Norwegian University
of Life Sciences

Master's Thesis 2019 30 ECTS
The Faculty of Landscape and Society

Assessing Sustainability of Tourism Development on Tioman Island, Malaysia

Atefeh Zeighami
International Environmental Studies

The Department of International Environment and Development Studies, Noragric, is the international gateway for the Norwegian University of Life Sciences (NMBU). Established in 1986, Noragric's contribution to international development lies in the interface between research, education (Bachelor, Master and PhD programmes) and assignments.
The Noragric Master theses are the final theses submitted by students in order to fulfil the requirements under the Noragric Master programme "International Environmental Studies", "International Development Studies" and "International Relations".
The findings in this thesis do not necessarily reflect the views of Noragric. Extracts from this publication may only be reproduced after prior consultation with the author and on condition that the source is indicated. For rights of reproduction or translation contact Noragric.

Email: atefeh.zeighamii@gmali.com

Noragric
Department of International Environment and Development Studies
P. O. Box 5003
N-1432 Ås
Norway
Tel.: +47 67 23 13 00
Fax.: +47 67 23 06 91
Internet: www.nmbu.no/noragric

Declaration

I, Atefeh Zeighami, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

Abstract

Coral reefs are highly diverse and productive ecosystems found in tropical oceans. Tioman Island on the east coast of Peninsular Malaysia is blessed with beautiful and diverse coral reef. In 1994, Tioman was announced as Marine Park to conserve its marine life from impacts of commercial fishing and other anthropogenic activities. Emergence of tourism brought new opportunities to local community for generating income and development of the island. However tourism has not been without its consequences. The main aim of this thesis is to assess tourism sustainability performance on Tioman Island. The conceptual framework guided the assessment was based on DPSIR (Driver-Pressure-State-Impact-Response) model. Data collection included both qualitative interviews as well as quantitative questionnaire to identify different stakeholders' perception on progress towards sustainable tourism development. This study found that tourism development as a driving force exerts pressures on the coral reef ecosystem. Pollution is identified as one of the main environmental problems in the island. Corals are also subject to damage by inexperienced snorkelers and divers. Trampling activities and direct contact makes physical damage to coral reef ecosystem. Pressures change the state of the marine ecosystem which result in environmental impacts such as coral degradation. In Tioman, different stakeholders offer response mechanisms to address the impact. Recycling and waste management, coral propagation, awareness raising projects, and tourist practices with lower impact are provided. The conservation efforts are still in early stages and require participation of the key stakeholders and more support from the local government.

Table of Content

List of Figures and Tables

List of Acronyms

ASEAN: Association of Southeast Asian Nations

COC: Code of Conduct

CT: Cintai Tioman

DMPM: Department of Marine Park Management

DPSIR: Driver-Pressure-State-Impact-Response

GF: Green Fins

IUCN: International Union for the Conservation of Nature and Natural Resources

JTP: Juara Turtle Project

NIA: Nutrient Indicator Algae

OT: The category Other

PADI: Professional Association of Diving Instructors

PSR: Pressure-State-Response

RB: Rubble

RCM: Reef Check Malaysia

RH: Rumah Hijau

RKC: Recently Killed Coral

SD: Sand

SI: Silt

SP: Sponges

TDC: Tioman Dive Center

UNEP: United Nations Environment Programme

WTO: World Tourism Organization

1. Introduction

Coral reefs are some of the most biodiverse and valuable ecosystems on Earth. Coastlines of more than 100 countries are covered with coral reefs. So livelihood of millions of people are dependent on this tropical ecosystem (Morberg & Folke, 1999). Coral reef provides numbers of goods and services including coastlines protection against damaging waves and storms, provision of natural resources such as food and medicine, and provision of habitat for many marine species (Veron et al., 2009). Still, coral reef ecosystems are under pressure of human-induced activities. Destructive fishing practices, coastal development, overexploitation, and unplanned tourism are among threats against wellbeing of coral reefs (Bryant et al., 1998).

Malaysia is one of the countries located in Coral triangle and enjoys great coral biodiversity. It is reported that around 80% of known coral species from coral triangle can be found in water around Malaysia (Toda et al., 2007). Off the east coast of Peninsular Malaysia, Tioman Island, one of the most popular island of the region, attracts great number of tourists with its rich coral reef (Muda et al., 2011). Marine tourism in Tioman Island has economic significance for its role in generating income and providing employment opportunities. Since 1990, Tourism has been the main source of income for Tioman locals (Chia et al., 2018). However, high number of tourist and development of tourism industry caused environmental challenges to the marine ecosystem (Salleh et al., 2012). Unregulated tourism makes detrimental impacts to coral reef ecosystem, yet, tourism could represent "a motivation and source of resources for its conservation" (Diedrich, 2007, pg.985). For a community with high level of dependence on tourism for its economic significance, it is necessary and rational to preserve the healthy state of its coral reef ecosystems (Diedrich, 2007). In addition, tourism can be a better alternative for coral reef use, relative to destructive activities such as coral harvesting and commercial fishing (Zakai & Chadwick-Furman, 2002). Thus, carefully planned and controlled tourism could be a shift from destructive practices like fishing as well as encourage the conservation of the marine ecosystem.

1.1. Problem Statement

In the 1970s, crystal water and pristine coral reefs led Tioman Island to be selected as one of the most beautiful islands in the world (Muda et al., 2011). Tioman Island has been developed as a tourist destination over the past few decades. Along with the growth of tourism, however, there is increasing concern over environmental impacts of tourism activities on coral reef. Despite

economic benefits, reef related tourism cause negative impacts such as pollution (Hanafiah et al., 2014) and physical damage to corals by direct contact of tourists (Shahubuldin et al, 2017).

1.2. Objectives and Research Questions

Determine to what extent tourism activities in Tioman Island is performed sustainably to ensure the coral reef protection.

Determine to what degree the tourism policies of Tioman Island addresses threats regarding the sustainability of coral reef.

1. What are the threats against the coral reef?

2. What are the impacts of marine tourism on coral reef ecosystem?

3. What is the perceived health status of coral reefs by actors in the tourism industry?

4. What are (if any) the current or planned approaches to make tourism practices more socially and environmentally sustainable?

2. Background

2.1. Coral reefs ecosystem

Coral reefs known as "tropical rainforests of the sea" is an underwater marine ecosystem and one of the most diverse one. Coral reefs cover only 1% of the ocean area but support 25% of all marine species in the world (WWF, n.d). Most coral reefs are built by Hermatypic, or Hard, corals. These types of corals produce a stony exoskeleton from calcium carbonate of seawater to support their soft bodies. Alcyonacea, or soft, are bendable coral species that resemble plants and trees. They are not involve in reef building and do not always have zooxanthellae(tiny algae). Sea fans and sea whips are examples of soft corals (Ross, 2018).

