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Appropriate participatory food waste management in the World Heritage Site, the Historic City of Ayutthaya

Patranit Srijuntrapun

Faculty of Social Sciences and Humanities, Mahidol University, Nakhon Pathom 73170, Thailand

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ABSTRACT

The waste problem in the Historic City of Ayutthaya is so serious that there are concerns it is affecting the image of the ancient city and may result in its deregistration as a World Heritage Site. An appropriate participatory food waste management system at this site was thus studied employing a quantitative method and Participatory Action Research (PAR) in order to create a decent urban environment and a good image for the World Heritage Site. The findings revealed that the primary barriers to participation in waste separation were the attitudes of the citizens concerning waste management and waste separation. The present study found that the majority of the sample group usually separated recyclable garbage (87.2%) but they did not separate food waste before disposing of their garbage (72.2%). In addition, by employing PAR to address the problem of food waste, it was found that the appropriate participatory food waste management strategy was "to produce bio-extract or bio-fertilizer from domestic food waste." Thus, appropriate waste management and waste separation plans should identify a format for participation in which citizens can contribute to an essential part of the process. Furthermore, participants in the community could apply the process of PAR to solve additional community problems.

Introduction

Today, environmental problems are becoming increasingly severe. Both natural resources, such as rivers and forests, and man-made resources, such as parks, roads, highways, parking lots and heritage areas, have been rapidly deteriorating and have become subject to over-use or over-consumption due to the self-interests of the population. Even though solutions to environmental problems have been created and applied, they have not been successful because governmental solutions in this area usually involve top-down strategies and lack the involvement of the people (bottom-up strategies).

Thus, the engagement of the people in solving environmental problems has become a crucial worldwide concern. As a result, the United Nations Environment Programme (2012) suggested that the involvement of people should be increased for sustainable solutions to environmental problems. Human behavior should be altered to fit with varied solutions such as: campaigns to reduce smoking; water and energy conservation; and waste separation and recycling. Solving such problems by changing human behavior is more economical than the use of expensive high technology. Moreover, the behavioral transformation can lead to sustainable solutions to environmental issues.

Participatory Action Research (PAR) is one of the social strategies utilized in increasing people's involvement in solving environmental issues via research. This method strengthens and equips the community with sustainable

E-mail addresses: nisa_lay@hotmail.com, Patranit.sri@mahidol.ac.th.
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solutions (Bottom-Up Model) (Sanrattana, 2007). This model allows local people to engage in conducting research and learning from their own experiences. The involvement of all parties is required in all research processes, from identifying problems, progressing, analyzing data, finding solutions, and supporting activities (Chantavanich, 2004; Erwin, 1976). Such engagement from local communities can then lead to appropriate context-specific solutions.

In Thailand, the problem of waste is a crucial environmental issue that has become increasingly serious due to an increase in population, especially in urban areas and tourist cities such as the Historic City of Ayutthaya. The site is located in Ayutthaya municipality and was declared a World Heritage Site by UNESCO on December 13, 1991. As a result, it is well known among tourists. In addition to its attraction as a World Heritage Site, its neighboring areas are designated as industrial development zones. Consequently, Thai and alien laborers have migrated to the area, causing the non-registered population to be five times greater than that of the local population. The aforementioned situations have contributed greatly to the waste problems endured by the city of Ayutthaya. This problem is so worrying that, if not solved promptly, it will lead to the removal of Ayutthaya from UNESCO's list of World Heritage Sites (Thai PBS, 2013).

A previous study noted that there were 20,000 tonnes of waste in the Ayutthaya municipality. Terrifyingly, the amount of waste at present day is five times greater than that found in the past. Before 2015, the one and only waste disposal area of the Phra Nakhon Si Ayutthaya municipality was a 30-rai area in the Baan Pom sub-district, Phra Nakhon Si Ayutthaya district. By using an open dumping system, this disposal area now holds nearly 300,000 tonnes of residual waste in the middle of paddy fields. Furthermore, daily waste collected in the Ayutthaya municipality amounts to about 90 tonnes; in addition to the 50 tonnes of waste originating from other organizations. All in all, approximately 140 tonnes of waste are dumped in this area on a daily basis.

