

## A Model of solid Waste Management Based Multilateral Co-operation in Semi-Urban Community

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### ABSTRACT

The purpose of this research was to construct a model of solid waste management based on multilateral cooperation in semi-urban community. Its specific objectives were to 1) study the solid waste situation and involvement of community in the solid waste management in Wangtaku Sub-district, Muang District, Nakhon Pathom Province; 2) construct a model of solid waste management based on multilateral cooperation in the semi-urban community of Wangtaku Sub-district; and 3) evaluate the efficiency of the model. The study followed the mixed method research design. The data were collected by using a questionnaire with 380 persons, in-depth interviews with 12 persons, and a focus group and an evaluation for the efficiency with 36 persons. The research results were as follows. 1) The situation and problems of solid waste in the community were at the high level ( $\bar{x}$  = 3.69) and the involvements of community in solid waste management were at the middle level ( $\bar{x}$  = 2.52). 2) The model of waste management based on multilateral cooperation in semi-urban community comprised occupational multilateral cooperation, solid waste management, local administrative organizations, community health promotion, and environmental networks. 3) Regarding the evaluation for efficiency of the model by the experts, the fitness of the model was at the highest level. The knowledge, awareness and practice about solid waste management of the participants with different genders, education levels, and occupations after joining the activity were increasingly higher than those of before joining the activity with statistical significance at the level of 0.05. The knowledge, awareness and practice about solid waste management of the participants with different genders, education levels, and occupations after joining the activity were not different.

### KEYWORDS

Model, solid waste management, Multilateral co-operation, Semi-urban community

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## Introduction

The amount of solid waste, both of general and dangerous waste, has been rapidly increased. This situation has placed an impact on the environment as generally seen in many areas. The main causes are from the continuing economic growth and the increasing number of population, in urban areas rather than rural areas, followed by the increasing number of factories. The technological development has been done to facilitate the human's consumption. The remaining from the daily consumption of both individuals and households becomes waste. Since the consumption of population has been increased within the crowded living, the amount of solid waste has also been increased in every minute. (Winai Wirawatthananon, 1995). The total amount of solid waste in Thailand is approximately 15.16 million tons per year or 41,532 tons per day. The capacity to collect the waste is about 12.73 million tons per year or 84.00%. With this figure, the amount of recycling waste is around 12.43 million tons or 82.00% (organic and recycled wastes). Semi-urban communities always seriously face a problem of solid waste management. This is because the limited managing potential of local administrative organizations. The problem is generally related to insufficient service provision, delayed collection, accumulative solid waste amount in community, and incorrect management of solid waste according to the sanitation principles. The involvement of community in waste separation is mostly little to none. This is because the lack of behavior and significant mechanism to clearly promote cooperative process.

The problem of solid waste in community has occurred because people lack knowledge, understanding and involvement in reducing and separating waste from the households. The waste from everyday use is in different forms. It is left into the waste lands and the containers provided by the local agencies. It is also burnt in one's own land. It is expected that the daily waste is about 8.5 tons. Regarding the local waste collection, it was found that the amount of waste which could be collected per day was about 7 cubic meters. This amount comprised 40% of degradable wet waste and another 60% of dry waste. They all were brought to put together into the waste land of municipality by piling and landfilling. Furthermore, it was found that an important obstacle for local community was that insufficient budget for dealing with the increasing amount of solid waste.

It is, therefore, the solid waste management based on an involvement of the community members with variety of occupations and using environmental education process will be a significant tool in providing them knowledge in order to promote awareness and behavioral changes toward the management of household waste. This method will lead to an establishment of solid waste management based on bilateral co-operation in the semi-urban community of Wangtaku Sub-district, Muang District, Nakhon Pathom Province.

## Research Objective

The main objective of this research was to propose a model of solid waste management based multilateral co-operation in semi-urban community with 3 specific objectives as the followings:

- i. Studying the current problems of solid waste management and participation at Wangtaku Sub-district, Muang District, Nakhon Pathom Province.