Coral is a structure made up of identical tiny animals referred to as ‘polyps’. Coral polyps are carnivorous invertebrates and live on limestone skeleton of their ancestors. Over centuries, they add to the existing carbonate structure creating a massive colony known as a coral reef (Ross, 2018). The process is quite complicated and several factors are involved. Many areas of tropical coastline characterized by frequent storms leading to destructive waves. Many organisms erode corals. Besides some fishes bite big chunk of corals and digest their tissue and algae on their surface. The lost parts of reefs result from these destructive activities are often filled by sand and rubble. Other corals and some algae could overgrow and form more solid structure by centimneting with more calcium carbonate. In this way coral reefs are formed. In fact development of coral reef is not a continuous development process but intervals of growth and inactivity and even erosion (Spalding et al., 2001).

Coral reefs are generally classified into four main types: barrier reef, fringing reef, atoll, and platform reef. Barrier reef is separated by extensive lagoons from landmass. The Great Barrier Reef in Australia is a well-known example of barrier reef. Fringing reef is distinguished by its shallow lagoon and includes most reefs in Caribbean and Red Sea. Atolls are described as a horseshoe shaped or ring-shaped coral reef encircles a lagoon. Most of the world's atolls are in the Indo-pacific. Platform reefs occur inside the lagoons created by other three types of reefs. Platform reefs are found in the Great Barrier Reef lagoon, Red sea and Bahamas (Moberg & Folke, 1999).

2.2. Research Area

Tioman Island is situated 32 kilometers off the east coast of Pahang State of Peninsular Malaysia, with 21 kilometers long and 12 kilometers wide. Access to the island is mainly by ferry from the coastal town of Mersing on the mainland or from Tanjung Gemok. The other way to reach the island is by flight from Subang airport in Malaysia or Changi airport in Singapore. From 1990 tourism has developed significantly and has been a major source of income for the local community (Chia et al., 2018). The Island encompasses 5 villages, which are: Salang, Tekek, Air Batang, Paya Genting, Mukat and Juara. In 2012, the population in Tioman Island estimated as 3,314 residents (Hanafiah, Jamaluddin & Zulkifly, 2013). Most job opportunities associated with tourism such as boat operators, nature guides, resorts, and small restaurants. The Tioman Island has coral reef and known for its dive sites which make the island popular among underwater adventurers. In addition, 3S's(sea, sun, and sand) tourism and other leisure activities as bird watching, boat sailing, jungle trekking, and rock climbing are taking place on the island. However, some resorts have to close their business between Decembers to February due to monsoon season (Chia et al., 2018). The inland rainforest has mostly hilly topography and covers large part of the Island. The Island is home to 45 species of mammals and 138 species of birds which many of them are protected species (Abdul, 1999). Reefs around the island are mainly fringing off-shore reefs and some submerged reefs (Reef Check Malaysia, 2013). In 1972, the Malaysian government acknowledged Tioman Island as a wildlife reserve for its high biodiversity. Tioman Island has been praised in several occasions. Once the island has been named as "the Jewel in the South China Sea". The 1958 Hollywood blockbuster "South Pacific" depicted the Tioman beautiful beaches. In the 1970s, time magazine selected the island of Tioman as one of the world's most beautiful islands. In 1994,under the Malaysian Fisheries Act 985 (amended 1993), Tioman island recognized as Marine Park Area(MPA) in pursuance of conserving its rich marine biodiversity from human damaging activities such as fishing. (Ho et al., 2017). The island has a small power generation station which supply electricity to all areas. There is supplement of freshwater based on several river systems originate from the hilly forested areas. In recent years, a municipal incinerator was constructed (Reef Check Malaysia, 2018).

Figure1: Location of Tioman Island (Shida, Abdul & Badaruddin, 2013, pg.329**)**

2.3. Tourism in Tioman Island

On the eastern side of the peninsula Malaysia, Tioman is the most popular tourist destination owning to its fantastic diving and snorkeling opportunities. Tioman Island is a duty-free area, which makes many items especially alcohol cheaper than the mainland. The island satisfied different type of travelers with variety of its resorts (Wonderful Malaysia, n.d.). There are three levels of tourist facilities including: the international class beach resort, mini resort, village chalet, and village chalets catering for the budget travelers (Hanafiah, Jamaluddin & Zulkifly, 2013). Shortly after Tioman Island grew as a tourism destination, a need for charging conservation fee released by the authorities. Initially the amount of RM 5 was charged for entering the Tioman Island, however, the fee has raised to RM 30 for non-Malaysian visitors (Tioman Ferry, n.d.).

The underwater coral reef around Tioman Island provides one of the best diving and snorkeling possibilities in Malaysia. The best time to visit Tioman is between Februarys to November out of the northeast monsoon. During the monsoon season, diving and snorkeling are not possible due to currents. Besides, underwater lives are less attractive and visibility is poor.

Snorkeling is the most popular activity in Tioman followed by diving, beach sports and surfing. Many of the resorts offers a house reef where travelers could enjoy snorkeling right in front of their cabana. Some of the resorts provide snorkeling tours around the island. Wearing life vest is compulsory by some of tours to preserve corals from physical damages by forcing snorkelers standing above the water all the time (Wonderful Malaysia). For diving visitors, there are many diving centers in the island. They offer courses for Open Water Diver (OWD), Professional Association of Diving Instructors (PADI), Scuba Schools International (SSI) and courses for fun dives (Lonely Planet, n.d.).

Although snorkeling and diving are main attractions in Tioman, there are plenty other activities. Kayaking, paddle boarding, surfing and jet skiing are popular above water activities. In addition, the inside of Tioman is covered in thick jungle which offer several jungle tracks. Since Tioman has one of the most diverse wildlife among Malaysia's national parks, hiking in its jungle would include spotting some precious spacious such as black giant squirrels, long-tailed macaques, brush-tailed porcupines and huge monitor lizards (Lonely Planet, n.d.).

2.4. Reef Check Malaysia

In 2007, Reef check Malaysia (RCM) was established in order to assist in management of coral reefs in Peninsular Malaysia. Since then, RCM has conducted an annual survey programme to assess the health of coral reefs. More than 200 reef sites around Malaysia has been surveyed. It has initiated several reef rehabilitation projects, and handled training and education programs around the country. Tioman Island was one of three locations chosen for annual coral reef survey program. Following damage assessment of a bleaching event in 2010, RCM collaborated with Department of Marine Park Malaysia (DMPM) to conduct a resilience survey around the island of Tioman. The result of survey indicated the need for improvement in management of coral reefs (UW360, 2016). In 2011, RCM established a large-scale rehabilitation programme on Tioman Island. In 2014, RCM initiated its first community programme with support of EcoKnights, the UNDP GEF Small Grants Programme (GEF SGP), Yayasan Sime Darby and HSBC Amanah Takaful. The campaign known as Cintai Tioman. "The Cintai Tioman Program is an integrated approach to assist in increasing the ecological and social resilience of the Island of Tioman. From activities on coral reef rehabilitation to community-based engagements, Cintai Tioman aims to help reduce the impact of human activities on coral reefs around Tioman Island, and also empower

the local communities to get involved in the management and conservation of the island's resources" (Reef Check, 2015). Cintai Tioman Programs strives to achieve two main goals as:
Goal 1: "Increase the ecological resilience of coral reefs around Tioman Island".
Goal 2: "Increase the social resilience of the community in Tioman Island". (Reef Check, 2015)
To achieve the first goals RCM initiated several programs including:

- An effective recycling system to improve waste management
- Green Fin program that aims at dive operators as well as their customers in order to promote responsible behavior and reduce negative impacts of tourism towards the environment.
- A responsible tourism program for resorts based on ASEAN green hotel standard.

