

SOCIAL CAPITAL IN MUNICIPAL SOLID WASTE MANAGEMENT IN THAI MUNICIPALITY

BY

CHIRA BUREECAM

**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF
PHILOSOPHY (ENGINEERING)
SIRINDHORN INTERNATIONAL INSTITUTE OF TECHNOLOGY
THAMMASAT UNIVERSITY
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A Dissertation Presented

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CHIRA BUREECAM

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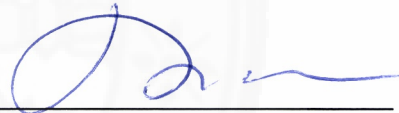
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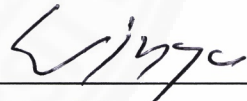
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Approved as to style and content by

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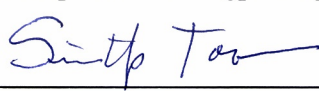
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Writing this dissertation is a process of documenting ideas; sometimes new, many times not. I have tried to remain original in my efforts giving credit where due. I apologize for not giving credit to those who developed ideas and concepts used herein. This is simply an oversight. As always, all errors in this dissertation are my sole responsibility.

Abstract

SOCIAL CAPITAL IN MUNICIPAL SOLID WASTE MANAGEMENT IN THAI MUNICIPALITY

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The main objectives of this study consists of the following: 1) investigating the determinants of MSW generation and collection cost, 2) examining the role of social capital to promote community participation in household waste recycling, and 3) performing economic evaluation for the application of social capital to MSW management.

To investigate the determinants of MSW generation and collection cost, the data was collected from questionnaires that were posted to 570 municipality's executives/chiefs across the country. In the analysis of the relationship between social capital and community participation on recycling activities, the data was collected from households with a total of 500 observations in the Bang Kruai Town municipality: Nonthaburi was selected as the case study. Then, the economic evaluation of the application of social capital and community participation to MSW management was performed by using the cost benefit analysis (CBA).

The results of this study showed that the population growth and urbanization were the key factors in the MSW generation, which results in a rapid growth of the MSW collection cost. Considering the role of social capital in MSW management, social capital is associated with the collaboration of the community in household waste recycling. The households' participation in recycling activities has

significantly reduced household wastes by about 32 percent. The estimated economic benefit from the application of social capital to build participation in MSWM of the municipality in three scenarios includes a social capital that causes the network to access the household waste recycling activities: this is for one-fourth, one-third and a half of all community in the municipality. In the case of social capital causing the network to participate in the recycling of waste, one-fourth of the entire community in the municipality enabled the cost of collection to come down from the recycling of waste compared to the ratio of savings to investment (SIR) was between 1.945 to 3.037 times and the adjusted internal rate of return was between 55.2% to 105.2%. Meanwhile, the case of one-third of the entire community in the municipality with the ratio of savings to investment (SIR) was between 2.309 to 2.829 times and the adjusted internal rate of return was between 75.7% and 110.3%. Finally, the case of a half of the entire community in the municipality with the cost of collection down from the recycling of waste compared to the ratio of savings to investment (SIR) was between 2.881 and 3.037 times and the adjusted internal rate of return was between 110.8% and 120.6%.

Keywords: social capital, solid waste management, municipality

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Chapter 1

Introduction

1.1 Introduction

Due to a high level of urbanization, economic development, and an increase of population, there has been a period of continuous outcome in a large quantity of heterogeneous solid waste. The Municipal Solid Waste Management (MSWM) has been trying to alleviate the increasing magnitude of the waste problem in many Thai local government authorities (LGAs), especially in rapidly urbanizing cities where these challenges are frequently exposed. Many LGAs are facing both large quantities of waste that has been overloading their capacity for management as well as creating a shortage of land for disposing the waste. Zurbrugg (2003) describes that one to two thirds of the solid waste generation in developing countries is not collected. As a result, the uncollected waste, which is often mixed with human and animal excreta, is dumped indiscriminately into streets and into drains, thus contributing to an unnecessary deluge of water, breeding of insects and rodent vectors, and spreading of diseases. Furthermore, even the collected waste is often disposed into uncontrolled dumpsites and/or burnt which have resulted in a pollution of water resources and air. This situation presents a serious risk towards public health.

In Thailand, LGAs are comprised of the Provincial Administrative Organizations (PAOs), Municipalities (Nakhon, Muang and Tambon), and Tambon Administrative Organizations (TAOs), which are primarily responsible for MSWM. These LGAs are allocated about 20% of the budget, which may reach to 35% by the year 2006. Therefore, the LGAs need to support themselves for an overall operation of MSW. This is the major driving force in finding solutions to reduce SWM problems (Mongkolnchaiarunya, 2003).

In order to enhance the capacity of LGAs in solid waste management, performance indicators are needed to assess the existing management systems. This assessment is useful to evaluate and monitor the performance of MSW services, and on deciding how to improve the solid waste management system and developing the

right approach to the process (Van de Klundert and Anschutz, 2001). The tools that can evaluate various aspects include the technical and environmental, financial and economic, social and cultural, and institutional and organizational aspects. These indicators should cover the overall MSWM and have the characteristics of an effective ability that are relevant, easy to understand, reliable and accessible (Hart, 1998).

1.2 Background of the study

The increase in MSW generation in municipality's area comes from the population growth and has changed 999 sanitary committees to become the status of the Tambol Municipality by the 1997 Constitution of Thailand kingdom in section 285. This Act stipulated that a sanitary committee is to be changed to the tambol (sub-district) municipality since the structure of a sanitary committee, which used a commission form (no separation of council and executive) and had an appointed district officer as the chairperson of the committee, was not in conformity with the Constitution. This resulted in the abolished of a sanitary committee form of local government and changed 999 sanitary committees to become the status of the Tambol Municipality. Thesaban is the local government authorities (LGAs) which has a high area of responsibility in MSWM. Thesaban are the municipalities in Thailand. There are three levels of municipalities - city, town and sub-district municipality. Both Bangkok and Pattaya are special municipal entities outside the thesaban system. The municipalities take over some of the responsibilities which are assigned to the districts (amphoe) or communes (tambon) for the non-municipal (rural) areas. The thesaban system was established in the Thesaban Organization Act of 1934 and has been updated several times since, starting with the Thesaban Act of 1939 which was replaced by the Thesaban Act of 1953. The 1953 act was most recently amended by the Thesaban Act (No. 12) of 2003.

Thesaban nakhon is usually translated as a city. To qualify for a city status, a municipality needs to have a population of at least 50,000 and a sufficient income to carry out the tasks of a city. When first organized in 1934 the minimum qualifications for city status were a population of 30,000 with a density of 1,000 per km². In 1939

the required population density was increased to 2,000 per km², along with the addition of a financial requirement. In 1953 the population density requirement was again raised, to 3,000 per km², before being removed entirely in 2000. Thesaban mueang is usually translated as a town. For a municipality to qualify as a town, it either needs to be a provincial capital, or have a population of at least 10,000 and sufficient income to cover the tasks of a town. When it was first organized in 1934, a minimum qualification for being considered as a town status was based on having a population of 3,000 with a density of 1,000 per km². In 1939, requirements were increased to a population of 5,000 with a density of 2,000 per km², plus a financial criterion. In 1953, the minimum population requirements were raised to the present value; the population density was also raised, to 3,000 per km², before being removed entirely in 2000. Thesaban tambon is the lowest level municipal unit. Despite the name, it may not necessarily cover the same area as a sub-district (tambon); i.e., it may not cover a tambon completely, or conversely, it may extend to over parts of more than one tambon. For an area to qualify as a thesaban tambon, it must have a gross income of at least 5 million baht and a population of at least 5,000 with a minimum density of 1,500 per km², plus a consensus of the population within that area. Most thesaban tambons today were originally sanitation districts (sukhaphiban), all of which were converted in May 1999, though many of them did not actually meet the criteria above. (<http://en.wikipedia.org/wiki/Thesaban>)

MSWM in Thailand is mandated by the local government authorities (LGAs). With rapidly growing rates of MSW, there has been a depletion of landfill spaces and problems in obtaining new disposal sites. This incident has caused most sites to become open dumps which are nearly exhausted. The intentions for improving the MSW recycling performance must be more than simply enhancing the efficiency of MSW management with relations to disposal facilities (Nitivattananon and Kulpradit, 2004). In this regard, recycling is widely accepted as a sustainable MSW management method which is attractive for LGAs because of its potential to reduce disposal costs and transport costs, and to prolong the life spans of sanitary landfill sites.

To realize the potential benefits of waste recycling, and organizing and managing recycling programs, LGAs need to consider appropriate options for recycling programs with regards to the financial-economic constraints; the existing

situation; regulation; and institutional, environment, socio-cultural, and technical issues. The most important factor among these is on the extent of the LGAs improving their recycling performance by promoting community participation in MSW recycling.

1.3 Objectives

The main objectives of this study are as followed:

- 1) to investigate the determinants of MSW generation and collection cost in Thai municipality.
- 2) to examine the role of social capital to promote community participation in household waste recycling.
- 3) to perform economic evaluation for the application of social capital to MSWM in Thai municipality.

1.4 Scope of the study

The scope of this study was covered with three objectives. The first is to investigate the determinants of MSW generation and collection cost for considering the relationship between the socio-economic factors of each municipality and change in MSW generation and cost. The benefit of an empirical result was to predict the growth of MSW generation and collection cost. An analysis of models using multiple regression by ordinary least squares (OLS) technique while the data was collected from questionnaires that were posted to 570 municipality's executives/chiefs across Thailand.

Secondly, examining the role of social capital in the household recycling scheme participation are based on having two techniques. The Bang Kruai town municipality in Nonthaburi province, Thailand was selected as the case study. First, the appreciation influence control process (AIC) was used in developing community participation in MSWM. There are 12 out of 47 communities that have joined the community waste management activities. Second, the Logit model was used to investigate the role of social capital in the household recycling scheme participation.

In the analysis of the relationship between social capital and community participation on recycling activities, the data was collected from households with a total of 500 observations in the Bang Kruai town municipality.

Finally, on performing an economic evaluation for the application of social capital to MSWM in Thai municipality, there are three supplementary measures of economic performance that are consistent with the cost benefit analysis (CBA) method of project evaluation. These are Net Saving (NS), Savings-to-Investment Ratio (SIR) and Internal Rate of Return (IRR). The economic evaluation of social capital integration in MSWM aimed in promoting household recycling schemes participation, which was put forward in the following assumptions: 1) Assuming, the project duration is 10 year, the population growth is 0.6 % per year and discount rate is 8% 2) Projection, the MSW generation of each municipality use the determinants of MSW generation model 3) MSW collection cost estimation of each municipality represents the MSW generate projection in the determinants of MSW collection cost model 4) Calculation, the MSW reduction of each municipality use determinants of MSW recycling model and represent in MSW generate projection and 5) The estimated economic benefit from the application of social capital to build participation in MSWM of the municipality in three scenarios includes a social capital that causes the network to access the household waste recycling activities: this is for one-fourth (scenario1), one-third (scenario 2) and a half of all community (scenario 3) in the municipality.

Chapter 2

Literature Review

Literature review in this study were based on the conceptual framework that consists of seven major parts: a) the definition of municipal solid waste (MSW) and municipal solid waste management (MSWM), b) concepts and research related to the determinants of MSW generation, c) the concepts and research related to the determinants of MSW collection cost, d) the definition, dimensions and measuring of social capital, e) the appreciation influence control process (AIC) in community participatory for development, f) the concept and research related to the determinants of households' recycling participation and role of social capital to be strengthened in the participation of the community and g) the concepts of economics evaluation in project development.

2.1 The definition of municipal solid waste and management

Municipal Solid Waste (MSW) can be defined as Chapter 21.3 of Agenda 21 (United Nations Conference on Environment and Development, Rio de Janeiro, June 14, 1992 Chapter 21 "Environmentally Sound Management of Solid Wastes and Sewage-related Issues") "Solid wastes...include all domestic refuse and non-hazardous wastes such as commercial and institutional wastes, street sweepings and construction debris. In some countries the solid wastes management system also handles human wastes such as night-soil, ashes from incinerators, septic tank sludge and sludge from sewage treatment plants. If these wastes manifest hazardous characteristics they should be treated as hazardous wastes."

MSW is thus seen as primarily coming from households but also includes wastes from offices, hotels, shopping complexes/shops, schools, institutions, and from municipal services such as street cleaning, and maintenance of recreational areas. The major types of MSW are food wastes, paper, plastic, rags, metal and glass, with some hazardous household wastes such as electric light bulbs, batteries, discarded medicines and automotive parts.

Table 2.1 highlights the main sources of MSW, the waste generators, and types of solid waste generated. Management is a cyclical process of setting objectives, establishing long term plans, programming, budgeting, implementation, operation and maintenance, monitoring and evaluation, cost control, revision of objectives and plans, and so forth. Management of urban infrastructure services is a basic responsibility of the municipal government. It is usually advantageous to execute service provision tasks that is in partnership with private enterprises (privatization) and/or with the users of services (participation). However, the final responsibility remains with the government.

Table 2.1 Sources and Types of Municipal Solid Waste

Sources	Typical waste generators	Types of solid waste
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, oil, tires) and household hazardous wastes
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, government center, hospitals, prisons	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal services	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas

Municipal solid waste management (MSWM) refers to the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste in urban areas. MSWM is a major responsibility of local governments. It is a complex task which depends upon the organization and the extent of cooperation between households, communities, private enterprises and municipal authorities. In addition, it relies upon

the selection and application of appropriate technical solutions for waste collection, transfer, recycling and disposal.

Furthermore, waste management is an essential task which has important consequences for public health and well-being, the quality and sustainability of the urban environment, and the efficiency and productivity of the urban economy. In most Thai municipalities, waste management is inadequate: a significant portion of the population does not have access to a waste collection service and only a fraction of the generated waste is actually collected. Systems for transfer, recycling and/or disposal of solid waste are unsatisfactory from the environmental, economic and financial points of view.

The first goal of MSWM is to protect the health of the urban population, particularly that of low-income groups who suffer most from poor waste management. Secondly, MSWM aims to promote environmental conditions by controlling pollution (including water, air, soil and cross media pollution) and ensuring the sustainability of ecosystems in the urban region. Third, MSWM supports urban economic development by providing the demand for waste management services and ensuring that there is an efficient use and conservation of valuable materials and resources. Fourth, MSWM aims to generate employment and incomes in the sector itself.

To achieve the above goals, it is necessary to establish sustainable systems of MSWM which meet the needs of the entire urban population. The essential condition of sustainability implies that MSWM systems must be absorbed and carried by society and its local communities. These systems must, in other words, be appropriate to the particular circumstances and problems of the city and locality. Such a system yield an employing and developing the capacities of all stakeholders which include the households and communities requiring service, private sector enterprises and workers (both formal and informal), and government agencies at the local, regional and national levels. However, MSWM goals cannot be achieved through an isolated or segmented approach. Sustainable MSWM depends on the overall effectiveness and efficiency of urban management, and the capacity of responsible municipal authorities.

2.2 The concepts and research related to the determinants of MSW generation

Municipal solid waste includes all solid wastes generated in the community except for industrial and agricultural wastes. It generally includes discarded durable and non-durable goods, containers and packaging, food scraps, yard trimmings, and miscellaneous inorganic waste which includes household hazardous wastes (for instance pesticides, batteries, left over paints etc.)

The factors determining the amount of MSW provides several important reasons to take advantage of management. The models and data from the examples that are used in the planning of waste management systems include the following: 1) the development of waste-management strategies (Daskalopoulos et al., 1998) 2) the planning of waste collection services and infrastructures (Dennison et al., 1996) or treatment facilities and capacities (e.g., the capacity evaluation of MSW incinerators by Chang and Lin, 1997) and 3) land demand for facilities, especially in the context of land-filling waste (Leao et al., 2001).

For the operation of waste management systems, waste generation related planning data have an essential influence on: 1) personnel and truck utilization (Matsuto and Tanaka, 1993), as well as operational costs with respect to collection and transportation and 2) monitoring of systems (e.g., assessing effects of waste prevention action, recycling activities, etc. (OECD, 2004)).

They serve as a basis for further improvements and optimization in terms of sustainability (environmental, economic and societal) targets. Previous studies of MSW generation estimation was determined by population growth, following

$$Waste_t = \text{per capita MSW generation per day} * Population_t \quad \dots(2.1)$$

$$\text{Or } Waste_t = W_0 * (P_0 * e^{rn}) \quad \dots(2.2)$$

Where $Waste_t$ is total MWS (ton), W_0 is total MSW₀/population₀, $Population_t = P_0 * e^{rn}$ (P_0 is population in base year, e is exponential, r is rate of population growth and n is number of year) and t is time ($t = 0, 1, 2, 3, \dots, n$). However, the traditional model is inappropriate for estimation due to the predicted value only being depended on population forecasting.

Due to the high heterogeneity of municipal solid waste streams and the diversity of their ways through the economy, the identification of parameters is a highly complex problem. Beigl et al. (2003) describes previous approaches, which can be classified by the type of model: 1) Input-output models: Here the input of the waste generator is assessed by using production, trade and consumption data about products related to the specific waste streams and 2) Factor models: These models focus on analyses of the factors, which describe the processes of waste generation. Examples of proved parameters are e.g. the income of households, dwelling types or the type of heating.

Based on this comparative study, only a few methodological procedures came into consideration for the application of the aimed forecasting model for cities. This was due to the following reasons:

- **Level of aggregation:** The identification of parameters has to be based on a database, which describes regional peculiarities. The exclusive use of national aggregates in input-output models (Patel et al., 1998) is not appropriate for explaining regional dynamics. Therefore preference was given to factor models that focus on socio-economic and demographic indicators available at a regional level (Bach et al., 2003).
- **Predictability of parameters:** The selection of model parameters has to prioritize parameters at the city level, which can be forecasted with a relatively high accuracy and a long forecasting horizon. Examples of such parameters with high inertia are the population age structure, household size or infant mortality rate (Lindh, 2003).
- **Applicability** refers to the user-friendliness of the aimed forecasting tool. Therefore, methods that provide easily available and standardized secondary data have to be favored over elaborate and time-consuming qualitative approaches such as the Delphi method.

Meanwhile, Salhofer (2001) has classified models for the analysis of waste generation into two categories. First, input–output models based on the flow of material to waste generators (input) or from waste generators (output) that focuses on the purely descriptive characterization of waste streams over the stages in product life cycle (from production, over trade to consumption). Second, factor models that use

factors describing the processes of waste generation is aimed at unveiling hypothesized causal relationships between factors for the prediction of waste generation. In addition, Sircar (Sircar et al., 2003 as cited in Beigl et al., 2008) have proposed horizontal and vertical factors for the prediction of municipal waste quantities. Horizontal factors describe the processes of interchanges between different waste types. As an example, shifts between residual waste, bulky waste, recyclables and illegally disposed waste are mainly caused by different modes of separate collection and do not affect the total waste quantity. Vertical factors are due to changes of the total sum of all waste streams depending on demographic, economic, technical and social developments. Many independent variables have been hypothesized and tested in order to explain the quantity of total or partial streams of MSW. Grouping is based on the focused stages in product life cycle: consumption-related and disposal-related variables.

Consumption-related variables reflect the relationship between living conditions and waste generation patterns. Most of these variables serve as proxies for the general level of affluence. This is especially true for the variables related to income (Hockett et al., 1995), tenure of property (Dennison et al., 1996) and the private consumption expenditures by product groups (OECD, 2004; Christiansen and Fischer, 1999). Other significant affluence-related proxies are represented by dwelling type (Emery et al., 2003; Dennison et al., 1996), employment status (Dennison et al., 1996; Bach et al., 2004), and population density and urbanization (Jenkins, 1993). Disposal-related factors may affect horizontal shifts between waste types. The employment by sectors, as well as branch-specific sales data, were successfully used as proxy for the percentage of commercial waste (Bach et al., 2004; Martens and Hockett et al., 1995), the promotion of recycling activities, container size, density of collection sites (Bach et al., 2004; Parfitt et al., 2001) and user fees (Hockett et al., 1995). These studies were based on consumption-related and disposal-related variables, which can be summarized as follows in table 2.2

For the empirical studies of the determinants of MSW generation that is using a variety of techniques, the estimation is as follows. Bach et al. (2004) investigated factors that influence the amount of collected paper; which is a prerequisite for the evaluation and reorganization of collection systems. The hypothesis is that the amount

of collected paper depends on both the waste potential and the factors which influence the convenience, such as the density of collection sites. For this study, we used a sample of 649 municipalities. Between the municipalities, the data show a high variance in terms of the collected waste paper per person and year. They developed a multivariate regression model providing valuable insights about the relationship between demographic parameters and the amount of collected waste paper. Furthermore, we found a significant positive impact of the convenience of the collection system.

Table 2.2 Characteristics of the reviewed the determinants of MSW generation models

Author	Independent variable type	Method*
Bach et al.(2003)	Consumption-related, Disposal-related	MR
Bach et al.(2004)	Consumption-related, Disposal-related	MR
Beigl et al.(2004)	Consumption-related, Disposal-related	MR, SR
Beigl et al.(2005)	Consumption-related	SR
Chang and Lin(1997)	Disposal-related	TSA
Hockett et al.(1995)	Consumption-related, Disposal-related	MR
Katsamaki et al.(1998)	Consumption-related	TSA
Leao et al.(2001)	Consumption-related	TSA
Martens and Thomas(1996)	Consumption-related, Disposal-related	GC, SR
Matsuto and Tanaka(1993)	Consumption-related	TSA
McBean and Fortin(1993)	Consumption-related	GC, SR
Navarro-Esbrí et al.(2002)	Consumption-related	TSA
Salhofer and Graggaber(1999)	Consumption-related, Disposal-related	MR

Source: Adaptation from Beigl, Lebersorger, and Salhofer.(2008) “Modelling municipal solid waste generation: A review” *Waste Management* Volume 28, Issue 1, Pages 200–214

* GC – Group comparison; MR – Multiple regression analysis; SR – Single regression analysis; TSA – Time-series analysis

Bruvoll and Ibreholt (1997), model of waste generation in the manufacturing sector was based on the sector's use of raw material and intermediate inputs. The authors expected waste generation to be proportional to either the level of production or the amount of material input. But their studies found that the growth of waste is better explained by the growth of inputs than by the growth of production. Chang (1991) developed a waste generation sub- model as part of a larger solid waste

management model. The model uses an econometric analysis to forecast the amount of waste generated over a planning period of 20 years. The formula was on dividing the total area into generation districts and projecting each waste as a linear function of dwelling units, per capita income, and population. The improvement in this model is the consideration of income as a determinant of waste generation. However, Chang does not differentiate waste by its sector like the one in Rao's model. Daskalopoulos et al. (1998) developed a model to estimate total waste generation at the country level by using aggregate observations on the municipal solid waste of industrialized countries. The total waste generated (in tons) was found to be in a non-linear function of the population size and living standard (represented by GDP per capita). Hockett et al. (1995) applied a linear regression model to identify and measure the variables that influence per capita municipal solid waste generation. This study was conducted using the county data in the Southeastern region of the United States. The variables include disposal fee, per capita retail sales, per capita construction costs, per capita sales of eateries, merchandise, food stores, apparel stores, per capita income, and urban population (as a percentage of the county population). The authors demonstrated that the disposal fees and retail sales have the greatest impact on waste generation. The higher the disposal fee, the lower the waste generation, and the higher the retail sales, the higher the waste generation. Leao et al. (2001) This paper presents a method to quantify the relationship between the demand and supply of suitable land for waste disposal over time using a geographic information system and modeling techniques. Based on projections of population growth, urban sprawl, and waste generation, the method can allow for policy and decision-makers to measure the dimension of the future problem in the shortage of land. The procedure can provide information to guide the design and schedule of programs to reduce and recover waste, and can potentially lead to a better use of the land resource. Porto Alegre City, Brazil was used as the case study to illustrate and analyze the approach. By testing different waste management scenarios, the results indicate that the demand for land that is used for waste disposal overcomes the supply of suitable land before the year 2050. Navarro-Esbrí (2002) Dynamic MSW generation analysis can be done using time series data of solid waste generated quantities. In this paper, some tools for time series analysis and forecasting are proposed to study MSW generation. A prediction

technique based on non-linear dynamics is proposed as comparing its performance with a seasonal Auto Regressive and Moving Average (sARIMA) methodology, and dealing with short and medium term forecasting. Finally, a practical implementation consisting of the study of MSW time series of three cities in Spain and Greece is presented.

2.3 The concepts and research related to the determinants of MSW collection cost

Empirical studies of factors determining the cost of waste management has been very substantial since the 1970s. There were many studies to this approach – “factors determining the cost of waste management”. The variables in the model mainly consists of waste collection (which is defined in the model as parameters to test for economies of scale), frequency of weekly collection, the density of population in the area, number of points collected, climate changes, and types of organization (carried out by the government or employed by the private sector), such as Stevens (1978), Tickner and McDavid (1986), Dubin and Navarro(1988), Szymanski and Wilkins (1993), which are often an empirical test to prove whether there are economies of scale.

The difference of management cost (between government and private sector), and the variety factors (frequency of collection per week, number of points to keep the density of population in the area of responsibility, climate, etc.,) were taken to see whether there was an affect in the amount and change of direction in the total costs for waste management. However, the studies did not differ much from the late 1970s in the explanatory variables of waste management costs model; the only exception was that most of them applied the time series data in the model. Nonetheless, the debate is still up in the air on the municipalities’ issue of the economies of scale in solid waste management cost, which was conducted by Reeves and Barrow (2000), Callan and Thomas (2001), Ohlsson. (2001), and Dijkgraaf and Gradus (2007). Empirical studies in the recent period can be summarized in table 2.3.

Table 2.3 Characteristics of the reviewed the determinants of MSW collection cost models

Author	Country	Explanatory variables
Reeves and Barro (2000)	Ireland (48)*	Number of collection units, service frequency, the type of collection, residential density, public or private service delivery.
Callan and Thomas (2001)	USA (110)*	The amount of waste generated, population density, frequency of collection, the form of services delivery, public monopoly or contracting out, the existence of municipal dump.
Dijkgraaf and Gradus (2003)	Netherlands (85)*	Number of collection points, density of collection points, type of collection, frequency of service, percentage of glass, paper and organic matter, public and private service delivery
Ohlsson (2003)	Sweden (115)*	The amount waste collected, frequency of service, the distance, price of labour and capital, the form of delivery.
Bel and Costas (2006)	Spain (186)*	The Amount of waste generated, wage cost, frequency of the service, availability of dumping site, form of production (public or private), population density, tourist.
Dijkgraaf and Gradus (2007)	Netherlands (543)*	Number of collection points, density of collection points, type of collection, frequency of service, characteristics of recycling, form of production.
Bel and Fageda (2009)	Spain (65)*	Volume of waste collected, percentage of recycling waste, frequency of waste collection, level of tourist activity in the municipality, incineration plant per employee at the provincial level, public and private service delivery.
Parthan et. al. (2011)	India (298)*	Population density, waste density. Number of vehicles used for transportation, average trips per vehicles per day, total number of staff employed, frequency of collection, privatization, medical waste collected and disposal separately.

Note: * Number of municipalities sample size

The study of the relationship between the cost of collection to the amount of waste has been in the same direction and with the economies of scale occurring (economies of scale) based on the study of Bel and Costas (2006) who used the data in that area. The figures from Catalonia Spain of 186 municipalities in 2000 showed that the economies of scale in municipalities with a lesser population (Bel and Fageda, 2009) used data municipality in Galicia Spain. 65 municipalities in 2005 showed that the economies of scale in municipalities with populations under 50,000 people. In

1997, the study by Callan and Thomas (2001) used a sample of 110 municipalities in Massachusetts USA and found no relationship to the economies of scale in any way. To test the differences in the cost of the collection between the public and private, the study found that the cost of MSW collection is lower than the government. Reeves and Barro (2000) used the 48 municipalities in Ireland from 1993 to 1995. In their study, there was an opposite effect than that implemented by the private sector. MSW collection costs are higher than the state and Ohlsson (2003) have used the 115 municipalities in Sweden in 1989, and Bel and Fageda (2009) used the area in Spain. The study found no difference in costs of collection significantly between the private and government, including Callan and Thomas (2001) and Bel and Costas (2006). The determinants of other relationships are in line with the cost of collection.

Environmental factors that are expected to be associated with the MSW cost of collection, such as the frequency in the collection a week of the Bel and Costas (2006), found that the frequency in the collection a week was in line with the waste management costs. According to the work done by Reeves and Barro (2000), they did not find any relationship between the cost of collection and frequency of collection. The population density was found to be associated with the cost of collection (Bel and Costas, 2006; Dijkgraaf and Gradus, 2011).

2.4 The application of social capital in community development

The term 'social capital' has been applied to a variety of ideas. It is generally concerned with economic returns from the networks of social relationships. While there has been limited work in economics on providing a theoretical context for social capital, there is a growing empirical literature that identifies considerable economic returns to networks of social relationships, trust in the norms of reciprocity, and institutions that foster civic engagement. Social capital first gained popularity from James S. Coleman's works (1990). Loury (1977) defined social capital as the set of resources that inhere in family relations and in community social organization while Coleman sees social capital as the social relationships which come into existence when individuals attempt to make best use of their individual resources.

However, Coleman stresses social capital as the resources that accrue to individuals, Putnam (1993) popularized a definition of social capital as referring to “features of social organization, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions”. Putnam is concerned not only with the role of social capital in economic development, but also with its role in forming democratic societies. Thus, he equates social capital with intensity of civic engagement.

There are also three levels of analysis for social capital: micro, meso and macro (though many social capital scholars only recognize the meso-level as social capital). At the micro-level, social capital consists of close ties to family and friends. Meso-level social capital refers to communities and associational organizations. Macro-level social capital consists of state and national-level connections such as common language and traffic customs (Halpern, 2005). According to Halpern, there is "some functional equivalence between the different levels" and declining social capital on one level can sometimes be compensated for increases on another level. For instance, if people in a society begin to have weaker ties to their family (declining micro-level social capital), this loss could be functionally offset by an increase in participation in community organizations (meso-level) or more fervent nationalism (macro-level).

Halpern (2005) identifies three "major cross-cutting dimensions" of social capital: components, levels of analysis, and function. There are three components of social capital: networks (the interconnecting relationships between people), norms (the rules, values and expectancies that govern social interaction), and sanctions (the punishments and rewards that enforce the norms). These three components interact, influence and reinforce each other. For example, networks are shaped by norms, which are enforced by sanctions and are expressed through networks. Thus, the components of social capital, though distinct, are interrelated and dependent upon each other.

Within a conceptual framework of social capital based at the household level, it is still important to recognize that there are a host of substantive issues on which relevant information can be obtained. On the basis of previous survey work on social capital, reading the literature, and obtaining input from our advisory group, we have

elected to arrange this material into six broad sections: (Grootaert and Bastelaer, 2002).

- **Groups and Networks.** This is the category most commonly associated with social capital. The questions here consider the nature and extent of a household member's participation in various types of social organizations and informal networks, and the range of contributions that one gives and receives from them. It also considers the diversity of a given group's membership, how its leadership is selected, and how one's involvement has changed over time.

- **Trust and Solidarity.** In addition to the canonical trust question asked in a remarkable number of cross-national surveys, this category seeks to procure data on trust towards neighbors, key service providers, and strangers, and how these perceptions have changed over time.

- **Collective Action and Cooperation.** This category explores whether and how household members have worked with others in their community on joint projects and/or in response to a crisis. It also considers the consequences of violating community expectations regarding participation.

- **Information and Communication.** Access to information is being increasingly recognized as central to helping poor communities that have a stronger voice in matters affecting their well-being (World Bank, 2002). This category of questions explores the ways and means by which poor households receive information in regards to the market conditions and public services, and the extent of their access to the communication infrastructure.

- **Social Cohesion and Inclusion.** "Communities" are not single entities, but rather are characterized by various forms of division and differences that can lead to conflict. Questions in this category seek to identify the nature and extent of these differences, the mechanisms by which they are managed, and which groups are excluded from key public services. Questions pertaining to everyday forms of social interaction are also considered.

- **Empowerment and Political Action.** Individuals are "empowered" to the extent that they have a measure of control over institutions and processes directly affecting their well-being (World Bank 2002). The questions in this section explore

household members' sense of happiness, personal efficacy, and capacity to influence both local events and broader political outcomes.

The concept of social capital has been successfully connected to numerous issues, such as development and economic growth (Sabatini, 2009; Dinda, 2008; Crudeli, 2006), health (e.g. Rostila, 2007) and environmental management and policy (Dev et al., 2003; Cramb, 2005; Pretty, 2003, 2007)

2.5 The appreciation influence control process (AIC) in community participatory for development

AIC is an organizing process that draws equally from the wisdom of ancient cultural traditions and from modern sciences. It is built on an understanding of the relationship between purpose and power. Every purpose creates a power field. The AIC process seeks to ensure that the full potential of that purpose is realized through the management of the three major components of the power field.

A - Appreciation - the power we use in relating to the "whole" system.

I - Influence - the power we use in relating to other "parts" of the system.

C - Control - the power we use with ourselves as an "individual part" of the whole system.

It sees the challenge of achieving the full potential of purpose as that of organizing the right mix of appreciative, influence and control relationships. The AIC process applies equally at the individual, organizational and community levels. AIC is a philosophy based on an understanding that the "power of relationships" are central to the process of organizing. This philosophy states that purpose, not wealth, is the authority or knowledge acting as the source of power. Every purpose, no matter how big or small, creates a power field that has the same AIC properties (World Bank, 2006).

AIC is not wedded to any particular methodology. It provides a framework that helps organizers choose or design methodologies that are appropriate to the phase of the organizing cycle and to the local situation. For example, the appreciative phase can use brainstorming, search for conferences, apply the Delphi techniques, utilize

story-telling, art, etc. In the influence phase, it can use methodologies such as dialogue, open-space, negotiation and conflict resolution.

The AIC self-organizing process is consciously trans-cultural. Through the study of natural and formal organizations in many cultures, we have learned that individuals, organizations and cultures manifest a particular pattern of appreciation, influence and control. The AIC process uses this knowledge to draw out the best of each culture's natural process but also transcends with natural limitations.

The AIC self-organizing process has been applied worldwide to both public and private organizations. It has been used at every level village, regional, national and global. It has been applied to projects ranging from village development to the design of national policy in Cambodia, Colombia, Hungary, Indonesia, Mali, Norway, Sierra Leone, Thailand and the United States (World Bank, 2006).

In Thailand, the self-organizing process has taken on a life of its own, in both the private and public sectors. A Thai Foundation, which promotes the process, has been formed under royal patronage. A series of "five star" partnerships between the government, the private sector, community and religious organizations, and NGOs have been created to promote programs of development that extend to 50,000 villages. In 1996, the National Planning NESDB completed the first national plan using the AIC process (Furugganan, 2002).

2.6 The concept and research related to the determinants of households' recycling scheme participation

Recycling is the act of processing used materials (waste) into new products to prevent waste of potentially useful materials, reducing the consumption of fresh raw materials, reducing energy usage, reducing air pollution (from incineration) and water pollution (from land filling) by reducing the need for "conventional" waste disposal, and lowering greenhouse gas emissions as compared to virgin production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, Recycle" waste hierarchy. Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics. Although similar in effect, the composting or other reuse of biodegradable waste such as food or garden waste is not

typically considered recycling. Materials to be recycled are either brought to a collection center or picked up from the curbside, then sorted, cleaned, and reprocessed into new materials bound for manufacturing.

Many studies have addressed recycling behaviour and strategies to encourage community involvement in recycling programmes. It has been argued that recycling behaviour is not natural because it requires a focus and appreciation for long term planning, whereas humans have evolved to be sensitive to short term survival goals; and that to overcome this innate predisposition, the best solution would be to use social pressure to compel participation in recycling programmes (Schackelford, 2006). However, recent studies have concluded that social pressure is unviable in this context. Pratarelli (2010) reasoned that social pressure functions well in small group ranging from 50 to 150 individual members (common to nomadic hunter-gatherer peoples) but not in communities numbering in the millions, as we see today. Another reason is that individual recycling does not take place in the public view. Social psychologist Burn (2006) found that personal contact with individuals within a neighborhood is the most effective way to increase recycling within a community. In his study, he had 10 block leaders talk to their neighbors and convince them to recycle. A comparison group was sent fliers promoting recycling. It was found that the neighbors that were personally contacted by their block leaders recycled much more than the group without personal contact. As a result of this study, he believes that personal contact within a small group of people is an important factor in encouraging recycling. Another study done by Oskamp (1995) examined the effect of neighbors and friends on recycling. It was found in his studies that people who had friends and neighbors that recycled were much more likely to also recycle than those who didn't have any friends and neighbors that recycled.

MSW recycling is a prominent indicator of environmental sustainability in the pursuit of sustainable development. Therefore, exploring the determinants of waste recycling is regarded as highly important to policy makers. Current research in recycling has explored several important factors to assess household participation in recycling such as socio- economic, individual's environmental awareness, and social capital.

Despite considerable research attempting to identify socio-economic factors which is significantly related with participation in recycling schemes, (particularly age, education, family size and income), the findings are rather inconsistent. Results based on the relationship between age and participation in recycling schemes sometimes suggest that older people participate in recycling schemes to a larger extent than younger people (Derksen and Gartrell, 1993; Ewing, 2001; Scott, 1999). On the other hand, Gamba and Oskamp(1994), and Werner and Makela (1998) found no relationship between age and recycling. Gamba and Oskamp (1994) work on the relationship between family size and recycling found that, on average, the total number of people living in a household was significantly higher for frequent recyclers as compared to less frequent recyclers. However, Werner and Makela(1998), Vining and Ebreo (1990) and Scott (1999) found no relationship between household size and recycling. Another socio-economic variable of interest is educational level. Some studies found that higher education level of households head participate in recycling schemes to a larger extent than families with lower education (Tsai, 2008; Damiano,2011). Finally, other socio-economic variables that have been analyzed in previous research include household income. Domina and Koch(2002), Gamba and Oskamp(1994), and Vining and Ebreo(1990) found that households with higher incomes participate in recycling schemes to a larger extent than families with lower incomes. However, the results concerning income are ambiguous as other studies have not found a significant relationship between income and recycling (Do Valle et al., 2004; Scott, 1999).

Environmental awareness or attitudes refer to knowledge of individual about environmental conservation. Previous research suggests that a positive relationship exists between less-specific environmental attitudes such as general environmental concern and recycling, but that the relationship is rather tenuous (Domina and Koch, 2002; Gamba and Oskamp, 1994; Scott, 1999; Vining and Ebreo, 1992).

On the issue of social capital, there has been little work on its role with relevance to solid waste management. An insightful article by Beall Jo (1997) examined two different examples of community involvement in solid waste management, in Bangalore, India, and in Faislabad, Pakistan. It shows that expectations based in the concept of social capital are waning because of the way in

which it obscures problems having to do with local power structures. Pargal, S., Gilligan, D. and Huq, M. (1999) seeks to identify the determinants of the private community-based provision of a public good: in this case, trash collection. Using survey data for Dhaka, Bangladesh, where some neighborhoods have managed to successfully organize an alternative to the municipal trash collection service, the paper examines why some communities or neighborhoods display such an initiative while others do not. Our results show that social capital is an important determinant of whether alternative systems arise in Dhaka. Other measures of homogeneity of interests are also important, and, interestingly so is the nature of associational activity. Finally, education levels are strongly and robustly associated with the existence of collective action for trash disposal. Tsai (2008) investigated the role of community in recycling by asking to what extent a region's degree of social coherence, measured as social capital, would influence its recycling rate. Using Taiwan as a case study, we applied the fixed effect model in panel data analysis to estimate the impact of social capital on the regional recycling rate. The estimation shows that the elasticity of social capital to regional recycling rate is about 0.38–0.43 at the 5% significance level. This provides evidence that a region's social relations are highly correlated with its recycling performance; a region's degree of social capital appears to increase its recycling rate. This finding implies that a successful recycling programme requires interactions between society and the environment. Enhancing a region's degree of social capital can also be incorporated as a part of that region's recycling programme. In order to identify and to analyze the determinants of household recycling scheme participation in the Bang Kruai town municipality area of Nonthaburi, Thailand, this study estimated two dichotomic Logit models, one for household recycling scheme participation model exclude social capital variables and one for household recycling scheme participation model include social capital variables. The Logit model can be specified as follows:

Let Z be the vector of the variables likely to influence household recycling scheme participation follows a utility function

$$U_1(Z) = V_1(Z) + e_1 \quad \dots(2.3)$$

and their non-use follows a utility function

$$U_0(Z) = V_0(Z) + e_0 \cdot V_i \quad \dots(2.4)$$

and e_i respectively represent the deterministic and random components, Z represents the argument.

