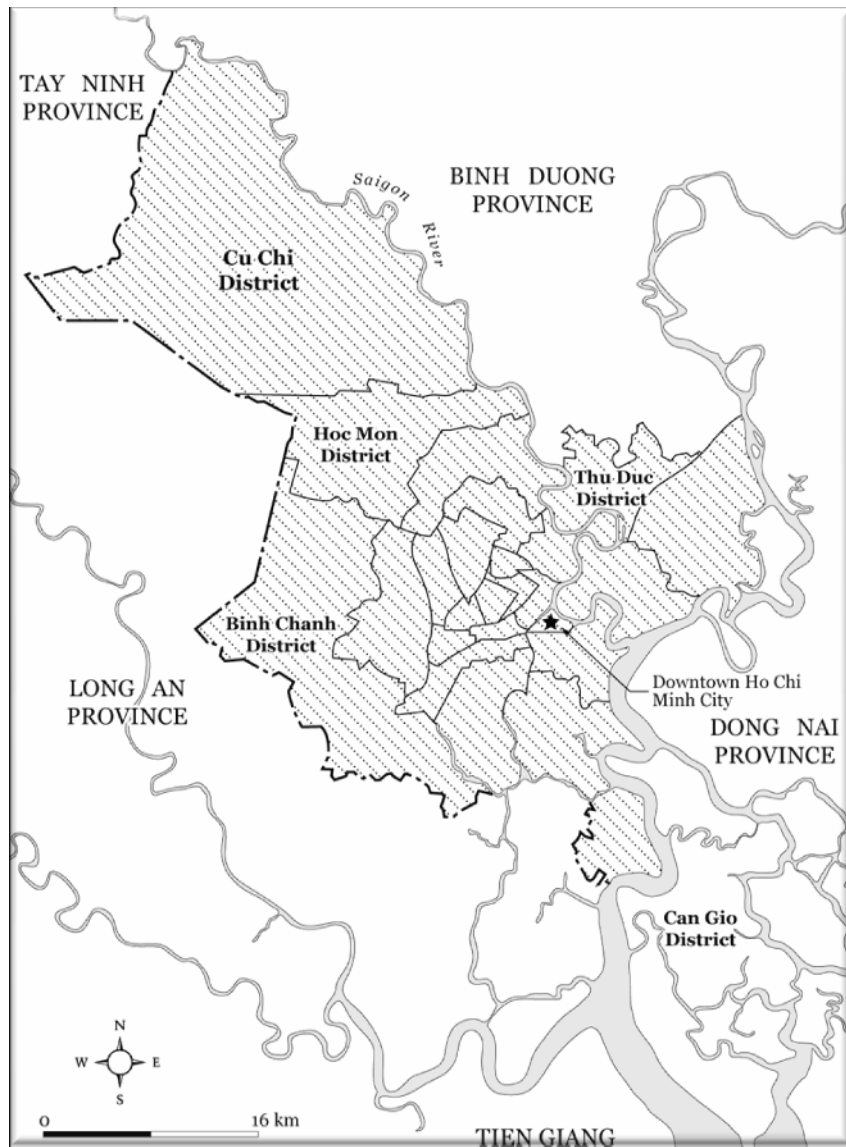
During the past two decades, ever since Vietnam began its economic reform, the country has experienced rapid economic growth, fluctuating between 4 and 10 percent annually from 1995 to 2008. The reforms began in 1986 with the introduction of *doi moi*, the national economic development and renovation policy meant to open up Vietnam as a market economy. As Vietnam has found itself enjoying growing levels of economic prosperity, the country has also been experiencing growing levels of environmental degradation. The negative environmental effects are especially visible in large cities where industry and population are heavily concentrated.

Urbanization has led to population growth and the siting of industries in proximity to populated neighbourhoods and vice versa. The influx of foreign direct investment (FDI) (US\$5.8 billion in 2005) has not only created a shift in the structure of Vietnam's economy, but also to its industrial processes evident through increased toxic industrial activities (O'Rourke, 2004; EIU, 2006). In the larger cities, population growth coupled with industrial

development has overwhelmed the capacity of urban infrastructure to cope with intensified stresses. These changes and their environmental impacts are most acutely observable in Hanoi and HCMC.

### **4.3 Ho Chi Minh City**

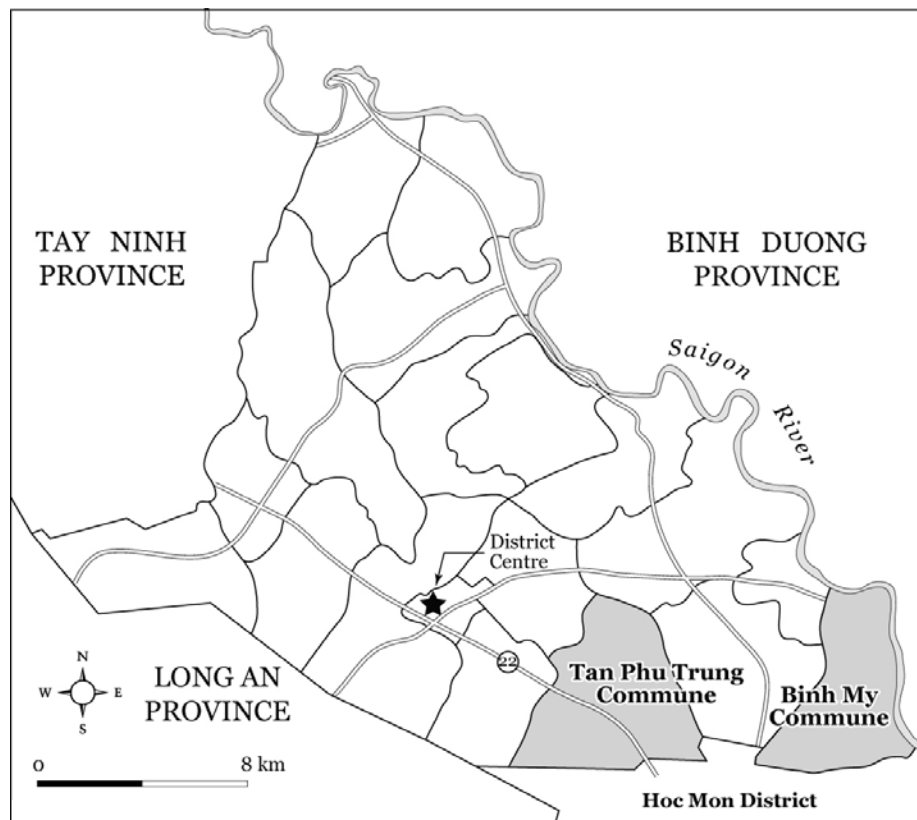
HCMC was chosen as the main case study site, representing an example of the current solid waste management trends in Vietnam. HCMC is Vietnam's largest city and the financial and commercial centre of the country. Chosen as a secondary case study, Quy Nhon with an estimated population of 250,000 is one of the fastest growing mid-sized coastal cities, with a promising new waste management program: decentralized community-based composting. The goal of this study was not to compare and contrast the two cities, but rather to examine the potential for compost use in HCMC, using the community-based composting project in Quy Nhon as a model. Therefore, more emphasis is given to highlighting the situation in HCMC than in Quy Nhon.



**Figure 4 - Map of HCMC**

The regional focus of this research is HCMC. Located near the Mekong Delta, HCMC occupies a physical area of 2,095 km<sup>2</sup> with an approximate population of 6.4 million residents in 2007. According to Simmons (2008), approximately 80,000 hectares in HCMC are used primarily for agricultural purposes (50,000 hectares for rice cultivation and 30,000 hectares for fruit and vegetable cultivation and livestock grazing land). Administratively, the city is divided into 19 inner (urban) districts of 495 km<sup>2</sup> and five peri-urban (rural) districts

with an area of 1,600 km<sup>2</sup>. The communes, Tan Phu Trung and Binh My, where the survey of farmers were conducted are located in the rural district of Cu Chi which is located in the northern portion of the HCMC (see Figure 5). Cu Chi the second largest district in HCMC has an area of 434 km<sup>2</sup>, of which 282 km<sup>2</sup> have been designated as agricultural land. However, agricultural land in the district is progressively being absorbed by non-agricultural land uses (Ha Trang, 23 July 2008).



**Figure 5 - Map of Cu Chi District, HCMC**

As a result of the national economic development and renovation policy of 1986, *doi moi*, the city experienced rapid economic growth since 1989 with an average annual rate of 11%, a figure higher than the national average. The city experienced a significant rise in population during the same period growing at an average of 3.5% annually. This process of growth and development changed the face of the city considerably. As a result, HCMC's population is not distributed equally throughout. The population density in the inner

districts is over 30,000 people/km<sup>2</sup>, whereas the density in suburban and rural areas of the city is much lower.

The living standard of the city's general population has increased significantly, reflected by a rise of per capita GNP and the abundance of imported goods. HCMC residents and government officials are now confronted with numerous urban problems such as the degradation of infrastructure, the inadequacy of public services, increased environmental pollution, the increasing demand for housing, schools, hospitals and other public facilities, and the widening gap between the rich and the poor.

#### **4.4 Agricultural Sector**

##### **4.4.1 The Changing Face of Agriculture**

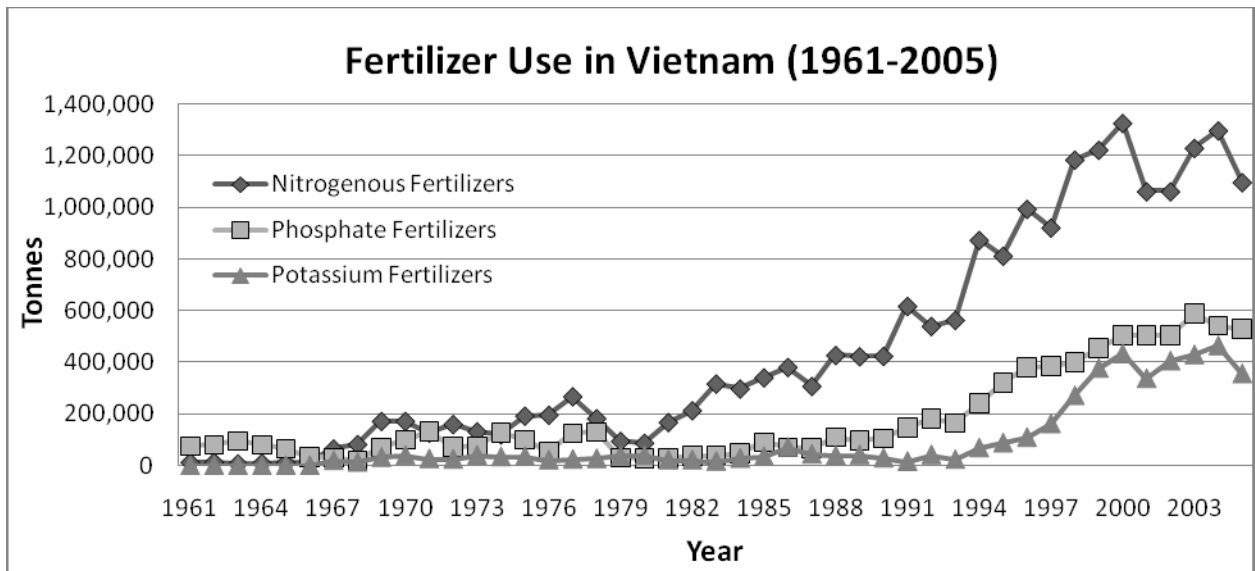
Agricultural production in much of Asia has become concentrated in urban and peri-urban zones where there exist large urban populations and high income elasticities of demand (Jansen, 1992). World-wide some 800 million people are believed to be involved in some form of urban and peri-urban agriculture (FAO, 1999). It is often assumed that the profitability and sustainability of urban and peri-urban agriculture in general, and that of vegetable production in particular, is virtually guaranteed by the nearby existence of large populations, relatively low transportation and packaging costs and low post-harvest losses. Enhanced urban and peri-urban farm income would provide the base for investment in value added and other high return activities in urban and peri-urban areas while contributing to overall economic growth (Boncodin, 2000; Goletti et al., 1999).

The farming practices of Vietnamese farmers were altered drastically in the 1980s upon their return to family-based farming systems after long years of working in a centrally planned economy (Interview 6). After the collectivization period, the area under crop production increased from an estimated 270,000 hectares to approximately 600,000

hectares in response to market demand rather than planning orders from the government. Along with this expansion, Vietnamese farming experienced considerable intensification. A study by the VEGSYS project of small-scale urban and peri-urban Vietnamese vegetable farmers in Hanoi determined that farmers relied heavily on widely accessible but often harmful chemical fertilizers and pesticides in order to continue intensive production (Leers, 2006; van den Bosch et al., 2002). In Vietnam, toxic pesticides in the past have caused many food poisoning scandals. Along with the over use of pesticides, chemical fertilizers have in Vietnam been utilized widely.

Fertilizers have become a widespread ingredient of agricultural production over much of Vietnam. Overall in Vietnam, the use of fertilizers from 1961 to 2005 (Figure 6) has increased 22-fold, from 89,000 tonnes to 1,984,000 tonnes. With an improved awareness of the food safety problems caused by pesticides and chemical fertilizers, and the increase in purchasing power of the growing urban population in Vietnam consumers are now seeking high value agricultural products such as *safe vegetables*. Safe vegetables are produced using a limited amount of agrochemicals, but farmers are not to use banned pesticides and are to follow specified pre-harvest interval applications of permitted pesticides thereby limiting the environmental health impact of pesticides (van Wijk et al., 2005).





