

Advancing bicycle tourism in Polonnaruwa for a sustainable and low-carbon travel experience

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Abstract

The sustainable tourism concept is widely disseminated and increasingly recognized as an essential strategy for long-term economic development, which also focuses on preserving natural and cultural heritage. Within this broader context, low-carbon travel options, such as bicycle tourism, hold a significant position in heritage-rich destinations like Sri Lanka's Cultural Triangle, offering a unique opportunity to minimize the negative impacts and maximize the positive impacts of the tourism industry. The growth scenario of bicycle tourism in Polonnaruwa, a UNESCO World Heritage site and a key site in Sri Lanka's cultural triangle, lacks adequate dedicated infrastructure, supporting services, and a clear strategic vision. This study aims to investigate the key barriers and opportunities for bicycle tourism within the rich archaeological landscapes in Polonnaruwa. It aims to propose a comprehensive strategy to promote this region as a destination for sustainable heritage travel. This proposed framework focuses on integrating three major pillars: first, addressing deficiencies in organizing bicycle tours to enhance quality service; second, fostering community engagement by involving local community in the supply chain; third, implementing a target marketing strategy to position Polonnaruwa as a premier destination for bicycle tourism. This study will follow an exploratory case study in Polonnaruwa. The planned methodology is designed to conduct direct observations, intercept interviews with international tourists, and semi-structured interviews with local tourism stakeholders. Findings revealed considerable deficiencies in the current organization of bicycle tourism in Polonnaruwa.

Keywords: Bicycle Tourism, Sustainable Tourism, Community-Based Tourism, Polonnaruwa

1.0 Introduction

Jeremy Smith states that sustainable travel is not about sacrificing comfort; but about gaining experience (Team, 2020). Moreover, low-carbon transportation has increasingly become a global trend, and making individual behavior adjustments can significantly reduce greenhouse gas emissions. In fact, the low-carbon travel behavior (LTB) of passengers is a fundamental factor that influences the expansion of low-carbon transportation (Wang et al., 2023). Additionally, a 2024 survey by Booking.com found that 75% of global travelers want to travel

more sustainably in 2025, while 62% believe that sustainable travel adds higher value to their experience... Consequently, Sri Lankan businesses were integrating low-carbon travel options into their product lines (Climate change story, 2024). Furthermore, non-motorized travel, which includes walking and cycling, is characterized by a zero-carbon footprint when focusing solely on the act of travel (DING et al., 2025)

Polonnaruwa, as a major UNESCO world heritage site in Sri Lanka highlights why the promotion of sustainable travel is important. This iconic tourist destination holds a significant position in developing its bicycle tourism.

Given these circumstances, this study focuses on investigating barriers and opportunities for bicycle tourism in Polonnaruwa. To position Polonnaruwa as a prime destination for bicycle tourism, this seeks to examine three major pillars such as service quality deficiencies of existing bicycle rental services, potential for higher community engagement, and effective marketing strategies to promote sustainable heritage travel in Polonnaruwa. Moreover, this study intends to offer a framework for encouraging low-carbon tourism while assisting with local livelihoods and cultural preservation by combining these three crucial aspects.

