

**WATER RESOURCE EFFICIENCY TOWARDS
SUSTAINABLE TOURISM AT PATONG MUNICIPALITY,
PHUKET PROVINCE, THAILAND.**



A Thesis Submitted in Partial Fulfillment of the Requirements
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การใช้ทรัพยากรน้ำอย่างมีประสิทธิภาพเพื่อการท่องเที่ยวอย่างยั่งยืน ที่เทศบาลเมืองป่าตอง จังหวัด
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การท่องเที่ยวเป็นหนึ่งในรายได้หลักของประเทศไทยที่ส่งผลโดยตรงต่อผลิตภัณฑ์มวลรวมในประเทศ การท่องเที่ยวส่งผลกระทบต่อภาคเศรษฐกิจ สิ่งแวดล้อม และสังคม การท่องเที่ยวอย่างยั่งยืนเป็นสิ่งสำคัญในการอนุรักษ์และบำรุงรักษาทรัพยากรธรรมชาติเพื่อคนรุ่นต่อไป การท่องเที่ยวอย่างยั่งยืนจำเป็นต้องใช้ทรัพยากรอย่างมีประสิทธิภาพ โดยเฉพาะอย่างยิ่ง ทรัพยากรน้ำ การวิจัยมีวัตถุประสงค์ เพื่อศึกษาการใช้ทรัพยากรน้ำอย่างมีประสิทธิภาพเพื่อการท่องเที่ยวอย่างยั่งยืน ที่เทศบาลเมืองป่าตอง อำเภอเกาะภูเก็ต จังหวัดภูเก็ต เนื่องจาก เทศบาลเมืองป่าตองมีปัญหาคารขาดแคลนน้ำมาเป็นเวลาหลายทศวรรษ แบบสอบถามถึงโครงสร้างนำมาใช้ในการสัมภาษณ์เชิงลึกกับผู้มีส่วนได้ส่วนเสียจำนวน 44 คน ประกอบไปด้วย กลุ่มธุรกิจโรงแรม ชุมชนท้องถิ่น องค์กรภาครัฐ และสมาคมที่เกี่ยวข้องกับการท่องเที่ยว ด้วยการเลือกกลุ่มตัวอย่างแบบเจาะจงเป็นกลุ่มเป้าหมายในการศึกษา ข้อมูลปฐมภูมิและทุติยภูมิจากการสัมภาษณ์ นำมาวิเคราะห์แบบเชิงพรรณนาและเนื้อหา การศึกษาพบว่า การประปาส่วนภูมิภาคสาขาภูเก็ต และเทศบาลเมืองป่าตอง เป็นผู้ให้บริการน้ำหลักในเทศบาลเมืองป่าตอง 50% ของผู้ถูกสัมภาษณ์ ใช้น้ำจากการประปาส่วนภูมิภาคสาขาภูเก็ต 13.51% ใช้น้ำจากเทศบาลเมืองป่าตอง นอกจากนี้ พบว่า 43.24% ใช้น้ำจากบ่อน้ำตื้น คลองธรรมชาติ ประปาหมู่บ้าน น้ำบาดาล และชื้อน้ำ 89.18% ของผู้ถูกสัมภาษณ์เผชิญกับปัญหาการขาดแคลนน้ำเป็นประจำทุกปี ซึ่งได้แก้ไขปัญหาคด้วยการเก็บกักน้ำฝนไว้ภายในถังเก็บน้ำที่มีขนาดใหญ่ขึ้น ในส่วนของการใช้น้ำเพื่อการท่องเที่ยวอย่างยั่งยืน การประหยัดน้ำ การใช้น้ำอย่างมีประสิทธิภาพ และการนำน้ำที่ผ่านการบำบัดแล้วมารดน้ำสวน จะเป็นการปฏิบัติที่มีประสิทธิภาพ การตระหนักเรื่องสิ่งแวดล้อมน่าจะมีบทบาทสำคัญในการใช้น้ำเพื่อให้เกิดการท่องเที่ยวอย่างยั่งยืน ดังนั้นควรมีความร่วมมือที่เข้มแข็งระหว่างผู้มีส่วนได้ส่วนเสียรวมถึงหน่วยงานราชการ รัฐวิสาหกิจ ภาคเอกชนและประชาชนในท้องถิ่นทุกคนซึ่งจะนำไปสู่การแก้ปัญหาการขาดแคลนน้ำในเขตเทศบาลเมืองป่าตองอย่างยั่งยืน

จุฬาลงกรณ์มหาวิทยาลัย
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Palida Rattanopas : WATER RESOURCE EFFICIENCY TOWARDS SUSTAINABLE TOURISM AT PATONG MUNICIPALITY, PHUKET PROVINCE, THAILAND. . Advisor: SANGCHAN LIMJIRAKAN, D.Tech.Sc

Tourism is one of the main incomes of Thailand that is directly contribute to the national GDP. Tourism affects not only on economic sector but also on the environment society. Sustainable tourism (ST) has become more important in conserving and maintaining natural resources for the next generation. The ST requires an efficient use of natural resources, particularly water resource. The objective of this research is to study water resource efficiency towards sustainable tourism at Patong Municipality, Kathu district of Phuket. Water shortage has taken place in Patong municipality for decades. A set of semi-structure questionnaires was used to in-depth interview respondents selected by using a purposive sampling method. The total respondents were 44 composing of 4 groups including hotel businesses, local communities, governmental organization, and tourism-related associations. Data obtained were analyzed using descriptive and content analysis method. The study found that the Phuket Provincial Waterworks Authority (PPWA) and the Patong Municipality are two major water suppliers in Patong municipality. 50% of respondents used water from the PPWA, while 13.51% of them used water from the Patong municipality. However, 43.24% of them also obtained water from their shallow well, natural canals, village water supply, groundwater, and purchasing water. 89.18% of respondents faced with water shortage yearly that be solved by collecting rainwater in bigger storage tanks. Concerning water usage leading to sustainable tourism, water saving, efficient water use and water treated reuse for gardening would be powerful actions. The environmental awareness would play a vital role on water use for sustainable tourism. Therefore, a stronger collaboration among stakeholders including governments, state-enterprises, private sectors and all local people would sustainably reduce water shortage in Patong municipality.

Field of Study:	Environment, Development and Sustainability	Student's Signature
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CHAPTER I

INTRODUCTION

1.1 Importance of the Study

In 2018, the World Travel and Tourism Council mentioned that tourism is considered as one of the largest economic sectors around the world. The percentage of global Gross Domestic Product (GDP) on travel and tourism in 2017 was 10.4% (World Travel and Tourism Council, 2018). Similarly, tourism in Thailand is one of the main national incomes of the country which is directly contributed to the national GDP of about 1,433.5 billion Baht (42.2 billion USD). This was accounted to 9.4% of total GDP in 2017. Tourism in Thailand affects not only on economic sector, but also on environment and society. The practicing of sustainable tourism, which is a part of sustainable development, has become more and more important in conserving and maintaining natural resources in good conditions for the next generation.

Generally, sustainable tourism (ST) requires an efficient use of natural resources, particularly water resources. According the principles for sustainable tourism of the United Nations World Tourism Organization (UNWTO) in 2004, ST should focus on using resources valuably and usefully, balancing the objectives among economy, society, culture and environment, and realizing a carrying capacity of resources. These principles are consistent to the efficiency of water use towards sustainable tourism. Resource efficiency (RE) consists of water resources, energy and wastewater (UNWTO, 2007). Therefore, efficiency of water use would lead to sustainable tourism.

Phuket is one of the popular tourist destinations of Thailand. In 2015, the number of tourists visiting the southern region of Thailand were 35,974,228 that accounted to visit Phuket of 12,520,769 (Department of Tourism, 2016). The number of tourists in Phuket increased to 13,410,658 in 2016 (Phuket Provincial Statistical Office, 2017). According to the increased number of tourists in Phuket each year, it increases resource consumption and production, particularly water resource that is an important

resource for tourism. In 2010, the Phuket Provincial Governor's Office (PPGO) reported that water demand using in Phuket increases about 2% each year. Water use in 2017 was about 61 million cubic meters and expected to increase to 78 million cubic meters in 2027, and 101 million cubic meters in 2037. In 2010, the Phuket Provincial Waterworks Authority (PPWA) also reported that the water demand in Phuket was 116,165 cubic meters per day, but actual water supply produced of 95,200 cubic meters per day. Therefore, water shortage was an important issue in Phuket and it still occurs today.

Patong municipality is located in Kathu district of Phuket province. The main water source of Patong comes from the Bangward reservoir. Regarding to the statistical data of Patong water consumption in Patong in 2012, the actual water use was 2,549 cubic meters per day while the demand of water use was higher at amount of 4,460 cubic meters per day (Seeduka, 2013). Besides, the number of hotels in Patong municipality has increased every year that predicted to increase from 134 hotels in 2012 to 278 hotels in 2032. This will lead to more water consumption and water shortage in Patong. Therefore, water shortage is an important issue in Patong municipality and still occurs today.

1.2 Research Objective

- To study water resource efficiency towards sustainable tourism at Patong municipality, Phuket province, Thailand.

1.3 Research Questions

- How to make water use sustainably at Patong municipality, Phuket province, Thailand?
- How can sustainable water use lead to sustainable tourism at Patong municipality, Phuket province, Thailand?

1.4 Scope of the Study

- The study area was at Patong, Phuket
- The study focused on water use in tourism sector at Patong, Phuket

- The study conducted using both quantitative and qualitative research methods
- Primary data obtained from target stakeholders in the study area using in-depth interviews and semi-structure questionnaire. Secondary data was obtained from desk studies such as governmental official documents, reports, and journal articles
- Data obtained were analyzed using descriptive and content analysis

1.5 Expected Outcomes

The expected outcomes of a study would be:

- Current situations of water use in tourism sector at Patong municipality, Phuket province
- Better understanding on water resource uses, problems and situation for sustainable tourism in Patong, Phuket
- The recommendation would be useful for further related study

1.6 Operational Definitions

- **Sustainable tourism (ST)**

Middleton and Hawkins in 1998 defined it as ‘Sustainable tourism means achieving a particular combination of numbers and types of visitors, the cumulative effect of whose activities at a given destination, together with the actions of servicing businesses, can continue into the foreseeable future without damaging the quality of the environment on which the activities the activities are based’. In 2005, UNEP described sustainable tourism as the tourism that is directly responsible for current and future economic, social and environmental impacts while addressing the needs of visitors, the industry, the environment and host communities. Moreover, sustainable tourism is to achieve growth without depleting the natural and built environment while preserving the cultural, history, heritage, and arts of the local community (Edgell Sr & David L, 2016). In addition, UNWTO (2004) stipulates that sustainable tourism should make best use of resources, maintain and conserve biodiversity, respect value systems of host communities, and distribute equally the socio-economic benefits for all stakeholders.

- **Water Resources**

Water resources are renewable and natural resources that are potentially useful, and water resources are used for agricultural, industrial, household, recreational and environmental activities (GreenFacts, 2008). Water resources consist of Ocean water, fresh water, surface water and other freshwater. 97% of the water on the Earth is salt water and only three percent is fresh water, and about two thirds of this is frozen in glaciers and polar ice caps (U.S. Department of the Interior, 2009). Fresh water is generally used by human in many activities. Sources of freshwater are surface water, under river flow water, groundwater, frozen water, and desalination (United Nations Development Programme, 2006). Furthermore, water resource uses are for tourism, agricultural, industrial, domestic, recreation and environmental purposes (Tervo-Kankare, 2014).

- **Water resource efficiency**

Water resource efficiency means doing more and better with less by obtaining more value with the available resources, by reducing the resource consumption and reducing the pollution and environmental impact of water use for the production of goods and services at every stage of the value chain and of water service provision (UNEP, 2014). Improving water resource efficiency means increasing water productivity that is, reducing the intensity of water use for, and pollution from socio economic activities through maximizing the value of the uses of water, improving the allocation of water among competing water uses so as to obtain greater socio-economic value per drop of water ensuring environmental flows, and improving technical efficiency of water services and the management efficiency of their provision over the complete life cycle.

CHAPTER II

LITERATURE REVIEWS

2.1 Sustainable Tourism

Tourism has both positive as well as negative impacts on environment and local population. Sustainable tourism can be a solution to the negative impacts by preventing the degradation and exploitation of natural resources. Sustainable development refers to the use without exploitation of natural, cultural, and all other resources from the current generation, it means to preserve them for future use by future generations (Angelevska & Rakicevik, 2012). The practice of sustainable development has become more and more important in conserving natural resources and maintaining them for the next generations. For instance, some tourist attractions are nature-based areas where natural resources have been destroyed and degraded over time. In consequence, the attractiveness of such destinations would be significantly destroyed as well. This also leads to attention for development of tourism, because potential tourists are interested in visiting attractive and clean destinations that offer services with high quality. Therefore, a good planning of sustainable tourism development directly concerns conserving the environment and natural resources in good conditions.

In 2016, the United Nation World Tourism Organization (UNWTO) provided the definition on sustainable tourism development consisting of 7 main points as follows;

- 1) operate under the ability to restore the environmental capacity in order to give services sustainably without decreasing or decaying the natural-resource values, and concern about community participation including community needs
- 2) fairly distribute all benefits to all members in community
- 3) give precious recreation experience to tourist
- 4) educate tourist about area, natural resources, and way of living
- 5) use local products and materials
- 6) apply sustainable tourism concept with all levels of management plans such as local, region, and national levels

7) rely on basic information for decision-making and auditing

Tourist behavior plays as a big influence to succeed sustainable tourism development. A well understanding of a concept of sustainable tourism and how to behave as a good tourist are very crucial for achieving sustainable tourism development plan. For instance, a case study in England by Miller, et. al. (2010) presented a lack of awareness that generates some negative impacts on environment. They found that tourists need to be educated more on what they should do and the information provided to them needs to be as practical as possible. However, some tourists did not know why they should act according to the information provided.

There are variation indicators of sustainable tourism developed by related organizations. Agyeiwaah, et. al. (2017) surveyed and evaluated seven indicator themes including job creation, business viability, quality of life, water quality, waste management, and energy conservation and maintenance of community integrity. The indicator theme is used to identify what needs to be assessed and monitored progress towards sustainable tourism is one of these indicators theme is water quality and play a role of water use in sustainable tourism.

2.1.1 Definitions of Sustainable Tourism

Tourism is one of the world's largest and fastest-growing industries. The impacts from tourism would be both positive and negative. Therefore, sustainable tourism is required to reduce negative impacts to environment, society, and economy.

There are various meanings of sustainable tourism. Some definitions of sustainable tourism are as follows:

Middleton & Hawkins (1998) defined sustainable tourism is an achieving a particular combination numbers and types of visitors, the cumulative effect of whose activities at a given destination, together with the actions of servicing businesses, that can continue into the foreseeable future without damaging the quality of the environment on which the activities the activities are based'.