The rational household will choose the option which provides the highest satisfaction utility. The probability that it asks for recycling scheme participation is expressed as follows:

$$\begin{aligned} P(Y=1) &= P[U_1 > U_0] = P[V_1(Z) + e_1 > V_0(Z) + e_1] \\ &= P[V_1(Z) - V_0(Z) > e_0 - e_1] \end{aligned} \quad \dots(2.5)$$

By supposing that $V_i = \beta_i Z$, we have: $V_1(Z) - V_0(Z) = (\beta_1 - \beta_0) Z$. Therefore,

$$P(Y=1) = P[\beta Z > e] = F(\beta Z) \quad \dots(2.6)$$

with $\beta = \beta_1 - \beta_0$, the vector of the parameters to be estimated and $e = e_0 - e_1$, the term of error.

$F(\beta Z)$ is related to a cumulative distribution; the Logit model supposes that F follows a logistic function. Under these conditions, the probability that an unspecified household asks for recycling scheme participation will be given by:

$$P(Y = 1) = \frac{\exp(\beta Z)}{1 + \exp(\beta Z)} \quad \dots (2.7)$$

Consequently, the probability of not using the recycling scheme participation will be given by:

$$P(Y = 0) = 1 - P(Y = 1) = \frac{1}{1 + \exp(\beta Z)} \quad \dots (2.8)$$

With $\exp$ the exponential function. The dichotomic Logit model was estimated by the method of maximum-likelihood. The Newton - Raphson algorithm was used to approximate $F(\beta Z)$ by a quadratic function from a Taylor series expansion around the unknown value β that maximizes F . Mc Fadden's R^2 is used to evaluate the quality of the adjustments.

2.7 The concepts of economics evaluation of project development

This study applies the concept of cost-benefit analysis (CBA) which was used in economics evaluation of project development. CBA is an economic method of project evaluation in which all costs arising from owning, operating, maintaining, and ultimately disposing of a project are considered to be potentially important to that

decision. CBA is particularly suitable for the evaluation of building design alternatives that satisfy a required level of building performance (including occupant comfort, safety, adherence to building codes and engineering standards, system reliability, and even aesthetic consideration), but that may have different initial investment costs; different operating, maintenance, and repair(OM&R) costs; and possibly different lives. However, CBA can be applied to any capital investment decision in which higher initial costs are traded for reduced future cost obligations. CBA provides a significantly better assessment of the long-term cost effectiveness of a project than alternative economic methods that focus only on first costs or on operating-related cost in the short-run. The documents that is used in the CBA can be shown in Table 2.4.

Table 2.4 Items to be documented in an CBA analysis

Item	Documents
Project description	General information, Type of decision to be made, Constraints
Alternatives	Technical description, Rationale for including them, Non-monetary considerations
Common Parameters	Study period, Base date, Service date, Discount rate, Treatment of inflation, Operational assumptions, Energy and water price schedules
Cost data and related factors	Investment-related costs, Operating-related costs, Energy usage amounts(by type), Water usage and disposal amounts, Timing of costs, Cost data sources, Uncertainty assessment
Computations	Discounting, Computations of life-cycle costs, Computations of supplementary measures
Interpretation	Results of CBA comparisons, Uncertainty assessment, Results of sensitivity analysis

To calculate the CBA, we first computed the present value of each cost to be incurred during the study period, using the discount rate. Then, the sum of these present values for each alternative result into a figure from the CBA. If other performance features are similar among the alternatives, the alternative with the lowest CBA is the preferred alternative; that is, it is the most cost-effective alternative for the application studied. Present value, project-related costs occurring at different points in time must be discounted to their present value as of the base date before they

can be combined into an CBA estimate for that project. The discount rate is used to discount future cash flows to present value that is based on the investor's time-value of money. In the private sector, the investor's discount rate is generally determined by the investor's minimum acceptable rate of return for investment of equivalent risk and duration. Since different investors have different investment opportunities, the appropriate discount rate can vary from investor to investor. Present value formula include the following:

- Present value formula for one-time amounts; The single present value (SPV) factor is used to calculate the present value (PV) of a future cash amount occurring at the end of year $t(F_t)$ and given discount rate (d) .

$$PV = F_t \cdot (1/(1+d)^t) \quad \dots(2.9)$$

- Present Value formula for annually recurring uniform amounts; The uniform present value (UPV) factor is used to calculate the PV of a series of equal cash amounts (A_0) that recur annually over a period of n years, given d .

$$PV = A_0 \cdot [((1+d)^n - 1)/(d \cdot (1+d)^n)] \quad \dots(2.10)$$

- Present Value formula for annually recurring non-uniform amounts; The modified uniform present value (UPV*) factor is used to calculate the PV recurring annual amounts that change from year to year at a constant escalation rate (e) (i.e. $A_{t+1} = A_t \cdot (1+e)$) over n year, given d . The escalation rate can be positive or negative.

$$PV = A_0 \cdot ((1+e)/(d-e)) \cdot [1 - ((1+e)/(1+d))^n] \quad \dots(2.11)$$

Using CBA widely accepted method, it is possible to compare the economics of different project alternatives that may have different cash flow factors, meanwhile providing a similar standard of service. Quite often, some project with the lowest first costs for new construction will require higher maintenance, repair, replacement, and energy costs during the project's life. So, even with their low first cost, these projects will have a higher cost.

There are three supplementary measures of economic performance that are consistent with the CBA method of project evaluation. These are Net Saving (NS), Savings-to-Investment Ratio (SIR) and Internal Rate of Return (IRR). They are consistent with the CBA method because they are based on stream of costs and savings over the same study period. NS can be used in place of the CBA measure

itself to determine the most cost-effective project alternative when evaluating two or more mutually exclusive project alternatives. The SIR and IRR measures are primarily useful for ranking independent projects when faced with a budget that is insufficient to fund all of the cost-effective projects; which are identified for a particular facility or agency. Calculating supplementary measures;

- Net saving (NS) is the difference between present value of the alternative and the base case. NS calculated by the present value of savings in operational costs of the alternative in year t minus the present value of additional investment costs of the alternative in year t. If the NS is greater than zero, then the alternative cost project is lower than the base case. NS method calculates the net amount, in present value of money, that a project alternative is expected to save over the study period. The calculation of NS is the following;

$$NS = C_{\text{base case}} - C_{\text{alternative}} \quad \dots(2.12)$$

While, general formula for NS is;

$$NS_{A:BC} = \sum (S_t / (1+d)^t) - \sum (\Delta I_t / (1+d)^t) \quad \dots(2.13)$$

Where $NS_{A:BC}$ is net saving in present value of the alternative(A), relative to the base case, If NS is greater than zero, the project is considered to be cost effective to the base case. S_t is savings in year t in operational costs associated with the alternative, ΔI_t is additional investment related cost in year t associated with the alternative, T is year of occurrence ($t=0,1,2,3,\dots,N$), d is discount rate and N is number of year in study period.

- Savings to Investment Ratio (SIR) is the ratio of the present value of savings to additional investment costs of alternative relative to base case. SIR is calculated based on the present value of the savings from the operational cost of alternative in year t relative to the present value of the additional investment-related costs in year t. SIR is greater than 1, indicating that the savings of the alternative is higher than the additional investment-related cost attributable to the alternative. The general formula for the SIR simply as a ratio:

$$SIR_{A:BC} = \sum (S_t / (1+d)^t) / \sum (\Delta I_t / (1+d)^t) \quad \dots(2.15)$$

Where $SIR_{A:BC}$ is the ratio of present value savings to additional and present value investment cost of the alternative relative to the base case, S_t is savings in year t in

operational costs associated with the alternative, ΔI_t is additional investment related cost in year t associated with the alternative, T is year of occurrence ($t=0,1,2,3,\dots,N$), d is discount rate and N is number of year in study period.

- Internal Rate of Return (IRR) is the discount rate or interest rate that causes the net present value of all cash flows to be equal to the initial investment. Usually, in comparison, the investment in a project which compares the IRR with the loan rate. If the IRR of a project is higher than the interest rate, it shows the value of project. The IRR is compared against the investor's minimum acceptable rate of return (MARR), which is generally equal to the discount rate used in the CBA. If the IRR is greater than the MARR, the IRR equals the discount rate, the project's savings just equal its costs and the project is economically neutral. The IRR can be computed easily using the following formula:

$$IRR = (1+r) \cdot (SIR)^{1/N} - 1 \quad \dots(2.16)$$

where IRR is adjusted internal rate of return, r is the reinvestment rate, N is number of year in study period and SIR is the ratio of present value savings to additional and present value investment cost of the alternative relative to the base case.

A project is being evaluated as an accept/reject proposition, each of the following economic decision criteria consistently indicate a cost-effective project: (Table 2.5)

Table 2.5 Economic measures of evaluation and their uses

Economic Measures	Type of Decision
Net saving (NS)	Yes (> 0)
Saving investment ratio (SIR)	Yes (> 1.0)
Internal rate of returns (IRR)	Yes ($>$ discount rate)

Chapter 3

Research Methodology

3.1 The determination of MSW generation and collection cost in Thai municipality

This section was considering the MSW profile that focused on general characteristics of the municipality, MSW generation and composition, in addition, this study was performed to estimate the MSW generation and collect costs to forecast changes in the waste quantities. Moreover, it the study was done to see if there were any costs that may have caused some problems in the MSWM in Thai municipality. The data collecting has divide by the objective of the study including; for firstly objective that to investigate the determinants of MSW generation in Thai municipality using questionnaires and surveys that were sent by mail to the responsible unit (mayor, senior executives, etc.) during the period from July 2009 to January 2010. 570 questionnaires were completed and returned for and estimated model. Questionnaires were collected from the region across country can be classified as follows.

The northern, 17 provinces, with a total of 154 questionnaires consisted of 2 city municipalities, 14 town municipalities and 138 sub-district municipalities. (Table 3.1)

Table 3.1 The municipality samples in the northern region

Province	Type of Municipality			
	Sub-district	Town	City	Total
Kamphaeng Phet	7	1	0	8
Tak	6	1	0	7
Nakorn Sawan	4	0	0	4
Nan	2	1	0	3
Phayao	4	2	0	6
Pichit	10	1	0	11
Phitsanulok	6	0	0	6
Lampang	12	1	1	14
Lamphun	10	1	0	11
Sukhothai	8	0	0	8
Uttaradit	10	1	0	11

Province	Type of Municipality			
	Sub-district	Town	City	Total
Uthai Thani	4	1	0	5
Chiangrai	15	0	1	16
Chiangmai	20	1	0	21
Phetchabun	11	1	0	12
Phrae	7	1	0	8
Mae Hong Son	2	1	0	3
Total	138	14	2	154

The north- eastern, 19 provinces, with a total of 162 questionnaires consisted of 2 city municipalities, 8 town municipalities and 152 sub-district municipalities. (Table 3.2)

Table 3.2 The municipality samples in the north eastern region

Province	Type of Municipality			
	Sub-district	Town	City	Total
Kalasin	14	0	0	14
Khon Kaen	13	0	1	14
Chaiyaphum	9	0	0	9
Nakorn Phanom	6	0	0	6
Nakorn Ratchasima	19	0	0	19
Buriram	9	0	0	9
Maharakham	4	1	0	5
Mukdahan	1	0	0	1
Yasothon	2	1	0	3
Roi Et	9	1	0	10
Sisaket	4	2	0	6
Sakon Nakhon	7	0	0	7
Surin	5	1	0	6
Nongkhai	8	0	0	8
Nongbualamphu	6	0	0	6
Amnat Charoen	4	0	0	4
Udon Thani	14	1	0	15
Ubon Ratchathani	10	1	1	12
Loei	8	0	0	8
Total	152	8	2	162

The central, 25 provinces, with a total of 183 questionnaires consisted of 3 city municipalities, 17 town municipalities and 163 sub-district municipalities. (Table 3.3)

Table 3.3 The municipality samples in the central region

Province	Type of Municipality			
	Sub-district	Town	City	Total
Kanchanaburi	17	0	0	17
Chanthaburi	8	1	0	9
Cha Choeng Sao	14	1	0	15
Chonburi	9	2	0	11
Chainat	7	1	0	8
Trat	2	1	0	3
Nakorn Nayok	2	0	0	2
Nakorn Prathom	6	0	0	6
Nonthaburi	3	1	0	4
Prathum Thani	5	1	0	6
Prachuap Khiri Khan	7	2	0	9
Prachin Buri	5	0	0	5
Phra Nakorn Si Ayuttaya	15	2	1	18
Rayong	7	0	1	8
Ratchaburi	15	1	0	16
Lopburi	7	0	0	7
Samutprakarn	6	1	0	7
Samutsongkram	1	0	0	1
Samutsakorn	1	0	1	2
Saraburi	9	0	0	9
Sakaeo	1	1	0	2
Sing Buri	2	0	0	2
Supanburi	8	1	0	9
Angthong	4	1	0	5
Phetchaburi	2	0	0	2
Total	163	17	3	183

And the southern, 14 provinces, with a total of 71 questionnaires consisted of 2 city municipalities, 7 town municipalities and 62 sub-district municipalities. (Table 3.4)

Table 3.4 The municipality samples in the southern region

Province	Type of Municipality			
	Sub-district	Town	City	Total
Krabi	2	0	0	2
Chumporn	6	0	0	6
Trang	5	0	0	5
Nakorn Si Thammarat	9	0	1	10

Province	Type of Municipality			
	Sub-district	Town	City	Total
Nara Thiwat	3	0	0	3
Pattani	3	0	0	3
Phang Nga	4	0	0	4
Pattalung	4	0	0	4
Phuket	1	2	0	3
Yala	2	1	1	4
Ranong	3	0	0	3
Songkhla	10	2	0	12
Satun	2	1	0	3
Suratthani	8	1	0	9
Total	62	7	2	71

Previous review of literature on factors in determining MSW generation was consistent for supporting the data collection. This allowed the study to apply the concept of the Consumption-related variables. The empirical studies made it possible to propose a general model for estimating the factors that determine MSW generation:

$$W = f(D, O, Z) \quad \dots(3.1)$$

In order to conduct the empirical analysis on the basis of this general model, it was necessary to have data with regards to the target variables for a broad sample of Thai municipalities. The empirical model for estimation is as followed: Where W is the MSW generation, D is the characteristic of demographic, O the characteristics of municipality, and Z the uncontrollable characteristics that affect the amount of MSW generation.

In order to conduct the empirical analysis on the basis of this general model, it was necessary to have data with regards to the target variables for a broad sample of Thai municipalities. The empirical model to be estimated is as followed:

$$W = \alpha + \beta_1 \text{DEN} + \beta_2 \text{HOS} + \beta_3 \text{DTOW} + \beta_4 \text{DCIT} + \varepsilon \quad \dots(3.2)$$

In this equation the dependent variable is the total of MSW generation, W the volume of MSW which was generated in each municipality during one year: expressed in tons. The data was gathered from municipalities across the country.

- DEN. Population density in the municipality: expressed in the number of citizen per square kilometer. One would expect to find a positive relationship

between population density and MSW generation. Therefore, the coefficient associated with this variable should be positive.

- HOS. Households' size, which measure from the ratio of population to number of household in each municipality, express in an average of number of household membership. One would expect to find a positive relationship between the average number of household membership and MSW generation, such that the coefficient of this variable should be positive.

- DTOW. Dummy variable that takes the value of 1 if organization was town municipality, and 0 otherwise. In fact, the size of municipality was the proxy of urbanization that represents the density of economic activity in areas such as commerce, manufacturing and services. Indeed, in order for the municipality to qualify as a town, it either needs to be a provincial capital, or have a population of at least 10,000 that would have a high MSW generation. Therefore, the coefficient associated with this variable should be positive.

- DCIT. Dummy variable that takes the value of 1 if organization was city municipality, and 0 otherwise. This variable reflects that urbanization refer to growth of economic activities in area, so that the by-product of activities were MSW generation. Therefore, the coefficient associated with this variable should be positive.

Upon analyzing the factors in determining MSW generation in this study, the ordinary least square regression (OLS) technique was used to model the estimation. Estimation of the determinants of MSW generation, explanatory variables in the model that consist of population density, household size, and urbanization were represented by the size of the municipality as dummy variable (town and city). The dependent variable was MSW generation per year. The ordinary least square regression (OLS) technique was used to model the estimation.

3.2 The determinants of household recycling scheme participation model

In order to identify and to analyze the determinants of household recycling scheme participation, this study estimated two dichotomic Logit models - one for household recycling scheme participation model exclude social capital variables, and

one for household recycling scheme participation model that includes social capital variables.

Econometric analysis was implemented to investigate the factors that influence household MSW recycling schemes participation. The regression approach used by the study follows that of models for binary choice, specifically the Logit model, where the dependent variable is a dichotomous variable, i.e., $R=1$ if the household is engaged in MSW recycling schemes and $R=0$ if it does not, regressed on some socio-economic characteristics, environmental awareness and individual social capital.

The Probit model may also be used to explain the behavior of a dichotomous dependent variable. The Probit model uses the normal cumulative distribution function (CDF), while the Logit uses the logistic cumulative distribution function. While the question of which model to use in a binary choice analysis is unresolved, it has been observed that in most applications, it does not make much difference since the models give similar results (Greene 1997; Gujarati 1995).

The empirical model is of the following form:

The determinants of household recycling scheme participation model exclude social capital variables.

$$R = \beta_0 + \beta_1 \text{AGE} + \beta_2 \text{EDU} + \beta_3 \text{MEM} + \beta_4 \text{INC} + \beta_5 \text{LAN} + \beta_6 \text{GHG} + \varepsilon \quad \dots(3.3)$$

The determinants of household recycling scheme participation model include social capital variables.

$$R = \beta_0 + \beta_1 \text{AGE} + \beta_2 \text{EDU} + \beta_3 \text{MEM} + \beta_4 \text{INC} + \beta_5 \text{LAN} + \beta_6 \text{GHG} + \beta_7 \text{INT1} + \beta_8 \text{INT2} + \beta_9 \text{SOT1} + \beta_{10} \text{SOT2} + \beta_{11} \text{SN1} + \beta_{12} \text{SN2} + \beta_{13} \text{PT1} + \beta_{14} \text{PT2} + \varepsilon \quad \dots(3.4)$$

This study identified a range of variables likely to have an influence on the decision to join the recycling scheme. The explanatory variables retained and used in the estimate of Logit models, as well as the expected theoretical effects, are presented and discussed below.

- AGE is a variable that measures the age of the household head. In the relationship between age and participation in recycling schemes, the results with regards to age sometimes suggest that older people participate in recycling schemes to

a larger extent than younger people. One would expect to find a positive relationship between the age of the household head and participation in the recycling schemes. Therefore, the coefficient associated with this variable should be positive.

- EDU measures the educational level of the household head. The educational level of a household head has a positive influence on the probability of participants in recycling schemes. Therefore, the coefficient associated with this variable should be positive.

- MEM measures the household's family size (all members, all ages). When the household head is a member of a large household, the probability for him to participate in recycling schemes is increased. Therefore, the coefficient associated with this variable should be positive.

- INC measure average household income per month (Baht). The average household income per month has a negative influence on the probability of participating in the recycling schemes. Therefore, the coefficient associated with this variable should be negative.

- LAN measures environmental awareness, these refer to an individual concern about the shortage of landfill space. The indicator was measured on 5 point Likert scale (1 representing not at all and 5 very high). The head of household, who was more concerned about the shortage of landfill space, would expect to find an increase of probability for him to participate in the recycling schemes.

- GHG measures environmental awareness - these refer to individual concerns about an increase of MSW generation that is caused by the problems of global warming. The indicator was measured on a 5 point Likert scale (1 representing not at all and 5 very high). The head of household who has more concern about the global warming would expect to find an increase in probability for him to participate in recycling schemes.

- INT1 measures institutional trust that refers to trust in the central government. The index was measured on a 1-10 Likert scale, with the lowest values being an indication of lower levels of institutional trust. The head of household, who has more stock of social capital in terms of trust in central government, would expect to find an increase in probability for him to participate in recycling schemes.

- INT2 measures institutional trust that refers to trust in the local government. The index was measured on a 1-10 Likert scale, with the lowest values being an indication of lower levels of institutional trust. The head of household, who has more stock of social capital in terms of trust in local government, would expect to find an increase in probability for him to participate in recycling schemes.

- SOT1 measures social trust that refers to trust in neighbor in community. The index was measured on a 1-5 Likert scale, with lowest values being an indication of lower levels of social trust. The head of household, who has more stock of social capital in terms of trust with the neighbors in community, would expect to find an increase in probability for him to participate in recycling schemes.

- SOT2 measures social trust that refers to trust in most people in community that was willing to provide assistance. The index was measured on a 1-5 Likert scale, with lowest values being an indication of lower levels of social trust. The head of household, who has more stock of social capital in terms of trust in most people in community that was willing to provide assistance, would expect to find an increase in probability for him to participate in recycling schemes.

- SN1 measure compliance with social norm that refer to the bribing of public officials. The index was measured on a 1-5 Likert scale, where 1 referred to completely unjustifiable action and 5 to the completely justifiable action. The head of household, who has more stock of social capital in terms of bribing public officials which enabled them to assist, would expect to find an increase in probability for him to participate in recycling schemes.

- SN2 measure compliance with social norm that refer to the corruption of public officials. The index was measured on a 1-5 Likert scale, where 1 referred to completely unjustifiable action and 5 to the completely justifiable action. The head of household, who has more stock of social capital in terms of corrupt public officials willing to assist, would expect to find an increase in probability for him to participate in recycling schemes.

- PT1 is a dummy variable that indexes the household head work on voluntary for local NGO taking on 1 if the household head works on a voluntary basis for local NGO in the past 12 months, and 0 if not. The head of household, who has

more stock of social capital in terms of work on voluntary for local NGO, would expect to find an increase in probability for him to participate in recycling schemes.

- PT2 is a dummy variable that indexes the household head was participated in social activities taking on 1 if household head was participated in social activities in the past 12 months, and 0 if not. The head of household, who has more stock of social capital in terms of social activities participation, would expected to find an increase in probability for him to participate in recycling schemes.

The determinants of MSW recycling model, an estimation was applied with the model of the determinants of MSW recycling of household participates in waste recycling schemes. The empirical studies have become possible for proposing a general model for estimating the factors that determine MSW recycling:

$$HR = f(H, ES, Z) \quad \dots(3.5)$$

Where HR was the percentage of household waste reduction by recycling schemes participation, H was the characteristic of household head socio-economic, ES were the environmental awareness and social capital, and Z the uncontrollable characteristics that affect the amount of household waste reduction.

In order to conduct the empirical analysis on the basis of this general model, it is necessary to have data regarding the target variables for a broad sample of household participating in waste recycling schemes. The empirical model to be estimated is the following:

$$HR = \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 MEM + \beta_4 INC + \beta_5 ENVI + \beta_6 SOCIAL + \varepsilon \quad \dots(3.6)$$

In this equation, the dependent variable is the percentage of household waste reduction by recycling schemes participation: HR measures by percentage of the ratio of household waste reduction from recycling schemes participation to the volume of household waste before participation.

- AGE measures the age of the household head. One would find a positive relationship between age and the percentage of household waste reduction. Therefore, the coefficient associated with this variable should be positive.

- EDU measures the educational level of the household head. One would find a positive relationship between educational level and the percentage of household

waste reduction. Therefore, the coefficient associated with this variable should be positive.

- MEM measures the household's family size (all members, all ages).

When the household head is a member of a large household, the percentage of household waste reduction is increased. Therefore, the coefficient associated with this variable should be positive.

- INC measure average household income per month (Baht). The average household income per month has a negative influence on household waste reduction. Therefore, the coefficient associated with this variable should be negative.

- ENVI measures environmental awareness, these refer to knowledge of individual about environmental conservation. Two questions were measured on the environment which was concerned with improper MSW management. In particular, environmental awareness included a shortage of landfill space and the concern of global warming. The indicator was measured on 10 point Likert scale (1 representing not at all and 10 very high). The head of household who has more concern about the environment would expect to find a direct relationship between the percentage of household waste reduction to increase. Therefore, the coefficient associated with this variable should be positive.

- SOCIAL measures individuals' social capital, which were the components of institutional trust, social trust, compliance with social norm, and social networking. The index was measured on an average score of social capital components, with the lowest values indicating lower levels of social capital. The head of household who has more stock of social capital would expect to find the direct relationship between the percentages of household waste reduction to be increased. Therefore, the coefficient associated with this variable should be positive.

An analysis is provided on these factors determining the percentage of household waste reduction by recycling schemes participation. In this study, the ordinary least square regression (OLS) technique was used to model on the estimation.

3.3 The economic evaluation of social capital in MSWM at source

The economic evaluation of social capital integration in the source of MSWM, which is aimed in promoting participation in household recycling schemes, was put forward in the following assumption:

- 1) Assuming, the project duration is 10 year, the population growth is 0.6 % per year and discount rate is 8% as the average of minimum loan rate (MLR) which is derived from the commercial bank in Thailand;
- 2) Projection, the MSW generation of each municipality used the determinants of MSW generation model;
- 3) MSW collection cost estimation of each municipality represents the MSW generate projection in the determinants of MSW collection cost model;
- 4) Calculation of the MSW reduction of each municipality use determinants of MSW recycling model and is represented in MSW generate projection;
- 5) The cost of promotional activities is set according to the size of the municipality. At the Bang Kruai town municipality area in the Nonthaburi province, the operation cost is equal to 1.5 million Baht. To build up sustainable development of social capital is on the assumption that there are initial investments and is going to continue on with three years after implementing reinvestment in the fifth year and in the eighth year respectively. Therefore, the cost of promotional activities to the sub-district town and city municipality will equal 4.5 million Baht, 9.0 million Baht and 18.0 million Baht, respectively.
- 6) Applying the cost benefit analysis (CBA) method that consists of Net Saving (NS), Savings-to-Investment Ratio (SIR) and Adjusted Internal Rate of Return (AIRR) to evaluate economic performance project alternative.

An acceptance or reject decision relates to the economic evaluation of a project having a single design or system option which we are considering for purchasing. A project is being evaluated as an accept/reject proposition. Each of the following economic decision criteria consistently indicates a cost-effective project: net saving (NS) of project greater than zero, saving-to-investment ratio (SIR) greater than 1.0 and the internal rate of return (IRR) greater than the discount rate.

Sensitivity analysis can help in several ways to assess the uncertainty of a CBA. It is a technique for determining which input values, if different, would make a crucial difference to the outcome of the analysis. It can also calculate a range of outcomes to determine the lower and upper bounds of a project's CBA or NS, or any other measure of economic evaluation. Although there are several formal methodologies for performing sensitivity analysis, there is but one simple way to apply it – varying the uncertain input values, performing on it one at a time, recalculating the measure of evaluation (NS, SIR, IRR) and looking at the resulting changes, and drawing conclusion about the degree of uncertainty. The study has to determine uncertainty in 3 scenarios; this includes the impact of social capital that makes household recycling reduced to an equal level to 8.33%, 11.11% and 16.67%, respectively.

Chapter 4

Results and Discussion

4.1 MSW generation and collection cost in Thai municipality

4.1.1 General characteristics of MSWM in Thai municipality

4.1.1.1 General characteristics of the municipality and MSW generation

Considerations with the general characteristics of the municipality that comprise of 515 sub-district, 46 town and 9 city municipality has been found to vary by the size - which city municipality had number of population, households, area and density of population, and households more than town and sub-district. From the survey, it was found that the district, town and city municipality were the following - the average number of population were equal to 7,233.89 persons, 25,238.63 persons and 72,393.22 persons, respectively. An average number of households were equal to 2,463.76 households, 10,082.43 households and 29,370.22 households, respectively.

The average of municipality area was equal to 19.64 km.², 25.87 km.², and 26.85 km.², respectively. The average population density was equal to 1,018.86 persons per km.², 2,113.71 persons per km.² and 3,185.05 persons per km.², respectively. And the average household density was equal to 345.32 households per km.², 853.02 households per km.² and 1,424.46 households per km.², respectively.

Meanwhile, the amount of MSW generation of city municipality was higher than town and sub-district. The survey found that, the city, town and sub-district municipality were the average amount of MSW per day equal to 132.11 tons, 44.94 tons and 6.10 tons, respectively. Per capita MSW per day were equal to 1.81 kg., 1.49 kg. and 0.97 kg., respectively. (Table 4.1)

Table 4.1 General characteristics of the municipality and MSW generation

Characteristics	Municipality		
	Sub-district	Town	City
Mean of population (person)	7,031.18	25,238.63	72,393.22
Mean of household (household)	2,463.76	10,082.43	29,370.22
Mean of area (km. ²)	19.64	25.87	26.85
Mean of population density (person/ km. ²)	1,018.86	2,113.71	3,185.05
Mean of household density(household/ km. ²)	345.32	853.02	1,424.46
Mean of MSW generation(ton/day)	6.10	44.94	132.11
Mean of MSW per capita (kg./day)	0.97	1.49	1.81

4.1.1.2 MSW composition

In consideration to the composition of MSW, there was no finding of significance between the differences in size of the municipality. Most of MSW was food waste resulting from the composition of city, while the town and sub-district were equal to 56.36% and 47.27%, respectively. In addition, a figure is shown below on the generation and composition of paper, plastic, glass and metal, respectively. (Figure 4.1, 4.2 and 4.3)

Figure 4.1 MSW composition of Sub-district municipality

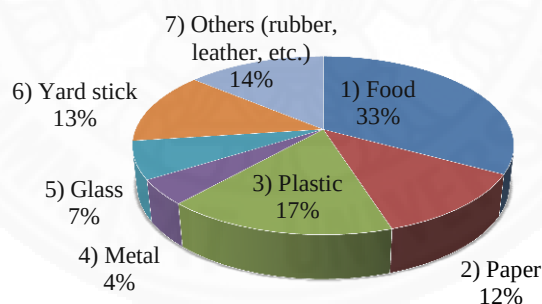


Figure 4.2 MSW composition of Town municipality

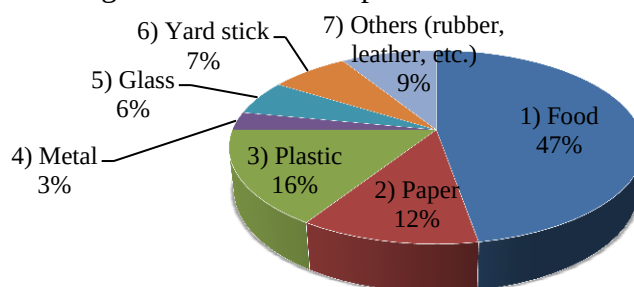
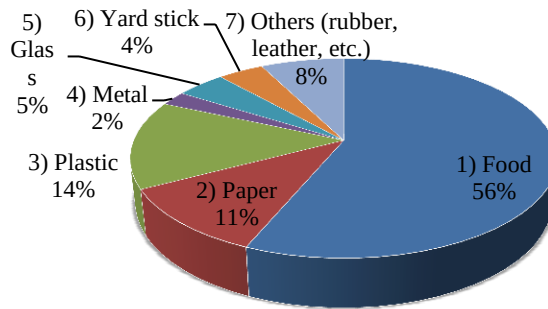


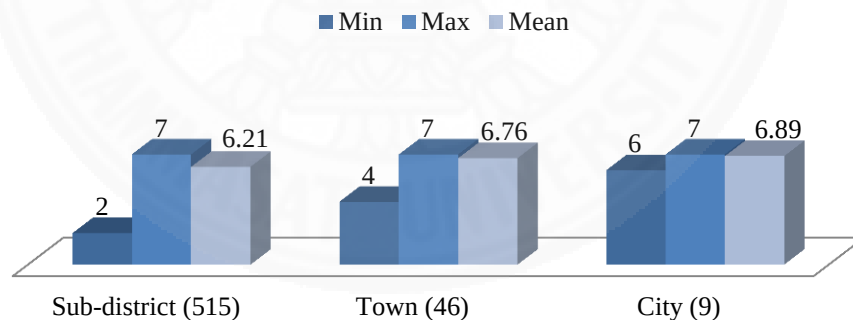
Figure 4.3 MSW composition of City municipality



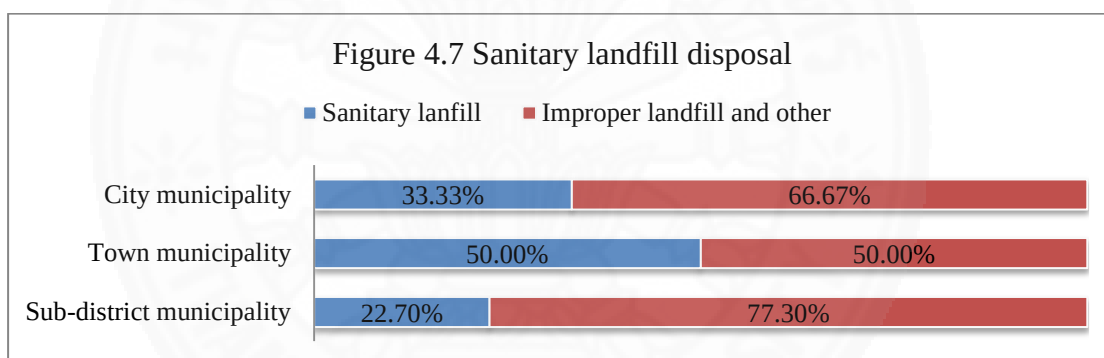
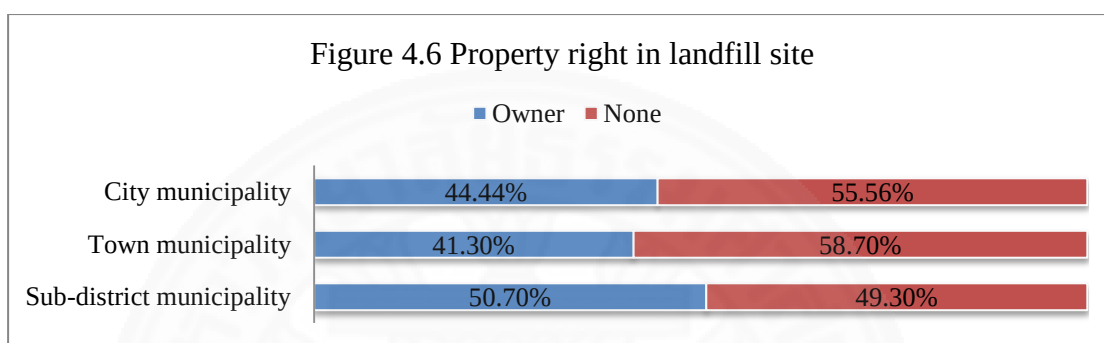
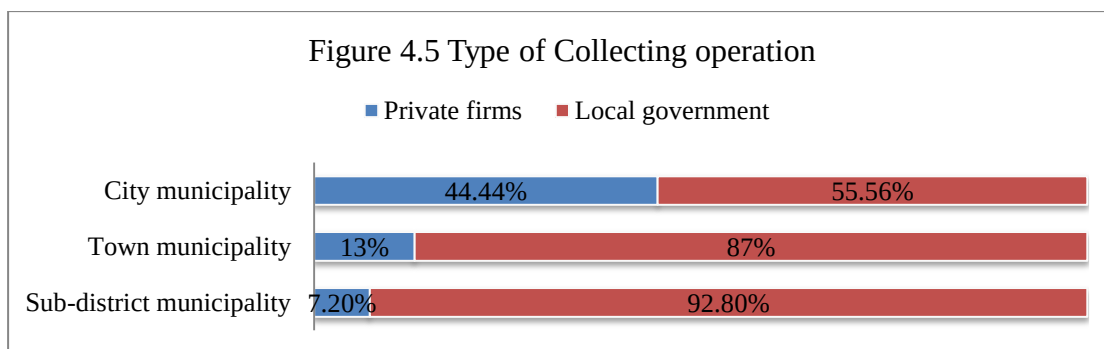
4.1.1.3 MSWM characteristics

The characteristics of MSWM includes the number of days per week in the collection, the type of collecting operation, landfill property rights, and forms of disposal. The survey found that the city, town and sub-district municipality resulted in The number of days per week in the collection was equal to 6.89, 6.76 and 6.21 days, respectively. (Figure 4.4)

Figure 4.4 MSW collection frequency (day per week)



Considering, the type of collecting, most of them had the operation done by the municipality. The city, town and sub-district municipality that had landfill property rights were equal to 44.44%, 41.30% and 50.70%, respectively. Meanwhile, the sanitary landfill disposal found that, 33.33% of city, 50.00% of town and 22.70% of sub-district were sanitary landfill disposal. (Figure 4.5, 4.6 and 4.7)



4.1.2 Estimation of the determinants of MSW generation

Explanatory variables in the model that consist of population density, household size, and urbanization were represented by the size of the municipality as dummy variable (town and city). The dependent variable was MSW generation per year. The ordinary least square regression (OLS) technique was used to model the estimation. However, to avoid the problem of independent variables in the model, the figures were highly correlated which made an error prediction or multicollinearity. Multicollinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. In this situation the coefficient estimates may change erratically in response to small changes in the model or the data. Multicollinearity does not reduce the predictive power or reliability of the model

as a whole, at least within the sample data themselves; it only affects calculations regarding individual predictors. That is, a multiple regression model with correlated predictors can indicate how well the entire bundle of predictors predicts the outcome variable, but it may not give valid results about any individual predictor, or about which predictors are redundant with respect to others. A high degree of multicollinearity can also cause computer software packages to be unable to perform the matrix inversion that is required for computing the regression coefficients, or it may make the results of that inversion inaccurate. Note that in statements of the assumptions underlying regression analyses such as ordinary least squares, the phrase "no multicollinearity" is sometimes used to mean the absence of perfect multicollinearity, which is an exact (non-stochastic) linear relation among the regressors. (<http://en.wikipedia.org/wiki/Multicollinearity>) Therefore, we tested the correlation of independent variables in the model. Based on the results, there was no relationship between high levels of independent variables.(Table 4.2)

Table 4.2 Correlation matrix of explanatory variables used in the MSW generation model

Variable	DEN	HOS	TOW	CIT
Population density (DEN)	1.000			
Household size (HOS)	0.559	1.000		
Town Municipality (TOW)	0.215	0.203	1.000	
City Municipality (CIT)	0.275	0.477	-0.038	1.000

The coefficient of determination (R^2) was one of the measures of the goodness of fit is 0.569. This means that the independent variables explain approximately 56.9% of the variability in the MSW generation. Other factors that were not included in the model could explain the remaining variation. The independent variables were statistically significant at the level 0.01, including population density (DEN), household size (HOS) and size of municipality was dummy variable that represented town municipality (TOW) and city municipality (CIT). The sign of the coefficients of the explanatory variables were positive which represents the variation of the dependent variable that was a direct change of independent variables. This can be explained as in Table 4.3

Table 4.3 Regression estimation of the determinants of MSW generation

Variable	Coefficient	Std. Error	Beta	t-statistic
Constant	1,472.960*	264.048		5.578
DEN	0.456*	0.075	0.205	6.121
HOS	102.518*	26.894	0.141	3.812
TOW(dummy)	8,349.640*	960.731	0.279	9.701
CIT (dummy)	32,291.488*	2,079.024	0.494	15.532
Dependent Variable : MSW generation (ton per year)				
$R^2 = 0.569$		Adj $R^2 = 0.566$		
F – Statistics = 186.590		Observation = 570		

Note : * Significant at level 0.01

Population density has a positive coefficient that describes the growth of population density that would cause an increase in the amount of MSW generation. Therefore, the population density per square kilometer, up to one person per square kilometer, had an increase of 0.456 tons of MSW per year.