RCM programs to achieve its second goal:

- Education program for school children as well as local residents to raise awareness on the importance of coral reef protection
- Several training programs for local residence to increase their working skills and service quality
- Introducing co-management strategies and involvement of all stakeholder in conservation programs(UW360, 2016)

2.5. Reef Check Malaysia Survey

Since registration of RCM in 2007, an annual national coral reef monitoring programme has been reported. The surveys are conducted by trained, certified volunteers and government official from the DMPM. The surveys are found on coral reef organisms known as "Indicator Species" which are distributed widely, identifiable by non-scientists, and give information about coral reef health. RCM applies a standard methodology to be able to compare data from surveys in different sites. Two depth contours (3 m to 6 m and 6 m to 12 m depth) are surveyed by RCM. The total exploited transect line is 100 m. The surveys are carried out along four 20 m transects separated by 5 m. Therefore, four replicates per transect for statistical analysis are provided. The collected data are divided into four types:

- **Fish abundance**: counting the indicator fish by swimming slowly along the transect line made up of four 20 m long x 5 m wide x 5 m high corridors

- **Invertebrate abundance**: counting the indicator invertebrates by divers along the same corridors
- **Substrate cover**: observing the substrate category for example live coral every 0.5 m by using the Point Intercept method
- **Impact**: assessing damages to coral reef from bleaching, destructive fishing, corallivores such as Crown-of-Thorns starfish, anchoring, and pollution (Reef Check Malaysia, 2018).

The regular Reef Check surveys allows managers and scientists to notice damaging changes early enough to take action by intervene as well as further in-depth studies. Therefore unwanted changes can be treated before becoming major problems.

RCM covers several islands off Peninsular Malaysia's East. Surveys are carried out in both Marine Protected Areas and non-protected areas.

In order to provide an overview of coral reef health, RCM adopted the criteria introduce by Chou et al, 1994 (Reef Check Malaysia, 2018).

Percentage of live coral cover	**Rating**
0-25	Poor
26-50	Fair
51-75	Good
76-100	Excellent

Table 1: Coral Reef Health Criteria (Reef Check Malaysia, 2018, pg.6)

Substrate:

- Rubble (RB) can be small pieces of rock, dead shells, and fragments of corals. RB is built by both natural and unnatural factors for instance wave action, storms, fish bombing, and diving. Since it is difficult for corals to recruit onto a mobile substrate, the high level of RB on reefs slow down the coral regeneration.

- Nutrient Indicator Algae (NIA) shows the amount of algae on reefs. NIA measure the herbivorous fish health, invertebrate populations on reefs, and the level of nutrient input to reefs. Although algae play vital role in coral reef ecosystem, when they grow unchecked, they could deprive corals of sunlight to photosynthesis, finally cause coral death by smothering them.
- Recently Killed Coral (RKC) indicates the amount of coral killed within the last 12 months caused by bleaching, predation, sedimentation, and other local stressors.
- Silt (SI) emerges from both natural sources such as mangroves and mudflats and land use changes like agriculture, forestry and development. Silt could cause corals smothering.
- Sponges (SP) are normal component of reefs. Under high levels of nutrients the right condition SP can reproduce.
- Sand (SD) is a natural component of reefs. The high amounts of SD could indicate disturbance as dead coral breaks off and eroded into SD by wave action.
- The category Other (OT) are natural components of coral reefs including all other sessile organisms that do not cause any impacts (Reef Check Malaysia, 2018).

Fish

Reef Check indicator fish species include:

- Butterflyfish- indicating fishing pressure for aquarium trade and reef health as they feed on coral polyps
- Sweetlips, Snapper, Barramundi Cod, Parrotfish (avoiding competition between corals and algal by controlling algal growth on reefs), Moray Eel, Grouper- indicating fishing pressure for food fish
- Humphead Wrasse and Bumphead Parrotfish- indicating fishing pressure for live-food fish trade (Reef Check Malaysia, 2018).

Invertebrates

Reef Check indicator invertebrate species include:

- Banded Coral Shrimp, Pencil Urchin, Triton Shell- indicating pressure for curio trade collection
- Collector Urchin, Sea Cucumber, Lobster, Giant Clam- indicating pressure for food collection

- Diadema Urchin(controlling algal growth on reefs toghter with herbivorous fish, however, its large numbers indicates eutrophication or overfishing of herbivores), Crown of Thorns starfish (causing serious damage to coral reef by feeding on them, a healthy coral reef can maintain 0.2-0.3 individuals per 100m2)- indicating pressure for Ecological Imbalance/predator outbreaks (Reef Check Malaysia, 2018).

2.6. Green Fins

Green Fins (GF) is an approach "to protect and conserve coral reefs by establishing and implementing environmental friendly guideline to promote a sustainable diving and snorkeling tourism industry" (REEF-WORLD Foundation, n.d.). Green Fins aims to motivate dive centers, snorkel operators, communities and government to incorporate in order to mitigate their environmental impacts. GF is originally an initiative of the United Nations Environment Programme (UNEP) and Reef-World established in 2004 to raise public awareness and encourage management efforts to conserve coral reefs and reduce negative impacts of marine tourism activities (REEF-WORLD Foundation, n.d.). With collaboration of members of the diving industry, the Thailand Government, UNEP and the Coral Reef Alliance, GF has developed 15 points Code of Conduct (COC) by which assist dive and snorkel centers to implement environmental standards. Members of GF are expected to follow these COC (Table 1).

