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# Knowledge, attitudes, and practices of source municipal solid waste management in rural and urban communities of Chachoengsao province, Thailand

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## Abstract

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Municipal solid waste is generated in all human communities, and individual practices such as purchasing decisions, daily habits, and household municipal solid waste management practices directly influence its volume. In 2025, urban communities generated 32,532.92 tons of municipal solid waste annually, compared with 2,325.74 tons in rural communities. Although urban areas produce more municipal solid waste due to population density and consumption patterns, rural areas often lack effective municipal solid waste management systems. This study employed a comparative cross-sectional design to assess knowledge, attitudes, and household municipal solid waste management practices among residents in urban and rural communities. A total of 124 participants were recruited, with 62 individuals from each area. The sample size was calculated using Cohen's effect size method with G*Power software. The inclusion criteria were individuals aged 18 years and above who were residing in Sanam Chai Khet District and Mueang Chachoengsao District, Chachoengsao Province. Data were collected using a structured questionnaire covering knowledge, attitudes, and municipal solid waste management practices. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used for analysis. The results showed that urban participants had a moderate level of knowledge (66.6%), while rural participants had a low level of knowledge (48.06%). Attitudes toward household municipal solid waste management were moderate in both groups, with mean scores of 2.95 ± 0.69 among urban residents and 2.60 ± 0.61 among rural residents. Regarding practices, urban participants demonstrated moderate household municipal solid waste management practices (2.89 ± 0.61), whereas rural residents showed inadequate practices (2.33 ± 0.71). These results highlight the necessity of focused interventions to promote acceptable home municipal solid waste management practices and increase understanding, especially in rural populations. In both urban and rural regions, bolstering community-based education and waste management initiatives may assist lower waste production and lessen environmental effects.

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## 1. Introduction

Municipal solid waste is generated wherever human settlements exist. Its production is directly influenced by individual practices, including purchasing decisions, daily practices, and choices regarding household municipal solid waste management [1]. The ways in which people acquire, utilize, and dispose of materials determine the consumption of energy and raw materials, as well as the overall volume of municipal solid waste generated. Consequently, municipal solid waste is intrinsically linked to the triple planetary crisis of climate change, pollution, and biodiversity loss. In addition to municipal solid waste, human activities generate substantial amounts of other types of municipal solid waste, including agricultural municipal solid waste, construction and demolition debris, industrial and commercial municipal solid waste, as well as healthcare municipal solid waste. These municipal solid wastes are produced on farms, construction sites, in factories, and within healthcare facilities [2]. The term "municipal solid waste" holds different meanings for different individuals. Variations in local conditions and data collection methodologies complicate efforts to establish a clear and

universally accepted definition. Commonly referred to as refuse, discards, municipal solid waste can be broadly defined as the unintended by-product of consumption and production processes. Assessing the degree of community knowledge, attitudes, and practices (KAP) about household municipal solid waste management is a prerequisite for putting suitable mitigation measures into place. However, urban environments have been the primary focus of the majority of earlier research assessing KAP in municipal solid waste management [3].

Municipal solid waste is highly heterogeneous, and there are multiple approaches to its classification. It can be categorized, for example, by Material such as food municipal solid waste or plastic municipal solid waste , Product type such as municipal solid waste (electrical and electronic municipal solid waste) or end-of-life vehicles, which are composed of multiple materials, Source such as municipal solid waste (MSW), which contains a variety of product types and materials [4]. Approximately 34.5% of the municipal solid waste, or around 9.31 million tons, is recovered for beneficial uses such as recycling and composting. Properly managed municipal solid waste, treated according to scientific and technical standards, accounts for about 10.17% of the total municipal solid waste. In contrast, improperly managed municipal solid waste amounts to approximately 7.47 million tons, representing 27.7% of the total municipal solid waste generated [5]. Several factors contribute to the high volume of municipal solid waste in Thailand.

The reopening of the country to accommodate tourists, labor, and investment has increased overall consumption [6]. Consumer practices, including the convenience-driven use of online shopping and food delivery services, further contribute to municipal solid waste generation. Additionally, public attitudes toward solid waste management significantly influence the quantity and handling of municipal solid waste [7]. Based on data from the Eastern Region of Thailand in 2023, the amount of municipal solid waste generated within pollution control areas was approximately 9,212.61 tons per day, increasing to 9,356.48 tons per day in 2024. This rise is consistent with the national trend, which shows an approximate 5% increase in municipal solid waste generation. The increase can be attributed to economic recovery following the COVID-19 pandemic, as well as growth in consumption activities and tourism.