Household size was measured by the number of family members. This variable has a positive coefficient which represents the larger household size or number of members increased which would cause an increase in the amount of MSW generation. An increase on person of household makes the volume of MSW grow up to 102.50 tons per year.

Town municipality, where the dummy variable has a positive coefficient, explained that if an organization was the town municipality then the volume of MSW also increases. From the coefficient of independent variable, it was found that the town municipality will have 8,349.64 tons of MSW per year more than the sub-district municipality.

City municipality, which dummy variable has a positive coefficient, represents the assumption that if an organization was the city municipality then the volume of MSW increases also. From the coefficient of independent variable, it was found that the city municipality will have 32,291.48 tons of MSW per year more than sub-district municipality.

The given MSW generation elasticity was the percentage change of independent variables that was compared with the percentage change in the amount of MSW generation. The population density elasticity for MSW generation is equal to 0.095 which can be explained if the population density growth of 1 percent would cause an increase in the amount of MSW generation to 0.095 percent. Meanwhile, the household size elasticity for MSW generation is equal to 0.229 which can be explained if household size extending at 1 percent would cause an increase in the amount of MSW generation to 0.229. Considering elasticity value was less than one which explained that the percentage change of MSW generation is less than the population density and household size. (Table 4.4)

Table 4.4 MSW generation elasticity estimation

Variable	Coefficient	Std. Error	Beta	t-statistic
Constant	6.618*	0.162		40.730
ln DEN	0.095*	0.027	0.133	3.454
ln HOS	0.229*	0.035	0.259	6.583
TOW	1.407*	0.115	0.385	12.190
CIT	2.431*	0.249	0.304	9.776
Dependent Variable : ln MSW generation				
$R^2 = 0.494$		Adj $R^2 = 0.490$		
F – Statistic = 137.936		Observation = 570		

Note : * Significant at level 0.01

Based on the results, the determinants of MSW generation model estimation indicates the socio-economic factors in the area. (As determined by population and urbanization) were positively correlated with the amount of MSW generation.

4.1.3 Estimation of the determinants of MSW collection cost

Explanatory variables in the model that consist of the volume of MSW collected in the municipality, percentage of recycled waste to total waste, distance from municipality center to disposal site, the frequency of MSW collection per week (the number of days per week on which waste was collected), population density,

hazardous waste separation (dummy variable that takes the value of 1 in the municipality which has hazardous waste separation before disposal and 0 otherwise) and the types of collection (dummy variable that takes the value of 1 if delivery has been local government provides the service directly and 0 if delivery has been contracted out to a private firm or joint venture between private firm and public) The dependent variable was MSW collection cost per year. The estimation was performed using the ordinary least squares estimator. However, avoiding the problem of independent variables in the model were highly correlated, which makes error prediction or multicollinearity. Therefore, we test the correlation of independent variables in the model. According to the results, there was no relationship between high levels of independent variables. (Table 4.5)

Table 4.5 Correlation matrix of explanatory variables used in the MSW collection cost model

	lnWAS	lnREC	lnDIS	lnFRE	lnDEN	HAZ	MAN
MSW collected (lnWAS)	1.000						
Recycle waste ratio(lnREC)	-0.090	1.000					
Distance (lnDIS)	0.195	-0.078	1.000				
Frequency per week(lnFRE)	0.153	0.054	-0.098	1.000			
Population density(lnDEN)	0.237	-0.034	0.047	0.244	1.000		
Hazardous waste (HAZ)	0.282	0.007	0.059	0.056	0.008	1.000	
Management (MAN)	-0.153	0.090	-0.154	0.202	0.021	-0.102	1.000

The coefficient of determination (R^2) was one of the measures of the goodness of fit is 0.748. This means that the independent variables explain approximately 74.8% of the variability in the MSW collection cost. Other factors not included in the model could explain the remaining variation. The independent variables were statistically significant, including the volume of MSW collected in the municipality (lnWAS), distance from municipality center to disposal site (lnDIS), population density (lnDEN), hazardous waste separation (HAZ) and the types of collection (MAN). The sign of the coefficients of the explanatory variables except types of

collection (MAN) were positive which represents the variation of the dependent variable was a direct change of independent variables. This can be explained in the figure given below. (Table 4.6)

Table 4.6 Regression estimation of the determinants of MSW collection cost

Variable	Coefficient	Std. Error	Beta	t-statistic
Constant	9.630**	0.281		34.294
lnWAS	0.569**	0.018	0.767	32.693
lnREC	0.019	0.056	0.007	0.342
lnDIS	0.037*	0.016	0.051	2.346
lnFRE	0.096	0.082	0.027	1.170
lnDEN	0.098**	0.016	0.138	6.151
HAZ	0.168**	0.040	0.093	4.185
MAN	-0.120*	0.061	-0.044	-1.979
Dependent Variable : lnC (MSW Collection Cost)				
$R^2 = 0.748$		Adj $R^2 = 0.745$		
F – Statistic = 238.613		Observation = 570		

Note : **, * Significant at level 0.01 and 0.05 respectively

The volume of MSW collected in the municipality (lnWAS) has a positive coefficient that describes the growth of the amount of waste collected which would cause an increase in MSW collection cost. Therefore, the coefficient associated with this variable was positive. In fact, the volume of waste generated was the main factor determining the total cost incurred by the corresponding municipality. However, the value of the coefficient associated with this variable was determined whether or not there are economies of scale. In the event that this value was less than 1, and significantly so, this would provide evidence that costs increase less than proportionally with increases in output.

Distance from municipality center to disposal site (lnDIS) has a positive coefficient that represents positive relationship between distance from municipality center to disposal site and MSW collection cost. The long distance from municipality center to disposal site would cause an increase in the cost of MSW collection.

Population density (lnDEN) has a positive coefficient that describes the growth of population density which would cause an increase in the amount of MSW collection cost.

As for hazardous waste separation (HAZ), this variable was a dummy variable that takes the value of 1 in the municipality, which has a hazardous waste separation before disposal and 0 otherwise. The coefficient associated with this variable was positive which represents that if an organization has hazardous waste separation before disposal then it would cause an increase in the cost of MSW collection.

With regards to the types of collection (MAN), this variable was a dummy variable that takes the value of 1: if delivery has been made by the local government in providing service directly and 0 if delivery has been contracted out to a private firm or joint venture between private firm and public. This explanatory variable has a negative coefficient, which can be explained if delivery has been local government providing the service directly which would cost less than private firm. In this regard, there was no consensus in the literature about the ability of private delivery to reduce the costs of solid waste collection services (Bel, Hebdon and Warner, 2007; Bel & Warner, 2008). A private delivery should enable cost savings by taking greater advantage of economies of scale by having a better incentive structure and through a possible introduction of competition for the contract. In the case of the present sample, however, it does not appear that these advantages have materialized. As such, it should be taken into account that privatization implies additional transaction costs derived from drawing up and overseeing the contract with a company that was external to the municipality. Moreover, competition for the contract was, in many cases, limited insofar as the concentration of companies and the monopolization of the contract by the first incumbent that was typical in this sector. Because of this, more importance must be given to regulatory policies (Massaruto 2007, Warner and Bel, 2008) and the design of regulatory institutions (Cunha Marques and Simões 2008).

4.1.4 Forecasting MSW generation

Predictions from the model showed that in 10 years, the growth rate of MSW generation of the most municipality average was 3,768.3 tons per year. From the estimation, it was found that the sub-district, town and city municipality were the

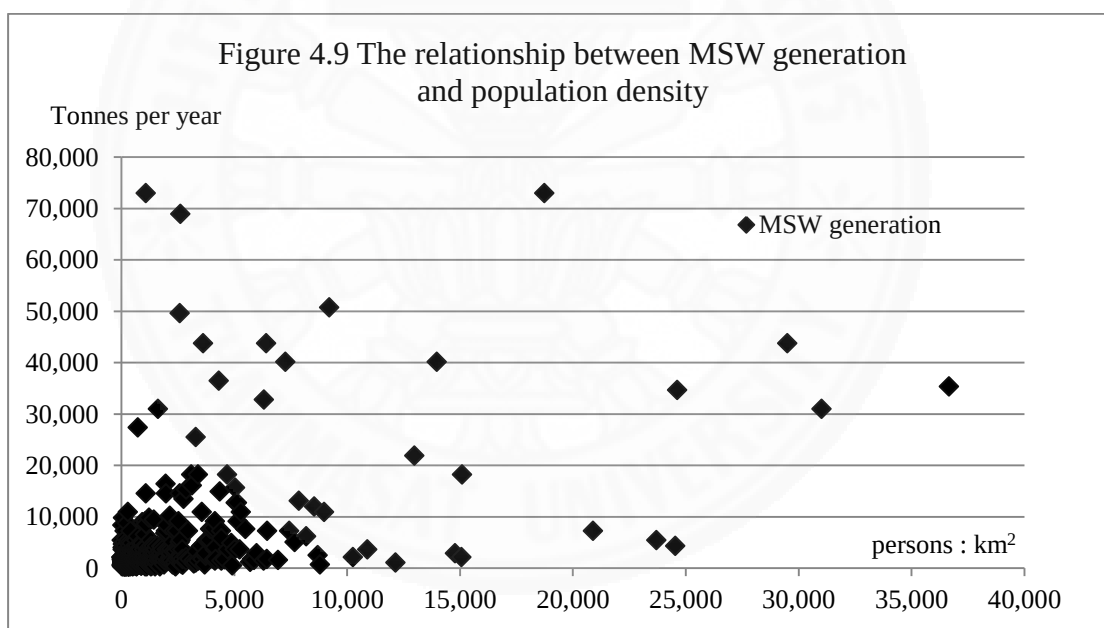
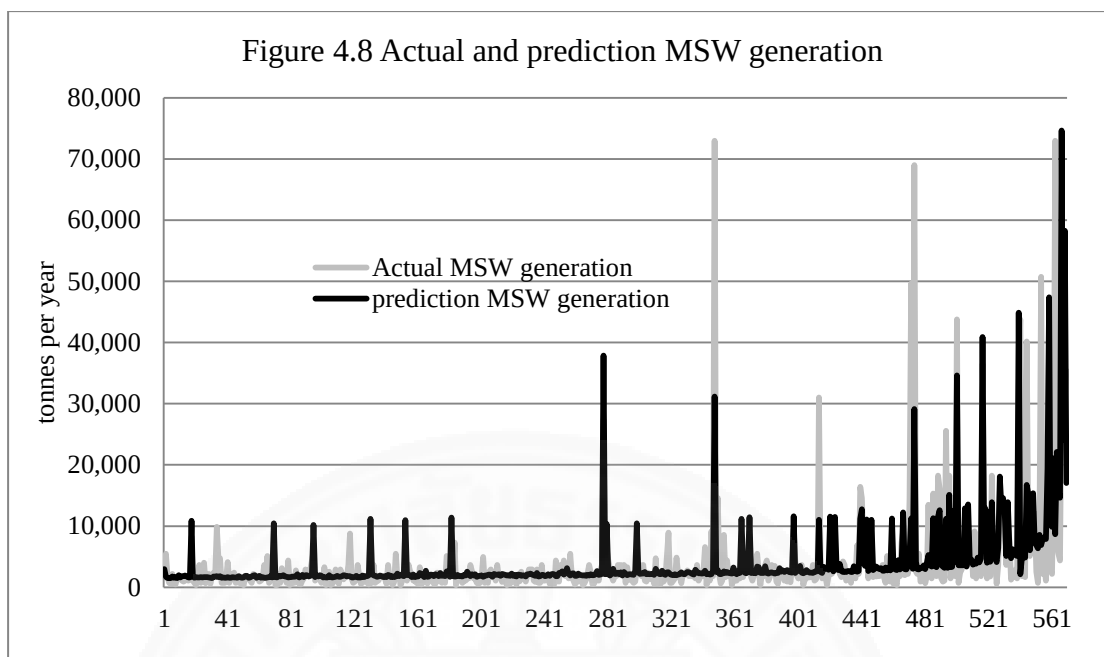
following –MSW generation per year were equal to 2,357.5 tons, 12,536.6 tons and 39,681.2 tons per year, respectively. Consideration, the proportion of the increase of the average MSW generation of town and city compared with sub-district municipality were equal to 5.31 times and 16.83 times, respectively. This is presented in Table 4.7.

Table 4.7 Forecasting MSW generation

Projection	Type of Municipality			
	Sub-district	Town	City	Total
MSW generation per year (1,000 tons)	2.3575	12.5366	39.6812	3.7683

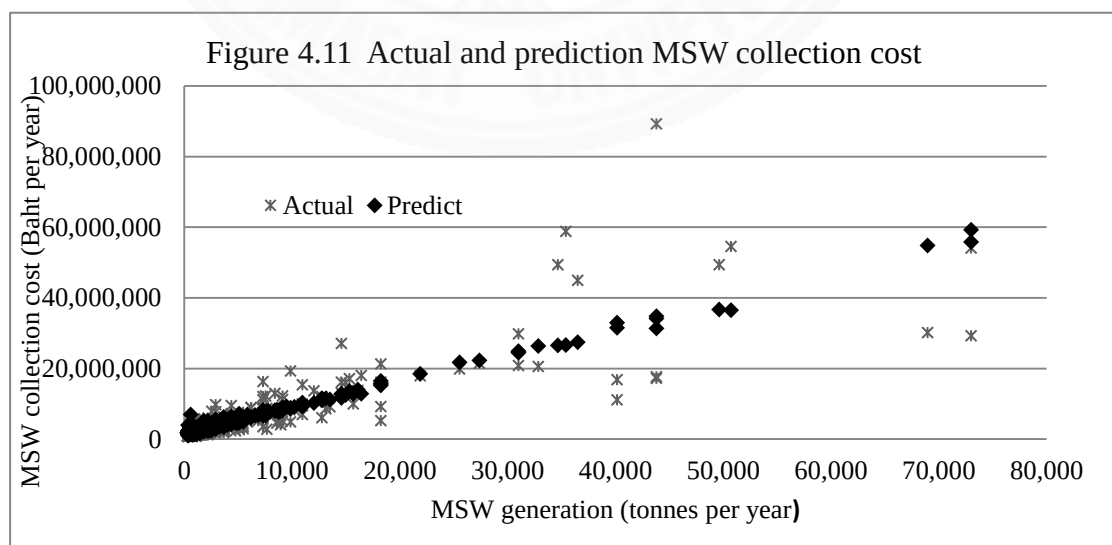
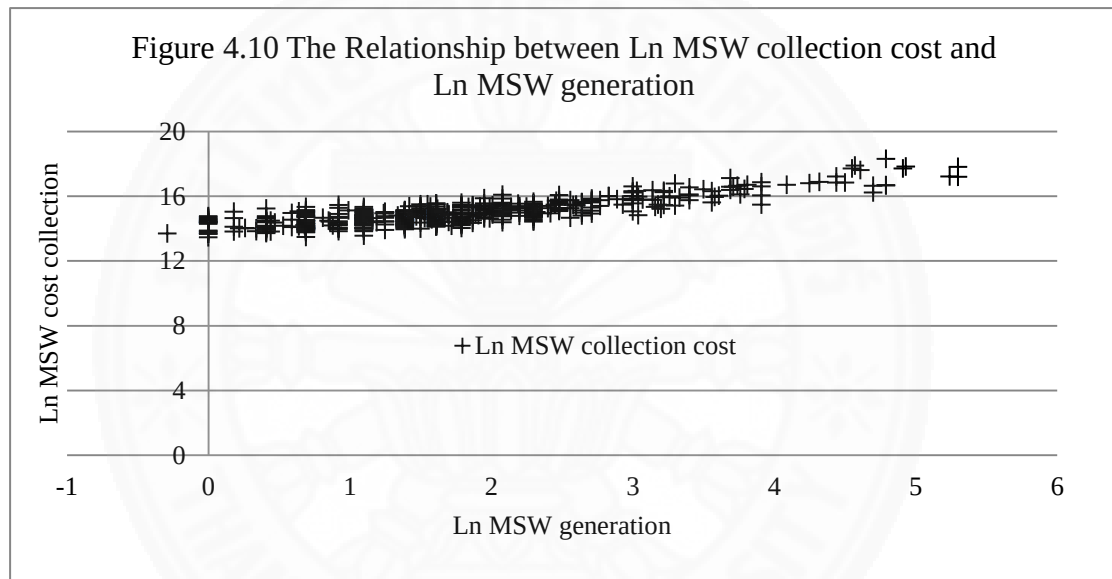
MSW problems in the context of the growth of the generating MSW continues to rise. The key factors in stimulating an increase in the volume of MSW are the population density and urbanization. Considering the growing trend of MSW generation by estimating the determinants of MSW generation model was found that linking the increase of the population growth has an increased population density and the average of household size has resulted in an increased generation of MSW. In addition, the urbanization that approximate by size of municipality found that the town and city municipality were concentration of economic activities that will increase MSW generation as well. (Figure 4.8 and 4.9)

Briefly, the increase in the volume of MSW will also lead to an increase in collection cost. In particular, the constraints of the municipality budget, which carry out mission to provide public services in many ways, will respond to the community. The MSWM cost increases will affect the poor in the collection. In addition, the increasing amount of MSW generation, resulting in a shortage of landfill space, leads to the elimination of the problem that causes health and environmental sanitation in the municipality. Therefore, the source of waste management by reducing the amount of MSW generated would be conducive to significant reductions in the cost of collection, which is useful in the management of the budget for proper disposal.



However, the efficiency of the service delivery, in comparison between the action by the local government and the operation by a private firms or a joint venture, found that the operation conducted by the municipality has lower costs than private firms or joint venture. This is in conflict with the privatization concept, which proclaims that a monopoly will have lower performance than the competition, or that operation by the private sector will perform better than the local government. On the grounds that the cost of MSW collection performed by the municipality is more feasible than private firms, one would expect results from the operation of contracting

out to be in accordance with the regulations concerning the environment. This is strictly a private transaction cost that is important to bear while being employed by the municipality that did not follow the same standards. Therefore, the higher transaction cost of the operation of the private firms will be added to the total cost, which will result in higher costs than the municipality. Due to the trend of increasing population and economic activity in the area of municipalities, the increase reflects the continued supply of MSW collecting service. This will increase the cost of collection and lead to the problem of municipal solid waste management in the future. (Figure 4.10 and 4.11)



Considering the MSW composition of the municipality such as sub-district, town and city, the study found that the majority of the waste is food waste, followed by paper, plastic, glass and metal, respectively. The nature of these residues can be recycled by encouraging households to take part in the separation of waste prior to disposal. The benefits of recycling activities have not only reduces the amount of municipal solid waste but also lowers the affect of the MSW collection cost.

4.2 Social capital in MSWM

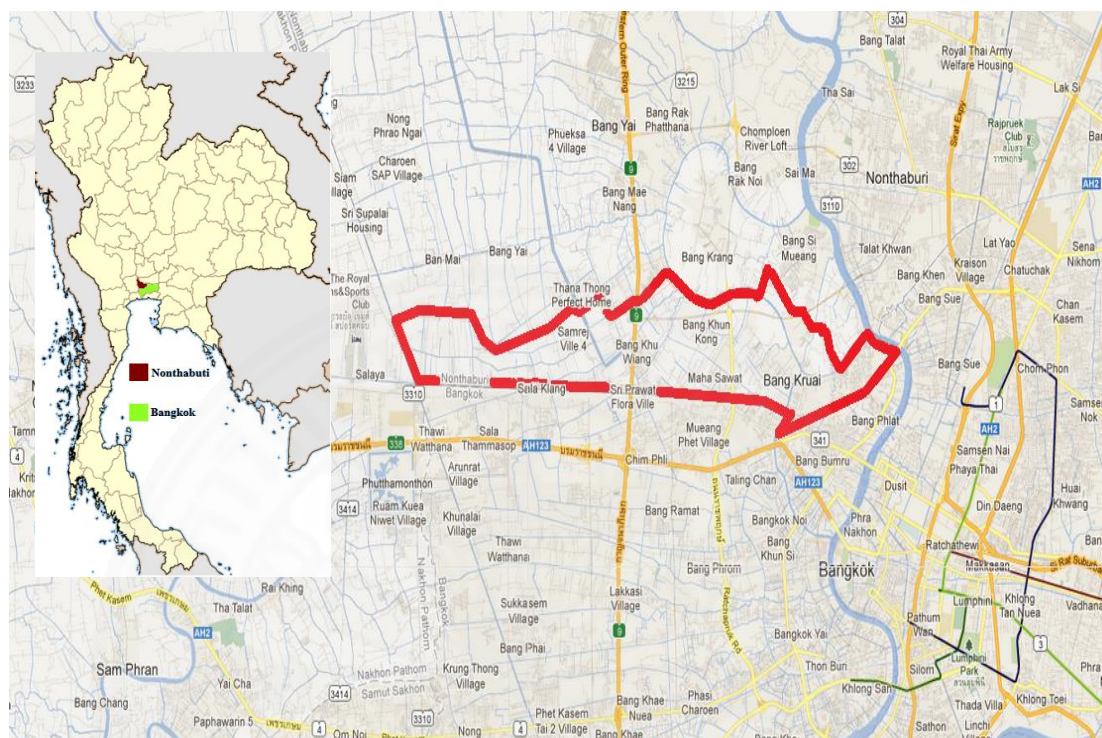
This section is to examine the role of social capital in the household recycling scheme participation with two techniques. The case study was conducted at the Bang Kruai town municipality, in the Nonthaburi province of Thailand. First, the appreciation influence control process (AIC) was used in developing community participation in MSWM. There were 12 out of 47 communities join that have taken part in the community waste management activities. Second, the Logit model was used for investigating the role of social capital in the household recycling scheme participation. In the analysis of the relationship between social capital and community participation on recycling activities, the data was collected from households with a total of 500 observations in the Bang Kruai town municipality.

4.2.1 Background of the Bang Kruai town municipality

Bang kruai town municipality is located in the Bang kruai district in the province of Nonthaburi. The area is 8.4 square kilometers, covering 9 villages of Bang kruai sub-district and 10 villages of the Wat Chalaw sub-district. The area is adjacent to the Chao Phraya river basin. There are many rivers and canals flowing through the line then it rains caused flooding in residential areas and arable land every year. (Figure 4.12) In 2010, Bang kruai town municipality had a number of 16,326 households: there were 41,902 citizens residing in this area. Furthermore, the population density is equal to 4988.62 persons per square kilometers and 47 communities in the area. However, due to the location of the commercial centre and the electricity generation of Thailand (EGAT) head office, it was expected that there

were more than a population of ten thousand that were non-registered as citizens in the area.

Figure 4.12 Bang kruai town municipality map



Source : <http://maps.google.com/maps?hl=en&tab=wl>, access Bang Kruai Municipality, Nonthaburi province, Thailand

4.2.2 The appreciation influence control process (AIC) in community participatory

AIC is an organizing process which consists of: a) identifying the purpose to be served; b) framing the power-field around that purpose with those who have control, influence and appreciation that is relative to the purpose; c) selecting those with the most influence which are relative to the purpose (stakeholders) from the three circles and designing a process of interaction between them; and d) facilitating a self-organizing process which ensures that the stakeholders: 1) step back from the current problems to fully appreciate the realities and possibilities inherent in the whole situation; 2) examine the logical and strategic options as well as the subjective feelings and values involved in selecting strategies; and 3) allow for free and informed choice of action by those responsible for implementing the decisions.

To promote an integrated of the public participation on properly community solid waste management. 12 communities voluntary were participated in municipal solid waste management program, that comprised of : Condo Somchay, Kong Makham, Panu Rangsee, Wat Lumkongkaram, Soonthorn Siri, Thanakorn2, Ruamjai Pattana, Rattanawan, Sookjai and Wat Chalaw. The results of the second objective which focus on community participation in solid waste management project by using Appreciation Influence Control process (AIC) can be summarized as follows.

1) Pattern of solid waste management; There are four steps of community solid waste management such as environmental goals setting, implementation, output or performance and targets for future performance which are detailed below

- Environmental Goals: There are determined the environment quality improvement which start from household toward community level. Solid waste management project has target on clean-up housing, community and canal as well as to develop community to a prototype of free-chemical society.
- Implementation: Prior, volunteerism group leaders have planning design including: waste management campaign, targeting communication, member admission and operation plans. Implementation of groups of recycling waste for sale which comprised of purchasing point determination, date of trading, waste donation and separation, recycle materials selling and record data. Meanwhile, implementation of group which is waste reprocessed to effective microorganism (EM) and compost the campaign of EM's benefit awareness, EM's production training, EM's leavening molasses distribution to members for trial practice and monitoring and evaluation.
- Performance: There are three outputs which include economic social and environmental aspects. Recycling waste for sale groups, waste separation activities has not only reduce waste volume but also to make more revenue from vend recycled materials as a result of economic benefit. Social aspect, meeting and talk with others member that come from waste recycling activities i.e. purchasing, donating and separating which improve in well interaction between people in community. Meanwhile, EM's and compost production groups, has focused on environmental aspect. Beginning, there is produced EM's and compost in household level in order to as fertilizer for plants, clean the restroom and pouring in sewer and

canal to get rid of smell and to get rid of smell and mosquitoes. The results showed that members have know-how to operate in urban waste management. The multiplier that is teacher of wisdom and knowledge in EM's production which leads to the prototype community as a learning model that can be reduced chemicals using in households.

- Targets for future performance, quantitative targets are mainly focused on the growing number of members participating and spread to retails and food service distributors in the area. As well as expanding cooperation in areas such as school, temple or nearby communities. Throughout, follow-up to be established microorganisms bank. Targets in terms of quality, groups have development guidelines towards a fully integrated waste management under a sense of community volunteerism such as to developed as a community learning center and a less chemicals community. As well as further cooperation to the establishment of welfare funds to share mental health in the community in order to make the strengthening of the groups that will lead to sustainable development in the future. (Figure 4.13-4.14)

2) Integration of social capital with the community participation in waste management which can be summarized as follows.

- Groups and networks dimension found that, group leaders has persuaded people in community to establish the waste management group. Members and the committee could attend to offer comments in the preparation of waste management plans, suggestions and guidelines for the operation to create sustainable development. Meeting regularly to seek funding to support the development of solid waste management activities. The above activities have reflected the strengthening of the integration of social capital with the participation of the community to learn solid waste management. As a result of individuals attending activities under a common goal, learning, practice and agreement together will develop into a systematic structure.

- Information and communication dimensions, integration of social capital to participate in the learning community's solid waste management that represents both of informal and formal information relationship between groups and networks. This information is useful to receive assistance in terms of capital and resources in order to promote growth and strengthen the group. In practice, each of

group has a channel of communication by invite people to join the project. The meeting to explain the benefits of waste management in the community, public relation by knock to door and community voice line, brochure presents the methods and benefits of waste segregation and setting recyclable materials market in community which purchasing price is higher than the market. The performances will be communicated in order to expand the concept of waste segregation to cover the area.

- Social cohesion and inclusion dimension, Integration of social capital such social cohesion and inclusion dimension in the solid waste management including cooperation in the opinions of members to improve performance, network expansion and to further waste management to the creation of cooperation in other activities related to life quality improving of community members. The discipline of the participants in waste management activities of its members a continuous and consistent. Integrated members of the scavenging in community as a partner and expand to the new target for example food stores, grocery stores, temple and school. Additionally, there is further integration into the establishment of public mind volunteer group which has been linked to the care of elderly, patients and charities activities in community in order to share the suffering - average happiness between community members.

- Collective action and cooperation dimension, integration of social capital to participate in the learning community's solid waste management. Beginning, dissemination of the concept of solid waste management for environmental preservation in the community and other communities to expand the number of members participating. Including creating a network of collaborative activities to improve environmental and operational experience to exchange information on sustainable development. The group, which aims to recycle waste to be sold has to create an integrated waste management network by the transfer or demonstrations of waste segregation methods to individual-level, household, and community as well as expands to other communities. Networking by promote scavengers in the community become to "cleanliness community volunteer". Extending the concept of separation of solid waste management to a new target in areas such as food deliveries and groceries as well as the collaboration between the school and community in integrate

waste management activities. In addition, the preparation of a community database system to be developed to bin-free society.

Figure 4.13 The AIC activities



Figure 4.14 The field trips and observe activities



4.2.3 Participatory action research in community MSWM

Participatory action research in community MSWM waste management has been operated in the Bang Kruai Town municipality area, and in the Nonthaburi province from August 2010 to April 2011. It focuses on the relationship between social capital and community participation by using the Appreciation Influence Control process (AIC). The first phase was a survey research method. The goal was to create a community profile by collecting data that was related to social capital and community environmental management. The second phase was a participatory action research (PAR) that used the AIC process. Brainstorming with the villagers, civil society and researchers provided an understanding on the true scope of the environmental problems in the community. At a later stage, planning and operational guidelines were promoted as household waste separation and recyclable waste sorting to continue with the act of reducing waste through an appropriate measure. The results showed significant changes in attitude and behavior of household solid waste management. These were the following examples:

1) Attitudes towards environmental issues due to growth of MSW in community; Previously, inappropriate attitude towards MSWM would cause the breeding and spread of disease, spoiled scenery, living discomfort, and threats on public health. Disregards to MSW issues lead to environmental problems such as the destruction of land, and the pollution of water and air. There was also socio-environmental problems awareness in terms of concernment on shortage of landfill area, global warming impact, growth of uncollected waste being blamed on family members, and the health of the neighborhood and community. (Figure 4.15)

2) The changing behavior in household waste separation; Previously, households' were only focused on sorting wet and dry waste which changed into wet and dry waste recycling separation. This has resulted in reducing the household waste volume and also lowered the frequency of discarded waste during the week. In addition, to improve the environmental quality of the community, there were changes in the form of willingness to pay the increased fees for MSWM; with the reason for improving the system of garbage collection, as well as meeting the demand for setting

up a community recycling center and to enhance skills of the personnel involved.
(Figure 4.16)

Figure 4.15 Bang Kruai Town municipality area, Nonthaburi province



Figure 4.16 MSW recycling activities in Bang Kruai Town municipality, Nonthaburi province



3) The changing of waste management activities in the community; The results of each community operations have expanded from waste sorting that can be divided into three main activities. The first activity is the extraction and sale of

recyclable waste for a recycling shop that provides an increase of income for the household. The second activity was the enzyme ionic plasma production from the households' food waste that can be used to clean toilets and sanitize the fresh market in the community to be free of germs residing within the food/produce being sold to the public. And the third activity was initiating household waste inventions, such as bags, hats, and lamps by using aluminum cans which adds value from reusing wastes. (Figure 4.16)

The impact of the AIC process to social capital in the community

1) The changes to the institutional trust: institutional trust, trust in mass communication organization (media and non government organizations (NGOs)), trust in political institutions (government, parliament and political parties), and trust in local authorities (municipality, mayor and councilors). The results showed that the index of institutional trust was highly increased with mass communication. This also lead to organizational trust and trust in the local authorities that reflect the relationship in the form of a community networking that interfaces between the mass communication organization and local authorities. Meanwhile, the index declined with the political institutions such as the government, parliament and political parties. Circumstances showed that the community has strength resulting from the collaboration of being truly self-reliant. The community felt that there was no need to rely on the central government to resolve this kind of issue.

2) The changes to the social trust: social trust that consist of trust in other people, trust in neighbor, trust in the integrity of neighbor, willingness to helping from neighbor and neighbor has been accepted as a member of the community. The results showed that the index increased with trust in other people, trust in neighbor, and trust in the integrity of neighbor. There was a willingness to accept help from neighbors, and the neighbors being accepted as a member of the community. The phenomenon indicates that the AIC process builds social trust.

3) Attitudes toward neighbor and community: Changes in neighbor and community attitudes are likely to have a positive contribution. In particular, there was trust in a neighbor of the same community and confidence in the integrity of neighbor in same community. Most of the people in the community were willing to help and be accepted as a member of the community. Meanwhile, there was a reduction in the

context of attitude such as the benefits of having self-interest. People in the community were more careful in being exploited upon. There is an improvement on accepting the opinions of others in the community. Also accepting bribery and corruption is essential to accomplishing a task.

4) Changes to participate in community activities: it was found that people tend to participate in community activities to increase both the time and effort in organizing activities for the community and participating in volunteer work for NGOs or charitable organizations in the area.

4.2.4 The estimation of determinants of household recycling scheme participation

The area of this study was the Bang Kruai town municipality of Nonthaburi province. Data was collected from 500 households during the period of August 2010 to April 2011. The sample can be divided into households who have participated in the recycling activities, (a total of 290 households), and those who did not participate in recycling (210 households). In consideration to the socio-economic factors, the findings were higher based on age, level of education, and family size for household head participation in the waste recycling schemes than those who did not participate in the waste recycling schemes. Likewise, there was an environmental awareness with regards to the shortage of landfill space and concerns about an increase of MSW generation that was caused by the problems of global warming. In addition, the household is engaged in MSW recycling schemes, who has more individual social capital stock such as social trust, compliance with social norm and social network – this is depicted in Table 4.8 below.

Econometric analysis was implemented to investigate the factors that influenced household MSW recycling schemes participation. The regression approach used by the study follows that of models for binary choice, specifically the Logit model, where the dependent variable is a dichotomous variable, i.e., $R=1$ if the household is engaged in MSW recycling schemes and $R=0$ if it does not, regressed on some socio-economic characteristics, environmental awareness and individual social capital. The determinants of household recycling scheme participation model exclude social capital variables.

Table 4.8 The socio-economic and social capital profiles of household head in the Bang Kruai town municipality of Nonthaburi, Thailand

	Intention to recycling (N = 290)		Non -intention to recycling (N = 210)	
	Mean	Std.	Mean	Std.
Socio-economic				
Age (year)	48.38	14.80	40.20	12.36
Education (level)	4.33	1.55	4.28	1.71
Household size (person)	4.46	1.59	4.24	2.15
Income (level)	3.21	1.82	3.25	1.64
Environmental awareness				
Lack of Landfill	3.46	1.08	2.41	1.10
Global warming	3.82	0.98	2.70	1.12
Social capital				
Institutional trust				
Trust in government	6.28	2.24	6.42	2.12
Trust in municipality	6.37	2.02	6.87	1.99
Social trust				
Neighborhood can be trusted	2.99	0.98	2.61	0.77
Neighborhood assistance	3.18	0.91	2.79	0.80
Social norms				
Bribing	3.78	1.03	2.89	1.15
Corruption	3.86	0.92	2.99	1.15
Social network				
Social activities participation	0.73	0.44	0.46	0.49
Volunteer for local NGO	0.65	0.47	0.27	0.44

The McFadden R^2 was one of the measures of the goodness of fit is 0.269. This means that the independent variables explain approximately 26.9% of the variability in the household recycling scheme participation. Other factors that were not included in the model could explain the remaining variation. The independent variables were statistically significant at the level 0.01, including the age of the

household head (AGE), concerning about the shortage of landfill space (LAN), concerning about an increase of MSW generation that is caused by the problems of global warming (GHG). The sign of the coefficients of the explanatory variables were positive which represents the variation of the dependent variable that was a direct change of independent variables. This can be explained as in Table 4.9.

Table 4.9 Logit model results of the determinants of household recycling scheme participation model exclude social capital variables

Variable	Coefficient	Std. Error	b/ Std. Error
Constant	-5.871**	0.773	-7.587
AGE	0.040**	0.008	4.836
EDU	0.056	0.073	0.773
MEM	0.046	0.075	0.623
INC	-0.060	0.065	-0.912
LAN	0.603**	0.095	6.292
GHG	0.720**	0.100	7.138
Dependent Variable : Household Recycling Participation (dichotomous variable)			
McFadden R^2 = 0.269		Chi-Square = 183.614	
Log likelihood function = -248.33		Observation = 500	

Note : **, * Significant at level 0.01 and 0.05

Individuals are concerned about the shortage of landfill space. The indicator was measured on 5 point Likert scale (1 representing not at all and 5 very high). This variable has a positive influence on the probability of participants in recycling schemes that refer to the head of household who was more concerned that the shortage of landfill space would cause an increase of probability for him to participate in the recycling schemes. The individual concerns about an increase of MSW generation were caused by the problems of global warming. The indicator was measured on a 5 point Likert scale (1 representing not at all and 5 very high). This explanatory variable has a positive influence on the probability of participants in recycling schemes that refer to the head of household who was more concerned that global warming would cause an increase in probability for him to participate in recycling schemes.

In concerning the determinants of household recycling scheme participation, the model include social capital variables that found the McFadden R^2 , which was one of the measures of the goodness of fit, is 0.473. This means that the independent variables explain approximately 47.3% of the variability in the household recycling scheme participation. Other factors that were not included in the model could explain the remaining variation. The independent variables were statistically significant at the level 0.01, including the age of the household head (AGE), concerning about the shortage of landfill space (LAN), concerning about an increase of MSW generation that is caused by the problems of global warming (GHG), trust in neighbor in community (SOT1), trust in most people in community that was willing to provide assistance (SOT2), the bribing of public officials (SN1), the corruption of public officials (SN2), the household head work on voluntary for local NGO (PT1) and the household head was participated in social activities (PT2). The sign of the coefficients of the explanatory variables were positive which represents the variation of the dependent variable that was a direct change of independent variables. This can be explained as in Table 4.10. With regards to the empirical analysis that was found, the coefficient of the age of the household head, the environmental awareness including concerns about the shortage of landfill space and concerns about an increase of MSW generation that is caused by the problems of global warming have a positive influence on the probability of participants in recycling schemes; which was the same as the determinants of household recycling scheme participation model excluding social capital variables.

The social capital includes institutional trust (trust in the central government and trust in the local government), social trust (trust in neighbor in community and trust in most people in community that was willing to provide assistance), compliance with social norm (the bribing of public officials and the corruption of public officials) and social network (the household head work on voluntary for local NGO and the household head was participated in social activities). The following are the results based on the Model estimation:

Social trust, trust in neighbor in community and trust in most people in community that was willing to provide assistance, the indicators were measured on a 5 point Likert scale (1 representing not at all and 5 very high). These explanatory

variables have positive influence on the probability of participants in recycling schemes that represent the head of household who has more stock of social capital in terms of trust with the neighbors in community or trust in most people in community that was willing to provide assistance that would cause to an increase in probability for him to participate in recycling schemes.

Table 4.10 Logit model results of the determinants of household recycling scheme participation model include social capital variables

Variable	Coefficient	Std. Error	b/ Std. Error
Constant	-5.789**	1.110	-5.213
AGE	0.028**	0.009	2.981
EDU	-0.045	0.089	-0.507
MEM	0.067	0.075	0.891
INC	-0.089	0.076	-1.179
LAN	0.435**	0.121	3.585
GHG	0.797**	0.124	6.423
INT1	-0.020	0.085	-0.243
INT2	-0.075	0.076	-0.991
SOT1	0.486**	0.174	2.783
SOT2	0.494**	0.173	2.859
SN1	-0.444**	0.148	-3.002
SN2	-0.473**	0.137	-3.429
PT1	0.772**	0.280	2.753
PT2	1.918	0.298	6.430
Dependent Variable : Household Recycling Participation (dichotomous variable)			
McFadden $R^2 = 0.473$		Chi-Square = 321.907	
Log likelihood function = -179.192		Observation = 500	

Note : **, * Significant at level 0.01 and 0.05

In compliance with social norms such as the bribing of public officials and the corruption of public officials, the indicators were measured on a 5 point Likert scale (1 representing not at all and 5 very high). These explanatory variables have

positive influence on the probability of participants in recycling schemes that represent the head of household who has more stock of compliance with social norm in terms of the bribing of public officials or the corruption of public officials that would cause an increase in probability for him to participate in recycling schemes.