- ii. Synthesizing a model of solid waste management based multilateral co-operation in semi-urban community.
- iii. Evaluating the efficiency of model actual performance to solid waste management based Multilateral Co-operation in Semi-Urban Community.

Theoretical concepts applied in this research are solid waste management, lateral cooperation concept, environmental education, Learning theories, and Semi-urban as the followings:

### ***Solid waste management concept***

Solid waste widely covers the waste or scrap materials from human's activities or from agricultural and industrial production processes. It is, for example, municipal solid waste, industrial waste, and infectious waste (Pollution Control Department, 2009). The municipal solid waste includes waste that left from houses, business workplaces, and government agencies within the community. Regarding the solid waste management, it is then necessary to know origins of the waste. Where is the waste from? What are amount and compositions of the waste? What are types of the solid waste? This information will help facilitate the correct, appropriate and efficient methods of solid waste management which does not cause impact on the environment and eventually on the health (Phatthana Munphruk, 1996). The waste management at present is quite complicated with related factors which are unable to be individually separated or isolated. They are, for example, rapidly expanded towns, insufficient budget, impacts of modern technology, and limited amounts of resource. Therefore, to make the solid waste management more efficient, it is vital necessary to have understanding of different parts of community waste managing system starting from littering till solid waste elimination in the final step. The system consists of 6 steps: 1) Littering, 2) management of its origins, 3) Collection and transport, 4) Transferring and Transport, 5) Transforming and recycling, and 6) Final elimination. ***Lateral cooperation concepts***

This concept of "lateral" cooperation was originally introduced in 1992 by Dr. Prawase Wasi (1992). At that time, the word "five-party (Benchaphakhi) cooperation" was used to mention that the work for economic and social development needs to get cooperation from people of all parts in order to plan, inspect and solve problems together. The people are from all parts such as community, private organizations, business, government agencies and academics. The "five-party" cooperation will coordinate with different parties to work and learn together. This is done for the highest goal that is the change of society with good quality of life of all people by using different and variety strength of each party to support or fulfill weakness of other ones. Within a working process, the practice or operation according to the concept of "five-party" cooperation cannot achieve easily since, regarding the nature of human, individuals have high "ego". Therefore, to get "five-party" cooperation truly happened it must seriously begin or coordinate by "high influence" persons (Anuchat Phuangsamli, 1996) who influence all relevant parties. They will promote each party with believe, trust and confidence in the way to move forward. A strong society will emphasize the power diffusion of society that comprises people from all parties, occupations, incomes and from all parts of the country (Thirayuth Boonmee, 1993). Therefore, the principal characteristics of a civil society involve 1) volunteer working, 2)

independent group, 3) democratic process, and 4) private sector for public. Moreover, a civil society has a process to form itself with four stages. They are having social awareness, having social organizations, having shared ideology, and crystallization to be ideological institution and organization groups.

### ***Environmental education concept***

The environmental education is the educational integration emphasizing on problems and multidisciplinary management. Its goal is to promote value, wellness, and awareness toward the environment. It also allows learners' involvement in expression as guidelines to promote awareness both at present and in the future (UNESCO, 1980). Environmental education process focuses on the promotion of attitude, behavior and value concerning maintenance, problem solution and development of the environment and life quality of human. This emphasis is consistent with the features from the workshop on environmental education in Belgrade, Yugoslavia (UNESCO, 1976). The features involved having 1) awareness, 2) knowledge, 3) positive attitude, 4) skills, 5) ability in evaluation, and 6) participation. The desires were targeted to the global citizen in order to provide them roles to protect, maintain, promote and develop the global environment.

