Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

69

Developing Low - carbon Homestays in Ban Tham Sua Using the Analytic Hierarchy Process (AHP)
การพัฒนาโฮมสเตย์คาร์บอนต่ำบ้านถ้ำเสือโดยการใช้กระบวนการวิเคราะห์ตามลำดับชั้น

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Abstract

This study aimed at investigating the factors influencing the establishment of low - carbon homestays and provide guidelines for this type of lodging to guarantee the sustainability of homestays after the COVID - 19 pandemic. Using those critical factors identified in the previous literature reviews, ten (10) stakeholders were interviewed within the context of homestays to gather data. Using the Analytical Hierarchy Process (AHP), the researchers entrusted the participants with identifying the crucial factors for the survival of their low - carbon homestays. Then the data analysis has allowed the researchers to figure out the relative importance of each factor. According to our findings, the establishment of low - carbon homestays in the Ban Tham Sua community can be divided into three primary categories. With a score of 66.65%, policy and waste management was the most significant factor, followed by water and energy management with a weightage of 24.07%. While tourism activity and transportation was the least significant factor with only a weightage of 9.29%. Hence, by using the aforementioned data, it is expected that the owners of homestays will be able to navigate critical factors and operate their businesses parallel with a low - carbon mindset in the future. In general, the results of this study will be beneficial for the stakeholders in the context of homestays or other types of accommodations, as they provide insights and guidelines regarding the vital critical factors in operating a successful low - carbon homestay.

Keywords: Analytic Hierarchy Process (AHP), Homestays, Low - carbon, Policy and Waste Management, Water and Energy Management, Tourism Activity and Transportation

70

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamananda, P.

บทคัดย่อ

งานวิจัยนี้สำรวจการพัฒนาโฮมสเตย์คาร์บอนต่ำในชุมชนบ้านถ้ำเสือ จังหวัดเพชรบุรี โดยใช้กระบวนการ
วิเคราะห์ตามลำดับชั้น (AHP) เป็นแนวทางหลัก เพื่อตอบสนองต่อภูมิทัศน์ที่เปลี่ยนแปลงไปของการท่องเที่ยว
และความจำเป็นในการนำแนวทางปฏิบัติที่ยั่งยืนมาใช้หลังสถานการณ์โควิด-19 การศึกษานี้มีวัตถุประสงค์เพื่อ
ระบุและจัดลำดับความสำคัญของปัจจัยที่สำคัญในการสร้างที่พักแบบโฮมสเตย์ที่รับผิดชอบต่อสิ่งแวดล้อม ระเบียบ
วิธีวิจัยนี้จะรวมข้อมูลเชิงคุณภาพที่รวบรวมผ่านการสัมภาษณ์ผู้มีส่วนได้ส่วนเสียเข้ากับการวิเคราะห์เชิงปริมาณ
โดยใช้กระบวนการวิเคราะห์ตามลำดับชั้น (AHP) ด้วยแนวทางบูรณาการนี้ การศึกษาได้เปิดเผยองค์ประกอบ
สำคัญที่กำหนดความยั่งยืนของโฮมสเตย์ที่มีคาร์บอนต่ำ ข้อมูลถูกรวบรวมโดยการสัมภาษณ์ผู้มีส่วนได้ส่วนเสีย
10 รายในบริบทของโฮมสเตย์ โดยใช้ปัจจัยสำคัญที่ระบุในวรรณกรรม กระบวนการวิเคราะห์ตามลำดับชั้น (AHP)
ผู้เข้าร่วมได้ระบุปัจจัยสำคัญสำหรับการดำรงอยู่ของโฮมสเตย์ที่มีคาร์บอนต่ำ ทำให้สามารถประเมินความสัมพันธ์
ของความสำคัญแต่ละปัจจัยได้ การจัดตั้งโฮมสเตย์แบบคาร์บอนต่ำในชุมชนบ้านถ้ำเสือแบ่งได้เป็น 3 ประเภท
หลัก ปัจจัยที่สำคัญที่สุดด้วยคะแนนร้อยละ 66.65 คือ การจัดการนโยบายและการจัดการขยะ รองลงมาคือ
การจัดการน้ำและพลังงาน ร้อยละ 24.07 และกิจกรรมการท่องเที่ยวและการคมนาคมมีน้ำหนักน้อยที่สุดที่
ร้อยละ 9.28 ข้อมูลนี้ช่วยให้เจ้าของโฮมสเตย์ได้รับข้อมูลเชิงลึกที่จำเป็นเพื่อสำรวจปัจจัยสำคัญและดำเนินธุรกิจ
ด้วยกรอบความคิดคาร์บอนต่ำ โดยรวมแล้ว ข้อค้นพบจากการศึกษาของเราจะพิสูจน์ว่ามีคุณค่าสำหรับผู้มี
ส่วนได้ส่วนเสียในธุรกิจโฮมสเตย์และที่พักแรมประเภทอื่น ๆ ให้ข้อมูลเชิงลึกและแนวทางอันมีค่าเกี่ยวกับปัจจัย
สำคัญที่จำเป็นต่อความสำเร็จของการดำเนินงานโฮมสเตย์แบบคาร์บอนต่ำ