Social networking, (interpreted as the household head working voluntary for local NGO and the household head participating in social activities), is the indicator that was measured on dummy variables. These explanatory variables have positive influence on the probability of participants in recycling schemes that represent the head of household who has more stock of social networking in terms of the household head's voluntary work for local NGO or the household head's participation in social activities. For which it would cause an increase in probability for him to participate in recycling schemes.

4.2.5 The estimation of determinants of household waste recycling

Household making decision to participate in recycling schemes was amounted to 290 households. The average of percentage of household waste reduction is equal to 32.76%. Explanatory variables in the model that consist of the age (AGE) and educational level (EDU) of the household head, household family's size (MEM) and average household income per month (INC), environmental awareness (ENVI) and including concerns about the shortage of landfill space, and concerns about an increase of MSW generation that is caused by the problems of global warming and individual social capital stock (SOCIAL). The ordinary least square regression (OLS) technique was used to model the estimation.

However, to avoid the problem of independent variables in the model, the figures were highly correlated which made an error prediction or multicollinearity. Therefore, we tested the correlation of independent variables in the model. Based on the results, there was no relationship between high levels of independent variables. (Table 4.11) The coefficient of determination (R^2), which was one of the measures of the goodness of fit, is 0.301. This means that the independent variables explain approximately 30.1% of the variability in the Percentage of MSW reduction by MSW recycling schemes participation. Other factors that were not included in the model could explain the remaining variation.

Table 4.11 Correlation matrix of explanatory variables used in the determinants of MSW recycling model

variable	AGE	EDU	HOUSIZ	INCOM	ENVI	SOCIAL
AGE	1.000					
EDU	-0.122	1.000				
MEM	-0.002	-0.101	1.000			
INC	-0.073	0.210	-0.032	1.000		
ENVI	0.080	-0.037	0.049	0.045	1.000	
SOCIAL	0.057	0.110	-0.072	0.035	-0.039	1.000

The independent variables were statistically significant at the level 0.01 including the age (AGE) and educational level (EDU) of the household head, household family's size (HOS), environmental awareness (ENVI) including concerns about the shortage of landfill space and concerns about an increase of MSW generation that is caused by the problems of global warming and individual social capital stock (SOCIAL). The sign of the coefficients of the explanatory variables such as the age of the household head (AGE), household family's size (HOS), environmental awareness (ENVI) and individual social capital stock (SOCIAL) were positive thus representing the variation of the dependent variable that was a direct change of independent variables. Meanwhile, the coefficient of the independent variable, educational level of the household head (EDU), was a negative. This is explained in table 4.12.

Environmental awareness (ENVI) includes the concern about the shortage of landfill space and concerns about an increase of MSW generation that is caused by the problems of global warming. This variable has a positive coefficient which represents a direct relationship between the percentage of household waste reduction to increase. Therefore, the head of household who has more concern about the environment would cause the percentage of household waste reduction to be increased.

The social capital stock of individual was based on the institutional trust, social trust, compliance with social norms, and social networking. This variable has a positive coefficient which represents a direct relationship between the percentages of

household waste reduction to be increased. Therefore, the head of household who has more stock of social capital would cause the percentage of household waste reduction to be increased

Table 4.12 Regression estimation of the determinants of MSW recycling model

Variable	Coefficient	Std. Error	Beta	t-statistic
Constant	-4.274**	5.435		-0.786
AGE	0.277**	0.047	0.242	4.806
EDU	-1.520**	0.456	-0.172	-3.332
MEM	3.437**	0.495	0.348	6.944
INC	-0.136	0.412	-0.017	-0.330
ENVI	1.867**	0.779	0.120	2.397
SOCIAL	2.681**	0.635	0.211	4.225
Dependent Variable : Percentage of MSW reduction				
$R^2 = 0.301$		Adj $R^2 = 0.286$		
F – Statistic = 20.340		Observation = 290		

Note : **, * Significant at level 0.01 and 0.05 respectively

The results of section 4.2, we were able to determine the context of the MSW problems associated with an efficiency of MSWM in Thai municipality that included the role of social capital with the participation of household waste recycling that influence MSWM at the source. Even if the municipality used the concept of social capital to develop policies to reduce waste at source, it will affect the performance of management in terms of reducing management costs and the expanding the life of the landfill site. The relationship between social capital that is associated with the source of waste management can be summarized as followed:

According to the forecast, if the population growth in the municipality is the same rate of the whole country then it would equal to 0.06% per year (according to estimates by the Asian Development Bank: ADB). The MSW generation will increase at a 10-year average of 2,633 tons per years for sub-district municipality, town municipality was 13,375 tons and 43,398 tons of city municipality.

Due to the trend of increasing population and economic activity in the area of municipalities, the increase reflects the continued supply of MSW collecting service. This will increase the cost of collection and lead to the problem of municipal solid waste management in the future. Considering the MSW composition of the municipality such as sub-district, town and city, the study found that the majority of the waste is disposed food items, followed by paper, plastic, glass and metal, respectively. The nature of these residues can be recycled by encouraging households to take part in the separation of waste prior to disposal. The benefits of recycling activities have not only reduce the amount of municipal solid waste but also lowers the affect of the MSW collection cost. In order for the promotion of household recycling to strive towards being successful in reducing the amount of household waste, there needs to be a great deal of increase in the number of households to take part in the recycling schemes. However, the encouragement for household recycling participation cannot be done by enforcing the law. Instead, it should be performed based on a voluntary basis.

The application of social capital for encouraging participation has been used extensively in the past two decades. One reason is the behavior in the community as a collective or the mutual benefit of the community from participating, which is driven by voluntary mind. If there is a community with a high social capital then it will lead to the expansion of a voluntary mind that leads to collaboration with the activities. Besides copying and pooling, which are components of social capital, they have contributed to the growth in the networking that will strengthen communities and bring forward sustainable development within their social environment.

The empirical study of the relationship between social capital and household recycling schemes participation discovered that social capital stock is accumulated by an individual's influence in making the decision to join the household recycling schemes. The growth of social capital accumulated in the individual has not only increased the propensity of households to participate in the recycling schemes but also significantly contributed to an increase in the percentage of household waste reduction. Consequently, social capital was used to determine the local government waste management policies to reduce waste at source, thus leading to reduce costs and

extending the life of a landfill site which should be a key strategy for managing waste in the municipality. In particular, the growth of social capital in the region makes it the process of encouraging a network of recycling that can be extended to the community with sustainable development.

Although social capital exists in the community, its development within the community needs to be done on a continuous manner. In this study, the AIC was used to generate community participation in waste recycling. In the process, which not only contributes to household waste, management was aware of problems in the area. But if such a process is to encourage community members to voice their opinion, then the implementation policy and action for resolving these issues must be performed through a decentralized scale where individuals take self-interest to ensure that results are based on what they have determined it to be.

Afterwards, an experience evaluation should be used to examine community participation for learning how to improve the approach on the most appropriate context of those areas. Working together means that there is a willingness on part of the citizens to solve community problems (which would create trust in the families or in society), agreeing on the validity and social norms, and voluntary networking for the community. The AIC can be recognized as extremely important in the accumulation of social capital in the area. In addition, social capital can be expanded in other areas of community development activities.

4.3 The economic evaluation of social capital in MSWM

Predictions from the model showed that in 10 years, the growth rate of MSW generation of the most municipality average was 3,768.3 tons per year. From the estimation, it was found that the sub-district, town and city municipality were the following –MSW generation per year were equal to 2,357.5 tons, 12,536.6 tons and 39,681.2 tons per year, respectively. In consideration, the proportion of the increase from the average MSW generation of town and city that was compared with the sub-district municipality was equal to 5.31 times and 16.83 times, respectively.

The net savings measure is a variation of the net benefits (NB) measure of economic performance of a project. The NS method calculates the net amount, in

present value of money, that a project alternative is expected to save over the study period. Forecasting the net savings from household recycling activities during the 10 year period found that the net savings from household recycling schemes participation of the municipality in scenarios 1, 2 and 3 were equal to 6.577 million Baht, 7.072 million Baht and 8.062 million Baht, respectively. (Table 4.13)

Savings to investment ratio (SIR); the savings to investment ratio is a measure of economic performance for a project alternative that expresses the relationship between its savings and its increased investment cost (in present value terms) as a ratio. Forecasting the savings to investment ratio from household recycling activities during the 10 year period of the municipality in scenarios 1, 2 and 3 were equal to 2.686 times, 2.788 times and 2.992, respectively. (Table 4.13)

The internal rate of return (IRR) is a measure of the annual percentage yield from a project investment over the study period. Forecasting the internal rate of return of project during the 10 year period of the municipality in scenarios 1, 2 and 3 were equal to 110.6%, 107.6% and 119.8%, respectively. (Table 4.13)

Sensitivity analysis is very useful when attempting to determine the impact of the actual outcome of a particular variable as well as seeing if it differs from what was previously assumed. By creating a given set of scenarios, the analyst can determine how changes in one variable(s) will impact the target variable.

With regards to the sensitivity analysis, the aim of this study was to determine the change in the output. Due to the effect of social capital's contribution to the community and of household participation in recycling, it has led to a reduction of municipal waste collection. In addition, it has led to a decrease in the cost of collection also. Results from the pilot project, in the Bang Kruai town municipality area of Nonthaburi province, found that household recycling activities that were driven under social capital developed up to one-fourth of the entire community. Activities and household waste recycling has dropped an average of 32 percent or less. The total of municipal solid waste was equal to 8.33 percent, which was predicted in this case.

In this case, social capital plays a role in the creation of an increase in one-third of the entire community while the assumption that "households do recycle the waste reduction rate in the original then the reduction of municipal solid waste" is

equal to 11.1 percent. In addition, if social capital plays a role in the creation of an increase in one-third of the entire community then the reduction of municipal solid waste is by 16.71 percent.

Sensitivity analysis can help in several ways to assess the uncertainty of a CBA. It is a technique for determining which input values, if different, would make a crucial difference to the outcome of the analysis. Although there are several formal methodologies for performing sensitivity analysis, there is but one simple way to apply it – varying the uncertain input values, performing on it one at a time, recalculating the measure of evaluation (NS, SIR, IRR) and looking at the resulting changes, and drawing conclusion about the degree of uncertainty. The results of sensitivity analysis are the following: (Table 4.13)

Table 4.13 Net savings, Savings to investment ratio, Net present value, The internal of returns and Sensitivity analysis

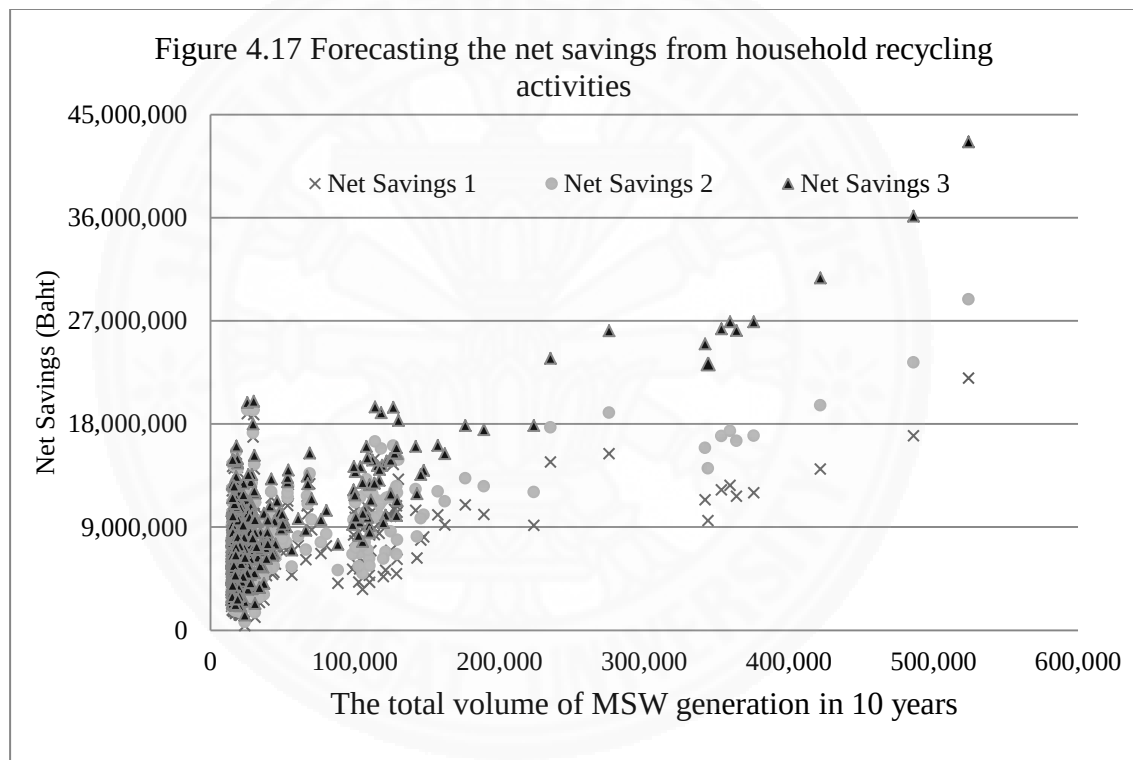
Projection	Type of Municipality			
	Sub-district	Town	City	Total
Net savings (million Baht)				
Scenario1	6.275	8.588	13.608	6.577
Scenario2	6.584	10.239	18.884	7.072
Scenario3	7.201	13.543	29.330	8.062
Savings to investment ratio(times)				
Scenario1	2.743	2.193	1.945	2.686
Scenario2	2.829	2.422	2.309	2.788
Scenario 3	3.001	2.881	3.037	2.992
Internal rate of returns (%)				
Scenario1	105.2	70.0	55.2	101.6
Scenario2	110.3	83.2	75.7	107.6
Scenario3	120.6	110.8	120.2	119.8

1) The net saving (NS): Forecasting the net savings from household recycling activities during the 10 year period are as followed; (Figure 4.17)

- Scenario 1, the net savings from household recycling schemes participation of the sub-district, town and city municipality were equal to 6.275 million Baht, 8.588 million Baht and 13.608 million Bath, respectively.

- Scenario 2, the net savings from household recycling schemes participation of the sub-district, town and city municipality were equal to 6.584 million Baht, 10.239 million Baht and 18.884 million Bath, respectively.

- Scenario 3, the net savings from household recycling schemes participation of the sub-district, town and city municipality were equal to 7.201 million Baht, 13.543 million Baht and 29.330 million Bath, respectively.



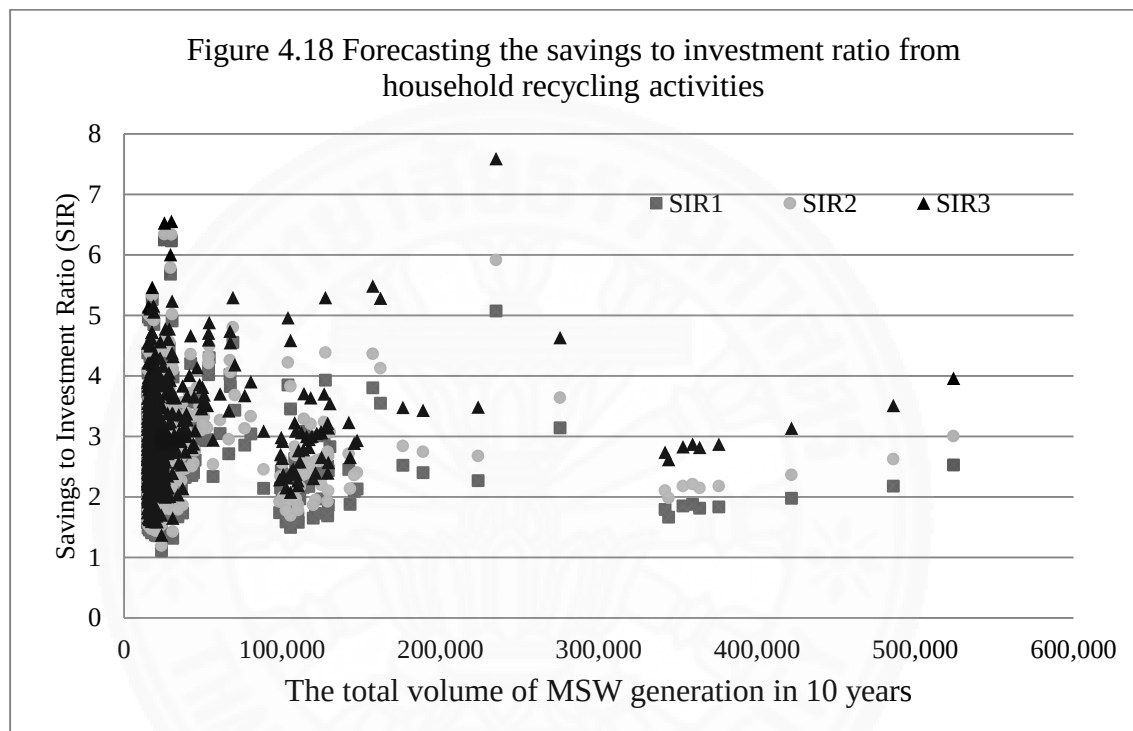
2) The savings to investment ratio (SIR): Forecasting the savings to investment ratio from household recycling activities during the 10 year period are as followed; (Figure 4.18)

- Scenario 1, the savings to investment ratio from household recycling schemes participation of the sub-district, town and city municipality were equal to 2.743 times, 2.193 times and 1.945 respectively.

- Scenario 2, the savings to investment ratio from household recycling schemes participation of the sub-district, town and city municipality were the

following – the savings to investment ratio were equal to 2.829 times, 2.422 times and 2.309, respectively.

- Scenario 3, the savings to investment ratio from household recycling schemes participation of the sub-district, town and city municipality were the following – the savings to investment ratio were equal to 3.001 times, 2.881 times and 3.037, respectively.

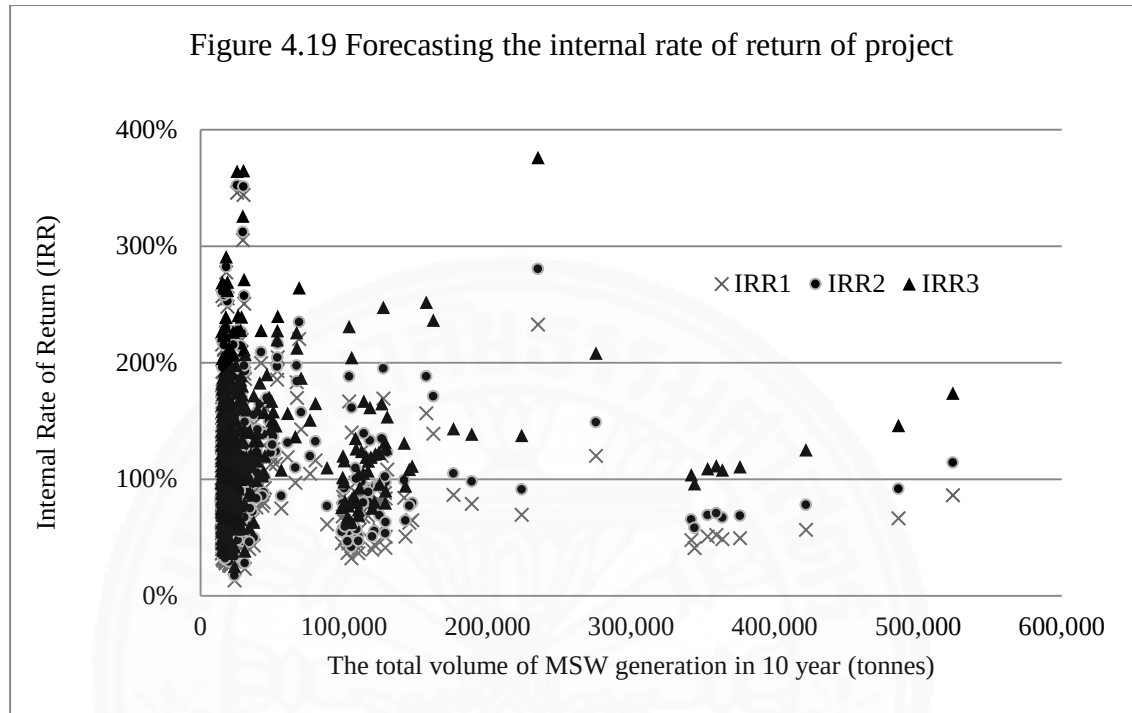


3) The internal rate of return (IRR) : Forecasting for the internal rate of return net present value of the project during the 10 year period is the following; (Figure 4.19)

- Scenario 1, the internal rate of return from the project promoting household recycling schemes participation of the sub-district, town and city municipality were equal to 105.2%, 70.0% and 55.2%, respectively.

- Scenario 2, the internal rate of return from the project promoting household recycling schemes participation of the sub-district, town and city municipality were equal to 110.3%, 83.2% and 75.7%, respectively.

- Scenario 3, the internal rate of return from the project promoting household recycling schemes participation of the sub-district, town and city municipality were equal to 120.6%, 110.8% and 120.2%, respectively.



The estimated economic benefit from the application of social capital to build participation in MSWM of the municipality in three scenarios include the social capital causing the network to access household waste recycling activities: one-fourth, one-third and a half of all community in the municipality. The results of economic evaluation has found that the key is to save the cost of recycling compared to the total collection cost (NS), which were on the savings and investment ratio(SIR) and the internal rate of returns (AIRR) that vary on the size of the municipality.

The phenomenon reflects that the municipality has embraced the concept of MSWM at source as the application for waste management. Social capital is an important driver that is not only for reducing the cost of MSWM, but also as the creation of networks to strengthen communities and achieving sustainable development.

Chapter 5

Conclusions and Recommendations

5.1 Conclusions

According to a high level of urbanization, economic development, and an increase in population, there has been a period of continuous outcome in a large quantity of heterogeneous solid waste. The municipal solid waste management (MSWM) has been trying to alleviate the increasing magnitude of waste problems in many Thai local government authorities (LGAs), especially in rapidly urbanizing cities where these challenges are frequently exposed. However, the efforts in tackling the problem of solid waste are a core function of local government. If the problem is in managing the waste that was the previously intended for the collection and disposal of the municipality or the management of the supply-side that has many problems (which includes budget constraints, the shortage of landfills area), then there has to be a change in people's attitude in which the belief is that waste management ought to be the local government's duty in providing this type of public service. Such a service translates into preventing the cost of burden to the household, encouraging or promoting public participation, and having a strong commitment in putting a sound waste management plan where it leads to a positive outcome. Aspects of these limitations lead to a poor performance in MSWM that does not cover the entire area, thus leading to challenges in disposing of garbage. The concept of the demand-side management and reducing waste at the source can be implemented through an encouragement of community participation in recycling for reducing collection cost and extending the life of the landfill area.

The three objectives of this study were as followed: 1) to investigate the determinants of MSW generation and collection cost in the Thai municipality, 2) to examine the role of social capital to promote community participation in household waste recycling, and 3) to perform an economic evaluation for the application of social capital to MSWM in the Thai municipality. The data collection has been divided by each objective in the study.

The first is to investigate the determinants of MSW generation and collection cost in the Thai municipality by using questionnaires and surveys that were sent by mail to the responsible unit (mayor, senior executives, etc.) during the period from July 2009 to January 2010. 570 questionnaires were completed and returned for developing an estimated model. The second objective examined the role of social capital to promote community participation in household waste recycling by using questionnaires and surveys that were gathered from interviewing the household heads in the Bang Kruai town municipality area in Nonthaburi, Thailand during the period from August 2010 to April 2011: the total number was 500 households. The third objective is to perform an economic evaluation by using the model simulation for the application of social capital to MSWM in the Thai municipality.

This study examined the following inquiries: Did the role of social capital in the MSWM led to a significant increase in MSWM reduction and how much did it reduce the municipality's spending? How much was its economic valuation? Has the municipality adopted social capital as an application to build household recycling participation. The results of this study can be summarized as the following:

5.1.1 The MSW generate determination and the relationship between population density and MSW generation

The result of the first objective was from examining the factors of MSW generation. The outcome on the coefficient of determination (R^2), that was one of the measures of the goodness of fit, is 0.569. This means that the independent variables explained approximately 56.9% of the variability in the MSW generation. Other factors that were not included in the model could explain the remaining variation. The independent variables were statistically significant at the level 0.01, including population density, household size, and size of the municipality. The sign of the coefficients of the explanatory variables were positive; which represents the variation of the dependent variable that was a direct change of independent variables.

The growth of population led to changes in economic activity in the municipality that caused pollution, especially in an increase in the amount of MSW generation. The empirical study found that population density that approximates the degree of urbanization is significantly positive in relation with the volume of MSW

generation. Using the determinants of MSW generation model to forecast the MSW growth in the different municipality for 10 years, the average MSW generate ton per year of sub-district, town and city municipality were equal to 2,357.5 tons, 12,536.6 tons, and 39,681.2 tons, respectively. So in the future, if the population growth continues to increase with the expansion of trade and industrial activity in the area, then there will also be an effect to the amount of increased waste.

5.1.2 The relationship between the volume of MSW generation and the cost of collection

According to the result of the determinants of MSW collection cost, the coefficient of determination (R^2) that was one of the measures of the goodness of fit, is 0.748. This means that the independent variables explained approximately 74.8% of the variability in the MSW collection cost. Other factors not included in the model could explain the remaining variation. The independent variables were statistically significant, including the volume of MSW collected in the municipality, distance from municipality center to disposal site, population density, hazardous waste separation, and the types of collection. The sign of the coefficients of the explanatory variables, except for the types of collection, were positive thus representing the variation of the dependent variable which was a direct change of independent variables.

According to the MSW generation forecast, it is likely to increase as long as there is an expansion of urbanization. The council recognizes the need to address waste management plan, particularly in the higher cost of MSW collection due to an increase in volume of municipal solid waste. An empirical study found that the positive relationship between growth of the cost and the amount of MSW, by the percentage change in the amount of MSW, increased 1 percent to a percentage that would affect the cost of MSW collection up to 0.569 percent. From the results, this study underscores the growing volume of MSW as the cost of waste management problem. Not only is this a shortage of funds, but it's also a shortage of landfill space.

However, a comparison between the cost of collection by municipalities and private sector operation found that the implementation of MSW collection by a private company would cost more than the municipality. Therefore, the option of passing the work to the privatization of waste management does not reflect the

performance of the cost in any case. The limited budget of the municipality is a significant drawback of the traditional waste management policy that focuses on disposal or supply-side waste management. In addition, the change to a private contractor was unable to reduce the cost of the collection. Thus, the concept of MSWM at source is an appropriate alternative method for the local government in waste management.

5.1.3 The role of social capital to promote community participation in household waste recycling

The relationship between social capital and community participation were conducted with the Appreciation Influence Control process (AIC). The first phase was a survey research method. The goal was to create a community profile by collecting data related to social capital and environmental community management. The second phase was a participatory action research (PAR) by using the AIC process. Brainstorming with the villagers, civil society and researchers provided an understanding on the true scope of the environmental problems in the community. At a later stage, planning and operational guidelines were promoted as household waste separation and recyclable waste sorting continued with the act of reducing waste through an appropriate measure.

The results showed significant changes in attitude and behavior of household solid waste management. These were the following examples: 1) Attitudes towards environmental issues due to growth of MSW in community. Previously, inappropriate attitude towards MSWM would cause the breeding and spread of disease, bad scenery, public inconvenience, and threats to public health. Issues pertaining to disregarding MSW lead to environmental problems, such as the destruction of land, and pollution of water and air. There was also awareness on socio-environmental problems in terms of concernment on shortage of landfill area, global warming impact, growth of waste that has not been collected, being blamed by family members, and the health of the neighborhood and community. 2) The changes in behavior of the household waste separation. Previously, households' were only focused on sorting wet and dry waste which were changed into wet and dry waste recycling separation. This has resulted in reducing the household waste volume and

has also lowered the frequency of discarded waste during the week. In addition, to improve the environmental quality of the community, there were changes in the willingness to pay increased fees for MSWM based on the reason for improving the system of garbage collection, as well as meeting the demand for setting up a community recycling center and to enhance the skills of the personnel involved. 3) The changing of waste management activities in the community. The results of each community operations have expanded from waste sorting, which can be divided into three main activities. The first activity is the extraction and sale of recyclable waste for a recycling shop that makes an increasing income for household. The second activity was the enzyme ionic plasma production from the households' food waste that can be used to clean toilets and sanitize the conditions of the fresh market in the community. And the third activity was initiating household waste inventions, such as bags, hats, and lamps by aluminum can which adds value from reusing wastes.

With regards to the determinants of household recycling scheme participation, the model include social capital variables that found the McFadden R^2 , which was one of the measures of the goodness of fit, with a score of 0.473. This means that the independent variables explained approximately 47.3% of the variability in the household recycling scheme participation. Other factors that were not included in the model could explain the remaining variation. The independent variables were statistically significant at the level 0.01, including the age of the household head, concerning about the shortage of landfill space, concerning about an increase of MSW generation that is caused by the problems of global warming, trust with the neighbor in the community, trust in most people in the community that was willing to provide assistance, the bribing of public officials, the corruption of public officials, the household head working voluntary for local NGO, and the household head that participated in social activities. The sign of the coefficients of the explanatory variables were positive, which represents the variation of the dependent variable that was a direct change of independent variables.

With regards to the empirical analysis that was found, the coefficient of the age of the household head, the environmental awareness including concerns about the shortage of landfill space, and concerns about an increase of MSW generation that is caused by the problems of global warming have a positive influence on the

probability of participants in recycling schemes; which was the same as the determinants of household recycling scheme participation model excluding social capital variables.

From the results shown, the key factor of MSWM at source is to encourage a cooperative community in recycling to minimize waste. In order for the promotion of household recycling to strive towards being successful in reducing the amount of household waste, there needs to be a great deal of increase in the number of households to take part in the recycling schemes. However, the encouragement for household recycling participation cannot be done by law enforcement; instead it should be performed under a voluntary basis.

The empirical study of the relationship between social capital and household recycling schemes participation discovered that social capital stock is accumulated by an individual's influence in making the decision to join the household recycling schemes. The growth of social capital accumulated in the individual has not only increased the propensity of households to participate in the recycling schemes but also significantly contributed to an increase in the percentage of household waste reduction. Consequently, social capital was used to determine the local government waste management policies to reduce waste at source, thus leading to reduce costs and extending the life of landfill site which should be a key strategy for managing waste in the municipality. In particular, the growth of social capital in the region encourages a network of recycling that can be extended up to the community with sustainable development.

Although social capital exists in the community, its development within the community needs to be done on a continuous manner. In this study, the AIC was used to generate community participation in waste recycling. In the process, which not only contributes to household waste, management was aware of problems in the area. But if such a process is to encourage community members to voice their opinion, then the implementation policy and action for resolving these issues must be performed through a decentralized scale where individuals take self-interest to ensure that results are based on what they have determined it to be.

Afterwards, an experience evaluation was used to examine community participation on improving how to approach the most appropriate context for those

areas. The context points out the need to work together, solve community problems that would create trust of the families in the community or social trust, agreeing on the validity and norms or social norms, and networking voluntary for the community. The AIC can be recognized as extremely important in the accumulation of social capital in the area. In addition, social capital can be expanded in other areas of community development activities.

5.1.4 An economic evaluation for the application of social capital to MSWM in Thai municipality

The estimated economic benefit from the application of social capital to build participation in MSWM of the municipality in three scenarios includes a social capital that causes the network to access the household waste recycling activities: this is for one-fourth, one-third and a half of all community in the municipality. With regards to the cost benefit analysis, the aim of this study was to determine the change in the output. Due to the effect of social capital's contribution to the community and of household participation in recycling, it has lead to a reduction of municipal waste collection.

In addition, it has lead to a decrease in the cost of collection as well. Results of the pilot project, in the Bang Kruai town municipality area in Nonthaburi, found that household recycling activities driven under the social capital builds the community up to one-fourth of the entire community. Activities and household waste recycling has dropped an average of 32 percent or less.

The total number of municipal solid waste was equal to 8.33 percent, in which it was predicted in this case. In this case, social capital plays a role in the creation of an increase in one-third of the entire community while the assumption that households do recycle the waste reduction rate in the original then the reduction of municipal solid waste is equal to 11.1 percent. In addition, if social capital plays a role in the creation of an increase that is one-third of the entire community then the reduction of municipal solid waste is by 16.71 percent.

Sensitivity analysis can help in several ways to assess the uncertainty of a CBA. It is a technique for determining which input values, if different, would make a crucial difference to the outcome of the analysis. Although there are several formal

methodologies for performing sensitivity analysis, there is but one simple way to apply it – varying the uncertain input values, performing on it one at a time, recalculating the measure of evaluation (NS, SIR, IRR) and looking at the resulting changes, and drawing a conclusion about the degree of uncertainty.

1) The net savings (NS): Forecasting the net savings from household recycling activities during the 10 year period are as followed; scenario1, the NS from household recycling schemes participation of the sub-district, town and city municipality were equal to 6.275 million Baht, 8.588 million Baht and 13.608 million Bath, respectively. Meanwhile, with scenario 2, the NS were equal to 6.584 million Baht, 10.239 million Baht and 18.884 million Bath, respectively. In addition, with scenario 3, the NS were equal to 7.201 million Baht, 13.543 million Baht and 29.330 million Bath, respectively.

2) The savings to investment ratio (SIR): Forecasting the savings to investment ratio from household recycling activities during the 10 year period are as followed; In scenario 1, the SIR from household recycling schemes participation of the sub-district, town and city municipality were equal to 2.743 times, 2.193 times and 1.945 respectively. In scenario2, the SIR was equal to 2.829 times, 2.422 times and 2.309, respectively. For scenario 3, the SIR was equal to 3.001 times, 2.881 times and 3.037, respectively.

3) The internal rate of return (IRR): Forecasting the internal rate of return net present value of project during the 10 year period are the following; in scenario1, the IRR from the project promoting household recycling schemes participation of the sub-district, town and city municipality were equal to 105.2%, 70.0% and 55.2%, respectively. In scenario2, the IRR were equal to 110.3%, 83.2% and 75.7%, respectively. According to scenario3, the IRR were equal to 120.6%, 110.8% and 120.2%, respectively.

The results of the economic evaluation has found that the solution is to save the cost of recycling with a comparison to the total collection cost (NS); which were on the savings and investment ratio (SIR) and the internal rate of returns (IRR) that vary on the size of the municipality.

5.2 Recommendations

The environmental crisis of the community was caused by the weakness of the social various systems in the area. Therefore, there was a need for some critical action to gain an environmental recovery in the community. "Social capital" refers to the strengthening of community organizations. This is the foundation of society and a strong concept if it will lead to solving other environmental problems in a systematic manner.

The author of the research recommends on strengthening the capacity of municipal solid waste management through a community participation initiative. This would enable the mechanism of social capital to replenish the shared natural resources and make the environment more sustainable. The guidelines are given as followed:

- Social capital gathering in the community is necessary. It is the basis for community support mechanism and deemed as the network to manage and protect natural resources and the environment associated with the development of a community; particularly with the environmental management of urban waste water treatment.
- Encouraging community awareness of the value of the environment as a way of life, and allowing participation in planning and implementation of solid waste management. The first step for conservation, reconstruction and development in the community is needed desperately. In order to be effective, waste management should focus on encouraging a cooperative community that takes part in recycling to minimize waste. However, the encouragement for household recycling participation cannot be done by law enforcement; instead it should be performed based on a voluntary basis.
- Applying social capital to promote the community participation such as grouping, sharing ideas, and co-operating which act as the guidelines and principles for the development of community self-reliance. However, to encourage community participation, it needs to be compatible with the participants' lifestyle as well as with their culture. Encouragement also calls for the participants to be exposed to the local wisdom in their community for proper guidance.

- Social capital set the course for the waste management policies of the local government to reduce waste at the source, thus leading to a reduction in costs and extending the life of landfill site. This was the key strategy for managing waste in the municipality. However, the social capital accumulation in each community is different. Typically, rural communities have higher levels of social capital than in the urban domain due to a difference in lifestyles and economic activities. Hence, the application of social capital is needed to understand the community context and to seek out the appropriate techniques to be used in the participation process.