1. Adopt the Green Fins mission statement
2. Display the adopted Green Fins agreement for the public to see
3. Adhere to Green Fins Friendly Diving and Snorkeling Guidelines and act as a responsible role model for guests
4. Participate in regular underwater cleanups at dive operator selected sites
5. Participate in the development and implementation of a mooring buoy program and actively use moorings, drift or hand place anchors for boats
6. Prohibit the sales of corals and other marine life at the dive operation
7. Participate in regular coral reef monitoring and report monitoring data to a regional coral reef database
8. Provide adequate garbage facilities on board facility's vessel and deal with responsibility

9. Operate under ‘minimum discharge’ policy
10. Abide by all local, regional, national, and international environmental laws, regulations and customs
11. Provide guest with an explanation of Green Fins Friendly Diving and Snorkeling Guidelines in pre dive briefing
12. Provide training, briefing and literature for employees and guests regarding good environmental practices for snorkeling, diving, boating, marine wildlife interaction and other marine recreational activities
13. Provide staff and guests with public awareness and environmental materials (ID books, pamphlets etc.)
14. Provide guests with information on local Marine Protected Areas, environmental rules and regulations
15. Promote a strict ‘No Touch’ policy for all reef diving and snorkeling

Table 2: Green Fins Code of Conduct (Hunt et al., 2013, pg.36)

GF provides a certificate for those dive centers who has been successfully assessed after the first time in order to promote these centers as an eco-friendly to tourists who prefer sustainable options. During the assessment process, a trained GF Assessor, who is a member of the National Teams or a trained volunteer from Reef-World Foundation, evaluates the effectiveness of environmental efforts to reduce their impacts by the dive staff and the dive center guests on a regular diving practice. Apart from the certification, GF offers several other incentives to its certified members including free promotion on GF website as an eco-friendly dive center and national tourism promotional incentives. On assumption that, the member dive center assessment score doesn't imply any improvement after two year, they may lose their certification (Hunt et al., 2013).

GF defines four statues for its members as follow:

Active Members follow the GF’s COC actively. They have been trained and their performance is assessed within the last 18 months. They reduce or maintain level of their environmental impacts comparing to their previous year performance.

Inactive Members have been trained to follow GF’s COC. They have been assessed at least for once but not in the last 18 months.

Interested Members have not been trained or assessed but they have shown their interest by filling out the membership form.

Suspended Members have not stuck with GF's COC and have not made effective efforts to reduce their environmental impacts within two years. They could have been involved in environmentally detrimental activity (Green Fins, n.d.)

2.7. ASEAN Tourism Standard: Green Hotel

Association of South East Asian Nations (ASEAN) was formed in 1967, initially consist of Thailand, Malaysia, Indonesia, Philippines, and Singapore. 5 other countries namely Brunei Darussalam, Cambodia, Lao PDR, Myanmar and Vietnam, later joined the program. ASEAN aims to standardize tourism services necessary for member nations to be a Quality Single Destination. Thus, ASEAN developed following six standards for different types of resorts: Green Hotel, Food and Beverage Services, Public Restroom, Home Stay, Ecotourism, Tourism Heritage (ASEAN Secretariat, 2007)

Green Hotel: "an establishment for the promotion of the environmentally friendly and energy conservation" (ASEAN Secretariat, 2016, pg. 12)

Major Criteria	Requirement
Standards for ensuring local guide quality and expertise	• Promotion of environmental activities in order to encourage the involvement of hotel staff, clients and suppliers to participate in environmental management practices. • Existence of plan for raising staff to be aware of environment i.e. training. • Existence of environmental management plan for hotel operation. • Existence of monitoring program for environmental management of hotels.
Use of green products	• Encouragement for the use of local products for hotel operation i.e. food and Handicrafts.

	• Encouragement for the use of environmentally friendly products.
Collaboration with the community local organizations	• Existence of plans/activities to help improve quality of life of the community. • Existence of awareness raising programs for local community on environmental Protection. • Creation of activities in promoting culture and traditional performance and local ways of life. • Creation of job opportunity for local community.
Human resource development	• Provision of training programs for operation and management staff on environmental management.
Solid waste management	• Introduction of waste management techniques e.g. waste reduction, reuse, recycling, waste separation and composting. • Encouragement of the involvement of hotel staff in waste reduction, reuse, recycling, waste separation and composting programme. • Encouragement of the involvement of hotel Guest in reuse, recycling, waste separation.
Energy efficiency	• Introduction of energy saving techniques and / or energy saving technology and equipment for hotel to reduce energy consumption. • Installation of meters/equipment to monitor energy consumption.
Water efficiency and water quality	• Introduction of water saving techniques and / or use of water saving technology and • Equipment to reduce water consumption. • Regular maintenance for water saving equipment.

	• Encouragement of the involvement of hotel Guest in water saving. • Ensure the quality of water used in the hotel.
Air quality management (indoor and outdoor)	• Designation of smoking and non-smoking area. • Regular monitoring and maintenance for equipment and hotel facilities to ensure the air quality i.e. air conditioning.
Noise pollution control	• Existence of noise control program from hotel operation.
Wastewater treatment and management	• The use of mechanisms to prevent water contamination and reduce waste water generation. • Promotion of the use of recyclable/grey water in operation i.e. watering trees. • Encouragement for an appropriate use of wastewater treatment.
Toxic and chemical substance disposal management	• Provision of clear signs for toxic substance. • Appropriate hazardous waste disposal management. • Regular inspection, cleaning and maintenance for storage in order to avoid leakage of gas or toxic chemical substance.

Table 3: ASEAN Green Hotel Standard (ASEAN Secretariat, 2016, pg. 7-10)

3. Conceptual Framework

3.1. Sustainable tourism

The concept of sustainable tourism is emerged in 1990, however, has its origins in decades earlier in the wider concept of sustainable development (Swarbrooke, 1999). The idea of sustainability is rooted in 1970 by growing importance of environmentalism. In the World Conservation Strategy of International Union for the Conservation of Nature and Natural Resources (IUCN, 1980) the concept of sustainable development was revealed. The original definition of sustainable development is provided from Our Common Future, also known as the Brundtland Report as

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987: 43). In addition the commission stated the importance of dynamic process of changes as "are all in harmony and enhance both current and future potential to meet human needs and aspirations" (WCED, 1987: 46) in comparison as a fixed state of harmony (Liu, 2003). In 1992, owing to growing interest in area of sustainability, United Nations Conference on Environment and Development (The Earth Summit) issued a comprehensive blueprint for implementing sustainable development (Agenda 21) and reported principles for global sustainable development. Accordingly, tourism was considered as one of the industries with potential to make contribution on reaching a healthier planet. On the context of tourism, several definitions for sustainability have been introduced. Swarbrooke(1999, chapter 1) suggested a definition for sustainable development based on Brundtland Report as " Forms of tourism which meets the needs of tourists, the tourism industry, and host communities today without compromising the ability of further generations to meet their own needs". The World Tourism Organization defined sustainable tourism as "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" (UNEP, 2005, pg.12). According to Cater (1993) sustainable tourism comprise of three main missions: improving living standards for host community in short and long term; meeting the increasing demands of visitors; maintaining the healthy states of environment to accomplish former objectives. Farrell (1999) introduced the idea of sustainable trinity as a form of development through clear integration of economy, society and environment (Liu, 2003). Clark (1997) proposed a framework for approaches on sustainable tourism. The framework holds four positions of understanding of sustainable tourism. The first position 'polar opposition' referring to mass tourism and alternative tourism due to their recognition as 'bad' and 'good' tourism. The concept of 'continuum', second position, is basically adapted as a flexible approach to first position as it adjusted the simplicity of polar opposition to a continuum between two extremes. These two approaches were criticized for simplicity and contradicting the reality. 'Movement', the third position, discussing the possibility of making mass tourism more sustainable by positive action. The fourth position 'convergence' representing the sustainable tourism as a goal to achieve rather than an issue in scale of tourism.