Butler (1999) described sustainable tourism is a tourism which is developed and maintained in an area in such a manner and at such a scale that it remains viable over an indefinite period and does not degrade or alter the environment (human and physical) in which it exists to such a degree that it prohibits the successful development and well-being of other activities and processes.

UNEP (2005) described sustainable tourism is a 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.

Edgell (2006) that sustainable tourism is an achieving growth in a manner that does not deplete the natural and built environment and preserve the cultural, history, heritage, and arts of the local community. This concept is becoming increasingly recognized that sustainable management of resources will lead to acceptable conservation and the development of a higher-quality tourism product.

The World Tourism Organization (UNWTO) (2004) defined sustainable tourism as guidelines and management practices are applicable to all forms of tourism in all types of destinations, including mass tourism and the various niche tourism segments. Sustainability principles refer to the environmental, economic and socio-cultural aspects of tourism development and a suitable balance must be estimated between these three dimensions to guarantee its long-term sustainability.

In 2004, UNWTO further stipulated that sustainable tourism should make optimal use of resources, maintain essential ecological processes, conserve natural heritage and biodiversity, respect the social and cultural heritage and value systems of host communities, contribute to greater understanding and tolerance, and, lastly, ensure economically viable operations and the socio-economic benefits to be distributed equitably amongst all stakeholders.

Making optimal use of environmental resources along with maintaining essential ecological processes and helping to conserve natural heritage and biodiversity constitute a key element in the development of sustainable tourism (UNWTO, 2004). Moreover, sustainable tourism needs to respect socio-cultural authenticity of the host communities as well as to conserve their cultural heritage and traditional values. The Global Sustainable Tourism Council estimated that tourism contributes to 5% of the global economic activities and responsible for about 7% of global employment (UNEP, 2015). This means that the tourism industry would continue to demand huge quantities of energy, water, and other natural resources to support its sector. Sustainable tourism development guidelines and management practices were applicable to all forms of tourism in all types of destinations including mass tourism and various niche tourism segments. Sustainability principles of tourism refer to the environmental, economic and socio-cultural aspects of tourism development, and a suitable balance established between these three dimensions to guarantee its long-term sustainability (UNWTO, 2004).

2.1.2 Principles of Sustainable Tourism

Sustainable tourism is sometimes used in parallel with ecotourism. There are several definitions of ecotourism and most of them consider nature-based tourism that embraces the principles of sustainable tourism to be an ideal. According to the Quebec Declaration on Ecotourism (adopted in 2001 during the UN International Year of Ecotourism), ecotourism embraces the principles of sustainable tourism and the following principles which distinguish it from the wider concept of sustainable tourism are; contributes actively to the conservation of natural and cultural heritage; interprets the natural and cultural heritage of the destination to the visitor; and lends itself better to independent travelers, as well as to organized tours for small size groups (UNWTO, 2002).

Twelves principles of sustainable tourism were established by the UNWTO (2004) as follows;

- 1) economic viability
- 2) local prosperity

- 3) employment quality
- 4) social equity
- 5) visitor fulfillment
- 6) local control
- 7) community wellbeing
- 8) cultural richness
- 9) physical integrity
- 10) biological diversity
- 11) resource efficiency
- 12) environmental purity

Sustainable tourism is a topic involving various parties such as hotels, government, and tourists. New businesses would turn their focuses on new ecological risks while environmental pressures such as safety, ethical, social, regulations remain the challenge. It should be their task to find new ways of providing more resource efficient products and services (Lordkipanidze et al., 2013). Phuket, as a top tourist destination of Thailand, have been facing the problem of water shortage during dry season. Phuket would provide well conditions for the need of resource efficiency and environmental purity as the main focuses of this research.

Commonly, natural resources are consumed by tourists as well as locals (Briassoulis, 2002). This means that carrying capacity of resources is extremely crucial in management of sustainable tourism. For example, one case study in Morocco also focused on water resource in tourism sector. The rationale was that water resources in Morocco were very limited with the total actual renewable water resources per capita annually below 900 cubic meters, the rate considered under the proper rate for livelihood (Tekken & Kropp, 2015). Therefore, water availability was led to water shortage (Snoussi, 2002; UNEP, 2009). According to the case study in Morocco, the study found that water scarcity was also from tourism activities. Sufficient water availability was a key success factor for tourism industry. To prevent water shortage, policies and strategies in tourism should include management and development of water resources. Consuming high amount of water made the management of carrying

capacity of resources and resource efficiency very important.

2.1.3 Global Partnership for Sustainable Tourism

Partner organizations share the common vision and understanding of the goal of "sustainable tourism". They collaborate internationally, regionally, or nationally to transform tourism globally. The Global Partnership for sustainable tourism is a gathering of tourism stakeholders from both public and private sectors, non-profits organizations, the United Nations agencies and programs, international organizations, and academic institutions (UNEP, 2016). The goal of this organization is to transform the way tourism is done worldwide. The way to achieve this goal is to build partnerships to support the implementation of sustainable tourism practices at destinations through adoption of effective policies, innovative and transformative projects, sharing of knowledge and experience. The organizations have used an implementation-oriented approach that focuses on building effective partnerships and the coordinating office of the Global Partnership under the jointly management of the United Nations Environment Program (UNEP) and the World Tourism Organization (UNWTO).

2.2 Sustainable Tourism in Thailand

Tourism industry in Thailand has brought a great economic significance accounted for 16.6% of Thailand's GDP in 2015 (Ministry of Tourism and Sports Thailand, 2017). Thai tourism industry was responsible for over 4.2 million jobs or 11% of total national employment in 2015. Moreover, the Ministry of Tourism and Sports stated that "Thailand will be the World's leading quality destination, through balanced development while leveraging Thainess to contribute significantly to the country's socio-economic development and wealth distribution inclusively and sustainably". The Designated Area for Sustainable Tourism Administration (DASTA), a public organization working on sustainable tourism in Thailand, are set up by the virtue of Royal Decree on the setting up of Designated Area for Sustainable Tourism Administration (Public Organization) B.E. 2546 (2003). Its objectives were set in accordance with government's policy to develop sustainable tourism (Sangsnit, 2013). In 2018, the Global Sustainable Tourism Council (GSTC), a neutral and independent

USA-registered non-profit organization that conducts global baseline standards for sustainable tourism, announced that Thailand's Sustainable Tourism Management Standard conducted by the DASTA has achieved the 'GSTC-Recognized Standard' status. Thailand's Sustainable Tourism Management Standard is set for managing tourism and helping all types and sizes of organization related in tourism to achieve higher performance than the basic level required by law (Tourism Authority of Thailand, 2018). The standards would be challenging for tourism-related organizations that desire to improve their operation to be more efficient. There are 10 destination standards and 30 hotels and tour operator standards that accomplished the GSTC-Recognized status. This means that the DASTA's sustainable tourism standards adhere to the international norms.

The adoption of this standard tends to increase and distribute income to local communities, with the roles defined for the DASTA (Sangsnit, 2013) as follows:

- 1) to have the administration and development of areas for tourism in an integrated manner
- 2) to be the central organization in the formulation of policies and strategic plans
- 3) to coordinate with localities or areas that are tourist destinations or to promote and develop areas with tourism potentials to have administration of area for quality tourism
- 4) to mobilize personnel, budget and tools for use in the administration of tourism with unity, and to solve problems promptly
- 5) to promote the use of knowledge of modern management in order to reach the set objectives.

2.2.1 Strategies of Sustainable Tourism in Thailand

The DASTA has developed destinations in 6 designated areas for sustainability in 3 dimensions; economic, social, and environmental.

In terms of social dimension, co-creation is the way to develop sustainable tourism by undertaking of projects that support a community-based tourism. Its rationale is to

support communities and local administrative organizations in the project area with tourism activities as various as traditional events held (Sangsnit, 2013). Especially, it aims to ensure “Community Benefitting Through Tourism” (CBTT).

For environmental dimension, there are 4 measures to reduce global warming conditions through tourism, namely, wastewater management and reuse, solid waste management, water efficiency, and energy efficiency. Moreover, low-carbon Destination is promoted in the development plan.

For economic dimension, The DASTA has selected “Creative Tourism” as a tool for community to improve economic situation. The DASTA stated in 2013 that “Creative tourism is tourism development that stresses on value creation for tourism resources on the basis of Thainess, such as the way of life, local wisdom, art and culture, and history”.

2.2.2 The Second National Tourism Development Plan (2017-2021)

Ministry of Tourism and Sports of Thailand developed the Second National Tourism Development Plan 2017-2021. It is a continuing plan from the first National Tourism Development Plan 2012-2016 (NTDP 2012-2016) which was the National Master Plan for Thailand tourism development. The first plan emphasized on improving tourism quality while balancing demand and supply (Ministry of Tourism and Sports Thailand, 2017). It succeeded economically with the tourism receipt growth of more than 15%, and 8 tourism groups were, then, established. For this reason, the Second National Tourism Development Plan 2017-2021 (NTDP 2017-2021) will continue with the same strategy. The main focus of the second is to lead Thailand to the global tourism market and strengthen sustainable tourism of Thailand.

According to the 20-year National Strategic Plan, Thailand shall move towards a better nation with “Prosperity, Stability and Sustainability”. Therefore, the second NTDP focuses on a long-term view by applying the 20-year national tourism development vision towards 2036 in order to reach more prosper, stable and

sustainable tourism as well. The 20-year vision of the second NTDP can be divided as follows;

1) Visions

Thailand tourism vision towards 2036 comprised of 5 key essences

- a. leading quality destination
- b. having a balanced development
- c. leveraging Thainess
- d. enhancing country's socio-economic development and wealth distribution inclusively
- e. contributing sustainable development

2) 5-year strategic objectives and targets

Table 2.1 Thailand's tourism's 5-year strategic objectives and targets

Objectives	5-year KPIs
Objective 1: To become quality tourism destination which increases tourism competitiveness	<ul style="list-style-type: none"> - Number of attractions/businesses with quality mark (To increase at least 5% p.a.) - Travel and Tourism Competitiveness Index TTCI (To become global top 30 or APAC top 7) - Level of confidence in tourism products and services (To exceed or equal to 90%)
Objective 2: To increase economic value of tourism industry with balance and sustainability	<ul style="list-style-type: none"> -International tourism receipts (To increase at least 10% p.a.) - Number of domestic tourism (person-time) (To increase at least 3% p.a.)
Objective 3: To distribute tourism income and benefits inclusively throughout the nation	<ul style="list-style-type: none"> -The ratio of international tourist traveling to Thailand during June - September (To become equal or more than 1/3 of annual total trips) - Tourism receipts in second-tier provinces (< 1m visitors per year) (To increase at least 12% p.a.)

<p>Objective 4: To sustainably develop tourism industry on the principle of Thainess and environmental sustainability</p>	<ul style="list-style-type: none"> - Thainess awareness index in international and Thai tourists (To increase every year) - Cultural and Entertainment tourism digital demand (TTCI) (To become world's top 10) - Composite of environmental sustainability indices (To improve at least 10 ranks in each index)
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Source: Ministry of Tourism and Sports Thailand (2017)

3) Thailand tourism 5-year strategic axes

To achieve such 4 objectives, there are 5 strategies established as follows:

Strategy 1 Develop tourism attractions, products, and services in a balance and sustainable way

- Developing all forms of tourism attraction, products, and services in good standard
- Developing sustainable tourism attractions, products, and services
- Balancing in tourism attractions, products, and services in all types of tourism focusing on areas, times, seasons, and tourism forms

Strategy 2 Develop basic infrastructure and amenities in order to prepare for the expansion of tourism industry

- Developing logistic systems in tourism sector
- Developing amenities in tourism sector
- Developing security system and sanitation in tourism destinations

Strategy 3 Develop human resource in tourism sector and encourage people participation for developing tourism

- Developing human resource ability in all systems related to tourism sector to have the utmost competitive ability at international standard level
- Encouraging people participation in tourism management to gain benefits from tourism

Strategy 4 Creating a balance for tourism through target groups, embracing Thainess, and creating confidence among tourists

- Enhancing quality image and security of Thailand
- Encouraging target group marketing to increase travelling and stimulate tourist spending
- Embracing Thai identity and characteristics including locals
- Promoting domestic tourism including suitable time and area to travel
- Cooperating with all stakeholders and using technology for marketing

Strategy 5 Integrating tourism management and promoting international collaboration

- Encouraging and maintaining tourism management efficiently
- Improving law regulations, policies relevant to tourism, and law enforcements
- Encouraging private sector investment and conducting tourism information center
- Promoting international collaboration for tourism development

Among these strategies, strategy 1 which aims to develop tourism attractions, products, and services in a balance and sustainable way is the most relevant to this research. Many products and services consist of water resource. To provide products and services more sustainably, water needs to be used in an effective way to meet tourist demands.

2.3 Sustainable Tourism in Phuket

Phuket, a city in the south of Thailand, is a tourist destination with an island landscape of beautiful beaches and clear ocean water (Phuket Provincial Statistical Office, 2017). Among Thailand's southern destinations, it is the top-rank tourist destination. Moreover, Phuket is well known for its culture and unique architecture. It also has an outstanding marine tourism. In the area, there are so many tourist activities such as recreation and water sports. There was a significant increasing trend in the number of tourists visiting Phuket (Phuket Provincial Statistical Office, 2017). In 2016, there were approximately 13 million visitors visiting Phuket.

According to the Phuket Development Plan 2018-2021 (PDP 2018-2021) made by the Phuket Governmental Office, it is stated that sustainable tourism is promoted in Phuket city (Phuket Provincial Governmental Office, 2018). The vision of the Phuket Development Plan 2018-2021 is “Phuket as an international tourism city to become a developed province”. The plan also follows the goals of the Sustainable Development Goals (SDGs) of the United Nation. One strategic agenda of the PDP 2018-2021 is to enhance sustainable tourism to support international development. This means that Phuket has incorporate sustainable tourism into its development plan.

In 2015, there was a joint conference on sustainable tourism between Phuket government sector and tourism-related private sector. The topic of the conference was “Security is the Heart of Tourism: A Sustainable Tourism”. Many organizations attended this conference such as the Ministry of Tourism and Sports, Phuket local administration, and hotels to clarify on roles and responsibilities in terms of compliance with laws and related regulations. The purpose of this gathering was to enhance the strength of Phuket’s sustainable tourism (Phuket Provincial Governmental Office, 2018).

Moreover, the Phuket Hotels Association, a non-profit organization with more than 60 member hotels and resorts, set up a forum called “Phuket Hotels for Islands Sustaining Tourism Forum 2018” or “PHIST”. PHIST is an event for all hotels in the industries and stakeholders such as government sector, corporate sector, academic sector, NGOs, start-ups, and international media to discuss environmental sustainability and community benefit. It also aimed to share best practice and opportunity for enhancing sustainable tourism in Phuket. The forum also discussed awareness raising and children educating.