### ***Learning theories***

Learning theories involves changes of individuals' behaviors which derive from individual experiences (Coon, 1994; Domjan, 1996; Lahey, 2001). Additionally, Supot Saeng-ngoen, et al. (2003: 9) mentioned that the learning of human is a lifelong learning in which its beginning point is from cultivation in family and community. The learning is obtained from stories told from generations, rules & prohibitions, traditions, and culture of the society. It also comes from opinions of different groups, participations in social activities, conversations among friends, and working. The study about learning process can be divided into 2 categories: an individual's learning and a community's learning. Furthermore, Bloom, et al. (1975) divided knowledge into 6 levels as follows. 1) Knowledge refers to a mental ability to maintain stories. To know how much each person can maintain stories, we can see from how well he/she choose things from his/her memory. 2) Comprehension refers to ability in conveying meanings to show one's own intentions and also to know other's meanings and desires. 3) Application refers to an ability to bring knowledge, memory and understanding into practice in solving new problems effectively. 4) Analysis refers to an ability to consider any topic into smaller parts. 5) Synthesis refers to an ability to combine smaller parts together into a topic. It is an ability to consider a topic in different aspects and then restructure its system. This will produce a new thing with better efficiency. 6) Evaluation refers to ability to judge and value things by using established criteria and standards.

The concepts and theories mentioned above were therefore used to design a conceptual framework of the research for constructing a model of solid waste management based on multilateral cooperation in the semi-urban community of Wangtaku Sub-district, Muang District, Nakhon Pathom Province. The model was operated through a cooperative process and a learning process at the multilateral level of community in managing the solid waste systemically in order to establish guidelines for developing a model appropriate to the area.

### **Semi-Urban concept**

In literature, different types explicating the "semi-urban" conditions can be found, which can be divided into two groups. The first type is descriptive, mostly trying to develop a framework for analysis under the following captions: the return to rural sprawl and semi-urban landscape. The second group is consistent with the development or strategic category for sustainable development, including urban gardening, lifestyle, landscape, agriculture, urban neo-rurality and Ecopolis. The inherent complexity of the area makes it traditional semi-urban, rural and urban areas in question. To give it to some problems Gulinck suggested difference between the seal sealing off the opening function of the city and the industrial and rural nature. This problem has been confirmed by Tacoli (1998), stating that the high rate of failure of development strategies, often due to a lack of awareness of the complexity of the interaction rural own that involves space as well as the sectorial dimension.

### **Methodology**

#### **The Sample**

The sample used in study was divided into 3 groups.

- i. The group of 380 people, covering 12 occupations of population of 5,946 people who live in Wang Traku Sub-district, Muang District, Nakhon Pathom Province, was used with a questionnaire and the data were calculated by using Taro Yamane's formula.
- ii. The group of 10 people selected from community leaders using purposive sampling was used with in-depth interviews.
- iii. The group of 36 participants of a focus group discussion and efficiency evaluation was selected by volunteering from people in 12 occupations (3 people each).

#### **Data Collection**

The research data were collected from a questionnaire, depth interviews, and a focus group and efficiency evaluation with details as follows.

- i. The data were gain from the review of theories, documents and research related to the model of solid waste management based multilateral co-operation in semi-urban community.
- ii. The data from the questionnaire asking 380 people in the area were statistically analyzed by using frequency, mean, percentage, standard deviation and t-test analysis.
- iii. The data from in-depth interviews of 10 people were analyzed by using descriptive method and content analysis.
- iv. Synthesizing a model of solid waste management based multilateral co-operation in semi-urban community followed the following steps. 1) The data obtained from the questionnaire and the interview forms were checked with their correctness. 2) All collected data were analyzed and synthesized, and then used as drafts. 3) A focus group discussion was organized with community leaders of all parts and data were collected from the discussion. 4) All data and conclusions were used to construct a model of solid waste management based on multilateral co-operation in semi-urban community, 5) draft of the model was brought

to experts to evaluate its quality and then the IOC was investigated, and 6) the draft was adjusted or improved to be used as a model of solid waste management based multilateral cooperation in semi-urban community.

