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Economic Value of the RDF Cilacap Eco-Edu-Park Development Plan, Central Java, Indonesia

(Nilai Ekonomi Rancangan Pengembangan Eco-Edu-Park RDF Cilacap, Jawa Tengah, Indonesia)

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ABSTRACT

The Refuse Derived Fuel (RDF) method of waste processing is focused on transforming garbage into a more environmentally sustainable replacement fuel. This caused Cilacap Regency to hosts an RDF Integrated Waste Processing Site (IWPS). The development of the Eco-Edu-Park further supported the RDF IWMS by improving the quality of environmental resources and making a positive contribution to the regional economic. Therefore, this study aimed to assess the circular economic value of the Eco-Edu-Park project at the Cilacap RDF IWPS. The adopted strategy comprised descriptive and quantitative analyses to ascertain economic value using the willingness to pay method. The results showed that the establishment of Eco-Edu-Park at RDF Cilacap garnered favorable support from all stakeholders, as the respondents expressed agreement and interest in visiting the park. The total potential income from the development process was projected to be IDR 5,504,235 for scenario 1, and this was based on the attraction's carrying capacity. For scenario 2, approximately IDR 5,502,603,733 was realized annually, which reflected the respondents' preferences for the diverse attractions. This study implied that integrating circular economic principles into educational tourism development tended to generate significant environmental benefits, while fostering public engagement in sustainable waste management.

Keywords: Eco-tourism; educational; environmental protection; refuse derived fuel; willingness to pay

ABSTRAK

Kaedah pemprosesan buangan bahan api terhasil dari sisa (RDF) bertujuan untuk mengubah sampah menjadi bahan api gantian yang lebih mampan terhadap alam sekitar. Wilayah Cilacap merupakan salah satu Tempat Pengelolaan Sisa Bersepadu (TPST) RDF. Pembangunan Eco-Edu-Park di Wilayah Cilacap akan menyokong TPST RDF dengan meningkatkan kualiti sumber alam sekitar dan memberi sumbangan positif kepada ekonomi wilayah. Kajian ini bertujuan untuk menilai nilai ekonomi kitaran projek Eco-Edu-Park di TPST RDF Cilacap. Strategi yang digunakan merangkumi analisis deskriptif dan kuantitatif untuk memastikan nilai ekonomi dengan menggunakan pendekatan kesanggupan membayar. Penemuan kajian menunjukkan bahawa penubuhan Eco-Edu-Park di RDF Cilacap mendapat sokongan yang menggalakkan daripada semua pihak berkepentingan, kerana semua responden menyatakan persetujuan dan minat untuk melawat Eco-Edu-Park di Cilacap. Jumlah potensi pendapatan daripada pembangunan Eco-edu-park di Cilacap diunjurkan sebanyak IDR 5,504,235 untuk senario 1, yang berdasarkan kepada kapasiti daya tarikan, dan IDR 5,502,603,733 setiap tahun untuk senario 2, yang mencerminkan pilihan responden sebagai tarikan yang mereka ingin kunjungi. Kajian ini menunjukkan bahawa pengintegrasian prinsip ekonomi kitaran dalam pembangunan pelancongan pendidikan dapat menghasilkan manfaat alam sekitar dan ekonomi yang signifikan, di samping memupuk penglibatan awam dalam pengurusan sisa lestari.

Kata kunci: Eko-pelancongan; pendidikan; perlindungan alam sekitar; bahan api terhasil dari sisa; kesanggupan membayar

JEL: I25; O32; Q26; Q51; Q53; Q56
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INTRODUCTION

The management of increasing waste generation is the most pressing challenge faced by the Indonesian government. According to the Ministry of Environment and Forestry (2019), the country produces approximately 64 million tonnes of waste annually. Majority of the municipal solid waste (MSW), mainly generated by households, was discarded directly at the final disposal sites (FDS) or landfills. It was also estimated that 60 to 70 per cent of the total MSW was transported to landfills by local waste management authorities. The continuous accumulation at these sites has led to significant environmental degradation, including water, air, and soil pollution, if not properly managed. Belli (2020), reported that landfills have been associated with adverse environmental effects such as soil and water acidification, ecosystem degradation, reduced land productivity, and contributions to global warming. Moreover, the health and well-being of communities residing near landfills tend to be at risk as a result of prolonged exposure to pollutants and contaminated environments. This led to the adoption of efficient and environmentally sound waste management systems that minimise the production of hazardous substances.

The use of Refuse-Derived Fuel (RDF), a relatively recent method introduced in Indonesia, was a promising innovation adopted to address the challenge earlier mentioned. RDF refers to an alternative fuel produced from processed waste through sorting, drying, and densification into pellets or briquettes. The implementation process has gained increasing attention as a dual-solution strategy to reduce the rising volume of MSW and dependency on fossil fuels. This fuel can be derived from both organic and inorganic waste materials, subsequently used as a renewable energy source in industrial applications, including cement production and power generation (Zaman 2023; Hudayarizka 2024; Qonitan et al. 2021; Suryawan et al. 2022). The integration into national waste management systems, potentially reduced the amount of waste directed to landfills, minimised greenhouse gas emissions, and reliance on non-renewable energy sources (PT SBI 2023). This caused several European countries, such as Germany, the Netherlands, and the United Kingdom, to implement a circular economic realized through the adoption of RDF in an integrated manner. The procedure included waste collection and sorting, which were processed into RDF at special facilities, and used as an alternative fuel in cement industries and power plants. It also fostered collaboration between the government, private sector, and communities to reduce carbon emissions, landfill use, as well as create economic value from waste.

Following the description above, Cilacap Regency in Indonesia has adopted the RDF waste processing method, specifically at the Integrated Waste Processing Site (IWPS) in Jeruklegi District. This method helped reduce land use at the Jeruklegi IWPS, as well as improved environmental quality. The RDF project is another major national initiative that processed waste into fuel, using German technology funded by the Danish government. The initiative was granted to the Indonesian Ministry of Environment and Forestry, which then transferred it to the Cilacap Regency Government. The waste processing capacity and potential input at the IWPS was approximately 200 tons, and 469 tons per day, respectively. Currently, roughly 150 tons of waste per day, sourced from 14 districts within Cilacap were processed into RDF. The conversion into an alternative fuel supports the circular economic principles aimed to reduce waste, conserve resources, and promote sustainable energy production.

