

A Potential Study of Waste-to-Wealth Program in Delta Tumpat, Kelantan, Malaysia

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Abstract. The waste-to-wealth program refers to the process of transforming waste from depleted usefulness to valued and desired utility. The waste-to-wealth program consists of recycling, upcycling and composting. This study explores the types of waste generated and waste disposal practices by the Delta Tumpat, Kelantan community and explores the waste-to-wealth program's potential. A total of 280 respondents participated in this study using stratified sampling. This study found the high potential to introduce waste-to-wealth programs to the community of Delta Tumpat based on the abundance of organic wastes generated, as well as the high awareness of waste-to-wealth and willingness to participate in waste-to-wealth programs in the future. Organic waste is the most generated waste by the Delta Tumpat community. Food and agriculture waste are the most significant contributors to the organic waste in the Delta of Tumpat. Burning is the primary disposal practice due to a lack of knowledge of sustainable waste disposal practices. Better intervention programs and initiatives are needed to increase the community's willingness to participate in the waste-to-wealth program.

1 Introduction

In recent years, the concept of converting waste to wealth has gained significant traction as a sustainable solution to waste management challenges. This approach addresses the mounting waste disposal issues and transforms waste materials into valuable resources, fostering economic growth and environmental sustainability [1]. Malaysia is one of the most successful transition economies in the world, with consistent economic growth due to stable political circumstances and a sufficient supply of resources [2]. However, solid waste management is a major environmental concern in Malaysia, with the country heavily dependent on landfills and open dumping as the primary means of disposing of waste and increasing yearly solid waste production [3]. Solid waste generation in Malaysia currently stands at 33,130 tons per day, and this figure is predicted to rise to 36,138 tons per day by 2020, 41,035 tons per day by 2026, and 49,670 tons per day by 2030 [4]. In Kelantan, Malaysia, the escalating volume

of municipal solid waste has posed severe environmental and health concerns, necessitating innovative waste management strategies [5].

According to Egun [6], waste-to-wealth refers to the process of transforming waste from a level of depleted usefulness to a level of valued and desired utility; examples of the waste-to-wealth program were recycling, up-cycle, composting, and 3R program. Thus, the waste-to-wealth idea aspires to develop a more sustainable future lifestyle in which waste is transformed into something valuable. According to Sinha and Tripathi [7], composting is one of the waste-to-wealth programs that is a suitable alternative technique for disposing of waste from hotels and restaurants because the composting method could be used to reduce the waste generated.

This study explores the feasibility and potential of implementing a waste-to-wealth program in Kelantan, focusing on converting waste into economically valuable products. Previous studies have shown that waste-to-wealth initiatives can significantly reduce waste volumes and generate substantial economic benefits [8]. Therefore, assessing the viability of a waste-to-wealth program in Kelantan could provide crucial insights into sustainable waste management practices and contribute to the region's socio-economic development.

2 Methodology

2.1 Study area

Tumpat is one of the Kelantan districts in Malaysia. It's home to several small islands offering unique attractions and cultural significance. This study focuses on the Delta Tumpat, Kelantan, which lies on the northeast coast of Malaysia in the Kelantan River Delta ($6^{\circ}11'0''$ to $6^{\circ}13'N$; $102^{\circ}9'$ to $102^{\circ}14'E$) (Figure 1). More than 17 small islands make up the delta of Tumpat, which covers about 1,200ha. However, only five (5) islands are inhabited with more than 1,000 households. The significant geography of this area influenced the community's cultural, economic, and environmental well-being. The primary income source of the community that lives in the Tumpat Delta is fisheries and coconut farming. This study area has been chosen because the local authority does not cover waste management in this delta due to the accessibility factor. Still, it has the potential for a waste-to-wealth program.



Fig. 1. Islands in the Delta Tumpat (Source: Google Earth 2024).