## Results and Discussions

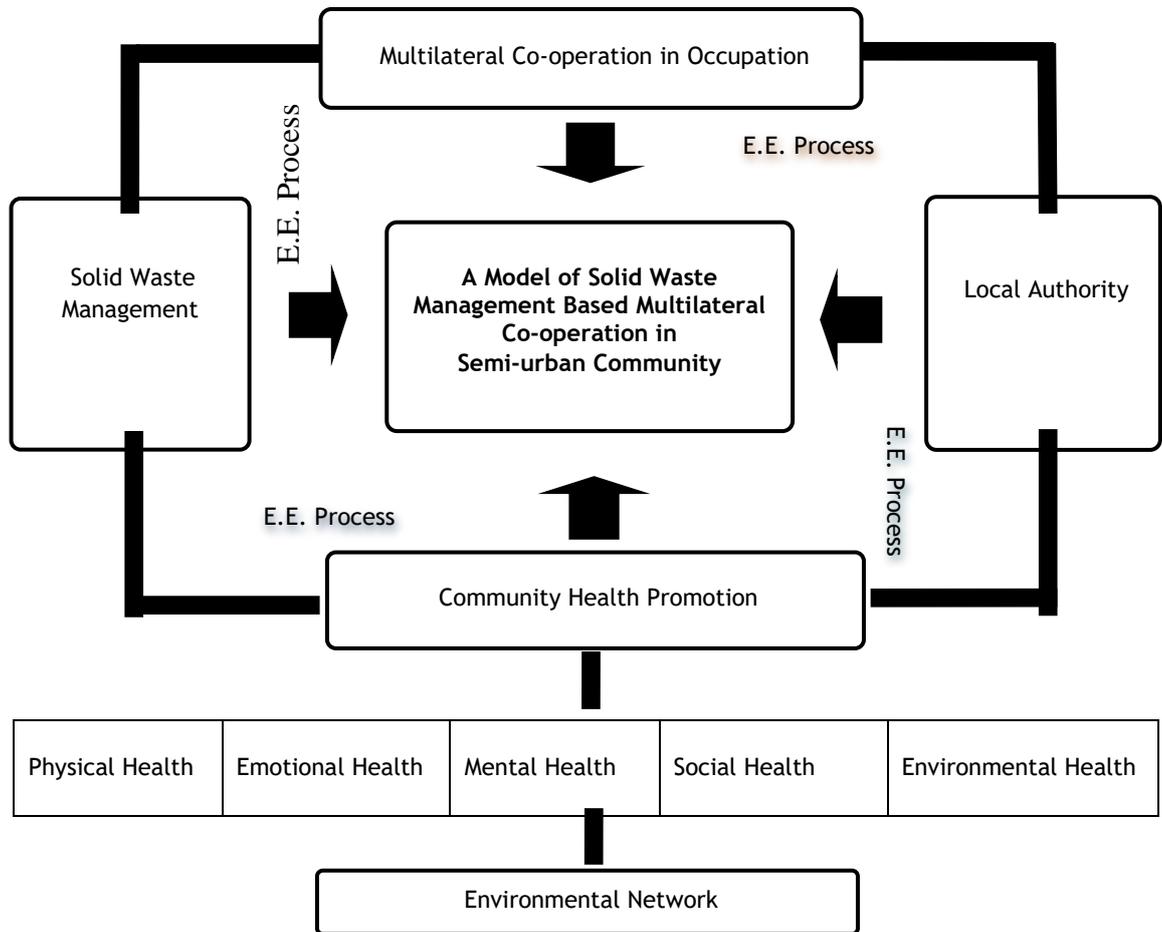
The results of study on a model of waste management based multilateral cooperation in semi-urban community were as follows.

1. Regarding the study of situation, it was found that the informants were female (58.20%), male (41.80%), married (73.20%), single (19.70%) and divorced (7.10% respectively). They were 36-45 (48.90%), 25-35 (29.50%), from 46 (13.20%), and 20-24 (8.40%) years of age. They completed lower secondary education (40.0%), upper secondary education/equivalent (36.60%), bachelor degree level (22.90%), and post graduate level (0.50%). When considering their occupations, it was found that people in community in Wangtaku Sub-district, Muang District, Nakhon Pathom Province were farmers (19.70%), personal business persons (12.60%), general laborers (11.10%), sellers (10.0%), company staff/shop assistants (9.20%), animal raisers (7.40%), househusbands/housewives (6.30%), entrepreneurs (6.30%), government officials (5.80%), gardeners (5.80%), fishermen (3.70%), and state enterprise staff (2.10%). Their income was lower than 12,000 baht (54.20%), 12,001-25,000 baht (35.30%), and from 25,001 upward (10.50%). They were Buddhists (78.20%), Muslim (15.80%), and Christians (6.10%). They were villagers (86.80%), other status (9.20%), community leaders or village committee members (2.60%), and sub-district administrative organization members (1.30%). According to the years of living in the community, they were from 6 years upward (32.10%), 4 years (20.80%), 5 years (17.40%), 3 years (13.20%), 1 year (9.20%) and 2 years (7.40%).

