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Woman and Urban Waste Management: A Case Study of Surakarta City

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Abstract Waste pollution will continue to be a severe problem, but many people are unaware of it. With population growth, industrial development, urbanization, and modernization, waste will continue to increase. Surakarta is one of the cities with an overcapacity landfill that has not been resolved, so the waste bank program that encourages people to practice the 3Rs (Reduce, Reuse, Recycle) will undoubtedly help the unresolved problem. Moreover, households contributed the most to the national waste, which reached 42.23% of the total. Women's participation in collecting recyclables from municipal waste, dumpsites, or landfills, on the other hand, was noticeable in almost all countries. So, the participation of homemakers in waste bank activities can be one solution to the waste problem. This study aims to see the significance of the role of women in household waste management. The descriptive approach method is used in the study to accurately represent an issue and its conditions. Secondly, quantitative analysis methods were used: by using multiple regression linear to estimate the determinants of Willingness to Pay for waste management. The results show that the significant data of the respondents of waste bank customers in Surakarta City that in fact, 85 percent are dominated by women. Thus, the research clearly shows that women have an essential role in the household's waste management.

Keywords Household, Waste, Waste Bank, Woman, 3R (Reduce, Reuse, Recycle)

1. Introduction

Waste is a waste product from human production and consumption activities, either in solid, liquid, or gas form, and is a cause of environmental pollution [1]. Waste pollution will continue to be a severe problem if not handled properly [2,3,4] especially in developing countries [5-7]. Waste generation will continue to rise as a result of population growth, industrial development, urbanization, and modernization [8]. Waste can cause physical, chemical, biological, socio-economic, cultural, and environmental hazards and even health problems such as diarrhea, cholera, and typhoid fever [9,10].

Waste issues are intriguing because Indonesia generates approximately 65.8 million tons of waste per year. In 2020, the rate of waste generation was 67.8 million tons per year, and this rate is expected to rise as the population grows, reaching 70.8 tons per capita by 2025. According to the Ministry of Environment and Forestry (KLHK) [11], 66.39% of Indonesian waste is landfilled, 19.62% is unmanaged, and only 2.2% is recycled or processed into

other resources such as fuel, biogas, and others.

By 2025, the Indonesian government intends to minimize waste created at the source by 30% (20.9 million tons) and divert 70% of waste from landfills (49.9 million tons annually) [12]. According to data from the World Bank Group, currently, Indonesia produces around 85,000 tons of waste every day, and by 2025 this value is expected to increase to 150,000 tons per day, an increase of 76% in just ten years [13].

The composition of waste is divided into two, namely organic and inorganic. Based on data from the Ministry of Environment in 2022 [14], 53.6% of waste generation is organic waste and the rest is inorganic waste. Inorganic waste includes plastic, iron, aluminum, paper, glass, cloth/leather, and so on. However, most inorganic waste is plastic waste. Plastic waste generation is 5.4 million tons per year, equivalent to 14% of the total waste [15]. In addition, Indonesia produced 3.2 million tons of plastic waste in 2010, with around 1.29 million tons flowing into the sea [16]. Plastic waste, the percentage of recycling, is only about 5% of the total waste [17]. Moreover, in 2014 solid waste generation was 175,000 tons per day, equivalent to 64.4 million tons per year (basic calculation is 0.7 kg waste/person/day).

Surakarta is one of the cities with a landfill that is already over capacity and has not been resolved. For example, the waste that entered the Putri Campo landfill in 2015 reached 1.5 million tons, exceeding the expected capacity of 1.3 million tons of waste [18]. Moreover, in this case, the city of Surakarta has potential in terms of actors and waste management activities. Because the city of Surakarta does not yet have facilities that can accommodate waste management activities as a whole, this is an opportunity for the need to create a facility that can accommodate various waste management activities in a more systematic, comprehensive, and sustainable manner which includes 3R-based activities [19].

On the other hand, knowledge of waste management with the 3R principle (Reduce, Reuse, Recycle) has become a national policy since the enactment of Law no. 18 of 2008 concerning Waste Management. According to Suryani [20], waste management is an effort to organize or manage waste from the process of storing, collecting, moving, transporting, and processing to the final disposal.

The Indonesian government through the Minister of Environment Regulation no. 14 of 2021, introduced the waste bank program. Waste banks are facilities formed and managed by the community, organizations, and/or local governments to manage waste using the 3R principles (Reduce, Reuse, Recycle) as a means of education, improvements in waste management, and circular economy implementation [21]. The waste bank program is one of the waste managements programs to motivate people to sort waste. Implementing this waste bank program will certainly increase family income while preserving the community environment. In order to create a clean, healthy, and comfortable environment, the waste banks are used as an alternative to providing waste management solutions to minimize waste [22]. Moreover, the Ministry of Environment (2015) [11] stated that there was an increase in the number of waste banks from 1,640 in 2011 to 2,861 units in 2015. The increase was in line with the amount of waste managed in waste banks from 2,347.8 tons/month to 5,551 tons/month.

Households contributed the most to the national waste, which reached 42.23% of the total, and this is, of course, a particular urgency to further increase knowledge in households regarding good waste management so that the national waste contribution rate can minimize the problems caused by waste in the environment resulting from household waste [11].

Competent domestic waste management is one of the most critical factors in ensuring environmental sustainability [23]. Environmental awareness at the household level is critical to the success of Indonesia's waste bank program. The social conditions in Indonesian society, where women are the focus of various household activities, make them important actors in waste management. Many studies in developing countries [11][24][25] have indicated that women play an essential role in environmental sustainability. Women are typically assumed to manage domestic tasks and activities. Women's involvement in collecting of recyclables from waste disposal facilities, dumpsites, or landfills was observed in nearly all countries [11]. It was also intriguing to discover that, when compared to males, women were more engaged in waste separation in their households [26].