Considering that RDF can serve as a substitute for fossil fuels and a solution for regional waste problems, its implementation feasibility must be guaranteed to ensure sustainability. Moreover, as part of ensuring the sustainability of the Cilacap Regency RDF IWPS, the location was developed into an Eco-Edu-Park to improve the quality of resources and the environment in the area. The park was intended to function as a new visitor attraction and an educational medium for the community regarding the importance of waste management. This initiative is a step towards creating awareness about waste management and alternative energy, as well as introducing the circular economic concept. To maximize the potential of the Eco-Edu-Park RDF Plant Cilacap based on circular economic principles, certain educational activities focused on sustainable systems were also performed. The developed plan included various attractions such as a Thematic Park to provide awareness on waste processing technology. The Biodiversity Park (Kehati Park) introduced various types of biodiversity and served as a campground. The Cultural Park (Taman Sasana Budaya) exhibited the local culture, while the Bale Palenggahan facility was designed for Meetings, Incentives, Conventions, and Exhibitions (MICE). The Eco-Edu-Park was used for student field trips, resulting in interactive discussions about waste management at the RDF Plant and the application of circular economic concepts. This study aimed to identify circular economic-based activities that supported the development of the Eco-edu-park in Cilacap as well as assess its economic value. The development process is expected to educate the public regarding the benefits and utility of properly processed waste.

LITERATURE REVIEW

SOCIAL ECONOMIC IMPACT OF RDF IMPLEMENTATION IN DEVELOPING COUNTRIES

The implementation of RDF in developing countries has garnered significant attention in recent academic literature. This was mainly due to the potential socio-economic benefits, including the role in sustainable waste management. RDF, which was produced from municipal solid waste (MSW), served as an alternative fuel, particularly during cement production in many developing nations. As a result, this review synthesized results from various studies to clarify the socio-economic impacts of RDF implementation.

The major socio-economic benefit of RDF is the potential to reduce waste volume and enhance management practices. In Indonesia, for example, the production from municipal waste has been shown to contribute positively to waste reduction efforts while simultaneously providing a sustainable energy source for cement kilns (Sari 2024; Sari et al. 2023). The comparative analysis of RDF variations in Jakarta outlined the need for policy frameworks that balance calorific value with waste reduction objectives, thereby motivating the adoption as a viable alternative fuel (Sari 2024). This dual focus addressed pressing waste management challenges as well as promoted economic savings through reduced landfill use and associated costs.

Financial feasibility studies, conducted in Morocco, focused on the economic advantages of RDF production. These studies reported that co-incineration of RDF in cement kilns led to significant savings on fossil fuels and a reduction in CO_2 emissions, thereby supporting global sustainability objectives (Ouigmane et al. 2022; Hasib et al. 2021). The financial assessments showed that substituting conventional fuels with RDF produced substantial cost savings for cement plants, making it an attractive option for industries in developing countries (Hasib et al. 2021; Zahir 2024). The economic assessment of RDF production evaluated its potential as a financially beneficial strategy for municipalities. This suggested that effective implementation led to both economic growth and improved waste management (Zahir 2024).

The implementation process fostered social development by creating job opportunities in waste management and RDF production sectors. As developing countries struggled with high unemployment rates, the establishment of RDF production facilities stimulated the local economies. This led to the provision of employment opportunities, particularly in urban areas where waste generation was extremely high (Resmianty et al. 2022). The integration of of this fuel into existing waste management systems also promoted community engagement and awareness regarding sustainable practices, thereby enhancing social cohesion, including environmental responsibility among residents (Resmianty et al. 2022).

The transition to RDF usage is characterized by certain challenges. According to Lara-Topete et al. (2022) and Abidin, (2024), developing countries faced infrastructural and technological barriers that impeded the effective implementation of relevant systems. For example, there is critical need to invest in appropriate technologies and facilities to process waste into RDF. This was outlined in the comparative analysis of waste management technologies in West Java (Abidin 2024). Additionally, the socio-political context, which included governance and regulatory frameworks, played a crucial role in determining the success of RDF initiatives. The potential benefits of RDF may not be fully realized, without supportive policies and institutional frameworks.

STUDY ON ECONOMIC VALUE OF TOURISM AND WASTE MANAGEMENT

Previous studies on the economic valuation of waste management have been conducted in several contexts across Indonesia. A typical example is the study on youth-led waste bank management in Bogor City. It was reported that waste management driven by teenagers presented distinct opportunities and challenges compared to conventional waste bank systems. In addition, the youth-managed waste bank collaborated with the Apparatus-Based Main Waste Bank (Bank Sampah Induk Berbasis Aparatur – BASIBA), which was administered by the Bogor City Environmental Service. The implementation process was performed effortlessly, with the main challenge identified as the dynamic nature of its human resources. This waste bank focused on waste sorting and the development phase of the treatment using the black soldier fly (Hermetia illucens) method (Falatehan 2020).

In 2021, a team of experts conducted a study on the potential for waste generation and household willingness to pay (WTP) for the management of the 3R Community Waste Processing Facility (Tempat Pengolahan Sampah Reduce-Reuse-Recycle – TPS 3R) in Babakan Village, Bogor Regency. The results showed that the amount of household waste generated, including participation levels, and WTP significantly influenced the feasibility of the TPS 3R program implementation. Despite the presence of free riders, it was reported that operational costs could still be covered through community participation and proper management mechanisms (Nuagi 2022).