Regarding the study of problems concerning solid waste management, analyzed from the questionnaire to the sample who lived in Wangtaku Sub-district, Muang District, Nakhon Pathom Province, it was found that opinions of the sample toward the situation and problems of solid waste management in general were at the high level ( $\bar{x}$  = 3.69). When considering in individual items, it was found that the opinions of people toward the situation and problems of solid waste management in Wangtaku Sub-district, Muang District, Nakhon Pathom Province were at the high level in 18 items.

Regarding involvement of the community, the involvement of sample in solid waste management in the area of Wangtaku Sub-district, Muang District, Nakhon Pathom Province was at the middle level ( $\bar{x}$  = 2.52).

2. Regarding the model of solid waste management based multilateral cooperation in the semi-urban community of Wangtaku Sub-district, Muang District, Nakhon Pathom Province; it could be synthesized as shown in Diagram 1.



**Diagram 1.** The model of solid waste management based multilateral cooperation in the semi-urban community of Wangtaku Sub-district, Muang District, Nakhon Pathom Province

From Diagram 1, the model of waste management based multilateral cooperation in the semi-urban community of Wangtaku Sub-district, Muang District, Nakhon Pathom Province comprised occupational multilateral cooperation from 12 occupations: farmers, government officials, state enterprise staff, company staff/shop assistants, sellers, fishermen, animal raisers, general laborers, househusbands/housewives, personal businesspersons, gardeners, and entrepreneurs, who involved in solving the problems and finding guidelines for solid waste management of the community. This could be done by local administrative organizations that played an important role to promote and support the community in solid waste management in order to provide people with knowledge and awareness about the waste problems. The organizations involved in finding ways to assist in solving the problems. Moreover, they were also concerned with the community health including physical health, mental health, emotional health, social health and environmental health. A good management of solid waste helps improve the environment in community. It also improves the community health. The way to make the solid waste management in community

sustainable must rely on the environmental networks, both inside and outside the community, as a channel to connect those promotions of waste management in different forms, such as buying and processing, etc., through the process of environmental education.

3. Researchers have created innovation to provide knowledge, understanding and awareness to manage solid waste and lead to solid waste management practice. Local authority has to participate in activity to support such as to participate in joint planning, to manage solid waste, to support budget, to encourage personnel in working unite to learn solid waste management including planning to carry right method to manage solid waste by principle of solid waste management at sources in households. Environmental education can be applied to be direction to promote public to get knowledge awareness and participation in solid waste management for cleanliness and tidiness of community for living in good environments.

4. The evaluation for efficiency of the model of solid waste management based multilateral co-operation in the semi-urban community of Wangtaku Sub-district, Muang District, Nakhon Pathom Province, was carried out into 2 stages as follows.

**Table 1.** Means and standard deviations by experts to evaluation results of the model of solid waste management based on multilateral cooperation in the semi-urban community

Items for evaluation	Level		Level of appropriateness
	Mean	S.D.	
<b>1. Model development</b>			
1.1 Appropriate model	4.60 <sup>4</sup>	0.55	Highest
1.2 Implementation	4.80 <sup>4</sup>	0.45	Highest
1.3 Spatial relation	5.00 <sup>4</sup>	0.00	Highest
1.4 Coverage of contents	4.80 <sup>4</sup>	0.45	Highest
1.5 Coverage in the areas of waste management	5.00 <sup>4</sup>	0.00	Highest
Total	4.84 <sup>4</sup>	0.17	Highest
<b>2. Implication</b>			
2.1 Be able to put into practice in all areas	4.80 <sup>4</sup>	0.45	Highest
2.2 Results from the practice	4.80 <sup>4</sup>	0.45	Highest
2.3 Flexibility toward the practice	4.40 <sup>3</sup>	0.55	High
2.4 Solutions for the waste problem of community	4.40 <sup>3</sup>	0.55	High
2.5 Adaptation for other areas	4.20 <sup>3</sup>	0.45	High
Total	4.52 <sup>4</sup>	1.34	Highest
Total	4.68 <sup>4</sup>	0.22	Highest