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Appendices



Appendix A

MSW generated prediction

Province	Municipality	Waste (1,000 ton)									
		YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	YEAR6	YEAR7	YEAR8	YEAR9	YEAR10
Krabi	Khlonghontai Subdistrict	2.049	2.083	2.120	2.158	2.200	2.243	2.289	2.338	2.390	2.445
Krabi	Kholantayai Subdistrict	1.986	2.016	2.049	2.084	2.120	2.159	2.200	2.243	2.290	2.339
Kanchanaburi	Samrong Subdistrict	1.622	1.631	1.640	1.650	1.661	1.672	1.684	1.696	1.709	1.723
Kanchanaburi	Thamuang Subdistrict	2.674	2.746	2.822	2.903	2.988	3.079	3.176	3.278	3.386	3.501
Kanchanaburi	Nongkho Subdistrict	4.415	4.591	4.778	4.976	5.187	5.409	5.645	5.896	6.161	6.442
Kanchanaburi	Takya Subdistrict	1.567	1.572	1.578	1.584	1.591	1.598	1.605	1.613	1.622	1.630
Kanchanaburi	Thalor Subdistrict	1.614	1.622	1.631	1.640	1.650	1.661	1.672	1.684	1.696	1.710
Kanchanaburi	Wangkanai Subdistrict	1.646	1.656	1.667	1.678	1.690	1.703	1.717	1.732	1.747	1.763
Kanchanaburi	Lukkae Subdistrict	2.158	2.199	2.243	2.289	2.338	2.390	2.444	2.503	2.564	2.630
Kanchanaburi	Tamaka Subdistrict	2.054	2.088	2.125	2.164	2.206	2.250	2.296	2.346	2.398	2.453
Kanchanaburi	Tamai Subdistrict	1.726	1.741	1.757	1.774	1.792	1.811	1.831	1.853	1.876	1.900
Kanchanaburi	Wainlaw Subdistrict	1.985	2.015	2.048	2.082	2.119	2.157	2.198	2.242	2.288	2.337
Kanchanaburi	Namtok saiyoknoi Subdistrict	1.622	1.631	1.640	1.650	1.660	1.672	1.683	1.696	1.709	1.723
Kanchanaburi	Bohplot Subdistrict	1.950	1.979	2.009	2.041	2.075	2.111	2.150	2.190	2.233	2.279
Kanchanaburi	Rangwai Subdistrict	1.609	1.617	1.626	1.635	1.645	1.655	1.666	1.677	1.689	1.702
Kanchanaburi	Nongfai Subdistrict	1.539	1.543	1.547	1.552	1.556	1.561	1.567	1.572	1.578	1.584
Kanchanaburi	Nongree Subdistrict	1.670	1.681	1.694	1.707	1.721	1.736	1.751	1.768	1.785	1.804
Kanchanaburi	Arawan Subdistrict	1.499	1.501	1.503	1.504	1.506	1.508	1.510	1.513	1.515	1.517
Kanchanaburi	Wangpho Subdistrict	1.647	1.658	1.669	1.680	1.693	1.706	1.719	1.734	1.750	1.766
Kalasin	Najan Subdstict	1.546	1.550	1.554	1.559	1.564	1.570	1.575	1.581	1.588	1.594
Kalasin	Huayphoh Subdistrict	1.556	1.561	1.566	1.571	1.577	1.583	1.590	1.597	1.604	1.612
Kalasin	Kudwa Subdistrict	2.034	2.068	2.104	2.141	2.181	2.224	2.269	2.316	2.367	2.420
Kalasin	Buakhao Subdistrict	2.018	2.051	2.086	2.122	2.161	2.202	2.246	2.292	2.341	2.394
Kalasin	Koksri Subdistrict	1.604	1.612	1.620	1.628	1.638	1.647	1.658	1.669	1.680	1.692
Kalasin	Yangtalad Subdistrict	1.859	1.882	1.906	1.932	1.960	1.989	2.020	2.053	2.087	2.124
Kalasin	Nongpan Subdistrict	1.574	1.580	1.587	1.593	1.601	1.608	1.616	1.625	1.634	1.643
Kalasin	Somdet Subdistrict	2.272	2.320	2.371	2.425	2.482	2.542	2.606	2.674	2.746	2.822
Kalasin	Kudsim Subdistrict	1.716	1.731	1.746	1.762	1.780	1.798	1.817	1.838	1.860	1.883
Kalasin	Nakoo Subdistrict	1.813	1.833	1.855	1.878	1.902	1.927	1.955	1.983	2.014	2.046
Kalasin	Khayyai Subdistrict	1.701	1.715	1.729	1.745	1.761	1.778	1.796	1.815	1.836	1.857
Kalasin	Khammuang Subdistrict	1.794	1.813	1.833	1.855	1.878	1.902	1.928	1.955	1.984	2.014
Kalasin	Thakanthosubdistrict	1.557	1.562	1.568	1.573	1.579	1.585	1.592	1.599	1.606	1.614
Kalasin	Nongkungri Subdistrict	1.800	1.819	1.840	1.862	1.885	1.910	1.936	1.964	1.993	2.024
Kamphaeng Phet	Khlonglanpattana Subdistrict	1.507	1.509	1.511	1.513	1.515	1.518	1.520	1.523	1.526	1.529
Kamphaeng Phet	Thungsai Subdistrict	1.521	1.523	1.526	1.529	1.533	1.536	1.540	1.544	1.548	1.552
Kamphaeng Phet	Kamphaeng Phet Town	10.738	10.793	10.851	10.912	10.978	11.047	11.120	11.198	11.281	11.368
Kamphaeng Phet	Pakdong Subdistrict	2.185	2.228	2.273	2.321	2.372	2.425	2.483	2.543	2.607	2.675
Kamphaeng Phet	Prankratat Subdistrict	3.351	3.464	3.583	3.710	3.844	3.986	4.137	4.297	4.466	4.645
Kamphaeng Phet	Tamakhue Subdistrict	1.781	1.799	1.819	1.839	1.861	1.884	1.909	1.935	1.963	1.992
Kamphaeng Phet	Khanuworaklaksaburi Subdistrict	1.817	1.837	1.859	1.882	1.907	1.932	1.960	1.989	2.020	2.053
Kamphaeng Phet	Lankrabue Subdistrict	1.706	1.719	1.734	1.750	1.766	1.784	1.802	1.822	1.843	1.865
Khon Kaen	Khon Kaen City	34.959	35.030	35.106	35.186	35.272	35.362	35.458	35.559	35.667	35.781
Khon Kaen	Sawathee Subdistrict	1.564	1.569	1.575	1.581	1.587	1.594	1.601	1.609	1.617	1.625
Khon Kaen	Bankho Subdistrict	1.529	1.532	1.536	1.539	1.543	1.547	1.552	1.556	1.561	1.566
Khon Kaen	Nonsila Subdistrict	1.630	1.639	1.649	1.659	1.671	1.682	1.695	1.708	1.722	1.737
Khon Kaen	Koksoongsamphan Subdistrict	1.777	1.795	1.815	1.835	1.857	1.879	1.904	1.929	1.957	1.986
Khon Kaen	Wangchai Subdistrict	1.803	1.823	1.844	1.866	1.890	1.915	1.941	1.969	1.999	2.030
Khon Kaen	Bankok Subdistrict	1.661	1.672	1.684	1.697	1.710	1.724	1.739	1.755	1.772	1.790
Khon Kaen	Chonnabot Subdistrict	2.629	2.698	2.771	2.849	2.932	3.019	3.112	3.210	3.314	3.424
Khon Kaen	Nongkae Subdistrict	1.755	1.771	1.789	1.808	1.828	1.849	1.872	1.896	1.921	1.948
Khon Kaen	Srichompo Subdistrict	2.079	2.116	2.154	2.195	2.238	2.284	2.333	2.384	2.439	2.497
Khon Kaen	Kaosuankwang Subdistrict	1.769	1.786	1.805	1.825	1.846	1.868	1.892	1.917	1.943	1.972
Khon Kaen	Nampong Subdistrict	1.527	1.530	1.534	1.537	1.541	1.545	1.549	1.554	1.558	1.563
Khon Kaen	Wangyai Subdistrict	1.566	1.571	1.577	1.583	1.590	1.597	1.604	1.612	1.620	1.629
Khon Kaen	Pueynoi Subdistrict	1.690	1.702	1.716	1.731	1.746	1.762	1.780	1.798	1.817	1.838
Chanthaburi	Chanthanimit Subdistrict	2.359	2.412	2.468	2.528	2.591	2.658	2.729	2.804	2.884	2.969
Chanthaburi	Chanthaburi Town	11.134	11.213	11.296	11.385	11.478	11.577	11.683	11.794	11.912	12.038
Chanthaburi	Bangkaja Subdistrict	1.717	1.731	1.747	1.763	1.780	1.799	1.818	1.839	1.861	1.884
Chanthaburi	Thamai Subdistrict	1.613	1.621	1.630	1.639	1.649	1.659	1.671	1.682	1.695	1.708
Chanthaburi	Noensoong Subdistrict	1.620	1.629	1.638	1.648	1.659	1.670	1.682	1.694	1.707	1.721
Chanthaburi	Paknam Lamsingha Subdistrict	1.584	1.590	1.597	1.605	1.612	1.621	1.629	1.639	1.649	1.659
Chanthaburi	Plew Subdistrict	1.590	1.597	1.605	1.613	1.621	1.630	1.639	1.649	1.659	1.670
Chanthaburi	Na vai arm Subdistrict	1.611	1.619	1.628	1.637	1.647	1.658	1.669	1.680	1.693	1.706
Chanthaburi	Tubchang Subdistrict	1.507	1.509	1.511	1.513	1.516	1.518	1.521	1.523	1.526	1.529
Cha Choeng Sao	Cha Choeng Sao Town	11.236	11.320	11.410	11.505	11.606	11.713	11.826	11.946	12.074	12.209
Cha Choeng Sao	Paknam Subdistrict	1.561	1.567	1.572	1.578	1.584	1.591	1.598	1.605	1.613	1.621
Cha Choeng Sao	Kohkhanoon Subdistrict	1.942	1.970	2.000	2.031	2.064	2.100	2.137	2.177	2.219	2.264
Cha Choeng Sao	Khaohinson Subdistrict	1.599	1.606	1.614	1.623	1.632	1.641	1.651	1.662	1.673	1.685
Cha Choeng Sao	Phanomarakam Subdistrict	2.987	3.077	3.174	3.276	3.384	3.498	3.620	3.749	3.885	4.030
Cha Choeng Sao	Thasaam Subdistrict	2.487	2.548	2.612	2.681	2.753	2.830	2.911	2.998	3.089	3.186
Cha Choeng Sao	Homsin Subdistrict	2.560	2.625	2.694	2.767	2.844	2.926	3.013	3.106	3.203	3.307
Cha Choeng Sao	Phimpha Subdistrict	1.560	1.565	1.570	1.576	1.582	1.589	1.596	1.603	1.611	1.619
Cha Choeng Sao	Dorchimplee Subdistrict	3.722	3.857	4.000	4.151	4.312	4.482	4.662	4.854	5.056	5.271
Cha Choeng Sao	Bangnampiao Subdistrict	2.153	2.194	2.237	2.283	2.331	2.383	2.437	2.495	2.556	2.621
Cha Choeng Sao	Saladang Subdistrict	1.619	1.628	1.637	1.647	1.657	1.668	1.680	1.692	1.705	1.719
Cha Choeng Sao	Sanamchaikhet Subdistrict	1.837	1.859	1.882	1.907	1.933	1.960	1.989	2.020	2.053	2.088
Cha Choeng Sao	Wangwua Subdistrict	2.093	2.130	2.169	2.211	2.255	2.302	2.352	2.405	2.460	2.520
Cha Choeng Sao	Huasamrong Subdistrict	1.786	1.804	1.824	1.845	1.867	1.891	1.916	1.943	1.971	2.001
Cha Choeng Sao	Plaengyao Subdistrict	1.781	1.800	1.819	1.840	1.862	1.885	1.909	1.935	1.963	1.992
Chonburi	Klonguamru Subdistrict	1.672	1.683	1.696	1.709	1.724	1.739	1.754	1.771	1.789	1.808
Chonburi	Bansuan Town	11.327	11.417	11.513	11.614	11.722	11.836	11.957	12.085	12.220	12.364
Chonburi	Donhualor Subdistrict	1.659	1.670	1.682	1.694	1.707	1.721	1.736	1.752	1.769	1.786
Chonburi	Nongmaidaeng Subdistrict	1.958	1.987	2.018	2.051	2.086	2.122	2.161	2.202	2.246	2.293
Chonburi	Huaykapi Subdistrict	1.775	1.793	1.812	1.832	1.854	1.877	1.901	1.926	1.954	1.982
Chonburi	Bangpra Subdistrict	2.296	2.345	2.397	2.453	2.512	2.574	2.640	2.710	2.784	2.863
Chonburi	Phanatnikom Town	11.845	11.966	12.095	12.231	12.376	12.529	12.691	12.863	13.046	13.239
Chonburi	Takhiantia Subdistrict	1.586	1.593	1.600	1.608	1.616	1.624	1.633	1.643	1.653	1.664
Chonburi	Phanthong Subdistrict	2.220	2.265	2.312	2.363	2.416	2.473	2.533	2.596	2.663	2.735
Chonburi	Nongsak Subdistrict	1.580	1.587	1.593	1.601	1.608	1.616	1.625	1.634	1.643	1.654
Chonburi	Kohchan Subdistrict	1.701	1.714	1.729	1.744	1.760	1.777	1.795	1.814	1.835	1.856

Province	Municipality	Waste (1,000 ton)									
		YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	YEAR6	YEAR7	YEAR8	YEAR9	YEAR10
Chainat	Chainat Town	10.887	10.950	11.018	11.090	11.166	11.246	11.332	11.422	11.518	11.620
Chainat	Wangtakean Subdistrict	1.492	1.493	1.494	1.496	1.497	1.498	1.500	1.501	1.503	1.504
Chainat	Hunkha Subdistrict	1.900	1.926	1.953	1.982	2.012	2.044	2.079	2.115	2.153	2.194
Chainat	Nongsang Subdistrict	1.496	1.497	1.499	1.500	1.502	1.503	1.505	1.507	1.509	1.511
Chainat	Nuenkham Subdistrict	1.494	1.495	1.496	1.498	1.499	1.501	1.502	1.504	1.506	1.508
Chainat	Sapphaya Subdistrict	2.101	2.139	2.179	2.221	2.266	2.313	2.364	2.417	2.474	2.533
Chainat	Samngamthaboat Subdistrict	1.876	1.900	1.926	1.953	1.981	2.012	2.044	2.078	2.114	2.153
Chainat	Hangnamsakorn Subdistrict	1.575	1.581	1.588	1.594	1.602	1.609	1.617	1.626	1.635	1.645
Chaiyaphum	Ladyai Subdistrict	1.810	1.830	1.852	1.874	1.898	1.924	1.951	1.979	2.009	2.042
Chaiyaphum	Banphetphukhieo Subdistrict	1.751	1.767	1.785	1.804	1.823	1.844	1.866	1.890	1.915	1.941
Chaiyaphum	Chaturat Subdistrict	2.030	2.063	2.099	2.136	2.176	2.218	2.263	2.310	2.360	2.413
Chaiyaphum	Nanongtun Subdistrict	1.929	1.956	1.985	2.015	2.048	2.082	2.119	2.157	2.198	2.242
Chaiyaphum	Banphet Subdistrict	2.671	2.743	2.819	2.900	2.986	3.076	3.172	3.274	3.382	3.497
Chaiyaphum	Bumnenarong Subdistrict	1.872	1.896	1.921	1.948	1.977	2.007	2.039	2.072	2.108	2.146
Chaiyaphum	Nonbuokhok Subdistrict	1.835	1.857	1.880	1.904	1.930	1.957	1.986	2.017	2.050	2.084
Chaiyaphum	Bankhaimeunpeaw Subdistrict	1.937	1.965	1.995	2.026	2.059	2.094	2.131	2.171	2.212	2.257
Chaiyaphum	Nonghuorawea Subdistrict	1.544	1.548	1.552	1.557	1.562	1.567	1.572	1.578	1.585	1.591
Chumphon	Paknamlangsuang Subdistrict	1.837	1.859	1.882	1.906	1.932	1.960	1.989	2.020	2.052	2.087
Chumphon	Napo Subdistrict	1.930	1.957	1.986	2.017	2.049	2.084	2.121	2.159	2.201	2.244
Chumphon	Nernsanti Subdistrict	1.605	1.613	1.622	1.630	1.640	1.650	1.660	1.671	1.683	1.696
Chumphon	Pathio Subdistrict	1.793	1.812	1.832	1.854	1.876	1.901	1.926	1.953	1.982	2.013
Chumphon	Mamammarit Subdistrict	1.685	1.697	1.711	1.725	1.740	1.756	1.773	1.791	1.810	1.830
Chumphon	Saplee Subdistrict	1.638	1.647	1.658	1.669	1.680	1.693	1.706	1.720	1.735	1.750
Trang	Huaiyod Subdistrict	1.535	1.539	1.543	1.547	1.552	1.556	1.561	1.567	1.572	1.578
Trang	Sikao Subdistrict	1.777	1.795	1.814	1.835	1.857	1.880	1.904	1.930	1.957	1.986
Trang	Lumpura Subdistrict	1.501	1.502	1.504	1.506	1.508	1.510	1.512	1.514	1.517	1.519
Trang	Nawong Subdistrict	2.168	2.210	2.254	2.301	2.350	2.403	2.459	2.518	2.580	2.647
Trang	Wanwises Subdistrict	1.698	1.711	1.726	1.741	1.757	1.774	1.792	1.811	1.831	1.853
Trat	Trat Town	9.892	9.896	9.900	9.904	9.909	9.914	9.920	9.925	9.931	9.938
Trat	Thaphriknoensai Subdistrict	2.784	2.863	2.946	3.034	3.128	3.227	3.332	3.443	3.561	3.687
Trat	Laemngob Subdistrict	2.069	2.104	2.142	2.182	2.225	2.270	2.318	2.368	2.422	2.479
Tak	Tak Town	10.978	11.047	11.120	11.197	11.279	11.366	11.459	11.557	11.660	11.770
Tak	Maingam Subdistrict	3.371	3.485	3.605	3.733	3.868	4.012	4.164	4.325	4.496	4.678
Tak	Maeku Subdistrict	1.940	1.968	1.997	2.029	2.062	2.097	2.135	2.174	2.216	2.261
Tak	Samngao Subdistrict	1.769	1.786	1.805	1.824	1.845	1.867	1.891	1.916	1.942	1.970
Tak	Maeramat Subdistrict	1.866	1.890	1.915	1.941	1.969	1.998	2.030	2.063	2.098	2.136
Tak	Phopphra Subdistrict	1.494	1.496	1.497	1.498	1.500	1.501	1.503	1.505	1.507	1.509
Tak	Umphang Subdistrict	1.548	1.552	1.557	1.562	1.567	1.573	1.579	1.585	1.592	1.599
Nakorn Nayok	Okgharak Subdistrict	1.849	1.871	1.895	1.920	1.947	1.976	2.006	2.038	2.072	2.108
Nakorn Nayok	Khawat Subdistrict	1.720	1.734	1.750	1.767	1.784	1.803	1.823	1.844	1.866	1.890
Nakorn Prathom	Prongmadua Subdistrict	3.093	3.191	3.294	3.403	3.518	3.641	3.771	3.909	4.055	4.210
Nakorn Prathom	Donyaihom Subdistrict	2.652	2.722	2.797	2.876	2.960	3.049	3.144	3.244	3.350	3.462
Nakorn Prathom	Lamphaya Subdistrict	1.507	1.509	1.511	1.514	1.516	1.519	1.521	1.524	1.527	1.531
Nakorn Prathom	Rangkratum Subdistrict	1.784	1.803	1.823	1.844	1.866	1.889	1.914	1.941	1.969	1.998
Nakorn Prathom	Samngam Subdistrict	1.954	1.983	2.013	2.046	2.080	2.116	2.155	2.195	2.239	2.285
Nakorn Prathom	Klongyong Subdistrict	1.862	1.885	1.909	1.935	1.963	1.992	2.023	2.056	2.091	2.128
Nakorn Phanom	Thaoten Subdistrict	1.571	1.576	1.583	1.589	1.596	1.603	1.611	1.620	1.628	1.638
Nakorn Phanom	Nakae Subdistrict	1.484	1.485	1.485	1.486	1.487	1.488	1.488	1.489	1.490	1.491
Nakorn Phanom	Banphaeng Subdistrict	1.545	1.549	1.553	1.558	1.563	1.568	1.574	1.580	1.586	1.593
Nakorn Phanom	Plapak Subdistrict	1.613	1.622	1.631	1.640	1.650	1.661	1.672	1.684	1.697	1.710
Nakorn Phanom	Nawha Subdistrict	3.492	3.613	3.741	3.877	4.021	4.174	4.336	4.508	4.689	4.882
Nakorn Phanom	Phonsawan Subdistrict	1.899	1.925	1.952	1.980	2.011	2.043	2.077	2.113	2.152	2.192
Nakorn Ratchasima	Phoklang Subdistrict	2.380	2.434	2.491	2.552	2.616	2.684	2.756	2.833	2.914	3.000
Nakorn Ratchasima	Nongkhainam Subdistrict	1.609	1.617	1.626	1.635	1.645	1.655	1.666	1.678	1.690	1.703
Nakorn Ratchasima	Nonghualai Subdistrict	1.497	1.498	1.499	1.501	1.503	1.505	1.506	1.508	1.511	1.513
Nakorn Ratchasima	Klangdong Subdistrict	1.711	1.725	1.740	1.756	1.773	1.791	1.810	1.831	1.852	1.875
Nakorn Ratchasima	Srimamongkol Subdistrict	2.483	2.543	2.607	2.675	2.747	2.823	2.904	2.990	3.080	3.177
Nakorn Ratchasima	Mueanpak Subdistrict	3.196	3.299	3.409	3.525	3.648	3.778	3.916	4.063	4.218	4.383
Nakorn Ratchasima	Soongnoen Subdistrict	1.806	1.826	1.847	1.869	1.893	1.918	1.945	1.973	2.003	2.034
Nakorn Ratchasima	Prathye Subdistrict	1.554	1.559	1.564	1.570	1.575	1.581	1.588	1.595	1.602	1.610
Nakorn Ratchasima	Dankwian Subdistrict	2.153	2.193	2.236	2.282	2.331	2.382	2.436	2.494	2.555	2.620
Nakorn Ratchasima	Dankhunto Subdistrict	2.157	2.197	2.240	2.286	2.334	2.386	2.440	2.498	2.559	2.624
Nakorn Ratchasima	Phratongkham Subdistrict	1.704	1.718	1.732	1.748	1.764	1.781	1.800	1.819	1.840	1.862
Nakorn Ratchasima	Khoksawai Subdistrict	1.679	1.691	1.704	1.717	1.732	1.747	1.764	1.781	1.800	1.819
Nakorn Ratchasima	Thachang Subdistrict	1.769	1.786	1.805	1.824	1.845	1.868	1.891	1.916	1.943	1.971
Nakorn Ratchasima	Hindad Subdistrict	1.899	1.925	1.952	1.981	2.011	2.044	2.078	2.114	2.152	2.193
Nakorn Ratchasima	Saiyong - Chaiwan Subdistrict	1.513	1.515	1.517	1.520	1.523	1.526	1.529	1.532	1.536	1.539
Nakorn Ratchasima	Kokkruat Subdistrict	4.210	4.374	4.548	4.732	4.928	5.135	5.354	5.587	5.833	6.095
Nakorn Ratchasima	Nonghuafan Subdistrict	1.778	1.797	1.816	1.837	1.858	1.882	1.906	1.932	1.960	1.989
Nakorn Ratchasima	Lathuakhao Subdistrict	1.518	1.521	1.524	1.527	1.530	1.533	1.537	1.540	1.544	1.549
Nakorn Ratchasima	Srida Subdistrict	1.680	1.692	1.705	1.719	1.734	1.749	1.766	1.783	1.802	1.821
Nakorn Si Thammarat	Nakorn Si Thammarat City	40.166	40.549	40.954	41.384	41.839	42.322	42.834	43.376	43.951	44.561
Nakorn Si Thammarat	Sichon Subdistrict	3.175	3.277	3.385	3.500	3.622	3.750	3.887	4.032	4.185	4.348
Nakorn Si Thammarat	Chawang Subdistrict	1.705	1.719	1.734	1.749	1.766	1.784	1.802	1.822	1.843	1.865
Nakorn Si Thammarat	Khanom Subdistrict	4.351	4.524	4.707	4.901	5.106	5.324	5.555	5.799	6.059	6.334
Nakorn Si Thammarat	Thongnian Subdistrict	3.155	3.256	3.363	3.476	3.596	3.723	3.858	4.001	4.153	4.313
Nakorn Si Thammarat	Lansaka Subdistrict	1.877	1.901	1.926	1.953	1.982	2.013	2.045	2.079	2.116	2.154
Nakorn Si Thammarat	Chandee Subdistrict	1.700	1.714	1.728	1.744	1.760	1.777	1.795	1.814	1.835	1.856
Nakorn Si Thammarat	Promlok Subdistrict	2.123	2.162	2.203	2.247	2.293	2.342	2.395	2.450	2.508	2.570
Nakorn Si Thammarat	Thonhong Subdistrict	1.767	1.785	1.803	1.823	1.844	1.866	1.889	1.914	1.940	1.968
Nakorn Si Thammarat	Banjak Subdistrict	1.685	1.698	1.711	1.726	1.741	1.757	1.773	1.791	1.810	1.831
Nakorn Sawan	Ladyao Subdistrict	1.550	1.554	1.559	1.564	1.569	1.575	1.581	1.588	1.594	1.602
Nakorn Sawan	Banggramung Subdistrict	1.548	1.553	1.558	1.563	1.568	1.574	1.580	1.586	1.593	1.600
Nakorn Sawan	Bangphothisai Subdistrict	1.582	1.589	1.595	1.603	1.610	1.618	1.627	1.636	1.646	1.656
Nakorn Sawan	Takfa Subdistrict	1.977	2.007	2.039	2.073	2.109	2.147	2.187	2.230	2.275	2.323
Nonhaburi	Saimar Subdistrict	1.978	2.008	2.040	2.074	2.110	2.148	2.188	2.231	2.277	2.325
Nonhaburi	Banghuatong Town	11.388	11.481	11.580	11.684	11.795	11.912	12.036	12.168	12.308	12.456
Nonhaburi	Plailang Subdistrict	1.969	1.998	2.030	2.063	2.098	2.135	2.175	2.217	2.261	2.308
Nonhaburi	Bangmoung Subdistrict	1.711	1.725	1.740	1.756	1.773	1.791	1.810	1.830	1.851	1.874
Nara Thawat	Tanyongmat Subdistrict	1.537	1.541	1.545	1.549	1.553	1.558	1.563	1.569	1.574	1.581
Nara Thawat	Bukata Subdistrict	1.517	1.519	1.522	1.525	1.528	1.531	1.534	1.538	1.542	1.546
Nara Thawat	Sirsakorn Subdistrict	2.120	2.159	2.200	2.243	2.289	2.338	2.390	2.445	2.503	2.565
Nan	Nan Town	10.480	10.520	10.561	10.605	10.652	10.701	10.754	10.809	10.868	10.931
Nan	Thawangpha Subdistrict	1.488	1.489	1.490	1.491	1.492	1.493	1.494	1.495	1.496	1.497
Nan	Nanoi Subdistrict	1.630	1.639	1.649	1.660	1.671	1.683	1.696	1.709	1.723	1.738
Buriram	Phanomrung Subdistrict	1.915	1.941	1.969	1.999	2.030	2.064	2.099	2.137	2.177	2.219
Buriram	Nonsuwan Subdistrict	1.781	1.799	1.819	1.840	1.862	1.885	1.909	1.936	1.963	1.993
Buriram	Phuthaisong Subdistrict	1.678	1.691	1.704							

Province	Municipality	Waste (1,000 ton)									
		YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	YEAR6	YEAR7	YEAR8	YEAR9	YEAR10
Buriram	Nondindaeng Subdistrict	2,244	2,290	2,339	2,390	2,445	2,503	2,564	2,630	2,699	2,772
Prathum Thani	Bangluang Subdistrict	2,516	2,579	2,645	2,715	2,790	2,868	2,952	3,041	3,135	3,234
Prathum Thani	Lakhok Subdistrict	2,674	2,746	2,821	2,902	2,987	3,078	3,174	3,275	3,383	3,497
Prathum Thani	Thaklong Town	13,154	13,353	13,563	13,786	14,023	14,274	14,540	14,821	15,120	15,437
Prathum Thani	Buengyiho Subdistrict	2,739	2,814	2,894	2,979	3,068	3,163	3,264	3,371	3,484	3,604
Prathum Thani	Lumsai Subdistrict	1,527	1,530	1,534	1,538	1,541	1,546	1,550	1,555	1,559	1,565
Prathum Thani	Nongsuea Subdistrict	1,734	1,750	1,766	1,784	1,802	1,822	1,843	1,865	1,889	1,914
Prachuap Khiri Khan	Prachuap Khiri Khan Town	13,561	13,785	14,023	14,274	14,541	14,824	15,123	15,441	15,777	16,134
Prachuap Khiri Khan	Huahin Town	23,290	24,097	24,953	25,860	26,822	27,841	28,921	30,066	31,280	32,566
Prachuap Khiri Khan	Nonghlab Subdistrict	1,506	1,508	1,510	1,512	1,515	1,517	1,520	1,522	1,525	1,528
Prachuap Khiri Khan	Thapsakae Subdistrict	2,715	2,789	2,868	2,951	3,039	3,133	3,232	3,338	3,449	3,567
Prachuap Khiri Khan	Bangsaphanno Subdistrict	1,513	1,515	1,518	1,520	1,523	1,526	1,529	1,533	1,536	1,540
Prachuap Khiri Khan	Raimai Subdistrict	1,741	1,757	1,774	1,792	1,811	1,832	1,853	1,876	1,900	1,925
Prachuap Khiri Khan	Raikao Subdistrict	2,016	2,048	2,082	2,119	2,157	2,198	2,241	2,286	2,335	2,386
Prachuap Khiri Khan	Bankrut Subdistrict	2,248	2,295	2,344	2,396	2,451	2,509	2,571	2,637	2,707	2,780
Prachuap Khiri Khan	Ronthong Subdistrict	3,027	3,120	3,219	3,323	3,434	3,552	3,677	3,809	3,949	4,097
Prachin Buri	Bannapruue Subdistrict	1,497	1,499	1,500	1,502	1,504	1,505	1,507	1,509	1,511	1,514
Prachin Buri	Khokmakok Subdistrict	2,152	2,193	2,236	2,282	2,330	2,382	2,436	2,494	2,555	2,620
Prachin Buri	Srabua Subdistrict	1,548	1,552	1,557	1,562	1,567	1,573	1,579	1,585	1,592	1,599
Prachin Buri	Kroksombun Subdistrict	1,652	1,662	1,674	1,686	1,699	1,712	1,726	1,742	1,758	1,775
Prachin Buri	Khokpeep Subdistrict	1,677	1,690	1,703	1,716	1,731	1,747	1,763	1,780	1,799	1,818
Pattani	Khokpo Subdistrict	1,573	1,579	1,585	1,592	1,599	1,606	1,614	1,623	1,632	1,641
Pattani	Bangpo Subdistrict	4,077	4,233	4,398	4,574	4,760	4,957	5,166	5,387	5,622	5,870
Pattani	Yarang Subdistrict	1,742	1,758	1,775	1,793	1,812	1,832	1,854	1,877	1,901	1,927
Phra Nakorn Si Ayutthaya	Phra Nakorn Si Ayutthana City	36,674	36,847	37,030	37,224	37,430	37,648	37,879	38,125	38,384	38,660
Phra Nakorn Si Ayutthaya	Ayothaya City Town	11,626	11,733	11,848	11,969	12,097	12,233	12,377	12,530	12,692	12,863
Phra Nakorn Si Ayutthaya	Sena Town	10,205	10,228	10,253	10,278	10,306	10,335	10,365	10,398	10,433	10,469
Phra Nakorn Si Ayutthaya	Hauwang Subdistrict	1,636	1,645	1,656	1,666	1,678	1,690	1,703	1,717	1,731	1,746
Phra Nakorn Si Ayutthaya	Nakhonloun Subdistrict	2,825	2,906	2,991	3,082	3,179	3,281	3,389	3,504	3,625	3,754
Phra Nakorn Si Ayutthaya	Bangnomkh Subdistrict	1,547	1,551	1,556	1,561	1,566	1,571	1,577	1,583	1,590	1,597
Phra Nakorn Si Ayutthaya	Phakhi Subdistrict	3,383	3,497	3,618	3,747	3,883	4,027	4,180	4,342	4,513	4,696
Phra Nakorn Si Ayutthaya	Thaluang Subdistrict	2,435	2,493	2,554	2,618	2,687	2,760	2,837	2,918	3,005	3,097
Phra Nakorn Si Ayutthaya	Rongchang Subdistrict	1,796	1,815	1,836	1,857	1,880	1,905	1,931	1,958	1,987	2,018
Phra Nakorn Si Ayutthaya	Maharat Subdistrict	1,998	2,030	2,063	2,099	2,136	2,176	2,218	2,262	2,310	2,360
Phra Nakorn Si Ayutthaya	Bansang Subdistrict	1,652	1,663	1,674	1,686	1,698	1,712	1,726	1,741	1,757	1,774
Phra Nakorn Si Ayutthaya	Prasattong Subdistrict	1,500	1,502	1,504	1,505	1,507	1,509	1,511	1,514	1,516	1,519
Phra Nakorn Si Ayutthaya	Bankrasan Subdistrict	1,998	2,030	2,063	2,098	2,136	2,175	2,217	2,262	2,309	2,359
Phra Nakorn Si Ayutthaya	Uthai Subdistrict	1,574	1,580	1,587	1,594	1,601	1,609	1,617	1,625	1,634	1,644
Phra Nakorn Si Ayutthaya	Bangpahun Subdistrict	2,130	2,169	2,211	2,255	2,302	2,352	2,405	2,460	2,520	2,582
Phra Nakorn Si Ayutthaya	Bangprak Subdistrict	1,570	1,576	1,583	1,589	1,596	1,603	1,611	1,620	1,628	1,638
Phra Nakorn Si Ayutthaya	Mahaphram Subdistrict	1,532	1,535	1,539	1,543	1,547	1,551	1,556	1,561	1,566	1,572
Phra Nakorn Si Ayutthaya	Rajakram Subdistrict	1,626	1,635	1,645	1,655	1,666	1,678	1,690	1,703	1,717	1,732
Phayao	Phayao Town	12,171	12,312	12,460	12,618	12,785	12,962	13,150	13,349	13,560	13,783
Phayao	Dongjen Subdistrict	1,773	1,790	1,809	1,829	1,850	1,872	1,895	1,920	1,947	1,975
Phayao	Bansai Subdistrict	1,664	1,676	1,688	1,701	1,714	1,729	1,744	1,760	1,777	1,796
Phayao	Bantham Subdistrict	1,518	1,521	1,523	1,526	1,530	1,533	1,537	1,540	1,544	1,549
Phayao	Dokkhamtai Town	10,359	10,391	10,425	10,461	10,499	10,540	10,583	10,628	10,676	10,727
Phayao	Maesai Subdistrict	1,676	1,688	1,701	1,715	1,729	1,744	1,761	1,778	1,796	1,815
Phang Nga	Krasom Subdistrict	1,549	1,554	1,558	1,563	1,569	1,575	1,581	1,587	1,594	1,601
Phang Nga	Khokkloy Subdistrict	1,534	1,537	1,541	1,545	1,550	1,554	1,559	1,564	1,570	1,575
Phang Nga	Kuraburi Subdistrict	1,589	1,596	1,603	1,611	1,620	1,628	1,638	1,647	1,658	1,669
Phang Nga	Kohyao Subdistrict	1,507	1,509	1,511	1,513	1,515	1,518	1,521	1,523	1,526	1,530
Pattalung	Khuanthuan Subdistrict	1,500	1,501	1,503	1,505	1,507	1,509	1,511	1,513	1,516	1,518
Pattalung	Thamadua Subdistrict	2,513	2,575	2,641	2,711	2,785	2,863	2,947	3,035	3,128	3,228
Pattalung	Maekree Subdistrict	1,643	1,653	1,664	1,675	1,687	1,699	1,712	1,726	1,741	1,757
Pattalung	Tamod Subdistrict	1,936	1,963	1,992	2,023	2,056	2,091	2,128	2,167	2,208	2,252
Pichit	Wangkrot Subdistrict	1,601	1,609	1,617	1,626	1,635	1,644	1,655	1,665	1,677	1,689
Pichit	Thalo Subdistrict	1,781	1,799	1,819	1,839	1,861	1,885	1,909	1,935	1,963	1,993
Pichit	Tapanhin Town	11,563	11,667	11,777	11,894	12,018	12,149	12,288	12,436	12,593	12,758
Pichit	Phothale Subdistrict	1,616	1,624	1,633	1,643	1,653	1,664	1,675	1,687	1,700	1,714
Pichit	Samngam Subdistrict	2,117	2,156	2,196	2,240	2,286	2,334	2,386	2,440	2,498	2,560
Pichit	Thakblo Subdistrict	1,638	1,648	1,658	1,669	1,681	1,694	1,707	1,721	1,736	1,752
Pichit	Saklek Subdistrict	1,827	1,848	1,871	1,895	1,920	1,947	1,975	2,005	2,037	2,071
Pichit	Huadong Subdistrict	2,571	2,636	2,706	2,780	2,858	2,942	3,030	3,123	3,222	3,327
Pichit	Wangsaipoon Subdistrict	1,553	1,558	1,563	1,568	1,574	1,580	1,586	1,593	1,600	1,608
Pichit	Kamphangdin Subdistrict	1,573	1,579	1,585	1,592	1,599	1,607	1,615	1,623	1,632	1,642
Pichit	Khasoi Subdistrict	1,630	1,640	1,650	1,660	1,672	1,683	1,696	1,709	1,724	1,739
Phitsanulok	Bangrakam Subdistrict	1,680	1,692	1,705	1,719	1,734	1,750	1,766	1,784	1,802	1,822
Phitsanulok	Prompiram Subdistrict	1,573	1,579	1,586	1,592	1,599	1,607	1,615	1,624	1,633	1,642
Phitsanulok	Watbot Subdistrict	1,644	1,655	1,665	1,677	1,689	1,702	1,715	1,730	1,745	1,761
Phitsanulok	Padang Subdistrict	1,677	1,689	1,702	1,715	1,730	1,745	1,761	1,778	1,797	1,816
Phitsanulok	Wongkong Subdistrict	1,712	1,726	1,742	1,758	1,775	1,793	1,812	1,832	1,854	1,876
Phitsanulok	Nuenkum Subdistrict	2,081	2,117	2,155	2,196	2,239	2,285	2,333	2,384	2,438	2,496
Phuket	Thepkasattree Subdistrict	1,618	1,627	1,636	1,646	1,656	1,667	1,679	1,691	1,704	1,718
Phuket	Kathu Subdistrict	12,245	12,390	12,544	12,707	12,879	13,062	13,256	13,462	13,680	13,911
Phuket	Patong Town	10,565	10,609	10,656	10,706	10,758	10,814	10,874	10,936	11,003	11,074
Mahasarakham	Mahasarakham Town	12,143	12,281	12,427	12,582	12,746	12,920	13,104	13,299	13,506	13,726
Mahasarakham	Borabue Subdistrict	2,310	2,360	2,413	2,469	2,529	2,592	2,659	2,730	2,806	2,886
Mahasarakham	Kokpra Subdistrict	1,594	1,601	1,609	1,617	1,625	1,634	1,644	1,654	1,665	1,676
Mahasarakham	Nadoon Subdistrict	1,758	1,775	1,793	1,812	1,832	1,854	1,877	1,901	1,926	1,954
Mahasarakham	Kaedam Subdistrict	1,702	1,716	1,730	1,746	1,762	1,779	1,798	1,817	1,838	1,859
Mukdahan	Nikomkamsoi Subdistrict	1,708	1,722	1,736	1,752	1,769	1,786	1,805	1,825	1,846	1,868
Yala	Yala City	34,104	34,124	34,144	34,167	34,190	34,215	34,241	34,269	34,299	34,330
Yala	Satengnok Subdistrict	1,899	1,924	1,951	1,980	2,010	2,042	2,076	2,112	2,150	2,191
Yala	Betong Town	11,813	11,932	12,059	12,192	12,334	12,485	12,644	12,813	12,992	13,182
Yala	Lammai Subdistrict	1,950	1,979	2,009	2,041	2,075	2,111	2,150	2,190	2,233	2,279
Yasothon	Yasothon Town	19,355	19,926	20,532	21,174	21,855	22,576	23,341	24,152	25,011	25,922
Yasothon	Kohwang Subdistrict	1,823	1,844	1,866	1,889	1,914	1,941	1,969	1,998	2,030	2,063
Yasothon	Saimoon Subdistrict	6,156	6,437	6,734	7,050	7,384	7,738	8,114	8,512	8,933	9,381
Ranong	Ngao Subdistrict	2,709	2,784	2,862	2,945	3,034	3,127	3,226	3,332	3,443	3,561
Ranong	Paknam Subdistrict	2,159	2,200	2,243	2,290	2,339	2,390	2,445	2,504	2,566	2,631
Ranong	Namchuet Subdistrict	1,902	1,928	1,955	1,984	2,015	2,047	2,082	2,118	2,157	2,198
Rayong	Rayong City	35,752	35,870	35,996	36,128	36,269	36,418	36,576	36,743	36,921	37,109
Rayong	Banphe Subdistrict	3,986	4,136	4,295	4,464	4,643	4,832	5,033	5,246	5,472	5,711
Rayong	Sunthornphu Subdistrict	2,038	2,072	2,107	2,145	2,185	2,227	2,272	2,320	2,370	2,423
Rayong	Tungkhwaikin Subdistrict	2,091	2,128	2,167	2,208	2,252	2,299	2,349	2,401	2,457	2,516
Rayong	Jompolchaopraya Subdistrict	2,337	2,389								