Therefore, the participation of women as homemakers in waste bank activities can be one solution to the waste problem. If all homemakers actively participate in managing waste, the waste problem may be resolved optimally. However, encouraging homemakers to actively participate in managing waste through waste banks is not an easy thing. According to data from the National Socio-Economic Survey (Susenas) conducted by the Statistics Indonesia (BPS) 2017 [27], 74.2% of rural households already understand the importance of sorting waste, and 80.3% of urban households also understand the importance of sorting waste. Sorting waste turns out that 69.3% of rural households never do it, and 73.3% of urban households themselves never sort their waste. This result shows that women as homemakers in rural and urban areas have different treatments in managing waste. The reason is that homemakers have a dual role, both domestic duties and sometimes also working outside the home. So when they decide to participate, a mother must be able to divide the time more strictly between the home, office, and waste bank activities.

Homemakers' environmental consciousness will influence their attitudes toward waste management. Because of the state of household waste, the 3R(Reduce, Reuse, Recycle) in the waste bank must have numerous ways to attract homemakers. The waste collection program at the waste bank is one of them. This condition will raise

the costs that homemakers who do not manage their waste must bear. Many studies have found that education, expenses, waste management services, waste management knowledge, and waste management practice all influence willingness to pay [28-32]. Previous research has not explored the position of women in waste management, as well as the factors influencing the willingness of women to pay for managing waste as a group. Therefore, this study aims to see the significance of the role of women in household waste management

2. Materials and Methods

2.1. Research Design

This research is using the descriptive approach method, which aims to accurately represent an issue and its conditions, with researchers confined to simply presenting facts rather than hypotheses. A descriptive study seeks to define human characteristics and social situations in society so that they can be used as research objects [33]. The descriptive approach is a good way to collect and interpret data. Furthermore, for a survey and in-depth interview using a purposive sampling technique, personal interaction between the researcher and the participant was required. Surakarta City was chosen as the research location because it is one of the cities in Central Java with a landfill that is already over capacity and has not been resolved.

2.2. Sampling Technique

To conduct this study, the researcher used Descriptive sampling method. Survey was conducted to define the characteristics of respondents in Surakarta City. The sample size was 120 respondents with 110 respondents for the ordinary interview and 10 respondents of waste banks manager for the in-depth interview. The sample was selected purposively. The sample is a member of a waste bank that actively implements 3R activities (Reduce, Reuse, Recycle). Interviews were conducted at the waste bank location after sorting and selling waste to the recycling industry every week. Open interviews were taken so that the author could get maximum results.

2.3. Data Analysis

After performing the survey and interview, the researcher followed some steps to analyze the data results of respondents. The data was analyzed by using descriptive method and quantitative analysis method by using multiple regression linear to estimate the significant relationship between dependent variable and independent variable [34]. The data was obtained from Descriptive analysis by collection data from surveying 120 people.

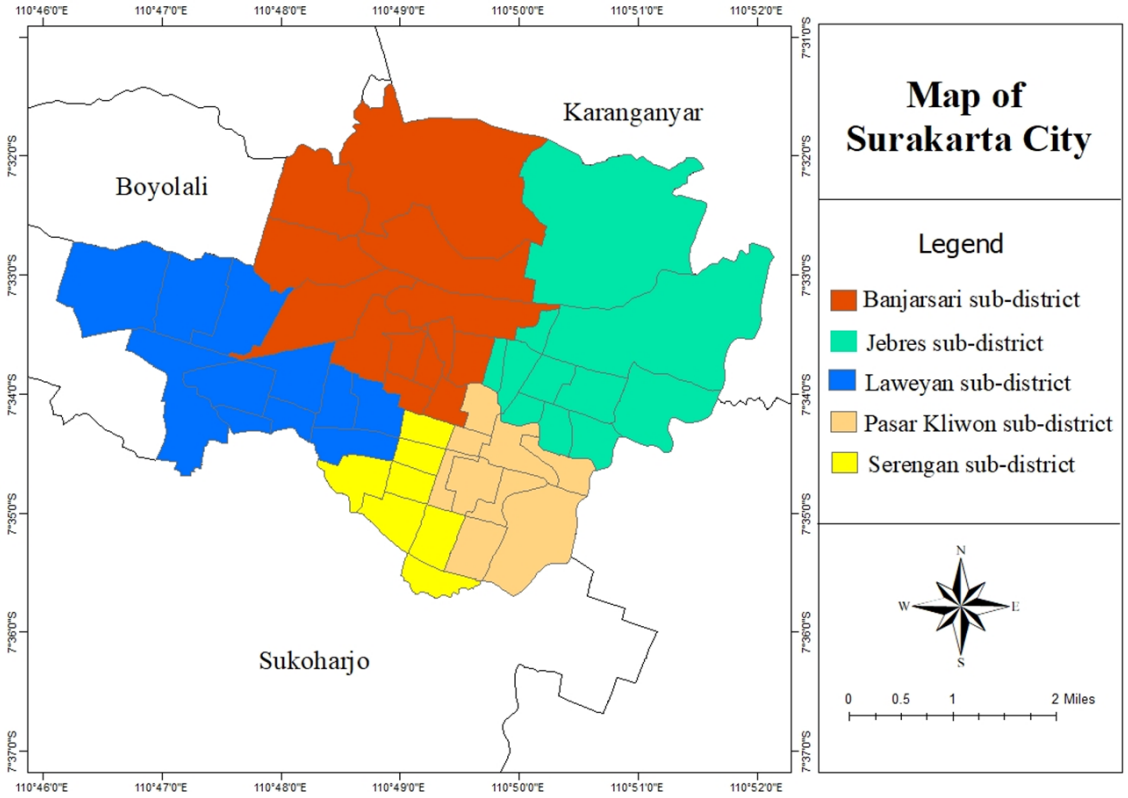
3. Result and Discussion

3.1. General Condition of Surakarta City

Surakarta City is one of the areas in Central Java Province with a total area of 46.72 km^2. The city is located between 7°36' and 7°56' South Latitude and between 110°45'15" and 110°45'35" East Longitude. The area of Surakarta City is classified as lowland with an altitude of 92 meters above sea level. The city of Surakarta has a tropical climate, with air temperatures in 2021 ranging from 19.4°C to 35°C and the highest rainfall is 303.4 mm.