<sup>3</sup>Refers to High ( $\bar{x}$  =3.51-4.50), <sup>4</sup>Refers to highest ( $\bar{x}$  =4.51-5.00)

From Table 1, it was found that the experts agreed with the model of solid waste management based on multilateral cooperation in the semi-urban community of Wangtaku Sub-district, Muang District, Nakhon Pathom Province, in general at the highest level ( $\bar{x}$ = 4.68) and in individual areas ( $\bar{x}$ = 4.84 and  $\bar{x}$ =

4.52) at the highest level. When considering in individual items, it was found that the items with highest mean were the items of Spatial relation and Coverage in the areas of waste management ( $\bar{X}= 5.00$ ) under the area of Model Development, and the item of be able to put into practice in all areas ( $\bar{X}= 4.80$ ) under the area of Implication. The item with lowest mean was the item of Adaptation for other areas ( $\bar{X}= 4.20$ ).

**Table 2.** Means scores and standard deviations of pre-test and post-test in all aspects of environmental education learning

Aspect	Pre-test (n=36)		Post-test (n=36)		t	p
	Mean	S.D.	Mean	S.D.		
Knowledge	.42	.10	.92	.06	-25.663	.000*
Awareness						
Receiving Stage	2.80	.40	4.41	.26	-22.315	.000*
Valuing Stage	2.82	.19	4.41	.26	-30.200	.000*
Responding Stage	2.88	.11	4.61	.24	-41.593	.000*
Total	2.77	.16	4.50	.14	-49.164	.000*
Practice	3.49	.15	4.64	.18	total	3.49 <sup>1</sup>

\* With statistical significance at the level of .05

Note: Knowledge: Low (=0.1-0.33) High (=0.34-0.66) Highest (=0.67-1)

Awareness, Practice: Middle (=2.51-3.50) High (=3.51-4.50) Highest (=3.51-4.50)

From Table 2, it was found that the knowledge, awareness and practice of solid waste management of the sample with different genders, education levels, and occupations were higher than those of before joining the learning with statistical significance at the level of .05.

**Table 3.** Comparisons of the knowledge, awareness and practice of solid waste management after using the model of solid waste management of the community representatives in each occupation (One-way MANOVA)

Independent Variables	Dependent Variables	Sources of Variation	SS	df	MS	F	p
Genders	Knowledge	Between groups	.079	1	.079	.070	.793
		Within group	38.476	34	1.132		
		Total	38.556	35			
	Awareness	Between groups	.000	1	.000	.020	.888
		Within group	.760	34	.022		
		Total	.760	35			
	Practice	Between groups	.033	1	.033	1.012	.321
		Within group	1.109	34	.033		
		Total	1.142	35			

**Table 3.** Continued.

Independent Variables	Dependent Variables	Sources of Variation	SS	df	MS	F	p
Education levels	Knowledge	Between groups	1.124	1	1.124	1.021	.319
		Within group	37.431	34	1.101		
		Total	38.556	35			
	Awareness	Between groups	.002	1	.002	.070	.792
		Within group	.759	34	.022		
		Total	.760	35			
	Practice	Between groups	.001	1	.001	.039	.845
		Within group	1.141	34	.034		
		Total	1.142	35			
Occupations	Knowledge	Between groups	17.222	11	1.566	1.761	.119
		Within group	21.333	24	.889		
		Total	38.556	35			
	Awareness	Between groups	.075	11	.007	.240	.991
		Within group	.685	24	.029		
		Total	.760	35			
	Practice	Between groups	.240	11	.022	.581	.825
		Within group	.902	24	.038		
		Total	1.142	35			

From Table 3, it was found that the knowledge, awareness and practice of solid waste management of the sample with different genders, education levels, and occupations after using the model of solid waste management based multilateral cooperation in semi-urban community were not different in general.

