



THE MANAGEMENT OF SOLID WASTES IN MUNICIPAL SUBDISTRICTS IN THE LOWER NORTHEAST, THAILAND

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ABSTRACT

This research studied the management of the solid wastes of municipal subdistricts in the Lower Northeast, Thailand as Nakhonchaiburin group. The Nakhonchaiburin group is in four provinces of the Lower Northeast are Nakhon Ratchasima province, Chaiyaphum province, Buriram province, and Surin province in Thailand. This study aimed to determine the proportion of different types of the solid wastes at the present time and to offer the right choices for the solid waste management. The results of this study showed that the average rate of the solid wastes in 3 seasons was 0.26 ± 0.11 kg/capita/day or was 51.94 ± 38.27 kg/km²/day of communities in the municipal sub districts. The results of this study also showed that the average rate of the solid wastes in 3 seasons was 757.97 ± 555.06 kg/day. The solid wastes that occur in communities with the average density were 190.71 ± 93.16 kg/m³ and the average moisture content was $55.23 \pm 14.47\%$. Analysis of the composition of the solid wastes according to the seasons found that the season was one of the factors that influence the amount of solid wastes but the season had low impact on the composition of the solid wastes in municipal sub districts in the Nakhonchaiburin group, Thailand. The results of the survey, the solid wastes could be classified into seven groups by mass balance were papers $15.53 \pm 5.28\%$, garbage $40.02 \pm 14.72\%$, plastics $14.52 \pm 2.45\%$, glasses $9.20 \pm 4.32\%$, metals $1.81 \pm 1.03\%$, woods $6.19 \pm 5.99\%$, and etc. $12.74 \pm 11.62\%$. In addition, the evaluation of alternative of the solid waste management in the communities of the municipal sub districts in the Lower Northeast, Thailand as the Nakhonchaiburin group. The results showed that the Sub district Administrative Organization (SAO) could be achieved through an integrated management approach. The solid waste management effectively, it was necessary to supplement with a solid waste separation system. The results showed that the percent of the proportion of the solid wastes that could be recycling was $41.06 \pm 13.08\%$ by the campaign for a separation of the solid wastes from household. The results also showed that the percent of the proportion of the solid wastes that could be composting was $46.20 \pm 20.71\%$. However, due to the separation of the solid wastes for recycling and composting were impossible to eliminate all the solid wastes of municipal sub districts. Finally, the remaining solid wastes that could not be eliminated with the above methods would be taken to eliminate with the sanitary landfill was $12.74 \pm 11.62\%$.

Keywords: solid waste management, municipal sub district, Nakhonchaiburin group.

INTRODUCTION

Development of the country had changed in the economy, society and environment. It's direct and indirect impact on the way of living of the people as decentralized management and the public service of local government. They could meet the needs of the people. That was, it enables people to consume more, and was followed by solid waste management problems in the municipal sub districts. The solid wastes in Thailand were likely to increase at a rate of 1 percent. The solid wastes of Thailand were 13.9 million tons in 2000, up from about 0.1 million tons of 1999 (Department of Pollution Control, 2003).

The Lower Northeast in Thailand as Nakhon Ratchasima province, Chaiyaphum province, Buriram province, and Surin province (Nakhonchaiburin group), faces increasing municipal solid wastes, while government capacities remain low, both in terms of budget and personnel skills. Many wastes were discarded in empty spaces scattered around the city which, was a leading cause for environmental pollution and health risk of residents. A fraction of generated wastes were collected by local governments and disposed of in designated dumpsites which were classified as open dumping. Burning is practiced from time to time to reclaim landfill

space. Sometimes, solid waste pickers burn the solid wastes to search for recyclables such as metals. The level of awareness on health risks associated with these improper practices is very low (Saengtorng and Keeratiurai, 2011; Sangarun and Pasomsouk, 2012).