The Surakarta City area is divided into five sub-districts; Laweyan, Serengan, Kliwon Market, Jebres, and Banjarsari; 54 kelurahan, 626 Neighborhood Units (RW), and 2,784 Neighborhood Units (RT). The largest area in Surakarta City is Banjarsari District, and the narrowest is Serengan District. Based on its geographical location, Surakarta City has the following regional boundaries:

- North Boundary: Boyolali Regency
- East Boundary: Karanganyar Regency
- South Boundary: Sukoharjo Regency
- West Boundary: Sukoharjo Regency



(Source: BPS Surakarta City, 2022) [35]

Figure 1. Surakarta City Area Map

The population is a critical factor in supporting development success [36]. Based on population data, the total population of Surakarta City in 2021 is 522,728 people. The population of Surakarta City is dominated by the female population and the age group of 15-64 years. Based on the data in Table 1, Surakarta City's sex ratio value is 96.84%, as can be seen. This means that there are only 96 male residents for every 100 female residents.

Table 1. Total Population of Surakarta City by Age and Gender Years 2021

	Gender		Total	Percentage (%)
	Male	Female		
0-14	55,564	53,546	109,110	20.87
15-64	182,216	186,247	368,463	70.49
>65	19,391	25,764	45,155	8.64
Total	**257,171**	**265,557**	**522,728**	**100.00**

Source: BPS Surakarta City (2022) [35]

In 2021, Surakarta City will receive a demographic bonus because the productive-age population reaches 70.49 percent. Demographic bonus can be interpreted as a phenomenon of the population of productive age that dominates an area compared to the population of non-productive age. This phenomenon is critical for a region because it has an opportunity to boost the economy and even reduce inequality [37].

The existence of a demographic bonus not only has the potential to bring benefits or benefits to the region but can also have a negative effect if it is not able to be optimized. The productive age population certainly has a variety of activities. Therefore, it is essential to know how the main activities of the population of a region, especially residents in the productive age category, are to optimize their role. Data on the total population of Surakarta City's productive age based on its main activities can be seen in full in Table 2.

Table 2. Total Population of Surakarta City Aged 15 Years Old and Over Based on Main Activities

Primary Activities	Gender		Total
	Male	Women	
Workforce	**158,706**	**123,472**	**282,178**
Work	145,699	114,326	260,025
Open employment	13,007	9,146	22,153
Non-Workforce	**44,624**	**95,035**	**139,659**
School	20,115	22,871	42,986
Taking care of household	12,071	63,826	75,897
Others	12,438	8,338	20,776
Total	**203,330**	**218,507**	**421,837**

Source: BPS Surakarta City (2022) [35]

Based on the data in Table 2, it is known that the labor

force population dominates the productive age population of Surakarta City. Surakarta City residents work more in number when compared to the number of residents who become open to unemployment. This means that the absorption of labor in the city of Surakarta is high in the hope of increasing the region's economic value [37]. The number of non-labor force residents in Surakarta City is dominated by women who take care of the household, which is more than 50 percent of the total non-labor force population. Most working-age women prefer to take care of the household because of the cultural influence of women as those in charge of household affairs [38].

The condition of the development of a region is observed chiefly based on the level of its economic growth, which is reflected in the value of the gross regional domestic product (GRDP). Based on data from the Surakarta City BPS (2022) [35], the GRDP value of Surakarta City for the last five years (2017-2021) has tended to increase. The decline only occurred in 2020, namely due to the Covid-19 pandemic. Data on the development of GRDP in Surakarta City can be seen in Table 3.

Table 3. Development of GRDP of Surakarta City Based on Current Prices and Constant Prices

Year	Gross Regional Domestic Product (Million Rupiah)	
	Nominal GRDP	Real GRDP
2017	41,042,339.48	31,685,480.46
2018	44,429,816.95	33,505,900.66
2019	47,999,714.41	35,441,107.67
2020	47,621,820.53	34,815,965.32
2021	50,371,564.19	36,211,248.26

Source: BPS Surakarta City (2022) [35]

Based on table 3, in 2021, the GRDP value of Surakarta City based on current prices is IDR 50.4 trillion, while based on constant prices, it is IDR 36.2 trillion. The GRDP value of Surakarta City is inseparable from the contribution of 17 economic sectors. Based on data from BPS Surakarta City (2022) [35], the sectors that dominate the value of the GRDP of the City of Surakarta are the construction sector (27%), the wholesale and retail trade sector; repair of cars and motorcycles (22%), and the information and communication sector (15%). This is also the same as research that has been done that the construction sector dominates the value of GRDP in Kendari City [39] and Malang City [40].

3.2. Waste Management in Surakarta City

Waste is one of the main problems in almost all cities in Indonesia. The high movement of rural people to urban areas increases the area's density. Every community activity cannot be separated from waste every day. Therefore, the denser a city is, the greater the waste volume. Surakarta City is one of the cities with a dense population. Similarly, the amount of waste is produced by the community. According to Surakarta City Environment Agency data in Table 4, the average amount of waste entering the landfill per day in 2020 was 294.73 tons, and it increased to 299.45 tons in 2021. The village and the general public are producing an increasing amount of waste. Household waste is waste generated in the village.

Table 4. Data on the amount of waste entering the Putri Cempo TPA (Landfills), Surakarta City

Source	Total Trash (Ton)		Average/Day (Ton)	
	2020	2021	2020	2021
Environmental Services				
1. Transport	17,344.83	8,940.41	47.39	24.49
2. Task Force + Gardens	3,479.34	2,775.27	9.51	7.60
Department of Commerce	8,539.29	7,885.12	23.33	21.60
Ward	71,557.65	80,802.07	195.51	221.38
Public	6,951.53	8,895.05	18.99	24.37
Total	107,872.64	109,297.92	294.73	299.45

Source: Surakarta City Environmental Service (2022) [30]

Since 2019, the City of Surakarta has entered into a cooperation agreement related to waste management with Waste Power Plant Putri Cempo, which has an area of 17 hectares. In addition, the Environment Depatment of Surakarta City also provides facilities and infrastructure for managing B3 waste and waste. This is so that the waste can be managed properly and does not disturb the environment. In order to increase public awareness about the importance of maintaining cleanliness and the environment, the government offers waste collection and processing services. There is a charge (retribution) if residents want to use waste collection and processing services. This retribution is used by the government to pay the workers who take the waste to each customer's house. This ultimately aims to improve services and the realization of community welfare [37].