Swarbrooke(1999) in his book 'Sustainable tourism management' discussed the players and different elements of sustainable tourism. He argued how complex web of stakeholders in

sustainable tourism challenges to reach a compromise on what sustainable tourism mean and how to achieve its goal. He identified the main stakeholders as: host community, governmental bodies, tourism industry, tourists, voluntary sector, experts, media, pressure groups, and tourism industry. Swarbrooke identified five types of environments which are important in sustainable tourism: coastal tourism, tourism on islands, tourism in countryside, mountain region tourism, and urban tourism. He also pointed different characteristic of each environment and call for objectified management plan for each environment to optimize balance between negative and positive impacts as well as satisfying tourist demand. Regarding tourism organizations the following are recognized: public sector bodies, private sector companies, volunteer sector bodies, large companies operates in several sector of tourism, large companies operate in one sector of tourism, medium and small enterprises, one-person business, organization which operate in foreign countries, and organization which operate in domestic market only.

In early days of sustainable tourism, sustainability has been considered as a mean to deal with the negative impacts of tourism and preserve its continuous growth (Liu, 2003). Following the recognition of the detrimental impacts of tourism, there were attempts to mitigate the negative excess for a short run. After all, the efforts were downscaled and did not aim to modify the nature of tourism (Swarbrooke, 1999). Saarinen (2006) discussed that even the main focus of tourism is to contribute to sustainable development on a local scale, it can be unsuccessful in minimizing impact and maximizing benefits on this level. Sharply (2000) claimed that, while, sustainable tourism strategies are mostly applied on the local, destination level, different sections of the tourism are in accordance with environmentally sustainable principles. However, there is not much evidence that the current development plans throughout the tourism industry are consistent with the principles of sustainable development. He clarified that sustainability strategies should aim for larger context at national or worldwide level, yet, local-scaled strategies are necessary and useful.

3.2. Indicators

Sustainable tourism is known as an approach to fulfill the wish for more environmentally, economically and socially beneficial tourism. Indicator system is useful practice to design and implement models focusing on sustainable tourism. Tourism managers employ indicators to be able to evaluate the state of the destination, and to diagnose issues that need to be tackled. Thus they can promote more sustainable form of tourism (Lozano-Oyola et al., 2012). The need for

parameters such as sustainability indicators, which evaluate tourism impacts, was realized by the first introduction of sustainable tourism. To understand the impacts of sustainable tourism and determine whether they are acceptable or not, indicators and other monitoring tools are required (Torres-Delgado & Saarinen, 2014). Sustainability indicators are considered as a powerful tool for simplifying, analyzing and communicating the complex information through emphasizing trends and conceptualization of phenomena (Singh et al., 2009). Bossel (1999, pg. 20) defined indicators as "system variables that provide us with all essential information about the viability of a system and its rate of change and about how that contributes to sustainable development of the overall system". World Tourism Organization (WTO) referring to indicators as set of information which can be both qualitative and quantitative, chosen to measure changes and are instructive for tourism management. Indicators are means to capture changes in internal factors of tourism, external factors which has impact on tourism, and tourism impacts (WTO, 2004).

In 2001, Bell and Morse published a paper in which they described a classification for sustainability indicators based on three dimensions as who has set the indicator (Whose), what type of indicator? (What), how the indicator is defined? (How). They noted that the location of an indicator is not discrete and could be placed anywhere within the space of these dimensions. The first descriptor, 'whose', is referring to origins of indicators. Sustainability indicators may derived from a top-down approach or bottom-up philosophy. Top-down approaches reflect the external expert's views. The indicators of sustainable development proposed by WTO are an example of this approach. These type of indicators are considered useful for starting point, but they lack local community's perspective. Bottom-up or community-based approaches involve variety of stakeholder perspectives. Although these approaches may increase participatory learning process in the tourism destination, they may fail to involve all important sustainability aspects (Schianetz& Kavanagh, 2008). Top-down approaches are more suitable for assessment of global issues such as climate change, while, the bottom-up approaches better suited when evaluating issues on local level. The bottom-up approaches have some disadvantages including being time-consuming, complex, and may lead to identifying more indicators that are practical. Another drawbacks of community-based approaches is when stakeholder's practices are incompatible with sustainability principles. In such cases bottom-up approaches may not contribute to sustainability (Reed, Fraser& Dougill, 2006).The second dimension 'what' regards two types of indicators as quantitative or numeral indicators and qualitative indicators (Bell & Morse, 2001). Scerri and James (2010, pg.51)

argued for an approach that "balance quantitative indicators, such as metrics, that a community needs to move away from or towards if it is to achieve sustainability with qualitative indicators that highlight the nature of community as a negotiated condition". Subsequently, they discussed a call for an approach to bond natural sciences and social sciences that one may evaluate sustainable development. Natural sciences offer facts that are not value free and social sciences provide norms and value within which a community deal with natural sciences driven facts (scerri2010accounting). Finally, 'how' dimension describes the way an indicator is defined. Whether explicitly, defined by a standard methodology aim for evaluation, or implicitly, with no methodology applied. Explicit sustainability indicators are clearly defined. For these indicators, value is prescribed by articulation with the methodology. Consequently, Bell and Morse represented two main common mindsets based on their indicators classification model. The reductionist and the conservational. The reductionist mindset representing as set of quantitative and explicit indicators, while the conservational offers qualitative and implicit featured indicators. Hence, both mindsets are not adequate, Bell and Morse argued for the need to develop a complementary hybridized approach.

3.3. Framework

Literature suggest that the term 'framework' can be applied to describe both the process of selecting indicators, and a conceptualized sustainability approach that criteria are driven from. Frameworks have been established to define the process of indicators selection and arranging the process into defined steps (White et al., 2006).

Reed et al (2006) noticed that the basic steps of sustainability indicators frameworks for both bottom-up and top-down approaches are the same. First, role of frameworks to provide the context, representing the society and environment, within which the indicators work. Second, frameworks must help planning sustainable development. Third, framework introduce the methods for selection of sustainability indicators. Lastly, frameworks include data collection and analysis.

3.4. DPSIR framework

In 1993, OECD introduced the Pressure-State-Response (PSR) model, originally proposed by Rapport and Friend (1979), for environmental evaluation. The model has been developed later by United Nations and European Commission in order to include the causes of changes and the

impacts on the state of environmental ecosystem and society. The PSR framework measures the pressure caused by human activities on the environmental ecosystems and driven changes on the state of the environment as well as anthropogenic responses for mitigating the pressure and improving the environmental condition (Smith et al., 2014). However, the PSR model was a useful tool to introduce to the literature the importance of measuring causes of anthropogenic activities and the environmental impacts and subsequence responded policies, the model was narrow on scope and disregarded the complexity of a system. Due to PSR shortcomings, the European Commission developed the Driver–Pressure–State–Impact–Response (DPSIR) Model (Bowen & Riley, 2003). The model describes the Pressure that environment undergone and caused by economic and social development which led to changes in the State of the environment. Consequently, these alterations causes Impacts on human health and natural resources which may result in a Response from humans such as adaptive or alleviative actions to react on the Driving forces. The DPSIR framework describes the origin and consequences of environmental issues and their relationships. The framework also focuses on the interactions between its elements (Smeets & Weterings, 1999).