**Figure 6 - Fertilizer Use in Vietnam from 1961 to 2005**

(source: FAO, 2006)

Not only are there signs of a slight shift away from pesticides in urban and peri-urban agriculture, there are also calls driven by healthy-conscious consumers for a more sustainable use of fertilizers and more organic fertilizers such as compost (Simmons, 2008). It is within this context that special attention is paid to the links between the urban and peri-urban vegetable sector and the municipal solid waste sector. The argument that urban and peri-urban vegetable production systems can absorb significant quantities of city waste is supported by experiences from several Asian countries, including Vietnam, the Philippines and, to a lesser extent, Nepal and India.

#### **4.4.2 The Link Between Waste and Urban and Peri-urban Agriculture**

An important constraint in producing compost is the lack of a nearby market, since transport of compost to rural areas is expensive. However, what sets urban and peri-urban agriculture apart from rural agriculture is proximity to large settlements of people, thereby creating the opportunity of converting organic waste into compost and marketing it in a cost effective manner. In addition to cost savings due to proximity, compost can have a

positive effect on agricultural yields. In a four year study at the University of Guelph, Canada of the agronomic effects of compost, it was determined that the yields of all-grass hay, soybeans and corn were generally enhanced by the addition of compost. Actually, in certain cases substantial increases in yield were attributed to compost (Alder et al., 1997). In addition, since urban and peri-urban vegetable production presents the opportunity to convert urban waste into nutritionally beneficial foods, governments are encouraged to take the ecological contribution of urban and peri-urban vegetable production into account in their investment decisions.

Despite the variation in nutrient content, bulkiness, and the presence of potentially detrimental pathogens and inert materials, compost used in urban and peri-urban vegetable production systems has been shown to offer potential solutions to municipal governments faced with overwhelming solid waste management problems (Furedy, 1997). This has been highlighted by various experiences in developed countries (Midmore, 1995; Allison & Harris, 1996). However, in the case of HCMC, the use of compost is scarce, and instead, urban organic wastes is simply landfilled. Unlike chemical fertilizers, compost adds organic matter to the soil and closes the nutrient cycle helping to prevent soil degradation and erosion (Midmore, 1995). Also, the composting of municipal solid waste has the potential to solve waste disposal problems in HCMC and increase the life span of current landfills. Jansen et al., (1996) estimate that urban and peri-urban vegetable production in and around HCMC could handle 665,000 tonnes of organic waste per year, which roughly works out to 133,000 tonnes of compost<sup>5</sup>.

Average solid waste production per capita in developing countries is estimated at 150 kg/year, of which 60-97% (90-145.4 kg) is organic in HCMC (Medina, 1993; Simpson, 1993).

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<sup>5</sup> Typically, only 20-30% of the input waste materials are converted into compost. A major portion of organic waste are made up of water and other liquids, in composting these liquids are displaced thus reducing the overall weight and size of the compost pile.

Assuming that all the organic solid waste from the 6.4 million residents of HCMC could be recycled, this would mean a total of 576,000-931,200 tonnes could be utilized in urban and peri-urban agriculture. However, the cost of collecting, sorting and treating this amount of organic solid waste deserves closer attention and analysis before embarking on large-scale projects such as current and historical projects in HCMC and Hanoi, as well as other cities in developing countries. In Hanoi for example, despite the fact that some 60% of total household waste is collected, less than 5% undergoes treatment in the URENCO large-scale composting plant (Midmore & Jansen, 2003). Development of effective linkages between the urban and peri-urban agricultural and urban waste sectors is needed, with particular attention to energy use, the cost of separation, adequate quality control and logistic issues.

#### **4.5 Development Context**

By the 1970s, southern Vietnam housed over 60% of all industry, particularly along the corridor linking the city with Dong Nai Province. Only nine sizeable factories operated outside of HCMC and surrounding regions. In 1975, at the end of the war the North Vietnamese army 'liberated' Saigon and changed its name to Ho Chi Minh City, named after the leader of national liberation from French colonialism in order to symbolize the end of colonial and capitalist influences (Seah & Nair, 2004). While the city was liberated in 1975, remnants of the old colony remained, namely the favoured economic region of Southeast Vietnam. However, toward the late 1970s the state implemented socialist economic policies, which increased the state's control over the country's economic development (Kokko & Sjolholm, 2000). In agriculture, these policies led to attempts at collectivization which often reduced farmers' incentives for agricultural production and led to food shortages.

The launching of the economic renovation policy of 1986, *doi moi*, sought to reverse the failure of the centrally planned economy, which had been unable to realize the socialist ideals of equality, prosperity, and freedom for the Vietnamese people. To move toward

these ideals, the state determined, based on national and international factors, that economic reform must be undertaken, transforming the planned, centralized, and subsidized economy into a market economy managed by the state dubbed the 'multisectoral market' (Duiker, 1995).

In the decades following the establishment of *doi moi*, sustained industrial development in urban industrial zones ensured that Vietnam's cities would play an important role in the country's economic renewal (EIU, 2006). As part of its renovation Vietnam turned outwards to foreign capital for financing and technology to develop its industrial base. The process of rapid urbanization and industrialization has been driven by the immense amount of FDI (EIU, 2006). The initial reforms stimulated an increase in private investment, which grew during the early 1990s. During the mid 1990s, Vietnam had one of the highest growth rates in the world at seven to eight percent a year (EIU, 2006). In the larger cities, population growth coupled with industrial development overwhelmed the capacity of urban infrastructure.

#### **4.6 Context for the Use of Compost in Urban and Peri-urban Agriculture in HCMC**

HCMC, like any other major city in developing countries, faces a number of challenges in good governance. Cities like HCMC have "to be attractive to businesses as a way of generating income and employment opportunities, to provide a good livelihood for their inhabitants, to generate enough resources to finance infrastructure and social needs, and to take care of their poor" (Freire, 2001). However, municipal solid waste volumes are increasing rapidly and the composition of waste is changing as consumption habits change. At the same time, domestic solid waste collection, treatment and disposal remain inadequate. Vietnam generates approximately 12.8 million tonnes of municipal solid waste per year (World Bank, 2004). O'Rourke (2004, p. 43) estimates that only about half is

collected and disposed of properly in the few existing sanitary landfills<sup>6</sup>. In Vietnam the urban population is expected to reach 43% by the year 2030, creating further demand for service provision (Globalis, 2005). Local authorities will have difficulties in keeping pace with this development and in meeting the increasing demand for solid waste management services, mainly collection, processing, and disposal services (Kassim & Ali, 2006). Despite all of HCMC's challenges and complexities, competition among actors in the solid waste management system is non-existent. Instead, the solid waste management system is marked by institutional disorganization and fragmentation (Interview 2 & 11). Vietnam's and HCMC's institutional arrangements are discussed in more depth in chapter 5.

#### **4.6.1 Decentralization in HCMC**

This section explores the relative balance between centralization and decentralization within HCMC's urban service delivery sectors. In socialist and former socialist states, reform is commonly in the form of decentralization, resulting in an increase in power of lower-tier governments. In Vietnam, the economic reforms of the last 20 years have had a profound effect on government and their policies (Fritzen, 2002). In the late 1980s, the Vietnamese government introduced decentralization-based market reforms (Gainsborough, 2003). With decentralization, presumably each local administration in Vietnam would have increased power and autonomy. Gainsborough (2003) contends that as economic reform leads to the decentralization of power to the local level, it also results in a strengthening of the local government in relation to the national centre. However, this growth in power and transfer of decision making authority is facing bureaucratic resistance, stemming from the attitudes and reinforcing interests of influential stakeholders (Fritzen, 2002).

Although HCMC has continued with its decentralization plan, implementation has been uneven and the legal framework is incomplete (Fritzen, 2002). Outside of the

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<sup>6</sup> Sanitary landfills are final solid waste deposit sites that meet international standards of safety and management (leachate and gas collection) (Thurgood, 1999).

decentralization plan, the HCMC government retains its lead role in water services, electrical energy, health, education, agriculture, irrigation, and fisheries. However, where decentralization has proceeded and produced some gains and greater public participation is in the service delivery sectors at the district level. While these reforms have created greater responsibilities at the district level, the reforms have also negatively reduced the financial support local governments receive from the central government.

However, it appears as though the full extent of the decentralization policy will not see its way to the lowest levels of government in Vietnam and HCMC due to its lack of coherence (Interview 11). Indeed, fundamental aspects of Vietnam's governance structure, such as its political centralization, and traditions of state direction, suggest extensive forms of decentralization are not likely to be on the policy agenda in the near future (Fritzen, 2002). Further, it will be important to see whether major allocations of authority and resources, which are part of the overall decentralization policy, see their way down to the various wards and communes of HCMC, especially in the less affluent areas.

#### **4.6.2 Impact of Equitization, Public-private Partnerships and Community-based Composting in HCMC**

In Vietnam, any major political change regarding the socio-political economy must involve the state (O'Rourke, 2004). This is vital in identifying and evaluating the impact of privatization of solid waste management services in HCMC. It is interesting to note that the more popular term in Vietnam for the concept of privatization is "equitization", or less commonly referred to as "socialization." This was encountered on several occasions in discussion with various stakeholders. The popular use of the term "equitization" in place of "privatization" was also reflected in the literature on Vietnam (see Kokko & Sjöholm, 2000). Essentially, equitization in Vietnam is a process in which state-owned enterprises are to a degree equitized through the establishment of joint stock companies. Since the 1986 reforms, a major policy priority for the ruling socialist party has been private sector

development. Until 1986, Vietnam's planned economy was dominated by state-owned enterprises. Since the introduction of the *doi moi* reform policies and after being actively promoted by the World Bank, equitization has been a major element in the government's economic policy strategy.

The current trend in Vietnam is that some firms are being equitized, while others are being forced to compete on their own (O'Rourke, 2004). The national government had a target to equitize 1,300 smaller state-owned enterprises, lease or sell another 500, merge 350, and declare bankrupt or dissolve 368 firms (O'Rourke, 2004). Plans are in place to equitize 600 of over 1,590 state-owned enterprises located in HCMC and Hanoi. Initially, according to Vu (2005), the equitization policy, established by the government in 1992, offered voluntary equitization to small and medium-sized enterprises. However, from 1992 to 1998, only 30 state-owned enterprises were equitized. It was not until the late 1990s that the equitization process was fully implemented. The government replaced the voluntary equitization plan with one that no longer gave state-owned enterprises the option to participate, instead it forced equitization, resulting in the equitization of 845 state-owned enterprises between 1998 and 2002 (Vu, 2005).

In line with this equitization plan, the current deregulation debate relating to the principles of neoliberalism that have prevailed since the late 1980s, and in response to the failure to provide adequate waste services, partial equitization of waste services is currently sought in HCMC by the Solid Waste Division (Heynen et al., 2007). The inadequate financial budget<sup>7</sup> of HCMC's Solid Waste Division to properly collect, process and dispose of waste in a satisfactory manner, reinforced the case for the involvement of the private sector (Interview 7).

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<sup>7</sup> The financial constraints that the solid waste management division in HCMC faces is not the main focus of this thesis; however, it is recommended that future research focus on this very important issue.

The Vietnamese government has put in place a plan to dispose of state-owned enterprises by either selling them or liquidating them (Vu, 2005). However, Vu (2005) points out that although the Vietnamese government has forced equitization on some state-owned enterprises, to date Vietnam has been unable to fully implement the national equitization strategy due to a number of shortcomings. First, the pace of equitization has been slow. Also, the equitization process has lacked transparency and actually proved beneficial for political elites in the government who hold large parts of the equitized firms. As a result, equitization has failed to attract investment from domestic investors and improve the management structure of equitized enterprises.

In HCMC there is support for increased private sector participation, which includes the informal sector, in the provision of municipal solid waste collection and treatment services in the city and its districts (Interview 7). Government officials also expressed support for public-private partnerships in the collection and transportation of solid waste that are presently not managed properly or are only poorly managed by the public sector (Interview 8a). These include organic wastes, and construction and demolition waste. Historically in Vietnam, the level of involvement of communities in environmentally based projects has always been high (O'Rourke, 2004). Gray-Donald (2001) argues that the effectiveness of a community-based project increases if the community is given a major role in the project, which in turn provides the community with an increased sense of ownership. Essentially this would imply a shift from centrally managed projects to those that have greater public participation. Still, partnerships and linkages between communities in urban and rural areas are often already well developed and complex, and must be unravelled and understood if the development of a composting program in HCMC is a goal (Barrow, 2005). Furthermore, MacMillian (2007) argues that decentralization alone will not lead to success for a community-based waste management project, but also enhanced capacity combined with improved technical skills.



## Chapter 5

### Solid Waste and Agricultural Systems of HCMC: Findings and Discussion

#### 5.1 Introduction

This chapter highlights and discusses the data obtained through literature reviews, interviews, a survey, and observations. A city's solid waste system is characterized by both formal and informal solid waste management. The formal system, better known as the conventional waste management system, is based on the precedent that waste is a burden to society. The formal system is designed to collect and transport waste to final waste disposal sites located away from a city's immediate living environment. The informal waste management system, where waste is utilized as a resource, diverts waste from the conventional chain of activities. The informal system is comprised of informal waste workers who collect, recycle and sell recovered waste to intermediaries, who, in turn, sell the goods to private industries and small enterprises.