The composition of municipal solid waste in Chachoengsao Province is similar to that of other areas, consisting mainly of organic municipal solid waste, recyclable municipal solid waste, hazardous municipal solid waste, and general municipal solid waste. However, a major challenge remains the low rate of municipal solid waste segregation at the source, which has not met established targets. As a result, most municipal solid waste is collected as mixed municipal solid waste and subsequently disposed of using methods that do not fully comply with proper technical and environmental standards [8]. Chachoengsao Province is located in the eastern region of Thailand, bordering Bangkok, Pathum Thani, Nakhon Nayok, Prachinburi, Sa Kaeo, Chanthaburi, Chonburi, and Samut Prakan provinces, with a short coastline of approximately 12 kilometers along the Gulf of Thailand. The urban areas of the province serve as important tourist destinations, contributing to an increasing number of visitors, while the rural areas are primarily devoted to agricultural activities. In 2024, Chachoengsao is recognized as a province with significant industrial and agricultural sectors, which likely contribute to the generation of municipal solid waste from these activities.

This study aimed to investigate the knowledge, attitudes, and practices related to source municipal solid waste management in rural and urban communities in Chachoengsao Province, Thailand. The research adopts an integrative and innovative scientific approach by combining environmental science, behavioral analysis, and community-based perspectives to address complex environmental challenges. By examining municipal solid waste management at the source through both social and environmental dimensions, the study moves beyond conventional technical solutions and provides a holistic understanding of how human behavior and local contexts influence environmental outcomes. The findings are expected to generate evidence-based insights that can support the development of effective, context-specific municipal solid waste management strategies and inform environmental education, community engagement, and policy formulation. Furthermore, the results may serve as a scalable framework for improving source municipal solid waste management practices in similar rural and urban settings, thereby contributing to sustainable environmental management and long-term municipal solid waste reduction. Participants in a study on community knowledge, attitudes, and practices on solid waste management in Iraq exhibited low levels of awareness about municipal solid waste management (40%) and negative attitudes (45.8%) as well as improper practices (49.7%). These results show that effective solid waste management in communities depends heavily on knowledge, attitudes, and practices [9]. The majority of earlier research has been on urban areas' municipal solid waste management. There is still a dearth of research comparing rural and urban locations while looking at community knowledge, attitudes, and practices (KAP) related to source-level waste management. Furthermore, behavioral, environmental, and community-context elements are not integrated to adequately explain how local contexts impact waste management practices. Therefore, by investigating the knowledge, attitudes, and practices of communities in a province that is divided into both urban and rural settings, this study seeks to give empirical evidence.

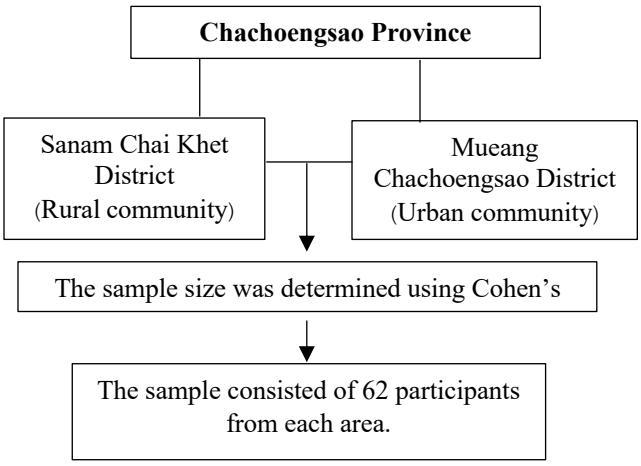
***Research Questions***

What are the levels of knowledge, attitudes, and practices regarding source municipal solid waste management among urban and rural communities.

## 2. Materials and Methods

***Study design and duration***

This study was designed as a comparative cross-sectional study and was conducted from February to April 2025.