Driver indicators: evaluate the changes in level of consumption and production associated with social and economic development in communities that induce pressure on the environment. Population growth and tourism activities are among these forces.

Pressures indicators: evaluate the introduction of substances, emissions, physical and biological agents as well as patterns of land use, resource use, and significant event. Jie et al (2007) introducing demographic dynamic as another form of pressure referring to population growth and flow of travelers that increase living demands and environmental pollution.

State indicators: evaluate the changes in dynamics and function of eco-environmental, social, and economic dimensions. Indicator of eco-environmental state cover the changes in current conditions of air, water, biodiversity, etc. Social indicators represent the community progress. Economic indicators assess the economic situation of local society.

Impacts indicators: evaluate both onsite and offsite effects of development. Onsite impacts occur at local level while offsite impacts take place a great distance from the area of study. Offsite impacts cannot be disregarded as they could hinder the sustainable development.

Response indicators: evaluate management actions by individuals, groups, and governmental bodies in order to prevent, compensate, and adapt human induced changes as well as increasing

efficiency of the system. Responses are occurred in different forms as international treaties, national and local legislation; site management plans, reactive and periodic monitoring, awareness raising, training, research and education (Smeets & Weterings, 1999; Wei et al., 2007; Bowen & Riley, 2003)

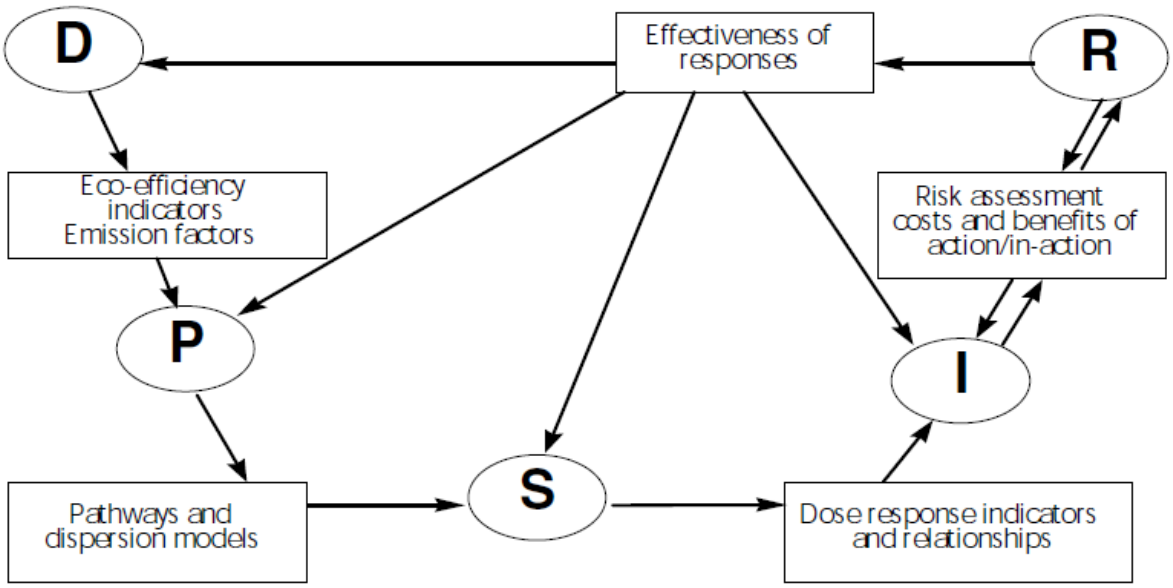

Figure 2: Indicators and information linking DPSIR elements (Smeets & Weterings, 1999, pg.7)

This approach is useful to understand the origin and insistence of an environmental problem. Besides the interaction between the environment and development can be evaluated through this framework (Carr et al., 2007). Considering assessment of tourism sustainability, the DPSIR framework is considered suitable to achieve the objectives of this study and is therefore adopted in this research.

4. Research Methods

4.1. Research Design

The study collected data that could help answering questions about sustainability of tourism practices, current situation and conservation regarding coral reefs ecosystem in Tioman Island. Although the main chosen research strategy for this thesis is qualitative method, quantitative data is also generated. The methodological approach taken in this study is a mixed methodology based on diversity of viewpoints. For this study, the convergent parallel design is used. This design method emphasis on collecting qualitative and quantitative data concurrently, following with separate analysis of two sets of data and final mixing of the results during interpretation (Creswell, 2013). Qualitative method offers an effective way of knowing the social world of the participants as examining their explanations (Bryman, 2012). Qualitative approach was adopted to collect data from NGOs, dive centers, tour operators and local community. To have an insight into tourists' perspective on the quality of their marine ecosystem experience, quantitative method was applied. It was considered that quantitative measures would usefully supplement the stakeholder's views on state of the marine ecosystem. Descriptive statistics is used to analysis quantitative data.

4.2. Sampling Methods

The field study took place in three different villages in Tioman Island as well as town of Mersing on the east coast of Johor, Peninsular Malaysia in April 2019. All qualitative interviews were conducted in Kampung (Kampung meaning village in Malay language) Tekek, Kampung Air Batang (ABC) and Kampung Juara in the Island. Majority of study was conducted in Tekek village as most participants were based on this village. Besides, being the most developed village in the island, Tekek has prospering marine tourism. For the qualitative part of this thesis, participants sampled through purposive and snowball methods. Purposive sampling is a nonrandom technique for selecting informants due to their relevance to the research questions. This method is based on researcher's judgment on what information needs to gain. Thus, the researcher deliberately chose those subjects who possess the sought information (Tongco, 2007). NGOs were selected purposively, according to their relevance to thesis topic. Reef Check Malaysia and Juara Turtle Project are active NGOs working on conservation of marine life in Tioman Island. By snowball sampling, potential participants were recruited after initial contact with relevant informants (Bryman, 2012). Participants from community and diving centers were sampled by snowball

methods. Tourists were chosen through convenient sampling. The quantitative questionnaires were filled by tourists both in the Island and town of Mersing. They were reached in different places such as restaurants, resorts, ferry, and bus terminal.

4.3. Data Collection

In this study, data collected from both primary and secondary sources. Primary data was gathered during the field study from semi-structured interviews and quantitative questionnaire.