คำสำคัญ: กระบวนการวิเคราะห์ตามลำดับชั้น, การจัดการน้ำและพลังงาน, กิจกรรมการท่องเที่ยวและการขนส่ง,
คาร์บอนต่ำ, นโยบายและการจัดการของเสีย, โฮมสเตย์

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

71

Introduction

Before the COVID-19 epidemic, tourism was one of the fastest-growing businesses in the world, contributing 10.3 % to GDP (WTTC Economic Impact Reports, 2019) and boosting growth. The tourism industry however has the potential to become a major source of greenhouse gas emissions (Adedoyin & Bekun, 2020), a larger energy user (Arenhart, Souza & Zanini, 2022) and environmental degradation due to its high demand on energy and other natural resources (Gössling, 2013). Specifically, the Earth's global surface temperature has risen by around 1.1 degrees Celsius (°C) since the preindustrial average, raising the frequency and severity of extreme weather occurrences. As part of the tourism industry, hotels are significant energy producers. Hotels and other lodging buildings account for 21% of the tourism industry's overall GHG emissions. The relationship between tourism including an accommodation sector and climate change has been the topic of discussion for several years (Hoogendoorn & Fitchett, 2016). Therefore, this study examines low - carbon accommodations, particularly in homestays as a crucial implementation to minimize carbon emission.

Hotels have the highest energy consumption intensity and that international tourism has a positive impact on energy consumption, which should prompt an emphasis on the development and utilization of renewable energy (Khanal & Rahman, 2021). The majority of this energy is derived from fossil fuels, and it is estimated that the hotel industry contributes between 160 and 200kg of CO_2 per square meter of room floor space annually, depending on the fuel mix utilized to provide energy. Understanding energy consumption is especially essential for the tourism industry, as the high cost of energy has a direct impact on room rates and the ultimate profitability of firms. Numerous research on energy and water use in hotels have been conducted over the past two decades, with the majority of studies focusing on electricity usage, some analyzing fuel consumption, and few confirming water consumptions (Eddine & Amara, 2021). The results revealed various factors that affect energy use, including star rating, room nights, occupancy, revenue, and hotel common areas.

Due to the severity of the climate change challenge, all sectors of the economy are reorienting their business operations to incorporate environmental preservation into their core values. In addition, several international standards and regulations are in place to monitor the tourism industry's compliance with environmental regulations such as the Energy Conservation and Carbon Reduction (ECCR), EarthCheck, the Green Seal Environmental Standard, the Green Tourism Business Scheme (GTBS) and Green Globe. Similarly, the Green Leaf Standard and the Green Hotel standard are two environmental standards utilized by the hospitality industry in Thailand. However, tourism and hotel industries are regarded as sectors with the greatest negative environmental impact (McLennan, Spagnoletti, & Hockings, 2017) while international tourists are more likely to select hotels that are environmentally friendly and have received awards (Yadegaridehkordi, Shuib, Nilashi, & Asadi, 2019; Choi, Jang, & Kandampully, 2015).

The selection of "Ban Tham Sua" as the main focus of this study is justified by the fact that it is a "Low - Carbon Tourism Community" model located at the entrance of the Phetchaburi

72

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

River. Clearly, this community effectively adheres to the BCG Model's governing principles for effective tourism management. Utilizing its natural resources as a foundation for these initiatives, the community entices visitors to engage in immersive ecotourism experiences within a lush forest ecosystem. Notably, the community has adopted a strategic approach to low - carbon tourism, emphasizing sustainable practices while reducing its carbon imprint. Exploration of this innovative model has the potential to elucidate transferable strategies applicable to comparable locales. In conclusion, the decision to examine the "Ban Tham Sua" community's "Low - Carbon Tourism Community" success model within the parameters of the BCG Model's guiding principles stems from its pioneering efforts in the fields of tourism, ecological consciousness, and communal advancement. Through a thorough examination of these aspects, substantial insights that are conducive to the development of sustainable and ethically - conscious tourism practices will be obtained.

Research Objective

To examine the factors that influence the establishment of low - carbon homestays and to provide guidelines for this type of accommodations.

Literature Review

From the growing influx of tourists, an increasing number of cities worldwide feature a substantial proliferation of hotel buildings (Nguyen & Rockwood, 2019). Across various countries and urban centers, tourism resorts are a common presence, and within the broader tourism industry value chain, hotels and resorts are vital participants (Vatan & Yilmaz, 2020). Hotels, resorts, and homestays have a range of adverse environmental impacts. They are known for their substantial consumption of resources, particularly in the form of energy and water. The primary environmental concerns linked to the operation of them include their significant energy usage, extensive water consumption, and the emission of carbon dioxide (CO_2) as a byproduct of their operations (Baxter & Srisaeng, 2021).

Several prior studies have analyzed and deliberated on the energy consumption, including CO_2 emissions, associated with tourism, considering the transportation, lodging, and recreational activities of tourists. The equilibrium between accommodation supply and demand plays a pivotal role in the tourism industry, especially for trips involving overnight stays. It is essential to investigate homestay energy usage and CO_2 emissions, as tourists have a high degree of independence when it comes to choosing accommodations with various amenities and service tiers (Tsai, Lin, Hwang, & Huang, 2014). Many studies posit that sustainable development and management can help reduce CO_2 emissions through effective energy and environmental management policies and related standards/indicators/guidelines can also help reduce carbon emissions. Low - carbon tourism, a branch of the low - carbon economy, is a variant of eco - tourism that emphasizes minimal pollution, reduced power consumption, and limited emissions. Its objectives are to enhance the quality of tourism services, preserve local ecosystems and cultures,

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

73

and offer positive benefits to the local population (Nitisoravut, Sangsnit, Dhiralaksh, & Nitivattananon, 2014).

