Journal of Administrative Science
Vol.20, Issue 1, 2023, pp.297-310
Available online at *http:jas.uitm.edu.my*

Sustainable Solid Waste Management Practices in Imbak Canyon Conservation Area (ICCA): An Assessment of Current Practices and Opportunities for Improvement

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Abstract

Malaysia places great importance on conserving biodiversity, as evidenced by the establishment of protected areas and national parks. The country's abundant and unique natural resources, combined with improved tourism services, attract visitors who wish to explore its remarkable landscapes. However, the increasing popularity of ecotourism and recreational activities poses potential threats to these protected areas. Similarly, the Imbak Canyon Conservation Area (ICCA) in Sabah, Malaysia, shares the objective of safeguarding the environment and biodiversity but faces challenges due to the negative impacts of recreational activities, including ecotourism. Therefore, it is crucial to assess sustainable practices for effectively managing solid waste in conservation centres. The rising volume of waste generation in Malaysia raises concerns about solid waste management. To determine the elements of sustainable solid waste management practices specifically within the ICCA, this study uses in-depth interviews and focus group discussions (FGD). Thematic analysis is employed to analyse and interpret the insights derived from these interviews and (FGD). The findings reveal the presence of sustainable solid waste management practices in various stages, including waste generation, storage, collection, transfer, recovery, and disposal within the ICCA. However, significant opportunities for improvement exist in the ICCA's solid waste management practices.

***Keywords**: Solid waste management, sustainability, conservation centre, sustainable practice*

INTRODUCTION

Received: 10 January 2023
Accepted: 19 May 2023
Published: 30 June 20233

Conservation areas are extremely important on a global scale because they possess incredible natural landscapes, hold historical significance, embody cultural value, and attract ecotourism. Unfortunately, the growing popularity of ecotourism has led to an increase in waste generation, posing several negative consequences. Inadequate waste management practices in conservation areas can have severe impacts on the environment, economy, and society. These include land degradation, depletion of resources, pollution of surface and groundwater, loss of biodiversity, and harm to the visual appeal of tourist destinations (Dunjic Jelena, Stojanovic Vladimir, Kicosev Vesna, 2017; Steg & Vlek, 2009)

Given the precious nature of these resources, it is essential to practice sustainable development in protected areas. Adopting pro-environmental behaviours, including proper waste management, can significantly support sustainable growth and environmental conservation on a global scale (Przydatek, 2019). Environmental

awareness is low among both residents and visitors in these areas, especially in Asia. Improper waste management, such as burning or landfilling waste, is a major risk to conservation areas and their valuable resources. Thus, it is crucial to implement strategies such as educational materials to raise environmental awareness and sustainable development-based policies (Przydatek, 2019).

Conservation areas play a critical role in preserving biodiversity and the functions provided by natural systems (Kolahi et al., 2013). They are unique and valuable due to their presence of one-of-a-kind natural resources, both animate and inanimate. National parks were established to protect these resources, including biodiversity, living things, and inanimate parts of the natural world and landscape, as well as to restore the proper state of altered natural habitats (Przydatek, 2019).

Malaysia has a long history of establishing conservation areas and national parks to protect its biodiversity. The British colonial rule in the early 1800s marked the beginning of conservation efforts in the country. Since then, numerous conservation areas have been established to the present day (Daim et al., 2011). The evolution of conservation areas in Malaysia has been significantly influenced by human impacts on natural regions. In some communities, conservation areas continue to serve social functions, such as providing food and space for cultural and spiritual practices. In addition to being crucial for biodiversity conservation, conservation areas are also important for maintaining the balance of the ecosystem (Daim et al., 2011).

Conservation areas in Malaysia have made significant economic contributions to the country through their provision of natural resources, land for agriculture, industry, and human settlement, and most notably, through tourism. Therefore, conservation areas play an essential role in maintaining the balance of natural systems and enhancing the nation's social welfare (Daim et al., 2011). Tourists are attracted to Malaysia's conservation areas due to the abundance and uniqueness of its natural resources, as well as its improved tourism services. Yayasan Sabah and Petronas have formed a partnership in Sabah to establish the Imbak Canyon Conservation Area (ICCA) as a protected area. While the establishment of nature conservation areas can bring positive benefits to the local community, such as job opportunities and economic growth through ecotourism, it can also have negative impacts on daily life (Ross et al., 1999; Scheyvens, 1999; Underwood et al., 2016).