This waste problem has been continuous and becoming increasingly serious; several parties conferred and came up with a solution to transfer 300,000 tonnes of waste from the Baan Pom disposal area to a 400-rai area in the Maha Phram subdistrict, Bang Ban district, Phra Nakhon Si Ayutthaya, located five kilometers from the original area. This area is open for private sector investment in producing environmentally friendly incinerators that can convert rubbish into heat and electricity. It is anticipated that in the future the new dumping ground will be able to manage waste from all areas in the province and thus successfully achieve its goal. However, it will take approximately one year to construct an incineration plant and transfer all rubbish from the old dump. In addition to a long installation process, this method uses technology for solving problems without considering the engagement of citizens who might be the real cause of waste problems in the area.

Theerapuncharoen and Limsantithum (2007) found that the residual waste in the area was due to ineffective garbage management, a lack of local population involvement, an insufficient budget for solving infrastructure problems, and a deficiency in the critical thinking of administrative personnel in problem solving. Consequently, the solutions for the waste problem are incomplete and do not comply with public policy. Evidently, the residual waste in the area is not separated; even though, 40 percent of it can be recycled.

The abovementioned study revealed that people did not engage in waste separation and waste management. In the near future, waste management in the study area will be conducted with the use of technology, however the solutions for the waste problem will not be sustainable if the public does not become involved in the management process. Therefore, in order to enhance public participation in garbage management in the study area, the focus of this study was divided into two parts: 1) survey research, using KAP (Knowledge, Attitude and Practices), to examine the causes which lead to a lack of participation from the local population in waste separation; and 2) Participatory Action Research (PAR) focusing on finding models of public participation in waste separation. These models rightly came from the needs of the community, resulting in practical solutions.

There were two main goals to this study: 1) to preserve the surrounding environment and create a positive image of the World Heritage Site as an essential tourist attraction of Thailand and 2) to encourage the community to solve garbage issues using their own experiences in order to create sustainable solutions to waste problems. Moreover, the strong involvement of the community in rubbish separation might lead to communal practices that could be shared with other communities.

Objectives

1. To examine problems and barriers to the participation of citizens in waste separation at the World Heritage Site, the Historic City of Ayutthaya
2. To discover an appropriate participatory food waste management system for implementation in the World Heritage Site, the Historic City of Ayutthaya

Methods

The study was conducted according to the research objectives: 1) survey research, by using a questionnaire to examine the causes which have led to a lack of local participation in waste separation at the World Heritage Site; and 2) PAR, by applying the focus group method to find models of public participation in waste separation.

Participants

Participants for Objective 1: 392 samples were selected utilizing a simple random sampling method from the 18,452 heads of household or representatives who were older than 18 years and living in the Phra Nakhon Si Ayutthaya district.

Participants for Objective 2: 20 participants were selected through a purposive sampling method from the citizens of a community that participated in Participatory Action Research (PAR). All participants were volunteers and

had good comprehension of waste separation and management. They were from the same community, which was chosen by purposive sampling from 50 communities in the Ayutthaya municipality area. Three qualifications were used in selecting the community: 1) from the preliminary survey, it had to be a community with a lot of household waste, 2) it had the potential for collaboration with, and management in various community affairs such as village funds, professional or business groups, and other public activities, and 3) it had to have a strong community leader.

Tools and Data Collection

1. The questionnaire contained four parts. Part 1 contained general information about the samples. Part 2 examined the sample group's comprehension and knowledge about waste management and separation. Part 3 explored the attitudes towards responsibility for waste management and separation. The questions in this part focused on attitudes about the value, importance, and benefits of waste separation. Part 4 inquired about behaviors related to waste management and separation. The questions in this part addressed the sample group's behaviors regarding waste disposal and waste separation to examine whether recycling knowledge was put into practice in order to reduce the amount of waste. Parts 5 and 6 identified problems in waste management and separation and identified guidelines for promoting garbage separation. The reliability of the questionnaire was scored 0.91 according to Cronbach's alpha. This high alpha value demonstrated that the questionnaire was reliable for data collection.

2. Focus group discussion is a tool for collecting data in PAR, which is an enhanced learning and collaborative process in problem solving for people in the community. Moreover, PAR is an effective tool for encouraging people to find practical and sustainable solutions for their problems. This tool was applied in this study due to the need for accurate and relevant data to answer research questions of a particular topic (Podhisita, 2007). The data were collected from the sample group on the topics of the waste problem in the World Heritage Site, patterns or guidelines that the community wanted for garbage separation, community resources that could be used for problem solving in accordance with the community's needs, and SWOT (strengths, weaknesses, opportunity, and threats) analysis.