4.3.1. Primary data

In order to gain in-depth knowledge of stakeholder's perspective on sustainability of coral reef tourism on the Island, face to face qualitative interviews were conducted. According to Galletta (2013) semi-structured interview is structured enough to answer specific aspects of the research questions besides provides space for interviewees to extent the study topic. Additionally, semi-structured interviews provide the opportunity for reciprocity between the researcher and the informant. In this regard, the researcher has a chance to pursue deeper understanding, clarification and strategic reflection. Majority of the data collection population were interviewed in-depth. Interview questions were set prior to the interviews and were based on the research objectives and role of interviewee in tourism. Duration of interviews varied from 20 to 150 minutes. All interviews were conducted in English. 11 people were interviewed with qualitative approach. In addition, some more locals in different jobs have been asked to share their opinions, however, they were not interviewed in formal manner. In this study, tourist's attitude towards the state of coral reefs was conducted in the form of a survey, with data being gathered via self-completion questionnaire generated in Google Survey. Questionnaire is fast and effective way to gather data from numbers of respondents. The questionnaire used in this study include mostly closed questions regarding the respondents experience with seawater quality and condition of coral reefs. However opened questions were also provided to receive any information respondents feel to share. Total of 42 tourists answered the questionnaire.

4.3.2. Secondary data

To address the research questions, a great deal of information were provided from secondary sources. The secondary data in this thesis drawn from different sources including books, relevant

previous studies on the island, academic articles, news articles, social media posts, reports from RCM, organizations' websites and their booklets.

4.4. Limitations

The scope of this study was limited in terms of absence of governmental officials as a respondent group. Thus concerns of this group was not heard. In addition, due to changes in organizational structure of DMPM, data related to management of Tioman Marine Park was not available. At time of this research, the department website was out of access and the sought data could not be found on other organizations' database.

5. Findings

5.1. Driver

Kristensen (2004) considered driving force as a need. There are two types of driving forces: primary and secondary needs. Basic human needs such as need for shelter, food, fuel, and water are primary driving forces, while, mobility, recreation and culture are categorized under secondary driving forces. In other words, driving forces are anthropogenic activities provoking changes in human overall consumption and production level through which pressures exert on the natural environment (Smeets & Weterings, 1999).

In Tioman, tourism has been the most vital industry and major source of income for islanders since the 1990 (Chia et al., 2018).

> "*About 90% of the islanders are involved directly or indirectly in tourism industry. There is not many alternatives for tourism in the island. Only few percent of locals are engaged in other activities such as fishing and plantation."* RCM said (Interview, April 2109).

The chart (figure 3) shows the number of tourists visited Tioman Island from 2000 to 2016. Despite dramatic fluctuations during 2000-2011, the recent trends indicates a gradual increase in the number of visitors. In 2016, the most current year with available data, 249,300 tourists visited Tioman.

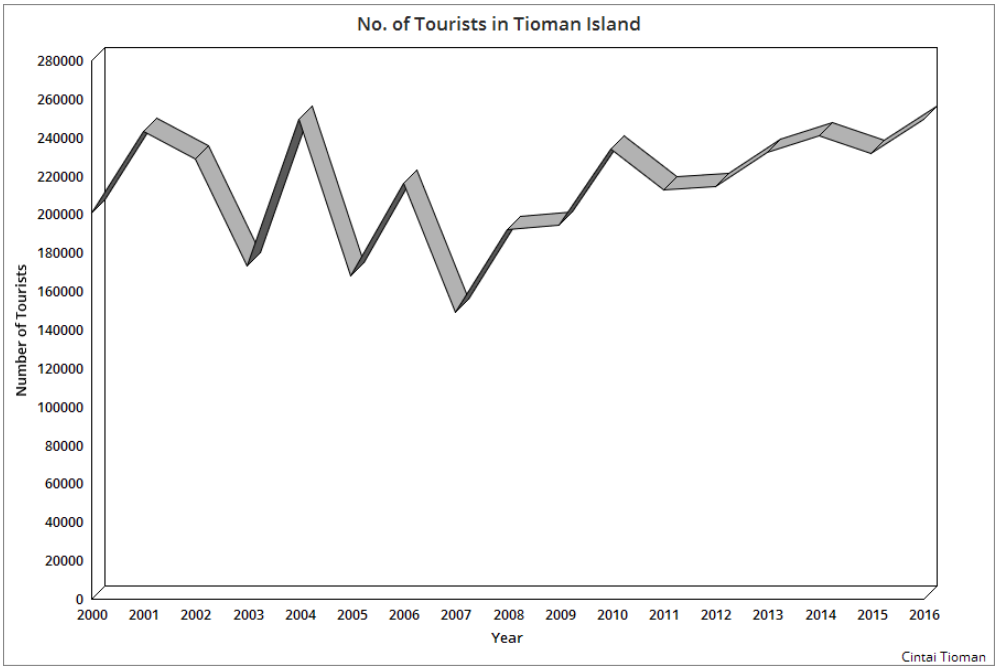

Figure 3: Number of visitors in Tioman Island (Cintai Tioman Report)

Director of tourism in Pahang hoped to boost the economic and tourism on the island by building a new airport. A bigger airport will increase number of visitors considering complicated transport to the island. Tourists have to take ferry to reach the island and during monsoon season the ferry service is disrupted. The existing airport located in Tekek village, handled only chartered flights which could carry about 12 passengers at any one time (The Sun Daily, 2017).

RCM representative said:

> "*The area of existing airport is 950m, only small planes can land. In the past one flight daily scheduled by a private aircraft which has the capacity of 40 passengers. It was so old and on 2013 got decommissioned. Shortly after, another company introduced a 12 seats plane. The flight was so expensive only few people afford it. About 10 years ago, there was a project to construct a new airport off the coast of the Paya village. Government made an assessment and canceled the project for its negative environmental impacts. In 2018, the project was revived and currently is under negotiation, however we protested and got the media attention."* (Interview, April 2109)

Tourism stakeholders have conflicting perspectives on the establishment of a new airport. Some pointed on its side effects. Some viewed the need for a bigger airport to stimulate tourism. (Chia

et al., 2018). Hanafiah, Jamaluddin and Zulkifly (2013) set out a research to determine the perspective of local community towards tourism on Tioman Island. Based on their findings the majority of residents supports new tourism facilities that will attract more tourism.

A chalet owner's opinion on further development of tourism:

> *"We still need to grow more. There are lack of resorts. There isn't enough room for tourists. Tourists are coming. We need more development. We can have more tourists."* (Interview, April 2109)

Regarding potential development of tourism, one of dive operators stated:

> *"Tourism in Tioman Island is not intensive. When we go in dive site we were the only boat for diving there. There is potential to growth. Tioman is 2.5 hours from the Mainland. Ferries are not frequent enough. Because of the tight. You see they are in very odd hours. That limits tourism to certain degree. And the airport stop operating so. Before they used to fly planes from Singapore and Kuala Lumpur. They do not have that anymore. That got effect. I don't see that (excessive tourism) is happening. I don't see massive construction are done. I don't see big projects, massive companies coming in. And you get a feeling working in this village, how it's like, how is the attitudes of people…. The land are primarily owned, it is not owned by big corporation. They are not allowed to sell to foreigners, they can rent but they can't sell the land. That's got effect also in speed of tourism. I was here 5 years ago* (He earlier had mentioned he has been in Tioman for 7 months)*, I see some development but nothing huge, nothing massive".* (Interview, April 2109)

Despite tourism being the main economic activity in Tioman Island, it is not practiced in a large scale and is in the form of ecotourism. However, the government plans for increasing number of tourist arrival and development of tourist infrastructures such as a new airport. As discussed above, different stakeholders take different sides towards the further tourism growth.