2.4 Water Usage

In 2011, water use in tourism-related activities was approximately less than 1% of global consumption. Although the rate of water use in global tourism was still increasing, it would not reach the significant level even if the sector continues to grow

at the anticipated rates of around 4% per year. However, the situations between different regional levels were not the same because tourism concentrates traveler flow in specific time and space. Nevertheless, it was often that water resources are limited in drier destinations. The direct water uses were such as accommodation and activities, while the indirect water use was fossil fuel use for transports, food, and infrastructure.

For accommodation, daily water consumption rates were in a range between 84 and 2000 liters per tourist or up to 3,423 liters per bedroom (Baillon & Ceron, 1991). For activities, there were so many tourist activities related to water use such as golfing and skiing with snowmaker. For example, golf course consumed water depending on soil, climate, and its size (Baillon & Ceron, 1991). For infrastructure, the construction and functioning of buildings were responsible for 17% of water consumption worldwide (Roselló-Batie, 2010). For food, UNESCO (2009) reported that, depending on local climate, crop varieties, and agricultural practices, it took 400 to 2,000 liters of water to produce one kilogram of wheat; and depending on livestock, feeding, and management, it took 1,000 to 20,000 liters of water to produce one kilogram of meat. Based on these figures, it was estimated that daily water requirement to support human daily diets range from 2000 to 5000 liters of water per person with an estimated of one liter of water for one kilocalories of food. For fuel use, water and energy were two factors related to energy production such as thermoelectric cooling, hydropower, minerals extraction and mining, fuel production, and emission controls.

Water for irrigation around the world was approximately 70%, with 15-35% of irrigation withdrawals being unsustainable (WBCSD, 2009). To produce enough food to satisfy one person's daily dietary need, it took approximately 2,000-3,000 liters of water (Steduto, 2017). This was considered as a big amount comparing to drinking water human body needs, which was just two and five liters.

The water used in industrial sector was approximately 22% (WBCSD, 2009). Hydroelectric dams, thermoelectric power plants that used water for cooling, and ore and oil refineries were major industrial users of water resources. They used water as a

solvent in chemical processes or manufacturing plants. The consumption was normally much lower than that of agriculture, but water withdrawal could be higher. Water could be used in renewable power generation. Hydroelectric power derived energy from the force of water flowing downhill, driving a turbine connected to a generator. The hydroelectricity was considered as a low-cost, non-polluting, and renewable energy sources, but were discontinuous. Hydroelectric power plants generally required the creation of a large artificial lake. The evaporation from this lake was higher than that from a river due to the larger surface area, and this resulted in higher water amount consumed.

Daily domestic water used in developed countries ranges from 100 to 180 liters per person, the number corresponding to 30–70% of the amount needed in an urban area (Friedler & Hadari, 2006). In the past decades, this amount has increased due to intensive and worldwide overexploitation, leading to high values of water stress issue. WBCSD stated in 2009 that there was about 8% of worldwide water that was used for domestic purposes. The domestic purposes include drinking water, bathing, cooking, toilet flushing, cleaning, laundry, and gardening. Peter Gleick was estimated that basic domestic water consumption requires around 50 liters a person, daily. This was not water for gardens. Specifically, drinking water was water that has high quality and would not bring harm or risk for consumers in both immediate and long-term harm. It was commonly called potable water. For domestic water use type, it was relevant to this research study of water resources in Patong, Phuket due to the fact that water consumptions in Patong were mainly domestic uses by tourists and locals alike.

Recreational water use was usually a very small but growing percentage of total water use. Moreover, recreational water use was mostly related to reservoirs. For instance, if a reservoir was kept fuller than it would otherwise be for recreation, then the water retained could be categorized as recreational usage. Usually, recreational usage was non-consumptive. Golf courses were often targeted as using immoderate amounts of water. However, it was still not being proved that recreational irrigation, including private gardens, had a direct effect on water resources. Recreational usage might reduce the availability of water for other users at specific times and places. For

example, water retained in a reservoir to allow boating in the late summer was not available to farmers during the spring planting season.

There was a very small percentage of environmental water use, but it was still growing. Environmental water usage includes watering of natural or artificial wetlands, artificial lakes intended to create wildlife habitat, fish ladders, and water releases from reservoirs timed to help fish spawn or to restore more natural flow regimes. Environmental usage was similar to recreation usage in terms of being non-consumptive, but it possibly reduces the availability of water for other users at specific times and places.

2.4.1 Sources of water use

For sources of water use, there are mainly five sources of water use, namely, surface water, under river flow, groundwater, frozen water, and desalination.

Surface water consists of water in a river, lake, or fresh wetland. Generally, surface water occurs by precipitation and lost through discharge to the oceans, evaporation, evapotranspiration, and groundwater recharge. The largest supply of surface water in the world was in Brazil, followed by Russia and Canada (Worldwater, 2009). The total amount of surface water depended on many factors such as capacity in lakes, wetlands, and artificial reservoirs, because they could affect the amount of water loss. Moreover, human activities were one of the factors effecting runoff water.

River flow is considered a combination between the visible free water and substantial contribution flowing through many rocks and sediments that underline the river. Its floodplain called hypogenic zone is a region beneath and alongside a stream bed where there is mixing of shallow groundwater and surface water. The hypogenic zone combines a dynamic between surface water and groundwater from aquifers. Moreover, it exchanges flows between rivers and aquifers that may fully depleted, resulting in an occurring of potholes and underground water.

Groundwater is fresh water located between soils and rocks; it also refers water flows in aquifer that is under water table (Columbia Water Center, 2009) This is sometimes called 'Fossil water'. Surface water and groundwater have some characteristics in common, namely, inputs, outputs, and storage. The difference for groundwater is that the storage is generally bigger comparing with inputs. In contrast, surface water's storage is small, but has bigger inputs. This makes human consumes a lot of surface water in unsustainable ways without concerning the consequences in long term. The natural input to groundwater is seepage from surface water. The natural outputs from groundwater are springs and seepage to the oceans. To increase the input to groundwater source, man-made reservoirs and detention ponds are built. Human use of groundwater can cause soil salinization. Moreover, ground water can be polluted by human activities as well.

For frozen water, several projects were proposed to make use of icebergs as a water source. Unfortunately, the real-world implementation of these projects has not yet been successful. Besides, glacier runoff is considered as surface water (Gleick, 1993). For example, the Himalayas, which were considered as the roof of the world due to its height, have the greatest area of glaciers and around ten Asia's largest rivers flow from there. It means that the livelihood of more than a billion people depended on them. From this fact, the most relevance to this situation of glaciers runoff was from the rising of temperature.

Desalination is an artificial process to convert saline water or seawater into freshwater. The most common desalination processes are distillation and reverse osmosis. However, desalination process is not cheap comparing to other sources of water, and only small number of people have accessed to desalination. For household and industrial uses, it usually is economically practical for high-valued uses. Nevertheless, there is also a significant growth in desalination for agricultural use.

2.4.2 Water Stress

According to the World Business Council for Sustainable Development (WBCSD), water stress is a situation where there is not enough water for every user. This

includes all agricultural, industrial, or domestic uses. There are more focuses on water use and its efficiency. Water scarcity is the lack of freshwater resources to meet water demand; this affects economic development, human health, and well-being.

Population growth is one of the causes of water stress. In 2000, the world population was at 6.2 billion; by 2050, the United Nations projected the number to be at an additional of 3.5 billion people, most of which will be born in developing countries where water stress already existed (United Nations, 2005). The World Bank stated that the assessment of water for producing food would be one of the most challenges for humanity (World Bank, 2010). World Bank said in 2010 that “Access to water will need to be balanced with the importance of managing water itself in a sustainable way while taking into account the impact of climate change, and other environmental and social variables”.

Expansion of business activities could lead to water stress. Industrialization has been expanding rapidly as well as business activities such as tourism and other entertainments. It requires water services in both supply and sanitation, which could lead to more pressure on water resources and natural ecosystems (World Bank, 2010).

Climate change could also have significant impacts on water resources around the world due to the connections between climate and hydrological cycle. The rise of temperature increase evaporation as well as precipitation; both floods and droughts could occur more frequent at different places in the different times. Furthermore, the dramatic changes in snowfall and snowmelt were also expected in mountainous areas. Higher temperature would also affect water quality in ways that were not well understood. Eutrophication was considered as a possible impact (World Bank, 2010). The demand for farm irrigation, garden sprinklers, and paraphed even swimming pools would increase when the climate changes (World Bank, 2010).

Water pollution is one of the major concerns of the world today. The governments all over the world are trying to eliminate this problem. Many pollutants threaten water supplies, but the most widespread one is the discharge of raw sewage into natural

waters. Sewage, sludge, garbage, and even toxic pollutants are all dumped into the water and generate water pollution. In addition to sewage, nonpoint source pollution such as agricultural runoff, along with urban stormwater runoff and chemical wastes dumped by industries and governments, are significant source of pollution in some parts of the world, along.

In recent years, the competition for water has significantly increased. It was true that compromising the necessities of water supply for human consumption, food production, ecosystems, and other uses was very difficult (Zwarteveen, 2009). Water administration was frequently involved in dispute and complex problems. Floods occur in several areas of the world, while, at the same time, low precipitations also happened in many places. Due to population and development increase, there would be a rise of water demand and other possible problems (Masters, Ela, & Parra, 2008). The example of an actual inter-state conflict over water took place between 2500 and 2350 BC between the Sumerian states of Lagash and Umma (Rasler & Thompson, 2006). Water stress had most often led to conflicts at local and regional levels (Postel & Wolf, 2001). China's Yellow River and the Chao Phraya River in Thailand have been confronting water stress for many years. A decrease in freshwater quality and quantity could affect health, economic development, and exacerbating larger conflicts (Postel & Wolf, 2001).

Water shortage is the most relevant issue to this research. Water resource management in Patong municipality emphasizes on how to eliminate water shortage. Patong municipality is a tourist attraction and has high rate of water consumption. Water shortage could mean that there is insufficient water supply or water quality is not good enough. This suggests growing conflicts with agricultural water users, who currently consume majority of the water used by humans. Generally speaking, more developed countries of North America, Europe, and Russia will not see a serious threat to water supply by the year 2025, not only because of their relative wealth, but also because their populations would be better aligned with available water resources (Zwarteveen, 2009).

2.4.3 Increasing Water Scarcity

Water scarcity occurs when there is not enough fresh water for water demand. The World Economic Forum listed water scarcity as the largest global risk in terms of potential impact over the next decade (World Economic Forum, 2015) . In the past, water was considered as an infinite resource, and there were much fewer population in the world. People were not as wealthy as today, and they absolutely consumed fewer than today as well. Less food, and water were consumed comparing to today's situation. In recent years, the use of freshwater resources has been much more intense (World Economic Forum, 2015). The reason was that there were seven billion people on the planet, and thus the higher consumption rate. Moreover, there was an increasing competition for water from industry, urbanization, biofuel crops, and water reliant food items. Furthermore, water would be more necessary and needed in food production due to the projection that world population would increase by 2.5 billion by 2050 (United Nations, 2007).

The International Water Management Institute in Sri Lanka conducted an assessment of water management in agriculture sector in 2007 to find out whether the world had sufficient water to provide food for the growing population or not (Molden et al., 2010).

They assessed the current availability of water for agriculture on a global scale and mapped out locations suffering from water scarcity. They found more than 1.2 billion people living in areas of physical water scarcity. Water sources could not meet all demands. More than 2.3 billion people did not have access to clean drinking water. To avoid a global water crisis, farmers would have to strive to increase productivity to meet growing demands of food, while industry and cities will have to find ways to use water more efficiently (Chartres & Varma, 2010). Improvements in irrigation methods and technologies, agricultural water management, crop types, and water monitoring were ways to produce more food with less water (Hsiao et al., 2009).

2.5 Water usage in Thailand

This research study focused only on domestic use specifically in tourism sector.

Water use in Thailand is under two state enterprises, the Metropolitan Waterworks Authority (MWA) and the Provincial Waterworks Authority (PPWA).

The Metropolitan Waterworks Authority is a state enterprise under the supervision of the Ministry of Interior. It was established on 16 August 1967 by the Metropolitan Waterworks Authority Act 1967. Its main mission is to secure raw water supply for production sector, transport sector, and selling sector in Bangkok, Nonthaburi and Samutprakarn. There were 18 branch offices and the service area covering over 2,384.9 square kilometers (Metropolitan Waterworks Authority, 2016). The production capacity was about 6.72 million cubic meters a day.

From table 2.1, the statistics of water use in Bangkok presents that the total user's number has generally increased from 2,113,674 users in 2013 to 2,328,598 users in 2017. Therefore, the amount of water consumption has also increased from 1,361,000,000 cubic meters in 2013 to 1,408,600,000 in 2017.

Table 2. 2 Statistics of water usage for Bangkok by the Metropolitan Waterworks Authority (MWA) between 2013 and 2017.

Details	Total Users (Individual)	Amount of water production (Cubic meter)	Amount of water consumption (Cubic meter)
2013	2,113,674	1,804,000,000	1,361,000,000
2014	2,171,371	1,797,000,000	1,377,200,000
2015	2,226,707	1,835,000,000	1,406,300,000
2016	2,281,058	1,965,900,000	1,406,300,000
2017	2,328,598	2,063,800,000	1,408,600,000

Source: Metropolitan Waterworks Authority (2017)

In 2017, the Provincial Waterworks Authority provided their services in Central, Eastern, Northern, Northeast, and Southern region. The PWA categorized the water users into 3 groups: 1) housing and others such as house, condominium, and vendor; 2) government and small business such as governmental institute, public school and public hospital; and 3) state enterprise, industry and large business such as private

school, private hospital, service and accommodation, and commercial bank. The statistical water usage from the PWA is shown in table 2.3. The total water users had significantly increased from 2,784,163 users in 2008 to 24,459,027 users in 2017, as well as the amount of water production that had gradually increased from 1,208,664,396 cubic meters in 2008 to 1,983,208,764 cubic meters in 2017 (Phuket Provincial Waterworks Authority, 2018). Besides, the amount of water consumption had also increased from 841,049,964 cubic meters in 2008 to 1,234,191,960 cubic meters in 2017.

Table 2. 3 Statistics of water usage in Thailand by the Provincial Waterworks Authority between 2008 and 2014.

Details	Total Users (Individual)	Amount of water production (Cubic meter)	Amount of water consumption (Cubic meter)
2008	2,784,163	1,208,664,396	841,049,964
2009	2,948,129	1,282,888,584	895,482,420
2010	3,118,946	1,312,192,452	904,739,952
2011	3,275,275	1,405,228,200	956,121,852
2012	3,434,948	1,525,476,540	1,018,522,536
2013	3,615,103	1,559,097,936	1,052,433,804
2014	3,794,222	1,674,366,312	1,108,600,692
2015	3,967,997	1,708,666,320	1,140,145,236
2016	4,140,323	1,787,180,592	1,162,757,376
2017	4,459,027	1,983,208,764	1,234,191,960

Source: Phuket Provincial Waterworks Authority (2018)

2.6 Water usage in Phuket

Water supply in Phuket is supplied by the Provincial Waterworks Authority (PPWA). The statistics of water usage in Phuket is shown in table 2.4. Water usage in Phuket is categorized into 28 user groups such as tourism sector, housing, retail store, etc. (Seeduka, 2013). The major water users are hotel businesses. The number of tourists visiting Phuket also increased of 12,520,769 in 2015 to 13,410,658 in 2016 (Phuket Provincial Statistical Office, 2017).