***Study area ad study site***

Chachoengsao Province is located in the eastern region of Thailand and is administratively divided into 11 districts. It is recognized as a part of the Eastern Economic Corridor (EEC). Participants were selected using purposive sampling from residents living in urban and rural communities. Sanam Chai Khet District covers an area of approximately 1,084.0 square kilometers and is characterized by uplands alternating with plains and low-lying basins, with a general slope toward the east. The district also contains low mountain ranges covered with forests and experiences a hot and humid tropical climate, representing a predominantly rural community setting. In contrast, Mueang Chachoengsao District covers an area of 378.7 square kilometers and functions as the economic center of the province. Located within the fertile floodplains of the Bang Pakong River, it serves as an important economic zone of Chachoengsao Province. The district borders Bangkok, the capital city of Thailand.

***Study Population and Sample***

The study population consisted of individuals aged 18 years and older residing in Sanam Chai Khet District and Mueang Chachoengsao District, Chachoengsao Province. The sample size was determined using Cohen's effect size formula through the G*Power program [10]. The parameters were set as follows: an effect size of 0.50, a significance level ($\alpha$) of 0.05, and a power ($1-\beta$) of 0.80, resulting in a required sample size of 51 participants per area. To compensate for potential incomplete responses (missing data) or participant withdrawal during the study, the sample size was increased by 20% [11]. Consequently, 62 participants were recruited from each area, yielding a total of 124 participants from both rural and urban communities. A simple random sampling technique was employed in this study. The inclusion criteria were as follows: 1) Individuals aged 18 years and above residing in Sanam Chai Khet District and Mueang Chachoengsao District, Chachoengsao Province. 2) Ability to communicate and comprehend the Thai language. 3) Willingness to participate in the study. The exclusion criteria were as follows: 1) Individuals experiencing severe illness or serious health problems during the data collection period. 2) Individuals who relocated from the study area during the data collection period.

***Research Instruments and Tools***

The research instrument for this study was a questionnaire, divided into four parts as follows

*Part 1*: Demographic Characteristics

This section includes the following variables: gender, age, occupation, income (THB), and educational level.

*Part 2*: The knowledge on household municipal solid municipal solid waste separation consists of 5 items.

The test format is dichotomous multiple-choice, with two options: Yes or No. Correct answers are scored 1 point, and incorrect answers are scored 0 points. The scores are interpreted based on Bloom's (1975) criterion-referenced approach into three levels [12]:

| Scores (%) | Knowledge level |
|---|---|
| 0.00 – 59.99% | low knowledge |
| 60.00 – 79.99% | moderate knowledge |
| 80.00 – 100% | high knowledge |

*Part 3*: Attitudes toward Household municipal solid waste management

This section consists of 5 items in a single-choice questionnaire format, with responses rated on a 5-point Likert scale as follows [13]:

5 = Strongly agree
4 = Agree
3 = Moderately agree
2 = Slightly agree
1 = Strongly disagree

The scores were analyzed to calculate the mean and standard deviation. The interpretation of the mean scores was divided into five levels, with the score range calculated as (5–1)/5 = 0.8. The score interpretation is as follows:

| Mean scores | Attitude level |
|---|---|
| 1.00 – 1.80 | very poor attitude |
| 1.81 – 2.60 | poor attitude |
| 2.61 – 3.40 | moderately positive attitude |
| 3.41 – 4.20 | good attitude |
| 4.21 – 5.00 | very good attitude |

*Part 4***:** Household municipal solid waste management Practices

This section consists of 10 items in a single-choice questionnaire format, with responses rated on a 5-point Likert scale as follows [13]:

The mean scores were used to interpret the levels of household municipal solid waste management practices based on Best's criteria, divided into three levels [14]:

| Mean scores | Practices level |
|---|---|
| 1.00 – 2.33 | Poor practices |
| 2.34 – 3.67 | Moderate practices |
| 3.68 – 5.00 | Good practices |

Based on pertinent literature and research goals, the questionnaire utilized in this study was created. Three experts used the Index of Item–Objective Congruence (IOC) to assess the instrument's content validity; the results showed a satisfactory content validity of 0.79. The reliability of the questionnaire was then evaluated through a pilot test involving thirty individuals in Tha Takiap District. Cronbach's alpha coefficient was used to assess the instrument's internal consistency dependability; the result was 0.82, indicating good reliability.