2.2 Data collection

The sample size has been determined using Krejcie and Morgan. Based on the total number of households in Delta Tumpat, the sample size for this study was 280 to represent a cross-section of the population [9]. The respondents were selected using a stratified sampling method to ensure the entire settlement had been covered at Tumpat’s Delta. The questionnaire of this study was developed based on rigorous processes such as content validation by experts and a pilot study (Cronbach alpha value>0.7). The questionnaire of this study consisted of five (5) sections as follows:
Section A: socio-demographic,
Section B: type of waste generated per week per kg,
Section C: waste disposal practices (nominal data),
Section D: knowledge of waste-to-wealth programs (nominal data),
Section E: awareness of waste-to-wealth programs (Five-point Likert scale),
Section F: willingness to participate in waste-to-wealth programs (Four-point Likert scale).

2.3 Data analysis

Descriptive statistics such as the frequency, percentage, mean, and standard deviation have been used in this study to describe the demographic of respondents, types of waste generated, waste disposal practice, knowledge and awareness of respondents and the willingness of the community in Delta Tumpat to participate in waste-to-wealth programs such as recycling, composting and upcycling.

3 Results and discussion

3.1 Respondents profile

Table 1 shows the gender distribution was 30.5% male and 69.5% female. The largest age group was 46-55 years old (30.5%), with the most miniature representation from the 26-35 age group (10.5%). All respondents were Malay and Muslim. Most were married (85.7%), with widowed/widowers making up 14.3%. Educationally, most respondents had a secondary school education (45.8%), followed by primary school (26.3%), degrees (16.9%), certificates or STPM/STAM (5.9%), and diplomas (5.1%). According to Msengi et al. [10], those with higher education levels are less likely to join sustainable programs due to their self-reliance. Household sizes ranged, with the majority having 4-6 members (49.2%). Most households had one (1) working member (52.3%), and the most common employment status for heads of households was self-employment, such as fisherman or farmer (84.8%). Income-wise, most households earned less than RM2500 (90.7%). Most had lived in their current residence for over 21 years (80.5%).

Table 1. Respondent profile.

Sociodemographic	Percentage (%)
Gender	
• Male	30.5
• Female	69.5
Age	
• 26-35 years old	10.5
• 36-45 years old	20.1
• 46-55 years old	30.5

Sociodemographic	Percentage (%)
56-65 years old >65 years old	20.1 18.8
Ethnic Malay	100
Religion Islam	100
Marital Status - Marriage - Widow/widower	85.7 14.3
Education Background - Primary School - Secondary School - Certificate/STPM/STAM - Diploma - Degree	26.3 45.8 5.9 5.1 16.9
Number of Household 1-3 persons 4-6 persons 7-9 persons ≥10 persons	31.4 49.2 16.1 3.4
Number of Working Person in Household 1 person 2 persons 3 persons 4 persons ≥5 persons	52.3 30.5 5.9 4.2 6.8
Employment of Household Head - Self-employed (fisherman/ farmer) - Government - Private sector	84.8 2.5 12.7
Income of Household - B1 (<RM2500) - B2 (RM2501-RM3170) - B3 (RM3171-RM3970) - B4 (RM3970-RM4850)	90.7 7.6 0 1.7
Number of years living in Delta Tumpat ≤5 years 6 years – 10 years 11 years –15 years 16 years – 20 years ≥ 21 years	4.2 4.2 7.6 3.4 80.5

3.2 Waste composition

Figure 2 shows the waste generated by the Delta Tumpat community. Food waste is the highest, averaging 0.74 kg per week. The second highest is coconut shell waste at 0.64 kg/week, followed by coconut coir waste at 0.52 kg/week. Cooking oil waste generates 0.22 kg/week, followed by plastics waste (0.14 kg/week), tin waste (0.10 kg/week), garden waste (0.09 kg/week), and bottle waste (0.08 kg/week). The lowest is paper waste, at only 0.04 kg/week. The high food waste generation is attributed to the community's household sizes. This finding aligns with Hashim et al. [11], who reported that food waste is the highest

household waste in Malaysia, with approximately 16,688 tonnes per day. Additionally, cooking oil waste is the second most prominent type of waste generated by the Delta Tumpat community.