Table 2. 4 Statistics of water usage in Phuket by the Provincial Waterworks Authority between 2008 and 2017.

Details	Total Users (Individual)	Amount of water consumption (Cubic meter)
2008	31,372	14,030,772
2009	34,914	14,023,176
2010	38,326	15,362,664
2011	41,672	16,737,312
2012	45,526	17,009,460
2013	49,269	18,873,672
2014	52,471	18,420,912
2015	54,980	18,809,940
2016	57,549	20,083,836
2017	60,108	20,463,336

Source: Phuket Provincial Waterworks Authority (2018)

2.6.1 The Phuket Provincial Waterworks Authority (PPWA)

The Phuket Provincial Waterworks Authority (PPWA) is located in Kathu district. In 1987, the production capacity was 1,000 cubic meters per hour, and the raw water source was from the Bang Yai canal, the Kathu waterfall and the Lockpalm mine. At that time, the PPWA only provided service in Patong municipality. Since then, the PPWA have improved and extended the production system and capacity. The chronicle activities of the PPWA are shown in the table 2.5.

Table 2. 5 Chronicle activities of the Phuket Provincial Waterworks Authority

Sessions	Years	Situations
1	1987	<ul style="list-style-type: none"> Built production system with 1,000 cubic meters per hour at Bangward water production station, the Bang Yai canal, the Kathu Waterfall
2	1997	<ul style="list-style-type: none"> Built new production system (Mobile Plant) with 500 cubic meters per hour at Bangward water production station The raw water source was from Bangward Reservoir
3	1999	<ul style="list-style-type: none"> Made contract with a private company for buying water with surface water system around 10,000 cubic meters per day
4	2005	<ul style="list-style-type: none"> Updated the contract with the private company from 10,000 cubic

		<p>meters per day to 16,000 cubic meters per day</p> <ul style="list-style-type: none"> • Made a contract of buying RO system's water from a private company with 12,000 cubic meters per day
5	2006	<ul style="list-style-type: none"> • Built a production area at Bang Joe water production station with 500 cubic meters using raw water from Klong Bang Nheaw Dham reservoir
6	2015	<ul style="list-style-type: none"> • Renovated the Bangward water filter plant • Increased the production capacity from 1,000 cubic meters per hour to 2,000 cubic meters per hour • Applied a new mobile plant water production system with 500 cubic meters per hour
7	2015	<ul style="list-style-type: none"> • Adjusted the Bang Joe water production station's water production capacity from 500 cubic meters per hour to 800 cubic meters per hour • Applied a new mobile plant water production system with 500 cubic meters per hour

Source: Phuket Provincial Waterworks Authority (2016)

In 2016, the PPWA had the total water production capacity of 76,800 cubic meters per day. This production capacity was from the PPWA and a private company. The PPWA had the production capacity at 36,000 cubic meters per day (24,000 cubic meters per day from Bangward water production station and 12,000 cubic meters per day from the Bang Joe water production station) It drew raw water from the Bangward reservoir, the Bang Yai canal, the Kathu waterfall, abandoned mines, and the Klong Bang Nheaw Dham reservoir (Phuket Provincial Waterworks Authority, 2018).

While private companies had production capacity at 40,800 cubic meters per day or 700 cubic meters per hour in 2016. There were 4 water production stations namely the Klong Kathu water production station, the Nam Kang Nguan water production station, the Karon RO water production station, and the Bang Tao water production station (Phuket Provincial Waterworks Authority, 2016).

As claimed by the PPWA in 2016, the average amount of water demand was at

90,000 cubic meters per day, and the highest water demand amount was at 110,000 cubic meters per day. However, the total amount of produced water and purchased water from private company was only at 94,000 cubic meters per day (Provincial Waterworks Authority, 2017) In 2017, The PPWA reported that there was a significant increase in the number of water users from 54,794 users in 2015 to 63,794 users in 2017. The water demand had also risen from 116,071 cubic meters per day in 2015 to 140,999 cubic meters per day in 2017. On the other hand, the production capacity remained stable at 76,800 cubic meters per day

2.7 Sustainable water usage

The United Nations (UN) stated that water is the important core of sustainable development in driving socio-economic development, better ecosystems, and for improving human well-being (United Nations, 2008). Water is a finite resource that is fundamental to human well-being; it is also an essential resource for many human activities. Therefore, water resource needs good management in order to sustain water availability for the next generations.

Sustainable water resources management focuses on the needs in the long-term future as well as the present (Loucks, 2000). Sustainable water resource systems are those designed and managed to completely contribute to the objectives of society for present and in the future as well as maintaining their ecological, environmental, and hydrological virtue (Loucks & Gladwell, 1999). Therefore, sustainable water usage is very crucial for human lives.

According to the Sustainable Consumption and Production (SCP) of the Sustainable Development Goals 12 (SDG12) under the United Nations (UN) promotes resource and energy efficiency use. Water resources is one of the SCP (UNEP, 2015). In 2017, the European Commission (EC) defined Resource Efficiency (RE) as a sustainable use of the Earth's restrictive resources in order to minimize impacts on the environment. The concept of RE is to create more with less and to deliver greater value with less input (European Commission, 2017). While Resource Efficient Scotland (n.d.a) stated that reducing water consumption makes commercial and

environmental sense in terms of money saving, organization's reputation enhancing and natural resource preserving.

2.7.1 Sustainable water programs and practices

There are several ways to manage water sustainably. For example, resource-efficiency technology in water supply and treatment such as wastewater reuse and wastewater treatment could hugely save a lot of water (Werner & Collins, 2012). Therefore, resource-efficiency policy should be grounded in an awareness concerning the impacts on the environment. Importantly, water shortage and drought issues should be the main topics of concern. Water use reduction and water use efficiency plans should be conducted once water situation is understood (Agyeiwaah, et. al, 2017). Reusing wastewater is another alternative way in sustainable water usage (Werner & Collins, 2012). This is especially true for islands and coastal regions where water recycling tends to be a good efficient use of freshwater while avoiding discharge to the sea.

Water-saving devices and measures to address leakage in water supply systems also play an important role. Over recent decades, there have been so many water efficient products that have greatly been improved such as washing machines, dishwashers, toilets, taps, showers, and general plumbing (Werner & Collins, 2012). Toilet flushing alone accounts for approximately 25-30% of total domestic water use. Using dual flush or low flush toilets daily could save about 30 liters per property (Waterwise, 2010). Moreover, using water efficient showerheads daily could also save water about 25 liters per property. Infrared-sensor taps which provide water only when detecting an object result in water savings of more than 70% of what had been.

Reuse of greywater and rainwater harvesting are other options to conduct sustainable water use (Werner & Collins, 2012). Greywater refers to all wastewater excluding that from toilets, baths, showers, kitchens, and washing machines. In the most simplistic reuse systems, greywater is stored and untreated, then, used for toilets flushing and gardening. Rainwater flowing from a roof can be transferred to a receiving container in order to be used for gardening or car washing.

Water leakage in water systems is usually a general issue in many places. The systems with high costs can sometimes be obstacles to eliminate such problem (Werner & Collins, 2012). According to the European Benchmarking Co-operation, they report distribution losses of about 5 cubic meters/day/km of mains in the supply network stating that the largest component of distribution loss is usually leakage. Leakage in sewerage system is also a key concern.

People's awareness on conserving water can possibly and hugely help conserve water. There are so many useful awareness-raising campaigns about conserving water. Those campaigns can encourage people through websites, education programs in schools, and advertising brochures.

In order to use water sustainably, sustainable programs could raise awareness of people to concern more about conserving water. There are some good example programs as follows;

1) The Project Planet Program

Project Planet, recognized around the world in hospitality industry such as hotels, is environmental linen and towel reuse programs. The program includes training and printed materials. For instance, the program sells printed materials such as door hanger and posters that consist of invitation message for guests to participate with the program. The program encourages guests to reuse towel and linen for saving water and energy (Green Suites, 2019).

2) Earth Check Certification

Earth Check is a benchmarking certification for travel and tourism industry. Earth Check works with governments, businesses, and local authorities to keep clean and safe destinations. They use their strategic consulting services and technology solutions. Moreover, the most important things are the certification and capacity building programs. Earth Check Certification are for hotels that concern about the environment and resource efficiency (EarthCheck, 2019). There are 6 steps to certify the Earth Check Certification:

a) Policy

Hotels need to follow environmental and sustainable development policies. There are policies from Earth Check to keep hotel on a good standard. Hotel progress needs to be improved every year. For some policy examples, hotels must communicate with stakeholders about their progress and what they are doing, follow the laws, and also buy local products and services.

b) Benchmarking

The program requires hotels to collect accurate data of water use, energy use, and the amount of solid waste. The collected data will be compared with the previous year. They will consider how they should manage their strategies to go beyond the previous-year data.

c) Compliance

Hotels need to follow the laws including international laws and code of conduct.

d) Approach

This is a very important step. It is about evaluating risks generated to environment by the hotel. There are many main key performance areas such as greenhouse gas, energy use, water use, wastewater treatment, solid waste, and hazardous waste.

e) Performance

This step is to take actions following the approaches of all key performance areas.

f) Communication

Communication means communicating with all stakeholders. For instance, a hotel must communicate with suppliers informing that the hotel is trying to reduce the amount of solid waste in the hotel, so the suppliers would reduce the use of wrapping, packaging or plastic bags to help decrease the amount of solid waste.

3) A practice to improve water efficiency

The Resource Efficient Scotland, for example by Scottish Government, helps

businesses and public organizations save money by using resources more efficiently, sets a 10-step practice guide to support water management, and efficiency improvements for Scottish organization (Resource Efficient Scotland, n.d.a). This practice is very useful for some organizations that do not have any plans concerning water resource efficiency. The practice is to help reduce water consumption while maximize water resource efficiency. There are 10 steps to improve water efficiency for Scottish organizations as following.

- a) Engage with your organization
- b) Identify where, how much, and why water is being used within your organization
- c) Review your bills and determine how much water consumption and disposal is costing your organization
- d) Develop a water mass balance for your site
- e) Develop a measuring and monitoring program for your organization
- f) Benchmark your organization against internal and external Key Performance Indicators (KPIs) and target to improvements.
- g) Developing a Water Efficiency Improvement Action Plan (WEAP)
- h) Water Efficiency Improvement Action Plan (WEAP)
- i) Review, evaluate and communicate
- j) Continuous improvement

These sustainable water programs and practices are real examples that any organization is able to conduct especially in tourism sectors.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Conceptual Research Framework

This research aims to study water resource efficiency for sustainable tourism in Patong Municipality, Phuket province, Thailand. The conceptual framework was designed as shown in Figure 3.1.

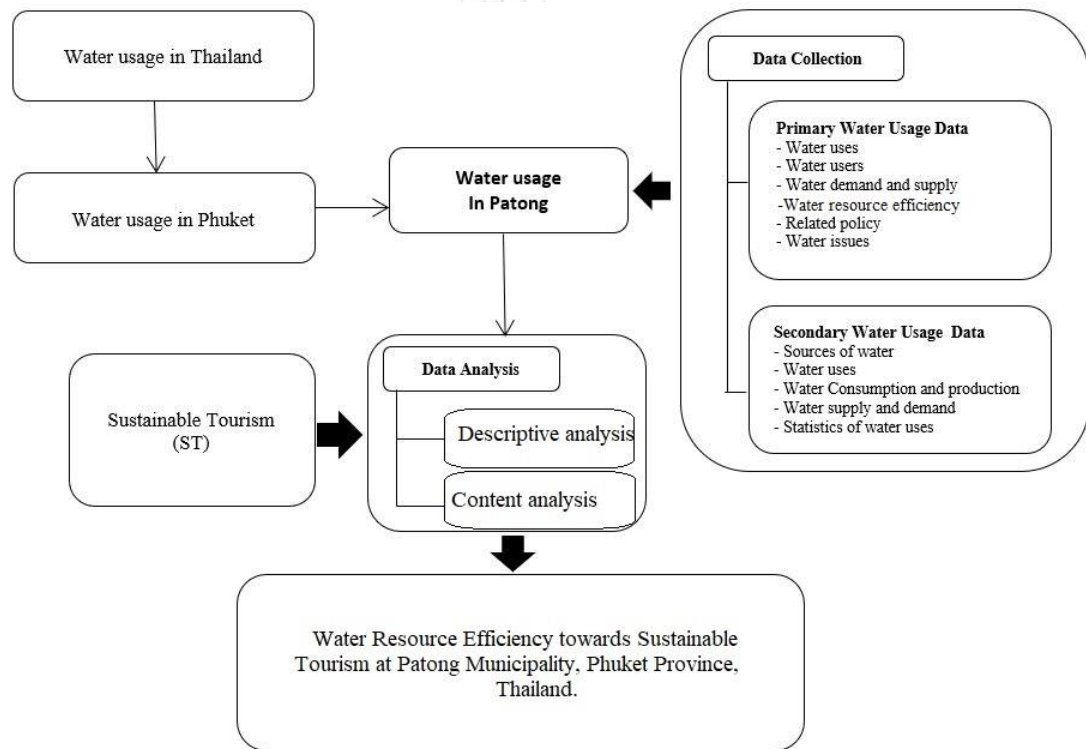


Figure 3. 1 The conceptual research framework on water resource efficiency towards sustainable tourism at Patong municipality, Phuket province, Thailand.

3.2 Study Area

This research study was at Patong municipality, a beach on the west coast of Phuket Island, Thailand as shown in Figure 3.2. Patong municipality is a sub-district located in Kathu district of Phuket Province. The transport networks are national highways number 4020 and 4029. It is approximately 16 kilometers from Phuket Town. Patong

municipality is located between 7°53'35"N latitude and 98°17'54"E longitude covering the area of 16.4 km².

The total population and household in Patong municipality are shown in Table 3.1. The number of male and female in Patong municipality were 10,120 and 10,529, respectively in 2016 with 4,815 households (Patong Municipality, 2017).