Prior studies on the economic valuation of sustainable tourism have been carried out in several contexts. For example, it was reported that in the Tangkahan Protected Area of Gunung Leuser National Park, North Sumatra, ecotourism possessed a relatively high economic value, supported by strong visitor interest and visitation intensity (Purwoko 2022). In 2023, another study examined household waste management based on circular economic framework using a dynamic system method in Cibanteng Village, Bogor Regency (Sapanli 2023). The results showed that most households had not implemented the advanced waste management practices. The simulation results of various dynamic system scenarios proved that an optimistic development produced the most effective outcome, with approximately 70 per cent of waste successfully managed.

Based on this scenario, the smallest average increase in household waste generation (653.1 tonnes per year) was achieved, alongside the highest reduction in emission load (−39.4 tonnes CO_2-eq per year) and greatest potential rise in income (IDR 2,264,031 per family per month) within the simulation period of 2022–2030. The achievement of this optimistic scenario required two main strategies (i) enhancing the capacity of the community and local institutions in Cibanteng Village, as well as (ii) developing markets for waste-derived products and activities evolving from local management initiatives.

Another case study on the economic benefits of tourism development was carried out at Goa Cemara Beach Nature Tourism Area in Bantul, Special Region of Yogyakarta. The result showed that visitors, business actors, and workers

perceived the condition of Goa Cemara Beach tourism as satisfactory. Furthermore, tourism activities in the area generated employment opportunities and stimulated local business growth (Nurrohmah & Falatehan 2023).

Considering the growing number of studies on the economic value of tourism and waste management, there remained a gap that integrated both domains. Previous studies that investigated tourism models based on waste management were limited. Additionally, information regarding the economic feasibility of educational tourism, particularly when associated with sustainable waste practices, played a crucial role in ensuring the long-term sustainability and replicability.

METHODOLOGY

LOCATION AND PERIOD

The present study was carried out in Cilacap Regency, Central Java. In addition, data collection and processing were performed from May to November 2024.

ANALYSIS METHOD AND DATA PROCESSING

The benchmarking method was systematically and logically adopted to improving the performance of business activities. The method also served as a reference point for continuous development and innovation. Benchmarking entailed the identification and comparison of best practices or performance advantages, which subsequently formed the basis for evaluating progress as well as strengthening the core competencies of the business activity under review (Winanda 2022). The conceptual framework in Figure 1, outlined the analytical flow and interrelation among the major components examined.

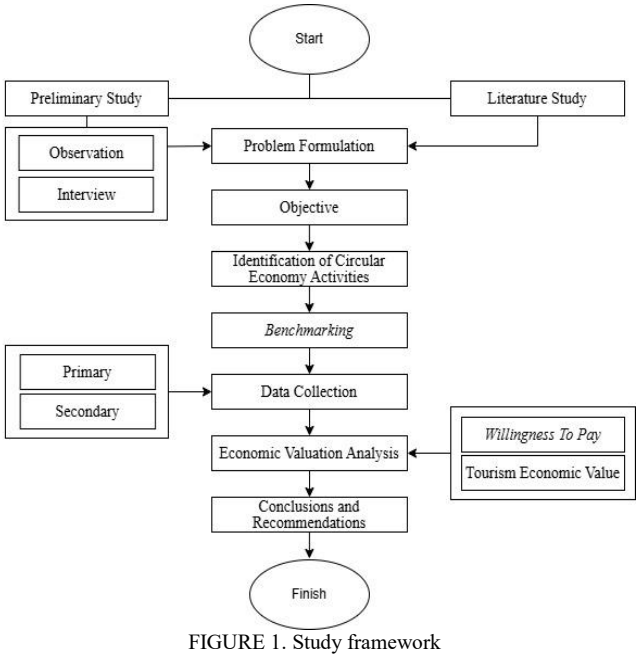

FIGURE 1. Study framework

Figure 1 shows the process started with the identification of significant waste management issues and the comparison with results from previous studies. In respect to the framework of the circular economic-based tourism management programme, benchmarking was conducted by comparing several other circular economic-oriented tourism sites. This comparative method aimed to provide a comprehensive understanding of the potential for circular economic practices and to identify opportunities for sustainable tourism development within the proposed Eco-Edu-Park in Cilacap Regency.

This study focused on two interrelated objectives, the first was to identify circular economic-based activities that effectively supported the development of the Eco-Edu-Park in Cilacap. The process was achieved by benchmarking comparable circular economic-based tourism areas. Additionally, the methodological stages included (1) Problem Identification, which entailed identifying and compiling the main waste management issues. (2) Observation, responsible for mandating the collection of primary data through direct field engagement and (3) Situation Analysis, that focused on synthesising data prior to the design and planning of the programme (Indiani 2022).

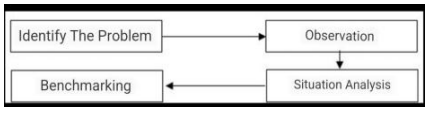

FIGURE 2. Benchmarking method

The second objective centered on estimating the economic utility value of potential circular activities that supported the development of the Eco-Edu-Park through valuation analysis. Meanwhile, economic valuation measured the maximum extent an individual is willing to make sacrifices in order to obtain alternative goods or services (Indiani 2022). The fundamental concept of valuing natural resources and environmental assets is grounded in the principles of sustainable development, which integrated three mutually interdependent dimensions, namely economic, social, and environmental.

Economic valuation served as an essential tool for decision-makers by providing quantitative insights into the benefits of natural resource and environmental management. This valuation type supports policy formulation, as well as helps to ensure the efficient, equitable, and sustainable utilisation of natural resources, thereby contributing to the long-term success of circular economic-based tourism initiatives.

In this context, the valuation method for natural resources aimed to estimate the total economic value (TEV) inherent in the resources being studied (total economic value). This total value included market-based (market value) and non-market, or value without a market price (non-market value).

Valuing visitor destinations is enabled environmental elements provide significant benefits to humans. The TEV can be divided into use and non-use, with the benefits of attraction areas further categorized as follows (Fauzi 2013):

1. Use value: benefits derived from the usage of attraction areas, such as revenue from related activities, entrance tickets, parking fees, etc.
2. Functional value: benefits from the ecological functions of natural visitor destinations, namely waste management through RDF and other environmental services.
3. Attributes value: additional inherent value related to human psychological needs, including new experiences gained from visiting visitor destinations, relaxation, pleasure, etc.