Based on table 5, the waste retribution rate is determined based on the type of waste owner according to the scale of the business entity, which is further divided into 4 class categories. The withdrawal of this levy is based on the Surakarta City Regulation Number 5 of 2016 concerning Regional Levies. The higher the household income, the more the number of family members, and the wider the building area, the higher the nominal retribution paid. Likewise, about business entities, the larger the scale of the business, the higher the retribution rate paid or up to the Class I category.

Waste management in Surakarta City refers to the Surakarta City Regulation Number 3 of 2010 concerning

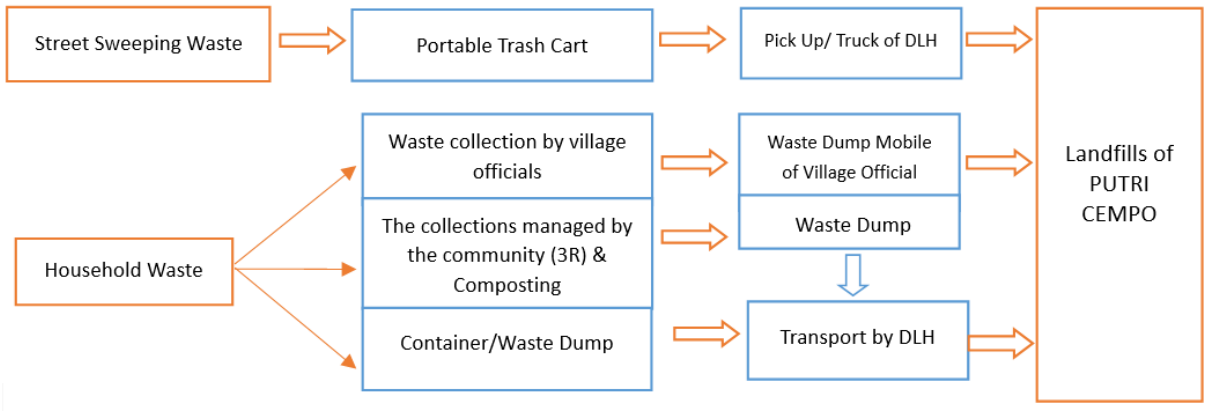
Waste Management. The waste management system in Surakarta City is not much different from that in other cities; that is, most of it is still in the form of collection, transportation, and disposal to the TPA [41]. Even so, based on a book published by the Environment Department of Surakarta City, since 2018, the City of Surakarta has begun to improve its waste management, not only through the 3P pattern but also by starting to implement the 3R.

Based on Figure 2, it can be seen that the waste management flow proposed by the Environment Department of Surakarta City is not only limited to the 3P pattern. One management flow for household waste is to apply 3R and composting. In this flow, the waste bank is one of the parties that play an essential role in realizing the management of household organic and inorganic waste. Household waste is the most waste that goes to Putri Cempo landfills. Therefore, good household waste management is needed so that it does not rely only on the capacity of the landfill.

Table 5. Retribution Tariffs for Waste Services in the City of Surakarta

Type	Nominal	Unit
Livelihood	3,000 – 7,000	Rp/Year
Industry	10,000 – 500,000	Rp/Year
Service Company	7,500 – 400,000	Rp/Year
Trading	5,000 – 400,000	Rp/Year
Public Facility	30,000 – 400,000	Rp/Year
	100	Rp/m^2/day/seller
Service Business and other companies	10,000 – 30,000	Rp/month
Incidental	150,000 – 300,000	Rp/activity

Source: Surakarta City Environmental Service (2022) [30]



(Source: Environmental Service of Surakarta City, 2018) [42]

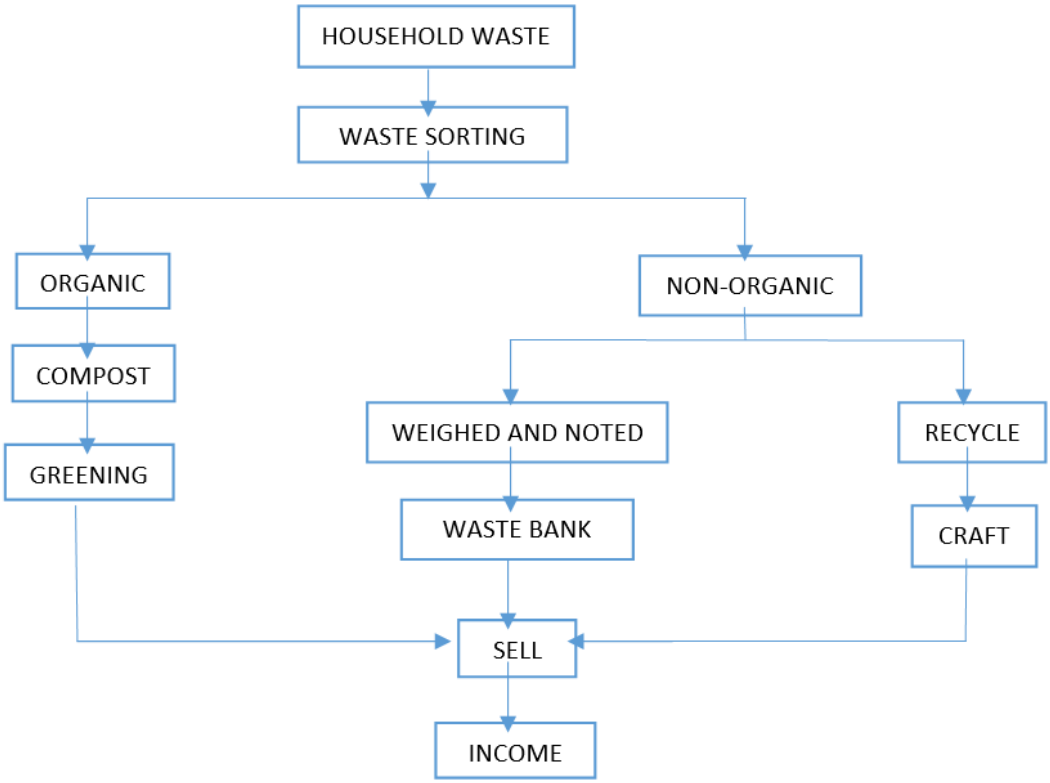
Figure 2. Waste Management Flow in Surakarta City