Data Analysis

The quantitative data were analyzed using descriptive statistics in terms of the frequency, percentage, mean, and standard deviation. For the PAR, the data were categorized using content analysis.

Results

The sample group consisted of 392 people (233 females and 159 males) representing 59.4% and 40.6%, respectively. The age group of 21–30 years made up the majority of the sample group with 81 people (20.7%). The smallest age group was the demographic younger than 21 years, with 43 people (11.0%). The majority, 300 people (76.5%), of the sample group had graduated from secondary school. The income of the majority of the sample group (193 people or 49.2%) was less than or equal to THB 10,000 per month. There were 156 people (39.8%) who earned THB 10,001–30,000 monthly. The majority lived in private houses, 344 people or 87.8 percent.

The majority—363 people (92.6%)—considered that waste collection was the municipality's responsibility. Additionally, 269 or 68.6 percent of people responded that they did not pay the garbage collecting fee. Moreover, people in the sample group thought that garbage trucks worked daily (41.6%); and some people answered that the trucks came twice a week (27.8%). When describing the most common types of waste, the majority of the sample group (52%) said that it was food waste as presented in Table 1.

Knowledge, Attitude, Behavior Regarding Waste Management and Separation

The findings revealed that the majority of the participants (233 people or 59.4%) had a high level of knowledge about waste management and waste separation. There were 156 people (39.8%) who had a moderate level of knowledge about waste management and waste separation. Interestingly, only 3 people (0.8%) had a low level as presented in Table 2.

The majority of the sample group had a positive attitude toward waste management and separation as presented in Table 3. The mean score was 4, and the standard deviation was 0.587. The question which received the most positive response was, “The garbage problem in the city of Ayutthaya should be solved urgently.” Furthermore, two questions which received moderate responses from the sample were: “The responsibility for waste management and separation belongs to the municipality not citizens”; and “People pay waste collection fees so they do not need to separate garbage nor solve the waste problem.” There were no recorded negative attitudes towards waste management and separation.

The sample group's behavior related to rubbish management and separation was at a moderate level with a mean score of 2.96 and a standard deviation of 0.670 as presented in Table 4. The behavior that received the highest score in this part was “collecting recyclable waste and selling it at recycling shops.” The behavior that received the lowest score was “producing bio-extract or bio-fertilizer from domestic food waste.”

To summarize, the sample group in this study had a high level of knowledge regarding waste management and separation. Interestingly, people in the group had a positive attitude; however, their behaviors were scored at a moderate level. These findings are in accordance with a study on waste management undertaken in the municipal community of Kokgruad sub-district (Yodsoungnhurn, Rattnawong, & Jundaon, 2015). Furthermore, the current findings are similar to a study concerning the factors that correlate with waste management behaviors for local government personnel in Lopburi province. These studies provide similar results demonstrating people's knowledge of waste management at a high level, but with a

Table 1
General information of the sample group

(n = 392)

General information		Number	Percentage
1. Gender	Male	159	40.6
	Female	233	59.4
2. Age	Younger than 21 years old	43	11.0
	21–30years old	81	20.7
	31–40 years old	60	15.3
	41–50 years old	79	20.2
	51–60 years old	73	18.6
	61 years old and older	56	14.3
3. Education	Secondary school	300	76.5
	Bachelor's degree	86	21.9
	Master degree	4	1.0
	Ph.D	1	0.3
	N/A	1	0.3
4. Income	10,000 Baht or lower	193	49.2
	10,001–30,000 Baht	156	39.8
	30,000 Baht or higher	14	3.6
	N/A	29	7.4
5. Accommodation	House	344	87.8
	Dormitory/apartment	27	6.9
	Restauarant	7	1.8
	Factory	1	0.3
	Market	1	0.3
	Others	5	1.3
	N/A	7	1.8
6. The garbage collecting organization	Municipality	363	92.6
	Private organization	1	0.3
	Others	25	6.4
	N/A	3	0.8
7. The organization in charge of the waste collection fee	Municipality	103	26.3
	Local Administrative Organization	21	5.4
	Private organization	2	0.5
	No fee	253	64.5
	N/A	12	3.1
8. The waste collection fee	1–50 Baht	113	28.8
	51–100 Baht	5	1.3
	101 Baht or higher	5	1.3
	No fee	269	68.6
9. Frequency of waste collection	1 time/week	51	13.0
	2 times/week	109	27.8
	3 times/week	55	14.0
	Daily	163	41.6
	N/A	14	3.6
10. Common type of waste	Food waste	204	52.0
	Recyclable waste	89	22.7
	Iron remnants	2	0.5
	Others	18	4.6
	N/A	79	20.2