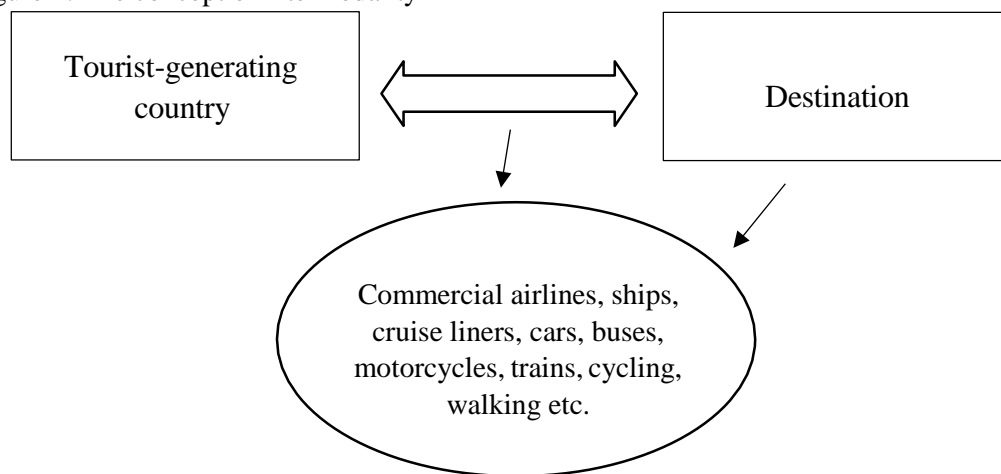
2.0 Literature Review

Tourism, a vital component of global economic activities, has witnessed unprecedented growth over the years, emerging as a key driver of economic development for many nations. However, this surge in tourism has not been without consequences, particularly concerning its environmental impact. The quest for Sustainable Tourism Development (STD) has gained prominence as a compelling paradigm to reconcile the economic benefits of tourism with the imperative of environmental conservation (Gupta et al., 2024). According to the United Nations World Tourism Organization, Sustainable tourism is the tourism that takes full account of its current and future economic, social, and environmental impacts, addressing the needs of visitors, the industry, the environment, and host communities (UN Tourism, 2005).

A key challenge to sustainable tourism is that it has significantly contributed to global carbon emissions (Niyommaneerat et al., 2024). For instance, UNEP and the World Meteorological Organization (WMO) in 2008 indicated that Travel & Tourism associated greenhouse gas emissions were estimated to be around 5% (1304 Mt) of global emissions in 2005. This figure included the emissions of three industries: transportation, accommodation, and other Travel & Tourism activities (A Net Zero Roadmap for Travel & Tourism, 2024), which clearly emphasizes how transportation impacts sustainable tourism. Therefore, previous studies have demonstrated the importance of low-carbon travel in achieving sustainable tourism development goals. In particular, low-carbon travel, which means daily travel, adopting more energy-efficient and environmentally friendly modes like public transport, cycling, and walking, is an important path to save energy and reduce emissions in the transportation sector (Wang & Lin, 2024).

Within this context of low-carbon travel, Intermodality is an important aspect for a region to offer a sustainable transport chain. Since every mode of transport has its advantages and limits, the combination provides a good solution to avoid unnecessary pollution due to motorized individual traffic. (Aschauer et al., 2021). Furthermore, Aschauer et al. (2021) define intermodality as the use of a combination of transport modes for a single journey. In this context, bicycle tourism can be integrated as a sustainable mode within the intermodal system. CONEBI (Confederation of the European Bicycle Industry) defines Bicycle tourism as a leisure travel that uses a bicycle to explore destinations, offering a sustainable, healthy, and eco-friendly way to see the world.

Figure 1: The concept of intermodality



Source: Authors constructed

3.0 Methodology

3.1 Research Design and Approach

This study conducted a thorough case study based on the existing role of bicycle tourism in Polonnaruwa using a qualitative exploratory case design. This method was chosen as the most suitable method to comprehend real-world barriers and opportunities to address the research objectives.

Data was gathered by following a mixed methods strategy to ensure a comprehensive analysis. Insights from direct observations and interviews are given priority in this qualitative study approach, which is supplemented by a small-scale visitor survey. This combination makes it possible to triangulate data, which improves the validity of the findings and offers a solid basis for the suggested strategy.

3.2 Study Area

The data collection was conducted within the Polonnaruwa archaeological site, a designated world heritage site situated in the North Central Province of Sri Lanka.

The geographical boundaries for the collection of data were specifically defined with the typical tourist experience. Field observations were primarily conducted along the main tourist route, starting from Pothgul Vihara complex, extending along the Parakrama Samudra Bund, and covering major archaeological sites up to Gal Vihara (Figure 2). This route was selected as representing the primary path taken by most tourists, including those on bicycles, and encompasses the main locations of bicycle rental services. By focusing on this corridor, this study was able to capture the most relevant interactions and procedures relevant to bicycle tourism within the heritage site.

