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Sustainable Tourism Goals Indicator: Challenges and Gap Analysis for Achieving Low Carbon Tourism in Chiang Mai

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Thailand adopted the Sustainable Tourism Goals (STGs) schemes in late 2023 which comprise 17 dimensions applied from UN-SDGs with a total of 86 indicators. The aim is to support sustainable development in the two major tourism sectors: hotel and transport. This paper emphasizes on the context of STG 7 (Clean energy) and 13 (Climate action) in tourism sector in Chiang Mai which is major tourist destination province in Northern Thailand. By using the onsite survey to 10 hotels and 10 transport companies, it was found that there were four major barriers to accelerate the low carbon target; i.e. (i) financial barriers, (ii) policy and institutional barriers, (iii) technology and innovation barriers, and (iv) knowledge barriers. Policy recommendations have been discussed. For the GHG mitigation potential after scaling up to the provincial level, there are vast mitigation potential of around 15,192.17 tCO_2-eq/y. Transitioning to using alternative energy sources from solar cells can reduce GHGs by 14,243.86 tCO_2-eq/y. Converting vehicles from diesel fuel to electric power can also reduce GHGs by 948.31 tCO_2-eq/y. More incentives for entrepreneurs, such as promoting energy conservation, using renewable energy, and fostering innovation should be strongly considered to achieve the STGs. Full supports on climate change issues from top-level management play an important role to the success of low carbon pathway for tourism businesses.

1. Introduction

According to the definition of the United Nations World Tourism Organization (UNWTO), sustainable tourism is tourism that considers environmental, economic, and social impacts, both present and future, including the needs of tourists, industry, the environment and local communities for creating the right balance (WTTC, 2021). There are many ways of sustainable tourism; e.g., green tourism that focuses on environmentally friendly tourism activities (Dory, 2023), community-based tourism that emphasizes on the process of participation in managing the natural and cultural capital of the community to create maximum benefits, and ecotourism that is not only an appreciation of nature, but also helps in creating economic opportunities for local communities (Furqan et al., 2010). In 2023, the world tourism industry was expected to reach $9.5 trillion in GDP according to the World Travel and Tourism Council (WTTC) forecast. UNWTO also forecasts that tourism proportion will reach 80% to 95% of the its level before the COVID-19 pandemic crisis period. It is expected that tourism growth in 2024 will increase and become the largest economic engine in the world economy (UN Tourism, 2023). Sustainability tourism is weakened by the capacity of transportation services (Hanpttanakit et al., 2018), population density, official tourism accommodation offers, water saving, and waste management. Therefore, it is necessary to promote renewable energy sources for maximizing and controlling the use of natural resources (Blancas et al., 2011). The use of electric vehicles (EVs) powered (Gossling et al., 2023) by batteries or fuel cells is more sustainable than internal combustion engine vehicles (ICEVs) (Boren and Ny, 2016).
Expedia Group and Wakefield Research released the sustainable travel study, which surveyed 11,000 global travelers from 11 countries; i.e., Canada, the United States, Mexico, Brazil, the United Kingdom, France,

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Germany, India, China, Japan and Australia during February - May 2022. It was found that 69% of travelers were looking for trips that reduce their environmental impact, 66% of travelers want to support the local economy, 65% of travelers are interested in local culture and community, and 52% of travelers want to visit attractions that are not yet known. (Expedia Group, 2022). From Thai statistical data on the numbers of tourists in 2023, it was found that the numbers of tourists compared to those in 2022 have increased at a rate of 39.21% (Ministry of Tourism and Sports, 2023). This leads to the increase in the volumes of solid wastes generated by tourists. For tourism industry, a carbon footprint is related to international tourist arrivals. To reduce greenhouse gas emissions, it is recommended that entrepreneurs use renewable energy, carbon-neutral transportation, and emission-free technology (Raihan, 2024). Policymakers can enhance ecotourism by promoting sustainable tourism; e.g., community-based tourism (Chiwaridzo, 2023).

In recent days, the tourism in Thailand is driven by the Bio-Circular-Green (BCG) model; i.e., (i) Bio Economy is product development and utilization of biomass materials and tourist attractions have a variety of biological resources in the community, (ii) Circular Economy is the management of waste materials and renewable energy, and (iii) Green Economy is the reduction of negative impacts on the environment and serving relationships and interests of all stakeholders in a comprehensive sustainable manner (Ministry of Tourism and Sports, 2022). Tourism Authority of Thailand develops the concept of sustainable tourism leading to high value services and standard by creating sustainable tourism standards. From the concept of sustainable development amount 17 sustainable development goals of the United Nations to the 17 STGs (TAT, 2022) that reflect sustainability for valuable experiences and responsible tourism. Chiang Mai is the long history province (Pongruengkiat et al., 2023) with the most tourists in the northern region and is ranked 6th in Thailand, with a total number of tourists of 10.68 M, divided into 7.76 M Thai tourists, 2.92 M foreign tourists, and a total income of 89,193.79 M THB (Ministry of Tourism and Sports, 2022). This paper studies the gap analysis for sustainable tourism barriers in two sectors: hotel and transport for the purpose to evaluate the potential and impact of the tourism industry in developing towards STGs.