Until the *doi moi* period, waste in Vietnam was composed of largely safe organic materials that, when disposed of, had little impact on the local environment. As the amount of solid waste generated by the residents of Vietnam grew, particularly in the urban centres of Hanoi and HCMC, and the composition of such waste changed, city collection served to clear out as much of the waste as possible from residential neighbourhoods and treat and dispose of the waste according to the common principle – *all at once at least cost*. With landfilling being the most effective and least expensive method of disposal, little emphasis was placed on treatment options other than discharging solid waste into dumps and landfills. However, with population growth in the urban areas outstripping the capacity of governments to provide the basic need of waste management services, community-based self-reliance and local governance has emerged (O'Rourke, 2004).

## **5.2 Solid Waste Management in Vietnam**

According to the World Bank (2004), in 2004, Vietnam produced over 15 million tonnes of waste from a variety of sources. Roughly 12.8 million tonnes came from municipal sources that include households, restaurants, markets, and other businesses. Approximately, 2.55 million tonnes (17%) was generated by industry, and about 150,000 tonnes (1%) of hazardous waste originated from hospitals and other health care centres, industry (toxic and flammable waste) and agriculture (pesticide and herbicide waste). Roughly 6 million tonnes (49% from 12.8 million tonnes) of the municipal solid waste produced originates from the urban areas of Vietnam which account for only 24% of the population. This is a direct result of urbanization and industrialization in the urban core, and of the increase in affluence of those living within these areas. In contrast, the average person in the countryside produces less than half of the solid waste produced by the average person in an urban area (0.3 kg/person/day vs. 0.7 kg/person/day) (World Bank, 2004). Also, the waste they produce is primarily organic in nature and can be easily composted or used as animal feed.

The World Bank (2004) estimates that by the year 2010, consumption patterns and the composition of goods will experience continued change and projects that cities in Vietnam will absorb 10 million more residents. From 2004 to 2010, a 60% increase in municipal solid waste generation is expected as result of these changes. It is estimated that HCMC could save 200 billion VND (US\$12 million) in disposal costs annually with a 10% reduction in the solid waste generated (World Bank, 2004, p. 7).

## **5.3 Solid Waste Management in HCMC**

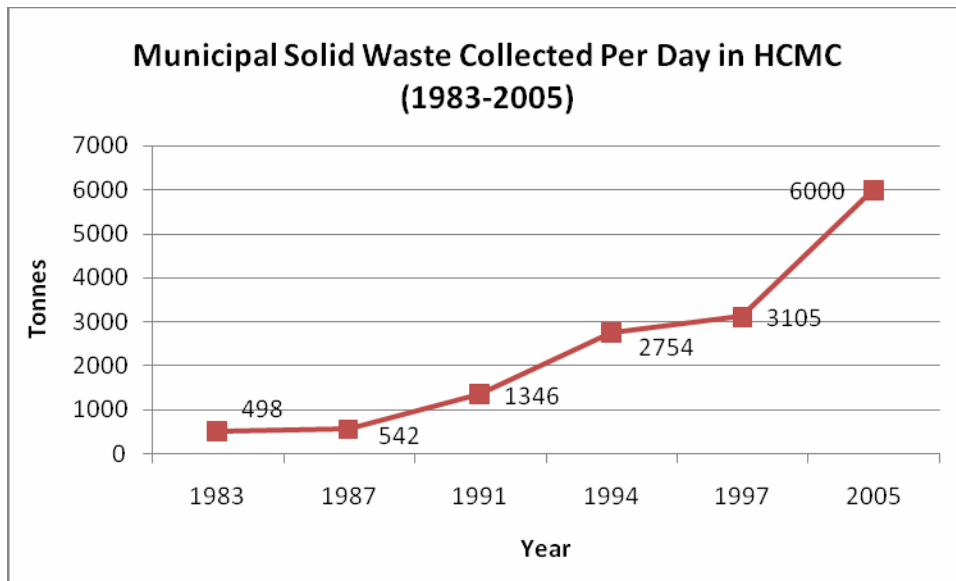
The most striking aspect of municipal solid waste management in HCMC is the dramatic increase in waste generation, with a compound annual growth rate of 25% from 1983 to 2005 (see Table 1 and Figure 7). HCMC's population has increased approximately 3.5% per year since 1990, and economic growth has been estimated at 11% every year for the past

decade. The 25% annual increase in waste collected reflects considerable changes in lifestyle and consumption. Table 1 demonstrates that since 1983 the amount of solid waste collected per day in HCMC has risen sharply, with an 11 fold increase to the year 2005. One must also consider the fact that waste derived from outside of municipal sources are also on the rise. Waste collected by municipal services do not simply originate from domestic sources but also include an increasing amount of waste from commercial, service, and industrial economic activities. However, an extensive evaluation and survey of these sources to determine precise figures is lacking, although anecdotal observation suggests that they make up a considerable portion of the solid waste stream.

**Table 1 - Quantity of Municipal and Commercial Solid Waste Collected Per Day in HCMC from 1983-2005**

Year	Waste collected per day (tonnes)	Growth rate (%) from Period to Period
<b>1983</b>	498	-
<b>1987</b>	542	9
<b>1991</b>	1346	148
<b>1994</b>	2754	104
<b>1997</b>	3105	13
<b>2005</b>	6000	93

(source: Personal Interview 8b)



**Figure 7 - Municipal Solid Waste Collected Per Day in HCMC (1983-2005)**

HCMC, the commercial centre of Vietnam, is by far the largest city in Vietnam. With urbanization and migration levels at an all time high, the flow of municipal solid waste continues to grow and has reached 6,000 tonnes/day for the year 2005. This figure does not include demolition waste (1,000 tonnes/day), sewage sludge (1095-1230 tonnes/day), industrial, medical waste, and other waste. Figures for industrial and medical waste totalled 261 tonnes in the year 2000 (Malaviya, 2002). In 2004, the city spent 453 billion VND/year (US\$29 million) on the management of solid waste, a rise of 24% from the year 2002. And in 2006, 600 billion VND/year (US\$37 million) was spent on the collection, transportation and treatment of HCMC's waste.

Of HCMC's 6.4 million residents, roughly 20,000 are employed in the waste management sector as city, private and informal collectors, street sweepers, itinerant buyers, transfer station employees, landfill employees and the list goes on (Interview 8b). Operating in the city today are 21 public and private companies that collect, transport, recycle and dispose of waste (Interview 8b). There are also over 700 recycling businesses that mostly recycle plastics and metals. The significance of this is that HCMC offers an abundance of labour that

has waste management experience that could be harnessed for a community-based composting program.

In the past decade the overall management of solid waste (collection, transportation, handling and disposal) in HCMC has improved significantly with less perceived impacts on the natural and social environment (Interview 8a). However, the solid waste system still faces serious environmental problems, especially at the landfills. Leachate, landfill gas, odour and other issues create a host of problems for the Solid Waste Division of HCMC, not to mention the city itself, which has to contend with land and groundwater contamination related issues surrounding the landfill sites and neighbouring households (Than Hien News, 10 November 2006). As a solid waste official from the Department of Natural Resources and Environment (DONRE) Thu Duc district pointed out, “diverting as much waste as possible from the landfills will ultimately reduce their overall environmental impact” (Interview 3a). However, continued landfilling at the current rate implies a loss of about 10 hectares of land per year and this number could rise considerably in the coming years. If used for residential development at a price of US\$190/m<sup>2</sup>, the accumulated value of this land would be about US\$19 million annually (Interview 11).

According to an official with HCMC’s City Environmental Company (CITENCO), in order for the solid waste management system to be financially responsible, HCMC residents first have to pay an appropriate fee (Interview 7). This can be in the form of a monthly fee or as part of the tax system. In other words, payment would be based on the user-pays principle. Currently, the government uses funds from other economic sectors to pay for solid waste management. He argues that it is not fair to those who generate little waste to have to subsidize the cost to those who generate a large amount of waste and pay relatively little. He suggests that the government publicize to the citizens the true costs for collection, transportation and treatment of one tonne of solid waste and convince people to pay a

higher fee. International experience has shown that, in contrast, residents believe that they should not have to pay for a service that does not meet their demands and expectations, nor do they want to participate in waste diversion programs if they perceive them to be poorly managed and operated (Fujii, 2008).

### **5.3.1 The History of Solid Waste Management in Vietnam and HCMC**

In Vietnam, the highly developed solid waste recovery and recycling system has existed for a number of years now (DiGregorio, 1994). In HCMC, as has always been the case, the recycling and reuse of waste is driven by economic incentives, and not necessarily based on environmental awareness as seen in developed countries (Interview 11). However, there is the possibility that this will change. Those who recover, process, sell or trade waste for the supplementary income it provides may not be inclined to continue to do so as cheaper alternatives are imported (Interview 11). DONRE will be forced to play a greater role in the drive for waste recovery using legislative enforcement and incentives or community education and policy development.

Historically, recyclers in less affluent areas of Vietnam have always made efficient use of recyclable waste (Interview 3a). As the demand for secondary raw materials increased in the various industrial sectors so did the solid waste recovery and recycling sector to meet this demand. While common to other developing countries, this well-developed system in Vietnam is further explained by wartime years, deprivation and economic isolation.

According to a solid waste official in HCMC (Interview 3a), the traditional activity of metal casting has existed in Vietnam for centuries as a special handicraft. Accordingly, the recycling of metals, especially waste copper, aluminum and iron, is common in Vietnamese society. Vietnamese farmers, also, for centuries have customarily recycled and reused waste, primarily solid and liquid agricultural or municipal waste as an agricultural input.

However, the use of waste by farmers over the years has declined steadily with the change in composition of refuse (more contaminants and inert materials) (Interview 6).

During the French colonial period, Vietnam experienced a new phase of growth. Industrial cities that had already established themselves grew, villages and towns became cities, beginning a process of urbanization. A consequence of this growth was the increase of waste being produced and disposed of haphazardly. A positive consequence was that the recycling of inorganic materials began to appear in the cities as waste generation increased (Interview 3a). At the outset, the Vietnamese-Chinese population predominated in this activity.

Initially, the formal solid waste management system in HCMC was comprised of mainly waste collection and reuse. A solid waste official in HCMC noted that, “prior to 1975, waste was collected informally and by private companies. There were no waste management office or departments” (Interview 3a). From 1965 to 1975, with the war intensifying into the countryside, rural to urban migration into HCMC was soaring. Imported goods (packaged materials) for consumption increased due to the American presence (Interview 3a). Even during the war, HCMC experienced some prosperity. Again as a consequence, the volume of waste generated increased exponentially (Interview 4).

After 1975, according to a solid waste official in Thu Duc district, HCMC (Interview 4), waste recycling underwent several phases. In general, the period after the war to 1989 was marked by a scarcity of goods and raw materials. The state factories under the centralized economic system were not able to meet the needs of the population in terms of the availability of goods. With a scarcity of resources, waste recycling activities flourished. Prior to the collectivization period, government policies encouraged the expansion of small to medium scale enterprises in the city. This resulted in the further development of waste

collection and recycling services. However, the institutional structure in HCMC underwent significant changes between 1978 and 1986 under the general policy of central planning. Private waste management processing facilities were forced into cooperatives or joint-ventures with the government. Government employees controlled and managed the businesses while the owners became technical employees of the state. However, since 1987, little by little, all the waste shops have been returned back to their original owners (Interview 3a). Nevertheless, this period affected the psychology of the shopkeepers and their abilities to manage operations in their own way. This was evident when discussing solid waste operations with the manager of a waste transfer station in HCMC (Interview 1). He appeared hesitant to discuss the collectivization period, preferring to steer the conversation toward another topic.

The first sign of improvements in the solid waste management system appeared after 1989. Reforms “along with renovation and recovery (*doi moi*) after 1989 brought attention to waste management issues. The focus was on cleaning the main districts within the city at the time, Districts 1, 3, 4, Tan Binh and Go Vap” (Interview 3a). Additional resources (e.g. finance and labour) were allocated to these areas because they were seen as the most important in HCMC. Also during this time, the primary method of solid waste treatment was landfilling. In the early 1990s there were five groups responsible for the collection, handling and treatment of HCMC’s solid waste. The Hoc Mon Refuse Composting Company, a state-owned enterprise, was directly responsible for the treatment of 70% of the waste volume (Interview 7). The remaining 30% was treated by the remaining four groups scattered throughout HCMC with the aim of covering the majority of city without traveling lengthy distances to handle the collected waste. This emphasis on landfilling further undermined recycling initiatives and the abilities of recyclers.



However, in 1995 the treatment and disposal of solid waste became a major concern of the local government (Interview 3, 4 & 8). During this period, the majority of the waste collected was landfilled at the Dong Thanh landfill, located approximately 28 km away from the city centre in Hoc Mon district. The 10 hectare site was nearly filled to capacity with no contingency plans for an alternative disposal site in the works. Due to the limited capacity of the landfill, the city had to enter into several agreements with a number of districts in order to allow for the disposal of waste in lakes, ponds, and smaller dump sites. Other than landfills and dump sites, the city lacked the facilities to divert waste away from the landfills, through formalized recycling, composting or incineration. However, a small portion of wastes were diverted through the informal sector. The inability to site a formal waste treatment facility was attributed to the lack of political will within the local government at the time (Interview 5). The lack of available land for a waste treatment facility was also seen as a barrier.