Figure 2: Data collection area starting from Pothgul vihara to Gal vihara



Source: (Lanka, 2024)

3.3 Data Collection Methods

Three complementary techniques were used to gather primary data for this study: direct observation, a tourist survey, and semi-structured interviews.

Semi-structured interviews were conducted with all four primary bicycle vendors operating at the site, representing a census of this key stakeholder group. These suppliers were selected as they are also community members, which offers valuable perspectives on both service quality

deficiencies (Pillar 1) and community engagement opportunities (Pillar 2). The interviews followed an open-ended and flexible format to discuss their business operations and challenges.

A short tourist survey was given to 10 randomly selected tourists using an intercept survey method. The questionnaire was designed to quickly collect data on tourists' perception of service quality of the existing bicycle tourism and their motivations, which would directly inform pillars 1 and 3.

Lastly, over the course of four days, direct observation was carried out at strategic areas, such as bicycle rental points and important archaeological sites. This method was used to collect the real-world process of bicycle rental, the interests of tourists, tourist flow, and vendor-tourist interaction. Photographs and field notes were taken to record and document these direct observations, providing rich contextual data for all three study pillars.

3.4 Data Analysis

The data gathered for this study were analysed by utilizing both quantitative and qualitative methodologies to provide an in-depth understanding of bicycle tourism in Polonnaruwa.

Qualitative Data Analysis

A thematic analysis technique was employed for all qualitative data, which was gathered from two main sources: the semi-structured interviews with bicycle vendors and the open-ended questions in the tourist survey.

The analysis process of the semi-structured interview with four bicycle vendors mainly focused on identifying their key business challenges, how they interpret tourists' demands, and what their future goals are. The interview transcripts were systematically analyzed to extract key themes related to growth opportunities, operational challenges, service quality gaps, and potential to increase community involvement. Important “supply-side” insights were obtained from this. Simultaneously, the written responses to the open-ended tourist survey questions were analyzed to comprehend the “demand side” perspective on challenges and desired enhancements.

Finally, the themes from visitor surveys and vendor interviews were combined and directly mapped onto the three main research pillars: service deficiencies, community engagement, and marketing strategy. This method made it possible to evaluate the qualitative data in a systematic way that directly addressed the main goals of the study.

Quantitative Data Analysis

Simple descriptive statistics were employed to analyse the quantitative data gathered from the closed-ended questions in the tourist survey. To summarize the results and highlight important trends, this required computing frequencies and percentages. For instance, the study calculated the percentage of tourists who rated their experience as “Excellent” or “Good”, the frequency of challenges faced, such as “lack of proper signboards”, and the proportion of tourists interested in purchasing local products. To support and collaborate with the detailed qualitative findings, this statistical summary provided a clear quantitative overview of tourist demographics, behaviors, and perceptions.

3.5 Ethical considerations

This study was conducted in strict adherence to ethical principles. All participants were given a clear explanation of the study goals and made aware that participation was entirely voluntary. The positionality of the authors connected to the Department of Archaeology, University of Kelaniya, was a crucial component of the fieldwork. The department's concurrent excavation work at the Polonnaruwa site provided a familiar and trusted context for the research. Every engagement was carried out professionally and with consideration for the participants' time and knowledge. Participants were informed that the collected data will be utilized for academic research purposes.

4.0 Findings

This chapter presents the findings of four days of fieldwork in Polonnaruwa. Direct field observations, interviews with bicycle vendors, and visitor questionnaires were used to gather data.

4.1 Visitor interviews

The demographic profile of the tourist survey participants is presented in the figures below. Italian tourists made up the highest percentage of participants by nationality (40%), followed by Russian and Indian tourists (20%) and Spanish and French participants (10%) (Figure 4). In terms of Gender, 40% of participants were male and 60% of participants were female; there was no representation in the “other” category (Figure 3). In terms of age distribution, 20% of people were under 20, 30% were between 21 and 30, 40% were between 31 and 40, none were between 41 and 50, and 10% were above 51 (Figure 5).