In the following of this article, section 2 presents the methodology of gap analysis and GHG mitigation potential. Data collection and analysis is collected and verified in section 3. The results are summarized and discussed in Section 4. Finally, Section 5 concludes the study with a brief overview.

2. Methodology

There are two main methodologies in this paper: i.e. (i) the gap analysis and (ii) GHG mitigation potential. The details are described below.

2.1 Gap Analysis

To see the general overview of Chiang Mai STGs, gap analysis from UN-SDGs has been used to cover four dimensions, which are (i) management, (ii) socio-economy, (iii) culture, and (iv) environment. The surveys to collect required data were carried out to perform gap analysis in two-entrepreneur sectors, which are hotel and transport, in Chiang Mai. Figure 1 shows STGs gap analysis for hotel and transport sectors in Chiang Mai.

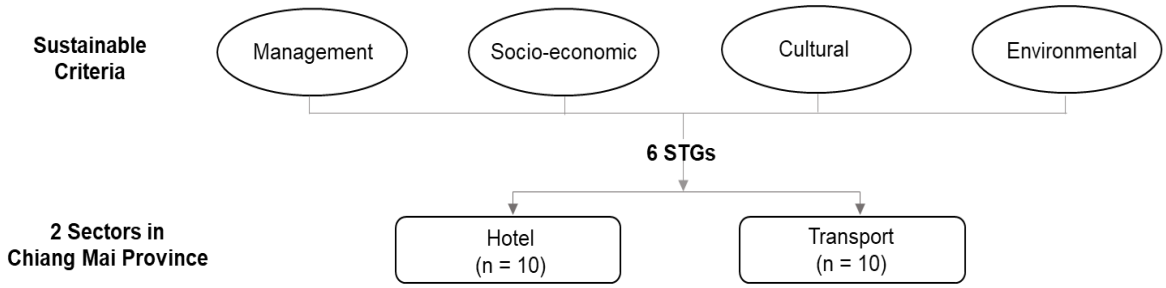

Figure 1: STGs Gap analysis in Chiang Mai.

2.2 GHG mitigation potential of tourism sector in Chiang Mai

GHG mitigation potential of tourism sector from energy consumption data can be computed by Eq (1) (IPCC, 2006).

$$GHG\ Emissions = AD \times EF \quad (1)$$

Where AD is activity data of GHG emission, which is divided into three types: direct combustion, indirect combustion and others (units); EF is emission factor of GHG emission, which is the rate of greenhouse gas

emissions from activities ($kgCO_2$-eq/unit). The energy consumption is then analyzed. Environment data is retrieved in terms of CO_2 which is based on the 2006 IPCC Guidelines.
The energy consumption of hotel comprises lighting, air conditioning, motor, water pumping, and heating systems. Using renewable energy from solar PV will lead to a reduction of GHG. Furthermore, the amount of solar PV installations can be calculated using Eq (2) (Raksakulkarn et al., 2023). The potential for greenhouse gas emissions can be calculated according to Eq (1).

$$E = P \times f_t \times f_d \times f_m \times f_i \times t \times d \quad (2)$$

Where E is the amount of electricity of the solar PV system installation; P is the quantity demand of electricity (W); f_t is the factor of the temperature rise at the solar panel under Standard Test Conditions (STC; %); f_d is the factor of dust and dirt that is on the solar panel under STC (%), f_m is the factor for wiring losses under STC (%); f_i is the factor for converting electricity with an inverter from DC to AC under STC (%); t is the solar hours with the most sunlight (h/day); d is the number of sunny days in Chiang Mai Province (d/y).
The amount of baseline greenhouse gases from transportation vehicles using fossil fuel are given by Eq (3) (TGO, 2022).

$$Baseline\ GHG = \Sigma_{i,x}[(SFC_{i,x} \times NCV_x \times EF_{CO_{2,x}}) \times L_{km,I} \times 10^{-9}] \quad (3)$$

Where $SFC_{i,x}$ is the specific energy consumption per distance from vehicle i using fossil fuel type x (tCO_2-eq/y); NCV_x is net calorific value of fossil fuel type x (unit/km); $EF_{CO2,x}$ is emission factor of GHG emission, which is the combustion of fossil fuel type x (kg CO_2-eq/TJ); $L_{km,i}$ is distance of electric vehicle replacing vehicle I (km/y)

3. Data Collection and Analysis

This section consists of two parts that are gap analysis and energy consumption.