In HCMC, since 1997, many improvements have occurred with regard to waste management, technological and institutional arrangements (Interview 8a). For example, collection services have been expanded reaching a greater number of residents. However, the majority of waste generated in the city continues to be sent to the landfills. Even though these landfills are considered sanitary, there are still many odour complaints and suspected leaks of leachate into surrounding waterways (Vietnam News, 24 June 2008).

In the 21<sup>st</sup> century, the management of solid waste in HCMC continues to evolve, adapting to new demands from city residents and international standards (Interview 8a). DONRE is now looking at various waste treatment options that could provide the city with the respite it needs to properly plan for the future. Future and current initiatives are discussed in subsequent sections.

### **5.3.2 Institutional Organization and Management**

Vietnam now has environmental protection agencies that are directing their attention to the various environmental issues and the deficient legal and policy system for solid waste management. However, major institutional problems still exist. First, the administrative organizational structure of environmental institutions is cumbersome (Interview 3b). There is duplication and a constant change of responsibilities as well as gaps and missing elements in the regulatory provisions for effective solid waste management. For instance, at the national level, the Ministry of Science, Technology and Environment (MOSTE) was until 2002 responsible for the research and development of waste management initiatives, but this role has shifted and now falls under the jurisdiction of the Ministry of Natural Resources and Environment (MONRE). There is also fragmentation of responsibilities between the various ministries and organizations in Vietnam and HCMC (Interview 2). In most cases, lines of responsibility are not clearly drawn. For example, in March 2006, the Solid Waste Division in HCMC developed a plan that would have established a source separation program for composting purposes. The plan was submitted to the Department of Construction and Finance for development. However, they refused to evaluate the program, stating that it was not their responsibility (Than Hien News, 13 May 2007). The second major institutional problem is that the solid waste management system is disorganized and incomplete due to constant financial difficulties arising from poor cost recovery and inadequate funding.

The responsibility for collection, treatment, and disposal of municipal solid waste in HCMC, lies with the HCMC DONRE (Interview 8a). DONRE manages solid waste directly and indirectly: directly through the specialized departments and indirectly by contracting out various solid waste management duties to semi-private waste management groups (Interview 3b). Extensive solid waste management services operate mainly in the urban areas. However, it is estimated that 70% of the rural population benefit from some form of solid waste services (mainly the rural localities which are in the proximity of cities).

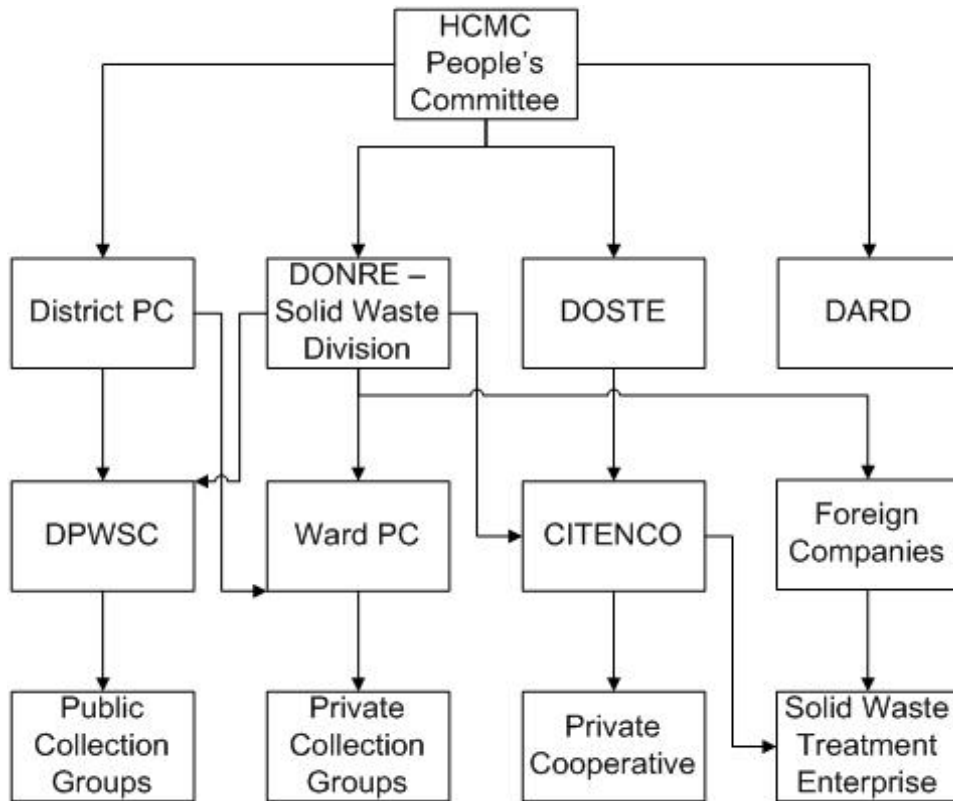
With respect to institutional structures, two research participants (Interview 2 & 11) stressed the need for the complete reorganization of how the public and private sectors interact in the solid waste system. Such reorganization is essential in the face of growing volumes of solid waste generated. In HCMC, the solid waste management system is characterized by the simultaneous existence of the formal conventional system (collection, handling, transportation and disposal by the public and private sectors) and the informal collection and recycling sector. The various actors involved in the provision of this service have differing interests and potential for contribution. Their roles and the coordination of their activities are crucial elements in organizing an appropriate management structure (Interview 4). The potential role of different actors and major problems encountered with the current institutional arrangement are addressed and identified in the next three sections.

In response to a growing number of solid waste related environmental problems in the past, HCMC implemented an evolving regulatory/institutional framework (Interview 8a). The implemented framework outlines the various roles of the numerous solid waste agencies in HCMC. Under the umbrella of the People's Committee<sup>8</sup> of HCMC (see Figure 8), the Solid Waste Division, under DONRE, is responsible for the planning and implementation of solid waste processing programs (Interview 11). Based on a number of decrees (see Table 2), the Solid Waste Division is to guide, monitor, and supervise the operation of the solid waste system in HCMC. More specifically, Table 2 highlights the legal texts that are most important in dealing with the environment and waste management. For example, in the 1997 decree 199/TTg, the Prime Minister focuses on the waste management problems Vietnam is facing such as uncollected waste, non-sanitary landfills, and the lack of appropriate technology to handle and treat waste. In this decree, the Prime Minister states

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<sup>8</sup> The Provincial People's Committee is the administrative/government arm that governs the province of Binh Dinh, in which Quy Nhon is located.

that all stakeholders in the solid waste management system are to control waste generation and collection, inhibit public littering, organize source separation initiatives, raise public awareness on waste disposal behaviour, and encourage the use of new collection technologies and treatment methods of waste.



**Figure 8 - HCMC Solid Waste Management System**

(source: Personal Interview 3a)

CITENCO, the largest state operated company belonging to HCMC’s DONRE, is responsible for the collection, transport, and disposal of waste in the city. It operates through an interdependent network of semi-autonomous enterprises established at the district level. These enterprises, named the District Public Works Service Company (DPWSC), are responsible for collecting domestic and commercial waste, and sweeping public streets within the twenty-four districts of HCMC (Interview 4). The DPWSCs receive their funding

from the Solid Waste Division of HCMC. The majority of state funding goes to pay a portion of the salaries of the many waste collectors (the other portion is paid through collection fees). If the household collection fee were to be raised then state support to the collectors would decrease increasing the availability of financial resources that could be distributed to the under funded DPWSC (Interview 4). However, a solid waste management expert in HCMC notes “nowadays, the government uses a lot of money for solid waste management, but their efficiency is very low. A lot of the money meant for waste management is wasted. If the government wants citizens to pay a higher sanitation fee, they have to prove that they will utilize the funds in an effective way” (Interview 11).

**Table 2 - Regulations Dealing with Waste**

Document Number	Issued by	Regulation Content
<b>Decree 199/1997/TTg</b>	Prime Minister	-Highlights the waste management problem in the urban areas of Vietnam and calls for urgent solutions.
<b>Decree 183/2003/TBVPCP</b>	Government	-Seeks to further develop waste treatment endeavours with advanced technologies.
<b>Decree 256/2003/TT</b>	Prime Minister	-Seeks to divert 30% of industrial waste from landfills by the year 2020. -Seeks to equip 30% of households and 70% of businesses with source separation services, and 80% of public areas with waste bins by the year 2010.
<b>Decree 121/2004/CP</b>	Government	-Imposes administrative penalties on violations of environmental protection rules.
<b>Decree 143/2004/CP</b>	Government (MONRE)	-Mandates that environmental impact assessments be conducted on solid waste management projects.

Additionally, HCMC has encountered a number of barriers in the effective implementation and enforcement of the regulatory framework (See Table 2). First, the solid waste division, along with CITENCO, suffer from a lack of resources to sustainably manage solid waste.

Resources in the form of equipment and capital, solid waste management trained staff, and a mandate for the cost-effective management of solid waste. Compounding the problem of resource scarcity is the inability of solid waste management officials in HCMC to effectively enforce regulations due to institutional incapacities at the operational level. These incapacities include “insufficient supervision of waste management practices, largely due to limited human resources, unclear mandates, fragmented and overlapping roles of various government agencies, and limited interagency coordination” (World Bank, 2004). This results in “limited incentives for proper operation of landfills, and has allowed inexpensive, unsafe methods of disposal – such as open dumping – to proliferate” (World Bank, 2004).

At the lower level of government in HCMC, officials from the solid waste office at the district level complain that they do not have adequate financial support from the centre to properly manage the solid waste system within their district. However, they also go on to say that it is important for them to be “somewhat autonomous” from the centre and to be able to implement their own waste management plans (Interview 4). This statement is somewhat contradictory, since a district cannot be completely autonomous from the centre and still receive funding from them.

#### 5.3.2.1 Private Sector

The private sector in HCMC’s waste management system is characterized as a group willing to operate in areas where there is a void. They do this without infringing on the territory of other private waste management companies or state-owned enterprises of HCMC. The *National Strategy for Environmental Protection 2001-2010 (NSEP)* released by MOSTE in 2001 is a general environmental strategy. The strategy contains numerous solid waste objectives, as well as objectives for overall environmental protection in the country. One of the objectives outlined in this strategy was enhancing the role of the private sector and increasing their involvement in the overall management of municipal waste (Watson, 2004). The DONRE Solid Waste Division is currently promoting new initiatives based on NSEP to fill

the gaps in the current HCMC solid waste system. For example, private and semi-private organizations such as CITENCO are encouraged, using financial incentives, to collect waste from rural communities and urban areas where there is no municipal waste collection or coverage. The goal behind this incentive program is for the waste collection companies to use the funds to purchase needed equipment, such as collection vehicles, thus enabling them to serve areas with no history of formal collection. However, NSEP strategy fails to address organic waste management and composting.

#### 5.3.2.2 Informal Sector

The main role of the informal sector in solid waste management is the recovery of reusable and recyclable solid waste. In Hanoi for example, the informal sector is responsible for the diversion of an estimated 20-25% of all Hanoi's municipal solid waste produced (World Bank, 2004; Maclaren, 2005). In major Asian cities, the informal sector is responsible for the recycling of 20 to 30% of municipal solid waste (Interview 2). The solid waste recovery and recycling system in HCMC is loosely organized involving a chain of collection, resale and the regeneration of a variety of waste materials into low price consumer goods for sale predominantly to the middle-class and poor. Components of the chain include waste pickers (door-to-door collectors, street sweepers, itinerant informal waste workers and transfer station managers), itinerant (door-to-door) waste buyers, junk shopkeepers, middlemen (or traders) and recycling factories (Interview 3; Maclaren, 2005).

Operating under economic pressures and income pressures of the labour force, itinerant informal waste workers are mainly women and children. The estimated total number of this workforce in HCMC is estimated to surpass 1,000 (Interview 8b). Besides itinerant informal waste workers, a more organized waste picker force operates at the three city dump sites. They also operate in areas of HCMC that do not receive as much attention from formal city collectors, especially along side streets and poorer neighbourhoods. However, currently, the informal sector in HCMC has not involved itself in the collection and processing of organic

waste material into compost (Interview 8b). With their relative large size and range the informal sector can take advantage of the potential of composting if conditions are favourable and a desire exists.

### **5.3.3 Collection and Transportation**

The collection and transportation of solid waste is a public service in HCMC, performed by the local government and collection enterprises. In HCMC, the main goal of the collection and transportation of solid waste from the source of generation is to safeguard public health, prevent unpleasant odours and aesthetically offensive sights, and limit congestion in an already crowded city (Interview 8a).

While solid waste collection in HCMC has improved over the years, poorer and rural areas still experience infrequent or no collection. However, there is a 90% collection rate in the urban districts and a 70 to 80% collection rate in the rural districts (Interview 7). These figures have steadily increased in the past decade. However, in HCMC and Vietnam, on average, the poor are largely not served by collection services; nine out of ten of the poorest urban households do not receive solid waste collection service (World Bank, 2004). In HCMC, more than 36,000 households live in slum areas along the 70 km of canals and waterways, these areas unfortunately receive no collection as a part of the solid waste system. Even manual laboured handcarts encounter difficulties accessing these areas. Residents instead simply dump generated refuse into the canals and waterways and open public spaces in the nearby environment. It is estimated that approximately 450 tonnes of different types of solid waste are dumped into the canals and waterways daily, contributing to the overall decline of the Sai Gon River in HCMC, the city's main source for drinking water (Vietnam News, 24 June 2008).