In municipal sub districts of the Nakhonchaiburin group consisted of homes, offices, restaurants, academies, sanitariums, fresh food markets, and official places. The municipal sub districts had a wide range of activities and more solid waste sources in the area. The municipal sub districts do not have any cooperation from the public and government agencies in helping to maintain cleaning of the communities. Solid wastes being dumped in empty space and in other public places. The solid wastes rapidly increase the problem of storage, transportation, disposal and environmental impact. The current solid waste management was not the separation system. As a result, the local government must cost a lot to collection, transportation and disposal.

Ngernmool (2000) concluded that responsible collect the solid wastes from the communities and then pour into the space. The solid wastes were released to decompose or were set on fire from time to time. Several studies had reported consistent patterns in the disposal of them. However such a way was not valid. The results also



showed that local governments could not be responsible for the management of the solid wastes in every area.

Life cycle assessment has been successfully utilized in the field of solid waste management, for example, to assess differences in environmental performance between different solid wastes incineration strategies (Bergsdal *et al.*, 2005) or related activities such as flue gas cleaning process of the municipal solid waste management of mixed solid wastes as well as of specific solid waste fractions (Mendes *et al.*, 2004; Arena *et al.*, 2003).

The Life cycle assessment result will support the municipality for further planning and optimizing improvements or strategies of the municipal solid waste management. The plastic fractions and wet feeds tocks were separated from the solid waste stream as a first priority (Saengtornng and Keeratiurai, 2011).

Of the issues mentioned above, researchers interested in the study of the solid waste management systems in municipal sub districts in the Lower Northeast, Thailand. This study aimed to determine the proportion of different types of solid wastes at the present time and to offer the right choices for the solid waste management in municipal sub districts, Thailand.

RESEARCH METHOD

Study area and scope of research

The management of solid wastes in municipal subdistricts in the Lower Northeast, Thailand was studied in four provinces. They are Nakhon Ratchasima province, Chaiyaphum province, Buriram province, and Surin province (Nakhonchaiburin group) in Thailand. This research was studied the solid waste management at the present time in municipal sub districts. Solid wastes in the municipal sub districts would be managed by the Sub district Administrative Organization (SAO) or local authorities.

METHODOLOGY

This research studied the management of solid wastes in municipal sub districts in the Nakhonchaiburin group. This study reviewed the information related to the management of solid wastes, classification, collected and transported wastes in the present time. This study collected data on all three seasons, including winter, summer and rainy season. The data collected during the winter months from December to February, the summer months from March to May, and the rainy months from July to September. Various data would be collected and separated into individual solid waste types. To determine the type and amount of waste associated with the season.

- The data was collected from the physical, population, social and business structures in the study area.
- The data on the solid waste management in the municipal sub districts or community's sources that was collected include; household, commercial,

government agencies, schools, markets, health centers and other.

- The data of the amount of solid wastes, type of solid wastes, the solid waste collection, and transport distance were collected for solid waste management in the area. The data collected was analyzed to determine the composition and characteristics of the solid wastes.

The separation method of the solid wastes used to collect data and evaluate the amount of the type of solid wastes that occurs. The separation method of the solid wastes did with the solid waste storage tanks 3 types. The weight of the solid wastes in each tank was weighed by the scales. The tanks were blue bins, green bins and black bins. Blue bins used to store solid wastes for recycling them. Green bins used to store solid wastes for the composting. Black bins used to store solid wastes, they were not the same as previously mentioned.

RESULTS AND DISCUSSIONS

Today, the solid waste management in municipal sub districts was considered to be a major problem of the communities due to inappropriate management. People in communities would manage the solid waste their own families. Some families use a whole pile and set fire. Some families leave it in the space or on the street.

Because the amount of solid wastes had increasing every day, therefore it was necessary to have an efficient solid waste management system. This study considered the elimination of the solid wastes by categories and type of the solid wastes to appropriate living conditions of people in the communities.

- The organic waste that could easily biodegradable was used to make organic composting in this category waste management.
- The papers, plastics, metals and glasses were sold or reused or recycled.
- The final of the solid wastes could not be used for any purpose. They were disposed on the principles of sanitary landfills.

After the sanitary landfill have full solid wastes. This section will be updated to the park again.