Ecotourism and recreational activities in protected areas, however, can have harmful effects on these natural regions. Indicators of visitor impact include erosion, damaged trees, distressed wildlife, and the spread of invasive species (Clark et al., 2003). Additionally, the rise in waste generated by tourists is a significant threat to the sustainability of the environment, especially in remote mountainous areas (Steg and Vlek, 2009).

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Problem statement

The protection of the natural world and the conservation of its biodiversity are the main goals of establishing conservation centres. However, earlier studies have shown that these facilities might unintentionally affect the environment and its biodiversity (Daim et al., 2011; Maldonado-Oré & Custodio, 2020). This is because ecotourism and recreational activities have a negative impact and may cause local waste production and environmental pollution, which may defeat the goal of the conservation centre. To explore the implementation of sustainable solid waste management practices in conservation centres, particularly focusing on waste generation, storage, collection, recovery, transfer and transport, as well as disposal, a case study was conducted in the Imbak Canyon Conservation Area (ICCA) located in Sabah, Malaysia. Interviews were conducted to collect data for the study, and a thematic analysis was employed to interpret the research findings.

Research objectives

1. To identify the element of sustainable solid waste management practices in the Imbak Canyon Conservation Area (ICCA).
2. To identify challenges in managing solid waste in Imbak Canyon Conservation Area (ICCA).

Sustainable solid waste management

According to Tchobanoglous, Theisen, and Vigil (1993), the management of solid waste pertains to the control of waste generation, storage, collection, transfer, transport, processing, and disposal. On the other hand, sustainable development, as defined by Idowu, Omirin, and Osagie (2011), involves meeting the present generation's demands without jeopardizing the ability of future generations to satisfy their own. Ogwueleka (2009) describes municipal solid waste management (MSWM) as a process that entails recycling, collection, transfer, treatment, resource recovery, and waste disposal within urban areas. Sustainable solid waste management is attained when waste management procedures are continuously implemented in a manner that safeguards the health and environment of people (Adewole, 2009).

The Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 and consist of 17 interlinked goals aimed at achieving a more sustainable future for all. The goals cover a broad range of sustainable development issues, including poverty, hunger, health, education, gender equality, clean water and

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sanitation, affordable and clean energy, decent work and economic growth, industry, innovation and infrastructure, reduced inequalities, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice and strong institutions, and partnerships for the goals. The SDGs are intended to be a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity United Nation (2022).

To ensure environmental protection and sustainable development in the long run, it is crucial to adopt sustainable practices for solid waste management (Agamuthu, 2004). Previous studies have highlighted the ongoing challenges faced by many developing countries in effectively managing their waste (Agamuthu et al., 2007). Unfortunately, open landfills remain the predominant waste management approach in these nations, posing significant environmental concerns (Sharholy et al., 2008; Sreenivasan et al., 2012; Zen & Siwar, 2015). The absence of comprehensive and unambiguous waste management policies in developing countries directly affects their ability to address the issue (Haidy & Mohammad Tahir, 2017; Haidy & Mohammad Tahir, 2018).

Methodology

Imbak Canyon Conservation Area (ICCA) was selected as the study's research site to identify sustainable practices for managing solid waste in a conservation area. The ICCA in Sabah, like many other protected areas in Malaysia, was established to serve the purposes of research, education, and sustainable tourism. This remarkable natural area offers a wide range of outdoor recreational experiences for visitors, catering to varying levels of skill and challenge. Activities such as day trips along the trails surrounding the base camp and climbing Mount Kuli provide opportunities for both novice and experienced adventurers. The distinctive physical features of Imbak, including waterfalls, rivers, misty peaks, and diverse biodiversity, further enhance the area's uniqueness and potential as one of Sabah's premier destinations for outdoor recreation (Daim et al., 2011).

The use of a qualitative approach in this study is based on the understanding that such an approach is well suited for exploring complex social phenomena, such as solid waste management practices in a conservation area. Qualitative research provides a means of obtaining detailed insights into the attitudes, beliefs, and behaviours of individuals and groups, which can be difficult to obtain through quantitative research methods (Creswell, 2014). To identify the elements of sustainable solid waste management practices in ICCA, in-depth interviews were conducted to key informants comprised of ICCA manager, head of department (HOD) and supervisor, focusing on the aspect of waste generation, waste storage, waste collection, waste transfer and

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transport, waste recovery, and disposal of waste. Focus group discussions (FGD) were also carried out among the employees of ICCA ranging from officers, rangers, receptionists, and housekeeping staff. A separate FGD was also conducted among the Visitors and tourists at ICCA during their stay there. The aim of including both staff and visitors in our study is to gain a comprehensive understanding of solid waste management practices in ICCA from multiple perspectives. An in-depth interview with the key informants and FGD includes a total of 8 respondents.