Solid waste collection in HCMC is carried out by two groups: public collectors and private collectors, which include informal collectors. Public waste collectors belong to CITENCO and



the district public service companies (DPWSC) serve the public areas (streets, parks, city squares, government buildings) and only a portion of household waste collection (20%). Public waste workers receive approximately 7,000-12,000 VND/household/month (US\$0.54-0.92). The fees are collected from the households door-to-door. The collected amounts are a part of the total funds that the agencies receive from the People's Committee every year for their waste collection tasks. The total amount of fees collected from public collection in 2004 is estimated at approximately 23.5 billion VND/year (US\$1.8 million). The private groups only serve households (Interview 7). An estimated 80% of the households are served by private collectors with a collection fee according to an agreement between household and collector of around 10,000-15,000 VND/household/month. The total amount of fees collected from private collection is estimated at 134.4 billion VND/year (US\$10.3 million).

Historically, a significant number of households in HCMC set aside recyclable waste so that they may be sold to itinerant buyers for profit. However, as household incomes continue to rise in the city many residents have discontinued this practice resulting in the landfilling of potentially recyclable waste. Nevertheless, enthusiastic waste collectors earn additional income by picking through household waste searching for valuable materials and selling these recyclables (Phan et al., 2006).

Currently in HCMC, CITENCO is responsible for the transportation of roughly 40% of solid waste collected from the transfer stations to the landfills. The 24 DPWSC's, which belong to the Districts People's Committee, are responsible for public area cleaning and the transportation of the remaining 60%. Working under contract with CITENCO, a small percentage of collected waste is transported by private cooperatives. The cost associated with the clean-up of city streets by the DPWSCs is the responsibility of the HCMC People's Committee. Total collection costs paid by the city amount to 218 billion VND/year (US\$14.3

million). Collection of waste from city canals and waterways accounts for a small percentage of this amount (Phan et al., 2006).

#### **5.3.4 Disposal**

In Vietnam, open dumping remains the dominant form of disposal of municipal waste. Of the 91 disposal sites in the country, 49 sites have been identified on a national list as hot spots with high environmental and human health risks and only 17 are considered sanitary landfills. In many areas, backyard disposal methods – such as burning or burying waste, or dumping in rivers, canals, and open fields – are impacting surrounding communities, including contamination of ground and surface water by untreated leachate, emissions of airborne pollutants, and the spread of odours, flies, mosquitoes, rodents, dust, and noise, leading to a high incidence of skin, respiratory, and digestive disease (World Bank, 2004).

In HCMC, waste treatment and disposal takes place mainly at sanitary landfills. At present, landfills in HCMC are operated by the Solid Waste Treatment Enterprise (SWTE), which belongs to CITENCO falling under the umbrella of DONRE. The SWTE currently operates the two city landfills of Go Cat and Phuoc Hiep, with each landfill receiving approximately 2500 tonnes per day. Go Cat landfill which was scheduled to close at the end of 2007 was still in operation in January of 2008. At that time the new landfill will open at Da Phuoc with a capacity of 3000 tonnes per day. The costs of landfill disposal are fully paid by the city (Phan et al., 2006). Prior to 2005 a tipping fee was not imposed. The costs of landfilling amounted to 91 billion VND (US\$6 million) in 2004, this corresponds to 51,600 VND/tonne (US\$3.40). This figure includes the net operation costs, including energy, soil cover, and labour. A more complete estimation of the costs of landfilling in HCMC yields a far higher amount of 270,000-350,000 VND/tonne (US\$17.80-23.10) (Phan et al., 2006).

The current socio-economic conditions in HCMC call for a method of treatment and disposal that meets the present requirements for timely treatment and disposal against an

unexpected rapid increase of solid waste. To meet these requirements landfilling in HCMC is considered the most timely and cost effective method to managing solid waste, requiring a low investment of capital which is suitable to the economic conditions of the city. However, landfilling requires large tracts of land which have now become somewhat scarce due to the economic boom, and urbanization and industrialization processes the city has experienced. Eventually, available landfill space within the city will run out, forcing the People's Committee to seek alternative locations for waste disposal outside of the city boundaries. This will result in substantial transportation costs which the state budget at this point cannot readily afford (Interview 2). The city is aware of this potential problem and as such has planned for other forms of waste processing such as formal recycling and composting and a lower level of dependence on landfills. However, the city is planning on expanding the Phuoc Hiep landfill, and opening two new landfills. The first is operated by a private American consortium opened in November of 2007 in Binh Chanh district, and the second is to be opened in 2010 in the neighbouring province of Long An. These openings and expansion suggest that the city does not have much faith in the planned waste processing schemes mentioned above.

### **5.3.5 Recycling**

Although municipal solid waste represents an unwanted by-product of certain economic activities, it is generally not devoid of resource value. Some of this value in HCMC is captured through private economic endeavours, for example, informal sector recycling and through households. Households routinely separate recyclable waste such as metals and paper for sale to itinerant buyers, or sell it directly to local depots. However, HCMC lacks the community-led recycling systems which are present throughout other cities in developing countries. Also lacking is the formal composting of organic waste.

The informal recycling system in HCMC has existed for many years. In fact, the recycling of municipal solid waste is an extremely well developed activity in Vietnam. This atypical

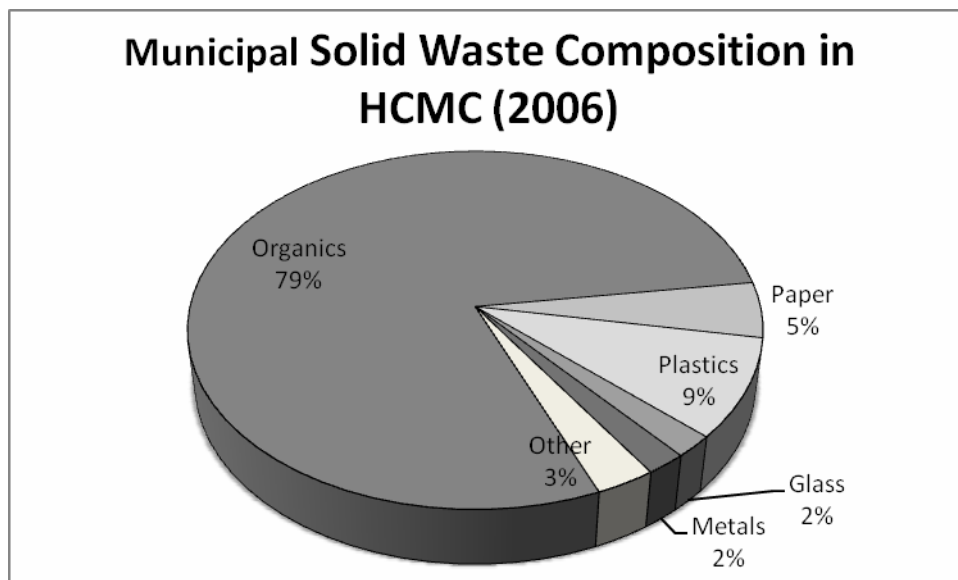
situation is explained by wartime years, historical hardships and economic isolation. The collection of recyclable materials is conducted by formal collectors (public and private) and informal waste collectors. They separate, collect and sell a number of recyclables including metals, certain plastics, glass, and various other materials. Waste recovery organization, intermediate elements of purchasing, concentrating and sorting materials, manual working units of treating and producing second rate materials, all these elements have for a long time formed a complex but perfectly structured world, that use a significant amount of labour and employ original techniques.

### **5.3.6 Composting**

In Vietnam and HCMC as part of the VAC system of farming, composting on a small-scale basis has long been a standard practice among subsistence and organic farmers. VAC in Vietnamese is *vuon, ao, chuong* which means garden/pond/livestock pen. The aim of VAC in Vietnam is to provide diversified agricultural products to meet the complex nutritional demands of humans. The recycled residues of the VAC ecosystem create a permanent biological agriculture, in which waste is recycled into organic fertilizers to replace chemical fertilizers and helps to protect the environment (Le, 2003). Miscellaneous unusable farm products (straw, leaves, and feathers), as well as household waste mixed with manure and allowed to decompose in pits or heaps, yield a valuable soil conditioner and fertilizer (Nunan, 2001). Most farm waste is organic and decompose quickly. On the other hand, municipal solid waste presents a different problem. Municipal solid waste contains a significant amount of inert materials, such as plastic, glass, rubber, and metal (Nguyen, 2005). This evolution of solid waste from organic to synthetic refuse has had an overall impact on the ability to produce a high quality compost product.

Still, roughly 60 to 97% (79% average) of solid waste discharged into landfills and dumps by municipal services is made up of organic matter (See Figure 9) (Phan et al., 2006). Essentially this means that a potential raw material for compost production is wasted in

landfills. Considering this high proportion of organic matter in the waste stream, it is conceivable that composting can be an option to treat and reduce the amount of waste that is landfilled, extending the lifespan of the landfills. At the same time, composting can reduce the burden on the environment and produce a marketable soil conditioner for agricultural purposes. However, compost was not available at the markets of HCMC. Though, based on the literature review and the exploratory survey of farmers, there is a strong demand for organic soil amendments for HCMC farms.



**Figure 9 - Solid Waste Generation in HCMC (2006)**

Currently in Vietnam, there are ten composting plants operating outside of HCMC using municipal solid waste (Table 3) (Phan, 2006). As of November 2007, there were no facilities composting municipal solid waste in HCMC. In HCMC and surrounding areas there are close to 60 plants that produce fertilizer utilizing agricultural waste, such as rice husks, manure, coconut shells, and residual organic waste from the sugar cane, tobacco, and soybean industry (Interview 2). The product produced by these plants is referred to as fertilizer due to the fact that it is enriched with additional nutrients, fungi and micro-organisms and inorganic materials (NPK).

**Table 3 - Existing Composting Plants in Vietnam**

Plant Name	Location in Vietnam	Year of Commencement	Status	Capacity (tonnes/day)
<b>Cau Dien</b>	Hanoi	1992	Operating	320
<b>Tan Thanh 1</b>	Vung Tau	1995	Under Going Maintenance	50
<b>Tan Thanh 2</b>	Vung Tau	2004	Operating	75-100
<b>Viet Tri</b>	Phu Tho	2001	Operating	100
<b>Nam Thanh</b>	Central	2003	Operating	120-150
<b>Nam Dinh</b>	Nam Dinh	2003	Operating	130-140
<b>Thuy Phuong</b>	Hue	2005	Operating	80
<b>Dong Vinh</b>	Vinh City	2005	Under Going Maintenance	300
<b>Quy Nhon</b>	Quy Nhon	2007	Operating	400
<b>Quy Nhon</b>	Quy Nhon	2007	Operating	9.7

A review of previous large-scale composting projects and initiatives in HCMC revealed that they have been largely unsuccessful (Interview 7 & 11). A solid waste official in HCMC points out that “composting initiatives in HCMC in the past used inadequate technologies producing a low quality product. To make up for inefficiencies and energy use in the technologies the price of the compost was high” (Interview 7). The main reasons why large-scale composting operations in HCMC have failed include mismanagement on the part of the operators; the application of mixed (unsorted) municipal solid waste as the input material resulting in low quality compost due to the presence of inert materials (such as plastic, glass, rubber); the lack of regulations and policy to control the quality of compost; a compost supply which has not been able to meet the market requirement; inappropriate technology and the rise of energy costs; high cost of compost<sup>9</sup>; and lack of available land and space for a compost plant (Interview 6, 7, 9 & 11).

<sup>9</sup> Mainly a result of having to use mixed waste (industrial waste also used), the use of fertilizers to raise the quality of the final compost product thus raising the price, and the fact that farmers were unwilling to pay the higher price for the enriched compost.

### 5.3.6.1 Source Separation

While single stream recycling collection is a viable program for urban and high-density population areas, this is not the best solution for areas producing a significant amount of organic and recyclable waste. The market value for source separated solid waste is much higher than for mixed waste. However, a solid waste management official in HCMC noted that it is: "...too costly to implement a source separation program" (Interview 7). Presently, all municipal composting plants in Vietnam utilize mixed solid waste in their operations.

Source separation requires a sufficient volume of commodities collected to offset the cost of separation. This volume simply does not exist without the extensive participation of city residents. The material must be received segregated and clean because on-site separation requires too much human power and is inefficient. Currently, HCMC lacks the regulations necessary to mandate source separation. Several waste management experts in the city noted three reasons why source separation should be encouraged (Interview 2, 3 & 11): firstly, through segregated recyclables to conserve resources in order to reduce the city's dependence on imported raw materials (such as metals, fibres, plastics); secondly, to save landfill space and reduce pollution from landfills due to the separation of recyclable materials; and thirdly, for compost production from source separated organic waste.

Solid waste officials of the Solid Waste Division in HCMC have in the past attempted to establish source separation programs for the city (Interview 8; Than Hien News, 13 May 2007). However, the majority of those initiatives have failed to get past the planning stages or been in the form of pilot programs and were relatively unsuccessful. For example, a source separation pilot program held in District 6 (2006-2007) of HCMC asked residents to separate their organics in one bag and inorganics in another. The majority of residents (60 to 70%) at the outset were able to properly separate their wastes. However, they later became discontented after discovering that waste collectors simply mixed the two bags up

at the collection stage, thus negating any separation conducted at home (see Appendix D, Photos 5 & 6).