Low - carbon Tourism and Community

Low - carbon tourism has shown a boom around the world over the years. Low - carbon tourism is a new concept proposed recently in 2009 as a form of sustainable tourism that aims to achieve maximum tourism experience with a new way of travel plan for the tourist and tourism industry to acquire higher social, economic, and environmental benefits for our society by reducing carbon emissions occurred in tourists' activities (Wang, Mao, Xian, & Liang, 2019). Cheng, Su, and Tan (2013) established a system of indicators to evaluate the low - carbon development of tourist attractions. Although there are significant differences between tourist attractions and urban tourism destinations, the dimensions of the eco - environment, tourist facilities, management system, and participant attitudes could still provide an adequate indicator framework for evaluating low - carbon development. Carbon dioxide emissions are due to energy consumption in transportation, operation, and development of infrastructures. Some examples are hotel construction, airways, roadways, railways, heating and cooling equipment, and other leisure activities.

Low - carbon tourism is regarded as a facet of sustainable tourism that strives to optimize the tourist experience through the utilization of low - carbon technologies, reduced energy consumption, minimized CO_2 emissions, and diminished pollution throughout the entire spectrum of transportation, lodging, sightseeing, and other leisure activities. This approach seeks to attain economic, social, and environmental benefits (Su, 2019). Carbon dioxide emissions attributed to the tourism industry encompass emissions resulting from various sources such as food wastage, aviation, transportation, accommodation, and recreational activities as well as energy consumption within tourism, travel processes, sightseeing, dining, and tourist behavior (Rico, Martínez - Blanco, Montlleó, Rodríguez, Tavares, Arias & Oliver - Solà, 2019). Carbon dioxide emissions in tourism can be categorized into two types: direct emissions, which result from fuel and energy consumption, accommodation operations, electricity, or gas usage, as well as various tourist activities; and indirect emissions, which arise from the energy generation and transportation infrastructure, the production of vehicles, and the construction of accommodation or restaurant facilities (Bhaktikul, Aroonsrimorakot, Laiphrakpam, & Paisantanaki, 2021).

Low - carbon Accommodation

Accommodation plays a pivotal role in the tourism value chain and contributes significantly to the sector's greenhouse gas emissions. Accommodation facilities are a fundamental component of the tourism sector, and their quantity has consistently expanded in tandem with the rise in international and domestic tourism (Gossling & Lund - Durlacher, 2021). Gossling & Peeters (2015) determined that the tourism sector accounts for 21% of CO_2 emissions when considering transportation, accommodation, and activities. On a global average, it is estimated that each guest night results in emissions of 14 kg of CO_2, primarily from direct energy - related sources, excluding gastronomy. Hotels are frequently regarded as some of the most energy - intensive

74 Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

buildings in many nations (Warren & Becken, 2017). Older hotel buildings are more energy - intense, attributed to the quality of building materials and construction techniques used in the past and to national/regional/local building regulations (Penner, Adams, & Robson, 2013). Moreover, guests also play an important role in energy use. This is because there is evidence that some races have expectations that lead to increased energy expenditure (Gossling, Araña, & Aguiar - Quintana, 2019).

The increasing global attention to environmental issues, and the impact of residential energy consumption, which is the terminal link of national energy consumption, on the environment has aroused widespread concern among researchers. In fact, the energy consumption of residents has now become an important source of global energy demand growth and carbon emissions growth (IEA, 2017; 2016; Nejat, Jomehzadeh, Taheri, Gohari, & Majid, 2015).

Climate change problems have become a worldwide concern. A low - carbon economy is an unavoidable choice for realizing sustainable development. In response to this recognition, there has been a proliferation of theories and policies aimed at driving tourism towards 'low - carbon tourism'. The problem becomes even greater if turning to cities. Numerous urban tourism destinations have been significantly affected by carbon dioxide (CO_2) emissions and the resulting climate policies (Zhang & Zhang, 2020). Air is the contamination of air by smoke particles and harmful gases. They are mainly carbon oxides, nitrogen, and sulfur. Some examples of air pollution include:

- The burning of fossil fuels like oil, gas, or coal
- The exhaust fumes from your vehicles
- The mismanagement of landfill waste caused by garbage pollution.
- The harmful fragrance or off - gassing from plastic production, paints and so on
- Nuclear accidents or radiation spills

For carbon dioxide emissions we find evidence that population increases are matched by proportional increases in emissions while a higher urbanization rate and lower average household size increase emissions. For sulfur dioxide emissions, we find a U - shaped relationship, with the population - emissions elasticity rising at higher population levels (Cole & Neumayer, 2004). They are all caused by waste, and the only cure is through growing forests and just a lot of trees everywhere.