All solid wastes could be adopted useful with the solid waste management system without the cost of the solid waste disposal alone.

Analysis of the average rate of solid wastes of sources on various seasons

The solid wastes occurred from the bins at points in municipal sub districts of four provinces. Each point had three bins to be used to separate types of the solid wastes on various seasons. The result of survey showed that the Nakhonchaiburin group had an average daily rate of the solid wastes 757.97 ± 555.06 kg/day of communities in the municipal sub districts of the four provinces in the Lower Northeast, Thailand. The season was one of the



factors that influence the amount of solid wastes but the season had low impact on the composition of the solid wastes. The municipal sub districts had the highest rate of the solid wastes in the summer and more in the rainy season and the lowest in winter, respectively as shown in Figure-1. The Nakhonchaiburin group in the municipal sub districts had the rate of solid wastes per capita per day of the communities 0.26 ± 0.11 kg/capita/day as shown in Figure-2. This value was lower than the threshold for a community municipal / sanitary. Recommendations of the Office of Environmental Policy and Planning (1996) defined the rate of solid wastes was 0.4 kg / capita / day. The results of this study also showed that the average rate of solid wastes in 3 seasons was 51.94 ± 38.27 kg/km²/day of communities in the municipal sub districts as shown in Figure-3.

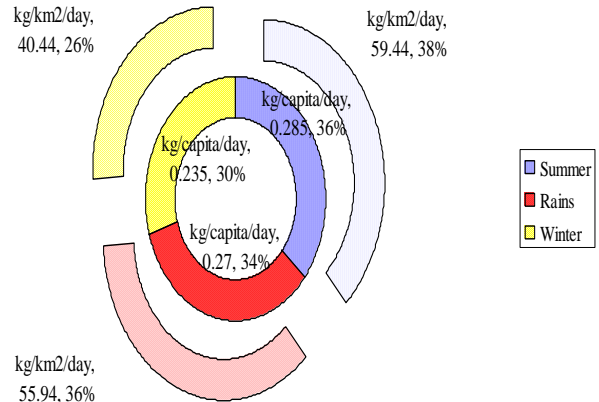


Figure-1. The average seasonal ratios of the solid wastes in the communities in the Nakhonchaiburin group.

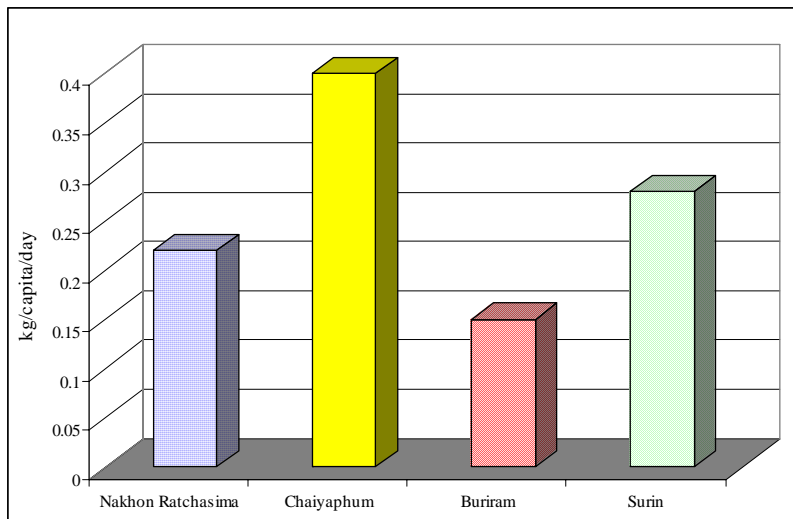


Figure-2. The average rate per capita per day of the solid wastes were disposed in the communities the Nakhonchaiburin group.