Figure 3: Gender of the tourists

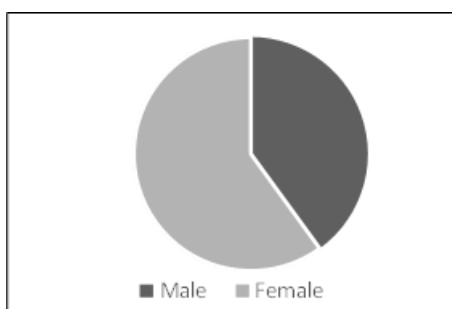


Figure 4: Nationality of the tourists

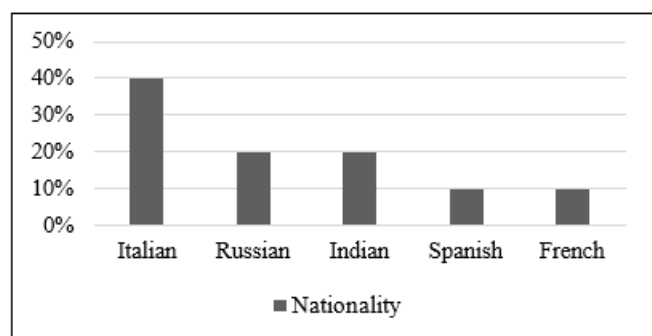
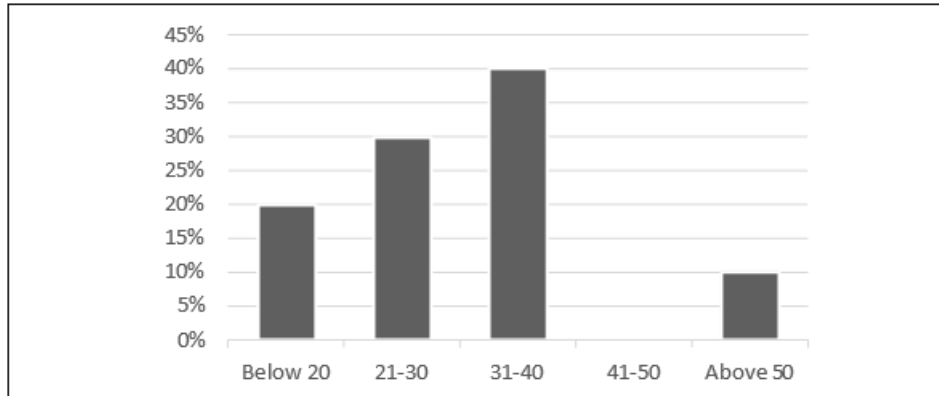


Figure 5: Age range of the tourists



Source: Authors constructed from the data gathered

There were fifteen questions in the survey that addressed both quantitative and qualitative aspects. The quantitative findings were focused on ratings of services, sustainable practices, existing facilities, challenges, and overall experiences along with visitor preferences for bicycle rental alternatives, pricing, and site navigation. Open-ended questions generated qualitative answers, providing insights into suggestions for improving bicycle tourism in Polonnaruwa.

4.2 Key themes for vendor interviews (Organized by three research pillars)

Only four vendors operate bicycle rentals in Polonnaruwa, with around 200 bicycles available and small lorries for transportation. Conflicts around vendors, excessive commissions asked by tourist guides, theft, dependence on brokers, lack of a fixed pricing system, seasonal declines in income generation, and poor maintenance of bicycles were key issues.

Pillar 1 - They suggested a recommended service quality system, stronger travel agency partnership opportunities, and standardized pricing.

Pillar 2 – Vendors were willing to collaboratively work with other local businesses through joint promotions, partnerships, and integrated visitor experiences.

Pillar 3 – They expected government endorsements, eco-certifications, joint cooperative promotions (Especially with travel agencies), and integration into larger bicycle tour networks.

4.3 Direct observation findings

Direct field observations revealed that both strengths and weaknesses can be seen in the current state of bicycle tourism in Polonnaruwa.

- (i) Infrastructure and processes

Pathways at the site are suited for cycling (Figure 6), showing strong potential for bicycle tourism. Night cycling till 10 pm could be introduced as a unique experience, but vendors close by 4 pm. Although the dockless approach is more convenient, it demands the use of trucks to pick up bicycles (Figure 6), which increases carbon emissions.