Factor that Influences Low - carbon Homestay

Water is an essential resource for human survival. According to the 2021 World Water Development Report released by UNESCO, the global use of freshwater has increased six - fold in the past 100 years and has been growing by about 1% per year since the 1980s. With the increase of water consumption, water quality is facing severe challenges. Industrialization, agricultural production, and urban life have resulted in the degradation and pollution of the environment, adversely affecting the water bodies (rivers and oceans) necessary for life, ultimately affecting human health and sustainable social development (Xu, Yang, & Li, 2022). Factors like precipitation, climate, soil type, vegetation, geology, flow conditions, groundwater, and human

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La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

75

activities influence water quality. Point sources of industries and municipalities pose the greatest threat to water quality. Activities like mining, Urban Development, and Agriculture also affect water quality. Non - point source pollution also includes nutrients, sediments, and toxic contaminants (Claudia, 2016).

Waste, the different sources of waste can be identified by recognizing the types of waste. Let us first define the term waste. Waste is any substance discarded after primary use, or, in other words, there is no further use for the product. We generate a considerable amount of waste in our day - to - day life. From the groundnut shells that we throw after eating to the food wrappers that we discard after consuming their contents are all parts of the activities that contribute to the generation of waste.

It is caused by the mismanagement of solid waste from human & their activities, waste collectors and waste disposal contractors. The effects of this type of pollution is the spread of harmful bacteria in the surroundings, as well as obnoxious odors which will also end up as air pollution. The water will also get contaminated, which will transmit parasites and bacteria to humans. And also Plastic waste generation has increased dramatically every day. Indiscriminate disposal of plastic wastes can lead to several negative impacts on the environment, such as a significant increase in greenhouse gas emissions and water pollution. Therefore, it is wise to think of other alternatives to reduce plastic wastes without affecting the environment, including converting them into valuable products using effective methods such as pyrolysis. Products from the pyrolysis process encompassing of liquid, gas, and solid residues can be turned into beneficial products, as the liquid product can be used as a commercial fuel and char can function as an excellent adsorbent. The char produced from plastic wastes could be modified to enhance carbon dioxide (CO_2) adsorption performance (Hussin, Aroua, Kassim, & Md. Ali, 2021). The more emissions that we produce due to how much trash we generate, affects us long term. One can develop diseases such as asthma, birth defects, cancer, cardiovascular disease, childhood cancer, COPD, infectious diseases, low birth weight, and preterm delivery. (Downs & Acevedo, 2022)

Energy - related greenhouse gas emissions account for the majority of all anthropogenic emissions - about 80% in the USA and the European Union, for example. Just 20% of final energy consumption is in the form of electricity, but the generation of electricity is responsible for over 40% of all energy - related emissions. Worldwide emissions of carbon dioxide (CO_2) from burning fossil fuels total about 34 billion tons (Gt) per year. About 45% of this is from coal, about 35% from oil and about 20% from gas. The impacts of electricity generation go beyond the emission of CO_2 and other greenhouse gases. (United Nations Economic Commission for Europe (UNECE), 2022) Home energy consumption is a major contributor, as energy inefficient homes waste significant amounts of energy through poor insulation, energy inefficient appliances, drafts due to improper sealing, and excessive water use. A main contributor within the home is poor insulation, as heat leaves the house quickly. (Make Wealth History, 2015)

76

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

Home stay Facilities, tourist accommodation account for another noticeable share of 21% (Koiwanit & Filimonau, 2021). To make global tourism more sustainable, effective mitigation is required within all its sub - sectors (Kim, Filimonau, & Dickinson, 2020). The Fifth Assessment Report of the IPCC asserts that anthropogenic greenhouse gas emission has warmed the Earth's climate and consequently climate change poses an increasing impact on natural and human systems 1. Intergovernmental Panel on Climate Change (IPCC) (2014). Consumption, including clothing, footwear, and household and personal goods all account for a significant amount of an individual's carbon footprint because these items all have associated emissions from gathering materials, production, and transport. In addition, many know that transportation significantly contributes to a carbon footprint simply because driving cars is polluting. Group transportation like trains or buses pollute less per person, but still have emissions that are associated with them (Make Wealth History, 2015).

Natural resources are the raw materials and sources of energy that we use. Petrol, metals, soil, sand, wind, water and everything in between are natural resources. Earth's natural resources include air, water, soil, minerals, plants, and animals. Conservation is the practice of caring for these resources so all living things can benefit from them now and in the future (McDaniel, Sprout, Boudreau, & Turgeon, 2019). There are natural sources of atmospheric carbon dioxide, such as outgassing from the ocean, decomposing vegetation and other biomass, venting volcanoes, naturally occurring wildfires, and even belches from ruminant animals. These natural sources of carbon dioxide are offset by "sinks" - things like photosynthesis by plants on land and in the ocean, direct absorption into the ocean, and the creation of soil and peat. During all the ice ages that have occurred over at least the past million years, these opposing branches of the carbon cycle have kept the atmospheric carbon dioxide level at or below 300 parts per million (ppm). Today, that level is close to 410 ppm. Not only is this the highest carbon dioxide has been during all of human civilization, it has reached these levels virtually instantaneously in geologic time frames. During ice age cycles of the past, a change this large would likely have taken thousands of years to occur (Herring, 2020). Sustainable transportation systems are in certain way a new paradigm where a business - as - usual approach is not possible. Vehicle makers produce more energy efficient vehicles. Nevertheless, fossil fuel is still the predominant source of energy. Regarding the level of carbon dioxide (CO_2) emissions, non - motorized transport modes are preferable over motorized transport modes, and public transportation modes preferable to private transportation modes. It is also import to include environmental consideration along the design, construction, maintenance, and operation of the transportation infrastructure. While vehicles powered by alternate fuel such as biofuel, electricity, and/or fuel cell are becoming more popular, shifting to more sustainable transport modes would also require changes on commuter behaviors and individual preferences. (Velazquez, Munguia, Will, Zavala, Verdugo, Delakowitz, & Giannetti, 2015) In the field of the tourism, hotels and homestay facilities account for considerable amounts of energy consumption and CO_2 emissions. Investigation conducted on the CO_2 emissions from four types of hotel in Taiwan. According to