The economic utility of transforming the FDS into an IWPS based on RDF, was determined. The value was calculated using the following formula:

$$\text{Tourism economic value } (\textit{Use Value}) = \sum \text{Economic Value/Scenario 1 and 2 tourism types} \quad \ldots.(1)$$

The economic value of tourism was calculated using the WTP method. In this context, WTP refers to the willingness of an individual to pay for goods and services derived from natural resources and the environment to improve resource quality (Fauzi 2020). This study distributed questionnaires during the interview session to determine the socio-economic characteristics and willingness of respondents to make payment or sacrifices for Eco-edu-park in Cilacap. The diverse stages constituting the WTP method were as follows

1. Explaining the problems related to the development of Eco-edu-park, particularly in waste management solutions to reduce pollution caused by the accumulation in Cilacap Regency.
2. Formulating market hypotheses based on the willingness of the respondents to visit as well as pay for admission to the Eco-edu-park in Cilacap.
3. Determining the auction value (bids) from the submitted hypotheses associated with assessing responses concerning the WTP, thereby allowing for the calculation of the WTP value from respondents.
4. Calculating the average WTP.

The following formula was used to determine the WTP value:

$$MWTP = \sum_{i=1}^{n} (WTP)i \ldots.(2)$$

Note:
MWTP : Average of Willingness to pay
WTPi : The value of i-th WTP
N : Total respondents
i : The i-th respondents who are willing to pay

5. Calculating the economic value of Eco-edu-park was realized by multiplying the average WTP with the total population or respondents. In addition, purposive sampling, and deliberate selection based on predetermined criteria, were adopted. The sample consisted of respondents who met the predetermined criteria for analyzing the WTP based on the respondent's institutional affiliation such as Regional Government Organizations (RGO), the general public, and academics. The selection of criteria was aimed to determine the price preferences for admission tickets to sites that served as educational tourism destinations by respective institutions. The selected respondents were residents who lived within or outside Cilacap Regency but were currently in the area, as evidenced by the Family Card (KK). The respondents were selected from three distinct groups, namely academics, RGOs, and general visitors to capture diverse

perspectives on the potential economic value of Eco-Edu-Park. The number of individuals selected was based on statistical sampling principles, which required a minimum of 30 data points/samples, with the data approaching normal distribution (Walpole 1992).

RESULTS AND DISCUSSION

THE POTENTIAL DEVELOPMENT OF ECO-EDU-PARK TOURISM IN CILACAP IWPS RDF WITH CIRCULAR ECONOMIC BASIS

Several people viewed the FDS as smelly and dirty places. Moreover, it was also assumed that waste had no economic value and must simply be discarded. This perspective should be replaced with a new paradigm, that viewed FDS as clean, environmentally sustainable space, responsible for identifying the economic value of waste as an alternative energy source. Waste was often viewed as valueless material that should simply be discarded. This perspective required a paradigm shift towards identifying FDS as clean, environmentally sustainable facilities, as well as understanding that the economic potential of waste when properly managed and converted into alternative energy or recyclable products.

Several innovations had been introduced to change the perception of FDS conditions in Indonesia. A typical example was the transformation of FDS into recreational and educational spaces for local communities. This entailed the incorporation of environmentally friendly waste management practices that positively impacted both the community and environment. The innovation was evident at the FDS Randegan in Mojokerto City, owned by the local government. Furthermore, the site offered various waste management options that educated the community and also engaged visitors. These individuals were able to witness the waste sorting process directly at Mojokerto's main waste bank. The mission of this bank was to assist local governments in the management process based on the 3R concept (reduce, reuse, recycle), aimed to reduce the amount of waste entering the FDS. This large-scale FDS also served as an effort to empower local communities and create jobs. The FDS Randegan comprised a collaborative facility with the city library and Mojokerto archives office. This facility helped foster an interest in reading, as well as attracted visitors. The public also viewed the creative works produced from the recycling process in the gallery. Visitors could access a photo spot at the top of the FDS Randegan to enjoy panoramic views of the area. Additionally, there was a beautiful garden pavilion for relaxation. The FDS Randegan regularly hosted educational visit programs for elementary, junior, and senior high schools, as well as college students and local community members. During these visits, participants learn about the waste management process and were invited to explore other facilities on the site. The development of FDS Randegan consistently improved waste management practices, including the collection of leachates, used as liquid fertilizer.

Another prominent example of environmentally based educational tourism is the Eco Green Park in Batu, East Java. This facility was operated by the Jatim Park Group, a private enterprise that specialized in tourism and education-based recreation. Meanwhile, Eco Green Park combined concepts of environmental protection, waste management, and renewable energy within an interactive learning environment. It is also part of the Jatim Park Group, a private company that specialized in tourism and entertainment in East Java. The park was established as an educational recreation center that integrated environmental themes, green technology, and nature conservation. The facility offered visitors the opportunity to explore the forest and learn about wildlife. The Eco Science Center also provided various information and interactive experiments that educated visitors on the significance of protecting the Earth. The center featured science demonstrations, which helped visitors understand how renewable energy functioned, including solar, wind, and water power. The Eco Science Center aimed to instill the value of environmentally friendly technology in daily activities. This site showed miniatures and simulations to show how renewable energy technology functioned. The process allowed visitors to witness how these technologies can replace fossil fuels. A water track facility was used to explain the significance of clean water management and the preservation of related resources. The visitors also explored art installations made from waste and recycled materials, such as bottles and plastic. This feature aimed to create awareness about the potential of waste products to be reprocessed into goods with economic value. The diverse offerings, enabled Eco Green Park to serve as a compelling educational destination, thereby raising awareness about environmental sustainability and the implementation of circular economic principles.