Essentially, the majority of source separation initiatives have failed for lacking at least one of the following four characteristics (Interview 2 & 7). Firstly, they lacked extensive educational campaigns. Secondly, they lacked policies to support households, private collectors, composting operations, and farmers. Thirdly, lacked in investment in source separation infrastructure (waste containers, proper collection devices/vehicles, transfer stations, composting plants). Lastly, they lacked quality assurance/monitoring systems to ensure proper source separation at the household level and proper collection on the street.

#### 5.3.6.2 Historical Composting Initiatives

The first solid waste composting company in HCMC was established in 1979. The Hoc Mon Fertilizer Company had a capacity of 250 tonnes/day. At that time, the management of solid waste was not a top priority resulting in limited funding for waste treatment. A series of technological failures, corroding equipment, and not being able to sell the compost due to its high cost and the presence of inert materials led to the closure of the company in 1989 (Pham, 2005). In 1981, a Denmark funded composting plant using urban solid waste began operating in HCMC. The plant, modest in size, was able to process 200 tonnes of waste per day, producing 80 tonnes of compost. However, the plant was shut down eight years after its inception due to the use of inappropriate technology leading to inefficient production (Interview 8a). The technology used was foreign made, too complicated and unsuitable to the local conditions.

From 1989 to the early 1990s, through private informal agreements between collectors and farmers, a small portion of the waste collected was transferred to peasant farmers who in turn composted the organic portion. Nevertheless during this period, untreated waste dumped haphazardly in various dumps/landfills caused serious environmental pollution,



affecting the city's waterways and groundwater. After 1993, the city began to invest in the treatment of solid waste, establishing more sanitary landfills and waste processing facilities (Pham, 2005).

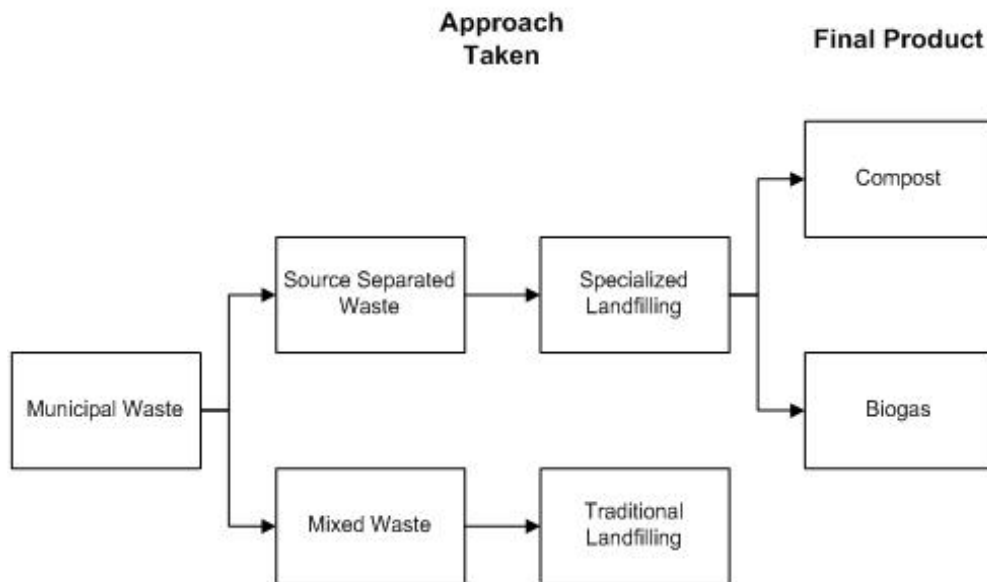
In 2002, a 1,502 billion VND (US\$100,000) composting facility operating in Tien Giang province, neighbouring HCMC, was forced to close after only two years in operation. The plant was closed after the government subsidies upon which it relied were discontinued. This again highlights the importance of a solid waste treatment enterprise to be financially sustainable and independent. In this example, the signs of failure were present almost immediately (Interview 4). In order for the plant to function properly, it relied on residents of the city to source separate their waste, which did not occur. As a result, the plant had to arrange for the separation of waste on site, using manual labour. At the same time the mechanical/energy intensive parts of the plant continued to operate. The hiring of the extra labour force cut into the profits of the plant.

#### 5.3.6.3 Current Composting Initiatives

According to a waste management official in a HCMC district, the city government has put on paper the need for composting operations but have not actually done much (Interview 3a). Currently in HCMC there are no government regulations related to compost production from municipal solid waste. The official suggests that the city government set-up small scale (5 ha) composting operations, where all mixed waste from the district would go and organic waste could be separated to produce compost (Interview 3a). This could be more effective than a large-scale mechanized composting plant, whose problems have been well documented. A discussion with a research participant revealed that all the composting plants in Vietnam (except for the Quy Nhon small-scale plant) are failing or will fail and that any future composting plants in HCMC are likely to fail as well. The research participant relates this to management and regulation problems in the city (Interview 13).

An initiative currently touted in HCMC by the Solid Waste Division involves the implementation of a sophisticated plan that would see the collection of landfill gas (converted into biogas for the generation of electricity), and compost production at all the sanitary landfill sites in the city (Figure 10) (Interview 8b). The idea is to recover landfill capacity, produce biogas, and to produce compost at the same time. Landfill gas occurs as a result of a breakdown of organic materials under anaerobic conditions (the absence of oxygen) in a landfill. This measure is sophisticated as it calls for the landfilling of source separated organic municipal waste in specially designated landfill cells, harvesting the landfill gas, conversion into biogas, and then mining the compost. The specially designated cells will house only organic waste and not mixed waste.

However, such a procedure has been previously attempted in Canada and the United States with limited success (Reinhart & Townsend, 1998; Das et al., 2002; Savage et al., 1993). One project was in the State of Florida and another in Simcoe County, Ontario. A study was conducted in a Naples, Florida landfill where stabilized landfilled waste, aged 10 to 15 years, was excavated. Seventy-five percent by weight of the materials in the landfill was recovered using a fine screen to refine the product of excavation. This approach was followed by an air knife to remove plastics and a magnetic separator to remove metals. Although the resulting product was below regulatory levels of heavy metals, it was still highly contaminated with an inert content level of 4-10% and was odorous (suggesting poor stability). The final product not suitable for agricultural purposes was used as daily landfill cover (Reinhart and Townsend, 1998; Das et. al, 2002).



**Figure 10 - Organic Waste to Landfill to Biogas and Compost Specialized Plan**

In HCMC, the attention that municipal waste management authorities currently give to the potential for composting using municipal solid waste is limited. The most cited reasons for this lack of attention include unaffordable costs of separation, treatment and transportation. However, it is clear from the discussion on community-based management in the literature review and the case study in Quy Nhon that there is potential to develop more labour intensive working methods, which are less costly than the energy intensive methods used in developed countries.

When planning for a composting operation in a developing country it is important to remember two practical issues. First, composting technologies used in large-scale projects require a significant investment and are very costly to operate, even with energy recovery. Second, if the financing is planned so that the municipality is not contributing funds at the beginning, long-term financial impact on the municipal budget should still be considered.

#### **5.4 Solid Waste Management in Quy Nhon**

In 2004, Vietnam was selected by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and Waste Concern (a solid waste management NGO based in Dhaka, Bangladesh) as a potential country to replicate a sustainable model for a small-scale compost plant and decentralized waste collection and composting initiated and successfully implemented in Dhaka, Bangladesh (Interview 10) (see Appendix D, Photo 7). Quy Nhon was selected as the pilot site for the replication of such a model, due to the open-minded attitude of the authorities in the city toward this initiative and the application of this model (Interview 10). After several delays, construction of the small-scale compost plant began in August 2006, with operations commencing in April 2007. The plant is able to process 9.7 tonnes of fresh solid waste and produce 2 tonnes of compost per day. The first batch of compost became available late June of the same year.

It is agreed that the replication of community-based solid waste collection and composting would be first implemented in sub-ward 5 (732 households) of Quy Nhon and then expanded to the surrounding sub-wards after experiences and lessons learned were drawn from the initial phase (Interview 12). Also, if this initial plant is an economic success then other plants will be built and operated in other parts of the city to expand the program's coverage (there are over 40 community-based composting operations employed in Bangladesh). Also, the compost currently produced in Quy Nhon is of good quality and is being sold on the market, providing a source of revenue for the community-based composting operation (see Appendix D, Photo 8). A second source of revenue are collection fees from households. A third source of revenue would capitalize on the Kyoto Protocol's Clean Development Mechanism (CDM) (Interview 10 & 11). The expected establishment of other plants throughout Quy Nhon would allow program administrators to obtain income through the sale of carbon credits in the CDM framework.

Prior to this initiative, only 350 of the 732 households located in sub-ward 5 received adequate collection from city collectors. Services were only provided to households located along the main streets. The remaining households, who did not have access to the formal waste collection system, burned or buried their waste in their backyards or simply threw it away in public spaces. However, with the new community-based collection and composting program all households in sub-ward 5 receive door-to-door collection services (Interview 11).

Establishing a community-based composting plant in Quy Nhon has yielded a number of benefits for the local community. However, difficulties were encountered along the way (Interview 11 & 12). Delaying the construction and thus operation of the plant was a problem relating to the designated land for the compost plant. Initially the plant was intended to be located near the city centre. However, several households living in the surrounding area of the designated land complained to the Provincial Binh Dinh People's Committee about the construction of the compost plant next to their houses, claiming that it would create air and water pollution and bad odour. Consequently, the Quy Nhon People's Committee under the direction of the Provincial People's Committee were ordered to find another location to situate the plant. Instead of the plant being located in the city centre it is now situated on the outskirts of the city resulting in an increase of operational costs and travel time in the collection and transportation of waste (Interview 10). This highlights an important factor in siting a composting plant, that of land availability and proximity to the producers of waste.

However, an advantage from the outset, in the planning stages, was the support provided by the city's Project Implementation Board<sup>10</sup>. Under the strong direction of the then Chairman of the Quy Nhon People's Committee, the board was committed and active in

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<sup>10</sup> Based on the management levels of Berkes (1994) and Sen & Nielsen (1996), the Project Implementation Board can be characterized as a management board.

organizing environmental promotional activities and establishing the collector and processing team. As well, the technical assistance provided by Waste Concern's experts was very helpful for local authorities in the process of project proposal formulation ensuring operational and financial feasibility and the promotion of their shared responsibilities in the project implementation process (Interview 10). This ongoing administrative support has translated into community support. The majority of households in Sub-ward 5 were very enthusiastic with the idea of solid waste separation and composting introduced by the project (especially after the plant was relocated away from the city centre). This has mostly resulted from the active operation of the community-based environmental volunteer group who have made great efforts in communicating with the community on those issues.

Community-based composting attempts to educate the public about potential opportunities and benefits from the recycling of organic waste with the long-term goal of promoting benefits to the natural and social environment in both the local and global level (Interview 10) (see Appendix D, Photo 9). An important component of the community-based composting program in Quy Nhon was the ability of the management board to identify and use unskilled poor people, waste workers and entrepreneurs as an essential component of the program.

#### **5.4.1 Large-scale Composting in Quy Nhon**

Also in Quy Nhon is a newly built large-scale mechanized composting plant (400 tonnes/day capacity) (see Appendix D, Photo 10). Much like other large-scale composting plants in developing countries, this plant utilizes foreign made technology that if not properly maintained would fare poorly in the long-term (see Appendix D, Photo 11). Moreover, the unsorted solid waste fed into it contained large amounts of non-organic material which may further damage the machinery (see Appendix D, Photo 12). A sample of the final compost product examined by this researcher and other experts showed that it was of poor quality with obvious signs inert materials (mainly glass) and low moisture content (see Appendix D,

Photos 13 & 14). These problems will undoubtedly raise operational costs, and with little effort to improve and market the final product “this project could see its end within the next 5 to 10 years” (Interview 10).

An important implication of the Quy Nhon community-based composting experience includes the provision of an innovative composting model which can be easily replicated in parts of HCMC, depending on certain conditions. These conditions include the capacity of the community, availability of land, demand for compost, will of government to implement such a project and initial financial support. The Quy Nhon experience in composting reveals that, with favourable conditions, composting can have a significant impact on the management of urban solid waste (timely and adequate collection), and also generates compost, a valuable soil conditioner. Perhaps the most important implication of the Quy Nhon experience is the potential for enhanced partnerships between the government and communities for effective solid waste management.

#### **5.4.2 Use of Compost by HCMC Farmers**

The composting process is highly efficient operationally and economically when the input material (organic solid waste) is sorted properly from the inert materials. As noted above, HCMC’s municipal solid waste already contain a considerably high amount of easy-to-decompose and stable material that is suited for this technology. It is estimated that roughly 200,000-300,000 tonnes of organic compost can be produced from one million tonnes of municipal solid waste. The total cultivated agricultural land area in the rural districts is 73,000 hectares. If 10 tonnes of compost is applied per hectare and using only 50% of land area, the amount of fertilizer needed is about 350,000 tonnes, not including the great demand for fertilizer of neighbouring provinces.