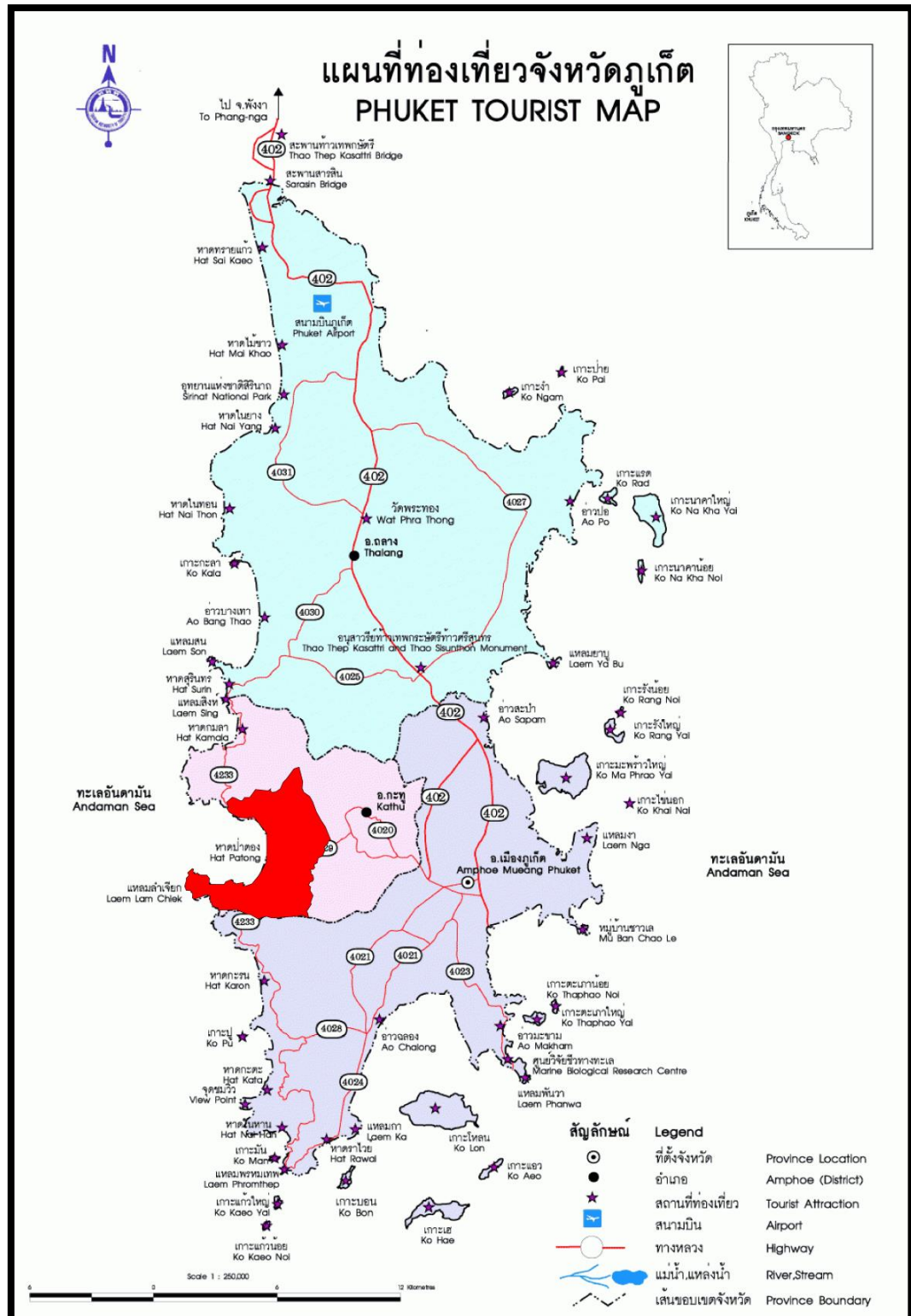


Figure 3. 2 The study area; Patong municipality (dark red shade), Phuket Province, Thailand.

Source: Tourism Authority of Thailand (2002)

Table 3. 1 Total population and household in Patong municipality

Years	Populations			Households
	Male	Female	Total	
2014	10,001	10,475	20,476	4,622
2015	10,019	10,501	20,520	4,705
2016	10,120	10,529	20,649	4,815

Source: Patong Municipality (2017)

Patong consists of 7 communities, namely Chai Wat, Ban Mon, Baan Sai Namyen, Baan Nai Na, Baan Khok Ma Kharm, Baan Ka Lhim, and Patong beach communities. The number of populations in each community is shown in Table 3.2 Baan Nai Na community has the highest populations of 4,294 (Patong Municipality, 2017).

Table 3. 2 The number of populations in Patong communities

Communities	Populations
1. Chai Wat	2,361
2. Ban Mon	3,018
3. Baan Sai Namyen	2,632
4. Baan Nai Na	4,294
5. Baan Khok Makarm	2,984
6. Baan Ka Lhim	1,307
7. Patong beach	2,651
- No defined community	1,402
Total	20,649

Source: Patong Municipality (2017)

Formerly, the main career of people in Patong municipality was farmer. They have changed their livelihoods when tourism business has bloomed. Therefore, the land areas have also changed to hotel business, accounting to 45% of all districts of Phuket. The main incomes of local people are from renting rooms or houses, car rental, boat rental, touring, trading (Patong Municipality, 2017). According to this report, there were 120 hotels, 492 guesthouses, 251 spas and 760 restaurants in Patong municipality.

In 2016, the Patong Municipality reported that there are 8 canals in Patong Municipality, namely Paklhak canal, Whangkee-aon canal, Bang Ton Kao canal, Toh Soong canal, Pakbang canal, Bangwat canal, Bangprurian canal, and Patong hospital canal. There are reservoirs and wells in Patong municipality including Bang Ton Khao Reservoir with a capacity of 1,200 cubic meters; and Nai Na community underground wells with a depth of 10 meters (Phuket Provincial Waterworks Authority, 2016).

For public utilities in Patong municipality, the electricity is under the Provincial Electricity Authority. Water supply is under the service of the Phuket Provincial Waterworks Authority (Phuket Provincial Waterworks Authority), where the raw water resource is from Ka Lhim Waterfall and Bangward reservoir, Bang Yai canal, and abandoned mine. In 2016, the total water users was 4,863 with the amount of used water of 5,655,358 cubic meters (Patong Municipality, 2017).

Water sources for consumption in Patong municipality come from the PPWA, natural water source, and public artesian wells. Table 3.3 presents that water use in different communities. Chai Wat, Ban Mon, Baan Na Nai, Baan Khok Makarm and Baan Ka Lhim communities had their own natural water source; and only Baan Ka Lhim had a community artesian well. However, the water did not cover all area of the communities, and the percentages are shown in Table 3.3

Table 3. 3 Water sources for consumption in Patong communities

Communities	Water from the PPWA		Natural water source		Community artesian wells	
	Use	Not covered	Use	Not covered	Use	Not covered
Chai Wat	●	50%	●	60%	-	-
Ban Mon	●	50%	●	20%	-	-
Baan Sai Namyen	●	70%	-	-	-	-
Baan Na Nai	●	25%	●	20%	-	-
Baan Khok Makarm	●	55%	●	15%	-	-
Baan Ka Lhim	●	20%	●	70%	●	50%
Patong beach	●	70%	-	-	-	-

Source: Patong Municipality (2017)

Patong municipality is one of the popular tourist destinations in Phuket. The hotels in Patong municipality were accounted to 45% of total hotels in Phuket in 2016. Water shortage has been an issue for a few decades due to the amount of water demand is high comparing to water supply. For example, the actual water use in 2012 was 2,549 cubic meters per day while the demand of water use was higher at amount of 4,460 cubic meters per day (Seeduka, 2013). At present, water shortage still occurs in Patong municipality, especially during the dry season.

3.3 Data Collection

This research study used both qualitative and quantitative research approaches for data collection, conducting at Patong, Phuket in Thailand. The secondary data was collected from desk study. The databases also were used as references for this research. Governmental documents such as the Phuket Provincial Statistical Office, the Phuket Provincial Waterworks Authority, and the Patong Municipality was used to support research findings as a secondary data. In-depth interview was conducted to obtain comprehensive information from target stakeholders in the study area using a purposive sampling method. The selected respondents were governmental agencies, tourism-related associations, local communities and hotel businesses as shown in

Table 3.4. A set of semi-structure questionnaires for in-depth interview composed of 3 parts namely general information of respondents, water use, and water use for sustainable tourism as presented in Appendix 1.

Table 3. 4 In-depth interview respondents

No.	Group	Respondents
1	Governmental agencies	<ul style="list-style-type: none"> • Head of the Phuket Provincial Waterworks Authority • Head of the Patong Municipality • Head of the Provincial Irrigation Office 15
2	Tourism-related associations	<ul style="list-style-type: none"> • Head of the Phuket Tourist Association • Head of the Phuket Hotel Association • Head of the Patong Hotel Association
3	Local communities	<ul style="list-style-type: none"> • Heads of villages • Local people • Restaurants
4	Hotel businesses	<ul style="list-style-type: none"> • Hotel owners • Hotel managers • Hotel chief engineer

3.4 Data analysis

The primary data collected from the field observation and the in-depth interview using questionnaires were analyzed using descriptive and content approaches. The secondary data was analyzed by using statistical analysis method.

CHAPTER IV

RESEARCH RESULTS

4.1 The study area

The study area is Patong Municipality which is located in Kathu district of Phuket province which is located between 7°53'35'N latitude and 98°17'54'E longitude as shown in Figure 4.1. Patong beach, 3 kilometers long, is a popular tourist destination. The Patong Municipality area covers 16.4 square kilometers, and far from Phuket city center of about 16 kilometers (Patong Municipality, 2017). It composes of 7 villages, namely Chaiwat, Baan Mon, Sai Namyen, Nanai, Baan Khok Makham, Baan Kalim, and Patong Beach villages (Patong Municipality, 2017). The study area has affected on water shortage during the dry season.

The topography of Patong Municipality is mountainous ranges with the altitude of 200-400 meters from the mean sea level. Only in the east of Patong municipality is lowland. The beach height is between 1 to 30 meters from the mean sea level. This topography makes water flow down from the mountain, accumulates in the lowland, and then flows to Patong beach.

The meteorological data between 2003 and 2015 were collected by the Phuket Meteorological Monitoring Station. The climate of Phuket is mainly influenced by the southwest and northeast monsoons (Thai Meteorological Department, 2017). Rainy season is influenced by the southwest and western monsoons between April and November, while summer season is influenced by the northeast and northern monsoons between December and March. The average annual rainfall was 2,347 mm and the average annual maximum rainfall was 113.6 mm as shown in Figure 4.2 and 4.3 respectively. The average mean temperature was 27.7 °C with the highest average temperature of 31.9°C and the lowest average temperature of 23.3°C as shown in Figure 4.4 (Thai Meteorological Department, 2017).

The Phuket Provincial Waterworks Authority (2019) reported that water shortage has taken place in Phuket for decades due to water demand is higher than water supply and the rapid expansion of tourism businesses as well. Eventhough Phuket has a long-period of rain, water shortage still occurs (Regional Irrigation Office 15, 2017). The increasing number of tourists every year has caused the increasing water demand, while raw water sources still remain stable. About 80% of water sources come from runoff water retaining in the storage ponds and wells (Regional Irrigation Office 15, 2017). Currently, the PPWA is unable to entirely provide water supply in the Patong Municipality (Phuket Provincial Waterworks Authority, 2019).

Today, water use in Patong Municipality comes from the Phuket Provincial Waterworks Authority (Phuket Provincial Waterworks Authority), natural canals, and community shallow wells (Patong Municipality, 2017). The data collected in this research reveals that all 7 villages mainly use water from the PPWA. However, Chai Wat, Ban Mon, Baan Nanai, Baan Khok Makarm, and Baan Kalim villages also use water from natural canals. Only Kalim village uses water from mountain nearby over than 20 years with a monthly service fee 150 baht per household per month. The Patong Municipality's water service is now being used in large hotel businesses. It is expensive than water from the PPWA.

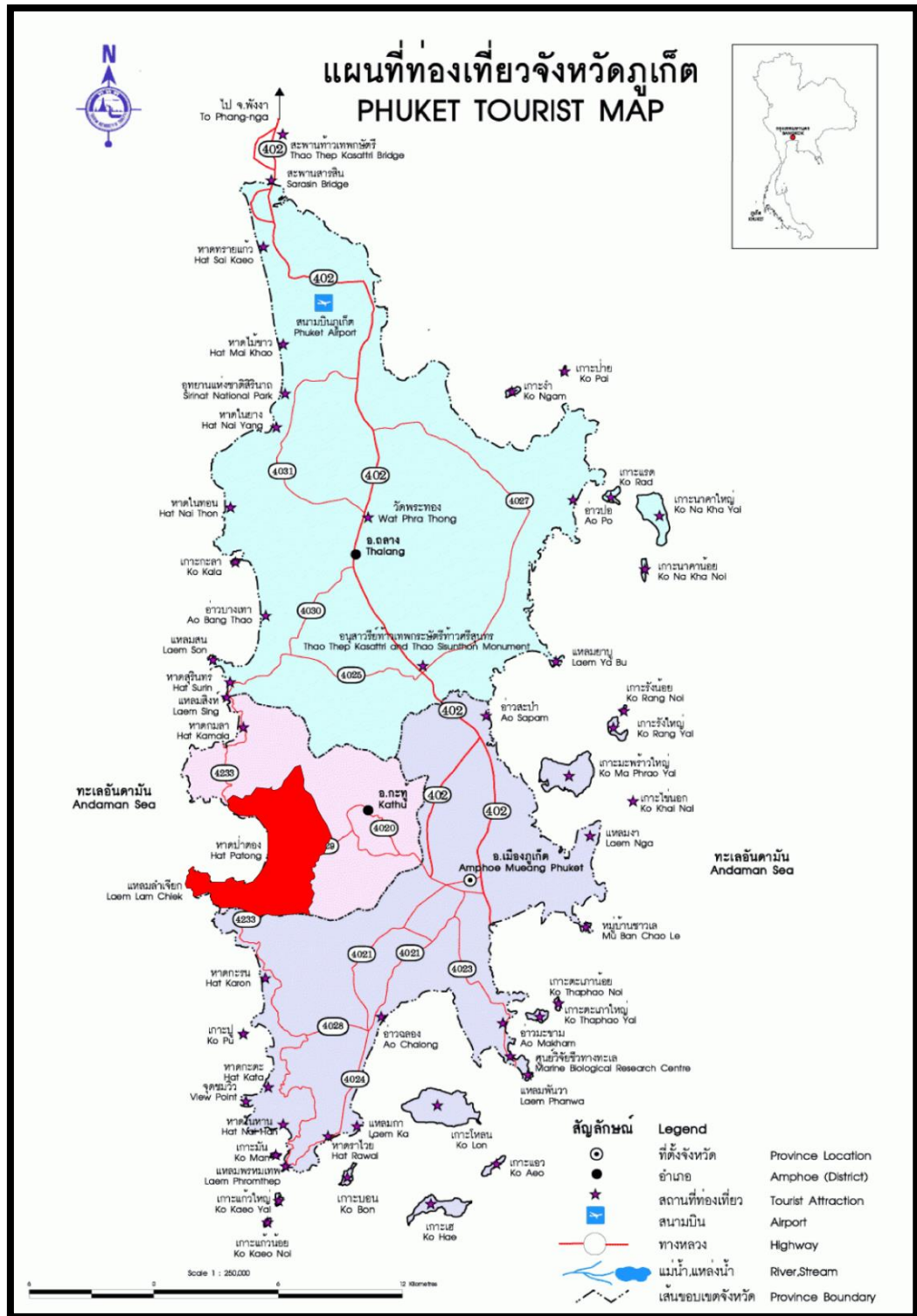


Figure 4. 1 The study area; Patong municipality (dark red shade), Phuket province, Thailand.