The Special Administrative Region of China, Hong Kong, characterized by a disposal site capable of accommodating 1.6 million tons of waste is also a typical example. The Sai Tso Wan disposal site was originally owned by the Hong Kong government through the local environmental protection department. After rehabilitation, the government decided to transform the region into an environmental educational and recreation park, known as the Sai Tso Wan Recreation Area. Currently, it is managed by the Hong Kong Cultural and Recreation Services Department. The main attraction is its use of renewable energy to meet electricity needs. Visitors were compelled to learn about the importance of waste management and use of renewable energy. This was realized through educational walking trails that provided information on recycling, as well as simple steps adopted to reduce waste. Sai Tso Wan was presumed to incorporate environmental and sustainable aspects in its facilities and operations.

The benchmarking method was adopted to identify the best practices and potential strategies for the Eco-Edu-Park RDF Cilacap development. This comparative analysis characterized by selected circular economic-based tourism areas showed the successful integration of waste management, environmental educational, and recreational activities. The specific

sites selected for comparison were FDS Randegan in Mojokerto, a domestic example of a landfill site that integrated waste management with educational and potential tourism development based on sustainability. The circular economic aspect mainly focused on reducing landfill volume through waste segregation and processing, as well as fostering public educational on sustainable management. The Eco Green Park in Batu, East Java, Indonesia was selected as a benchmark due to its success in integrating environmental educational and conservation with engaging tourism attractions. Asides from not being a landfill, it outlined the principles of reduce, reuse, recycle (3R) in its operations and educated visitors on the importance of environmental sustainability, which is highly relevant to the educational concept of the RDF Eco-Edu-Park. Finally, the Sai Tso Wan Disposal Site in Hong Kong was also selected as benchmarking. This international case study was relevant due to its transformation from a former landfill into a green recreational park (Sai Tso Wan Recreation Ground). The project represented successful land reclamation and environmental rehabilitation efforts following the closure of a landfill. It focused on creating green spaces and recreational facilities from a previously contaminated site, which supported the eco-educational park concept for former landfill areas.

The successful transformation of these waste disposal sites into educational tourism destinations showed a paradigm shift that directly supported the viability of the Cilacap Eco-Edu-Park concept. The numerous case studies reported three critical success factors, namely (1) integration of educational components with recreational facilities, (2) strong government or institutional support, and (3) effective community engagement programs. Furthermore, the economic sustainability achieved by the sites, through diversified revenue streams from tourism, educational, and waste processing, led to the formulation of a model using the circular economic method proposed for Cilacap. This evidence suggested that the transformation of waste disposal sites into eco-educational tourism destinations is an environmental initiative as well as economically viable development strategy, responsible for generating substantial community benefits.

The development of Eco-Edu-Park in Cilacap is a crucial step toward educating the public about the significance of waste management and alternative energy, while also introducing the concept of a circular economic. Activities that outlined a sustainable system were essential to fully maximize the potential of the park within the circular economic framework. Various attractions were developed, such as Thematic Parks that educated visitors on waste processing technologies. Additionally, the Kehati Park introduced diverse types of biodiversity as well as served as a campground for visitors, offering a beautiful natural setting. Cultural attractions showcasing local traditions were integrated as educational tools for visitors. Bale Palenggahan was designed to host events, including MICE. Besides being a venue for MICE, Eco-edu-park also served as a location for student field trips, offering interactive educational experiences related to waste management and the application of the circular economic concept.

1 Development Plan for Eco-Edu-Park Tourism

Eco-Edu-Park Tourism is a development plan to transform the IWPS RDF into an educational tourist attraction located in Cilacap Regency. It consisted of several attractions, namely Thematic, and Kehati Parks, Taman Sasana Budaya, as well as Bale Palenggahan. At Thematic Park, visitors enjoyed educational tours focused on waste management and the transformation into environmentally friendly alternative fuels. The attraction could be explored while learning about the waste processing procedure, as explained by a tour guide. At Taman Sasana Budaya and Kehati Park, visitors relaxed, enjoyed the surroundings, and learnt about the local culture as well as biodiversity. After exploring the three previous locations, the visitors rested and enjoyed the facilities at Bale Palenggahan.

The strategic design of the park's attractions reflected a comprehensive method to sustainable tourism development that addressed multiple stakeholder needs. The integration of educational (Thematic Park), recreational (Kehati Park), cultural (Taman Sasana Budaya), and commercial (Bale Palenggahan) components created a general experience that extended beyond traditional waste management awareness. The multi-faceted method ensured long-term sustainability due to diversified revenue streams, appealing to various visitor segments, which led to the reduced dependence on single-purpose tourism. The inclusion of MICE facilities positioned Cilacap as a destination for professional and academic conferences, leading to the potential establishment as a regional hub for sustainability discourse and practice

2 Potential Tourist Segments at Eco-Edu-Park

Eco-Edu-Park comprised several tourist attractions, namely Thematic, and Kehati Parks, Taman Sasana Budaya, including Bale Palenggahan. Based on these attractions, potential visitors to Eco-Edu-Park were individuals who had previously visited other similar attractions in Cilacap Regency, such as Teluk Penyu Beach. Regarding the interview data and field observations, the respondents visited Teluk Penyu Beach on both weekdays and holidays, depending on respondent's job type and place of residence. The visitors working in Cilacap City visited the beach on weekdays and during holidays. Meanwhile, those residing outside the city typically visited only on holidays. The estimated number of visitors generally visiting Teluk Penyu Beach on weekdays exceeded 100, while during holidays, it increased to over 200 people.

The RGO and academics were considered potential visitor groups. These segments played a valuable role, considering the participation in two types of activities related to MICE tourism. In this context, MICE tourism referred to the organized travel for conventions, incentive trips, and exhibitions designed for participants to discuss issues of common interest (Kusuma 2019).