Province	Municipality	Waste (1,000 ton)									
		YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	YEAR6	YEAR7	YEAR8	YEAR9	YEAR10
Ratchaburi	Khaong Subdistrict	2.289	2.338	2.390	2.444	2.502	2.564	2.629	2.699	2.772	2.850
Ratchaburi	Thapa Subdistrict	4.425	4.601	4.789	4.987	5.198	5.421	5.657	5.908	6.174	6.456
Ratchaburi	Krachap Subdistrict	6.448	6.746	7.062	7.397	7.752	8.128	8.527	8.950	9.398	9.873
Ratchaburi	Huaykrabok Subdistrict	1.542	1.546	1.550	1.555	1.559	1.565	1.570	1.576	1.582	1.589
Ratchaburi	Chetsamian Subdistrict	1.647	1.657	1.668	1.680	1.692	1.705	1.719	1.733	1.749	1.765
Ratchaburi	Khaokwang Subdistrict	2.453	2.512	2.574	2.640	2.710	2.784	2.863	2.946	3.034	3.127
Ratchaburi	Bansing Subdistrict	1.532	1.535	1.539	1.543	1.547	1.551	1.556	1.561	1.566	1.571
Ratchaburi	Bankong Subdistrict	1.966	1.995	2.026	2.059	2.094	2.132	2.171	2.213	2.257	2.304
Ratchaburi	Damnoensaduak Subdistrict	2.528	2.591	2.657	2.728	2.803	2.883	2.968	3.057	3.152	3.252
Ratchaburi	Bangghae Subdistrict	2.333	2.385	2.440	2.498	2.559	2.624	2.693	2.766	2.844	2.926
Ratchaburi	Watpleng Subdistrict	1.611	1.619	1.628	1.637	1.647	1.658	1.669	1.680	1.693	1.706
Ratchaburi	Suamphung Subdistrict	1.483	1.484	1.484	1.485	1.486	1.486	1.487	1.488	1.489	1.490
Ratchaburi	Chatpaway Subdistrict	1.994	2.025	2.058	2.093	2.130	2.170	2.211	2.256	2.303	2.352
Roi Et	Roi Et Town	16.724	17.137	17.575	18.039	18.531	19.052	19.605	20.190	20.811	21.470
Roi Et	Wang Subdistrict	8.224	8.628	9.057	9.512	9.994	10.504	11.046	11.619	12.228	12.873
Roi Et	Suwannaphum Subdistrict	2.076	2.112	2.151	2.191	2.234	2.280	2.328	2.379	2.434	2.491
Roi Et	Phanomprai Subdistrict	1.886	1.911	1.937	1.965	1.995	2.026	2.059	2.094	2.132	2.171
Roi Et	Kasetsai Subdistrict	1.482	1.482	1.483	1.483	1.483	1.483	1.483	1.484	1.484	1.484
Roi Et	Atsamart Subdistrict	2.123	2.162	2.204	2.247	2.294	2.343	2.395	2.450	2.509	2.571
Roi Et	Banniwet Subdistrict	1.684	1.697	1.710	1.724	1.739	1.755	1.772	1.790	1.809	1.829
Roi Et	Thonganee Subdistrict	2.087	2.124	2.163	2.204	2.248	2.295	2.344	2.396	2.451	2.510
Roi Et	Muangsuang Subdistrict	1.958	1.987	2.018	2.051	2.085	2.122	2.161	2.202	2.246	2.292
Roi Et	Chiangmai Subdistrict	1.708	1.722	1.736	1.752	1.769	1.786	1.805	1.825	1.846	1.868
Lopburi	Thasala Subdistrict	1.778	1.796	1.815	1.835	1.857	1.880	1.904	1.930	1.957	1.986
Lopburi	Khoksamrong Subdistrict	1.981	2.012	2.044	2.078	2.114	2.152	2.193	2.236	2.282	2.330
Lopburi	Lammarai Subdistrict	3.363	3.477	3.597	3.724	3.859	4.002	4.153	4.314	4.484	4.665
Lopburi	Thawung Subdistrict	1.973	2.003	2.035	2.068	2.104	2.142	2.182	2.225	2.270	2.317
Lopburi	Thaklong Subdistrict	2.521	2.584	2.651	2.721	2.796	2.876	2.960	3.049	3.143	3.244
Lopburi	Banthaluang Subdistrict	1.543	1.548	1.552	1.557	1.562	1.567	1.572	1.578	1.585	1.591
Lopburi	Sabot Subdistrict	2.330	2.381	2.436	2.494	2.555	2.620	2.688	2.761	2.838	2.920
Lampang	Kelangnakorn Town	10.717	10.771	10.828	10.888	10.952	11.019	11.091	11.167	11.247	11.333
Lampang	Lampang City	35.414	35.513	35.618	35.729	35.846	35.971	36.103	36.244	36.392	36.550
Lampang	Luangpuea Subdistrict	1.566	1.572	1.577	1.584	1.590	1.597	1.605	1.613	1.621	1.630
Lampang	Jaehom Subdistrict	1.842	1.864	1.887	1.912	1.938	1.966	1.996	2.027	2.060	2.095
Lampang	Kokkha Subdistrict	2.105	2.142	2.182	2.225	2.270	2.317	2.368	2.422	2.478	2.539
Lampang	Patunnakua Subdistrict	1.649	1.660	1.671	1.682	1.695	1.708	1.722	1.736	1.752	1.768
Lampang	Lormrad Subdistrict	2.067	2.102	2.139	2.179	2.221	2.265	2.313	2.363	2.416	2.472
Lampang	Wiangmok Subdistrict	1.822	1.843	1.865	1.888	1.913	1.939	1.967	1.997	2.028	2.061
Lampang	Sobprab Subdistrict	1.931	1.959	1.988	2.019	2.052	2.086	2.123	2.162	2.203	2.247
Lampang	Maeprik Subdistrict	2.320	2.371	2.425	2.482	2.542	2.606	2.674	2.746	2.822	2.903
Lampang	Maepu Subdistrict	1.865	1.889	1.914	1.940	1.968	1.997	2.029	2.062	2.097	2.135
Lampang	Hangchat Subdistrict	1.616	1.624	1.633	1.643	1.653	1.664	1.675	1.687	1.700	1.714
Lampang	Setnngam Subdistrict	1.962	1.991	2.022	2.055	2.089	2.126	2.165	2.206	2.250	2.297
Lampang	Maemoh Subdistrict	2.284	2.333	2.384	2.438	2.496	2.557	2.622	2.691	2.763	2.840
Lamphun	Lamphun Town	10.154	10.174	10.195	10.217	10.241	10.266	10.292	10.320	10.350	10.382
Lamphun	Rimping Subdistrict	1.574	1.580	1.586	1.593	1.600	1.608	1.616	1.624	1.633	1.643
Lamphun	Banpan Subdistrict	1.512	1.515	1.517	1.520	1.523	1.526	1.529	1.532	1.536	1.539
Lamphun	Banklang Subdistrict	5.882	5.828	6.089	6.365	6.657	6.968	7.296	7.645	8.015	8.406
Lamphun	Maetuen Subdistrict	1.592	1.599	1.607	1.615	1.623	1.632	1.642	1.652	1.662	1.674
Lamphun	Moungnoy Subdistrict	1.579	1.586	1.592	1.599	1.607	1.615	1.623	1.632	1.642	1.652
Lamphun	Pasang Subdistrict	2.126	2.166	2.207	2.251	2.298	2.347	2.399	2.455	2.514	2.576
Lamphun	Banhong Subdistrict	2.460	2.519	2.581	2.647	2.718	2.792	2.871	2.955	3.043	3.137
Lamphun	Sobsoa Subdistrict	1.786	1.804	1.824	1.845	1.868	1.891	1.916	1.943	1.971	2.001
Lamphun	Umong Subdistrict	3.116	3.214	3.318	3.429	3.546	3.670	3.801	3.941	4.089	4.245
Lamphun	Thakat Subdistrict	2.109	2.147	2.187	2.230	2.275	2.323	2.374	2.428	2.485	2.546
Sisaket	Sisaket Town	10.731	10.785	10.842	10.903	10.967	11.035	11.108	11.184	11.265	11.351
Sisaket	Kanthak Town	9.973	9.982	9.991	10.001	10.012	10.023	10.035	10.047	10.061	10.075
Sisaket	Kumpueng Subdistrict	1.528	1.532	1.535	1.539	1.543	1.547	1.551	1.556	1.561	1.566
Sisaket	Kantaron Subdistrict	3.864	4.007	4.159	4.319	4.490	4.671	4.862	5.065	5.280	5.508
Sisaket	Muangkong Subdistrict	2.564	2.629	2.698	2.772	2.850	2.932	3.020	3.112	3.211	3.315
Sisaket	Prangku Subdistrict	1.781	1.800	1.819	1.840	1.862	1.885	1.910	1.936	1.964	1.994
Sakon Nakhon	Kusumal Subdistrict	1.591	1.598	1.606	1.614	1.622	1.631	1.641	1.651	1.661	1.673
Sakon Nakhon	Phannanikhom Subdistrict	1.509	1.511	1.513	1.516	1.518	1.521	1.524	1.527	1.530	1.533
Sakon Nakhon	Warichaphum Subdistrict	1.484	1.485	1.486	1.487	1.487	1.488	1.489	1.490	1.491	1.492
Sakon Nakhon	Pangkhn Subdistrict	1.766	1.784	1.802	1.822	1.843	1.865	1.889	1.913	1.940	1.968
Sakon Nakhon	Songdao Subdistrict	2.272	2.320	2.370	2.423	2.480	2.540	2.604	2.671	2.742	2.818
Sakon Nakhon	Dongmafi Subdistrict	2.051	2.086	2.123	2.162	2.203	2.247	2.293	2.342	2.394	2.449
Sakon Nakhon	Charoensin Subdistrict	1.715	1.729	1.744	1.760	1.778	1.796	1.815	1.835	1.857	1.880
Songkhla	Khaorupchang Subdistrict	2.663	2.734	2.809	2.888	2.973	3.062	3.156	3.256	3.363	3.475
Songkhla	Khohong Town	12.170	12.311	12.460	12.618	12.786	12.963	13.152	13.351	13.563	13.787
Songkhla	Thachang Subdistrict	1.767	1.785	1.803	1.823	1.844	1.866	1.890	1.914	1.941	1.969
Songkhla	Ranod Subdistrict	1.580	1.586	1.593	1.600	1.608	1.616	1.624	1.633	1.643	1.653
Songkhla	Padangbezar Town	10.628	10.676	10.727	10.781	10.838	10.899	10.964	11.032	11.104	11.181
Songkhla	Sumakkham Subdistrict	1.616	1.625	1.634	1.644	1.654	1.665	1.676	1.688	1.701	1.715
Songkhla	Chana Subdistrict	1.799	1.818	1.839	1.861	1.884	1.909	1.935	1.962	1.992	2.023
Songkhla	Klong ngae Subdistrict	5.444	5.682	5.935	6.202	6.485	6.786	7.104	7.441	7.799	8.178
Songkhla	Sathingra Subdistrict	1.583	1.590	1.597	1.604	1.612	1.620	1.629	1.638	1.648	1.659
Songkhla	Sabayoi Subdistrict	1.507	1.509	1.511	1.514	1.516	1.518	1.521	1.524	1.527	1.530
Songkhla	Phatong Subdistrict	1.586	1.592	1.599	1.607	1.615	1.623	1.632	1.642	1.652	1.663
Songkhla	Banpru Subdistrict	1.670	1.681	1.694	1.707	1.721	1.736	1.752	1.768	1.786	1.805
Satun	Satun Town	11.841	11.961	12.090	12.225	12.369	12.522	12.684	12.855	13.037	13.229
Satun	Klongkhud Subdistrict	1.622	1.630	1.640	1.650	1.660	1.671	1.683	1.696	1.709	1.723
Satun	Thungwa Subdistrict	2.252	2.298	2.348	2.400	2.456	2.514	2.577	2.643	2.713	2.787
Samutprakarn	Phrapradaeng Town	10.386	10.420	10.455	10.493	10.533	10.575	10.620	10.667	10.718	10.771
Samutprakarn	Samrongtai Subdistrict	4.460	4.636	4.822	5.019	5.228	5.450	5.685	5.934	6.198	6.478
Samutprakarn	Bangmuang Subdistrict	10.028	10.541	11.084	11.660	12.271	12.919	13.605	14.332	15.103	15.921
Samutprakarn	Dansamrong Subdistrict	18.201	19.204	20.268	21.395	22.589	23.856	25.198	26.621	28.129	29.727
Samutprakarn	Kumpoo Subdistrict	5.678	5.930	6.197	6.480	6.780	7.098	7.435	7.792	8.171	8.572
Samutprakarn	Phrasamutchedi Subdistrict	5.379	5.613	5.861	6.124	6.402	6.697	7.010	7.342	7.694	8.066
Samutprakarn	Bangbo Subdistrict	1.952	1.981	2.011	2.043	2.077	2.113	2.152	2.192	2.235	2.280
Samutsongkram	Nokkwag Subdistrict	1.538	1.542	1.546	1.550	1.555	1.560	1.565	1.570	1.576	1.582
Samutsakorn	Samutsakorn City	34.264	34.294	34.325	34.358	34.393	34.430	34.469	34.511	34.555	34.602
Samutsakorn	Banphaeo Subdistrict	1.480	1.480	1.480	1.481	1.481	1.482	1.482	1.483	1.484	1.484
Saraburi	Phukrang Subdistrict	1.591	1.598	1.605	1.613	1.622	1.630	1.640	1.650	1.660	1.672
Saraburi	Banno Subdistrict	1.608	1.616	1.625	1.634	1.643	1.654	1.664	1.676	1.688	1.701
Saraburi	Nongkhae Subdistrict	3.699	3.832	3.974	4.123	4.282	4.450	4.629	4.818	5.018	5.230
Saraburi	Nongmoo Subdistrict	1.642	1.653	1.663	1.675	1.687	1.700	1.713	1.728	1.743	1.759
Saraburi	Saohai Subdistrict	1.541	1.545	1.549	1.554	1.559	1.564	1.569	1.575	1.581	

Province	Municipality	Waste (1,000 ton)									
		YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	YEAR6	YEAR7	YEAR8	YEAR9	YEAR10
Sakaeo	Wathananakhon Subdistrict	2.475	2.535	2.599	2.667	2.738	2.814	2.894	2.979	3.069	3.165
Sing Buri	In buri Subdistrict	1.620	1.629	1.639	1.648	1.659	1.670	1.682	1.694	1.707	1.721
Sing Buri	Phosungkho Subdistrict	1.482	1.483	1.483	1.484	1.484	1.485	1.486	1.486	1.487	1.488
Supanburi	Sonpeenong Town	10.799	10.857	10.919	10.985	11.055	11.129	11.207	11.290	11.378	11.471
Supanburi	Samchuk Subdistrict	1.938	1.965	1.995	2.026	2.059	2.094	2.131	2.170	2.212	2.256
Supanburi	Wanyang Subdistrict	1.735	1.750	1.767	1.784	1.803	1.823	1.844	1.866	1.889	1.914
Supanburi	Paikhongdin Subdistrict	1.518	1.521	1.524	1.527	1.530	1.534	1.537	1.541	1.545	1.549
Supanburi	Bangplama Subdistrict	1.704	1.718	1.732	1.748	1.764	1.782	1.800	1.820	1.841	1.863
Supanburi	U-Thong Subdistrict	1.898	1.924	1.950	1.979	2.009	2.041	2.075	2.111	2.149	2.190
Supanburi	Thungkok Subdistrict	1.607	1.615	1.624	1.633	1.642	1.653	1.663	1.675	1.687	1.700
Supanburi	Suantang Subdistrict	1.565	1.571	1.577	1.583	1.589	1.596	1.604	1.611	1.620	1.628
Supanburi	Nongyasai Subdistrict	1.552	1.556	1.561	1.567	1.572	1.578	1.584	1.591	1.598	1.606
Suratthani	Kohsamul Subdistrict	11.008	11.079	11.154	11.234	11.318	11.408	11.503	11.603	11.710	11.823
Suratthani	Thakhanon Subdistrict	1.645	1.655	1.666	1.677	1.690	1.703	1.716	1.731	1.746	1.763
Suratthani	Bansong Subdistrict	1.654	1.664	1.676	1.687	1.700	1.713	1.728	1.743	1.759	1.775
Suratthani	Yandindaeng Subdistrict	1.872	1.896	1.921	1.948	1.977	2.007	2.039	2.073	2.109	2.147
Suratthani	Bangsawan Subdistrict	1.485	1.486	1.486	1.487	1.488	1.489	1.490	1.491	1.492	1.493
Suratthani	Donsak Subdistrict	2.193	2.236	2.281	2.329	2.381	2.435	2.492	2.553	2.618	2.687
Suratthani	Chiewlan Subdistrict	1.651	1.662	1.673	1.685	1.697	1.711	1.725	1.740	1.756	1.773
Suratthani	Phanom Subdistrict	1.880	1.905	1.930	1.957	1.986	2.017	2.049	2.084	2.120	2.159
Suratthani	Kohphangan Subdistrict	1.834	1.856	1.878	1.903	1.928	1.955	1.984	2.015	2.047	2.081
Surin	Surin Town	11.969	12.097	12.233	12.377	12.530	12.691	12.863	13.045	13.238	13.442
Surin	Rangaeng Subdistrict	1.536	1.540	1.544	1.548	1.553	1.557	1.562	1.568	1.573	1.580
Surin	Thatoom Subdistrict	1.708	1.722	1.737	1.753	1.769	1.787	1.806	1.826	1.847	1.870
Surin	Rongghab Subdistrict	2.413	2.469	2.529	2.592	2.659	2.731	2.806	2.886	2.971	3.060
Surin	Chumpolburi Subdistrict	1.643	1.653	1.664	1.675	1.687	1.700	1.714	1.728	1.743	1.760
Surin	Buachet Subdistrict	2.856	2.939	3.026	3.119	3.218	3.323	3.434	3.551	3.676	3.808
Sukhothai	Bankluei Subdistrict	4.124	4.283	4.451	4.629	4.818	5.018	5.230	5.455	5.693	5.946
Sukhothai	Srisamrong Subdistrict	2.108	2.146	2.186	2.229	2.274	2.322	2.373	2.427	2.484	2.544
Sukhothai	Hadsiew Subdistrict	3.559	3.684	3.817	3.957	4.106	4.264	4.431	4.608	4.796	4.996
Sukhothai	Lanhoi Subdistrict	1.912	1.939	1.966	1.996	2.027	2.060	2.095	2.133	2.172	2.214
Sukhothai	Bantanode Subdistrict	1.706	1.720	1.735	1.751	1.767	1.785	1.804	1.824	1.845	1.867
Sukhothai	Thunglaung Subdistrict	1.824	1.845	1.868	1.891	1.916	1.942	1.970	2.000	2.032	2.065
Sukhothai	Kongkraitai Subdistrict	1.975	2.005	2.037	2.071	2.107	2.145	2.185	2.227	2.273	2.321
Sukhothai	Srinakorn Subdistrict	1.598	1.606	1.614	1.622	1.631	1.640	1.650	1.661	1.672	1.684
Nongkhai	Nongsong Subdistrict	1.594	1.601	1.609	1.617	1.626	1.635	1.645	1.655	1.666	1.677
Nongkhai	Phompisai Subdistrict	1.504	1.506	1.508	1.510	1.512	1.515	1.517	1.520	1.522	1.525
Nongkhai	Sri chiangmai Subdistrict	1.509	1.511	1.513	1.515	1.518	1.521	1.523	1.526	1.530	1.533
Nongkhai	Sri pana Subdistrict	3.174	3.276	3.384	3.499	3.620	3.749	3.885	4.030	4.183	4.345
Nongkhai	Thasa-ard Subdistrict	1.739	1.755	1.772	1.790	1.809	1.829	1.850	1.873	1.897	1.922
Nongkhai	Sopisai Subdistrict	1.506	1.508	1.510	1.512	1.515	1.517	1.520	1.522	1.525	1.528
Nongkhai	Don yanang Subdistrict	2.977	3.067	3.163	3.264	3.371	3.485	3.606	3.734	3.869	4.013
Nongkhai	Pakkad Subdistrict	2.090	2.127	2.166	2.208	2.252	2.298	2.348	2.400	2.456	2.515
Nongbualamphu	Namafueang Subdistrict	2.700	2.773	2.851	2.934	3.021	3.114	3.212	3.317	3.427	3.544
Nongbualamphu	Nakhamhai Subdistrict	5.467	5.706	5.960	6.229	6.514	6.817	7.137	7.477	7.837	8.218
Nongbualamphu	Kudoo Subdistrict	1.659	1.670	1.682	1.694	1.707	1.721	1.736	1.752	1.769	1.787
Nongbualamphu	Nonsoongplueai Subdistrict	1.505	1.507	1.509	1.511	1.514	1.516	1.518	1.521	1.524	1.527
Nongbualamphu	Jomthong Subdistrict	1.808	1.828	1.850	1.872	1.896	1.922	1.949	1.977	2.007	2.039
Nongbualamphu	Bankok Subdistrict	1.494	1.495	1.497	1.498	1.500	1.501	1.503	1.505	1.506	1.508
Amnat Charoen	Nayom Subdistrict	2.259	2.306	2.356	2.409	2.465	2.524	2.587	2.654	2.724	2.799
Amnat Charoen	Namleek Subdistrict	4.635	4.825	5.026	5.239	5.465	5.705	5.959	6.228	6.513	6.815
Amnat Charoen	Pana Subdistrict	1.523	1.526	1.529	1.532	1.536	1.540	1.544	1.548	1.552	1.557
Amnat Charoen	Senangkanikom Subdistrict	1.679	1.692	1.705	1.719	1.733	1.749	1.766	1.783	1.802	1.821
Udon Thani	Nonghua Subdistrict	3.252	3.358	3.471	3.591	3.718	3.853	3.996	4.147	4.307	4.477
Udon Thani	Banchan Subdistrict	1.515	1.517	1.520	1.523	1.526	1.529	1.532	1.536	1.539	1.543
Udon Thani	Nikomsongkraw Subdistrict	1.712	1.726	1.741	1.757	1.774	1.792	1.811	1.832	1.853	1.876
Udon Thani	Bankha Subdistrict	2.656	2.727	2.802	2.881	2.966	3.055	3.150	3.251	3.357	3.470
Udon Thani	Huaykeng Subdistrict	2.135	2.174	2.216	2.261	2.308	2.358	2.410	2.466	2.526	2.589
Udon Thani	Kumwapee Subdistrict	1.900	1.925	1.952	1.981	2.012	2.044	2.078	2.114	2.153	2.194
Udon Thani	Pakho Subdistrict	8.350	8.762	9.199	9.662	10.153	10.674	11.226	11.810	12.430	13.087
Udon Thani	Nongmek Subdistrict	2.234	2.280	2.328	2.380	2.434	2.492	2.553	2.617	2.686	2.759
Udon Thani	Banpue Subdistrict	2.453	2.512	2.574	2.640	2.710	2.784	2.863	2.946	3.034	3.128
Udon Thani	Nangua Subdistrict	1.635	1.644	1.655	1.665	1.677	1.689	1.701	1.715	1.729	1.744
Udon Thani	Sammoh Subdistrict	3.363	3.477	3.597	3.724	3.859	4.002	4.154	4.314	4.485	4.665
Udon Thani	Toomfong Subdistrict	2.174	2.216	2.261	2.308	2.358	2.411	2.468	2.527	2.590	2.657
Udon Thani	Banchiang Subdistrict	2.583	2.649	2.719	2.793	2.872	2.956	3.044	3.138	3.237	3.343
Udon Thani	Nonsoong-Namkham Town	10.612	10.660	10.710	10.763	10.819	10.878	10.942	11.008	11.079	11.155
Udon Thani	Nongwasow Subdistrict	1.879	1.903	1.928	1.955	1.984	2.014	2.046	2.081	2.117	2.155
Uttaradit	Uttaradit Town	13.414	13.630	13.858	14.100	14.356	14.627	14.915	15.221	15.544	15.887
Uttaradit	Bankoh Subdistrict	1.554	1.558	1.563	1.568	1.574	1.580	1.586	1.593	1.600	1.607
Uttaradit	Nampad Subdistrict	2.935	3.023	3.116	3.214	3.318	3.429	3.546	3.670	3.802	3.941
Uttaradit	Naimuang Subdistrict	1.723	1.737	1.753	1.770	1.788	1.807	1.827	1.848	1.870	1.894
Uttaradit	Thasak Subdistrict	1.790	1.809	1.830	1.851	1.874	1.898	1.923	1.950	1.979	2.009
Uttaradit	Huadong Subdistrict	1.504	1.506	1.508	1.510	1.512	1.514	1.517	1.519	1.522	1.525
Uttaradit	Ssipanammatt Subdistrict	1.718	1.733	1.748	1.765	1.782	1.801	1.821	1.841	1.864	1.887
Uttaradit	Bankaeng Subdistrict	1.497	1.499	1.500	1.502	1.504	1.505	1.507	1.509	1.512	1.514
Uttaradit	Wangkapee Subdistrict	2.782	2.861	2.944	3.032	3.125	3.224	3.329	3.440	3.558	3.683
Uttaradit	Bankok Subdistrict	2.329	2.380	2.435	2.492	2.553	2.618	2.687	2.760	2.837	2.918
Uttaradit	Ruamjit Subdistrict	1.547	1.551	1.556	1.561	1.566	1.572	1.577	1.584	1.590	1.597
Uthai Thani	Uthai Thani Town	11.449	11.546	11.650	11.759	11.875	11.998	12.128	12.266	12.412	12.567
Uthai Thani	Thapthan Subdistrict	2.156	2.197	2.240	2.286	2.335	2.386	2.441	2.499	2.560	2.625
Uthai Thani	Talukdoo Subdistrict	1.985	2.016	2.048	2.083	2.119	2.158	2.199	2.243	2.289	2.338
Uthai Thani	Banrai Subdistrict	1.508	1.510	1.512	1.514	1.517	1.519	1.522	1.525	1.528	1.532
Uthai Thani	Khaobangkarak Subdistrict	1.605	1.613	1.621	1.630	1.640	1.650	1.660	1.671	1.683	1.696
Ubon Ratchathani	Ubon Ratchathani City	45.061	45.735	46.449	47.206	48.008	48.858	49.760	50.715	51.728	52.801
Ubon Ratchathani	Ubon Subdistrict	2.349	2.401	2.457	2.516	2.578	2.644	2.714	2.788	2.867	2.950
Ubon Ratchathani	Khamyai Subdistrict	12.666	13.337	14.049	14.803	15.602	16.450	17.348	18.301	19.310	20.380
Ubon Ratchathani	Angsila Subdistrict	1.994	2.025	2.058	2.093	2.130	2.169	2.211	2.255	2.302	2.352
Ubon Ratchathani	Trakarnphuephon Subdistrict	1.929	1.956	1.985	2.016	2.048	2.082	2.119	2.158	2.198	2.242
Ubon Ratchathani	Dhetudom Town	13.218	13.421	13.636	13.865	14.107	14.363	14.635	14.923	15.229	15.553
Ubon Ratchathani	Buangam Subdistrict	1.485	1.486	1.486	1.487	1.488	1.489	1.490	1.491	1.492	1.493
Ubon Ratchathani	Nasuang Subdistrict	1.876	1.900	1.926	1.953	1.982	2.012	2.044	2.078	2.114	2.153
Ubon Ratchathani	Nayear Subdistrict	1.498	1.500	1.501	1.503	1.505	1.507	1.509	1.511	1.513	1.515
Ubon Ratchathani	Sansuk Subdistrict	12.292	12.940	13.628	14.356	15.128	15.947	16.815	17.734	18.709	19.743
Ubon Ratchathani	Bandan Subdistrict	1.567	1.572	1.578	1.584	1.591	1.598	1.605	1.613	1.621	1.630
Ubon Ratchathani	Posai Subdistrict	1.540	1.544	1.548	1.552	1.557	1.562	1.567	1.573	1.579	1.585
Angthong	Angthong Town	9.848	9.849	9.850	9.852	9.853	9.855	9.857	9.858		

Province	Municipality	Waste (1,000 ton)									
		YEAR1	YEAR2	YEAR3	YEAR4	YEAR5	YEAR6	YEAR7	YEAR8	YEAR9	YEAR10
Chiangrai	Padad Subdistrict	1.673	1.684	1.697	1.710	1.724	1.739	1.754	1.771	1.789	1.808
Chiangrai	Muangpan Subdistrict	1.746	1.762	1.779	1.798	1.817	1.838	1.859	1.882	1.907	1.933
Chiangrai	Maesai Subdistrict	3.335	3.446	3.564	3.689	3.822	3.963	4.112	4.270	4.437	4.615
Chiangrai	Boonrueng Subdistrict	7.053	7.388	7.743	8.119	8.517	8.940	9.387	9.862	10.365	10.899
Chiangrai	Chiangsan Subdistrict	2.069	2.105	2.143	2.183	2.225	2.270	2.318	2.369	2.423	2.479
Chiangrai	Wiangmueng Subdistrict	1.663	1.674	1.686	1.699	1.712	1.727	1.742	1.758	1.775	1.793
Chiangrai	Chediluang Subdistrict	1.704	1.718	1.733	1.748	1.764	1.782	1.800	1.820	1.841	1.862
Chiangrai	Banplong Subdistrict	1.712	1.726	1.741	1.757	1.774	1.792	1.811	1.831	1.853	1.875
Chiangrai	Maekhum Subdistrict	1.555	1.560	1.565	1.571	1.577	1.583	1.589	1.596	1.603	1.611
Chiangrai	Pakhodam Subdistrict	1.911	1.937	1.965	1.994	2.026	2.059	2.094	2.131	2.170	2.212
Chiangrai	Maelao Subdistrict	1.648	1.658	1.669	1.681	1.693	1.706	1.720	1.735	1.751	1.767
Chiangrai	Chanchwa Subdistrict	3.627	3.756	3.893	4.037	4.191	4.353	4.526	4.709	4.902	5.108
Chiangrai	Payamengrai Subdistrict	1.855	1.878	1.902	1.927	1.954	1.983	2.013	2.046	2.080	2.116
Chiangrai	Banta Subdistrict	2.357	2.410	2.466	2.526	2.589	2.656	2.727	2.802	2.882	2.966
Chiangmai	Nonghot Subdistrict	1.721	1.736	1.752	1.768	1.786	1.805	1.824	1.845	1.867	1.891
Chiangmai	Faham Subdistrict	1.715	1.730	1.745	1.761	1.778	1.796	1.816	1.836	1.858	1.881
Chiangmai	Bankha Subdistrict	1.628	1.638	1.648	1.658	1.669	1.681	1.694	1.707	1.721	1.736
Chiangmai	Banklang Subdistrict	1.996	2.027	2.060	2.094	2.131	2.170	2.212	2.256	2.303	2.352
Chiangmai	Sanpatong Subdistrict	1.659	1.670	1.682	1.694	1.707	1.721	1.736	1.752	1.769	1.786
Chiangmai	Nongphueng Subdistrict	2.295	2.344	2.396	2.451	2.510	2.571	2.637	2.706	2.780	2.858
Chiangmai	Saraphee Subdistrict	1.525	1.528	1.531	1.535	1.538	1.542	1.546	1.550	1.555	1.560
Chiangmai	Muangkanpattana Town	10.007	10.018	10.029	10.042	10.054	10.068	10.082	10.098	10.114	10.131
Chiangmai	Maepang Subdistrict	2.466	2.526	2.589	2.655	2.726	2.801	2.881	2.965	3.054	3.149
Chiangmai	Chedimaekrua Subdistrict	3.371	3.485	3.605	3.733	3.868	4.011	4.163	4.324	4.495	4.676
Chiangmai	Nongjom Subdistrict	2.707	2.781	2.860	2.943	3.030	3.124	3.223	3.327	3.438	3.556
Chiangmai	Hangdong Subdistrict	1.547	1.551	1.556	1.561	1.566	1.572	1.578	1.584	1.591	1.598
Chiangmai	Thkham Subdistrict	1.868	1.891	1.916	1.943	1.971	2.001	2.032	2.066	2.101	2.139
Chiangmai	Tadue Subdistrict	1.619	1.628	1.637	1.647	1.657	1.668	1.680	1.692	1.705	1.718
Chiangmai	Maajo Subdistrict	2.106	2.143	2.183	2.226	2.270	2.318	2.368	2.422	2.479	2.539
Chiangmai	Chalprakam Subdistrict	2.071	2.107	2.144	2.184	2.227	2.271	2.319	2.369	2.423	2.480
Chiangmai	Yangneng Subdistrict	2.638	2.708	2.782	2.860	2.944	3.032	3.125	3.224	3.329	3.440
Chiangmai	Maenam Subdistrict	1.491	1.492	1.493	1.494	1.495	1.497	1.498	1.499	1.501	1.503
Chiangmai	Jomthong Subdistrict	1.860	1.883	1.907	1.933	1.961	1.990	2.021	2.053	2.088	2.125
Chiangmai	Nongthongpattana Subdistrict	1.929	1.956	1.985	2.016	2.048	2.082	2.119	2.157	2.198	2.242
Chiangmai	Sansaihuang Subdistrict	2.598	2.666	2.737	2.812	2.893	2.978	3.068	3.163	3.264	3.371
Phetchaburi	Bangtaboon Subdistrict	2.293	2.342	2.394	2.450	2.508	2.570	2.636	2.705	2.779	2.858
Phetchaburi	Banlad Subdistrict	1.610	1.618	1.626	1.635	1.645	1.655	1.666	1.678	1.690	1.703
Phetchaburi	Phetchabun Town	11.256	11.341	11.432	11.528	11.630	11.738	11.853	11.974	12.103	12.239
Phetchaburi	Lomkao Subdistrict	1.973	2.003	2.034	2.068	2.104	2.141	2.182	2.224	2.269	2.317
Phetchaburi	Wichianburi Subdistrict	3.304	3.414	3.530	3.653	3.784	3.922	4.068	4.224	4.389	4.563
Phetchaburi	Nongphai Subdistrict	1.754	1.771	1.789	1.808	1.828	1.849	1.872	1.896	1.921	1.948
Phetchaburi	Takham Subdistrict	1.564	1.569	1.575	1.581	1.588	1.595	1.602	1.610	1.618	1.627
Phetchaburi	Chondan Subdistrict	2.079	2.115	2.153	2.194	2.237	2.283	2.332	2.383	2.438	2.496
Phetchaburi	Subsamotod Subdistrict	4.975	5.185	5.407	5.643	5.893	6.158	6.439	6.737	7.052	7.387
Phetchaburi	Phutoey Subdistrict	4.158	4.318	4.489	4.669	4.861	5.063	5.278	5.506	5.748	6.004
Phetchaburi	Dongkhui Subdistrict	1.647	1.657	1.668	1.680	1.692	1.705	1.719	1.734	1.749	1.766
Phetchaburi	Nachiang Subdistrict	2.938	3.026	3.119	3.218	3.322	3.433	3.551	3.675	3.807	3.947
Phetchaburi	Taidong Subdistrict	2.143	2.183	2.226	2.271	2.318	2.369	2.422	2.479	2.540	2.603
Phetchaburi	Tapon Subdistrict	2.075	2.111	2.150	2.190	2.233	2.279	2.327	2.378	2.432	2.490
Loei	Na-or Subdistrict	1.495	1.496	1.497	1.499	1.500	1.501	1.503	1.505	1.507	1.508
Loei	Chiangkam Subdistrict	1.701	1.715	1.729	1.744	1.760	1.777	1.796	1.815	1.835	1.857
Loei	Khaokaew Subdistrict	1.899	1.925	1.952	1.981	2.011	2.044	2.078	2.114	2.152	2.193
Loei	Dansai Subdistrict	1.501	1.502	1.504	1.506	1.508	1.510	1.512	1.514	1.517	1.519
Loei	Pakchom Subdistrict	1.665	1.676	1.688	1.701	1.715	1.729	1.745	1.761	1.778	1.797
Loei	Phurua Subdistrict	2.587	2.654	2.724	2.799	2.879	2.963	3.053	3.147	3.248	3.354
Loei	Phukradueng Subdistrict	1.522	1.524	1.527	1.531	1.534	1.537	1.541	1.545	1.549	1.554
Loei	Nadwang Subdistrict	1.587	1.594	1.601	1.609	1.617	1.625	1.635	1.644	1.655	1.665
Phrae	Phrae Town	12.137	12.276	12.422	12.578	12.743	12.918	13.104	13.300	13.509	13.730
Phrae	Maelai Subdistrict	1.509	1.511	1.513	1.516	1.518	1.521	1.524	1.527	1.530	1.534
Phrae	Thungphong Subdistrict	1.798	1.817	1.837	1.859	1.882	1.906	1.932	1.959	1.988	2.019
Phrae	Maechua Subdistrict	1.523	1.526	1.530	1.533	1.536	1.540	1.544	1.548	1.553	1.558
Phrae	Song Subdistrict	1.921	1.948	1.976	2.007	2.039	2.072	2.108	2.146	2.187	2.230
Phrae	Soongmen Subdistrict	1.711	1.725	1.740	1.756	1.773	1.791	1.810	1.830	1.852	1.874
Phrae	Wangchin Subdistrict	1.671	1.683	1.696	1.709	1.723	1.738	1.753	1.770	1.788	1.807
Phrae	Nongmuangkai Subdistrict	1.788	1.807	1.826	1.848	1.870	1.894	1.919	1.946	1.974	2.004
Mae Hong Son	Mae Hong Son Town	9.913	9.919	9.924	9.930	9.937	9.944	9.951	9.958	9.967	9.975
Mae Hong Son	Maesariang Subdistrict	2.181	2.223	2.268	2.316	2.367	2.420	2.477	2.537	2.601	2.668
Mae Hong Son	Maelanoi Subdistrict	1.703	1.717	1.732	1.747	1.763	1.781	1.799	1.819	1.839	1.861

Appendix B

The net saving (NS), savings to investment ratio (SIR) and the internal rate of return (IRR) of project