Source: Tourism Authority of Thailand (2002)

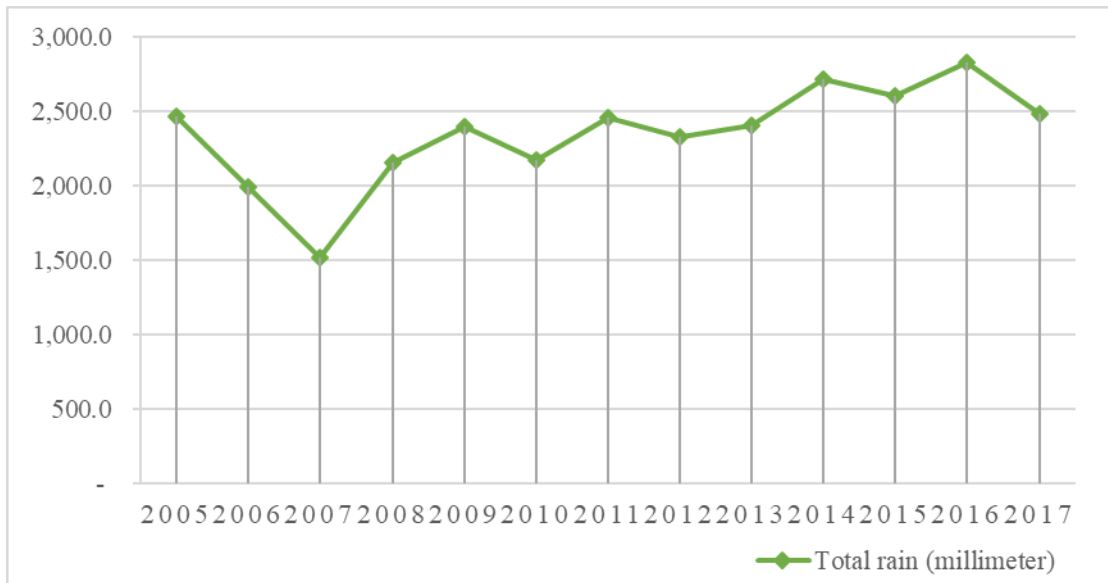


Figure 4. 2 Average annual rainfall (mm.) between 2003 and 2015 at the Phuket Meteorology Station

Source: Meteorological Department, Ministry of Information and Communication Technology (2015)

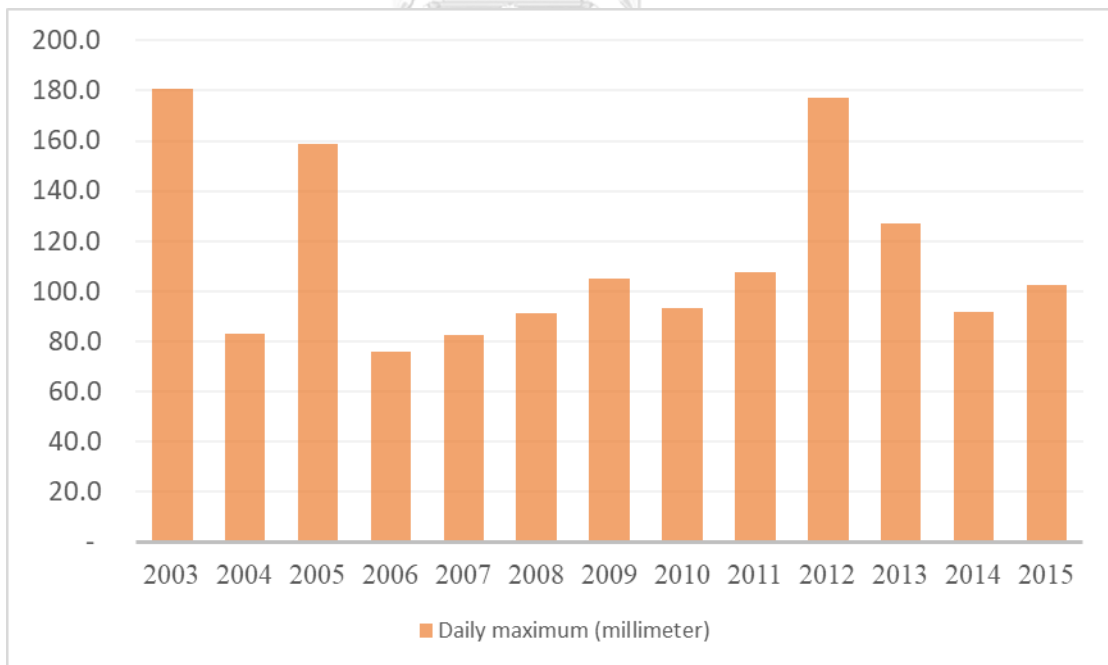


Figure 4. 3 Average annual maximum rainfall (mm.) between 2003 and 2015 at the Phuket Meteorology Station

Source: Meteorological Department and Ministry of Information and Communication Technology (2015)

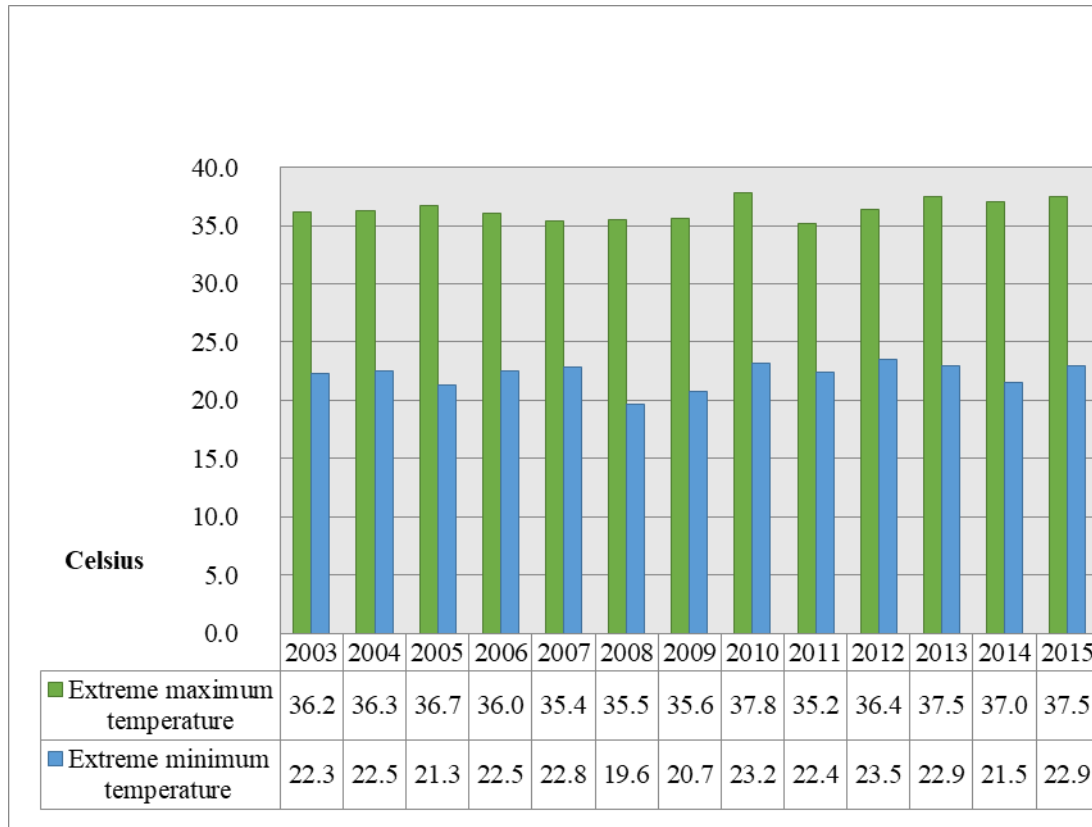


Figure 4. 4 Temperature monitored at Phuket meteorological station between 2003 and 2015.

Source: Meteorological Department and Ministry of Information and Communication Technology (2015)

4.2 General information of respondents

The respondents of the study were specifically considered based on the research objective. They were selected by using the purposive sampling method. The purposive sampling is known as judgmental, selective, or subjective sampling that is selected based on characteristics of a population and the objective of the study (Given, 2008). The total respondents were 44 composing of 4 groups, namely hotel business, local community, governmental organization, and tourism-related associations. The data were obtained using a set of semi-structure questionnaires to in-depth interview respondents selected. The questionnaires set composes of general information of

respondents, water use in Patong Municipality and water use towards sustainable tourism in Patong Municipality, as presented in an appendix. The general information of the respondents are presented in Table 4.1.

Table 4. 1 General information of respondents

Component	Respondents (N=44)	Percentage
1. Gender	Male	59.09
	Female	40.91
2. Age (year)	18-30 years	6.81
	31-40 years	25.00
	41-50 years	27.27
	51-60 years	29.54
	over 61 year	11.36
3. Educational Background	None	2.72
	Primary school	2.72
	Secondary School	11.36
	Highschool	9.09
	Vocational Certificate	9.09
	Higher Vocational Certificate	29.54
	Bachelor's Degree	31.81
	Master's degree	4.54
4. Occupation	Governmental Officer	9.09
	NGO Officer	6.81
	Chief Engineer	31.81
	Human Resource Manager	2.27
	Hotel Owner	4.54
	Restaurant Owner	11.36
	Restaurant Manager	4.54
	Head of Village	15.90
	Self-employed	9.09
	Employee	2.27
	Housewife	2.27

Table 4.1 presents general information of respondents interviewed on their gender, age, educational background and career. 59.09% of them were male and 40.91%

were female. For their age, the high percentage was in the range of 51-60 years of 29.54% and 41-50 years of 27.27%. For educational level, respondents obtaining a bachelor's degree were 31.81% and higher vocational certification were 29.54%. In terms of occupation, 31.81% were chief engineer in hotel businesses, 15.90% were heads of villages, and 9.09% were governmental officers.

4.3 Water use

According to the UN-Water (2019), since the 1980s water use around the world has been increasing by about 1% each year. Population growth, socio-economic development and changing consumption patterns were considered as drivers to an increasing of water use. The United Nations in 2008 stated that water use refers to use of water by agriculture, industry, energy production and households, including in-stream uses such as fishing, recreation, transportation and waste disposal. The use of freshwater resources is much more intense (World Economic Forum, 2015). The trend of global water demand seems to continue increase until 2050, mainly because the increasing of demand in the industrial and domestic sectors (World Water Assessment Programme, 2019). Moreover, there were approximately 4 billion people experiencing water shortage during at least one month of the year. Water scarcity is considered as one of the largest global risks in terms of potential impact (World Economic Forum, 2015). Water scarcity can occur depending on supply or demand, and it has several causes (United Nations Development Programme, 2006). The UN-Water stated in 2006 that “water scarcity often has its roots in water shortage”.

Data collected on water supply and water use were obtained from all respondents and responsible organizations such as the Phuket Provincial Waterworks Authority (PPWA), the Regional Irrigation Office 15, the Patong Municipality, and the Phuket Provincial Administrative Organization.

4.3.1 Water supply and water use

The data obtained from the interviews presents that the Phuket Provincial Waterworks Authority (PPWA) and the Patong Municipality are two major suppliers of water service in Patong with the capacity of producing 136,200 (103,200 cubic meters from

the PPWA and 33,000 cubic meters from outsourced company) and 6,000 cubic meters per day, respectively.

The total capacity of the PPWA comes from 8 water production stations which are operated by the PPWA 3 stations and outsourced companies 5 stations.

Table 4. 2 Water supply from the Phuket Provincial Waterworks Authority (PPWA)

Water production station	Raw water source	Water production capacity (cubic meter/day)
Bangward	1. Bangward reservoir	60,000
	2. Abandoned mine	
	3. Kathu waterfall	
Bang Jo	Bang Nheaw Dhum reservoir	31,200
Klong Katha	Klong Katha reservoir	12,000
Total		103,200

Source: Phuket Provincial Waterworks Authority (2019)

The PPWA has 3 water production stations, namely Bangward, Bang Jo, and Klong Katha, with total capacity of 103,200 cubic meters per day. The Bangward station has the highest capacity of 60,000 cubic meters/day which raw water comes from Bangward reservoir, abandon mines, and Kathu waterfall. The Bang Jo station has the second capacity of 31,200 cubic meters/day which raw water comes from the Bang Nheaw Dhun reservoir. The Klong Katha station has the capacity of 12,000 cubic meters/day which raw water comes from The Klong Kratha reservoir as shown in Table 4.2.

Table 4.3 presents water supply from the outsourced company. There are five stations with total capacity of 33,000 cubic meters per day

Table 4. 3 Water supply from outsourced company

Water production stations	Water production capacities (cubic meter/day)
Kathu	13,000
Keng Nguan	3,000
Karon (Reverse Osmosis)	12,000
Chaofah	3,000
Cheng Talat	2,000
Total	33,000

Source: Phuket Provincial Waterworks Authority (2019)

The PPWA reported in 2018 that there were 62,224 water users in Phuket including residents 75.39%, small business 17.87%, large business 6.40%, governmental offices 0.26%, and state-enterprises 0.08%. While there were 4,806 water users (30.44%) in Patong using water from the PPWA (Phuket Provincial Waterworks Authority, 2019).

In addition to the PPWA, the Patong Municipality also supplies water to hotel businesses. Its raw water comes from treated water, mountain springs, groundwater, and reverse osmosis (RO) water. The capacity of water production is up to 6,000 cubic meters per day. Data from interviews reflects that such amount of water does not meet to the water demands. Related respondents mentioned that 30,000 cubic meters of raw water can only yield 12,000 cubic meters of usable water.

The study found that 50% of respondents used water supply from the PPWA. While 43.24% of them obtained water from their shallow well, natural canals, village water supply, groundwater, and purchased water. 13.51% of them used water from the Patong municipality. In addition, 27.27% them used more than one source of water, for instance, hotels businesses used water service from the PPWA as well as groundwater. Moreover, one hotel had a 46,000-cubic-meters on-site weir to collect water from canals nearby.

For hotel businesses, the study found that they required multiple sources of water supply. According to the respondents, they viewed that water supply from the PPWA is not always reliable, especially in the dry season. Alternatively, 27.27% of respondents from hotel businesses used RO water supply from the Patong Municipality. This supply has started in 2017 when the municipality adopted the reverse osmosis technology. However, the study found that they relied on the RO's water supply than the PPWA's water supply during the water shortage. Moreover, they viewed that the RO's water from the Patong Municipality is the most expensive water supply.