The data collected from the in-depth interviews with key informants and the focus group discussions (FGD) among employees, visitors, and tourists at ICCA were analysed using thematic analysis. Thematic analysis is a qualitative research method that involves identifying, analysing, and reporting patterns or themes within the data to gain a deeper understanding of the research topic (Braun & Clarke, 2006). The transcripts of the interviews and FGD were carefully reviewed and coded. Coding involves the process of systematically assigning labels or codes to segments of data that are relevant to the research objectives. In this study, the codes were assigned to segments of data related to waste generation, waste storage, waste collection, waste transfer and transport, waste recovery, and disposal of waste.

After the initial coding, similar codes were grouped together to form overarching themes. These themes represented the main patterns or recurring ideas that emerged from the data. The themes were then reviewed, refined, and named to accurately represent the content and meaning of the data. Once the final themes were established, the researchers conducted a thorough analysis of the data within each theme. This involved examining the specific quotes and examples that supported each theme and identifying any variations or contradictions in the data. The findings of the thematic analysis provided a comprehensive understanding of the elements of sustainable solid waste management practices in ICCA. They revealed insights into the attitudes, beliefs, and behaviours of different stakeholders, including ICCA managers, employees, and visitors. This qualitative approach allowed for a rich exploration of the complex social phenomena surrounding solid waste management in a conservation area like ICCA.

Findings and discussion

Waste generation

The Imbak Canyon Conservation Area (ICCA) is a protected area located in Sabah, Malaysia. The area is known for its rich biodiversity and is home to several endangered species. However, like many protected areas, ICCA faces challenges in managing waste generated within its boundaries. To address this issue, a study was conducted to investigate waste generation and management practices within the conservation area based on interviews conducted with staff members.

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The findings of the study suggest that waste generation and management practices within ICCA need improvement. The study found that waste generated within ICCA is primarily composed of plastic waste, tin cans, organic waste, and food waste. Staff members were identified as the primary source of waste generation within the conservation area. The staff population in ICCA consists of 37 individuals, with an estimated 50 people when including their families, who contribute significantly to waste generation.

The study also revealed that ICCA lacks a tracking system to monitor the amount of waste generated within the conservation area, except for recyclable items such as aluminium and scrap metal, which are weighed for sale. This lack of data makes it difficult to assess the effectiveness of waste management efforts and identify areas that require improvement.

Food waste management was found to be effective when providing food to visitors or tourists, as ICCA is aware of the potential increase in waste that could result from visitors bringing their own food. However, waste generated by tourists who bring their own food is beyond ICCA's control. This highlights the need for education and awareness campaigns to encourage visitors to adopt sustainable waste management practices.

Visitors who come are encouraged to bring their own drink containers or water bottles that can be reused because ICCA provides water coolers in several buildings at ICCA. In addition, the ICCA kitchen provides food (lunch packs) to staff or visitors using food containers that can be reused, the food containers will be brought to the ICCA kitchen to be reused after the visitors return to Imbak Canyon Learning Center (ICLC). This effort is to reduce the amount of solid goods every time after visitors enter ICCA.

Operational activities, such as paper and ink waste, were identified as another source of waste generation in ICCA. This finding suggests that ICCA could benefit from implementing policies and practices that promote paperless operations and reduce paper waste.

In conclusion, the study highlights the need for ICCA to improve waste management practices to ensure the conservation area remains sustainable and free from waste pollution. The findings suggest that tracking waste generation, educating visitors, and implementing policies to reduce waste from operational activities could significantly improve waste management in ICCA. By implementing these recommendations, ICCA can ensure that it remains a thriving ecosystem and a beacon of sustainable conservation practices.

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Waste storage

Based on the findings, the waste storage and management system in the Imbak Canyon Conservation Area (ICCA) has both strengths and weaknesses. The conservation area has implemented a system that includes six rubbish huts strategically placed in different locations, each with three trash cans with specific labels. This system encourages visitors to separate their waste before throwing it in the garbage and is helpful in promoting proper waste management.