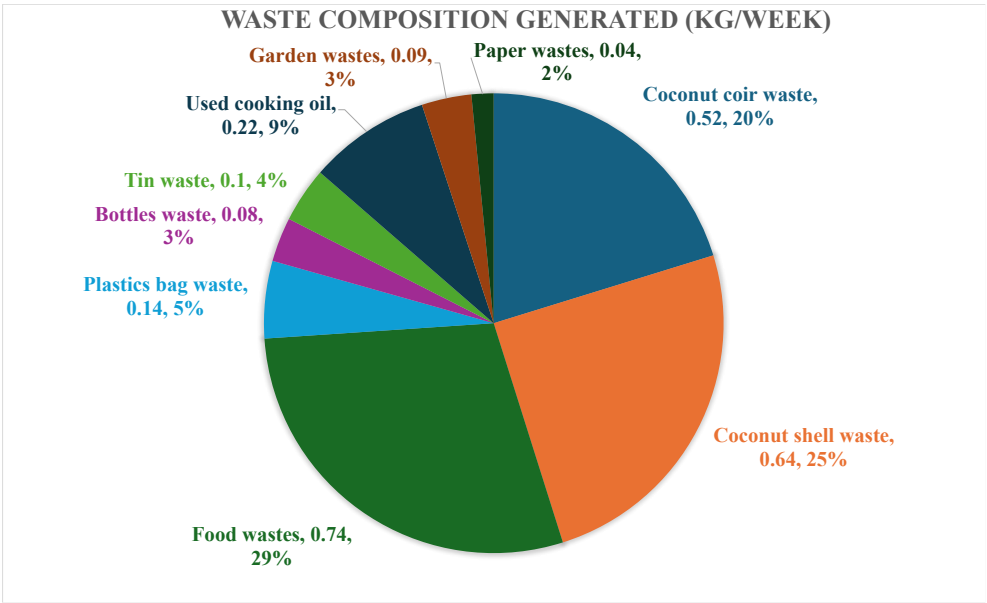


Fig. 2. Waste composition generated by respondents.

3.3 Waste disposal practice

Table 2 displays the waste disposal practices among the Delta Tumpat community. Most respondents (90.7%) burn their waste generated. Besides that, most of the respondents do not bury their waste for disposal purposes (76.3%), do not throw the waste/garbage into the drain (61.9%), do not throw the waste into the river (89%), and do not dispose of the waste in the trash bin provided (77.1%).

This high percentage suggests that burning is the predominant method of waste disposal among the respondents. Burning waste, especially without proper control, can lead to air pollution, releasing harmful substances like dioxins, furans, and particulate matter into the atmosphere [12]. Possible reasons for this practice could include lack of access to proper waste management services, insufficient awareness about the environmental and health impacts, or traditional practices [13].

Table 2. Waste disposal practice by respondents.

Statements	Yes (%)	No (%)
I burn the waste generated	90.7	9.3
I buried the waste generated	23.7	76.3
I threw the waste into the drain	38.1	61.9
I threw the waste into the river	11.0	89.0
I disposed the waste into the trash bin provided	22.9	77.1

3.4 Knowledge and awareness of the waste-to-wealth

Table 3 reveals a significant gap in knowledge among the respondents concerning the waste-to-wealth, with 51.2% providing incorrect answers overall. Despite this, a notable portion of the respondents answered three questions correctly, indicating some level of understanding. Most respondents do not know that the waste-to-wealth program can transform coconut waste into handicraft items (66.9%) and do not know that the waste-to-wealth program only requires a low cost.

A particularly concerning finding is that 66.9% of the respondents need to learn that coconut waste can be transformed into handicraft items. This lack of awareness suggests a missed opportunity for promoting eco-friendly and potentially profitable ventures within the community. The transformation of coconut waste into handicrafts represents a valuable application of waste-to-wealth principles, which can foster economic development and environmental sustainability.