***Analysis of Research Data***

Analysis of demographic data was conducted using frequency and percentage. The levels of knowledge, attitudes, and practices regarding municipal solid waste management were analyzed using mean, standard deviation, and percentage. The comparison of knowledge, attitude, and practice scores between urban and rural communities was analyzed using an independent samples t-test.

**Fig. 1** Community leaders and public health practitioners collected and sorted household solid waste from urban and rural communities

## 3. Results and Discussion

Based on reports of municipal solid waste generation from 2023 to 2025, urban areas produced 35,586.04, 31,172.09, and 32,532.92 tons per year, respectively. In contrast, rural areas generated 2,017.93, 2,070.65, and 2,325.74 tons per year during the same period as presented in Fig. 2 [15]. The trend in municipal solid generation observed in both urban and rural communities cannot be explained solely by population growth. Notably, a decline in waste generation was observed in the urban area in 2024, indicating that other contributing factors may have influenced the fluctuation. Changes in consumption patterns, economic activities, and the timing of data collection may partially explain this variation. For instance, data collected during festive periods may lead to temporary increases or fluctuations in municipal solid waste generation within the area.

The amount of municipal solid waste in rural communities shows an increasing trend, which may lead to environmental impacts and degradation of residential areas, as well as changes in the social and community context. The demographic characteristics of the sample in the urban community area indicated that the majority were female, totaling 49 participants (79.10%), while 13 participants (20.90%) were male. Most participants were aged 18–27 years (35.5%), and the predominant occupation was trading (40.3%). In terms of income, 19 participants (30.6%) earned less than 10,000 Baht per month, and the largest proportion had attained a high school education (32.2%), respectively. For the rural community area, the majority of participants were female (87.10%, n = 54), while 8 participants (12.90%) were male. Most participants were aged 48–57 years (35.5%), with farming being the primary occupation (51.6%). The majority had a monthly income of less than 10,000 Baht (60.0%), and the highest proportion had attained a high school education (45.2%), respectively,
as shown in Table 1.

The study found that the level of knowledge regarding household municipal solid waste segregation at source among residents in urban and rural communities differed. Residents in urban communities demonstrated a moderate level of knowledge (66.6%), whereas residents in rural communities exhibited a lower level of knowledge (48.06%), as shown in Table 2. The study revealed that attitudes toward household municipal solid waste management among residents in both urban and rural communities were at a moderate level. Residents in urban communities had a higher mean attitude score ($2.95 \pm 0.69$) compared with those in rural communities ($2.60 \pm 0.61$), as shown in Table 3. Urban participants demonstrated moderate household municipal solid waste management practices ($2.89 \pm 0.61$), whereas rural residents exhibited inadequate practices ($2.33 \pm 0.71$), as shown in Table 4.

The demographic characteristics of the sample in both urban and rural communities indicated that the majority were female. In the urban community, most participants were engaged in trading, had a monthly income of less than 10,000 Baht, and had attained a high school level of education. In contrast, participants in the rural community were predominantly aged 48–57 years, worked primarily as farmers, earned less than 10,000 Baht per month, and had completed high school education. This finding is consistent with the study on municipal solid waste sorting behavior in urban and rural [13] which found that the proportion of females was higher than that of males. Females were generally more likely to participate in and show greater interest in environmental and municipal solid waste management activities compared to males. The age differences between urban and rural communities, where participants in urban areas were generally younger than those in rural areas, may contribute to variations in experience, understanding, or attitudes toward municipal solid waste management. According to the study on municipal solid waste sorting behavior in urban and rural China, increasing

age was found to be associated with a decline in the intention to engage in municipal solid waste segregation and a greater likelihood of encountering obstacles in actual municipal solid waste -sorting practices. It was found that trading occupations in urban communities and farming occupations in rural communities were both associated with a monthly income of less than 10,000 Baht. In addition, the majority of participants in both urban and rural communities had attained a high school level of education [16].