Eco-Edu-Park tourism in respect to the MICE tourism included meetings between academics or RGOs and Focus Group Discussions to analyze and solve a problem. Furthermore, incentive trips were organized as Thematic packages that outlined the RDF (Refuse Derived Fuel) process and other Eco-Edu-Park attractions. The exhibition activities were also carried out at the Taman Sasana Budaya location where visitors learn about local cultures by watching performances

according to the tour packages provided by the event organizer. On weekdays, a minimum of 10 people per RGO division and 95 academics visited Eco-Edu-Park in the mornings or afternoons.

TABLE 1. Percentage of willingness to visit

No	Attractions	Type of Respondent		
		Academition	OPD	General
1	Taman Sasana Budaya (Playing Ground and Culture Centre Park)	60%	41%	60%
2	Kehati Park (Biodiversity Park)	76%	58%	50%
3	Thematic Park	100%	58%	70%
4	Bale Palenggahan (Camping Ground)	76%	76%	73%
5	Bale Palenggahan (Swimming Pool)	60%	47%	36%

Source: Processed Data

The visitor preference data in Table 1 shows significant insights into market segmentation and attraction prioritization for Eco-Edu-Park development. The universal appeal of the Thematic Park among academics (100%) showed strong institutional support for waste management education, which was crucial for establishing credible academic partnerships. The high interest in Kehati Park among academics (76%) compared to general visitors (50%) suggested that biodiversity awareness resonated more strongly with educated professionals. This described the importance of scientific rigor in educational content. However, the relatively lower interest in swimming pools among general visitors (36%) compared to camping facilities (73%) showed a preference for nature-based experiences over conventional recreational amenities. These results suggested that Eco-Edu-Park should prioritize educational and nature-based attractions, as well as maintain recreational facilities as complementary offerings. The consistently high interest across all respondent types in camping facilities (73-76%) showed strong potential for overnight stays, increasing visitor spending and engagement. In accordance with the interviews, the willingness to visit was driven by accessible location, diverse attractions, and high curiosity about the Eco-Edu-Park, describing strong development potential.

ECONOMIC VALUE OF IWPS AS ECO-EDU-PARK

The economic value of using IWPS as the Eco-Edu-Park development was derived from the WTP value of prospective visitors, potential carrying capacity (CC) for each attraction, and number of service days. The attractions planned for visitors included Thematic, and Kehati Parks, Taman Sasana Budaya, Bale Palenggahan, Swimming Pool, as well as Entrance Ticket. Meanwhile, the respondents consisted of general visitors, academics, and RGO, which were used to calculate the WTP value of prospective visitors. Table 2 shows the characteristics of each respondent.

TABLE 2. Respondent characteristics

Characteristics	Respondents		
	General	Academics	Regional Apparatus Organizations
Gender			
a) Male	13	1	8
b) Female	17	5	9
Total	30	6	17
Age			
a) 17-27	11	-	1
b) 28-38	9	-	4
c) 39-49	8	5	4
d) >50	2	1	8
Total	30	6	17
Regional			
a) Cilacap	20	4	15
b) Outside Cilacap	10	2	2
Total	30	6	17
Education			
a) Junior High School	4	-	-
b) Senior High School	21	-	-
c) College	5	6	17
Total	30	6	17
Income			
a) < 1.000.000	10	-	1
b) 1.000.001 – 4.000.000	12	3	3
c) 4.000.001 – 6.000.000	4	2	4
d) 6.000.001 – 10.000.000	2	-	5
e) > 10.000.000	2	1	4
Total	30	6	17

Source: Processed Data

The respondent characteristics, in Table 2, showed important demographic patterns that significantly influenced the economic viability of Eco-Edu-Park. The predominance of local visitors (75% of general visitors and 88% of RGO respondents from Cilacap) showed strong community support and sustainable flow from the immediate region. However,

the limited representation of those from outside Cilacap (only 33% of general visitors) described the need for broader marketing strategies to attract regional and national visitors. The educational profile showed a clear correlation between higher educational levels and institutional affiliation, with all academics and RGO respondents holding college degrees. The general visitors showed more diverse educational backgrounds, suggesting that educational content should be designed with multiple complexity levels to accommodate different related segments. The income distribution showed that RGO respondents had the highest earning capacity (53% earning above IDR 4 million), followed by academics, and general visitors. This stratification directly impacted WTP calculations, implying that pricing strategies should be differentiated to maximize accessibility and ensure economic sustainability.

The carrying capacity (CC) reflected the maximum number of visitors the site could accommodate, considering geographical conditions, infrastructure, and environmental factors. Furthermore, the WTP value was measured to assess respondents' WTP for various attractions. The average WTP represented the number of individuals willing to make payment in order to improve resource quality. The average WTP was multiplied by the CC value and number of service days (considering weekdays/weekends and seasonality) to produce an optimistic economic value projection (Scenario 1). In scenario 2, a more moderate projection was generated based on the percentage of respondents' preferences for specific attractions, multiplied by the average WTP, CC, and service days. A detailed explanation of the CC calculations were shown in Tables 3 and 4.

TABLE 3. Calculation of CC for rdf cilacap eco-edu-park tourist attractions

Type of Attraction	Organizer		Visitor			Carrying Capacity
	Land area m2 (a)	Operational hour (b)	Comfortable area/ people m2 (c)	Visit Time (hour) (d)	Visit Rotation (b/d)=(e)	(a/c)*e
Taman Sasana Budaya (Playing Ground and Culture Centre Park)	200	8	100	4	2	100
Kehati Park (Biodiversity Park)	400	8	400	2	4	400
Bale Palenggahan (Camping Ground)	300	24	60	24	1	60
Thematic Park	200	8	400	1	8	400
Bale Palenggahan (Swimming Pool)	400	8	400	2	4	400