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La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

77

the results, the average CO_2 emissions of international tourist hotels, standard tourist hotels, general hotels, and homestay facilities are 28.9, 19.2, 12.5, and 6.3 kg - CO_2/person - night, respectively. Hotels with higher service levels produce higher average CO_2 emissions per person - night. Analytical results indicate that increasing stays at hotels with low CO_2 emissions (such as homestay facilities and general hotels), accommodating more guests together per room, and enhancing energy usage efficiency, can effectively reduce hotel CO_2 emissions without reducing the total number of guests (Tsai, Lin, Hwang, & Huang, 2014).

Methodology

Sampling Design

The aim of this research was to obtain data from the Banthamsua community, located in Phetchaburi province, Thailand. This community serves as a model for conservation efforts and is committed to transitioning towards zero carbon tourism. To ensure the appropriateness of the sample selection, the purposive sampling method was employed (Dong & Saaty, 2014)

Emphasizes that, for AHP analysis, the quality of the interview sample outweighs its size. Therefore, the criteria for selecting interviewees ensured that they were respected experts in the chosen field. In this study, the researcher gathered information from a local homestay host in Banthamsua, who possessed over ten years of experience in providing homestay hospitality services via interviewing. This served as evidence of the sample's exceptional expertise. A total of 10 expert homestay stakeholders were included in this research.

Questionnaire Development

Creating Decision Making Hierarchical Tree

Utilizing the insights gained from the literature, the researcher constructed a Hierarchical model to depict the variables that could impact the factors influencing the establishment of low - carbon homestays. Drawing upon the literature review presented earlier, a questionnaire was developed, consisting of six primary factors for AHP analysis, to transform satisfaction data from interview into numerical scores for evaluating homestays, facilitating the identification of the most suitable option. This entails converting satisfaction values into a format ranging from homestay 1 to homestay n, aiding in the decision - making process, as illustrated in Figure 1.

The Importance Value Attribute Fundamental Scale

To conduct pair comparison, a questionnaire is being designed and distributed among the respondents. The interviewee must understand how significant each criterion is in comparison to the other criterion(s) while comparing the importance of each pairwise factor. The interviewee must be required to orally describe several importance levels, such as considerably more important, fairly important, slightly more important, most important, etc. during the interview. The researcher will convert these distinct priorities into numerical values in order to provide a more accurate analysis of the data. This involves the conversion of qualitative interview data into quantitative data, eliminating the need for direct comparisons with interviewees and minimizing the potential for errors associated with requesting quantitative information. Saaty
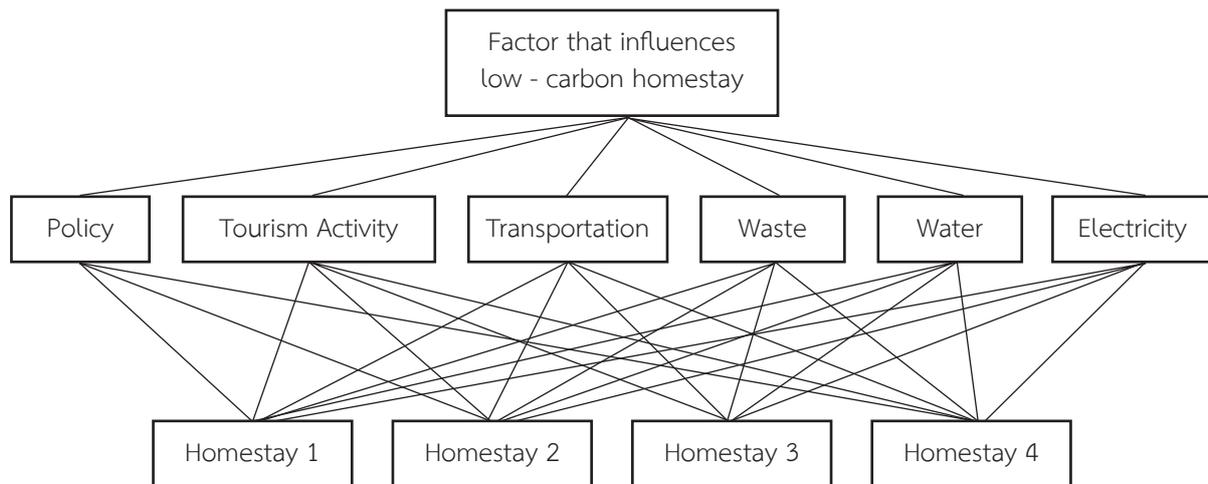
78

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

Figure 1 Hierarchical structure

(2008) create the pairwise scale and the importance value attributed to each number as show in table 1. These figures are used to compare the weights and establish the relative importance of each factor in the decision - making process in the following steps.