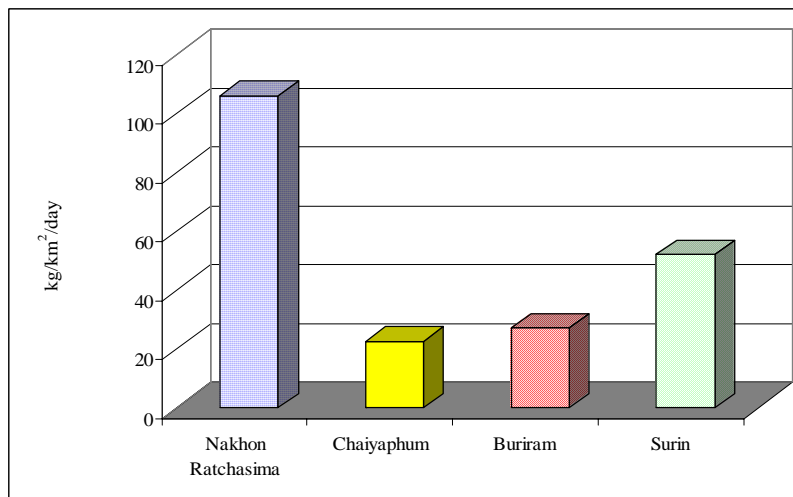


Figure-3. The average rate per area per day of the solid wastes were disposed in the communities the Nakhonchaiburin group.



Analysis of the composition of the solid wastes

The compositions of the solid wastes were surveyed in four provinces of the Lower Northeast of Thailand as shown in Table-1. The solid wastes could be classified the composition into seven groups were paper group, garbage group, plastic group, glass group, metal group, wood group, and etc. The compositions of the solid wastes showed the results in the solid waste management as composting, recycling, and sanitary landfill in the four provinces of the Nakhonchaiburin group. The organic

wastes that could easily biodegradable were used to make organic composting in this category waste management. The papers, plastics, metals and glasses were sold or reused or recycled. The solid waste recycling could be made with the establishment of the solid waste bank in municipal subdistricts of each province. The final of the solid wastes could not be used for any purpose. They were disposed on the principles of sanitary landfills. The final of solid wastes were cement fragments, rubbles, and waste of construction materials.

Table-1. The percentage of the compositions of the solid wastes in the various seasons in the Nakhonchaiburin group.

Provinces	Nakhon Ratchasima	Chaiyaphum	Buriram	Surin
% Papers	9.74±7.93	12.39±9.41	20.24±19.36	19.77±14.86
% Garbage	40.17±5.67	55.53±14.52	20.21±25.73	44.17±5.61
% Plastics	11.22±8.48	15.88±3.79	14.16±10.76	16.81±5.91
% Glasses	5.99±3.35	5.25±4.46	11.30±13.58	14.26±5.80
% Metals	2.83±2.60	2.55±1.82	1.04±1.22	0.81±1.24
% Woods	15.01±9.70	3.52±2.22	4.45±1.02	1.77±0.20
% Etc.	14.89±2.85	4.98±2.19	28.28±46.10	2.81±4.27

The data in Table-1, this analysis of the relationship between the percentage proportion of each type of solid waste and the waste composition of the different seasons was shown in Figures 4 and 5. The most

of the solid wastes from the sources of all the four provinces was 40.02% of garbage from waste as shown in Figure-4.

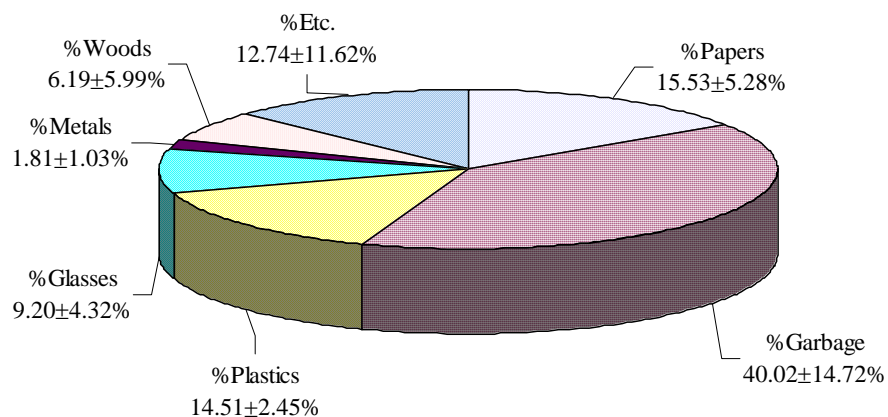


Figure-4. The percentage of the solid wastes from the communities in the Nakhonchaiburin group.