Regarding village water supply, only Kalim village is under this service from a nearby mountain spring distributing in the community. This village water supply is under the head of Kalim village. This service started 20 years ago, and costs 150 baht per month per household. In addition, approximately 50% of households in Kalim village used this service.

In terms of the amount of water use, 43.24% of respondents did not know their monthly water use because of no water meter, particularly shallow well and groundwater users. 24.32% of all respondents used 300-399 liters of water per day for a single person. 27.02% of hotel business respondents used 450 to 499 liters of water per day for a single person. 16.21% of all respondents used 250 to 299 liters of water per day for a single person.

For water cost, 24.32% of respondents did not pay for water because they used shallow well, while 9.09% of them who were from hotel businesses stated that they spent around 10,000 to 15,000 baht per month. They claimed that the cost of water was high because they purchased water truck service.

Water shortage is a common problem taken place in Patong Municipality. 89.18% of respondents faced with water shortage yearly that be solved by collecting rainwater in bigger storage tanks. All respondents from hotel businesses (100%) had a problem of water shortage. 50% of respondents reduced their impact by buying water truck

service from private sector. They viewed that was a lack of public goods' services which should be properly provided by related governmental agency. The second common problem revealed by 40.54% of them was water quality. Only 16.21% of them were able to solve this problem by installing a strainer. The third common problem expressed by 11.36% of them was about water supply service with a low water flow. Respondents disclosed that collecting rainwater in bigger storage tanks and getting water from shallow wells can prevent water shortage in the dry season. 44% of them also faced with water quality, particularly suspended sediment.

In terms of education and training on water use, 75.67% of respondents were educated on how to use water properly, while 24.33% of them not be educated. However, 45.94% of them mentioned that the Patong Municipality generally conducted a meeting among community members, community leaders, and all entrepreneurs in order to share their ideas and discuss about water situations every 1 or 2 months.

4.3.2 Practices of sustainable water use

In order to use water sustainably, good practices would help improve water efficiency and use. The European Commission in 2017 described that resource efficiency (RE) means using the Earth's limited resources in a sustainable manner while minimizing impacts on the environment. It allows us to create more with less and to deliver greater value with less input. For instance, water users could identify where water is being used, review bills to determine how much water consumption is costing, develop measures and monitoring methods, and evaluate the results frequently (Resource Efficient Scotland, n.d.a). Reusing water and collecting rainwater could help sustain water use (European Commission, 2017). Using water-saving devices in the toilets, taps, and showers would also help reduce water use. Using low flush toilets daily would save about 30 liters per property (Waterwise, 2010). Using water efficient showerheads would also save water about 25 liters per property a day. Furthermore, water leakage is also a key concern in sustainable water use (European Commission, 2017). Therefore, checking for water leakage frequently could help prevent water loss.

In this regard, all respondents (100%) stated that water saving, efficient water use and water treated reuse for gardening would help sustain water use in Patong municipality. 42.85% of them viewed that water saving and efficient use would lead to sustainability of water use in Patong municipality. Only 4.54% of them recognized the importance of environmental awareness and behavior change for water saving. They also emphasized the role of hotel employees rather than hotel customers in doing so.

For the current practices, 70.27% of them did not reuse water at all. Only 29.27% of them reused water for their gardening. The hotels have made a treatment on wastewater and reuse for gardening. 68.18% of hotel business mentioned that water-saving devices such as tap sensor, showerhead, and flush sensor would help saving water. 43.75% of them checked water leakage in order to prevent water loss. While 20% of them adjusted water tap valves to reduce water leakage.

4.4 Sustainable water use towards sustainable tourism

The United Nations (UN) in 2008 stated that water is crucial resource in sustainable development in driving socio-economic development, better ecosystems, and human well-being. Water is an essential resource for many human activities, and also fundamental of human well-being. Therefore, sustainable water use is very crucial for developing of sustainable tourism. Reusing water and treating wastewater are one of the ways in managing sustainable water use (European Commission, 2017). According to the Sustainable Consumption and Production (SCP) by the United Nations (UN), it includes the promoting of resource efficiency (RE) including water resources (European Commission, 2017). Then, using water most efficiently would lead to sustainable water use. For sustainable tourism, people's awareness on conserving water would help conserve more water. Sustainable water programs would possibly raise people's environmental awareness and control the use of water.

Concerning water use towards sustainable tourism in the study area, the study found that 82.92% of respondents known that sustainable water use would lead to sustainable tourism, while 17.07% of them heard about sustainable tourism but did

not understand the concept or its meaning. 93.18% of them from hotel businesses understood on sustainable tourism, and all respondents from tourism-related associations (100%) recognized about the promoting of sustainable tourism in Phuket.

Regarding the rapid expansion in tourism sector in Patong municipality, 70.27% of respondents viewed that tourists' number in Patong has increased rapidly. This impact on demand rised while water supply remains limited. Adversed impacts on environment are bound to be, and tourism cannot be sustained without sufficient natural resources.

For sustainable tourism in Patong municipality, the study found that 34.09% of respondents desired more assistance in water supply for sustainable tourism from governmental agencies. They stated that sustainable tourism should focus on conserving natural resources, tourist safety, and local benefits. They also viewed that resource efficiency plays a primary role in developing sustainable tourism and building green tourism.

Regarding the current water use situations for sustainable tourism in the study area, only 11.36% of respondents viewed that sustainable tourism in Phuket is becoming more popular nowadays. Their reason was that Patong municipality is a popular tourist destination and the tourism businesses have been growing. They also mentioned that sustainability in a form of conserving natural resource and energy is a concern among local people, tourists, and hotel businesses. In practice, some hotels have conducted natural resource conservation and energy saving programs such as Green Hotel and Greenleaf. These would lead to sustainable tourism because by handling proper policies in terms of standards, practices, measures, and benchmarks to be certified by national and international tourism-related organizations. The programs are directly related to water saving and water efficiency. However, data from interviews with tourism-related organizations found that 34.09% of them revealed that sustainable tourism in Phuket is now also focusing on single-use plastics and foams and 9.75% of them believed that the natural resource conservation practices has declined to Phuket's sustainable tourism.

In terms of environmental awareness, this study found that 12.19% of respondents viewed that environmental awareness plays a vital role in sustainable tourism. They believed that the biggest obstacle in sustainable tourism is raising awareness in tourists themselves. This is because hotels can only control employees' behavior on limiting water use, but customers are mainly water use in hotel.

All respondents (100%) from governmental agencies stated that water supply is an important driving factor contributing to sustainable tourism. The Patong Municipality revealed that solving water problem such as wastewater, flood, and water shortage would substantially contribute to sustainable tourism. The insufficient water would decline sustainable tourism in Patong municipality.

In terms of plans, measures, guidelines such as policies on water use, 58.53% of respondents revealed that there is no policies for water use in sustainable tourism in the study area, while 41.46% of them stated that they have some measures including routine leakage checking (17.07%) and water off turning when not in use (9.75%). 9.75% of respondents from hotel businesses has a water-saving policy in place.

The study found that 15.90% of respondents from hotel business conducted a towel-reuse program for customers by putting a sign in each room in order to inform customers that towel will be changed only when they dropped it on bathroom floor. 13.51% of respondents from hotel businesses mentioned that there were meeting, training, and educating sessions in their hotels for employees in order to increase environmental awareness.

In order to reduce water problems in the study area, the PPWA has planned to buy more water from private company of 12,000 cubic meters per day and from a water piping line from Kamala sub-district of about 2,400 cubic meters per day. The Klong Katha station has been set up for more water production and the RO water from Karon water production station would lead to sustainable tourism in the study area.

While hotel businesses have conducted the ‘Planet 21’ program (water, oil, gas, and water usage), the Green hotel, the Green Leaf and the Kin-Na-Ree programs.

In addition, 31.81% of respondents from the government agencies suggested that the stronger collaboration among all stakeholders including governments, state-enterprises, private sectors and local people would reduce water shortage in Patong municipality. The government should seriously take action in solving water shortage and other stakeholders should aware on wastewater, flood, and water shortage in tourism sector. They suggested that the communication among all related stakeholders should go forward in the same direction. The government should provide more budgets to the Patong Municipality to support its water production plan. All respondents (100%) suggested that the government should make a contraction with abandon-mined owners to use water from their storages.

The PPWA should improve their water quantity and quality. Furthermore, each household should collect more rainwater, use water efficiently and increase water saving.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The objective of this research study is to study water resource efficiency for sustainable tourism at Patong municipality, Phuket province, Thailand. The study area is the Patong Municipality which is located in Kathu district of Phuket province. The study area has affected on water shortage during the dry season. The respondents of the study were specifically considered based on the research objective. They were selected by using the purposive sampling method. The total respondents were 44 composing of 4 groups, namely hotel business, local community, governmental organization, and tourism-related association. The data were obtained using a set of semi-structure questionnaires to in-depth interview respondents selected. The questionnaires set composes of general information of respondents, water use in Patong Municipality and water use towards sustainable tourism in Patong Municipality.

Data collected on water supply and water use were obtained from all respondents and responsible organizations such as the Phuket Provincial Waterworks Authority (Phuket Provincial Waterworks Authority), the Regional Irrigation Office 15, the Patong Municipality, and the Phuket Provincial Administrative Organization. The data obtained from the interviews presents that the Phuket Provincial Waterworks Authority (Phuket Provincial Waterworks Authority) and the Patong Municipality are two major suppliers of water service in Patong with the capacity of producing 136,200 (103,200 cubic meters from the PPWA and 33,000 cubic meters from outsourced company) and 6,000 cubic meters per day, respectively. The study found that 50% of respondents used water supply from the PPWA. 13.51% of them used water from the Patong municipality. In addition, 43.24% of respondents obtained water from their shallow well, natural canals, village water supply, groundwater, and purchased water. However, the study found that they relied on the RO's water supply than the PPWA's water supply during the water shortage. Regarding village water supply, only Kalim

village is under this service from a near-by mountain spring distributing in the community. Water shortage is a common problem taken place in Patong. 89.18% of respondents faced with this problem. All respondents from hotel businesses (100%) had a problem of water shortage. The second common problem revealed by 40.54% of them was water quality. The third common problem expressed by 11.36% of them was about water supply service with a low water flow. In terms of education and training on water use, 75.67% of respondents were educated on how to use water properly, while 24.33% of them not be educated. However, 45.94% of them mentioned that the Patong Municipality generally conducted a meeting among community members, community leaders, and all entrepreneurs in order to share their ideas and discuss about water situations every 1 or 2 months.

For the practices of sustainable water use in the study area, all respondents (100%) stated that water saving and efficient water use would help sustain water use in Patong. 70.27% of them did not reuse water at all. Only 29.27% of them reused water for their gardening. The study found that 68.18% of hotel business mentioned that water-saving devices such as tap sensor, showerhead, and flush sensor would help saving water. 43.75% of all respondents checked water leakage in order to prevent water loss. Only 4.54% of them recognized the importance of environmental awareness and behavior change for water saving.

Concerning water use towards sustainable tourism in the study area, the study found that 82.92% of respondents known that sustainable water use would lead to sustainable tourism, while 17.07% of them heard about sustainable tourism but did not understand the concept or its meaning. 93.18% of them from hotel businesses understood on sustainable tourism, and all respondents from tourism-related associations (100%) recognized about the promoting of sustainable tourism in Phuket. All respondents (100%) from governmental agencies stated that water supply is an important driving factor contributing to sustainable tourism. The study found that 34.09% of respondents desired more assistance in water supply for sustainable tourism from governmental agencies. They also viewed that resource efficiency plays a primary role in developing sustainable tourism and building green tourism. Some

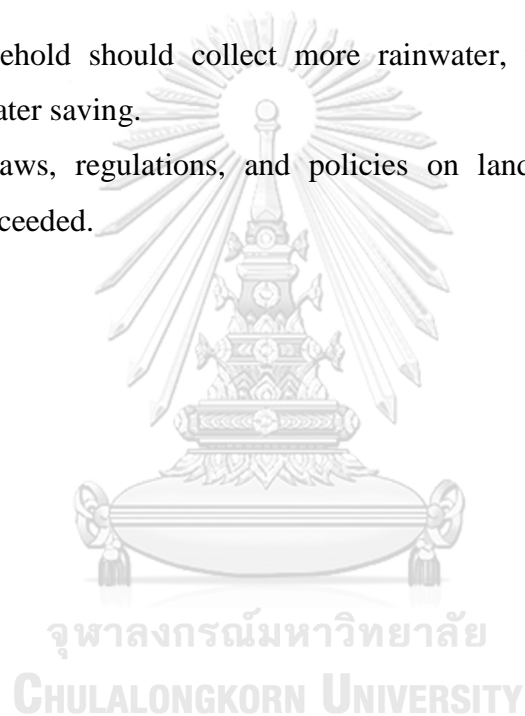
hotels have conducted natural resource conservation and energy saving programs such as Green Hotel and Greenleaf. The programs are directly related to water saving and water efficiency. In terms of plans, measures, guidelines such as policies on water use, 58.53% of respondents revealed that there is no policies for water use in sustainable tourism in the study area, while 41.46% of them stated that they have some measures including routine leakage checking (17.07%) and water off turning when not in use (9.75%). In addition, 31.81% of respondents from the government agencies suggested that the stronger collaboration among all stakeholders including governments, state-enterprises, private sectors and local people would reduce water shortage in Patong.

Water resource is one of the important resources to lead to sustainable tourism in the study area (Seeduka, 2013). All related stakeholders including private and public sectors, tourism businesses, tourism-related associations, entrepreneur, small business, and local people have to take actions to comply with the laws and regulations of the City Planning, B.E. 2548 (A.D. 2005) issued under the City Planning Act B.E. 2518 (A.D. 1975), the Notification of Ministry natural resources and environment RE: Territory and environment protection measure for Phuket B.E. 2546 (A.D. 2003), the Patong Municipality's by law regulations RE: Prohibition of construction and modification or change the usage of certain types of buildings in the area of Patong Municipality, Kathu district, Phuket B.E. 2548 (A.D. 2005), the Ministerial Regulation No.20 B.E. 2532 (A.D. 1989) issued under the Building Control Act B.E. 2522, and the Ministerial Regulation No.15 B.E. 2529 (A.D. 1986) issued under the Building Control Act B.E. 2522 (Wongchoo et.al, 2015). Legality would benefit to the development of Patong Municipality in terms of enhancing economic, social and environmental conditions (Nipan Vichiennoi, 2009).

5.2 Recommendations

To reach to sustainable tourism in Patong municipality, some recommendations on water use should be considered as follows:

- i. There should be a stronger collaboration among all stakeholders including governments, state-enterprises, private sectors and local people would reduce water shortage in Patong municipality.
- ii. The government should provide more budgets to the Patong municipality to support its water production plan.
- iii. The government should make a contraction with abandon-mined owners to use water from their storages.
- iv. The PPWA should increase their water quantity and improve their water quality.
- v. Each household should collect more rainwater, use water efficiently and increase water saving.
- vi. Relevant laws, regulations, and policies on land-use planning should be strictly proceeded.