Table 2
Level of knowledge about waste management and waste separation

(n = 392)

Level of knowledge about waste management	Number	Percentage
Low	3	0.8
Moderate	156	39.8
High	233	59.4

moderate level of behavior. People have a good understanding about garbage management due to the number of campaigns for raising public awareness and enhancing understanding through various media. However, people's behaviors remain at a moderate level because they preserve some negative attitudes, that discourage behaviors for managing and separating garbage. For example, local people agreed with the sentiment that "the responsibility for waste management and separation belongs to the municipality not citizens"; and "people pay waste collection fees, so they do not need to separate garbage nor solve the waste problem." These responses reflect people's lack of awareness and intention in waste management and separation.

Table 3
Level of attitudes toward waste management and separation

(n = 392)

Level of attitudes toward waste management and separation	Number	Percentage
Negative	–	–
Moderate	159	40.6
Positive	233	59.4

Table 4
Behaviors concerning waste management and separation

(n = 392)

Behaviors concerning waste management and separation	Number	Percentage
Low	64	16.4
Moderate	255	65.1
High	73	18.6

Problems Regarding Waste Disposal and Waste Separation

The present study found that the majority of the sample group usually separated recyclable garbage (87.2%). Only 11% of people in the sample group did not separate their waste, explaining that they "did not have time for waste separation due to their work routine" (29%)and "felt lazy or felt that waste separation was complicated." (21%). Regarding the models to enhance recyclable waste separation, the majority of the sample group (30.4%) wanted Ayutthaya municipality to provide two different-colored trash bins to each household, with one bin for food waste and the other for recyclable waste. Moreover, municipal trash trucks should collect the two types of waste on different days. Nevertheless, there was a group of people (19.1%) who did not want to separate rubbish at all.

Regarding waste separation, it was found that the majority of the sample group did not utilize food waste (72.2%) and only 24.5 percent composted food waste and used it to feed animals or to produce bio-fermented water. When the sample group was asked about methods for enhancing domestic food waste separation, 108 people (27.6%) did not want to separate and make use of food waste. However, there were some people willing to separate food waste, but they did not want to create income from food waste separation (27%).

The findings reflected a significant problem of waste management and separation as a significant number of people (72.2%) had little participation in domestic food waste separation before disposing of their garbage. In contrast, there were a number of people (87.2%) who separated their recyclable garbage due to three factors.

The first factor was the value of the waste. People separated it so that they could make money from recyclable

waste; while food waste had no value because people could not sell it (Abdul-Rahman & Wright, 2014). Consequently, they took less interest in dividing food waste.

Secondly, people held the belief that waste management and separation were the municipality's responsibility; they believed they had to neither separate garbage nor help to solve the significant waste problem. Therefore, they left domestic food waste to the municipality. Furthermore, most people in the sample group did not pay a waste collection fee, so they felt that they did not have to be responsible for the garbage they had created. This action directly opposes the Polluters Pay Principle stating that polluters should be responsible for expenses in preventing and controlling pollution which affects the public. The "Pay-As-You-Throw" approach is one such tool for collecting fees in line with Polluters Pay Principle (Bravo & De Moor, 2008; Morlok, Schoenberger, Styles, Galvez-Martos, & Zeschmar-Lahl, 2016). From the previous study, due to the fact that people did not have to pay a garbage collection fee, they lacked awareness about public responsibility and the realization about the impacts of their waste. In addition, they assumed that every issue was under governmental authority and operation. As a result, people held the attitude that waste management was the government's duty, not their own.