Province	Municipality	NS1	NS2	NS3	SIR1	SIR2	SIR3	IRR1	IRR2	IRR3
Krabi	Klonghontai Subdistrict	5.511	5.804	6.389	2.532	2.613	2.776	94.1%	99.0%	109.0%
Krabi	Kholantayai Subdistrict	6.476	6.758	7.322	2.800	2.878	3.035	107.3%	112.1%	121.8%
Kanchanaburi	Samrong Subdistrict	4.621	4.842	5.283	2.284	2.346	2.468	75.6%	79.3%	86.6%
Kanchanaburi	Thamuang Subdistrict	7.383	7.782	8.578	3.052	3.162	3.384	122.7%	129.3%	142.8%
Kanchanaburi	Nongkho Subdistrict	10.864	11.556	12.939	4.019	4.211	4.596	185.1%	196.6%	219.7%
Kanchanaburi	Takya Subdistrict	8.372	8.583	9.006	3.326	3.385	3.503	142.8%	146.7%	154.6%
Kanchanaburi	Thalor Subdistrict	4.079	4.298	4.737	2.134	2.195	2.316	66.7%	70.2%	77.4%
Kanchanaburi	Wangkanai Subdistrict	8.303	8.528	8.977	3.307	3.370	3.495	141.4%	145.5%	153.8%
Kanchanaburi	Lukkae Subdistrict	6.542	6.853	7.476	2.818	2.905	3.077	108.2%	113.5%	124.1%
Kanchanaburi	Tamaka Subdistrict	8.684	8.978	9.565	3.413	3.495	3.658	147.9%	153.1%	163.5%
Kanchanaburi	Tamai Subdistrict	5.849	6.087	6.564	2.625	2.692	2.824	96.5%	100.6%	108.9%
Kanchanaburi	Wainlaw Subdistrict	4.527	4.809	5.373	2.258	2.336	2.493	73.6%	78.1%	87.2%
Kanchanaburi	Namtok sayoinoi Subdistrict	5.309	5.530	5.971	2.475	2.537	2.659	87.3%	91.0%	98.6%
Kanchanaburi	Boploi Subdistrict	4.565	4.841	5.394	2.269	2.345	2.499	74.3%	78.7%	87.7%
Kanchanaburi	Rangwai Subdistrict	5.296	5.514	5.951	2.472	2.532	2.654	87.1%	90.8%	98.3%
Kanchanaburi	Nongfai Subdistrict	9.924	10.131	10.544	3.758	3.815	3.930	172.3%	176.2%	184.1%
Kanchanaburi	Nongree Subdistrict	3.911	4.140	4.597	2.087	2.150	2.278	64.0%	67.6%	74.9%
Kanchanaburi	Arawan Subdistrict	5.388	5.588	5.988	2.497	2.553	2.664	88.8%	92.3%	99.3%
Kanchanaburi	Wangpho Subdistrict	4.109	4.333	4.783	2.142	2.204	2.329	67.2%	70.8%	78.1%
Kalasin	Najan Subdistrict	5.162	5.370	5.785	2.435	2.492	2.608	84.9%	88.4%	95.6%
Kalasin	Huaypo Subdistrict	8.398	8.607	9.026	3.334	3.392	3.508	143.3%	147.2%	155.1%
Kalasin	Kutwa Subdistrict	6.079	6.369	6.950	2.689	2.770	2.931	100.2%	105.0%	114.9%
Kalasin	Buakhao Subdistrict	5.801	6.088	6.663	2.612	2.692	2.852	95.3%	100.1%	109.8%
Kalasin	Koksir Subdistrict	10.941	11.158	11.593	4.040	4.101	4.222	191.7%	195.9%	204.1%
Kalasin	Yangtad Subdistrict	8.632	8.892	9.414	3.399	3.471	3.616	147.2%	151.9%	161.3%
Kalasin	Nongpan Subdistrict	1.619	1.831	2.257	1.450	1.509	1.627	29.9%	32.8%	38.8%
Kalasin	Somdet Subdistrict	5.841	6.172	6.832	2.623	2.715	2.899	95.6%	101.1%	112.1%
Kalasin	Kudsim Subdistrict	1.690	1.927	2.400	1.470	1.535	1.667	30.8%	34.0%	40.7%
Kalasin	Nakoo Subdistrict	4.607	4.860	5.366	2.280	2.351	2.491	75.2%	79.2%	87.5%
Kalasin	Khamyai Subdistrict	6.312	6.546	7.014	2.754	2.819	2.949	104.8%	108.9%	117.1%
Kalasin	Khammuang Subdistrict	4.983	5.233	5.732	2.385	2.454	2.593	81.5%	85.6%	93.9%
Kalasin	Thakantho Subdistrict	5.879	6.089	6.508	2.634	2.692	2.809	97.3%	101.0%	108.4%
Kalasin	Nongkungsir Subdistrict	7.061	7.311	7.813	2.962	3.032	3.171	118.2%	122.6%	131.5%
Kamphaeng Phet	Khonglanpattana Subdistrict	7.022	7.223	7.626	2.951	3.007	3.119	117.9%	121.6%	129.0%
Kamphaeng Phet	Thungsai Subdistrict	4.301	4.504	4.911	2.195	2.252	2.365	70.4%	73.8%	80.6%
Kamphaeng Phet	Kamphaeng Phet Town	8.309	9.768	12.685	2.155	2.357	2.763	67.6%	79.4%	104.3%
Kamphaeng Phet	Pakdong Subdistrict	4.387	4.703	5.334	2.219	2.307	2.482	71.1%	76.0%	86.0%
Kamphaeng Phet	Prankratat Subdistrict	6.663	7.176	8.201	2.852	2.994	3.279	108.6%	116.8%	133.5%
Kamphaeng Phet	Tamakhue Subdistrict	5.397	5.644	6.139	2.500	2.568	2.706	88.6%	92.7%	101.1%
Kamphaeng Phet	Khamuworakabsuri Subdistrict	3.577	3.830	4.337	1.994	2.064	2.205	58.5%	62.4%	70.3%
Kamphaeng Phet	Lankrabue Subdistrict	5.132	5.367	5.836	2.426	2.491	2.622	84.1%	88.1%	96.0%
Khon Kaen	Khon Kaen City	12.243	16.928	26.297	1.851	2.176	2.827	50.6%	68.9%	108.9%
Khon Kaen	Sawathee Subdistrict	4.623	4.834	5.256	2.285	2.343	2.461	75.7%	79.2%	86.3%
Khon Kaen	Bankho Subdistrict	2.140	2.345	2.755	1.595	1.652	1.766	37.2%	40.2%	46.2%
Khon Kaen	Nonsila Subdistrict	4.541	4.763	5.207	2.262	2.324	2.447	74.3%	77.9%	85.3%
Khon Kaen	Koksoongsamphan Subdistrict	4.901	5.148	5.641	2.362	2.431	2.568	80.1%	84.2%	92.4%
Khon Kaen	Wangchai Subdistrict	3.986	4.237	4.740	2.108	2.177	2.317	65.0%	68.9%	77.0%
Khon Kaen	Bankok Subdistrict	3.405	3.632	4.087	1.946	2.009	2.136	56.0%	59.5%	66.6%
Khon Kaen	Chonnabot Subdistrict	5.362	5.752	6.533	2.490	2.599	2.816	86.8%	93.0%	105.6%
Khon Kaen	Nongkae Subdistrict	9.992	10.235	10.721	3.777	3.844	3.979	173.2%	177.7%	186.7%
Khon Kaen	Srichompo Subdistrict	6.034	6.332	6.928	2.677	2.760	2.925	99.3%	104.3%	114.4%
Khon Kaen	Kaosaunkwang Subdistrict	5.783	6.028	6.519	2.607	2.675	2.812	95.3%	99.5%	108.0%
Khon Kaen	Nampong Subdistrict	7.668	7.872	8.282	3.131	3.188	3.301	129.8%	133.5%	141.1%
Khon Kaen	Wangyai Subdistrict	5.177	5.388	5.810	2.439	2.497	2.615	85.1%	88.7%	96.0%
Khon Kaen	Pueynoi Subdistrict	6.115	6.347	6.811	2.699	2.764	2.893	101.3%	105.3%	113.5%
Chanthaburi	Chanthanimit Subdistrict	6.519	6.864	7.554	2.812	2.908	3.099	107.5%	113.3%	124.9%
Chanthaburi	Chanthaburi Town	9.790	11.316	14.367	2.360	2.572	2.996	79.6%	92.3%	118.8%
Chanthaburi	Bangkaja Subdistrict	4.087	4.324	4.797	2.136	2.202	2.333	66.7%	70.5%	78.1%
Chanthaburi	Thamai Subdistrict	4.499	4.718	5.156	2.250	2.311	2.433	73.6%	77.2%	84.5%
Chanthaburi	Noensoong Subdistrict	4.716	4.936	5.377	2.311	2.372	2.494	77.2%	80.9%	88.3%
Chanthaburi	Paknamlamsingha Subdistrict	5.696	5.910	6.339	2.583	2.643	2.762	94.1%	97.8%	105.3%
Chanthaburi	Subdistrict	6.863	7.078	7.509	2.907	2.967	3.087	114.5%	118.8%	126.5%
Chanthaburi	Subdistrict	6.941	7.160	7.598	2.929	2.990	3.111	116.3%	120.2%	128.1%
Chanthaburi	Subdistrict	4.775	4.977	5.379	2.327	2.383	2.495	78.4%	81.7%	88.6%
Cha Choeng Sao	Cha Choeng Sao Town	8.446	9.989	13.074	2.174	2.388	2.817	68.4%	80.9%	107.0%
Cha Choeng Sao	Paknam Subdistrict	5.485	5.695	6.116	2.524	2.583	2.700	90.4%	94.0%	101.4%
Cha Choeng Sao	Kokkhanoon Subdistrict	5.927	6.202	6.751	2.647	2.723	2.876	97.6%	102.2%	111.6%
Cha Choeng Sao	Khaohinson Subdistrict	5.211	5.428	5.862	2.448	2.508	2.629	85.6%	89.3%	96.8%
Cha Choeng Sao	Phanomrakam Subdistrict	7.137	7.588	8.490	2.983	3.109	3.359	117.7%	125.1%	140.1%
Cha Choeng Sao	Thasaam Subdistrict	11.867	12.233	12.967	4.298	4.400	4.603	208.0%	214.5%	227.5%
Cha Choeng Sao	Homsin Subdistrict	2.485	2.864	3.621	1.691	1.796	2.006	41.5%	46.7%	57.3%
Cha Choeng Sao	Phimpha Subdistrict	5.226	5.436	5.857	2.452	2.511	2.628	86.0%	89.5%	96.8%
Cha Choeng Sao	Dorchimpletee Subdistrict	7.818	8.393	9.542	3.173	3.332	3.652	129.0%	138.3%	157.3%
Cha Choeng Sao	Bangnampiao Subdistrict	4.662	4.972	5.593	2.295	2.382	2.554	75.6%	80.5%	90.5%
Cha Choeng Sao	Saladang Subdistrict	6.993	7.213	7.654	2.943	3.005	3.127	117.2%	121.2%	129.1%
Cha Choeng Sao	Sanamchaikhet Subdistrict	6.610	6.867	7.381	2.837	2.908	3.051	109.9%	114.4%	123.4%
Cha Choeng Sao	Bangwua Subdistrict	11.925	12.225	12.825	4.314	4.397	4.564	209.9%	215.3%	226.2%
Cha Choeng Sao	Huasamrong Subdistrict	5.086	5.334	5.831	2.413	2.482	2.620	83.3%	87.4%	95.7%
Cha Choeng Sao	Plaengyao Subdistrict	5.270	5.518	6.013	2.465	2.533	2.671	86.4%	90.5%	98.9%
Chonburi	Klonguamru Subdistrict	7.960	8.189	8.647	3.212	3.276	3.403	135.0%	139.1%	147.5%
Chonburi	Bansuan Town	14.298	15.856	18.972	2.987	3.203	3.636	119.1%	133.0%	161.4%
Chonburi	Donhualor Subdistrict	6.965	7.192	7.646	2.936	2.999	3.125	116.7%	120.7%	128.8%
Chonburi	Nongmaidaeng Subdistrict	6.673	6.950	7.505	2.854	2.931	3.086	110.9%	115.7%	125.3%
Chonburi	Huaykapi Subdistrict	8.168	8.415	8.908	3.270	3.338	3.475	138.7%	143.1%	152.0%
Chonburi	Bangphra Subdistrict	3.703	4.037	4.706	2.029	2.122	2.308	60.0%	65.0%	75.2%
Chonburi	Phanatikom Town	6.950	8.596	11.887	1.966	2.194	2.652	56.3%	68.9%	95.7%
Chonburi	Takhlantia Subdistrict	6.084	6.299	6.728	2.691	2.750	2.870	100.9%	104.7%	112.3%
Chonburi	Phanthong Subdistrict	7.938	8.260	8.903	3.206	3.295	3.474	133.6%	139.2%	150.4%
Chonburi	Nongsak Subdistrict	1.681	1.895	2.322	1.467	1.527	1.645	30.7%	33.7%	39.8%
Chonburi	Khochan Subdistrict	6.280	6.514	6.982	2.745	2.810	2.940	104.2%	108.3%	116.5%
Chainat	Chainat Town	10.395	11.879	14.846	2.444	2.651	3.063	84.9%	97.5%	123.6%

Province	Municipality	NS1	NS2	NS3	SIR1	SIR2	SIR3	IRR1	IRR2	IRR3
Chainat	Wangtakean Subdistrict	4.792	4.991	5.388	2.332	2.387	2.497	78.7%	82.0%	88.8%
Chainat	Hunkha Subdistrict	7.492	7.760	8.295	3.082	3.157	3.305	125.9%	130.6%	140.1%
Chainat	Nongsang Subdistrict	2.321	2.520	2.919	1.645	1.700	1.811	39.9%	42.8%	48.7%
Chainat	Nuenkham Subdistrict	4.732	4.932	5.330	2.315	2.370	2.481	77.6%	81.0%	87.8%
Chainat	Sapphaya Subdistrict	7.097	7.399	8.002	2.972	3.056	3.224	118.4%	123.5%	134.0%
Chainat	Samgambhabat Subdistrict	7.291	7.554	8.081	3.026	3.099	3.246	122.3%	126.9%	136.2%
Chainat	Hangnamsakorn Subdistrict	5.875	6.087	6.513	2.633	2.692	2.810	97.2%	100.9%	108.4%
Chaiyaphum	Ladyai Subdistrict	3.774	4.026	4.531	2.049	2.119	2.259	61.6%	65.5%	73.5%
Chaiyaphum	Banphethukhieo Subdistrict	5.849	6.091	6.576	2.625	2.693	2.827	96.5%	100.7%	109.0%
Chaiyaphum	Chaturat Subdistrict	5.866	6.156	6.735	2.630	2.711	2.872	96.4%	101.3%	111.0%
Chaiyaphum	Nanongtum Subdistrict	1.653	1.925	2.470	1.459	1.535	1.686	30.2%	33.9%	41.4%
Chaiyaphum	Banphet Subdistrict	8.322	8.720	9.516	3.313	3.423	3.644	140.0%	146.8%	160.4%
Chaiyaphum	Bummetnarong Subdistrict	5.422	5.685	6.210	2.507	2.580	2.726	88.9%	93.3%	102.1%
Chaiyaphum	Nonbuokhok Subdistrict	3.558	3.815	4.328	1.989	2.060	2.203	58.2%	62.1%	70.1%
Chaiyaphum	Banphaimuepaw Subdistrict	5.660	5.934	6.482	2.573	2.649	2.801	92.9%	97.5%	106.8%
Chaiyaphum	Nonghuorawea Subdistrict	4.464	4.671	5.086	2.241	2.298	2.413	73.1%	76.5%	83.5%
Chumphon	Paknamlangsuan Subdistrict	6.231	6.488	7.001	2.731	2.803	2.946	103.1%	107.6%	116.5%
Chumphon	Napo Subdistrict	8.791	9.064	9.609	3.443	3.519	3.670	150.1%	155.0%	164.8%
Chumphon	Nernsanti Subdistrict	6.872	7.089	7.525	2.910	2.970	3.091	115.0%	118.9%	126.8%
Chumphon	Pathio Subdistrict	13.842	14.091	14.590	4.847	4.916	5.055	247.8%	252.5%	261.9%
Chumphon	Mapammarit Subdistrict	6.495	6.726	7.188	2.805	2.869	2.998	108.1%	112.2%	120.3%
Chumphon	Saplee Subdistrict	1.837	2.060	2.507	1.511	1.573	1.697	32.9%	36.0%	42.3%
Trang	Huaiyod Subdistrict	9.631	9.837	10.250	3.677	3.734	3.848	166.7%	170.6%	178.4%
Trang	Sikao Subdistrict	9.181	9.428	9.922	3.551	3.620	3.757	157.7%	162.3%	171.3%
Trang	Lumpura Subdistrict	2.926	3.126	3.527	1.813	1.869	1.980	48.8%	51.8%	58.0%
Trang	Nawong Subdistrict	2.840	3.153	3.778	1.789	1.876	2.050	46.9%	51.4%	60.6%
Trang	Wanwises Subdistrict	8.294	8.527	8.994	3.305	3.370	3.499	141.1%	145.4%	153.9%
Trat	Trat Town	8.288	9.604	12.235	2.152	2.334	2.700	67.9%	78.8%	101.6%
Trat	Thaphriknoensai Subdistrict	5.371	5.788	6.621	2.493	2.608	2.840	86.8%	93.4%	106.7%
Trat	Laemngob Subdistrict	2.908	3.204	3.796	1.808	1.890	2.055	48.0%	52.3%	61.1%
Tak	Tak Town	8.322	9.821	12.818	2.156	2.365	2.781	67.6%	79.7%	105.1%
Tak	Maingam Subdistrict	6.650	7.165	8.197	2.848	2.991	3.278	108.3%	116.6%	133.4%
Tak	Maeku Subdistrict	1.293	1.567	2.116	1.359	1.435	1.588	25.2%	28.9%	36.3%
Tak	Samngao Subdistrict	3.616	3.861	4.352	2.005	2.073	2.209	59.2%	62.9%	70.6%
Tak	Maeramat Subdistrict	6.564	6.826	7.349	2.824	2.897	3.042	109.1%	113.6%	122.7%
Tak	Phoppha Subdistrict	2.972	3.171	3.570	1.826	1.881	1.992	49.5%	52.5%	58.7%
Tak	Umphang Subdistrict	4.812	5.020	5.436	2.337	2.395	2.511	78.9%	82.4%	89.5%
Nakorn Nayok	Ongkharak Subdistrict	5.295	5.554	6.071	2.471	2.543	2.687	86.7%	91.0%	99.7%
Nakorn Nayok	Khowai Subdistrict	8.796	9.034	9.508	3.445	3.510	3.642	150.6%	154.9%	163.6%
Nakorn Prathom	Prongmadua Subdistrict	5.494	5.963	6.900	2.527	2.657	2.918	88.5%	95.8%	110.8%
Nakorn Prathom	Donyaihom Subdistrict	5.631	6.025	6.814	2.565	2.674	2.893	91.4%	97.7%	110.6%
Nakorn Prathom	Lamphaya Subdistrict	2.827	3.029	3.432	1.786	1.842	1.954	47.3%	50.3%	56.5%
Nakorn Prathom	Rangkratum Subdistrict	10.424	10.673	11.169	3.897	3.966	4.104	181.5%	186.1%	195.2%
Nakorn Prathom	Samngam Subdistrict	6.290	6.567	7.120	2.748	2.825	2.979	104.0%	108.7%	118.3%
Nakorn Prathom	Klongyong Subdistrict	7.649	7.910	8.432	3.126	3.198	3.343	128.9%	133.5%	142.8%
Nakorn Phanom	Thauten Subdistrict	4.341	4.553	4.977	2.206	2.265	2.383	71.1%	74.5%	81.6%
Nakorn Phanom	Nakae Subdistrict	7.245	7.442	7.837	3.013	3.068	3.178	122.0%	125.7%	133.0%
Nakorn Phanom	Banphaeng Subdistrict	4.111	4.319	4.734	2.142	2.200	2.316	67.3%	70.7%	77.5%
Nakorn Phanom	Plapak Subdistrict	9.190	9.409	9.848	3.554	3.615	3.737	158.2%	162.3%	170.5%
Nakorn Phanom	Nawha Subdistrict	9.222	9.758	10.830	3.563	3.712	4.010	155.5%	164.5%	182.5%
Nakorn Phanom	Phonsawan Subdistrict	3.723	3.990	4.525	2.035	2.109	2.258	60.7%	64.8%	73.2%
Nakorn Ratchasima	Phoklang Subdistrict	6.183	6.531	7.228	2.718	2.815	3.009	101.5%	107.3%	118.9%
Nakorn Ratchasima	Nongkhainam Subdistrict	6.193	6.411	6.849	2.721	2.782	2.903	102.8%	106.6%	114.4%
Nakorn Ratchasima	Nongbualai Subdistrict	5.236	5.436	5.835	2.455	2.511	2.622	86.2%	89.6%	96.6%
Nakorn Ratchasima	Klangdong Subdistrict	3.212	3.447	3.919	1.892	1.958	2.089	53.0%	56.5%	63.8%
Nakorn Ratchasima	Srimamongkol Subdistrict	6.141	6.507	7.238	2.707	2.808	3.011	100.6%	106.6%	118.7%
Nakorn Ratchasima	Mueankpak Subdistrict	6.672	7.159	8.131	2.854	2.989	3.260	109.0%	116.9%	132.8%
Nakorn Ratchasima	Soongnoen Subdistrict	9.643	9.895	10.398	3.680	3.750	3.890	166.5%	171.1%	180.3%
Nakorn Ratchasima	Prathye Subdistrict	6.074	6.283	6.702	2.688	2.746	2.862	100.8%	104.5%	111.9%
Nakorn Ratchasima	Dankwian Subdistrict	7.015	7.325	7.945	2.949	3.036	3.208	116.8%	122.1%	132.8%
Nakorn Ratchasima	Dankhntod Subdistrict	6.733	7.044	7.665	2.871	2.958	3.130	111.7%	117.0%	127.6%
Nakorn Ratchasima	Phratongkham Subdistrict	3.494	3.729	4.198	1.971	2.036	2.167	57.3%	60.9%	68.3%
Nakorn Ratchasima	Khoksawai Subdistrict	9.476	9.706	10.166	3.633	3.697	3.825	163.5%	167.8%	176.3%
Nakorn Ratchasima	Thachang Subdistrict	8.568	8.814	9.304	3.381	3.449	3.586	146.2%	150.6%	159.6%
Nakorn Ratchasima	Hindad Subdistrict	6.351	6.619	7.154	2.765	2.839	2.988	105.2%	109.8%	119.0%
Nakorn Ratchasima	Saiyong - Chaiwan Subdistrict	3.614	3.816	4.220	2.004	2.060	2.173	59.4%	62.6%	69.1%
Nakorn Ratchasima	Kokkrut Subdistrict	7.683	8.340	9.655	3.135	3.318	3.683	125.7%	136.3%	157.7%
Nakorn Ratchasima	Nonghuafan Subdistrict	7.811	8.058	8.552	3.171	3.239	3.377	132.0%	136.4%	145.3%
Nakorn Ratchasima	Lathuakhao Subdistrict	3.920	4.123	4.529	2.089	2.146	2.259	64.3%	67.5%	74.2%
Nakorn Ratchasima	Srida Subdistrict	3.006	3.237	3.698	1.835	1.899	2.028	49.9%	53.3%	60.3%
Nakorn Si Thammarat	Nakorn Si Thammarat City	14.054	19.616	30.740	1.976	2.363	3.136	56.3%	77.9%	125.0%
Nakorn Si Thammarat	Sichon Subdistrict	8.742	9.225	10.190	3.430	3.564	3.832	147.1%	155.2%	171.5%
Nakorn Si Thammarat	Chawang Subdistrict	7.230	7.465	7.934	3.009	3.074	3.205	121.4%	125.6%	134.0%
Nakorn Si Thammarat	Khanom Subdistrict	6.993	7.674	9.036	2.943	3.133	3.511	113.0%	123.8%	145.7%
Nakorn Si Thammarat	Thongnian Subdistrict	6.033	6.512	7.470	2.676	2.810	3.076	97.7%	105.4%	120.8%
Nakorn Si Thammarat	Lansaka Subdistrict	5.138	5.401	5.928	2.428	2.501	2.647	84.0%	88.3%	97.1%
Nakorn Si Thammarat	Chandee Subdistrict	6.493	6.727	7.195	2.804	2.869	2.999	108.0%	112.1%	120.4%
Nakorn Si Thammarat	Promlok Subdistrict	5.178	5.483	6.094	2.439	2.524	2.693	84.4%	89.3%	99.3%
Nakorn Si Thammarat	Thonhong Subdistrict	4.825	5.070	5.560	2.341	2.409	2.545	78.9%	82.9%	91.0%
Nakorn Si Thammarat	Banjak Subdistrict	3.378	3.609	4.072	1.939	2.003	2.132	55.5%	59.1%	66.3%
Nakorn Sawan	Ladyao Subdistrict	5.552	5.760	6.177	2.543	2.601	2.717	91.6%	95.2%	102.5%
Nakorn Sawan	Banggramung Subdistrict	9.572	9.780	10.197	3.660	3.718	3.834	165.6%	169.5%	177.4%
Nakorn Sawan	Bangphorhisai Subdistrict	7.533	7.747	8.175	3.093	3.153	3.272	127.2%	131.1%	138.9%
Nakorn Sawan	Takfa Subdistrict	6.518	6.799	7.360	2.811	2.889	3.045	108.1%	112.9%	122.6%
Nonthaburi	Saimar Subdistrict	7.768	8.049	8.610	3.159	3.237	3.393	130.9%	135.8%	145.8%
Nonthaburi	Bangbaotang Town	9.698	11.266	14.401	2.348	2.565	3.001	78.6%	91.7%	118.8%
Nonthaburi	Plaihang Subdistrict	10.245	10.524	11.082	3.847	3.925	4.080	177.7%	182.8%	192.9%
Nonthaburi	Bangmoung Subdistrict	8.494	8.730	9.201	3.361	3.426	3.557	144.9%	149.2%	157.8%
Nara Thawat	Tanyongmat Subdistrict	5.970	6.177	6.589	2.659	2.717	2.831	99.0%	102.6%	109.9%
Nara Thawat	Bukata Subdistrict	4.465	4.667	5.073	2.241	2.297	2.410	73.2%	76.5%	83.3%
Nara Thawat	Sirsakorn Subdistrict	3.716	4.021	4.630	2.033	2.117	2.287	60.4%	65.0%	74.4%
Nan	Nan Town	6.255	7.670	10.500	1.869	2.066	2.459	51.6%	62.5%	85.6%
Nan	Thawangpha Subdistrict	6.080	6.678	6.674	2.690	2.745	2.855	101.0%	104.5%	111.6%
Nan	Nanoi Subdistrict	5.307	5.529	5.973	2.475	2.536	2.660	87.2%	91.0%	98.6%
Buriram	Phanomrung Subdistrict	6.444	6.714	7.254	2.791	2.866	3.016	106.8%	111.5%	120.8%
Buriram	Nonsuwan Subdistrict	4.865	5.113	5.608	2.352	2.421	2.558	79.5%	83.6%	91.8%
Buriram	Phuthaisong Subdistrict	5.419	5.649	6.109	2.506	2.570	2.698	89.1%	93.0%	100.9%
Buriram	Lahansai Subdistrict	5.950	6.296	6.989	2.653	2.750	2.942	97.4%	103.1%	114.6%
Buriram	Bankruat Subdistrict	4.320	4.557	5.029	2.201	2.266	2.398	70.5%	74.3%	82.1%
Buriram	Taladnikomprasat Subdistrict	9.100	9.332	9.796	3.529	3.593	3.722	156.4%	160.6%	169.2%
Buriram	Pakam Subdistrict	5.626	5.887	6.409	2.564	2.636	2.781	92.5%	96.8%	105.7%
Buriram	Nonghong Subdistrict	7.099	7.353	7.859	2.973	3.043	3.184	118.9%	123.3%	132.3%
Buriram	Nondindaeng Subdistrict	10.407	10.732	11.383	3.892	3.982	4.163	180.3%	186.1%	197.7%
Prathum Thani	Bangluang Subdistrict	8.715	9.086	9.829	3.422	3.525	3.732	147.7%	154.1%	166.9%

Province	Municipality	NS1	NS2	NS3	SIR1	SIR2	SIR3	IRR1	IRR2	IRR3
Prathum Thani	Lakhok Subdistrict	14.053	14.450	15.246	4.905	5.016	5.237	250.3%	257.3%	271.3%
Prathum Thani	Thaklong Town	10.442	12.307	16.038	2.451	2.710	3.228	83.8%	99.1%	130.9%
Prathum Thani	Buengyitho Subdistrict	5.030	5.438	6.256	2.398	2.511	2.738	81.1%	87.4%	100.4%
Prathum Thani	Lumsai Subdistrict	8.877	9.082	9.491	3.467	3.524	3.638	152.4%	156.3%	164.0%
Prathum Thani	Nongsuea Subdistrict	8.165	8.405	8.884	3.269	3.336	3.469	138.7%	143.0%	151.7%
Prachuap Khiri Khan	Prachuap Khiri Khan Town	8.125	10.060	13.930	2.129	2.398	2.936	64.5%	79.5%	111.2%
Prachuap Khiri Khan	Huahin Town	15.403	18.978	26.130	3.140	3.637	4.631	119.7%	148.7%	208.1%
Prachuap Khiri Khan	Nongphlab Subdistrict	6.453	6.654	7.056	2.793	2.849	2.961	107.6%	111.2%	118.5%
Prachuap Khiri Khan	Thapsakae Subdistrict	10.734	11.139	11.949	3.983	4.096	4.321	185.7%	192.8%	206.9%
Prachuap Khiri Khan	Bangsaphanoi Subdistrict	5.016	5.218	5.623	2.394	2.450	2.563	82.4%	85.9%	92.8%
Prachuap Khiri Khan	Raimai Subdistrict	4.753	4.994	5.476	2.321	2.388	2.522	77.7%	81.6%	89.6%
Prachuap Khiri Khan	Raikao Subdistrict	9.456	9.743	10.317	3.628	3.707	3.867	162.5%	167.7%	178.0%
Prachuap Khiri Khan	Bankrut Subdistrict	4.718	5.045	5.697	2.311	2.402	2.583	76.5%	81.6%	92.1%
Prachuap Khiri Khan	Ronthong Subdistrict	6.060	6.517	7.433	2.684	2.811	3.066	98.4%	105.7%	120.6%
Prachin Buri	Bannapruae Subdistrict	8.877	9.077	9.476	3.467	3.523	3.633	152.5%	156.2%	163.8%
Prachin Buri	Khokmakok Subdistrict	1.598	1.908	2.528	1.444	1.530	1.703	29.3%	33.4%	41.9%
Prachin Buri	Srabua Subdistrict	4.712	4.920	5.336	2.309	2.367	2.483	77.2%	80.7%	87.8%
Prachin Buri	Kroksombun Subdistrict	2.773	2.998	3.450	1.770	1.833	1.959	46.4%	49.7%	56.5%
Prachin Buri	Khokpeep Subdistrict	4.891	5.121	5.581	2.359	2.423	2.551	80.1%	83.9%	91.6%
Pattani	Khokpo Subdistrict	4.797	5.009	5.434	2.333	2.392	2.510	78.6%	82.2%	89.4%
Pattani	Bangpu Subdistrict	6.937	7.571	8.841	2.928	3.104	3.457	112.4%	122.5%	143.0%
Pattani	Yarang Subdistrict	3.432	3.673	4.155	1.954	2.021	2.155	56.3%	60.0%	67.5%
Phra Nakorn Si Ayutthaya	Phra Nakorn Si Ayutthaya City	11.991	16.964	26.910	1.833	2.179	2.870	49.3%	68.4%	110.4%
Phra Nakorn Si Ayutthaya	Ayothaya Town	9.920	11.529	14.745	2.378	2.602	3.049	80.4%	93.7%	121.5%
Phra Nakorn Si Ayutthaya	Sena Town	5.347	6.716	9.454	1.743	1.933	2.314	44.9%	55.2%	77.1%
Phra Nakorn Si Ayutthaya	Hauwiang Subdistrict	7.701	7.924	8.370	3.140	3.202	3.326	130.2%	134.3%	142.4%
Phra Nakorn Si Ayutthaya	Nakhonloung Subdistrict	8.215	8.638	9.485	3.283	3.401	3.636	137.8%	144.9%	159.3%
Phra Nakorn Si Ayutthaya	Bangnomkh Subdistrict	3.128	3.336	3.752	1.869	1.927	2.043	51.8%	55.0%	61.5%
Phra Nakorn Si Ayutthaya	Phakhi Subdistrict	8.052	8.569	9.604	3.238	3.381	3.669	133.8%	142.4%	159.6%
Phra Nakorn Si Ayutthaya	Thaluang Subdistrict	8.673	9.031	9.747	3.410	3.510	3.709	147.0%	153.2%	165.6%
Phra Nakorn Si Ayutthaya	Rongchang Subdistrict	5.762	6.012	6.512	2.601	2.671	2.810	94.9%	99.2%	107.7%
Phra Nakorn Si Ayutthaya	Maharat Subdistrict	6.937	7.221	7.789	2.928	3.007	3.165	115.6%	120.5%	130.4%
Phra Nakorn Si Ayutthaya	Bansang Subdistrict	3.735	3.961	4.412	2.038	2.101	2.226	61.2%	64.7%	71.9%
Phra Nakorn Si Ayutthaya	Prasatong Subdistrict	3.876	4.076	4.476	2.077	2.133	2.244	63.6%	66.8%	73.3%
Phra Nakorn Si Ayutthaya	Bankrasan Subdistrict	3.732	4.016	4.585	2.037	2.116	2.274	60.8%	65.1%	73.9%
Phra Nakorn Si Ayutthaya	Uthai Subdistrict	9.421	9.634	10.059	3.618	3.677	3.795	162.7%	166.6%	174.7%
Phra Nakorn Si Ayutthaya	Bangpahun Subdistrict	5.363	5.669	6.282	2.490	2.576	2.746	87.5%	92.5%	102.7%
Phra Nakorn Si Ayutthaya	Banprak Subdistrict	6.086	6.298	6.722	2.691	2.750	2.868	101.0%	104.7%	112.2%
Phra Nakorn Si Ayutthaya	Mahaphram Subdistrict	4.152	4.357	4.768	2.154	2.211	2.325	68.0%	71.3%	78.1%
Phra Nakorn Si Ayutthaya	Rajakram Subdistrict	3.663	3.884	4.327	2.018	2.079	2.202	60.1%	63.5%	70.6%
Phayao	Pahyao Town	6.184	7.884	11.284	1.859	2.096	2.568	50.3%	63.0%	90.0%
Phayao	Dongjen Subdistrict	1.569	1.815	2.307	1.436	1.504	1.641	29.1%	32.4%	39.3%
Phayao	Bansai Subdistrict	5.851	6.079	6.535	2.626	2.689	2.816	96.7%	100.6%	108.6%
Phayao	Bantham Subdistrict	2.982	3.185	3.591	1.829	1.885	1.998	49.6%	52.7%	59.0%
Phayao	Dokkhamtai Town	3.563	4.958	7.747	1.495	1.689	2.076	32.0%	41.9%	63.0%
Phayao	Maesai Subdistrict	4.704	4.933	5.393	2.307	2.371	2.499	76.9%	80.7%	88.4%
Phang Nga	Krasom Subdistrict	6.523	6.732	7.148	2.813	2.871	2.987	108.8%	112.5%	120.0%
Phang Nga	Khokkloy Subdistrict	5.701	5.907	6.319	2.584	2.642	2.756	94.2%	97.8%	105.1%
Phang Nga	Kuraburi Subdistrict	5.584	5.799	6.229	2.552	2.611	2.731	92.1%	95.8%	103.3%
Phang Nga	Kohyao Subdistrict	5.319	5.521	5.923	2.478	2.534	2.646	87.6%	91.1%	98.1%
Pattalung	Khuankhanun Subdistrict	9.805	10.005	10.405	3.725	3.780	3.892	170.1%	173.9%	181.6%
Pattalung	Thamada Subdistrict	9.865	10.235	10.977	3.741	3.844	4.051	169.5%	175.9%	188.9%
Pattalung	Maekree Subdistrict	4.785	5.009	5.457	2.330	2.392	2.516	78.3%	82.1%	89.6%
Pattalung	Tamod Subdistrict	6.239	6.512	7.059	2.734	2.810	2.962	103.1%	107.8%	117.2%
Pichit	Wangkrot Subdistrict	4.269	4.486	4.921	2.186	2.247	2.367	69.8%	73.4%	80.5%
Pichit	Thalo Subdistrict	4.432	4.679	5.174	2.232	2.300	2.438	72.3%	76.3%	84.4%
Pichit	Tapanhin Town	5.232	6.830	10.025	1.727	1.949	2.393	43.5%	55.2%	80.2%
Pichit	Phohale Subdistrict	14.124	14.343	14.782	4.925	4.986	5.108	253.7%	257.9%	266.3%
Pichit	Samngam Subdistrict	5.788	6.092	6.700	2.608	2.693	2.862	94.9%	100.0%	110.1%
Pichit	Thabklo Subdistrict	7.475	7.698	8.145	3.077	3.139	3.263	126.0%	130.1%	138.2%
Pichit	Sakiek Subdistrict	6.002	6.257	6.768	2.668	2.739	2.881	99.1%	103.4%	112.3%
Pichit	Huadong Subdistrict	9.390	9.770	10.532	3.609	3.715	3.927	160.3%	166.9%	180.1%
Pichit	Wangsaipoon Subdistrict	5.639	5.848	6.266	2.567	2.625	2.741	93.1%	96.7%	104.1%
Pichit	Kamphangdin Subdistrict	3.061	3.274	3.699	1.851	1.910	2.028	50.8%	54.0%	60.6%
Pichit	Khaosai Subdistrict	4.379	4.601	5.045	2.217	2.279	2.402	71.6%	75.2%	82.5%
Phitsanulok	Bangrakam Subdistrict	12.302	12.532	12.993	4.419	4.483	4.611	218.0%	222.3%	231.1%
Phitsanulok	Promptam Subdistrict	4.567	4.779	5.204	2.269	2.328	2.446	74.8%	78.3%	85.4%
Phitsanulok	Watbot Subdistrict	5.503	5.727	6.176	2.529	2.592	2.716	90.6%	94.4%	102.2%
Phitsanulok	Padaeng Subdistrict	4.734	4.964	5.424	2.316	2.380	2.507	77.5%	81.2%	88.9%
Phitsanulok	Wongkong Subdistrict	9.541	9.776	10.248	3.651	3.717	3.848	164.7%	169.0%	177.8%
Phitsanulok	Nuenkum Subdistrict	5.345	5.643	6.238	2.485	2.568	2.734	87.3%	92.2%	102.0%
Phuket	Thepkasatree Subdistrict	12.005	12.225	12.665	4.336	4.397	4.520	212.3%	216.5%	224.9%
Phuket	Kathu Town	13.163	14.875	18.301	2.829	3.067	3.543	108.1%	123.0%	153.5%
Phuket	Patong Town	11.740	13.170	16.028	2.631	2.830	3.227	96.8%	109.3%	135.1%
Maharakham	Maharakham Town	4.931	6.625	10.015	1.685	1.921	2.392	41.1%	53.3%	79.4%
Maharakham	Borabue Subdistrict	6.056	6.393	7.066	2.683	2.777	2.964	99.4%	104.9%	116.2%
Maharakham	Kokpra Subdistrict	5.363	5.579	6.011	2.490	2.550	2.670	88.3%	92.0%	99.4%
Maharakham	Nadon Subdistrict	3.600	3.844	4.331	2.001	2.068	2.204	58.9%	62.7%	70.3%
Maharakham	Kaedam Subdistrict	3.455	3.689	4.157	1.960	2.025	2.155	56.7%	60.3%	67.6%
Mukdahan	Nikomkamsoi Subdistrict	12.687	12.922	13.392	4.526	4.591	4.722	225.4%	229.9%	238.7%
Yala	Yala City	11.367	15.908	24.988	1.790	2.105	2.736	47.5%	65.1%	103.7%
Yala	Satengnok Subdistrict	6.287	6.554	7.089	2.747	2.821	2.970	104.0%	108.6%	117.9%
Yala	Betong Town	10.019	11.659	14.939	2.392	2.620	3.076	81.1%	94.7%	123.0%
Yala	Lammai Subdistrict	8.877	9.153	9.705	3.467	3.544	3.697	151.7%	156.6%	166.6%
Yasothon	Yasothon Town	9.131	12.042	17.866	2.269	2.673	3.483	69.2%	91.0%	137.5%
Yasothon	Kohwang Subdistrict	10.774	11.028	11.537	3.994	4.065	4.206	188.1%	192.8%	202.2%
Yasothon	Saimoon Subdistrict	6.673	7.658	9.629	2.854	3.128	3.676	104.6%	119.7%	150.6%
Ranong	Ngoa Subdistrict	7.302	7.706	8.514	3.029	3.142	3.366	121.1%	127.9%	141.5%
Ranong	Paknam Subdistrict	0.382	0.693	1.316	1.106	1.193	1.366	13.1%	17.1%	25.2%
Ranong	Namchuet Subdistrict	5.763	6.031	6.567	2.601	2.676	2.825	94.8%	99.3%	108.4%
Ravong	Rayong City	11.694	16.512	26.148	1.812	2.147	2.817	48.4%	66.9%	107.7%
Ravong	Banphe Subdistrict	8.416	9.035	10.274	3.339	3.511	3.855	139.6%	149.8%	170.2%
Ravong	Sunthornphu Subdistrict	8.401	8.692	9.273	3.335	3.415	3.577	142.6%	147.7%	158.1%
Ravong	Tungkhwaikin Subdistrict	10.905	11.205	11.805	4.031	4.114	4.280	190.2%	195.6%	206.4%
Ravong	Jompolchaopraya Subdistrict	9.222	9.564	10.246	3.563	3.658	3.847	157.5%	163.5%	175.5%
Ravong	Paknamprasee Subdistrict	6.610	6.873	7.397	2.837	2.910	3.056	109.9%	114.4%	123.6%
Ravong	Chumsang Subdistrict	9.665	10.032	10.765	3.686	3.788	3.992	165.7%	172.1%	184.9%
Ravong	Kongdin Subdistrict	11.302	11.564	12.088	4.141	4.214	4.359	198.2%	203.1%	212.7%
Ratchaburi	Ratchaburi Town	10.937	13.241	17.851	2.520	2.840	3.480	86.2%	104.7%	143.3%
Ratchaburi	Huachinsi Subdistrict	6.402	6.752	7.453	2.779	2.876	3.071	105.4%	111.2%	123.0%
Ratchaburi	Lukmuang Subdistrict	5.769	6.353	7.521	2.603	2.765	3.090	92.3%	101.3%	119.8%
Ratchaburi	Khaongu Subdistrict	9.484	9.817	10.483	3.636	3.728	3.913	162.6%	168.5%	180.2%
Ratchaburi	Thapa Subdistrict	11.255	11.948	13.335	4.128	4.320	4.706	192.6%	204.2%	227.4%
Ratchaburi	Krachap Subdistrict	7.343	8.377	10.447	3.041	3.328	3.903	116.0%	132.1%	164.8%