Figure-5 presented an analysis of the composition proportion of the solid wastes that followed the seasons of the Nakhonchaiburin group. The results of this analysis showed that the seasons had very low impact on the composition of the solid wastes as paper group, garbage group, plastic group, and glass group. The type of solid

wastes as papers, garbage, plastics, and glasses would be occurred by the normal life of the communities in municipal sub districts. The metal and wood wastes did not occurred from the normal life of the communities in municipal sub districts of the Nakhonchaiburin group.

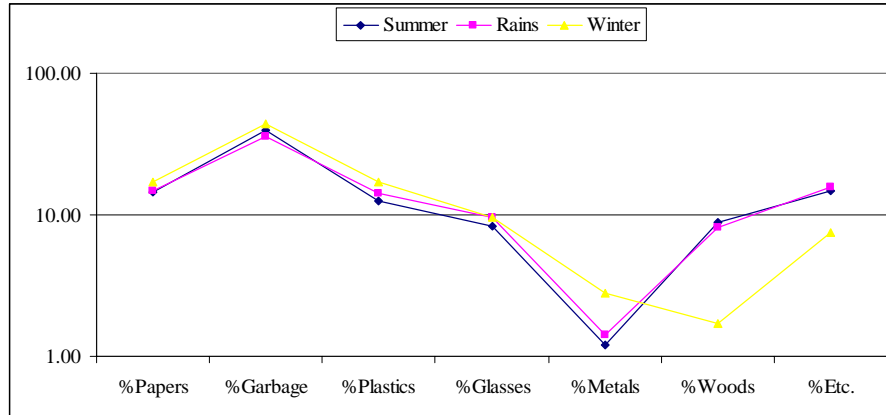


Figure-5. Analysis of the compositions of the solid wastes that occurs seasonally in the Nakhonchaiburin group.

This research presented the results of chemical properties. The chemical properties were one of the means used for the solid waste management. The nutrients of the dry solid wastes that were beneficial to plant growth were the percentage of carbon, nitrogen, phosphorus, potassium were $0.14 \pm 0.03\%$, $1.17 \pm 0.49\%$, $0.12 \pm 0.09\%$ and $0.77 \pm 0.45\%$, respectively. The results of this study showed that a part of the solid wastes was used to make composting.

This research also presented the results of physical properties that showed the average of density and the percentage of moisture content of solid wastes in the Nakhonchaiburin group. The physical properties were one of the means used for the solid waste management. They were used for the preparing vehicles and fuel that used to transport the solid wastes, the composting, or to assess the possibility of bringing the waste to other benefits. This study showed that the average of density and the percentage of moisture content of the solid wastes in the Nakhonchaiburin group was $190.71 \pm 93.16 \text{ kg/m}^3$ and $55.23 \pm 14.47\%$, respectively. The results of this study also showed the average bulk density of each solid waste of the communities in the four provinces as shown in Table-2. The results showed that the garbage was the most density of the solid wastes that was explored at the markets and food stores. The solid wastes were mostly papers, plastics, and glasses from the school and shops. These solid wastes were low density. While other types of the solid wastes were brickbats and fragments of cement. They could be utilized less than other types of the solid wastes.

Table-2. The average bulk density of each solid waste of the communities in the four provinces.