However, the conservation area has encountered some challenges in ensuring that staff, visitors, and tourists segregate their waste properly. The area previously had a zero-waste policy that required visitors to pay a deposit and declare their waste (Tampui), but this policy is no longer implemented. Additionally, the hostel rooms in the area only provide one type of dustbin, making it difficult for visitors to segregate their waste.

Despite these challenges, the conservation area has taken steps towards proper waste management. The area has provided organic waste bins in the dining hall, which is a positive step towards proper waste management. Organic waste, such as food waste, will be sent to a designated area for organic waste.

However, the conservation area has also encountered challenges in managing organic waste. While the conservation area has an organic waste machine, it is not economically feasible to operate due to the high operation and maintenance costs. The costs can amount to RM20000, making it difficult for the conservation area to run the machine efficiently.

Overall, the waste management system in the Imbak Canyon Conservation Area is a continuous effort that requires ongoing education and awareness campaigns to encourage staff, visitors, and tourists to segregate their waste properly. Additionally, exploring more sustainable waste management options, such as reducing waste generation, promoting recycling and upcycling, and utilizing eco-friendly materials, may be beneficial. By implementing these measures, the conservation area can continue to promote proper waste management and contribute to the preservation of the environment.

Waste Collection

Visitors are responsible for separating their waste and putting it in the designated bins. However, in reality, staff members have to sort the waste, which can be time-

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consuming and not the most efficient use of their time. The responsibility of visitors to separate their waste is emphasized, but it is not easy to enforce.

Moreover, tourism is not the core business of the conservation centre, which may result in a lack of emphasis on proper waste management practices. Staff members only collect waste upon request or after visitors check out, which may result in waste accumulating for longer periods, causing a potential health and environmental hazard.

There is also a difference in the mindset and duration of stay between researchers and tourists. Researchers stay for longer periods and may generate more waste due to the nature of their work, while tourists may generate more single-use plastic items.

Overall, the waste collection system in the ICCA has strengths, such as proper disposal of waste and segregation for recycling purposes. However, there are also weaknesses, including the difficulty in ensuring visitors segregate waste properly, the lack of emphasis on proper waste management practices, and the potential health and environmental hazards resulting from waste accumulation.

Waste recovery

Based on the findings, the waste recovery system in the Imbak Canyon Conservation Area (ICCA) appears to be quite comprehensive. The centre has taken steps to facilitate the recycling process by separating organic and inorganic waste types starting from the staff house and Dining Hall kitchen. Each trash can in the trash hut is labelled with a special label to make the waste separation process easier. Furthermore, a food waste trap is present in every kitchen to facilitate the separation and collection of food waste before it is channelled to the manhole. Containers for the separation of food waste and solids in the Dining Hall are provided for this separation process.

The center provides three types of dustbins based on categories, and each garbage hut functions as a food waste collection point except in the ICCA kitchen. The food waste collected in the Dining Hall is according to the number and rate of visitors at one time, therefore there is a special container in the Dining Hall for the collection of food waste before disposal. The organic waste is treated at a certain area and is currently being maintained.

Additionally, the ICCA has a composting area or "rumah pemprosesan" where organic waste is processed into fertilizer. The centre had also invested in a composting machine, but its use and operation are not very effective considering the cost and limited electricity supply.

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Overall, the waste recovery system in the ICCA appears to be quite effective and well-organized. The centre has taken steps to facilitate the recycling process, separate waste types, and provide separate containers for food waste and solids. The organic waste is treated at a specific area and is being maintained, while the composting area is used to process organic waste into fertilizer.

Waste transfer and transport

Based on the findings, the waste transfer and transport system in the Imbak Canyon Conservation Area (ICCA) involves several components. The conservation area has arranged for a Mitsubishi SAA 7139 P truck or any other suitable vehicle to collect and dispose of solid waste at the disposal centre in either Telupid District or Tongod District. The frequency of disposal is at least twice a month, taking into account the amount of accumulated waste and current weather conditions.

The garbage or waste material is collected at the garbage hut according to the category for the recycling process or disposed of at the solid waste collection centre in Telupid District or Tongod District. Waste material that can be sold is collected at the Service Building before the material is sent for sale. However, there is no specification on the type of dustbin provided, which may result in inconsistencies in waste disposal.

The transportation of waste is carried out using lorries and 4WD vehicles. However, there are several issues that affect the waste transfer and transport system. Firstly, there are vehicle problems and weather problems that may delay the transportation process. Additionally, transportation costs are high since the landfill is located more than 95 km away from the conservation area. The admin department handles the transportation, and it is aligned with any office duties. However, poor road conditions also pose a challenge to waste transportation.