The study found that the level of knowledge regarding household municipal solid waste segregation at source among residents in urban and rural communities differed. Residents in urban communities demonstrated a moderate level of knowledge, whereas residents in rural communities exhibited a low level of knowledge. These results align with the study conducted in Vinh Trung Commune, Hau Giang Province, Vietnam, which investigated the knowledge, attitudes, and practices of local communities regarding municipal solid waste management. The present study revealed that community members exhibited a basic understanding of household municipal solid waste management, despite only moderate access to information [17]. Most participants reported receiving information through television and radio, while few accessed updates via the internet or newspapers, and none obtained guidance from local authorities. These findings are consistent with previous research in Vinh Trung Commune, Hau Giang Province, Vietnam, which similarly highlighted that residents' knowledge was relatively high even when engagement with official information channels was limited. Limited access to authoritative sources may hinder active participation in municipal solid waste management practices, as suggested by prior studies indicating that information accessibility and government support significantly influence household municipal solid waste segregation behavior [18].

This study found that attitudes toward household municipal solid waste management were at a moderate level among residents in both urban and rural communities. Residents in urban areas had a higher average attitude score ($2.95 \pm 0.69$) compared to those in rural areas ($2.60 \pm 0.61$) Table 3. This finding is consistent with a study conducted in Thailand on factors associated with household municipal solid waste management behavior. The study found that households had a moderate level of attitudes toward household solid waste management, with a mean score of ($3.67 \pm 0.426$) [19], which aligns with previous studies indicating that urban residents generally exhibit more positive attitudes toward municipal solid waste management than their rural counterparts. The higher attitude scores observed in urban communities may be influenced by several factors, including greater access to information and education, as well as better-developed infrastructure that facilitates effective municipal solid waste management practices.

**Table 1** Number and percentage of the demographic characteristics of participants in urban and rural communities.

| Demographic characteristics of the participants | Urban communities (n=62) | | Rural communities (n=62) | |
|---|---|---|---|---|
| | Number | percentage | Number | percentage |
| **Sex** | | | | |
| Male | 13 | 20.90 | 8 | 12.90 |
| Female | 49 | 79.10 | 54 | 87.10 |
| **Age group (years)** | | | | |
| 18-27 | 26 | 41.9 | 11 | 17.7 |
| 28-37 | 14 | 22.5 | 7 | 11.3 |
| 38-47 | 16 | 25.8 | 10 | 16.1 |
| 48-57 | 4 | 6.6 | 22 | 35.5 |
| ≥ 58 | 2 | 3.2 | 12 | 19.4 |
| **Occupation** | | | | |
| Farmer | 0 | 0.0 | 32 | 51.6 |
| Daily wage worker | 4 | 6.5 | 15 | 24.2 |
| Government officer | 10 | 16.1 | 2 | 3.2 |
| Private employee | 23 | 37.1 | 0 | 0.0 |
| Business owner / Trader | 25 | 40.3 | 11 | 17.7 |
| **Monthly income (Baht)** | | | | |
| < 10,000 | 19 | 30.6 | 37 | 60.0 |
| 10,000–20,000 | 14 | 22.6 | 21 | 33.8 |
| 20,000–30,000 | 16 | 25.8 | 3 | 4.7 |
| ≥ 30,000 | 13 | 21.0 | 1 | 1.5 |
| **Education level** | | | | |
| Primary school or below | 2 | 3.2 | 5 | 8.1 |
| Lower secondary school | 10 | 16.1 | 21 | 33.8 |
| Upper secondary school | 20 | 32.2 | 28 | 45.2 |
| Diploma / Higher vocational certificate | 18 | 29.0 | 5 | 8.1 |
| Bachelor's degree or higher | 12 | 19.5 | 3 | 4.8 |