3.3. General Condition of Waste Banks in Surakarta City

The increase in the population in the city of Surakarta, of course, also impacts the amount of waste produced. One of the most common sources of waste is waste originating from household activities. The amount of waste produced by households and the limited number of landfills owned require every household to be able to manage its household waste. This management is intended so that the community avoids various kinds of impacts that can be caused by waste, such as disturbances in water pH, air pollution, and causing various kinds of diseases [43].

Environment Department of Surakarta City continues to support the existence of waste banks in every area of Surakarta City in dealing with household waste problems. The waste bank is one of the strategies for implementing the 3R concept (Reduce, Reuse, Recycle) in waste management at the household level [44]. Waste banks have an essential role in reducing waste entering landfill and realizing integrated waste management from the minor parties, namely households to the government [20].

Establishing a waste bank in Surakarta City is not only intended to manage household waste. It is hoped that the waste bank that is formed in every community's environment can also be a place to improve the community's economy. The management of organic waste into fertilizer and inorganic waste into handicrafts is expected to increase the selling value of waste so that it has economic value. The flow chart of waste bank activities in Surakarta City can be depicted in Figure 3.



(Source: Environment Department ofSurakarta City, 2017) [45]

Figure 3. Flowchart of Waste Bank Activities in Surakarta City

Since 2014, Environment Department of Surakarta City has continued promoting a waste bank formation. Until 2020, the total number of recorded waste banks in Surakarta City is 123 waste banks, both those that already have a decree and those that do not. However, over time, not all waste banks can run well. Some waste banks are no longer active for several reasons, such as the pandemic, which has prevented people from carrying out waste bank activities. Based on Table 6, until 2021, only 70 waste banks will be included in the data collection. In order to maintain the number of active waste banks, the Surakarta City Environment Department also made various efforts, such as providing waste bank administrators with instruction and support through the provision of facilities and infrastructure.

Table 6. Total Waste Bank in Surakarta City

Total Waste Bank	Training Status		Activity	
	Trained	Untrained	Active	Inactive
70	40	30	57	13

Source: Environmental Service of Surakarta City (2021) [46]

3.4. Characteristics of Respondents

The characteristics respondent is illustrated in Table 7. Based on the analysis of primary data in Table 7, it can be seen that the respondents of waste bank customers in Surakarta City are dominated by women, namely 85 percent. This is the same as the research of Yuningsih et al. [47] that women are mostly more concerned with environmental cleanliness. Most of the respondents are aged between 51 and 60 years old, have a high school education, and have a main job as a housewife. Based on the research of Munizu et al. [48], most waste bank customers in Makassar also work as housewife, this is because almost all homework produces waste, and housewife is the party who plays the most role in this activity. Most of the respondents live with 4 family members and have an income of more than IDR 3,500,000.00. We ran an instrument test, and the results show in Table 8 that the instrument is both valid and reliable.

Table 7. Characteristics Respondents of Waste Bank Surakarta City

No	Characteristics	Total	%
1	**Gender**		**100.0**
	Male	18	15.0
	Female	102	85.0
2	**Age**		**100.0**
	21-30	4	3.3
	31-40	15	12.5
	41-50	32	26.7
	51-60	47	39.2
	>60	22	18.3
3	**Education Status**		**100.0**
	Did not finish Elementary School	2	1.7
	Elementary School	20	16.7
	Junior High School	26	21.7
	Senior High School	47	39.2
	Diploma	14	11.7
	Bachelor	11	9.2
4	**Main Job**		**100.0**
	Housewife	40	33.3
	Teacher	5	4.2
	Trader	31	25.8
	Entrepreneur	37	30.8
	Retired	1	0.8
	Unemployed	6	5.0
5	**Family members total**		**100.0**
	1	8	6.7
	2	15	12.5
	3	24	20.0
	4	37	30.8
	5	26	21.7
	6	8	6.7
	7+	2	1.7
6	**Income per month**		**100.0**
	<1,500,000	25	20.8
	1,500,001-2,500,000	22	18.3
	2,500,001-3,500,000	27	22.5
	>3,500,000	46	38.3

Source: Primary Data Analysis 2022

Table 8. Instrument Test

Reliability	**Cronbach's Alpha**
Reliability	0.626
Validity	**Pearson Correlation**
Satisfaction with waste management	0.254
Satisfaction with waste bank services	0.309
Knowledge of waste management	0.486
Implement independent waste management	0.522
Knowledge of 3r	0.670
Implementing the 3r	0.782
Implementing recycle activities	0.661
Total expenditure	0.383
Education	0.285
Number of family	0.390

Source: Primary Data Analysis, 2023

3.5. Women and Waste Managements

The global waste management problem is getting worse by the day, and waste from households is one of the most complex issues in the current situation. Household waste management is a major concern because most of the waste in Surakarta comes from households. Waste management is essential for environmental sustainability, economic efficiency, public health, and community development [49, 50]. It requires participation not only from communities in Surakarta but also individuals at the household level. Both men, women, and children have their roles in waste management.

There are differences in the involvement of men and women in waste management. Women tend to be more actively involved in waste management activities, including waste reduction, recycling, and composting, compared to men. This can be attributed to several factors, including societal norms, varying across cultures, regions, and gender roles [50-53]. Women have faced social discrimination for centuries, making the gender gap appear insignificant.