Source: Processed Data

TABLE 4. CC calculation based on cilacap eco-edu-park tourism operational days

Type of Attraction	Carrying Capacity (CC)/Operational Day						
	Monday (a)	Tuesday (b)	Wednesday (c)	Thursday (d)	Friday (e)	Saturday (f)	Sunday (g)
Taman Sasana Budaya (Playing Ground and Culture Centre Park)	0	0	0	0	100	100	100
Kehati Park (Biodiversity Park)	400	400	400	400	400	400	400
Bale Palenggahan (Camping Ground)	0	0	0	0	60	60	0
Thematic Park	0	0	400	0	0	0	0
Bale Palenggahan (Swimming Pool)	400	400	400	400	400	400	400
Total Carrying Capacity (CC)/Operational Day	800	800	1200	800	960	960	900
Carrying Capacity(CC) Admission Ticket (a+b+c+d+e+f+g)/7				917			

Source: Processed Data

In Table 4, the CC for all Eco-Edu-Park attractions was in line with the interviewed respondents, including academics, RGOs, and general visitors. The CC calculations showed critical insights into operational efficiency and revenue optimization. The strategic scheduling of attractions created an uneven distribution of visitor capacity throughout the week, with Wednesday showing the highest potential (1,200 visitors) due to Thematic Park operations. Meanwhile Monday, Tuesday, and Thursday exhibited lower capacities of 800 visitors each. This pattern suggested significant opportunities for revenue optimization through dynamic pricing strategies and promotional campaigns, which targeted underutilized days. The decision to operate Thematic Park only on Wednesdays limited its revenue potential given the high visitor appeal (76% average willingness to visit). The continuous operation of Kehati Park and swimming facilities provided a stable visitor base, with the weekend-focused operation of cultural and camping facilities supporting leisure travel patterns. However, the average daily CC of 917 visitors implied substantial physical infrastructure capacity that could support greater visitor volumes if operational schedules were optimized. This analysis suggested that current operational planning could be conservative and benefitted from increased service frequency for high-demand attractions.

TABLE 5. Average value of WTP

Average Value of WTP/Type of Respondent									
	Regional Apparatus Organizations			Academics			General		
WTP (Rp)	Amount (Person)	Percentage (%)	Total (Rp)	Amount (person)	Percentage (%)	Total (Rp)	Amount (person)	Percentage (%)	Total (Rp)
Admission Ticket of Eco-Edu-Park									
7,000	12	72%	84,000	4	67%	28,000	19	63%	133,000
13,000	1	5%	13,000	2	33%	26,000	6	20%	78,000
18,000	-	-		-	-		4	13%	72,000
23,000	1	5%	23,000	-	-		1	3%	23,000
>28.000	-	-		-	-		-	-	
Lainnya	3	18%		-	-		-	-	
Total	17	100%	120,000	6	100%	54,000	30	99%	306,000
WTP Average			7,059			9,000			10,200
Taman Sasana Budaya (Playing Ground and Culture Centre Park)									
5,000	9	53%	45,000	2	33%	10,000	14	47%	70,000
10,000	5	29%	50,000	3	49%	30,000	11	37%	110,000
15,000	1	5%	15,000	-	-	-	3	9%	45,000
20,000	-	-		1	17%	20,000	2	7%	40,000
30,000	1	5%	30,000	-	-	-	-	-	-
Free	1	5%							
Total	17	97%	140,000	6	99%	60,000	30	100%	265,000
WTP Average			8,235			10,000			8,833
Kehati Park (Biodiversity Park)									
5,000	10	59%	50,000	3	49%	15,000	14	47%	70,000
10,000	5	29%	50,000	2	33%	20,000	7	24%	70,000
15,000	2	12%	30,000	-	-		4	13%	60,000
20,000	-	-	-	1	17%	20,000	4	13%	80,000
25,000	-	-	-	-	-	-	-	-	-
Not Interested	-	-	-	-	-	-	1	3%	-
Total	17	100%	130,000	6	99%	55,000	30	100%	280,000
WTP Average			7,647			9,167			9,333
Bale Palenggahan (Camping Ground)									
10,000	1	5%	10,000	-	-	-	-	-	-
15,000	2	12%	30,000	-	-	-	-	-	-
25,000	1	5%	25,000	-	-	-	-	-	-
30,000	10	61%	300,000	4	66%	120,000	13	43%	390,000
35,000	1	5%	35,000	-	-		4	13%	140,000
40,000	1	5%	40,000	1	17%	40,000	1	3%	40,000
45,000	-	-	-	-	-	-	1	3%	45,000
50,000	1	5%	50,000	-	-	-	2	7%	100,000
Not Interested	-	-	-	1	17%	-	9	30%	-
Total	17	98%	490,000	6	100%	160,000	30	99%	715,000
WTP Average			28,824			26,667			23,833
Thematic Park									
5,000	2	12%	10,000						
10,000	3	18%	30,000	1	17%	10,000	2	7%	20,000
15,000	2	12%	30,000	-	-				
20.000	-	-	-				1	3%	20,000
30,000	9	53%	270,000	5	83%	150,000	19	63%	570,000
35,000	-	-		-	-		5	17%	175,000
40,000	1	5%	40,000	-	-		2	7%	80,000
45,000	-	-					-	-	
50,000	-	-					-	-	
Not Interested							1	3%	
Total	17	100%	380,000	6	100%	160,000	30	100%	865,000
WTP Average			22,353			26,667			28,833
Swimming Pool (Camping Ground)									
5,000	1	5%	5,000						
10,000	3	18%	30,000	2	33%	20,000	1	3%	10,000
20,000	9	53%	180,000	3	49%	60,000	22	74%	440,000
25,000	2	12%	50,000	-	-		6	20%	150,000
30,000	-	-		-	-		-	-	
35,000	-	-		-	-		-	-	
>35,000	-	-		-	-		-	-	
Not Interested	2	12%		1	17%		1	3%	
Total	17	100%	265,000	6	99%	80,000	30	100%	600,000
WTP Average			15,588			13,333			20,000

Source: Processed Data

The average WTP was calculated by initially establishing a baseline value to be offered to visitors, which served as the reference point for this analysis. In this context, the average WTP was determined by multiplying the individual value by the number of respondents. The value obtained was further divided by the overall number of respondents. This calculation provided an estimated mean WTP for each attraction, with the results shown in Table 5.