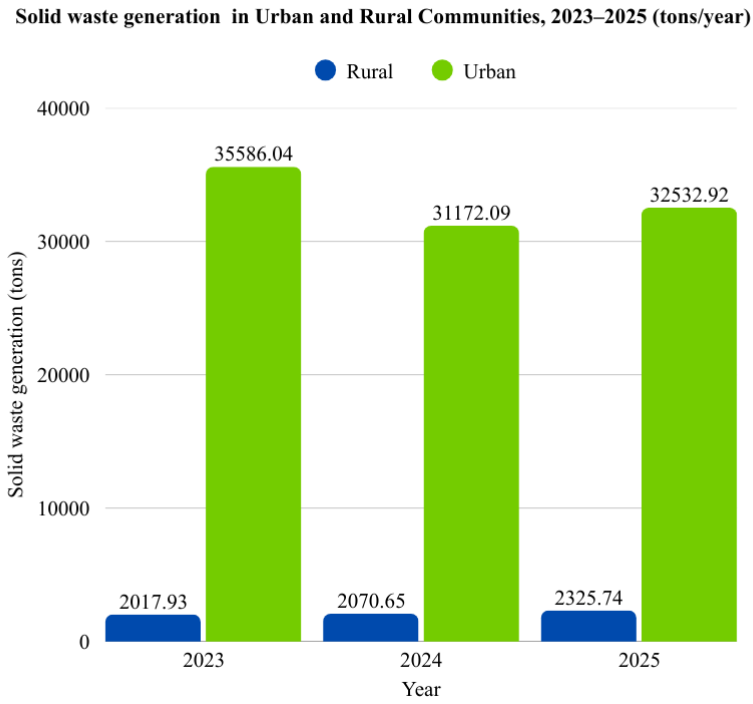



**Fig. 2** Amounts of municipal solid waste in urban and rural areas, 2023–2025

**Table 2** Knowledge of household municipal solid waste segregation from an environmental health perspective in urban and rural communities, Chachoengsao province.

| No. | Items on municipal solid waste Segregation Knowledge | Urban area | | Knowledge level | Rural area | | Knowledge level |
|---|---|---|---|---|---|---|---|
| | | Correct (%) | Incorrect (%) | | Correct (%) | Incorrect (%) | |
| 1 | Household municipal solid waste such as food municipal solid waste, paper, plastic, peels, and leaves | 62.12 | 37.88 | Moderate | 33.87 | 66.13 | Low |
| 2 | Used flashlights, batteries, fluorescent lamps, and chemical containers are hazardous municipal solid waste | 75.80 | 24.20 | Moderate | 67.74 | 32.26 | Moderate |
| 3 | Disposable masks or face masks do not need to be separated from other municipal solid waste | 37.09 | 62.91 | Low | 17.74 | 82.26 | Low |
| 4 | Open burning of municipal solid waste causes air pollution that affects health and the environment | 70.96 | 29.04 | Moderate | 59.67 | 40.33 | Low |
| 5 | Glass, paper, plastic municipal solid waste, UHT cartons, beverage cans, metal scraps, aluminum, and rubber tires can be recycled | 87.09 | 12.91 | High | 61.29 | 38.71 | Moderate |
| | Average | 66.61 | 33.39 | Moderate | 48.06 | 51.94 | Low |

In contrast, rural communities often face challenges such as limited access to information and insufficient support from local authorities, which can negatively impact both attitudes and practices related to municipal solid waste management. Improving residents' attitudes toward household municipal solid waste management therefore requires targeted interventions, including enhanced educational programs, improved access to accurate information, development of appropriate municipal solid waste management infrastructure, and active support from local authorities. Such measures are essential to raise awareness and encourage sustainable participation in municipal solid waste management practices across both urban and rural communities [20, 21].

The study revealed that household municipal solid waste management practices among residents in both urban and

rural communities were at a moderate level. Residents in urban areas demonstrated a slightly higher average behavior score (2.89 ± 0.61) compared to those in rural areas (2.75 ± 0.71), which aligns with previous studies indicating that urban communities generally exhibit better municipal solid waste management practices than rural ones. The observed differences in municipal solid waste management practices between urban and rural communities may be influenced by multiple factors, including access to information and education, availability of supportive infrastructure, and assistance from local authorities. Urban communities typically benefit from better access to educational resources and information, as well as more developed infrastructure that facilitates effective municipal solid waste management practices. In contrast, rural communities often face challenges such as limited information access and insufficient local support, which can negatively affect residents' municipal solid waste management practices. This is consistent with the study Household municipal solid waste management in Relation to Health and Environmental Risks: A Cross-Sectional Study in the Kindu Health Zone, which found that 99.2% of respondents did not practice municipal solid waste sorting [22, 23].