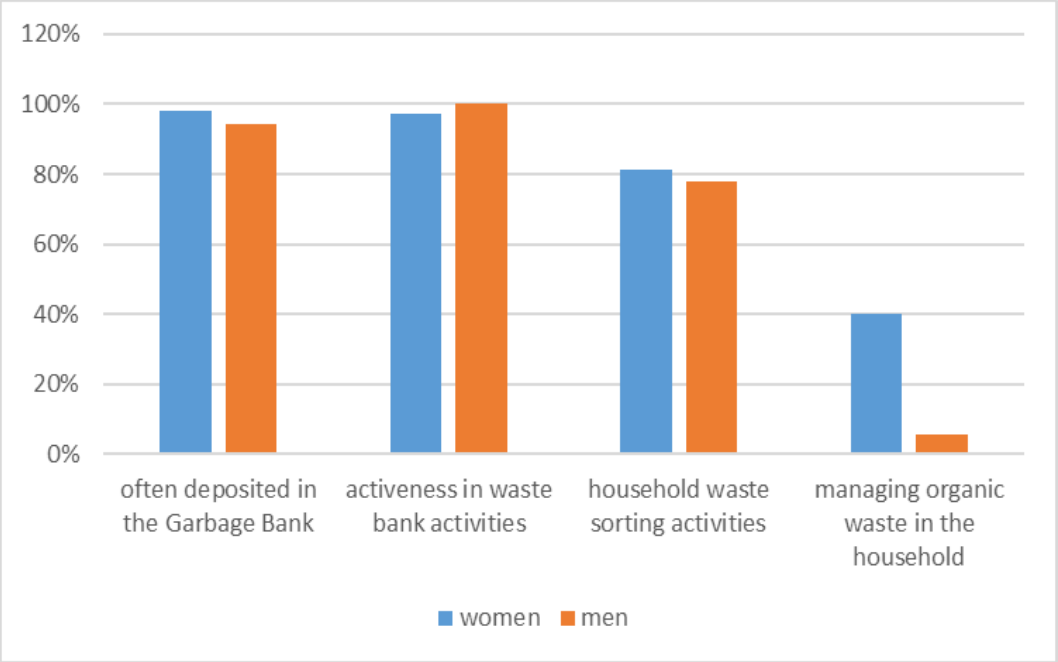
Women play a significant part as homemakers because they are the ones who know and decide when, what, and how many items are needed in the house. Women also take on the role of managing food waste and leftovers, as they are typically involved in cooking and meal preparation. Whether in a developed, developing, or underdeveloped country, homemakers are directly connected to household chores [54]. Most decisions in the household are taken by women including in waste management in Surakarta as shown in table 8.

Knowledge about waste management empowers individuals and communities to take ownership of their waste and actively participate in waste reduction efforts [55]. Women generally have a greater awareness and concern for waste management. They are more likely to view waste management as a means to protect the environment and promote sustainable practices. Table 9 shows that most of the respondents who are members and administrators of the waste bank are women with 71.7% of women respondents in Surakarta having knowledge of waste management and 51.7% of women respondents knowing 3R (Reduce, Reuse, Recycle). Knowledge and awareness foster a sense of responsibility and environmental stewardship, leading to a cleaner and healthier living environment. Although the majority of respondents in Surakarta have good knowledge of waste management and even the 3Rs, most choose not to do waste management and the 3Rs. 56.7% of respondents in Surakarta are not willing to implement waste management and 57.5% do not implement 3R. This is very unfortunate, considering that households already know waste management, but this has not been fully realized. It can contribute to the active participation in waste management initiatives such as the development of waste banks.

Table 9. Awareness and application in waste management

Activity	Yes				No				**Total**	
	Men		Women		Men		Women			
	n	%	n	%	n	%	n	%	**n**	**%**
Knowledge about waste management	15	12,5	**86**	**71,7**	3	2,5	16	13,3	**120**	**100**
Implementing waste management	6	5	34	28,3	12	10	**68**	**56,7**	**120**	**100**
Knowledge about 3R	10	8,3	**62**	**51,7**	8	6,7	40	33,3	**120**	**100**
Implementing 3R	6	5	32	26,7	13	10,8	**69**	**57,5**	**120**	**100**