Aside from diversion benefits of composting, one farmer noted that, “after years of chemical fertilizer use, compost can have a positive effect on impoverished soils.” The most

cited benefit of compost by the farmers and a local farm cooperative manager was that it is a good product as a baseline soil conditioner and that it has a positive impact over the long term as opposed to chemical fertilizers which tend to work best in the short term. And as such, the majority of farmers surveyed (7 of 11) (see Table 4) indicated that they would be willing to use compost, however, it was nowhere to be found in the markets. This was confirmed by a Cu Chi Department of Agriculture and Rural Development (DARD) representative (Interview 5). Another factor contributing to the use of compost is access. Several farmers (5 of 11) noted that they would be more likely to use compost if easily accessible. Transportation and weight are major issues in access due to the bulkiness of compost. This is a major reason why urban and peri-urban farmers stand to benefit the most from municipally produced compost.

Part of the farmers' willingness to use compost relates to their overall knowledge of the product. The majority of the farmers surveyed (8 of the 11) were aware of compost and its potential benefits in agriculture and, as a result, were prepared to comment on their willingness to use it. This confirms the findings of Maxwell and Zziwa (1993). In their study of farmers in Kampala, Uganda, they were able to determine that due to a lack of knowledge of the product, farmers were not using compost.

Another factor associated with farmers' willingness to use compost is the quality of the product. From the survey, I identified three main concerns relating to quality. First, there is concern among the farmers (7 of 11) of the short-term and medium-term agronomic effects of compost. They felt as though compost was more beneficial in the long-term. Second, there is concern among the farmers (6 of 11) of the heavy metal content in compost and the subsequent long-term effects of such contamination. The last concern relating to quality is that of the presence of pathogenic and inert contaminants impacting human health. A



number of farmers (4 of 11) cited that their previous use of compost was marred by the presence of inert materials such as glass and plastics.

Immediate crop growth, followed by the long-term effects on soil fertility, were the farmers' main measure for assessing the quality of compost. Several of the farmers (3 of 11) who had never used compost were willing to use it on the condition that the product must be proven to them to be comparable to fertilizers in terms of productivity. The surveyed farmers were interested in the performance of their crops in compost enriched soil, and in time, and whether the soil would eventually become polluted. This concern is related to high levels of heavy metals found historically in compost. Also, the high concentration of glass fragments found in the compost from the Quy Nhon plant and other composting initiatives was seen as a possible constraint to use, especially in the short-term. It is obvious then that compost produced from municipal waste cannot be considered feasible in agriculture if it contains foreign and hazardous materials. Future use of compost will depend on the restriction of these contaminating materials.

**Table 4 - Summary of Results from Farmer Survey**

Query	Response
<b>Gender</b>	Male – 9 Female – 2
<b>Marital Status</b>	Single – 3 Married – 8
<b>Educational Level</b>	Primary/Secondary – 8 High School – 2 University/College – 1
<b>Crops Currently Grown by Farmers</b>	Rice; spinach; lettuce; cauliflower; mangosteen; pepper; peanuts; sugar cane; cucumber; durian; bitter melon
<b>Inputs Used</b>	Compost – 0 Fertilizer – 11 Pesticides/Herbicides – 10 Ash – 3
<b>Previous Use of Compost</b>	Have – 8

	Have not – 3
<b>Satisfied With Previous Use of Compost</b>	Satisfied – 4 Not satisfied – 4
<b>Reasons for Disappointment</b>	Presence of heavy metals, pathogens and inert materials; not cost effective when compared to manure or ash; too heavy/bulky
<b>Cost of Fertilizers</b>	NPK fertilizer: Now – 270,000-300,000/50kg; 25-30 years – 60,000-80,000/50kg Ash: Now – 15,000/20kg; 15-20 years – 7,000-10,000/20kg Manure fertilizer: Now – 5000/6kg; 30 years – free
<b>Evolution of Farm Operations</b>	Increase in fruit/vegetable varieties; increase in fertilizer variety; mechanization of operations increasing productivity; less labour needed; increase in insect species leading to an increase in pesticide use; increase in water pollution; easier transportation of crops to markets (improved transportation infrastructure); increase in government programs to support farmers
<b>Factors Influencing the Use of Compost</b>	Access and ease of access; presence of heavy metals, pathogens and inert materials; agronomic effects; bulkiness; cost
<b>Advantages to Applying Inputs</b>	Provide a better yield; organic fertilizers help recover the land after over use of chemical fertilizers; no chemicals in compost
<b>Disadvantages to Applying Inputs</b>	Chemical fertilizers help degrade soil properties; fertilizers cause infestations; odours; cost of NPK
<b>Environmental Problems Relating to the Use of Inputs</b>	Water pollution; wildlife impacts; contaminated soil; waste disposal
<b>Health Problems Relating to the Use of Inputs</b>	Skin rashes; headaches; lung cancer
<b>Impact of Inputs on Quality and Safety of Foods</b>	Using fertilizers will make the fruits bigger, currently consumers prefer smaller vegetables because they believe the bigger the fruit the more chemicals it has; pesticide use effects the safety of foods which in turn affects human health
<b>Aware Compost is Made Up of Waste</b>	Yes – 8 No – 3
<b>Willing to Use Compost</b>	Yes – 7 No – 4

The survey revealed that the majority of the farmers said they were willing to use compost (7 of 11). However, the problem is finding a way or a process to produce compost that is easy to access, of high quality and with a cost acceptable to farmers. In terms of cost, a number of them revealed that the price must be right when compared to chemical fertilizers. The survey revealed that farmers are currently paying 89 times more for chemical fertilizers than they were 15 years ago, a compound annual growth rate of 38%, leaving farmers disenchanted with chemical fertilizers. If compost is priced affordably, farmers have another alternative to the more expensive chemical fertilizers.

## Chapter 6

### Conclusion and Recommendations

The world's economic activities in terms of GDP increased fifteen-fold from 1950 to 2000. The growth of consumer societies all over the world has seen a large increase in waste produced by each person, and the composition of waste has also become ever more complex. For municipalities around the world the changing and increasing amount of waste presents a significant problem. In Vietnam and other developing countries, where the increasing rates of economic and population growth and urbanization, this problem is more serious. Institutional and financial constraints prevent municipal government in developing countries from tackling these problems effectively.

In the past number of years, society has taken for granted that our waste is landfilled and many of the materials that make up our waste stream are taken from nature but cannot be reabsorbed by it. There is a growing consensus that waste should be viewed as a valuable resource in disguise and that the idea of 'waste' should be substituted by the concept of 'resource' (Girardet, 2004). The purpose of this thesis, then, was first to document the institutional infrastructure necessary for composting initiatives; second to examine the current state of municipal solid waste management in Vietnam and HCMC; next to look at new options for managing urban waste; and last to evaluate the potential for composting and compost use in urban and peri-urban HCMC.

At present the solid waste management situation in HCMC is characterized by the following:

- Enthusiastic solid waste officials but inappropriate waste management policies hinders the implementation of sustainable waste management initiatives (until November 2007 HCMC lacked a composting operation/plant that produced compost

from municipal solid waste). For example, a number of research participants noted that they were interested in various waste management diversion programs, unfortunately, these programs would be difficult to realize without sound institutional policies and financial support for waste management services, programs, and initiatives;

- Inefficiency and ineffectiveness of waste management programs and regulations. There are many regulations but they are difficult to enforce, conflict with each other, are very broad, and many organizations are involved. For example, the sudden change of roles among bodies of government as exemplified by MOSTE and MONRE;
- Inorganic recyclables (metals, plastics, glass) are recycled through a highly efficient and well organized system of informal collection and formal trading;
- Insufficient support in the form of an appropriate policy and legal base to the private sector from state bodies even though the government is pushing for further equitization of state enterprises; and
- Fragmentation and poor co-ordination among stakeholders to address waste management problems (i.e. little to no communication between collectors and compost operations, private collectors and public collectors, compost operations and farmers).

### **6.1 Changes and Implications of the marketization reforms on HCMC's Municipal Solid Waste System**

Ever since the introduction of the 1986 *doi moi* reforms, Vietnam has experienced rising FDI, substantial industrial development and a mushrooming population moving to urban centres at a rate of 12% a year. Cities are under pressure to deal with the environmental pressures placed upon them. Urban infrastructure planning and investment is seldom sufficient and equipment (such as collection vehicles, compactors, loaders) tends to be poorly maintained, seriously overloaded, and obsolete.

The main changes to HCMC's solid waste management system as a result of the *doi moi* reforms includes a change in the volume and types of waste generated. This change reflects a major cultural and economic shift taking place in Vietnam. Essentially, a shift from a low consuming, thrift-based society whose products were largely derived from organic materials to a high consumption society whose products are derived from inorganic materials and come from industrial processes. The shift of waste generation has impacts on environmental management and health issues, and on the breakdown of inherited waste management practices based on symbiotic rural-urban exchanges and uses of organic wastes.

As noted earlier, waste treatment in urban and rural areas of Vietnam to the mid-1980s was similar in many ways (DiGregorio, 1994). Most of the waste was organic and used as fuel, livestock feed, or to produce compost. The small portions of inorganic waste that did have value (glass bottles, waste paper, rubber, and scrap metal) were collected and sold to itinerant waste buyers.

In addition, a review of historical changes in the waste management system of HCMC found that as the economy continues to grow, social and financial flexibility of households increases with fewer people being forced to rely on the income supplements that selling recyclables provide. Young people are staying in school longer and inevitably engaging in activities and industries that are more lucrative and more reputable than waste management. The recycling industry also faces competition from cheaper, imported raw materials, which lower the market price for recyclable materials. Also, an increasingly popular modern lifestyle has influenced consumption patterns and preferences, resulting in more packaging and an increase in the amount of inorganic waste. Despite this increase in inorganic waste, the organic waste portion of HCMC's waste remains very high.

The HCMC government has acknowledged this by ordering DONRE to prepare management plans for a waste processing and disposal site. In reality, this will translate into the application of end-of-pipe, short-term technological solutions. Socio-cultural matters tend to be shoved aside in favour of tangible systems and concrete structures, which are symbolic of progress. However, large-scale composting operations have been shown to be wholly inappropriate in developing countries. Without a sense of environmental concern supporting these recycling activities, the situation will not be sustainable.

## **6.2 Partnerships and Institutional Frameworks Necessary for the Support of a Composting Program in HCMC**

In evaluating the institutional models (decentralization, privatization, public-private partnerships, community-based management) that are necessary for a composting program in HCMC, it is clear that none of the four models on their own are enough, you need components of each of these for success. Each of these models have good aspects that can be used and unfavorable aspects that should be avoided in a composting program. The number of well documented failures of solid waste management programs and initiatives in HCMC has led to a continuous shift in responsibilities between agencies and the various levels of government, as well as bringing about some degree of decentralization and equitization. Unfortunately, this shift has not affected the balance of power between the central government of HCMC and the local districts. Essentially, the transfer of power from the People's Committee to the districts does not appear to be on top of the policy agenda, they only say it is. Thus the autonomy the districts demand from central government will not likely happen in the near future. However, the decentralization and grassroots democratization policy (Decree 45/1998/NQ) has strengthened the legislative functions of the governance system paving the way for steps that ensure that democracy is respected at all levels of government. The implication of this is that decisions are increasingly made in the public eye, with transparency and inclusiveness.

Historically, the provision of municipal services by local governments was based on a “socialist welfare subsidy system” (Interview 2 & 11). However, due to increased financial constraints and limited public resources, there has been a shift in government policy toward partial equitization with an emphasis on the user pays principle and increased public involvement. In Vietnam, the equitization of waste management services entails increasing the involvement of the private sector and, also community groups. However, in the design, planning, implementation, management and maintenance stages of public services, there is no real involvement of the public. Although this top-down approach is still prevalent in the decision-making process in HCMC, partnerships and community aspirations and initiatives are being recognized elsewhere. In Quy Nhon, local communities are involved and taking some responsibility in the operation of the community-based composting program. They currently play a role in the separation and collection of waste, and with their participation, waste management initiatives have a greater opportunity for success (Deelstra, 1989). While this type of program is heavily reliant on the community, it also relies on the local government for institutional and technical support. Although, the long-term success of this program remains to be seen, I am hopeful that the Quy Nhon community-based composting program does not develop into the historical failures of past composting projects in Vietnam and other developing countries.

The term public-private partnership describes a spectrum of possible relationships between public and private parties for the cooperative provision of a service. The only essential requirement is some degree of participation from the private sector in the delivery of traditionally public-domain services. In HCMC, it remains to be seen whether private firms can improve solid waste management services delivered to the community. Often when government officials seek help from the private sector they expect that their involvement will provide an automatic solution to the delivery of proper solid waste management



services, but this may not occur. The involvement of the private sector in HCMC changes the state's responsibility, but does not eliminate it. The reality is that equitization does not guarantee efficient and effective waste services, at the advertised low cost. Problems arise when equitization is poorly conceived and poorly regulated by the legal system that supports it. These issues that surround the notion of equitization suggest that further problems are likely in HCMC.

However, generally speaking, in a community-based composting project, the board in charge of the project is responsible for the management of the project. A board is typically made up of local representatives from the public sector, private sector, civil society, a household community group, and agricultural cooperatives. The board must be prepared to plan and coordinate various waste to compost activities, including program development, funding, and mobilizing assistance. A board similar to what is described above manages the community-based composting program in Quy Nhon. The success of this program is based on how it is managed and on the use of an appropriate composting technology that is suited to Vietnamese conditions (climate and technological capacity) and in combination with sound financial management, as well as an appropriate marketing strategy based on current agricultural trends and demands, i.e., safe vegetables.