There is no specific schedule to transfer the waste. It is sometimes based on the waste generation itself or subjected to the logistic availability. However, waste is sent to the landfill at least every two weeks to prevent the accumulation of waste in the conservation area.

In summary, while the Imbak Canyon Conservation Area has a waste transfer and transport system in place, there are several challenges that need to be addressed, including vehicle problems, high transportation costs, and poor road conditions. A more consistent waste disposal approach, coupled with proper scheduling of waste transportation, may help to address these challenges and improve the overall waste transfer and transport system in the conservation area.

Waste disposal

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Based on the information provided, it seems that the waste disposal system in the Imbak Canyon Conservation Area (ICCA) involves both recycling and proper disposal of waste. The garbage huts are used as collection points for different categories of waste, which are then either sent for recycling or disposed of at the solid waste collection centre in Telupid District or Tongod District.

It is important to note that non-organic waste is originally sent to Tongod District and now to Telupid District for disposal, while organic waste is processed within the ICCA area. This indicates that the conservation area has measures in place to handle different types of waste, which is essential for reducing the impact of waste on the environment.

However, it is also important to consider the challenges associated with waste disposal in ICCA. For instance, transportation cost is high due to the distance to the landfill, which is more than 95 km away. The poor road condition also poses a challenge, and there is no specific schedule for waste transfer. This suggests that waste disposal in ICCA is subject to logistic availability and waste generation.

In conclusion, while the Imbak Canyon Conservation Area has a waste disposal system that includes recycling and proper disposal, there are challenges that need to be addressed to improve the effectiveness and efficiency of the system.

Challenges

The findings of this study have shed light on the challenges faced by ICCA in managing solid waste effectively. These challenges are not unique to ICCA, as many other tourist destinations worldwide struggle with similar issues. One of the significant issues identified is the lack of a permanent buyer for waste materials such as dirty oil, iron, paper, plastic, and bottles. This finding highlights the need for governments and industries to promote sustainable waste management practices by establishing effective recycling systems and markets.

Another challenge identified in this study is the ineffective use of compost machines at ICCA. The limited electricity supply and insufficient food waste for processing hinder the composting process. This challenge points to the need for sustainable energy solutions and more effective food waste management practices. The distance and high vehicle fuel consumption required to deliver solid waste to the collection centre is another significant challenge faced by ICCA. This finding highlights the importance of locating waste disposal centres strategically to reduce transportation

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costs and carbon emissions. It also underscores the need for promoting sustainable transportation practices, such as carpooling and the use of public transportation.

Finally, the rate of accumulated waste at ICCA is increasing alongside visitor numbers, which underscores the need for effective waste management practices. This finding highlights the importance of promoting sustainable tourism practices that reduce waste generation and promote waste reduction, reuse, and recycling. In response to these challenges, ICCA is exploring alternative solutions such as establishing a suitable waste disposal centre that adheres to forest regulations. This approach highlights the need for collaboration between governments, industries, and local communities to develop sustainable waste management solutions that are ecologically sound and economically feasible.

Overall, this study highlights the need for sustainable waste management practices that promote ecological sustainability and support economic development. Governments, industries, and local communities must work together to develop effective waste management systems that minimize waste generation, promote waste reduction, reuse and recycling, and ensure that waste disposal is ecologically sound and economically feasible. By doing so, we can create a more sustainable future for all.

Conclusion

The study reveals that elements of sustainable solid waste management practices in ICCA do exist, particularly in the aspect of waste generation, storage, collection, transfer, recovery, and disposal. However, there is significant room for improvement in ICCA's sustainable solid waste management. Overall, the study reveals strengths and weaknesses in waste management practices in the Imbak Canyon Conservation Area. The conservation area has taken steps towards proper waste management, such as providing organic waste bins in the dining hall and implementing a waste separation system in the rubbish huts. However, ongoing education and awareness campaigns, as well as exploring more sustainable waste management options, are necessary for the conservation area to promote proper waste management and contribute to the preservation of the environment. The study emphasises the need for continuous improvement in waste management practices in conservation areas to preserve the environment and ensure sustainability.

Acknowledgements

The authors would like to extend their gratitude to Yayasan Sabah for the support they provided during the time that this research was being carried out at ICCA.

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