Type of solid wastes	Average of density (kg/m^3)
Papers	95
Garbage	320
Plastics	70
Glasses	185
Metals	280
Woods	150
Etc	235

Possible approaches to the solid waste management

The survey of economic and social conditions of the communities in municipal sub districts found that the people had a moderate economic status. The average density of population was $376.95 \pm 179.19 \text{ capita/km}^2$ in the Nakhonchaiburin group. The Sub district Administrative Organization did storage and waste disposal services in the area of the communities. The basic physical and chemical properties were used to evaluate for possible solutions in the solid waste management. The results showed that the average weights of the solid wastes, were used for recycling, composting, and sanitary landfill process were 311.20 kg/day , 350.23 kg/day , and 96.54 kg/day , respectively as shown in Table-3. The results also showed that the approaches to the solid waste management in the subdistrict municipalities of the communities could be done two ways to do together were recycling and composting. The papers, plastics, glasses, and metals could be handled by the recycling was $41.06 \pm 13.08\%$. The food waste or garbage, wood chips, leaves could be handled by composting was $46.20 \pm 20.71\%$. Finally, the solid wastes that could not be handled by the methods mentioned above to be dumped at the sanitary landfill was $12.74 \pm 11.62\%$. These approaches to the solid waste management were presented the proportions by various methods as shown in Figure-6.



Table-3. Weight of the solid wastes in the solid waste management practices of strategic possibilities.

Strategic approaches	Weight (kg/day)
Recycling	311.20
Composting	350.23
Sanitary landfill	96.54

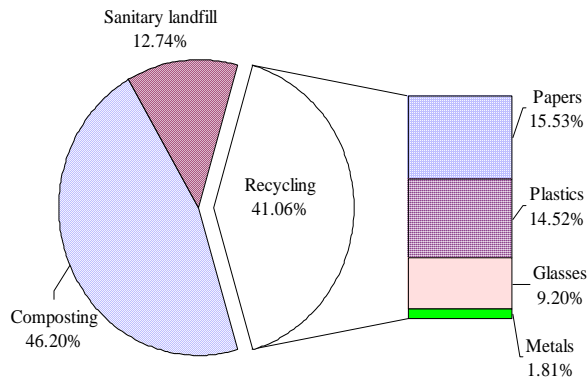


Figure-6. Proportion of the possible approaches in solid waste management.

CONCLUSIONS

This study aimed to determine the proportion of different types of the solid wastes at the present time and to offer the right choices for the solid waste management in the Nakhonchaiburin group. The results of this study showed that the average rate of the solid wastes in 3 seasons was 0.26 ± 0.11 kg/capita/day or was 51.94 ± 38.27 kg/km²/day of communities in the municipal sub districts. Analysis of the composition of the solid wastes according to the seasons found that the season was one of the factors that influence the amount of solid wastes but the season had low impact on the composition of the solid wastes in municipal sub districts in the Nakhonchaiburin group, Thailand. The results of the survey, the solid wastes could be classified into seven groups by mass balance were papers $15.53 \pm 5.28\%$, garbage $40.02 \pm 14.72\%$, plastics $14.52 \pm 2.45\%$, glasses $9.20 \pm 4.32\%$, metals $1.81 \pm 1.03\%$, woods $6.19 \pm 5.99\%$, and etc. $12.74 \pm 11.62\%$.

In addition, the evaluation of alternative of the solid waste management in the communities of the municipal sub districts in the Lower Northeast, Thailand as the Nakhonchaiburin group. The results showed that the Sub district Administrative Organization (SAO) could be achieved through an integrated management approach. The solid waste management effectively, it was necessary to supplement with a solid waste separation system. The results showed that the percent of the proportion of the solid wastes that could be recycling was $41.06 \pm 13.08\%$ by the campaign for a separation of the solid wastes from household. The results also showed that the percent of the proportion of solid wastes that could be composting was $46.20 \pm 20.71\%$. However, due to the separation of solid

wastes for recycling and composting were impossible to eliminate all the solid wastes of the municipal sub districts. Finally, the remaining solid wastes that could not be eliminated with the above methods would be taken to eliminate with the sanitary landfill was $12.74 \pm 11.62\%$.

The benefits of this approach in the management of solid wastes in municipal sub districts were revenue from the sale of solid wastes that they could recycle, revenue from the sale of compost from solid wastes, clean and pleasant residential communities, reduce the environmental impact of solid wastes, such as air pollution, water pollution from leach ate, the sanitary landfill could be used longer.

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