Based on the Table 5, the respondents were categorized into three groups, namely RGOs, (17 respondents), academics (6 respondents), and general visitors (30 respondents). The assessed attractions within the Eco-Edu-Park comprised Taman Sasana Budaya, Taman Kehati, Camping Ground, Thematic Park, and the Swimming Pool at Bale Palenggahan.

The analysis implied that the average WTP for entrance tickets to the Eco-Edu-Park was within the range of IDR 54,000 to IDR 306,000. The visitors exhibited different levels of WTP, with majority opting for the lowest value to enjoy all the attractions. The average WTP value for each attraction in Taman Sasana Budaya, Taman Kehati, Camping Ground, Thematic Park, and Swimming Pool at Bale Palenggahan were within the ranges of IDR 8,235 - IDR 10,000, IDR 7,647 - IDR 9,333, IDR 23,833 - IDR 28,824, IDR 22,353 - IDR 28,833, and IDR 13,333 - IDR 20,000, respectively. These prices represented the minimum and maximum WTP value that visitors were willing to spend to enjoy the facilities at Eco-Edu-Park. In respect to the results of the WTP, the facilities at Eko-edu-park were categorized into several classes of economic importance. Taman Sasana Budaya and Taman Kehati fell into the low economic importance category, with the swimming pool at Bale Palenggahan grouped under the medium category. Additionally, the camping ground and theme park were categorized under the high economic importance. The average WTP were used to calculate the economic value according to scenario 1, which entailed determining the CC for each attraction. The value was determined by multiplying the CC per attraction by the average WTP. The outcome was adjusted based on seasonality, to obtain the annual economic value. The average WTP was applied when calculating the annual economic value based on visitors' preferences for specific attractions, as proven by the results of the interview. The calculation of the economic value for each scenario were shown in Tables 6 and 7.

TABLE 6. Calculation of economic value for scenario 1

Economic value of scenario 1 (number of visits according to CC)							
Type of Attraction	CC/day	Days of Service/year		WTP Average (Rp)		Economic Value of Tourism/year (Rp)	
		Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Taman Sasana Budaya (Playing Ground and Culture Centre Park)	100	40	80	10,000	8,833	40,000,000	70,666,667
Kehati Park (Biodiversity Park)	400	200	80	9,167	9,333	733,333,333	298,666,667
Bale Palenggahan (Camping Ground)	60	40	40	26,667	23,833	64,000,000	57,200,000
Thematic Park	400	40	0	26,667	28,833	426,666,667	0
Bale Palenggahan (Swimming Pool)	400	200	80	13,333	20,000	1,066,666,667	640,000,000
Admission Ticket	860	200	80	8,753	8,753	1,505,505,882	602,202,353
Economic value of tourism value (seasonality) (Rp)						3,836,172,549	1,668,735,686
Economic value of tourism value (seasonality)/year (Rp)						5,504,908,235	

Source: Processed Data

TABLE 7. Calculation of economic value for scenario 2

Economic Value For Scenario 2 (number of visits according to tourist preferences)							
Type of Attraction	CC/day	Days of Service/year		WTP Average (Rp)		Economic Value of Tourism/year (Rp)	
		Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Taman Sasana Budaya (Playing Ground and Culture Centre Park)	99	40	80	10,000	8,833	39,600,000	69,960,000
Kehati Park (Biodiversity Park)	400	200	80	9,167	9,333	733,333,333	298,666,667
Bale Palenggahan (Camping Ground)	59	40	40	26,667	23,833	63,360,000	56,628,000
Thematic Park	400	40	0	26,667	23,833	426,666,667	0
Bale Palenggahan (Swimming Pool)	400	200	80	13,333	20,000	1,066,666,667	640,000,000
Admission Ticket	860	200	80	8,753	8,753	1,505,516,000	602,206,400
Economic value of tourism value (seasonality) (Rp)						3,835,142,667	1,667,461,067
Economic value of tourism value (seasonality)/year (Rp)						5,502,603,733	

Source: Processed Data

Following the calculated economic value to produce an optimistic projection, the maximum potential income was obtained by considering the physical capacity of the location and the visitors' WTP (scenario 1). In Scenario 2, the economic value projection was in line with the percentage of respondents' preferences for specific tourist attractions. This value was multiplied by the average WTP, CC for each attraction, and number of service days, considering the seasonality (weekdays and weekends) and respondent. The entire procedure resulted in a more moderate economic value projection.

CONCLUSION AND RECOMMENDATION

In conclusion, the development of the Cilacap RDF Eco-Edu-Park was a significant step in educating the public about the relevance of effective and efficient waste management based on circular economic principles. Furthermore, this project served as a promotional tool for sustainable local tourism. The combination of educational tourism with cultural experiences,

enabled the Cilacap RDF Eco-Edu-Park to change the public's perspective on waste, thereby creating environmental awareness. Marketing strategies through social media and the official website must be strengthened, to attract more visitors. The presentation of engaging content such as educational videos, documentation of tourist attractions, and visitor testimonials enhanced the appeal of the Eco-Edu-Park. The development of a digital tour guide and informational media also facilitated visitors' exploration of the park, providing awareness on waste management, renewable energy, as well as understanding the circular economic. The potential of Eco-Edu-Park as a MICE tourism destination and integrated educational program for related institutions should be promoted by offering special packages to attract visitors.

Based on the calculation of the tourism economic value, two scenarios were identified. The results showed that the TEV of tourism per year for scenario 1 was Rp5,504,908,235. Meanwhile, the TEV of tourism per year for scenario 2 was Rp5,502,603,733 which showed there were differences in interests or preferences between respondents. This led to different insignificant value in the TEV of tourism. To increase Eco-Edu-Park tourism revenue, certain efforts were required to change the schedule of Thematic Park attraction which was previously only opened on Wednesdays. This included the opening on a daily basis to generate Eco-Edu-Park tourism revenue and potential visitors whose interest in Thematic Parks was not perceived as an obstacle.

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