Province	Municipality	NS1	NS2	NS3	SIR1	SIR2	SIR3	IRR1	IRR2	IRR3
Ratchaburi	Huaykrabok Subdistrict	3.759	3.966	4.380	2.045	2.102	2.217	61.7%	65.0%	71.7%
Ratchaburi	Chetsamian Subdistrict	5.052	5.277	5.726	2.404	2.466	2.591	82.9%	86.6%	94.3%
Ratchaburi	Khaochwang Subdistrict	7.503	7.864	8.586	3.085	3.185	3.386	125.2%	131.4%	143.7%
Ratchaburi	Bansing Subdistrict	10.070	10.275	10.686	3.798	3.856	3.970	175.1%	179.0%	186.9%
Ratchaburi	Bankong Subdistrict	2.917	3.196	3.753	1.811	1.888	2.043	48.3%	52.3%	60.6%
Ratchaburi	Damnoensaduak Subdistrict	12.455	12.828	13.575	4.461	4.565	4.773	219.4%	226.0%	239.2%
Ratchaburi	Bangphae Subdistrict	9.193	9.533	10.215	3.555	3.649	3.839	157.0%	162.9%	174.9%
Ratchaburi	Watpleng Subdistrict	3.449	3.668	4.106	1.958	2.019	2.141	56.7%	60.1%	67.0%
Ratchaburi	Suaphung Subdistrict	7.691	7.889	8.283	3.137	3.192	3.302	130.3%	133.9%	141.3%
Ratchaburi	Chatpaway Subdistrict	4.580	4.864	5.431	2.273	2.352	2.509	74.5%	79.0%	88.2%
Roi Et	Roi Et Town	10.087	12.555	17.490	2.402	2.744	3.430	78.5%	97.8%	138.4%
Roi Et	Wang Subdistrict	10.250	11.584	14.252	3.848	4.219	4.961	166.7%	188.0%	230.9%
Roi Et	Surwannahum Subdistrict	6.954	7.251	7.846	2.933	3.015	3.180	115.8%	120.9%	131.2%
Roi Et	Phanomprai Subdistrict	8.150	8.415	8.946	3.265	3.339	3.486	138.1%	142.9%	152.4%
Roi Et	Kasetsai Subdistrict	5.245	5.442	5.836	2.458	2.512	2.622	86.4%	89.8%	96.7%
Roi Et	Atsamat Subdistrict	3.908	4.214	4.824	2.086	2.171	2.341	63.4%	68.1%	77.6%
Roi Et	Baniwet Subdistrict	9.287	9.518	9.981	3.581	3.645	3.774	159.9%	164.2%	172.8%
Roi Et	Thongane Subdistrict	5.096	5.396	5.994	2.416	2.499	2.666	83.0%	87.9%	97.7%
Roi Et	Muangsuang Subdistrict	10.232	10.509	11.064	3.843	3.920	4.075	177.5%	182.5%	192.6%
Roi Et	Chiangmai Subdistrict	3.122	3.357	3.827	1.868	1.933	2.064	51.6%	55.1%	62.3%
Lopburi	Thasala Subdistrict	7.875	8.122	8.615	3.188	3.257	3.394	133.2%	137.6%	146.5%
Lopburi	Khoksamrong Subdistrict	10.100	10.381	10.943	3.807	3.885	4.041	174.9%	180.0%	190.2%
Lopburi	Lamarai Subdistrict	5.675	6.189	7.218	2.577	2.720	3.006	91.2%	99.3%	115.6%
Lopburi	Thawung Subdistrict	4.776	5.056	5.616	2.327	2.405	2.561	77.8%	82.3%	91.4%
Lopburi	Thaklong Subdistrict	6.836	7.209	7.954	2.900	3.003	3.210	113.0%	119.2%	131.7%
Lopburi	Banthalaung Subdistrict	3.841	4.048	4.463	2.067	2.125	2.240	63.0%	66.3%	73.0%
Lopburi	Sabot Subdistrict	2.922	3.262	3.942	1.812	1.907	2.096	48.0%	52.9%	62.8%
Lampang	Kelanganakorn Town	4.771	6.226	9.136	1.663	1.865	2.269	40.5%	51.1%	73.8%
Lampang	Lampang City	12.626	17.388	26.911	1.877	2.208	2.870	52.0%	70.6%	111.4%
Lampang	Luanpuea Subdistrict	4.048	4.260	4.682	2.125	2.184	2.301	66.3%	69.7%	76.6%
Lampang	Jaehom Subdistrict	5.617	5.874	6.390	2.561	2.632	2.776	92.3%	96.7%	105.4%
Lampang	Kohkha Subdistrict	5.154	5.456	6.060	2.432	2.516	2.684	84.0%	88.9%	98.8%
Lampang	Patunnakua Subdistrict	4.900	5.125	5.575	2.362	2.424	2.549	80.3%	84.0%	91.6%
Lampang	Lorrad Subdistrict	3.194	3.490	4.081	1.888	1.970	2.134	52.4%	56.7%	65.6%
Lampang	Wiangmok Subdistrict	3.805	4.059	4.568	2.057	2.128	2.269	62.1%	66.0%	74.1%
Lampang	Sobrab Subdistrict	3.713	3.985	4.531	2.032	2.108	2.259	60.5%	64.7%	73.2%
Lampang	Maeprik Subdistrict	3.337	3.676	4.352	1.927	2.021	2.210	54.3%	59.2%	69.4%
Lampang	Maepu Subdistrict	1.444	1.706	2.229	1.401	1.474	1.620	27.3%	30.9%	38.0%
Lampang	Hangchat Subdistrict	3.255	3.475	3.914	1.905	1.966	2.088	53.7%	57.1%	63.9%
Lampang	Setnngam Subdistrict	5.811	6.088	6.644	2.615	2.692	2.846	95.5%	100.2%	109.6%
Lampang	Maemoh Subdistrict	3.611	3.943	4.607	2.003	2.096	2.280	58.6%	63.5%	73.6%
Lampoon	Lamphun Town	4.206	5.566	8.286	1.584	1.773	2.151	36.6%	46.5%	67.5%
Lampoon	Rimping Subdistrict	5.292	5.505	5.930	2.471	2.530	2.648	87.1%	90.7%	98.0%
Lampoon	Banpan Subdistrict	1.741	1.943	2.348	1.484	1.540	1.652	31.6%	34.4%	40.2%
Lampoon	Banklang Subdistrict	12.783	13.671	15.448	4.552	4.799	5.293	220.0%	234.7%	264.1%
Lampoon	Maetuen Subdistrict	2.471	2.687	3.118	1.687	1.747	1.867	42.0%	45.1%	51.5%
Lampoon	Moungnoy Subdistrict	5.875	6.088	6.515	2.633	2.692	2.811	97.2%	100.9%	108.5%
Lampoon	Pasang Subdistrict	6.031	6.336	6.948	2.676	2.761	2.931	99.2%	104.3%	114.6%
Lampoon	Banhong Subdistrict	3.751	4.113	4.836	2.042	2.143	2.344	60.6%	65.9%	76.9%
Lampoon	Sobso Subdistrict	4.474	4.722	5.219	2.243	2.312	2.450	73.0%	77.0%	85.1%
Lampoon	Umong Subdistrict	4.084	4.557	5.502	2.135	2.266	2.529	65.1%	72.1%	86.4%
Lampoon	Thakat Subdistrict	7.419	7.722	8.327	3.062	3.146	3.314	124.2%	129.5%	140.0%
Sisaket	Sisaket Town	4.171	5.628	8.543	1.580	1.782	2.187	36.2%	46.6%	69.0%
Sisaket	Kanthakul Town	9.832	11.161	13.820	2.366	2.551	2.920	80.7%	92.1%	115.7%
Sisaket	Kumpaeng Subdistrict	5.247	5.452	5.862	2.458	2.515	2.629	86.3%	89.9%	97.0%
Sisaket	Kantrrom Subdistrict	9.476	10.074	11.272	3.633	3.800	4.132	159.7%	169.6%	189.6%
Sisaket	Muangkong Subdistrict	8.988	9.368	10.127	3.498	3.603	3.814	152.7%	159.3%	172.4%
Sisaket	Prangku Subdistrict	14.207	14.455	14.950	4.948	5.017	5.155	255.0%	259.6%	269.0%
Sakon Nakhon	Kusumal Subdistrict	5.597	5.813	6.244	2.555	2.615	2.735	92.3%	96.0%	103.6%
Sakon Nakhon	Phannikhom Subdistrict	4.419	4.620	5.023	2.228	2.284	2.396	72.4%	75.7%	82.5%
Sakon Nakhon	Wattichaphum Subdistrict	5.247	5.444	5.839	2.458	2.513	2.623	86.4%	89.8%	96.7%
Sakon Nakhon	Pangkho Subdistrict	7.537	7.782	8.272	3.095	3.163	3.299	127.0%	131.3%	140.1%
Sakon Nakhon	Songdao Subdistrict	4.994	5.325	5.985	2.388	2.480	2.663	81.1%	86.3%	97.0%
Sakon Nakhon	Dongmafi Subdistrict	3.894	4.187	4.773	2.082	2.164	2.327	63.3%	67.8%	76.9%
Sakon Nakhon	Charoensin Subdistrict	4.137	4.373	4.846	2.150	2.215	2.347	67.6%	71.3%	79.0%
Songkhla	Khaochang Subdistrict	10.969	11.365	12.157	4.048	4.158	4.378	190.4%	197.3%	211.1%
Songkhla	Khohong Town	10.298	11.998	15.398	2.431	2.667	3.140	83.2%	97.3%	126.6%
Songkhla	Thachang Subdistrict	6.074	6.319	6.809	2.688	2.756	2.892	100.5%	104.7%	113.2%
Songkhla	Ranod Subdistrict	9.620	9.834	10.261	3.673	3.733	3.851	166.4%	170.4%	178.5%
Songkhla	Padangbezar Town	5.546	6.986	9.866	1.771	1.971	2.371	46.2%	57.0%	80.0%
Songkhla	Summakham Subdistrict	9.888	10.107	10.547	3.748	3.809	3.931	171.5%	175.6%	183.9%
Songkhla	Chana Subdistrict	4.771	5.022	5.523	2.326	2.396	2.535	77.9%	82.0%	90.3%
Songkhla	Klong ngae Subdistrict	10.852	11.717	13.448	4.016	4.256	4.737	183.1%	197.3%	225.7%
Songkhla	Sathingpra Subdistrict	3.140	3.354	3.782	1.873	1.932	2.051	52.0%	55.2%	61.9%
Songkhla	Sabai Subdistrict	4.443	4.644	5.047	2.235	2.291	2.403	72.8%	76.1%	82.9%
Songkhla	Phatong Subdistrict	5.519	5.734	6.163	2.534	2.593	2.713	91.0%	94.7%	102.1%
Songkhla	Banpu Subdistrict	5.201	5.430	5.887	2.445	2.509	2.636	85.4%	89.2%	97.0%
Satun	Satun Town	9.914	11.559	14.848	2.378	2.606	3.063	80.2%	93.8%	122.1%
Satun	Klongkhud Subdistrict	5.380	5.601	6.042	2.495	2.556	2.679	88.5%	92.3%	99.9%
Satun	Thungwa Subdistrict	4.503	4.830	5.484	2.251	2.342	2.524	72.9%	78.0%	88.4%
Samutprakarn	Phrapraeng Town	5.994	7.393	10.192	1.833	2.027	2.416	49.7%	60.4%	83.1%
Samutprakarn	Samrongtai Subdistrict	11.872	12.569	13.964	4.299	4.493	4.881	204.6%	216.3%	239.7%
Samutprakarn	Bangmuang Subdistrict	10.538	12.176	15.453	3.928	4.384	5.294	169.0%	194.9%	247.2%
Samutprakarn	Dansamrong Subdistrict	14.656	17.673	23.707	5.073	5.911	7.588	232.6%	280.3%	376.1%
Samutprakarn	Bangpoo Subdistrict	8.739	9.643	11.453	3.428	3.680	4.183	142.8%	157.3%	186.6%
Samutprakarn	Phrasamutchedi Subdistrict	6.154	7.008	8.717	2.710	2.948	3.422	96.7%	109.7%	136.4%
Samutprakarn	Bangbo Subdistrict	5.806	6.082	6.635	2.613	2.690	2.844	95.5%	100.1%	109.5%
Samutsongkram	Nokkwag Subdistrict	9.576	9.783	10.196	3.661	3.719	3.833	165.7%	169.6%	177.4%
Samutsakorn	Samutsakorn City	9.550	14.117	23.252	1.663	1.981	2.615	40.8%	57.9%	95.9%
Samutsakorn	Banghae Subdistrict	2.060	2.257	2.651	1.573	1.627	1.737	36.1%	39.0%	44.7%
Saraburi	Phukrang Subdistrict	8.215	8.430	8.861	3.283	3.343	3.462	139.8%	143.8%	151.8%
Saraburi	Banno Subdistrict	6.915	7.134	7.571	2.922	2.982	3.104	115.8%	119.7%	127.6%
Saraburi	Nongkhae Subdistrict	5.037	5.608	6.750	2.400	2.558	2.876	80.0%	88.6%	106.3%
Saraburi	Nongmoo Subdistrict	5.811	6.035	6.483	2.615	2.677	2.802	96.0%	99.9%	107.7%
Saraburi	Saohai Subdistrict	8.137	8.344	8.758	3.261	3.319	3.434	138.5%	142.3%	150.0%
Saraburi	Nongsang Subdistrict	7.508	7.708	8.110	3.086	3.142	3.254	126.8%	130.5%	138.0%
Saraburi	Muaklek Subdistrict	5.464	5.660	6.054	2.518	2.573	2.682	90.2%	93.6%	100.5%
Saraburi	Kumphran Subdistrict	7.412	7.676	8.206	3.060	3.133	3.280	124.5%	129.1%	138.5%
Saraburi	Khotchasit Subdistrict	5.653	5.879	6.330	2.571	2.634	2.759	93.2%	97.1%	104.9%
Sakaeo	Aranyaprathet Town	7.803	9.129	11.783	2.084	2.269	2.637	63.9%	74.8%	97.5%
Sakaeo	Wathananakhon Subdistrict	5.089	5.454	6.183	2.414	2.516	2.718	82.4%	88.2%	99.9%
Sing Buri	In buri Subdistrict	5.238	5.458	5.899	2.456	2.517	2.639	86.1%	89.8%	97.4%
Sing Buri	Phosungkho Subdistrict	3.986	4.184	4.578	2.108	2.163	2.272	65.4%	68.6%	75.1%
Supanburi	Sonpeenong Town	6.943	8.412	11.350	1.965	2.169	2.577	56.7%	68.2%	92.5%

Province	Municipality	NS1	NS2	NS3	SIR1	SIR2	SIR3	IRR1	IRR2	IRR3
Supanburi	Samchuk Subdistrict	9.860	10.134	10.682	3.740	3.816	3.969	170.4%	175.4%	185.3%
Supanburi	Wanyang Subdistrict	2.035	2.275	2.754	1.566	1.632	1.765	35.6%	39.0%	45.8%
Supanburi	Paikhongdin Subdistrict	4.532	4.735	5.142	2.259	2.316	2.429	74.3%	77.6%	84.5%
Supanburi	Bangplama Subdistrict	8.763	8.997	9.466	3.435	3.500	3.631	150.0%	154.2%	162.9%
Supanburi	U-Thong Subdistrict	5.425	5.692	6.226	2.507	2.582	2.730	88.9%	93.4%	102.3%
Supanburi	Thungkok Subdistrict	9.057	9.275	9.712	3.517	3.578	3.699	155.7%	159.7%	167.9%
Supanburi	Suantang Subdistrict	6.472	6.683	7.105	2.799	2.857	2.975	107.9%	111.6%	119.2%
Supanburi	Nongyasai Subdistrict	3.355	3.564	3.982	1.932	1.990	2.106	55.3%	58.5%	65.1%
Suratthani	Kohsamui Town	14.966	16.470	19.478	3.079	3.288	3.706	125.5%	139.1%	166.8%
Suratthani	Thakhanon Subdistrict	4.376	4.601	5.050	2.216	2.279	2.403	71.5%	75.2%	82.6%
Suratthani	Bansong Subdistrict	4.096	4.322	4.774	2.138	2.201	2.327	67.0%	70.6%	77.9%
Suratthani	Yandindaeng Subdistrict	11.166	11.429	11.955	4.103	4.176	4.322	195.6%	200.4%	210.1%
Suratthani	Bangsawan Subdistrict	3.773	3.971	4.366	2.049	2.104	2.213	62.0%	65.1%	71.6%
Suratthani	Donsak Subdistrict	5.394	5.711	6.345	2.499	2.587	2.763	88.0%	93.1%	103.6%
Suratthani	Chiewlan Subdistrict	3.428	3.654	4.105	1.953	2.015	2.141	56.4%	59.8%	66.9%
Suratthani	Phanom Subdistrict	7.139	7.403	7.931	2.984	3.057	3.204	119.5%	124.1%	133.4%
Suratthani	Kohphangan Subdistrict	6.548	6.804	7.317	2.820	2.891	3.033	108.8%	113.3%	122.2%
Surin	Surin Town	14.438	16.104	19.436	3.006	3.238	3.701	119.9%	134.6%	164.7%
Surin	Rangaeng Subdistrict	8.346	8.552	8.964	3.319	3.377	3.491	142.4%	146.2%	153.9%
Surin	Thaotom Subdistrict	9.089	9.325	9.795	3.526	3.591	3.722	156.1%	160.4%	169.1%
Surin	Rongthab Subdistrict	8.815	9.169	9.878	3.450	3.548	3.745	149.7%	155.9%	168.2%
Surin	Chumpolburi Subdistrict	6.175	6.399	6.847	2.716	2.778	2.903	102.4%	106.4%	114.3%
Surin	Buachet Subdistrict	5.090	5.518	6.376	2.414	2.534	2.772	81.9%	88.6%	102.2%
Sukhothai	Bankluai Subdistrict	8.190	8.833	10.118	3.276	3.455	3.812	135.2%	145.7%	166.8%
Sukhothai	Srisamrong Subdistrict	7.014	7.316	7.922	2.949	3.033	3.201	116.8%	122.0%	132.5%
Sukhothai	Hadsiew Subdistrict	11.534	12.082	13.177	4.205	4.358	4.662	199.6%	208.9%	227.5%
Sukhothai	Lanhoi Subdistrict	3.576	3.846	4.385	1.994	2.069	2.219	58.4%	62.5%	70.8%
Sukhothai	Bantanode Subdistrict	12.698	12.932	13.402	4.529	4.594	4.725	225.6%	230.1%	238.9%
Sukhothai	Thunglaung Subdistrict	2.158	2.413	2.923	1.600	1.671	1.812	37.3%	40.9%	48.2%
Sukhothai	Kongkraitat Subdistrict	4.689	4.969	5.530	2.303	2.381	2.537	76.3%	80.8%	89.9%
Sukhothai	Srinakorn Subdistrict	6.387	6.604	7.037	2.775	2.835	2.956	106.3%	110.1%	117.9%
Nongkhai	Hnong-songhong Subdistrict	6.748	6.964	7.396	2.875	2.935	3.055	112.8%	116.7%	124.5%
Nongkhai	Ponphisai Subdistrict	3.929	4.130	4.532	2.092	2.148	2.259	64.4%	67.7%	74.2%
Nongkhai	Sri Chiangmai Subdistrict	6.692	6.894	7.297	2.860	2.916	3.028	111.9%	115.6%	122.9%
Nongkhai	Sri Phana Subdistrict	2.628	3.110	4.075	1.730	1.864	2.132	43.0%	49.6%	63.1%
Nongkhai	Tha Sa-ard Subdistrict	5.876	6.117	6.598	2.633	2.700	2.834	97.0%	101.1%	109.5%
Nongkhai	Soh Phisai Subdistrict	8.567	8.768	9.171	3.381	3.437	3.548	146.6%	150.4%	158.0%
Nongkhai	Don Yanang Subdistrict	4.265	4.714	5.612	2.185	2.310	2.560	68.2%	74.9%	88.6%
Nongkhai	Pakkad Subdistrict	6.979	7.278	7.878	2.939	3.023	3.189	116.2%	121.4%	131.7%
Nongbualamphu	Namafueang Subdistrict	1.129	1.531	2.336	1.314	1.425	1.649	22.7%	27.9%	38.4%
Nongbualamphu	Nakhamhai Subdistrict	10.153	11.022	12.760	3.821	4.063	4.546	169.7%	183.9%	212.4%
Nongbualamphu	Kudoo Subdistrict	3.917	4.144	4.598	2.089	2.152	2.278	64.1%	67.7%	75.0%
Nongbualamphu	Nonsoongplueai Subdistrict	4.939	5.140	5.542	2.372	2.428	2.540	81.1%	84.5%	91.4%
Nongbualamphu	Jomthong Subdistrict	7.803	8.055	8.559	3.168	3.238	3.379	131.8%	136.3%	145.4%
Nongbualamphu	Bankok Subdistrict	3.797	3.996	4.395	2.055	2.111	2.221	62.3%	65.5%	72.0%
Amnat Charoen	Nayom Subdistrict	3.769	4.097	4.754	2.047	2.139	2.321	61.1%	66.0%	76.1%
Amnat Charoen	Namleeek Subdistrict	4.798	5.527	6.985	2.333	2.536	2.941	74.8%	85.6%	107.6%
Amnat Charoen	Pana Subdistrict	7.944	8.148	8.556	3.208	3.264	3.378	134.9%	138.7%	146.3%
Amnat Charoen	Senangkaniom Subdistrict	1.456	1.687	2.147	1.405	1.469	1.597	27.6%	30.7%	37.1%
Udon Thani	Nonghua Subdistrict	5.713	6.208	7.199	2.588	2.725	3.001	92.0%	99.8%	115.6%
Udon Thani	Banchan Subdistrict	7.096	7.298	7.704	2.972	3.028	3.141	119.3%	123.0%	130.4%
Udon Thani	Nikomsonkraw Subdistrict	10.108	10.344	10.816	3.809	3.875	4.006	175.5%	179.9%	188.7%
Udon Thani	Bankha Subdistrict	8.495	8.890	9.680	3.361	3.470	3.690	143.3%	150.0%	163.6%
Udon Thani	Huaykerng Subdistrict	7.187	7.494	8.108	2.997	3.082	3.253	119.9%	125.2%	135.9%
Udon Thani	Kongwapee Subdistrict	5.636	5.903	6.439	2.566	2.641	2.789	92.6%	97.0%	106.1%
Udon Thani	Pakho Subdistrict	8.823	10.179	12.890	3.452	3.829	4.582	139.9%	161.2%	204.3%
Udon Thani	Nongmek Subdistrict	4.636	4.960	5.608	2.288	2.379	2.559	75.1%	80.2%	90.6%
Udon Thani	Banpue Subdistrict	5.187	5.548	6.269	2.441	2.542	2.742	84.1%	89.8%	101.5%
Udon Thani	Nangua Subdistrict	8.233	8.455	8.901	3.288	3.350	3.474	140.1%	144.2%	152.4%
Udon Thani	Sammoh Subdistrict	7.002	7.516	8.545	2.946	3.089	3.375	114.7%	123.0%	139.9%
Udon Thani	Tongfon Subdistrict	6.109	6.422	7.050	2.698	2.785	2.959	100.5%	105.7%	116.3%
Udon Thani	Banchiang Subdistrict	5.903	6.285	7.050	2.640	2.747	2.959	96.3%	102.5%	115.0%
Udon Thani	Nonsoong-Namkham Town	10.726	12.164	15.038	2.490	2.690	3.090	87.9%	100.3%	125.8%
Udon Thani	Wuasow Subdistrict	4.402	4.666	5.194	2.223	2.297	2.443	71.7%	75.9%	84.4%
Uttaradit	Uttaradit Town	7.845	9.755	13.575	2.090	2.355	2.886	62.4%	77.1%	108.2%
Uttaradit	Bankoh Subdistrict	7.518	7.728	8.146	3.089	3.147	3.264	127.0%	130.8%	138.5%
Uttaradit	Nampad Subdistrict	5.767	6.209	7.093	2.603	2.726	2.971	93.4%	100.4%	114.7%
Uttaradit	Naimuang Subdistrict	6.421	6.658	7.134	2.784	2.850	2.982	106.7%	110.9%	119.2%
Uttaradit	Thasak Subdistrict	5.206	5.455	5.953	2.447	2.516	2.654	85.3%	89.4%	97.8%
Uttaradit	Huadong Subdistrict	12.152	12.352	12.754	4.377	4.433	4.544	215.4%	219.3%	227.1%
Uttaradit	Ssipanammatt Subdistrict	4.451	4.688	5.162	2.237	2.303	2.434	72.7%	76.5%	84.3%
Uttaradit	Bankaeng Subdistrict	2.708	2.908	3.307	1.753	1.808	1.919	45.6%	48.5%	54.6%
Uttaradit	Wangkapee Subdistrict	6.051	6.468	7.301	2.682	2.797	3.029	98.6%	105.3%	118.9%
Uttaradit	Bankok Subdistrict	2.569	2.909	3.589	1.714	1.808	1.997	42.8%	47.6%	57.3%
Uttaradit	Ruamjit Subdistrict	7.906	8.114	8.530	3.197	3.255	3.371	134.2%	138.0%	145.7%
Uthai Thani	Uthai Thani Town	4.656	6.234	9.391	1.647	1.866	2.305	39.4%	50.7%	75.0%
Uthai Thani	Thapphan Subdistrict	5.839	6.150	6.771	2.623	2.709	2.882	95.8%	100.9%	111.3%
Uthai Thani	Talukdoo Subdistrict	8.311	8.593	9.157	3.310	3.388	3.545	141.0%	146.0%	156.0%
Uthai Thani	Banrai Subdistrict	2.344	2.545	2.948	1.651	1.707	1.819	40.2%	43.1%	49.1%
Uthai Thani	Khaobangkrak Subdistrict	11.921	12.139	12.575	4.313	4.373	4.495	210.7%	214.9%	223.2%
Ubon Ratchathani	Ubon Ratchathani City	16.967	23.354	36.127	2.179	2.622	3.510	66.3%	91.5%	145.8%
Ubon Ratchathani	Ubon Subdistrict	12.562	12.905	13.591	4.491	4.586	4.777	221.8%	227.9%	240.2%
Ubon Ratchathani	Khamyai Subdistrict	9.158	11.242	15.409	3.545	4.124	5.282	138.9%	171.1%	236.5%
Ubon Ratchathani	Angsila Subdistrict	5.504	5.788	6.354	2.530	2.608	2.766	90.2%	94.8%	104.3%
Ubon Ratchathani	Trakarnphuephon Subdistrict	5.185	5.457	6.002	2.441	2.516	2.668	84.7%	89.2%	98.3%
Ubon Ratchathani	Dhetudom Town	6.285	8.161	11.915	1.873	2.134	2.656	50.6%	64.4%	94.0%
Ubon Ratchathani	BuangamSubdistrict	3.222	3.420	3.815	1.896	1.950	2.060	53.3%	56.4%	62.6%
Ubon Ratchathani	Nasaung Subdistrict	1.329	1.592	2.119	1.369	1.442	1.589	25.8%	29.3%	36.4%
Ubon Ratchathani	Nayear Subdistrict	6.651	6.851	7.250	2.848	2.904	3.015	111.2%	114.8%	122.1%
Ubon Ratchathani	Sansuk Subdistrict	10.072	12.092	16.133	3.799	4.360	5.483	156.4%	187.9%	251.8%
Ubon Ratchathani	Bandan Subdistrict	5.078	5.289	5.712	2.411	2.470	2.587	83.4%	87.0%	94.2%
Ubon Ratchathani	Posat Subdistrict	3.659	3.866	4.279	2.017	2.074	2.189	60.1%	63.3%	70.0%
Angthong	Angthong Town	5.307	6.616	9.232	1.737	1.919	2.283	44.8%	54.7%	75.7%
Angthong	Posa Subdistrict	7.049	7.248	7.647	2.959	3.014	3.125	118.4%	122.1%	129.4%
Angthong	Pamok Subdistrict	8.855	9.111	9.624	3.461	3.532	3.675	151.5%	156.1%	165.4%
Angthong	Ketchaiyo Subdistrict	5.450	5.665	6.095	2.515	2.574	2.694	89.8%	93.5%	100.9%
Angthong	Samko Subdistrict	3.805	4.204	5.001	2.057	2.168	2.390	61.2%	67.1%	79.1%
Chiangrai	Chiangrai City	21.982	28.855	42.600	2.527	3.005	3.960	85.9%	114.1%	173.7%
Chiangrai	Maechan Subdistrict	5.674	5.946	6.490	2.577	2.652	2.804	93.2%	97.7%	107.0%
Chiangrai	Padad Subdistrict	1.547	1.776	2.234	1.430	1.494	1.621	28.8%	32.0%	38.4%
Chiangrai	Muangpan Subdistrict	5.107	5.349	5.832	2.419	2.486	2.621	83.7%	87.7%	95.8%
Chiangrai	Maesai Subdistrict	6.156	6.666	7.685	2.711	2.852	3.136	99.6%	107.7%	124.2%
Chiangrai	Boonrueng Subdistrict	4.094	5.230	7.504	2.138	2.454	3.085	61.1%	76.7%	109.6%
Chiangrai	Chiangsan Subdistrict	5.854	6.150	6.742	2.627	2.709	2.874	96.1%	101.1%	111.1%

Province	Municipality	NS1	NS2	NS3	SIR1	SIR2	SIR3	IRR1	IRR2	IRR3
Chiangrai	Wiangmueng Subdistrict	6.644	6.871	7.326	2.846	2.909	3.036	110.8%	114.8%	122.9%
Chiangrai	Chedluang Subdistrict	5.334	5.569	6.038	2.482	2.548	2.678	87.6%	91.6%	99.6%
Chiangrai	Banplong Subdistrict	7.246	7.482	7.953	3.014	3.079	3.210	121.7%	125.9%	134.4%
Chiangrai	Maekhum Subdistrict	3.653	3.863	4.282	2.015	2.073	2.190	60.0%	63.3%	70.0%
Chiangrai	Pakhodam Subdistrict	6.737	7.007	7.546	2.872	2.947	3.097	112.1%	116.8%	126.2%
Chiangrai	Maelao Subdistrict	4.351	4.576	5.026	2.209	2.272	2.397	71.1%	74.8%	82.2%
Chiangrai	Chanchwa Subdistrict	4.860	5.419	6.536	2.351	2.506	2.816	77.1%	85.5%	102.7%
Chiangrai	Payamengrai Subdistrict	5.018	5.278	5.797	2.394	2.467	2.611	82.0%	86.3%	94.9%
Chiangrai	Banta Subdistrict	4.646	4.990	5.680	2.291	2.387	2.578	75.1%	80.5%	91.5%
Chiangmai	Nonghoi Subdistrict	15.342	15.579	16.054	5.263	5.329	5.461	277.4%	281.9%	290.9%
Chiangmai	Fahaam Subdistrict	10.785	11.021	11.494	3.997	4.063	4.194	188.5%	192.9%	201.8%
Chiangmai	Bankha Subdistrict	10.363	10.585	11.028	3.880	3.941	4.065	180.6%	184.7%	193.1%
Chiangmai	Banklang Subdistrict	3.436	3.719	4.286	1.955	2.034	2.191	56.1%	60.4%	69.1%
Chiangmai	Sanpatong Subdistrict	3.198	3.425	3.879	1.889	1.952	2.078	52.8%	56.2%	63.3%
Chiangmai	Nongphueng Subdistrict	18.876	19.210	19.878	6.246	6.338	6.524	345.9%	351.9%	364.1%
Chiangmai	Saraphae Subdistrict	14.283	14.488	14.896	4.969	5.026	5.140	257.0%	260.9%	268.9%
Chiangmai	Muangkanpattana Town	5.854	7.189	9.859	1.813	1.999	2.370	48.8%	59.0%	80.8%
Chiangmai	Maepang Subdistrict	3.045	3.408	4.134	1.846	1.947	2.149	49.7%	54.9%	65.5%
Chiangmai	Chedimaekrua Subdistrict	6.010	6.525	7.556	2.670	2.813	3.100	97.0%	105.2%	121.7%
Chiangmai	Nongjom Subdistrict	8.443	8.847	9.654	3.346	3.458	3.683	142.2%	149.1%	162.9%
Chiangmai	Hangdong Subdistrict	9.344	9.552	9.968	3.597	3.654	3.770	161.2%	165.1%	173.0%
Chiangmai	Thkham Subdistrict	4.201	4.463	4.987	2.167	2.240	2.386	68.4%	72.5%	80.9%
Chiangmai	Tadue Subdistrict	4.360	4.580	5.021	2.212	2.273	2.395	71.3%	74.9%	82.2%
Chiangmai	Maajo Subdistrict	10.923	11.225	11.829	4.035	4.119	4.287	190.5%	195.9%	206.8%
Chiangmai	Chaiprakarn Subdistrict	5.175	5.471	6.064	2.438	2.520	2.685	84.4%	89.2%	99.0%
Chiangmai	Yangneng Subdistrict	18.812	19.204	19.988	6.228	6.337	6.555	343.9%	350.9%	364.8%
Chiangmai	Maenam Subdistrict	6.327	6.526	6.923	2.758	2.813	2.924	105.4%	108.9%	116.1%
Chiangmai	Jomthong Subdistrict	2.871	3.131	3.653	1.798	1.870	2.015	47.7%	51.5%	59.3%
Chiangmai	Nonghongpattana Subdistrict	4.815	5.088	5.633	2.338	2.414	2.565	78.5%	82.9%	91.8%
Chiangmai	Sansailueng Subdistrict	16.837	17.222	17.993	5.679	5.786	6.000	305.1%	311.9%	325.6%
Phetchaburi	Bangtaboon Subdistrict	3.962	4.296	4.964	2.101	2.194	2.379	64.1%	69.1%	79.5%
Phetchaburi	Banlad Subdistrict	7.222	7.441	7.878	3.007	3.068	3.189	121.4%	125.4%	133.3%
Phetchabun	Phetchabun Town	9.383	10.928	14.020	2.304	2.518	2.948	76.1%	88.9%	115.5%
Phetchabun	Lomkao Subdistrict	4.979	5.259	5.818	2.384	2.461	2.617	81.2%	85.7%	94.9%
Phetchabun	Wichianburi Subdistrict	4.750	5.255	6.263	2.320	2.460	2.741	75.7%	83.3%	98.9%
Phetchabun	Nongphai Subdistrict	4.206	4.449	4.935	2.169	2.236	2.372	68.6%	72.5%	80.4%
Phetchabun	Takham Subdistrict	4.763	4.973	5.395	2.323	2.382	2.499	78.1%	81.6%	88.7%
Phetchabun	Chondan Subdistrict	3.813	4.111	4.706	2.060	2.142	2.308	62.0%	66.5%	75.7%
Phetchabun	Subsamotod Subdistrict	7.367	8.153	9.725	3.047	3.266	3.703	118.7%	131.2%	156.4%
Phetchabun	Phutaoey Subdistrict	7.308	7.957	9.253	3.031	3.211	3.571	119.0%	129.4%	150.4%
Phetchabun	Dongkhui Subdistrict	5.721	5.946	6.396	2.590	2.652	2.777	94.4%	98.3%	106.1%
Phetchabun	Nachaiang Subdistrict	2.400	2.843	3.728	1.667	1.790	2.036	40.0%	45.9%	58.2%
Phetchabun	Taidong Subdistrict	6.243	6.552	7.169	2.735	2.821	2.992	102.9%	108.1%	118.5%
Phetchabun	Tapon Subdistrict	8.268	8.565	9.159	3.298	3.380	3.545	140.0%	145.3%	155.8%
Loei	Na-or Subdistrict	5.831	6.030	6.428	2.620	2.676	2.786	96.6%	100.1%	107.2%
Loei	Chiangkarn Subdistrict	6.852	7.086	7.554	2.904	2.969	3.099	114.5%	118.7%	127.0%
Loei	Khaokaew Subdistrict	2.173	2.440	2.975	1.604	1.678	1.827	37.5%	41.2%	48.8%
Loei	Dansai Subdistrict	5.844	6.044	6.444	2.624	2.680	2.791	96.8%	100.3%	107.4%
Loei	Pakchom Subdistrict	4.062	4.290	4.746	2.129	2.192	2.319	66.4%	70.0%	77.4%
Loei	Phurua Subdistrict	6.907	7.291	8.058	2.920	3.026	3.239	114.2%	120.5%	133.4%
Loei	Phukradueng Subdistrict	3.297	3.501	3.908	1.916	1.973	2.086	54.5%	57.6%	64.0%
Loei	Nadwang Subdistrict	4.994	5.209	5.638	2.388	2.448	2.567	81.9%	85.6%	92.9%
Phrae	Phrae Town	10.843	12.538	15.927	2.507	2.742	3.213	87.9%	102.1%	131.5%
Phrae	Maelai Subdistrict	5.898	6.100	6.503	2.639	2.695	2.807	97.7%	101.3%	108.5%
Phrae	Thunhong Subdistrict	7.377	7.627	8.128	3.050	3.120	3.259	124.0%	128.4%	137.3%
Phrae	Maechua Subdistrict	10.949	11.153	11.561	4.043	4.099	4.213	192.0%	196.0%	203.8%
Phrae	Song Subdistrict	6.536	6.807	7.350	2.816	2.892	3.042	108.5%	113.1%	122.5%
Phrae	Soongmen Subdistrict	6.526	6.761	7.233	2.813	2.879	3.010	108.6%	112.7%	121.1%
Phrae	Wangchin Subdistrict	4.129	4.358	4.816	2.147	2.211	2.338	67.5%	71.1%	78.6%
Phrae	Nongmuangkai Subdistrict	1.967	2.216	2.713	1.547	1.616	1.754	34.6%	38.1%	45.1%
Mae Hong Son	Mae Hong Son Town	10.306	11.626	14.265	2.432	2.615	2.982	84.8%	96.2%	119.9%
Mae Hong Son	Maesiang Subdistrict	5.411	5.726	6.356	2.504	2.591	2.766	88.3%	93.4%	103.8%
Mae Hong Son	Maelanoi Subdistrict	5.870	6.105	6.574	2.631	2.697	2.827	97.0%	101.0%	109.1%