Table 1 The fundamental scale

The fundamental scale		
Intensity of importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

Source : Saaty (2008)

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

79

Data Collection

For this study, the researcher collected information from local homestay hosts within the community who are expected to possess the necessary knowledge to provide the specific data required for analysis. To gather the data, face - to - face interviews were conducted at the local community in Ban Tam Sua village, which served as the research site. This approach was chosen for its convenience to the interviewees. By conducting interviews, the AHP questionnaire could elicit the most precise responses from the interviewee group. In order to minimize inaccuracies resulting from potential misinterpretations of the questionnaire and the interview process, the researcher provided relevant information during the interviews. Additionally, the researcher pursued interesting interview - related topics to enhance the overall interview experience.

Data Analysis

Create Comparison Matrix from the Gathered Data

The data obtained from the interviews and questionnaires will be subjected to pair - wise comparisons using a matrix, as illustrated in Table 2.

Table 2 The comparison matrix pairwise

	Factor 1	Factor 2	Factor 3	Factor n
Factor 1	1	a_{12}	a_{13}	a_{1n}
Factor 2	a_{21}	1	a_{23}	a_{2n}
Factor 3	a_{31}	a_{32}	1	a_{3n}
Factor n	a_{n1}	a_{n2}	a_{n3}	1

In the pair - wise comparison process, the importance of factor 1 compared to factor 2 (denoted as a12) is evaluated with respect to the objective of the study. It is also equal to the reciprocal value of a_{21}. This comparison is performed row by row and column by column, systematically continuing the pairwise comparison of related factors until it reaches the "n" factor, which is considered the final factor in the analysis.

Calculate the Importance Weight of Each Factor

After obtaining the pairwise comparison matrix, the eigenvector is computed using normalized matrix averages. In case an inconsistent matrix is encountered, the calculations should be repeated multiple times until convergence is achieved among the set of answers through successive iterations of this process. Subsequently, the following formula is applied to transform the raw data into meaningful absolute values and normalized weights (Taherdoost, 2017).

80

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

Normalize weight (w) = (w1, w2, w3... wn)

$Aw = \lambda max\ w,\ \lambda max \geq n$

$$\lambda max = \frac{\Sigma ajwj\text{-}n}{w1}$$

$A = \{a_{ij}\}$ with $a_{ij} = 1/a_{ij}$

A: pair wise comparison

w: normalized weight vector

λmax: maximum eigen value of matrix A

a_{ij}: numerical comparison between the values i and j

Calculation Consistency Ratio

To validate the results of the Analytic Hierarchy Process (AHP), the consistency index (CI) is calculated using the following formula. $CI = \frac{\lambda max\text{-}n}{n\text{-}1}$ The consistency ratio (CR) is then determined by dividing the CI by the random index (RI). Please note that the specific formula for calculating the consistency index depends on the size of the matrix (n x n), where "n" represents the number of factors or criteria being compared. The value of RI will be taken from Table x and is related to the dimension of the matrix. It should be noted that a consistency ratio of less than 0.10 confirms the validity of the comparison's findings. (Taherdoost, 2017)

Table 3 The value of random consistency index

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.5	1.49

Source: Golden and Wang (1990)

Results

In order to examine the factors that influence the establishment of low - carbon homestays, based on the table presented, it is evident that the primary focus for homestay providers in Ban Tham Sua is policy management, with a weight of 37.30%. Following this, waste management is the second most crucial factor, with a weight of 29.35%. The next set of priorities are related to public utility management, with water management being assigned the third priority, accounting for 13.01%, and energy management being fourth with 11.06%. The last group comprises of other priorities, beginning with tourism activities and transportation management, which have a significance score of 5.24% each.

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

81

Table 4 Fectors influencing the establishment of low - carbon homestays

Factors	Policy	Tourism activity	Transportation	Waste	Water	Energy	Importance weight	Importance ranking
Policy	1.000	4.333	5.000	2.333	4.500	4.667	37.30%	1 (First)
Tourism Activity	0.231	1.000	2.000	0.164	0.198	0.213	5.24%	5
Transportation	0.200	0.500	1.000	0.151	0.267	0.297	4.04%	6 (Last)
Waste	0.429	6.112	6.608	1.000	4.000	4.500	29.35%	2
Water	0.222	5.060	3.750	0.250	1.000	1.500	13.01%	3
Energy	0.214	4.701	3.364	0.222	0.667	1.000	11.06%	4
	2.296	21.707	21.723	4.121	10.631	12.177	100.00%	

1. Policy Management (37.30%): Interviews with experts consistently underscored the paramount importance of effective policy management in the success of homestay operations. Policies dictate the behavior and outcomes of various aspects, such as tourism activities, water and electricity resource management, and waste disposal. In a community focused on educational eco - tourism rather than profit, aligning policies with this objective is crucial. Achieving low - carbon eco - tourism, a significant goal for the community, also heavily relies on effective policy management.

2. Waste Management (29.35%): Given the Ban Tham Sua Homestay Community's dedication to environmental preservation, waste management emerged as the second most significant factor. In this context, managing waste pollution holds greater importance than addressing other forms of pollution, as it directly impacts the quality and reputation of the homestays. The term "waste" is seen as more tangible and directly tied to environmental pollution compared to water or energy. The visibility and tangibility of waste pollution make it a top concern for guests in the community.