Based on an analysis of the general municipal solid waste issues in HCMC, some basic problems have been identified which hinder the application of a community-based or public-private partnership program. The first problem is institutional. The participation of the public and communities in solid waste management initiatives is not seriously considered. As a result, authorities have not included these actors in waste policies tackling solid waste problems. The second problem is educational. The public and communities lack access to clear guidelines, information, authorities, or technical means to improve their community and environment. The third problem is financial. According to ENDA, the

financial barriers that private business have to endure to enter into the solid waste system, particularly small local firms, may be relatively high because of the larger scope of service provision, particularly for urban solid waste collection, and the resulting relatively high capital cost requirements (Interview 9).

### **6.3 Potential Compost Use in Urban and Peri-urban HCMC**

In attempting to identify the potential of compost use in urban and peri-urban HCMC, it is important to consider a number of product related factors. The first factor is demand for the product. If there is no market for compost then the support for composting is limited. The limited survey of farmers that I conducted in Cu Chi district revealed that there is demand and presumably this demand would apply to farmers elsewhere in the city.

The other two factors to consider in determining the potential of compost are related to the actual production of compost, namely quality and cost. Historically, composting initiatives by the government in HCMC and Vietnam have produced compost that is expensive and of poor quality. Compost has been of poor quality mainly because of the use of mixed wastes in the composting processes. In order for the compost to be marketable, those managing the composting program were forced to enrich the compost with synthetic chemical fertilizers, and as a consequence increasing its cost. When considering all of these factors and the current solid waste and agricultural system, the results of this thesis lead to the conclusion that HCMC is not ready for the use of compost. This is not to say that HCMC will never be ready. With the necessary changes and under the right conditions, the use of compost has potential in HCMC.

It is evident that source separation programs are needed to address the issue of cost and quality. The use of mixed waste in the composting process tends to produce a lower quality product. The example set by District 6 (in which 60 to 70% of households properly source separated their waste), suggests that there is potential for source separation programs.

With increased public education, participation can increase. With that being said, problems at the collection stage will need to be sorted in order for a source separation program to be successful. Collectors will need further education and training and the equipment (e.g. collection vehicles) currently in use will require updating. While these ideas may seem minor in nature, in solid waste management they could mean the difference between the success or failure of an initiative.

Organic wastes from sources other than households can also be used in the production of compost. For example, wet market waste is primarily organic in nature and appropriate for composting. Currently in HCMC, this waste is mixed in with other waste and landfilled. An enhanced quality compost can be processed at a lower cost using wet market waste if collected separately for composting purposes.

As outlined in this thesis, attempting to link agriculture with solid waste management is a policy and governance issue. Without appropriate governance arrangements and supportive policies, the potential for compost production and use will remain limited. Strong political will is necessary in order for the implementation of such policies. Essentially, this research has discovered that linking solid waste management to urban and peri-urban agriculture is somewhat restricted. Despite the environmental appeal of composting, an economically strapped city in a developing country struggling to provide adequate waste collection will ultimately seek the much cheaper disposal method of landfilling. Waste management officials in HCMC stressed the fact that at the end of the day their main objective was to remove waste off the streets and dispose of it in an affordable way.

The research has also revealed that with supportive policies in place and widespread demand, there is opportunity to improve the quality, cost and access to compost. The future of organic waste management and treatment in HCMC also depends on the

appropriate participation of all actors in the waste management system, appropriate waste processing and handling technology, a fair distribution of the financial burden, and an increase in the cost recovery efficiency at the collection, handling, and treatment stages. Obstacles that remain in the way include ill-defined and muddled implementation mechanisms and an inappropriate legal base that needs to be specific to waste management issues. Overall, the experiences of other Southeast Asian cities, particularly Manila, Bangkok, and Jakarta, suggest that HCMC's problem with producing compost can be found elsewhere. However, the decentralized waste management system in place in Manila has had some success with source separation and composting initiatives. Manila has been able to achieve this by updating its waste management and legislation policy.

#### **6.4 Recommendations**

The appropriate scale for a waste management initiative requires further research. Under the right conditions, the development of a community-based composting program can be successful. However, other alternative strategies such as formal recycling programs need to be considered as well and are perhaps best put into practice at the local level and then expanded throughout HCMC. Also, the state must maintain responsibility for ensuring that waste services are provided to all communities and it is up to the state to work with communities and the private sector to make these services available, affordable and acceptable. The government must also consider increased partnerships with local community groups. Fortunately, as O'Rourke (2004) and the World Bank (1997) have noted in Vietnam, a community's awareness of environmental pollution and their ability to mobilize is fairly high. Mobilization is based on the capacity of the community. A local community can play a variety of roles in developing the link between waste management and agriculture, for example: a farming cooperative could be responsible for raising awareness among farmers in regards to the use of compost, and conducting experiments to determine the quality of compost. Also, individual households can ensure that they properly

source separate their waste and local community organizations (women's groups, youth groups) can assist in educational campaigns and information dissemination.

### **6.5 Filling the Gap: Spatial Linkages**

In Vietnam, it is interesting to note that, spatially, the majority of waste generation occurs in urban areas while taking place in a country that is still substantially agrarian in its population distribution, economic structure and employment. By analyzing the linkages between solid waste management and urban and peri-urban agriculture using a spatial perspective (urban and peri-urban connection) this thesis reveals important insights regarding waste management and agricultural issues. The more obvious insight is that the specifics of these issues vary greatly over space, and thus call for localized capacities to respond to them. Beyond this observation, policy makers need to recognize more clearly the interconnectedness of waste management issues and policies for population and community growth, physical infrastructure and other socio-economic factors. A concern is that these socio-economic factors, which help contribute to the waste management problem, are not reflected in current waste management policies. Furthermore, the low level of community participation in the process of formulating waste management policies makes the collaboration of central government and local communities weak. As a result the policies and programs designed for sustainable solid waste management and compost production are restricted. Therefore, to improve waste management practices and services it should be recognized that localized communities can play an integral role in the development of compost policies and initiatives. If the recognition does not occur then communities themselves need to find the capacity to mobilize in order to seek change to the policies and programs for compost production using municipal solid waste.

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## **Appendix A**

### **Interviews**

Interview 1 – Mr. Hanh (pseudonym), Transfer Station Manager. Thu Duc District, HCMC, Vietnam, May 6, 2007.

Interview 2 – Mrs. Phan Thi Giac Tam, Economics Professor, Nong Lam University. Thu Duc District, HCMC, Vietnam, May 15, 2007.

Interview 3a – Mr. Danh, Thu Duc Department of Natural Resources and Environment (DONRE) Solid Waste Official. Thu Duc District, HCMC, Vietnam, May 25, 2007.

Interview 3b – Mr. Danh, Thu Duc Department of Natural Resources and Environment (DONRE) Solid Waste Official. Thu Duc District, HCMC, Vietnam, May 30, 2007.

Interview 4 – Mr. Nguyen, Thu Duc District Public Works Service Company (DPWSC) Official. Thu Duc District, HCMC, Vietnam, May 26, 2007.

Interview 5 – Mr. Tu (pseudonym), Agricultural Representative, Cu Chi People's Committee. Cu Chi District, HCMC, Vietnam, May 31, 2007.

Interview 6 – Mr. Trung (pseudonym), Tan Phu Trung Cooperative Manager. Cu Chi District, HCMC, Vietnam, May 31, 2007.

Interview 7 – Mr. Doan (pseudonym), City Environmental Company (CITENCO) Solid Waste Official. HCMC, Vietnam, June 7, 2007.

Interview 8a – Mr. Viet, Department of Natural Resources and Environment (DONRE) Solid Waste Official. HCMC, Vietnam, June 8, 2007.

Interview 8b – Mr. Viet, Department of Natural Resources and Environment (DONRE) Solid Waste Official. HCMC, Vietnam, July 23, 2007.

Interview 9 – (Group Discussion) Mr. Tuan, Mr. Khai, and Mr. Cu, Environmental Development Action in the Third World Vietnam (ENDA) NGO officials. HCMC, Vietnam, July 2, 2007.

Interview 10 – Mr. Aliani, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Official. Quy Nhon, Vietnam, July 12-13, 2007.

Interview 11 – Mr. Tuan, Environmental Development Action in the Third World Vietnam (ENDA) NGO Official. Quy Nhon, Vietnam, July 12-13, 2007.

Interview 12 – Mr. Hung (pseudonym), Quy Nhon People’s Committee Official. Quy Nhon, Vietnam, July 12-13, 2007.

Interview 13 – Mr. Thao (pseudonym), World Bank Operations Officer. Hanoi, Vietnam, August 6, 2007.

## Appendix B

### Interview Questions for Solid Waste Officials

1. How is HCMC's waste managed?
2. What is the primary responsibility of your department?
3. What is your role in the department?
4. How long have you been in your current position?
5. How many waste officials does the government employ?
6. How many waste officials are employed in your department?
7. What is the overall solid waste management budget for HCMC?
8. What type of collection, sorting, and disposal system is in place for all the various types of neighbourhoods? (transfer stations? Open dumping or closed landfill? And how are the dumps and landfills managed?)
9. What are the different types of collection vehicles? E.g. human or animal push carts, and/or motorized trucks? And what is the condition of the trucks?
10. What recent environmental policies have been made to promote more sustainable development?
11. What current and past initiatives has your department undertaken to promote sustainable waste management?
12. In the past 30 years, what institutional changes or reforms relating to organic waste management have taken place?
13. What are the overall waste management goals/objectives for HCMC and where does organic waste recycling fit in?
14. Is organic waste considered a resource by your department?
15. What programs have been attempted that specifically divert organic wastes from landfills?
16. What institutional problems have you had to overcome to manage organic wastes in a sustainable manner?
17. What are the potential beneficial uses of organic solid wastes?
18. What are some of the drawbacks to using organic wastes, treated and untreated?
19. What is the nature of the market for organic wastes and compost in HCMC?
20. What are some of the historical changes that you have noticed in relation to the management of organic wastes in terms of application, treatment and composition?
21. Are there any plans to standardize or provide certification of organic compost produced?
22. Why are there no composting plants currently operating in HCMC?
23. In what aspects does the waste management system need improvement?
24. What is the relationship between the solid waste office and private industry when it comes to waste management?
25. How can the citizens of HCMC help in the improvement of the waste system?

## **Appendix C**

### **Farmer Survey**

1. Name of respondent: \_\_\_\_\_
2. Address: \_\_\_\_\_
3. Age: \_\_\_\_\_
4. Marital status
5. Educational level
6. Occupation
7. How long have you been a farmer? \_\_\_\_\_
8. How many members are there in your household and how many are working in agriculture? \_\_\_\_\_
9. What crops do you currently grow?
10. What are the agricultural inputs consumed in your daily farm operations?
11. Have you ever applied compost?
12. If yes, were you satisfied with the results? If no to question 11, skip to question 20.
13. How much have you and do you currently pay for compost and fertilizer?
14. What are the advantages and disadvantages to applying compost?
15. How would you compare compost to the conventional growth inputs (fertilizers, artificial compost, sewage sludge and manure)?
16. Do you still use compost in your farm operations? If so, for how long have you done so? If not, why did you stop?
17. How has compost changed over time, in relation to yield, quality, health and safety?
18. Has your use of compost increased or decreased over time? Why?
19. How has the operation of your farm changed over time?
20. Why have you not made use of compost?
21. What are the advantages and disadvantages to applying conventional growth inputs?
22. Have you encountered any environmental problems relating to the use of conventional growth inputs and/or compost?
23. Have you encountered any health related problems (skin rash, sores, eye rash, etc.) relating to the use of conventional growth inputs and/or compost?
24. Do you think that the quality and safety of foods are impacted by the use of conventional growth inputs and/or composts?
25. Do either conventional growth inputs or composts make your products worth more economically?
26. Are you aware that traditional composts are made up of urban waste?

## Appendix D

### Photographs



Photo 11 - Saigon fertilizer used by the majority of farmers in Cu Chi, HCMC



Photo 12 - Typical small plot farm in Cu Chi, HCMC





**Photo 13 - Waste from a fruit and vegetable market in HCMC. The waste is made up of primarily organic matter**



**Photo 14 - Transfer Station in Thu Duc, HCMC. The waste workers are sifting through the waste searching for recyclables (plastics, metals, glass) ignoring the organic waste**



**Photo 15 - Source separated organic waste from a pilot program in District 6 in HCMC is mixed with other waste**



**Photo 16 - Source separated organic waste from a pilot program in District 6 in HCMC is mixed with other waste**



**Photo 7 - Quy Nhon small-scale composting plant**



**Photo 8 - Finished compost from the Quy Nhon small-scale composting plant**



**Photo 9 - Test plots using compost produced at the Quy Nhon small-scale composting plant**



**Photo 10 - Quy Nhon large-scale composting plant**



**Photo 11 - Quy Nhon large-scale composting plant**



**Photo 12 - Composting windrows at the Quy Nhon large-scale composting plant. Note the presence of significant amounts of contaminants due to the lack of source separation**



**Photos 13 & 14 - Compost produced at the Quy Nhon large-scale composting plant. A close-up of the compost reveals the presence of contaminants (glass and stone)**