**Table 3** Attitudes toward household municipal solid waste management in urban and rural communities, Chachoengsao province.

| No. | Attitude Statements | Urban area | | Attitude level | Rural area | | Attitude level |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | | Mean | SD | |
| 1 | Municipal solid waste segregation for recycling is difficult and requires a large space only | 2.43 | 0.57 | Poor | 2.13 | 0.60 | Poor |
| 2 | Separating municipal solid waste before disposal can reduce the amount of municipal solid waste prior to treatment | 3.26 | 0.62 | Moderate | 2.28 | 0.76 | Poor |
| 3 | Solving household municipal solid waste problems is solely the responsibility of government agencies | 2.72 | 0.71 | Moderate | 2.63 | 0.57 | Moderate |
| 4 | Reusing or selling/donating bottles, paper, and glass can help reduce municipal solid waste and solve environmental problems | 2.81 | 0.59 | Moderate | 3.48 | 0.63 | Good |
| 5 | Public relations and providing people with knowledge about municipal solid waste help reduce the amount of municipal solid waste | 3.56 | 0.54 | Good | 2.52 | 0.52 | Poor |
| | Average | 2.95 | 0.69 | Moderate | 2.60 | 0.61 | Moderate |

The results of the independent samples t-test showed that residents in urban communities had significantly higher knowledge, attitude, and practice scores than those in rural communities. The mean knowledge score in urban areas was 3.33 ± 1.05 compared with 2.40 ± 1.12 in rural areas ($p < 0.001$). Similarly, the mean attitude score was significantly higher among urban residents (2.95 ± 0.69) than rural residents (2.60 ± 0.61) ($p = 0.003$). In addition, the practice score of urban residents (2.89 ± 0.61) was significantly higher than that of rural residents (2.33 ± 0.71) ($p < 0.001$) Table 5.

Regarding the levels of knowledge, attitudes, and practices, the study by Robinson et al. [24] found that urban residents demonstrated significantly better knowledge, attitudes, and practices than rural residents, with statistically significant differences. The proportion of individuals with a good level of knowledge in urban areas was nearly twice that of rural areas, reflecting the important role of education and access to information. Clear differences in attitudes were observed, with only 1.9% of urban respondents exhibiting poor attitudes, whereas a substantially higher proportion was found among rural residents. Although municipal solid waste management practices were generally at a good level in both groups, urban residents showed a higher rate of appropriate practices than their rural counterparts. These findings suggest that enhancing municipal solid waste management practices in both urban and rural areas requires targeted interventions, including improving access to education and information, developing appropriate infrastructure, and strengthening support from local authorities. Such measures are essential to promote sustainable household municipal solid waste management practices across different community contexts [25].

Furthermore, Local government authorities and relevant stakeholders should promote and support proper municipal solid waste management in order to maintain a healthy environment and safeguard the health of the local population. In addition, the municipal authority should improve the town's municipal solid waste management system by constructing adequate municipal solid waste landfill facilities, providing shared municipal solid waste containers, and implementing door-to-door municipal solid waste collection services for residents within the municipal area [26].

**Table 4** Practices toward household municipal solid waste management in urban and rural communities, Chachoengsao province.

| No. | Practices Statements | Urban area | | Behavior level | Rural area | | Behavior level |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | | Mean | SD | |
| *Municipal solid waste reduction at source* | | | | | | | |
| 1 | Choose products made from recycled or environmentally friendly materials | 2.87 | 0.62 | Moderate | 2.13 | 0.73 | Poor |
| 2 | Accept plastic bags, foam containers, and single-use packaging from shops | 2.70 | 0.71 | Moderate | 2.20 | 0.62 | Poor |
| 3 | Choose refill products (e.g., dishwashing liquid, fabric softener, liquid soap) | 3.36 | 0.51 | Moderate | 2.07 | 0.61 | Poor |
| *Municipal solid waste Segregation* | | | | | | | |
| 4 | Household has separate bins for biodegradable and non-biodegradable municipal solid waste | 3.21 | 0.42 | Moderate | 2.30 | 0.58 | Poor |
| 5 | Clean food containers before separating by municipal solid waste type | 2.26 | 0.74 | Poor | 2.10 | 0.74 | Poor |
| 6 | Dispose of food municipal solid waste and plastic bags together in the same bag | 3.04 | 0.68 | Moderate | 2.45 | 0.68 | Moderate |
| *Recycling and Reuse* | | | | | | | |
| 7 | Separate recyclables (glass, metal, paper, plastic bottles/bags) for sale | 2.28 | 0.50 | Poor | 3.95 | 0.78 | Good |
| 8 | Discard damaged plastic bottles/containers without reuse | 2.36 | 0.47 | Moderate | 2.41 | 0.77 | Moderate |
| 9 | Deliver recyclables to agencies/shops for recycling into new products | 2.15 | 0.56 | Poor | 1.75 | 0.54 | Poor |
| *Municipal solid waste Disposal* | | | | | | | |
| 10 | Burn municipal solid waste or plastic materials in household/public areas | 3.81 | 0.65 | Good | 1.98 | 0.69 | Poor |
| | Average | 2.89 | 0.61 | Moderate | 2.33 | 0.71 | Poor |