Source: Primary Data Analysis, 2023

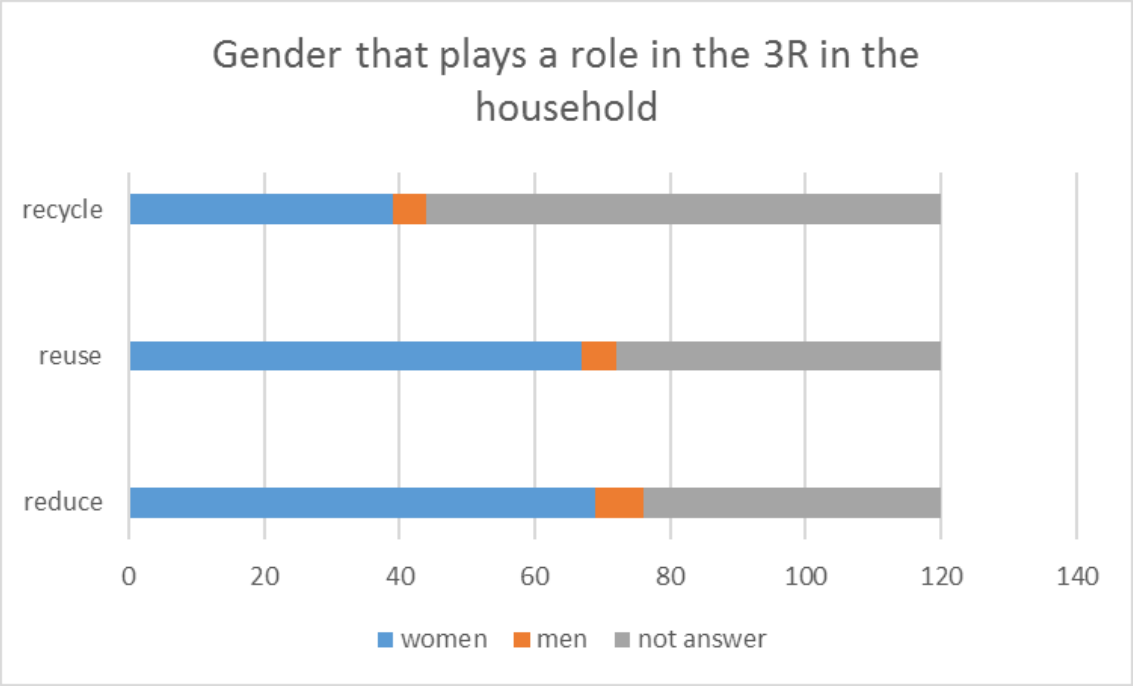


Source: Primary Data Analysis, 2023

Figure 4. Proportion of waste management activities in households

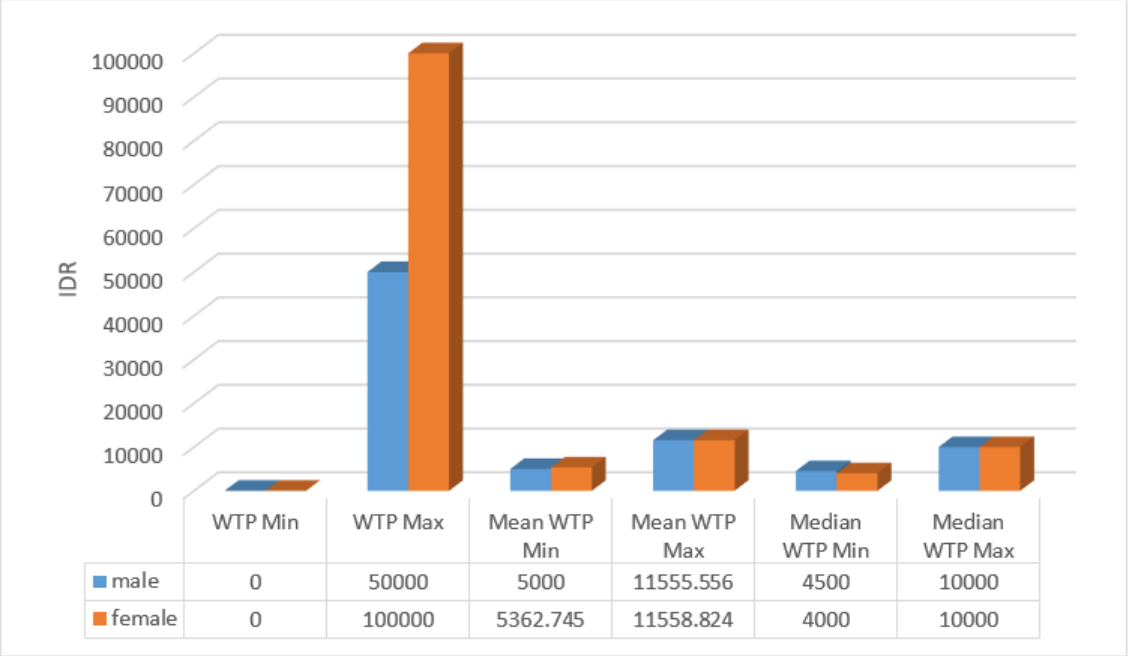
The role of women in community waste management is significant and multifaceted [50,55]. One of the community waste management that is supported individually is the waste bank. As we see in Figure 4, female respondents in Surakarta have a higher proportion (98%) of frequently depositing waste in the waste bank than male respondents (94%). This is in contrast to the activity in the waste bank for male respondents (100%) who have a higher proportion than female respondents (97%). This proportion occurs due to the nature of men who are more active in the community. In the activity of selecting waste and managing organic waste, women (81%) (40%) had a higher proportion than male respondents (78%) (8%). Women's understanding of proper waste segregation, recycling techniques, and composting can contribute to more efficient waste management practices and environmental sustainability [55-58]. Men, on the other hand, may be more involved in waste management at the community or industrial level such as waste collection services or recycling facilities, where they handle larger quantities of waste and operate heavy machinery [58].

Apart from sorting waste and composting organic waste, several Surakarta respondents also carried out 3R (Reduce, Reuse, Recycle). Implementing 3R has many benefits such as environmental, health, and economic benefits. Women's participation in waste management can lead to environmental and economic benefits for themselves and their communities. By reducing waste and implementing recycling initiatives, women can contribute to cost savings on waste disposal and potentially generate income through recycling programs [50]. Reduce refers to minimizing the amount of waste generated by consuming and purchasing goods more consciously, avoiding unnecessary packaging, and practicing portion control. As many as 69 female respondents did reduce activities with 7 male respondents doing reduce and 44 respondents did not answer. Furthermore, reuse involves finding alternative uses for items that would otherwise be thrown away, such as repurposing containers or donating unwanted items to others. In reuse activities, 67 female respondents did reuse, 5 male respondents did reuse and 48 respondents did not answer. Finally, recycling is the process of transforming waste materials into new products, thereby reducing the demand for raw materials and energy consumption. The recycling activity was the least carried out by respondents, namely 39 female respondents who did recycle, 5 male respondents who did recycle, and 76 respondents who did not answer. Figure 5 shows that there is a decrease in the number of respondents at each stage starting from reduce to reuse and the least recycle. This is followed by the 3R hierarchy theory where the 3R sequence starts from reduce, reuse, and recycle.