3. Water and Energy Management (Water - 13.01%, Energy - 11.06%): Although both water and energy management were recognized as important, water management received slightly higher emphasis. This distinction arises from the community's historical and practical emphasis on water as a critical resource for life. It is seen as more essential than electricity, which is considered a more peripheral concern falling under the responsibility of the central municipality. Water and energy management, while important, are perceived as on par with each other in the context of tourism management.

4. Homestay Activities (5.24%) and Transport (4.04%): These factors received the lowest significance scores. Interviewees noted that homestay activities are flexible and contingent on various factors such as season, age, and policy, and are not considered crucial for achieving low - carbon eco - tourism. Instead, they are viewed as tools to support and respond to policies designed to achieve sustainability goals. Regarding transportation, experts assigned it low priority

82

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

because the community has limited control over it. While they can recommend eco - friendly transportation options, controlling carbon emissions from visitors is challenging. Despite the potential benefits of effective transport management, particularly in the context of the homestay's carbon reduction efforts, these factors were considered less critical than policy and waste management.

This research, based on qualitative interviews with experts in the Ban Tham Sua community engaged in homestay operations, has unveiled critical factors shaping the success of low - carbon homestays. Policy management emerged as the most pivotal, with policies instrumental in guiding various aspects of homestay operations in line with the community's educational eco - tourism goals. Waste management closely followed in significance, reflecting the community's strong commitment to environmental preservation. Water management, considered more vital than energy due to its life - sustaining nature, received notable attention. Conversely, homestay activities and transport were deemed of lesser importance, seen as flexible tools supporting broader policy goals and challenging to control, respectively. These findings offer practical guidance for homestay providers, aligning their operations with the community's objectives and values, with policy and waste management recognized as the paramount priorities in this context

Conclusion and Discussion

From the results of this study, it showed that the important factors that influence the establishment of low - carbon homestay Ban Tham Sua community were divided into 3 groups: 1) policy and waste management (66.65%), 2) water and energy management (24.07%), and 3) tourism activity and transportation (9.28%).

Policy and Waste Management

This study examines low - carbon accommodations, particularly in homestays as a crucial implementation to minimize carbon emission. And also indicate the factors that influence the establishment of low - carbon homestays and to provide a model for this kind of accommodations. The results suggested that the primary focus for homestay by providers in Ban Tham Sua is policy management, with a weight of 37.30%. It is that policies play a significant role in determining the behavior and outcomes of various homestay operations, including tourism activities, water, electricity resource management, and waste management. That the result is correspond to Energy Institute Team of P.R. China National Development and Reform Commission (2009) said Hotel operations are one of the major carbon dioxides emitting industry through its large consumption of energy, water, and non - renewable resources. Many studies posit that sustainable development and management can help reduce CO_2 emissions through effective energy and environmental management and the same that Changbo and Jingjing (2011) said to relate standards/indicators/guidelines can also help reduce carbon emissions. A low - carbon hotel is a hotel based on low energy consumption, low pollution, and low CO_2 emission. Its core principle is to use energy efficiently, use clean energy technology and pollute less.

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

83

The second focus in the research was attributed to waste management. it is considered to be a critical aspect of the top group with a weight of 29.35%. That the result is same of Energies 2021 said It is caused by the mismanagement of solid waste from human & their activities, waste collectors and waste disposal contractors. The effects of this type of pollution is the spread of harmful bacteria in the surroundings, as well as obnoxious odors which will also end up as air pollution. The water will also get contaminated, which will transmit parasites and bacteria to humans. And also Plastic waste generation has increased dramatically every day. Indiscriminate disposal of plastic wastes can lead to several negative impacts on the environment, such as a significant increase in greenhouse gas emissions and water pollution. Therefore, it is wise to think of other alternatives to reduce plastic wastes without affecting the environment, including converting them into valuable products using effective methods such as pyrolysis. Products from the pyrolysis process encompassing of liquid, gas, and solid residues can be turned into beneficial products, as the liquid product can be used as a commercial fuel and char can function as an excellent adsorbent. The char produced from plastic wastes could be modified to enhance carbon dioxide (CO_2) adsorption performance also Austin Downs and Richard Acevedo February 28, 2019 have suggest the more emissions that we produce due to how much trash we generate, affects us long term. One can develop diseases such as asthma, birth defects, cancer, cardiovascular disease, childhood cancer, COPD, infectious diseases, low birth weight, and preterm delivery.

Water and Energy Management

In interviews with homestay owners, it was observed that a significant portion of water consumption can be attributed to guest behavior. This finding aligns with the research conducted by Pensiri and Nantaporn (2016), which underscores the importance of water usage per guest night stay and guest behavior in influencing overall water consumption. The interview findings revealed that water consumption primarily emanated from activities such as handwashing at faucets, usage of bathroom faucets, showering, and toilet flushing. Consequently, one of the most effective strategies for water conservation is to raise guest awareness about the direct impact of their resource consumption on the quantity of water consumed per individual.