(ii) Tourist experience and safety

Limited safety gear (Helmets, Knee guards, etc.) (Figure 8), some paths which are not suitable to ride bikes, Poor signage and maps (Mostly in Sinhala) (Figure 9), lack of water points, and poor maintenance of bicycles can be seen as challenges to enhance visitor experiences. The dockless system also gets confused when bikes are taken mistakenly.

(iii) Environmental and operational concerns

Travel agency vehicles follow cyclists (Figure 10) and vendors go by lorries to collect dockless bicycles (Figure 7) and increase carbon emissions. Shared roads with large buses further raise safety risks and reduce appeal.

Figure 6: The main cycling pathway



Figure 7: Transportation of dockless bicycles



Figure 8: Limited safety gears



Figure 9: Poor road signage boards



Figure 10: Travel agency vehicle following cyclists



Source: Onsite field observations

4.4 Government and institutional issues

The central cultural fund (CCF), together with the Department of Archaeology regulates the overall management of the Polonnaruwa heritage site under the UNESCO guidelines. However, field observations revealed several shortcomings in the organizational intervention in the development of bicycle tourism as below.

Pathways and safety infrastructure - The possibility of nighttime cycling tours is limited by the lack of path lighting system; pathways are lack of directions for bicycles. The safety of cyclists is further reduced by problems like pits monkeys' movements on the road, lack of road guidelines and first aid facilities.

Need for a clear masterplan – Currently, bicycle tourism in Polonnaruwa primarily operates as a daily income generating service with no clear long-term plan. The lack of a proper master plan implement by the government limits the development of bicycle tourism as an organized sustainable business model.

Safety and accessibility – Safety equipment and well-equipped bicycles continue to be expensive for suppliers. The absence of government in the form of financial aid or loan schemes limits the vendors' capacity to upgrade their offerings and ensure visitor safety.

Other crucial facilities – Some basic visitor facilities such as proper resting areas, faded sign boards, water filter facilities reduce the comfort and accessibility for cyclists.

5.0 Conclusions & Recommendations

The study highlights the three key findings regarding bicycle tourism in Polonnaruwa that directly connect the three major objectives (3 Pillars) of the research. Pillar 1 showcases the deficiencies in service quality, such as conflicts among vendors, inconsistent pricing, poor maintenance of bicycles, inefficient travel voucher system, and lack of safety gears have impacted traveller experience, and limited growth. Regarding pillar 2, while vendors are willing to collaborate with other local businesses, the community engagement is underutilized. There's a huge opportunity for vendors to join with local food vendors, handicraft sellers, homestay providers, and guides. Providing sufficient training and awareness on sustainable practices and maintenance of bicycles could also be considered. Additionally, pillar 3 emphasizes the need for a targeted marketing strategy. Marketing efforts are inadequate to promote bicycle tourism at the premises. Institutional support in the form of eco-certification branding, advertising campaigns highlights the cultural, ecological, and experiential value of cycling at Polonnaruwa, and integration into broader tour networks, such as village tours, has not been successfully put into practice.

Beyond the three key pillars, the study highlights the stronger institutional support. Bicycle tourism in Polonnaruwa cannot reach its full potential without active intervention of Central Cultural Fund (CCF) and Department of Archaeology. Respective authorities should

- Create a comprehensive masterplan that incorporates community engagement, quality services and infrastructure
- Improve pathways and safety measures such as well maintaining the pathways, first aid stations, lighting, specified parking areas and sign boards
- Make sure the site has the basic amenities such as water filters, resting places, multilingual signages and road maps (can be included in the visitor ticket)
- Strict guidelines should prohibited lorries from collecting dockless bicycles and should limit the ability of travel agency vehicles to follow cyclists, at the end of the route tourists should return their own bicycle
- Providing financial support for vendors to improve their service quality

With well coordinated government support, community engagement and vendor initiatives Polonnaruwa can become a prime destination for sustainable and low-carbon heritage travel. Moreover, future studies should evaluate the feasibility of the above recommended suggestions.

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