The third factor involved individuals' time schedules in urban communities, as people had routine work and consequently did not have much time to separate waste (Bulkeley & Askins, 2009; Chuenmuenwai & Inmuong, 2011). Furthermore, they did not want benefits from food waste since it was not relevant to their living patterns in an urban population. Even though there were some campaigns promoting food waste reduction by utilizing it to produce bio-extract, bio-gas, bio-fertilizer, or animal food (Chaiyasut, 2010; Matete & Trois, 2008; Sharp & Sang-Arun, 2012), the campaigns did not receive positive responses from urban people due to the complicated and time-and space-consuming process of production (Corral-Verdugo, 2003). Furthermore, the bio-extract, bio-gas, bio-fertilizer, and animal food products were not what urban people wanted because of a mismatch between the products and the city lifestyle (Sharp & Sang-Arun, 2012). The urban population, therefore, lacked motivation in utilizing food waste by producing compost, bio-gas, or bio-fermented water. People then chose to dispose of food waste in trash bins. Consequently, the amount of food waste is likely to rise and became a problem that needs to be solved urgently. This situation differed from other areas; for instance, in Amphawa district, Samut Songkhram province, 58.4 percent of households made use of food waste in many ways such as producing compost and bio-gas (Jeamponk, 2012). The physical environment played a major role as the population of the study area of Amphawa district worked in the agricultural sector (24.3%), so they gained benefits from bio-fertilizer and/or bio-fermented water.

Guidelines for Promoting Food Waste Separation

The second objective was to find an appropriate participatory food waste management program for the World Heritage Site, the Historic City of Ayutthaya through PAR. The method of focus group discussion was applied as a tool for data collection; and the findings are presented below.

1. **Community need:** It was found that food waste became a community problem due to the fact that the municipality did not collect waste on a daily basis. Consequently, food waste caused unpleasant smells and led to conflicts between neighbors. Therefore, the community wanted to solve the food waste problem by utilizing it instead of disposing of it.
2. **Potential resources in the community for solving food waste problem:** SWOT analysis was applied to analyze the community resources for solving food waste problems and identified the following.

Weaknesses: 1) villagers lacked knowledge on how to utilize domestic food waste; 2) there was no assistance from the municipality regarding food waste utilization; and 3)villagers did not have enough household space to make use of their food waste.

Strengths: 1) there were some villagers who knew the process of bio-fermented water production. Moreover, they were willing to provide suggestions and arrange a training session to produce bio-fermented water from food waste.

Opportunities: 1) connections with other organizations such as Mahidol University that can prepare training programs for villagers.

Threats: 1) the municipality did not have a clear policy regarding food waste management and furthermore, the municipality did not have a schedule for collecting waste; and 2) the community lacked a budget for food waste management.

3. **Models of public participation in waste separation**: Considering the community's needs and resource possibilities, the community offered various models of waste and food waste management. However, after sharing ideas and discussing each model, the community agreed that they would like to use bio-fermented water because they had an expert who knew how to produce it as a strength of the community. This would reduce the cost of hiring a trainer and would promote the community's sustainable development.
4. **Project monitoring and evaluation:** After conducting the bio-fermented water training program, the monitoring and evaluating team found that: 1) participants were satisfied with the project, because the trainer was a neighbor with whom the participants felt comfortable asking advice; 2) the project was useful as it could reduce the amount of waste in the community; and 3) the project allowed villagers to design a solution for a problem by themselves.

To conclude, the most important benefit from domestic food waste management is the reduction and utilization of waste. Bio-fermented water is non-toxic and effective for bathroom cleaning and reducing unpleasant smells. The present study represents a pilot project in the Historic City of Ayutthaya to initiate guidelines for food waste management at a community scale. Throughout the study the

sample group was able to apply the techniques of Participatory Action Research for solving communal problems, in order to enhance participation from all sectors. Using the principles of Participatory Action Research, people collaborated in planning, developing, and following their plans in order to achieve the goal of solving problems according to community needs (Chantavanich, 2004; Erwin, 1976). Furthermore, this process allowed people to use local knowledge (Chevalier & Buckles, 2013) and human capital in strengthening and sustaining their community.

Recommendations

1. Ayutthaya municipality should enhance and support positive attitudes regarding participation in waste management and separation. Moreover, people should pay a waste collection fee so that they are aware of the effects produced by the waste they create and realize that they should separate waste to decrease the overall amount of garbage.
2. Ayutthaya municipality should involve people in the process of waste management and separation starting with acknowledging situations and problems, then planning and making decisions concerning those problems, and ultimately carrying out activities or projects regarding garbage management. Such a process could be conducted through the process of Participatory Action Research with the assistance of local educational institutions as mentors.
3. Separation, reduction, and utilization of domestic food waste should be promoted.

Recommendations for Further Research

Factors influencing people's behavior in waste management and separation at the World Heritage Site should be studied and the results utilized to enhance the engagement of the people in garbage separation.

Conflict of Interest

There is no conflict of interest.

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