Source: Primary Data Analysis, 2023

Figure 5. Gender that plays a role in the 3R in the household



	WTP Min	WTP Max	Mean WTP Min	Mean WTP Max	Median WTP Min	Median WTP Max
male	0	50000	5000	11555.556	4500	10000
female	0	100000	5362.745	11558.824	4000	10000

Source: Primary Data Analysis, 2023

Figure 6. Willingness to Pay for Surakarta community waste management

Apart from carrying out their waste management activities, the people of Surakarta also manage waste with the help of formal waste managers. This formal waste manager is supported by Environment Department of Surakarta and will collect household waste from time to time. This formal waste management will be charged a fee every month. Figure 6 shows that the willingness to pay for women is higher than for men even though the difference is slight. Previous research did not consider the role of women in willingness to pay for waste management. Women as decision-makers in the household are also the reason why women's WTP score is higher because basically women are more aware of the environment, health, and society

According to the results of the regression analysis in Table 10, the factors that influence the willingness to pay for waste management for the Surakarta community are total expenditures, satisfaction with waste management, satisfaction with waste bank services, knowledge of waste management, implementing 3R, and implementing recycling. The prob value > F reaches 0.0002 and the R^2 value is 0.294. The total household expansion affects willingness to pay for waste management and has a positive relationship. Higher expenditure increases the willingness to pay for waste management because the higher the respondent's expenditure, the more waste will be generated. When more waste is generated, social women as the most respondents will apply a higher WTP. This is contrary to research by Akhtar et al. [59] and Graham et al. [60] which states that the willingness to pay (WTP) is often influenced by the total household expenditure. As the total household expenditure increases, individuals may be less willing to pay for additional services or fees, including waste management. This is because as daily needs and expenses increase, the addition of waste management fees can further burden their financial budget. Additionally, as individuals age, it is assumed that their cost of living also increases, which can further reduce the magnitude of WTP. Therefore, the total household expenditure is an important factor to consider when estimating the WTP of individuals.

Table 10. Determinants of willingness to pay for waste management for the Surakarta community

Variable	**Coefficient**	**Standard Error**
Education	-459.0146^{ns}	442.427
Number of Household	-1062.562^{ns}	960.7728
Total household Expenditure	.0007319**	.0003235
Satisfaction with waste management	-10430.7**	4113.459
Satisfaction with waste bank services	-13833.49***	5054.553
Knowledge of waste management	8254.799**	3621.117
Implementing independent waste management	-3544.899^{ns}	2818.624
Knowledge of 3R	-3319.973^{ns}	3009.347
Implementing the 3R	-9929.578***	3549.117
Implementing recycle activities	13323.12***	3262.547
Constants	25618.02***	8246.426
F (Prob>F)	3.78 (0.0002)	
R^2	0.294	
Number of Observations	120	
*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level		

Source: Primary Data Analysis, 2023

Satisfaction with waste management significantly affects the WTP of waste management. These two variables have a negative relationship where the higher the satisfaction with waste management, the lower the willingness to pay for waste management because the respondents feel that with the price they are currently paying, they are already getting satisfactory results, so they don't want to add WTP to waste management. This also applies to the satisfaction variable with the waste bank. This finding contradicts the results of Suryani's research [61] when individuals are satisfied with the quality and effectiveness of waste management in their area, they may be more willing to pay for the services provided. This is because they perceive value in the service and recognize the benefits of proper waste management, such as a cleaner environment and improved public health. On the other hand, if individuals are dissatisfied with the current waste management practices, they may be less willing to pay for the services or may demand improvements before being willing to contribute financially.

Knowledge of waste management has a positive relationship and influences the WTP of waste management. This happens because the more respondents understand the problem of waste management, the higher their willingness to pay to keep the environment beautiful, healthy, and free from disease. They often have a better level of knowledge and awareness about waste management practices, which contributes to their active participation in waste management. Individuals who understand the importance of proper waste management and its effect on the environment and public health may be more willing to pay for the services provided. This is because they recognize the value and benefits of effective waste management and are more likely to support and contribute financially to its implementation. On the other hand, if individuals have limited knowledge or misconceptions about waste management, they may be less willing to pay for the services or may not see the need for proper waste management practices [60]. Therefore, improving knowledge and awareness about waste management can positively influence the WTP of individuals [50].

Implementing 3R has a negative relationship and influences the WTP of waste management. This happened because the respondents felt that they had helped the community in managing waste through the 3Rs so that it would reduce the WTP of waste management. The willingness to pay (WTP) for implementing the 3R (Reduce, Reuse, Recycle) principles in waste management can vary among individuals. A study by Akhtar et al. [59] has shown that individuals who are more aware of the environmental benefits of the 3R approach are more willing to pay for its implementation. This is due to their understanding of the long-term benefits of reducing waste generation, reusing materials, and recycling resources, such as conserving natural resources, lowering pollution, and mitigating climate change. On the other hand, individuals who have limited knowledge or understanding of the 3R principles may be less willing to pay for its implementation. Therefore, raising awareness and providing education about the benefits of the 3R approach can positively influence the WTP of individuals.

This is the opposite of implementing the variable recycle waste. The variable of implementing waste recycling has a positive influence and relationship to the WTP of waste management. This happens because the goods that are recycled have a selling value so they can attract respondents to increase income. One of the purposes of selling recycled goods is to waste banks or third parties. This economic value makes respondents willing to pay more for WTP waste management. People who are more aware of the environmental and economic benefits of recycling are more willing to pay for its implementation [59].

Women's waste management awareness in Surakarta is demonstrated by the fact that they receive education about the 3Rs and implement it even though it is not yet optimal. Community-based waste management, such as waste banks, will be able to function if the community, particularly homemakers, provides full support in terms of time, energy, and material. Several factors have been discussed that influence people's willingness to pay for waste management in Surakarta. The government must take this into account. As a result, the government is expected to better educate the community and provide solutions that can entice people, particularly housewives, to manage waste both individually and as part of a community.

4. Conclusions

From those findings, we may conclude that women play an important role in household waste management. Homemakers are people who take care of various things in the household, including small things like managing household waste, whereas men work to provide goods in the household. Thus, providing all women with knowledge and awareness about household waste management are critical, and because women play a critical role in it, it will have a significant impact on the environment if all women contribute well to managing household waste. In addition, the willingness to pay for waste management for the Surakarta community is influenced by total household expenditure, satisfaction with waste management and waste bank services, knowledge of waste management, implementation of 3R and recycling activities. This study would be useful to make recommendation and policy implication in preserving the environment. Regarding future research, we suggest developing a better method for women to better understand and implement waste management information in their daily household lives, as well as developing strategies that will benefit the

development of waste banks in Indonesia.

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