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APPENDIXES

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

APPENDIX 1



เลขที่แบบสอบถาม.....

แบบสอบถามข้อมูล ชุดที่ 1

เรื่อง การใช้ทรัพยากรน้ำอย่างมีประสิทธิภาพเพื่อการท่องเที่ยวอย่างยั่งยืน ที่เทศบาลเมืองป่าตอง
จังหวัดภูเก็ต ประเทศไทย

คำชี้แจง:

1. แบบสอบถามนี้จัดทำขึ้นโดย นางสาว ปาลิดา รัตโนภาส นิสิตปริญญาโท สาขาสังแวดล้อม การพัฒนา และความยั่งยืน บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
2. วัตถุประสงค์เพื่อสอบถามความคิดเห็นเชิงลึกในเรื่องการผลิตน้ำและให้บริการน้ำใช้เพื่อการท่องเที่ยวอย่างยั่งยืน ที่เทศบาลเมืองป่าตอง จังหวัดภูเก็ต ประเทศไทย
3. แบบสอบถามประกอบด้วยคำถาม 2 ตอน ดังนี้;
ตอนที่ 1 ข้อมูลทั่วไปของผู้ตอบแบบสอบถาม จำนวน 5 ข้อ,
ตอนที่ 2 คำถามเกี่ยวกับการผลิตและให้บริการน้ำเพื่อการท่องเที่ยวอย่างยั่งยืน จำนวน 8 ข้อ

ข้อมูลที่ท่านให้ไว้ในแบบสอบถามนี้ ทั้งข้อมูลส่วนบุคคล และข้อคิดเห็นต่างๆ ผู้ศึกษาจะนำมาวิเคราะห์และประมวลผล เพื่อประกอบการศึกษาสำหรับวิทยานิพนธ์นี้เท่านั้น

ผู้ศึกษาขอขอบพระคุณเป็นอย่างสูงที่ท่านได้ให้ความร่วมมือในการตอบแบบสอบถามครั้งนี้

ขอแสดงความนับถือ

นางสาวปาลิดา รัตโนภาส

ตอนที่ 1: ข้อมูลทั่วไปของผู้ตอบแบบสอบถาม

คำชี้แจง กรุณาทำเครื่องหมาย “X” ลงในช่องว่าง ที่ท่านเลือกตอบ พร้อมเติมข้อความที่เหมาะสม

วัตถุประสงค์: เพื่อจัดเก็บข้อมูลทั่วไปของผู้ตอบแบบสอบถามในพื้นที่ศึกษา

1. เพศ

ชาย

หญิง

2. อายุ

18-30 ปี

31-40 ปี

41-50 ปี

51-60 ปี

มากกว่า 61 ปี

3. ระดับการศึกษา

ปริญญาตรี

ปริญญาโท

ปริญญาเอก

อื่นๆ (โปรด

ระบุ).....

4. ชื่อหน่วยงานของท่าน

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5. ปัจจุบันท่านดำรงตำแหน่งใดในหน่วยงานของท่าน

หัวหน้าหน่วยงาน/หัวหน้าฝ่าย/หัวหน้าแผนก

ผู้จัดการ

พนักงาน

อื่นๆ (โปรด

ระบุ).....)

ตอนที่ 2: คำถามเกี่ยวกับการผลิตน้ำและให้บริการน้ำใช้เพื่อการท่องเที่ยวอย่างยั่งยืน

คำชี้แจง กรุณาทำเครื่องหมาย “X” ลงในช่องว่าง ที่ท่านเลือกตอบ พร้อมเติมข้อความที่เหมาะสม

วัตถุประสงค์: เพื่อจัดเก็บข้อมูลการผลิตน้ำและให้บริการน้ำใช้เพื่อการท่องเที่ยวอย่างยั่งยืนในพื้นที่ศึกษา

1. หน่วยงานของท่านมีนโยบายหรือแผนงานการจัดการผลิตและให้บริการน้ำเพื่อการท่องเที่ยวอย่างยั่งยืนหรือไม่ อย่างไร

มี (โปรด

ระบุ).....

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ไม่มี

2. หน่วยงานของท่านมีสถานีผลิตน้ำกี่แห่ง ที่ใดบ้าง

CHULALONGKORN UNIVERSITY

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3. หน่วยงานของท่านใช้แหล่งน้ำดิบในการผลิตน้ำจากแหล่งใดบ้าง

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4. หน่วยงานของท่านมีกำลังการผลิตน้ำที่ลูกบาศก์เมตรต่อวัน และและเป็นไปตามเป้าหมายที่กำหนดไว้หรือไม่ อย่างไร และเพียงพอต่อความต้องการของผู้ใช้น้ำหรือไม่ อย่างไร

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5. หน่วยงานของท่านได้ให้บริการน้ำแก่หน่วยงาน/ชุมชนใดบ้าง อย่างไร

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6. ท่านคิดว่าสิ่งใดเป็นอุปสรรคหรือปัญหาในกระบวนการผลิตและให้บริการน้ำของหน่วยงานของท่าน และหน่วยงานของท่านมีแนวทางแก้ไขปัญหาดังกล่าวอย่างไรบ้าง

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7. ท่านคิดว่าการผลิตน้ำและให้บริการน้ำใช้สามารถทำให้เกิดการท่องเที่ยวอย่างยั่งยืนได้หรือไม่ อย่างไร

ได้ (โปรด

ระบุ).....

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ไม่ได้

8. ท่านมีข้อเสนอแนะเพิ่มเติมอย่างไรบ้างในเรื่องของการผลิตน้ำและให้บริการน้ำใช้เพื่อส่งเสริมการท่องเที่ยวอย่างยั่งยืน

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เลขที่แบบสอบถาม.....

แบบสอบถามข้อมูล ชุดที่ 2

เรื่อง การใช้ทรัพยากรน้ำเพื่อการท่องเที่ยวอย่างยั่งยืน ที่เทศบาลเมืองป่าตอง จังหวัดภูเก็ต ประเทศไทย

คำชี้แจง:

4. แบบสอบถามนี้จัดทำขึ้นโดย นางสาว ปาลิดา รัตโนภาส นิสิตปริญญาโท สาขา
สิ่งแวดล้อม การพัฒนา และความยั่งยืน บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
5. วัตถุประสงค์เพื่อสอบถามความคิดเห็นเชิงลึกในเรื่องการใช้น้ำเพื่อการท่องเที่ยวอย่างยั่งยืน
ที่เทศบาลเมืองป่าตอง จังหวัดภูเก็ต ประเทศไทย
6. แบบสอบถามประกอบด้วยคำถาม 2 ตอน ดังนี้;
ตอนที่ 1 ข้อมูลทั่วไปของผู้ตอบแบบสอบถาม จำนวน 4 ข้อ,
ตอนที่ 2 คำถามเกี่ยวกับการใช้น้ำเพื่อการท่องเที่ยวอย่างยั่งยืน จำนวน 11 ข้อ

ข้อมูลที่ท่านให้ไว้ในแบบสอบถามนี้ ทั้งข้อมูลส่วนบุคคล และข้อคิดเห็นต่างๆ ผู้ศึกษาจะ
นำมาวิเคราะห์และประมวลผล เพื่อประกอบการศึกษาสำหรับวิทยานิพนธ์นี้เท่านั้น

ผู้ศึกษาขอขอบพระคุณเป็นอย่างสูงที่ท่านได้ให้ความร่วมมือในการตอบแบบสอบถามครั้ง
นี้

ขอแสดงความนับถือ

นางสาวปาลิดา รัตโนภาส

ตอนที่ 1: ข้อมูลทั่วไปของผู้ตอบแบบสอบถาม

คำชี้แจง กรุณาทำเครื่องหมาย “X” ลงในช่องว่าง ที่ท่านเลือกตอบ พร้อมเติมข้อความที่เหมาะสม

วัตถุประสงค์: เพื่อจัดเก็บข้อมูลทั่วไปของผู้ตอบแบบสอบถามในพื้นที่ศึกษา

1. เพศ

- ชาย หญิง

2. อายุ

- 18-30 ปี 31-40 ปี
 41-50 ปี 51-60 ปี
 มากกว่า 61 ปี

3. ระดับการศึกษา

- ไม่ได้รับการศึกษา ประถมศึกษา
 มัธยมศึกษาตอนต้น มัธยมศึกษาตอนปลาย
 อนุปริญญา/ปวส ปริญญาตรี
 ปริญญาโท ปริญญาเอก
 อื่นๆ (โปรด

ระบุ).....

4. ปัจจุบันท่านดำรงตำแหน่งใดในหน่วยงาน/ชุมชนของท่าน

- หัวหน้าหน่วยงาน/หัวหน้าฝ่าย/หัวหน้าแผนก ผู้จัดการ
 เจ้าของกิจการ พนักงาน
 หัวหน้าชุมชน(ผู้ใหญ่บ้าน/กำนัน) อื่นๆ (โปรด

ระบุ).....

ตอนที่ 2: คำถามเกี่ยวกับการใช้น้ำเพื่อการท่องเที่ยวอย่างยั่งยืน

คำชี้แจง กรุณาทำเครื่องหมาย “X” ลงในช่องว่าง ที่ท่านเลือกตอบ พร้อมเติมข้อความที่เหมาะสม

วัตถุประสงค์: เพื่อจัดเก็บข้อมูลการใช้น้ำเพื่อการท่องเที่ยวอย่างยั่งยืนในพื้นที่ศึกษา

1. ท่านทราบหรือไม่ว่าจังหวัดภูเก็ตเป็นจังหวัดที่ถูกส่งเสริมด้านการท่องเที่ยวอย่างยั่งยืนอย่างไร

ทราบ (โปรด

ระบุ).....

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ไม่ทราบ

2. ท่านทราบหรือไม่ว่าหน่วยงาน/ชุมชน/บ้านของท่านใช้น้ำจากแหล่งน้ำใด

ทราบ (โปรด

ระบุ).....

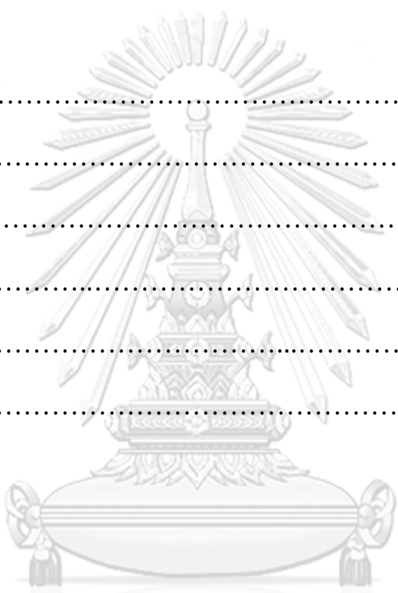
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ไม่ทราบ



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CHULALONGKORN UNIVERSITY

3. หน่วยงาน/ชุมชน/บ้านของท่านมีปริมาณการใช้น้ำประมาณกี่ลูกบาศก์เมตรต่อวัน และจ่ายค่าน้ำเท่าไรต่อเดือน

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4. หน่วยงาน/ชุมชน/บ้านของท่านเคยประสบปัญหาในเรื่องการใช้น้ำหรือไม่ อย่างไร และมีการแก้ไขปัญหาดังกล่าวอย่างไรบ้าง

เคย (โปรด

ระบุ).....

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ไม่เคย

5. ท่านทราบหรือไม่ว่าการใช้น้ำอย่างยั่งยืนสามารถทำได้โดยวิธีใดบ้าง อย่างไร

ทราบ (โปรด

ระบุ).....

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ไม่ทราบ

6. ท่านคิดว่าการบริหารการใช้น้ำอย่างประหยัดและคุ้มค่า จะช่วยส่งเสริมการใช้น้ำอย่าง
ยั่งยืนได้หรือไม่ อย่างไร

ได้ (โปรด

ระบุ).....

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ไม่ได้

7. ท่านได้นำน้ำที่ใช่แล้วไปใช้ประโยชน์อย่างอื่นหรือไม่ อย่างไร

ใช่ (โปรด

ระบุ).....

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ไม่ใช่

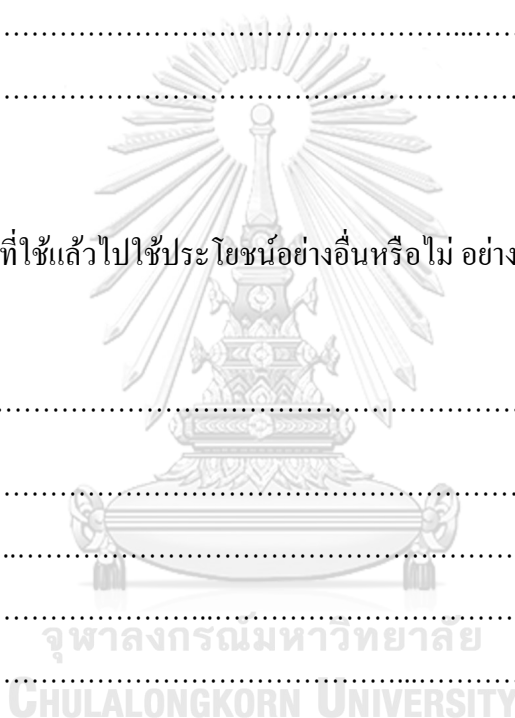
8. หน่วยงาน/ชุมชนของท่านได้มีการส่งเสริมหรือให้ความรู้เกี่ยวกับเรื่องการใช้น้ำที่ถูกต้อง
เหมาะสมเพื่อส่งเสริมการท่องเที่ยวอย่างยั่งยืนหรือไม่ อย่างไร

มี (โปรด

ระบุ).....

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ไม่มี

9. หน่วยงาน/ชุมชน/บ้านของท่านมีแนวทางการปฏิบัติ มาตรการ นโยบาย หรือการวางแผนการจัดการการใช้น้ำเพื่อส่งเสริมการท่องเที่ยวอย่างยั่งยืนหรือไม่ อย่างไร

มี (โปรด

ระบุ).....

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ไม่มี

จุฬาลงกรณ์มหาวิทยาลัย

Chulalongkorn University

10. ท่านมีปัญหาและอุปสรรคในการจัดการการใช้น้ำเพื่อการท่องเที่ยวอย่างยั่งยืนหรือไม่ อย่างไร

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11. ท่านมีข้อเสนอแนะอย่างไรบ้างในการใช้น้ำเพื่อส่งเสริมการท่องเที่ยวอย่างยั่งยืนในเขตเทศบาลเมืองป่าตอง

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APPENDIX 2

Photos from field collection at the study area.

	
<p>Interviewed respondent of the PPWA</p>	<p>The Karon RO water production station</p>
	
<p>Interviewed hotel respondent of hotel business</p>	<p>Hotel's on-site water treatment plant</p>
	
<p>Hotel's weir and its storage</p>	<p>Interviewed with the Phuket Provincial Administrative Organization</p>
	
<p>Visited hotel's on-site water treatment plant</p>	<p>Visited The Bangward reservoir</p>

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