Furthermore, the respondents need to learn of the low cost associated with the waste-to-wealth program, which highlights another critical educational gap. The misconception that such initiatives require significant investment may deter participation and innovation. More community members might be encouraged to engage in sustainable practices by clarifying that these programs are cost-effective.

These findings underscore the necessity for targeted educational campaigns to improve knowledge about waste-to-wealth initiatives. Awareness programs should focus on illustrating the economic and environmental benefits of converting waste into valuable products, particularly highlighting low-cost opportunities. As noted by Taweesan [14], effective community engagement and education are crucial in promoting sustainable waste management practices. Accordingly, a concerted effort by government, NGOs, and community leaders is essential to bridge these knowledge gaps and foster a culture of sustainability.

Table 3. Knowledge of respondents on the waste-to-wealth program.

Questions	Correct (%)	Wrong (%)
Composting, recycling and upcycling (creative reuse of waste) are examples of waste-to-wealth program.	55.1	44.9
Coconut wastes (coir/shell) cannot be reused as handicraft items.	33.1	66.9
The initiative of the waste-to-wealth program (Composting, recycling and upcycling) can lead to profit.	70.3	29.7
The initiative of the waste-to-wealth program (Composting, recycling and upcycling) requires low costs	22.0	78.0
Garden/ food waste can be reused as a valuable resource.	67.8	32.2
Total Percentage	48.8	51.2

Table 4 indicates that respondent's awareness of the waste-to-wealth program is relatively high, with less than 12% needing more awareness overall. This suggests a positive level of engagement or familiarity with the program, which is a promising sign for the potential success of such initiatives. Furthermore, the data shows that 59.3% of respondents understand that the waste-to-wealth program contributes to environmental well-being. This level of awareness is significant, as it reflects a good grasp of the program's environmental benefits. However, this figure also implies that approximately 40.7% of respondents either need to recognise or are uncertain about the environmental advantages of the program.

This discrepancy highlights a critical area for improvement. While a majority acknowledges the environmental benefits, a substantial minority remains unaware or unclear about these benefits. According to Manso and Andrade [15], effective waste management programs often succeed when they are supported by a widespread understanding of their environmental impact. Therefore, bridging this gap in awareness is crucial for maximising the program's impact. Educational campaigns should reinforce the link between waste-to-wealth initiatives and environmental sustainability. Clear communication and targeted outreach can enhance understanding and support among less informed people. Integrating success stories and practical examples of how the program benefits the environment could further solidify public support and participation.

Table 4. Knowledge of respondents on the waste-to-wealth program.

Statements	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
I am aware that the waste-to-wealth program can help take care environmental well-being.	5.1	1.7	33.9	38.1	21.2
I am aware that the waste-to-wealth initiative can generate income.	5.9	7.6	39.8	33.9	12.7
I am aware that the waste-to-wealth program requires time and energy.	4.2	12.7	50.8	22.0	10.2
I am aware that most of the waste generated can be used for waste-to-wealth program	2.5	11.0	42.4	30.5	13.6

(1=Strongly disagree, 2= Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree)

3.5 Willingness to participate in waste-to-wealth program

Table 5 illustrates a strong willingness among respondents to engage in the waste-to-wealth program, with over 60% expressing readiness to participate, given the availability of opportunities and training. Expressly, 66.1% of respondents indicated a willingness to join the handicraft program, while 64.4% showed interest in the composting program. This data is encouraging as it demonstrates a significant level of readiness to adopt waste-to-wealth initiatives, provided that adequate support is offered. The high percentage of respondents willing to participate in the handicraft and composting programs reflects a positive attitude towards turning waste into valuable resources. This willingness is crucial for the success of such programs, as active participation can lead to more significant waste reduction and resource recovery.