**Table 5** Comparison of knowledge, attitude, and practice scores between urban and rural communities

| Variables | Area | n | Mean ± SD | t | p-value |
|---|---|---|---|---|---|
| knowledge | Urban | 62 | 3.33±1.05 | 4.77 | <0.001* |
| | Rural | 62 | 2.40 ± 1.12 | | |
| Attitudes | Urban | 62 | 2.95 ± 0.69 | 2.99 | 0.003* |
| | Rural | 62 | 2.60 ± 0.61 | | |
| Practices | Urban | 62 | 2.89 ± 0.61 | 4.71 | <0.001* |
| | Rural | 62 | 2.33 ± 0.71 | | |

**Note:** *Significant at $p < 0.05$

## 4. Conclusion

This study was designed as a comparative cross-sectional study with the aim of examining the levels of knowledge, attitudes, and practices regarding household municipal solid waste segregation between rural and urban communities in Chachoengsao Province, Thailand. The findings indicated that residents in urban communities demonstrated a moderate level of knowledge on household municipal solid waste segregation (66.6%), whereas residents in rural communities exhibited a low level of knowledge (48.06%). Residents in both urban and rural communities exhibited similar attitudes toward household municipal solid waste management, with the overall attitude level being moderate. Urban and rural societies have diverse approaches to household municipal solid waste management. Urban communities behave moderately in terms of home municipal solid waste management, whereas rural groups behave inappropriately. The outcomes of this

study show that rural populations have knowledge and habits that could be improved, which has consequences for both national and provincial plans and policies. These findings can help to guide the development and implementation of programs aimed at increasing knowledge and promoting proper household municipal solid waste management practices among residents in both rural and urban areas, ultimately contributing to municipal solid waste reduction and environmental impact mitigation. Residents in urban communities of Chachoengsao Province demonstrated significantly higher levels of knowledge, attitudes, and practices regarding municipal solid waste management than residents in rural communities of Sanam Chai Khet District. This finding suggests that factors such as access to information, public awareness campaigns, and local municipal solid waste management systems play an important role in influencing residents' waste management practices.

## 5. Suggestions

Particularly in remote regions, ongoing initiatives should be put in place to spread knowledge and increase awareness about municipal solid waste management. Training programs, the creation of community garbage banks, and community-based waste management learning centers are a few examples of these initiatives. These programs can stimulate community involvement and sustainable waste management techniques.

## 6. Acknowledgement

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## 7. Declaration of Generative AI in Scientific Writing

During the preparation of this manuscript, ChatGPT was utilized solely as a tool for English language editing. The entire content was carefully reviewed, revised, and refined by the authors to enhance clarity, accuracy, and academic coherence. The authors take full responsibility for the originality, integrity, and reliability of the final published work.

## 8. CRediT Author Statement

**Sureeporn Thummikkaphong:** Conceptualization, Methodology, Investigation, Data analysis, Writing – Original Draft, Review & Editing.

**Sirinun Kumsri:** Conceptualization, Methodology, Investigation, Data analysis, Writing – Original Draft, Review & Editing.

**Chanapon Singsook:** Conceptualization, Methodology, Investigation, Data analysis.

## 9. Research Involving Human and Animals Rights

This study did not involve human participants or animals; therefore, it does not raise any ethical considerations related to human or animal research.

## 10. Ethics Approval and Consent to Participate

This study was approved by the Human Research Ethics Committee of Rangsit University (COA No. RSUERB2024-186)

## 11. Declaration of Competing Interest

The authors confirm that they have no conflicts of interest to declare.

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