## Discussions

1. Regarding the study about waste problems and the involvement of community in solid waste management, it was found that opinions of the sample toward the waste situation and problems in community in general were at the high level ( $\bar{x} = 3.69$ ). The item with highest mean was that about the community where you live has problem about waste disposal/treatment ( $\bar{x} = 4.22$ ). The items with lowest mean were those about your household has problem of bad smell waste and your household reduces daily amount of waste ( $\bar{x} = 2.51$ ).

2. For participation of the people in solid waste management, it was found that the sample involved in the solid waste management in general at the middle level ( $\bar{x} = 2.52$ ). When considering in individual items, it showed that people involved in the solid waste management at the high level in 1 item. The item with highest involvement was that you are interested in participating in the solid waste management of community ( $\bar{x} = 3.52$ ). The item with lowest involvement was that you used to participate in evaluating the solutions of solid waste management process in the community ( $\bar{x} = 2.38$ ). The findings were consistent with the research results of Prakop Sutthikamot (2005) which studied the

involvement of community in waste management with the case study of Wat Klang Community, Bang Kapi District, Bangkok.

3. The model of solid waste management for the semi-urban area of Wangtaku Sub-district, Muang District, Nakhon Pathom Province, was obtained by the synthesis from participation of agencies, community organizations, government sector, academics and representatives of each occupation. It was found that the model comprised 4 areas of component: community health promotion, local authority, solid waste management by using environmental education, and multilateral co-operation in occupation. The results from evaluation of fitness of the model of solid waste management by experts revealed that the fitness was at the highest level. The results agreed with the National Environmental Quality Promotion and Maintenance Act B.E. 2535 (Department of Environmental Quality Promotion, 1992). The Act established the guidelines for solid waste management as basis and the related policy and plan were made for the long period of 20 years (1997-2016). The results were also consistent with the action plan 21 of the United Nations (UN) which determined policies for sustainable development concerning waste management. They were, for example, the policy to prevent and eliminate pollution from waste. In summary, the waste management must be carried out correctly according to the sanitation principles. The policies also included the control of dangers from waste production of population, the promotion of waste recycling, the promotion and support of private sector to co-invest in construction and/or administration concerning waste management, the promotion and support private organizations and people to have more involvement in solving the waste problems. However, the operations of those plans and guidelines have been still with many limitations. As the waste is a kind of manufacturing factor. Many agencies have currently tried to reduce the problems about pollutions from waste by recycling. More groups and networks have been established at the community and local levels. For example, grass root network was the grouping of 19 local groups and was supported by Thai Community Foundation in using the waste bank model or waste and egg exchange project. Moreover, there was a recycle center in different forms including the use of efficiency microorganism or EM (Bureau of Environmental Policies and Planning, 1997).

4. Regarding the evaluation for efficiency of the model, the model of solid waste management based multilateral co-operation in semi-urban community was implemented with the sample of 12 occupations through workshops. The results from the use of the model showed that the knowledge, awareness, and practice about solid waste management of the sample, classified by gender, education level and occupation, in general were higher than those before the workshops with statistical significance at the level of .05. The knowledge, awareness, and practice concerning solid waste management of the sample with different genders, education levels and occupations were not different. This might be because the training process was conducted through the learning process which focused on providing participants more opportunities to practice in solid waste management and to exchange or share knowledge and experience. The process also involved the studies from experiences of the agencies with the success of solid waste management based on cooperation. The waste issues from the past and at present were integrated into the learning process which allowed the participants to propose their own solutions. The results were consistent with the cognitive theory in the group of knowledge and comprehension. The theory explains that learning is the effect of process of thinking and understanding. The recognition of