3.1 Gap Analysis

Gap analysis of sustainable tourism goals for hotel and transport sectors were conducted by surveying in two contexts; i.e. (i) entrepreneurs perspective, and (ii) academic expert perspective. The survey details on these two sectors cover six major STG indicators; i.e., STG 6: Clean water accessibility and sustainable water ecosystems in tourism, STG 12: Responsible tourism, STG 13: Tourism climate action, STG 15: Land tourism ecosystems, STG 16: Safety and security in tourism, and STG 17: Tourism partnerships for sustainable tourism goals. The survey questionnaires were distributed to 10 hotels and 10 transportation companies in Chiang Mai to retrieve data based on entrepreneur perspective. The survey results with respect to six STGs are shown in Figure 2. Gap analysis of six STGs from academic expert perspective were also carried out on hotel and transportation sectors as shown in Figure 3.

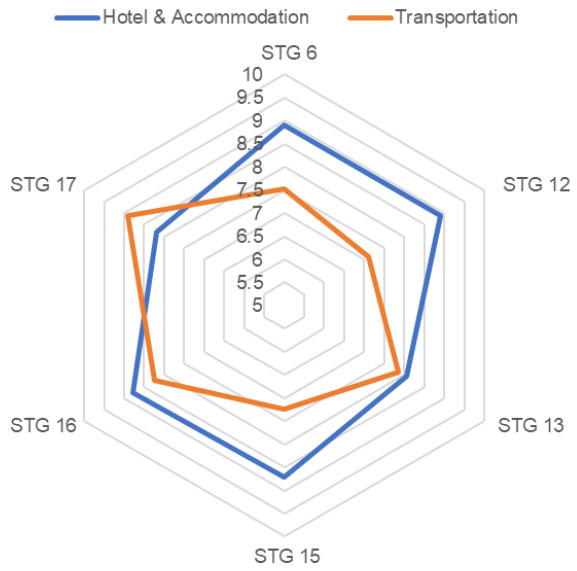

Figure 2: Gap analysis from entrepreneur perspective

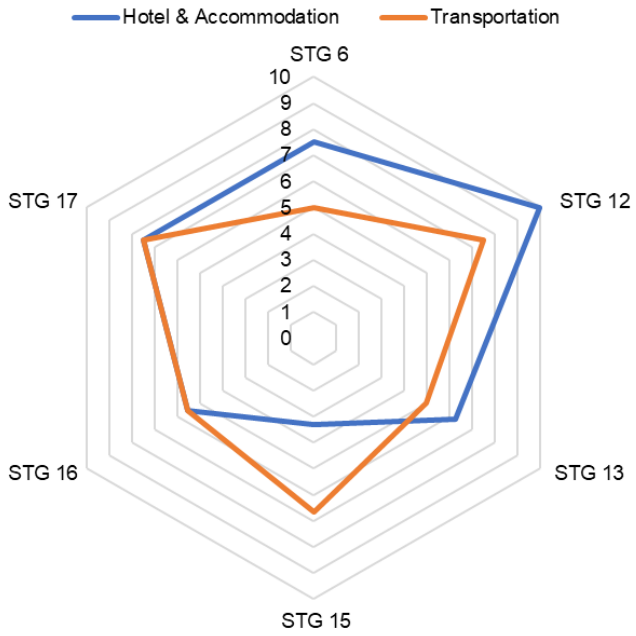

Figure 3: Gap analysis from academic expert perspective.

Surveys of 10 hotels showed that hotels utilize water from the Provincial Waterworks Authority with standard filtration system to meet the tourist needs. High technological equipment and resource saving campaign signs were installed to conserve water and wastewater management before releasing them to communities. Moreover, more safety and cultural concerns to the public have to be promoted. But there is still a lack of consideration for climate change issues and cooperation from some entrepreneurs in Chiang Mai. For expert point of view on hotels, there are solutions to access clean water and to promote sustainable tourism despite a little concern over climate change, ecosystems and safety issues.
For transportation sectors, it was found that there was one sustainable collaboration between transport company with the government, shopping mall and university focusing on the environmental, cultural, economic and safety issues. There are much more to improve on the water conservation and ecosystems as well as promotion of sustainable tourisms.

3.2 Energy Consumption

The energy consumption of hotels (Wongapai, 2016) consists of two main types: (i) electricity, which includes lighting, air conditioning, motor, and water pumping system and (ii) heat, which includes boiler and generator, as shown in Table 1. Furthermore, the energy consumption of tourist vehicle in Chiang Mai is presented in Table 2.

Table 1: Energy Consumption of 10 hotels in Chiang Mai in 2023 (DEDE, 2023).