However, it is important to consider the underlying factors contributing to this willingness. McDougall et al. [16] highlight that adequate training and transparent opportunities are critical to fostering waste management program participation. Therefore, the willingness of respondents to join these programs suggests that providing targeted education and resources could significantly enhance engagement and effectiveness. Nevertheless, while the willingness is notable, the actual implementation of these programs must address potential barriers to participation, such as access to materials, logistical challenges, and ongoing support. Successful waste management initiatives often require a comprehensive approach that includes initial training, continuous support and feedback mechanisms to sustain participant motivation and program efficacy [17]. Accordingly, while the high willingness to participate is a positive indicator, ensuring that training and opportunities are effectively provided and addressing potential implementation challenges are essential for achieving successful outcomes in waste-to-wealth programs.

Table 5. Knowledge of respondents on the waste-to-wealth program.

Statements	1 (%)	2 (%)	3 (%)	4 (%)
I am willing to participate in waste-to-wealth program related to composting	12.7	22.9	55.1	9.3
I am willing to participate in waste-to-wealth program focusing on handicrafts from coconut waste	14.4	19.5	53.4	12.7

(1=Strongly disagree, 2= Disagree, 4=Agree, 5=Strongly Agree)

3.6 The potential of a waste-to-wealth program in Delta Tumpat

The data on waste generated and disposal practices presents a significant opportunity for implementing a waste-to-wealth program, especially given the varying quantities of different waste types and the community's readiness to participate. Food waste, at 0.74 kg per week, and coconut shell waste, at 0.64 kg per week, represent substantial quantities of organic materials that can be effectively utilised in waste-to-wealth programs. Composting food waste and converting coconut shells into eco-friendly products or handicrafts can significantly reduce the amount of waste that ends up being burned. This is particularly relevant given that most respondents (90.7%) currently burn their waste. Composting can help improve soil health and reduce greenhouse gas emissions from waste incineration [18].

Coconut waste, such as its coir and shell, is the second and third highest type of waste, and there is a clear potential for turning these materials into valuable products. Coconut coir can be used in various applications, including erosion control and plant growth mediums, while coconut shells can be crafted into handicrafts or used as biofuel. The low awareness among respondents (66.9%) about the potential of transforming coconut waste into handicrafts highlights an area for educational outreach and program development. The high rate of waste burning (90.7%) indicates a significant opportunity to redirect waste management practices towards more sustainable methods. With many respondents not using available waste disposal options, such as trash bins, there is a clear need for better waste management practices aligning with waste-to-wealth objectives.

The fact that a significant portion of respondents (51.2%) provided incorrect answers overall and needed to gain knowledge about the low cost and benefits of waste-to-wealth programs underscores the need for comprehensive training and awareness campaigns. Addressing these gaps through targeted education can increase participation and the program's effectiveness [19, 20]. The willingness of over 60% of respondents to participate in the program if given opportunities and training is a strong indicator of potential success. Specifically, 66.1% expressed interest in joining the handicraft program, and 64.4% were open to composting. This enthusiasm suggests a ready market for these programs, provided that the necessary infrastructure and educational support are established [21, 22].

4 Conclusion

The potential for a waste-to-wealth program in this community is considerable, given the high volumes of organic waste and the community's willingness to participate in such initiatives. This study identified several types of waste, such as coconut coir, coconut shell, food, bottles, and tin waste, which can be transformed into valuable resources. Food waste,

for example, can be composted to improve soil structure, health, and nutrient retention. Coconut shell waste can be converted into eco-friendly products that generate profits. The waste disposal practices of the Delta Tumpat community were found to be unsustainable, indicating a need for improvement through proper waste management techniques like recycling and upcycling. Enhancing these practices could not only increase profits but also reduce household waste. The study recommends that governments and NGOs promote efficient waste-to-wealth programs by encouraging recycling, upcycling, and composting. For these programs to be successful, there must be a concerted effort to address knowledge gaps, provide practical training, and improve waste management practices. Implementing these changes can transform waste into valuable resources, contributing to environmental sustainability and economic development. The government should mainly focus on rural areas like Delta Tumpat by organising programs to boost community participation in these programs. Governments and NGOs should also offer more convenient, cost-effective, and accessible waste management methods.

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