stimulus which stimulates with the past experience of an individual will facilitate learning which is combined between those present and past experiences. This needs intellectual process which also influences learning. The theory therefore emphasizes cognitive process rather than determining conditions for producing behaviors. The learning theory in this group involves, for example, the learning theory of social intellectual learning and theory of insight learning. It is a field theory which focuses on the receivers who will produce learning behavior. From aspects of analysis and experience, learning is an effect of intelligence together with experience and analytical thinking (Tisana Khemmani, 2014). The workshops also included interesting activities which provided participants opportunities to propose their own solutions for the waste issues. These activities affected the knowledge, awareness and practice about solid waste management of the sample after the use of the model of solid waste management in semi-urban community. The results agree with the research results of Surakrai Wangsakan (2005) which studied the development of training plans to promote the involvement of community leaders in solid waste management of Cha-e Sub-District Municipality, Cha-e District, Mukdahan Province. The study was carried out to establish guidelines to develop and promote awareness of community leaders and to develop a model of training plans to promote involvement of the community leaders in 5 areas: planning, operation, decision making, responsibility and monitoring & evaluation. The research results found that, after the participation in activities, the levels of knowledge, attitude and participation about solid waste management of the sample were higher. This resulted that the amount of solid waste of Cha-e Sub-District Municipality was reduced. The training plans could be applied to use with neighboring communities or organizations which were appropriate to the context of Mukdahan Province. It was also found that the community used degradable waste to produce compost (56.5%) and biological fermentation (74.10%). A fund to buy waste was established and 82.40% of villagers joined as members of the fund. The findings were also consistent with the research results of Nichaphat Phoemthong-In (2007) which studied the environmental education for the environmental management at Wat Lamphaya Floating Market, Banglen District, Nakhon Pathom Province. The results revealed that the levels of knowledge, understanding and awareness about the environment concerning environmental pollutions and the community environmental management or landscape management of the sample vendors, at Lamphaya Floating Market and who participated in the workshop, were increased. When comparing differences of the tests of knowledge and awareness before and after the workshop using the statistic t-test, it was found that they were different with statistical significance at the level of 0.05. The skill in participation was at the high level. The study was in relation with the research results of Surasak Muangphrom (2008) which studied and developed a training model of solid waste management in rural areas of Roi-Et Province. The study found that the practice of solid waste management after the training was higher than that of before the training with statistical significance at the level of .05. The knowledge, attitude and practice about solid waste management of people with different genders, education levels and training experiences were not different.

## Conclusions and Recommendations

### Conclusions

The purpose of this research was to construct a model of solid waste management based on multilateral cooperation in semi-urban community. Its specific objectives were to 1) study the waste situation and involvements of

community in waste management in Wangtaku Sub-district, Muang District, Nakhon Pathom Province; 2) develop a mode of solid waste management based on multilateral cooperation in the semi-urban community of Wangtaku Sub-district; and 3) evaluate the efficiency of the model. The research results could be summarized as follows. The waste situation and problems in the community were at the high level ( $\bar{x}= 3.69$ ) and the involvements of community in waste management were at the middle level ( $\bar{x}=2.52$ ). The model of solid waste management based multilateral cooperation in semi-urban community comprised 4 areas of components: (1) occupational multilateral cooperation for waste management, (2) local administrative organizations, (3) community health promotion, and (4) environmental networks. Regarding the evaluation for efficiency of the model by the experts, the fitness of model was at the highest level. The knowledge, awareness and practice about solid waste management of the participants with different genders, education levels, and occupations after joining the activities were higher than those of before joining the activities. The knowledge, awareness and practice about solid waste management of the participants with different genders, education levels, and occupations after joining the activities were not different.

### Recommendations

- i. Knowledge, understanding and awareness should be promoted by using printed materials and activities to make best of waste to reduce its amount and also in agriculture should be also promoted.
- ii. Community should be strengthening by establishing a committee for waste management in order to eliminate burdens of the local administrative organizations.
- iii. Beside the use of research dimensions, the participating process should also use that strategy to get access to community to gain trust and believe from society.
- iv. Results of the research and the model of solid waste management should be brought into practice with other semi-urban community for improvement of their future waste management.

### Disclosure statement

No potential conflict of interest was reported by the authors.

### Notes on contributors

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