Sectors		Existing technology				New technology
		Energy Consumption			GHG Emission	Solar Cell
		LPG (kg)	Electricity (kWh)	Diesel (Litre)	(tCO_2-eq)	(Installed kW)
1	Hotel 1	49,920.00	840,434.31		420.13	791.72
2	Hotel 2	55,620.00	1,254,360.00		627.05	1,181.66
3	Hotel 3	128,544.00	2,616,278.40		1,307.88	2,464.64
4	Hotel 4	68,547.64	3,188,160.00		1,593.76	3,003.38
5	Hotel 5		1,056,704.00		528.25	995.46
6	Hotel 6		5,685,120.00		2,841.99	5,355.61
7	Hotel 7	59,460.00	2,147,540.00		1,073.56	2,023.07
8	Hotel 8	21,120.00	2,374,420.36		1,186.97	2,236.80
9	Hotel 9		5,264,800.00	232,486.00	2,631.87	4,959.66
10	Hotel 10		4,065,600.00		2,032.39	3,829.96
Total		383,211.64	28,493,417.07	232,486.00	14,243.86	26,841.96

Table 2: Energy Consumption of 10 transport companies in Chiang Mai in 2023 (CMU, 2023).

Transport	Existing technology				New technology (EV replacement)	
	Vehicle (No.)		Distance (km)	GHG (tCO_2-eq)	Electricity Consumption (kWh/km)	GHG from EV (tCO_2-eq)
Transport 1	Bus	3	65,700.00	58.69	1.00	32.84
Transport 2	Bus	9	186,150.00	166.29	1.00	93.06
	Van	3	104,400.00	20.62	0.216	11.27
Transport 3	Bus	6	153,300.00	136.95	1.00	76.63
Transport 4	Bus	36	657,000.00	586.91	1.00	328.43
	Van	10	401,500.00	79.32	0.216	43.35
Transport 5	Bus	3	71,175.00	63.58	1.00	35.58
Transport 6	Bus	22	525,600.00	469.53	1.00	262.75
Transport 7	Bus	3	78,475.00	70.10	1.00	39.23
Transport 8	Bus	13	293,825.00	262.48	1.00	146.88
	Van	10	392,375.00	77.51	0.216	42.37
Transport 9	Van	8	262,800.00	51.92	0.216	28.38
Transport 10	Bus	4	94,900.00	84.78	1.00	47.44
	Van	2	87,600.00	17.31	0.216	9.46
Total		132	3,374,800.00	2,145.99		1,197.68

4. Results

Gap analysis of sustainable tourism goals for hotel and transport sectors were carried out to investigate six indicators on STG 6, 12, 13, 15, 16, and 17. It was found that, from entrepreneur perspective, the hotel managements in Chiang Mai have accelerated the sustainable development especially during the COVID-19 period resulting in obtaining the required STGs. Issues on climate actions need to be promoted and improved. For entrepreneur perspective on transportation sector, there are vast potentials in four STG indicators, which include clean water access and sustainable water ecosystems, responsible tourism, climate action for tourism businesses, and land use for tourism ecosystems. For expert perspective, it was found that there are still rooms to improve for all six STGs in hotel and transportation sectors in Chaing Mai. For the STG 7 and 13, the hotel energy consumptions are from electricity, LPG, and diesel fuel. In 2020, a total of 28.49 GWh of energy was used in 10 hotels emitting GHGs of 15,525 tCO_2-eq/y. With the use of renewable energy from solar energy, GHG emissions were reduced by 14,243.86 tCO_2-eq/y. For transport sector in recent days, vans and buses are powered entirely by diesel, resulting in GHG emissions of 2,145.99 tCO_2-eq/y. If all vans and buses are converted into electric power system, GHG emissions could be reduced by 1,197.68 tCO_2-eq/y.

5. Conclusions

Challenges and gap analysis to achieve STGs in Chiang Mai hotel and transport sector have been investigated. It was found that government agencies and private sectors must raise their support and awareness on the understanding of the sustainable tourism situations. It is essential to increase the tourism sector competitiveness by focusing on the replacement of low energy efficiency appliances with high energy efficiency appliances or solar PV and EV. International standards, such as ISO 21401 (Sustainability Management System for Accommodation Establishments) and ISO 21101 (Safety Management Systems), need to be introduced to tourism businesses to raise the tourism standard as a whole. For greenhouse gas issues, if the hotels change their use of electrical energy in lighting, air conditioning, motor, and water pumping into solar energy, approximately 14,244 tCO_2-eq/y would be reduced. In addition, converting vehicles from diesel into electric power would reflect on the potential of 948 tCO_2-eq/y GHG emissions reduction. Full supports on climate change issues from top-level management play an important role to the success of low carbon pathway for tourism businesses.

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