Additionally, the interviews highlighted the homestay owners' adeptness in resource management and energy conservation practices. Their initiatives included the deployment of solar panels to mitigate the carbon footprint associated with energy consumption, the strategic planting of trees to provide natural shading and reduce energy consumption, diligent maintenance of equipment and appliances within the accommodation, and the transition from incandescent bulbs to energy - efficient compact fluorescent bulbs (commonly known as chopstick tubes), which consume significantly less power.

Tourism Activity and Transportation Management

The final group consists of other priorities identified by informants, commencing with tourism - related activities and continuing with transportation management. The complexity of

84

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

the relationship between tourism and the environment are a result of the multiple activities that people engage in during their leisure time - while they travel in their own country or abroad, visiting different places for a specific purpose, such as rest and relaxation, entertainment, or knowledge enhancement (Ştefănică, Sandu, Butnaru, & Haller, 2021). Participants ranked transport and tourism activities as the least vital components of a low - carbon homestay. This is because they believe ecotourism activities such as bamboo rafting, seed - bullet shooting, organized activities to learn community lifestyle, and volunteering through CSR activities in reforestation are beneficial to the environment. Both tourism transport and tourism activities conducted at the scale of accommodation systems, and tourists' recreational activities within as well as outside accommodation structures can have a negative impact on the environment, which is significantly affected by the frequency with which they occur in time and space. This is consistent with the study of Cavallaro, Galati, and Nocera (2020) stating that 75 % of tourism - related emissions result from transportation, and projections indicate that the proportion will rise. Similarly, a number of previous studies confirmed that the activities of tourists have a direct or indirect negative impact on the environment, including the loss of biodiversity (Pickering & Hill, 2007), air pollution (Gulistan, Tariq, & Bashir, 2020), and depletion of natural resources (Gössling, Peeters, Hall, Ceron, Dubois, & Scott, 2012).

Conclusion

In conclusion, this study highlights the significant factors that influence the establishment of low - carbon homestays in the Ban Tham Sua community. The findings emphasize the importance of three key factors: policy and waste management, water and energy management, and tourism activity and transportation. Policy management emerges as the foremost priority, with policies shaping various aspects of homestay operations, including tourism activities, water and electricity resource management, and waste management. Waste management is identified as the second most significant factor, reflecting the community's commitment to environmental preservation. Water and energy management are also key priorities, with the community emphasizing the importance of efficient resource utilization.

While tourism activities and transportation management were considered less significant by the interviewees, it is crucial to address the environmental impact of these factors. Sustainable tourism activities and transportation options can significantly reduce carbon emissions. However, the community acknowledges the challenges in controlling visitor travel emissions and places greater emphasis on policy - driven approaches.

Understanding the factors influencing decision - making among homestay stakeholders is essential for enhancing the sustainability and environmental impact of low - carbon homestays. Further research is needed to expand the scope of study to different geographical locations and larger sample sizes. Longitudinal studies would also provide insights into the dynamics and fluctuations in decision - making over time. By gaining a comprehensive understanding of these factors, stakeholders can make informed decisions and implement effective strategies to promote sustainability in homestay operations.

Journal of Social Sciences and Humanities Research in Asia 29(3), Sep.-Dec. 69-90
La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

85

Limitations and Suggestions

The present research examined the perspectives and behaviors of stakeholders within the Ban Tham Sua community, a unique ecotourism destination. This study acknowledges that the distinct characteristics and operational policies of Ban Tham Sua may lead to variations in data and sample group characteristics compared to other ecotourism providers. Generalizing the findings of this study to other ecotourism contexts should be approached with caution. The operational policies, community dynamics, and local ecological considerations in Ban Tham Sua might differ significantly from those in other regions or communities. Therefore, the findings may not be universally applicable and should be interpreted within the specific context of the Ban Tham Sua community.

The study's limitations are noteworthy and deserve careful consideration. Firstly, the sample size used in this study is relatively small, which may limit the generalizability of the findings. It is crucial to recognize that a larger and more diverse sample, consisting of a broad spectrum of stakeholders, could potentially produce contradictory results. Such an expanded dataset would likely provide a deeper understanding of ecotourism - related decision - making processes.

The temporal dimension of data collection is an additional factor that must be considered carefully. This investigation was conducted exclusively in February 2023. Therefore, the findings may be affected by specific temporal factors, such as seasonal variations or prominent local events that occurred during the study period. It is essential to exercise caution when extrapolating these results to other time periods or comparing them to studies conducted at various times of the year. This sensitivity to time emphasizes the need for a nuanced interpretation of the results.

Further research is recommended to expand upon these findings. It would be valuable to include multiple geographical locations to understand decision - making factors in diverse regions. Employing different sampling methods and conducting longitudinal studies over an extended period would enhance the representativeness and provide insights into the dynamics of decision - making in ecotourism. Considering these factors in future research would contribute to a more comprehensive understanding of ecotourism communities and facilitate sustainable practices for the benefit of stakeholders and visitors.

Acknowledgements and Ethics Approval

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86

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La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
Vachirakajorn T., Simachokdee W., & Putamanonda, P.

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Vachirakajorn T., Simachokdee W., & Putamanonda, P.

87

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88

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Vachirakajorn T., Simachokdee W., & Putamanonda, P.

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La-ong-in Thayarnsin, S., Seyanont, A., Laohaviraphap, T., Prayoorachart J.,
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89

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