5.2. Pressure

The assessment of driving forces identifies the main drivers affecting the natural ecosystem. Pressure element indicates the direct stresses from anthropogenic activities on the environment. Pressure indicators describe development in introduction of emissions (of chemicals, waste, noise), the resource extraction, land use changes, and physical and biological disruptions (Stanners et al., 2007). Carr et al (2007) addressed pressures as result of human activities as well as natural events such as volcano eruption and solar radiation. Bradley and Yee (2015) listed environmental pressures into three categories, which are:

- Changes in land use: coastal development, land development, shoreline alteration, hydrologic modifications.
- Release of pollutant: chemicals pollution (e.g., fertilizers, pesticides), air pollution (vehicle and smokestack emissions), water pollution (point and nonpoint source discharges)
- Physical damage: deforestation, boating activities, anchor damage and so forth.

> "*There are two local threats to coral reef: trash and unsustainable tourism."* RCM said (Interview, April 2109).

5.2.1. Changes in Land Use

The islanders traditionally involved in farming, coconut cultivation and fishing. About 70%-80% of residents worked in these fields. In 1965, land use alteration started by occupation of the Malay people in waterfront lands. Consequently, those local and international business corporation interested in various aspects of tourism such as resort and hotel, travel and tour, and development of golf courses, assign the ownership. The success of international beach resort contributed to changes in land use. The landowners got encourage to involve in tourism benefits. Therefore, they started operating their own chalet (Hanafiah, Jamaluddin & Zulkifly, 2013).Since 1980, local participation in tourism industry has increased (Abdul, 1999). Azaruddin (1994) described the development of tourism in Tioman in three phases. The first phase started in the 1950s when small number of travelers came to the island. 1975 was the start of the second phase with establishment of the first hotel and subsequent building of chalets and increase in number of visitors. In 1990 the third phase began with promotion of Tioman as a tourist destination in foreign market and introduction of incentives to attract investors to establish tourism facilities. According to Omar et

al. (2015) between 2000 to 2015 there was a significant development of resorts in Tioman since tourism becoming an important part of the island economy. During this period around 58 new resorts were established. Beside many of the older resorts received refurbishment in order to follow new trends such as boutique style.

5.2.2. Physical Damage

Shahabudin et al. (2017) identified scuba diving, snorkeling, anchoring, reef walking, and boating activities in shallow water areas as major contributing factors for the decline of coral reef in Tioman, as they might cause partial mortality of corals.

> *"The tourism industry coming hurtful. It is not managed properly. And I've seen pictures of people while doing snorkeling stepping on corals, while diving they kicking corals...And at the end it is always directly related, the more people the more damage would be. Because it is impossible to have like a hundred percent people without making an impact. The moment you are going diving, you are making impacts. Once you go you are changing animal's behavior, you are making noise"* a business owner said (Interview, April 2109).

> *"Some put their feet down. They kicking the corals. And also we see it a lot when people feeding bread to fishes to get them to come to them…..People coming with fishing rods. It has quite minimal effect on reef but they can possibly catch something like shark which take long time to hatch. We seeing lots of fishing, people with fishing rods off the jetties. I don't think it is not the number one issues but it is still need to be tackled. I seeing people catching sharks. There is no specific laws about not catching sharks."* a dive Tour operator said (Interview, April 2109).

> "*20 years ago corals was so big you could see them out of water. Now see. Divers came and start going to water and take photos. Maybe the photo has special meaning to you. I told them, you hurting corals... It was not fishing. It was not bleaching. There was just one bleaching some years ago. It is all divers.*" a local said (Interview, April 2109).

5.2.3. Pollution

> "Tioman *has over 3700 population adding to that large number of tourists who together produce about 6 tons of trash daily"*
>
> *"Water pollution, the biggest problem is sewage, gray water and not receiving any treatment. Most of resorts use septic tanks, some even do not have it."* RCM said (Interview, April 2109).

In Hanafiah, Jamaluddin & Zulkifly (2013) study, the majority of locals agreed that tourism caused pollution and destroy island beauty with littering. The islanders also agreed that tourism makes noise pollution and creates large amount of wastes. Various tourism stakeholders agreed that Pollution had changed the environmental condition in the island. By increase in number of visitors, solid waste increased, both by tourists and resorts (Chia et al., 2018). Ho et al (2017) examined the perceptions of four stakeholder groups of Tioman Island (local residents, tourist, entrepreneurs, and government officials) on its environmental problems. They identified dirty beaches as the problem which achieved consensus among the stakeholders on receiving immediate attention.

5.3. State

Pressure forces alter the state of the natural environment. Wei et al. (2007) assessed the status of natural heritage site in three dimensions of environmental, social and economic. The environment dimension describes the environmental condition of ecosystem. Social dimension reflects community development and its living condition. And economic dimension describes changes in economic structure.

5.3.1. Community Progress

Development of tourism in Tioman Island, has successfully provided desirable job opportunity for the local community. Majority of the islander agreed on economic benefits of tourism. They also agreed that their living standard has increased as a result of tourist spending. In social dimension, the Tioman residents agreed that tourism brought more recreational activities, encouraged a variety of cultural activities and increased local's pride in their culture (Hanafiah, Jamaluddin & Zulkifly, 2013). Ng et al. (2017) evaluated sustainability achievement of tourism on Tioman Island using the Sustainable Ecotourism Indicator System. Based on their findings, in the entire tourism system

on Tioman Island, the most sustainable relationship was between tourism and the community which reflects the socio-economic benefits of tourism for the community. Chia et al (2018) found some dissatisfactions in current social and economic state of Tioman Island. There is economic leakage problem in Tioman. Most business linked to tourism are owned by locals. However, they mostly hire outsiders because local workers either are not interested or run their own business. The cost of food and beverage is higher form the mainland. Moreover prices in popular villages are relatively higher. Based on their findings, the local community were not satisfied with the way Tioman is managed. Locals looking for their fair share on decision making and management of the island. They also consider the government efforts on tourism promotion inadequate.

5.3.2. Corals Condition

Shahabudin et al. (2017) studied coral status in Tioman Island using the coral video transect (CVT) method. Based on their findings, the coral conditions in the island varied from 'fair' to 'good'. Most of reef sites located in the area with less coastal development and human activity put under the category of 'good'. While the coral conditions in the well-developed area that are under pressure of human activities, mostly categorized as 'fair'. Salleh et al. (2012) evaluated tourist satisfaction on environmental service quality offered on Tioman Island. The attributes of environmental service quality for the purpose of the study are as follow: abundance and variety of coral reef, abundance and variety of fishes, clean and clear water, peaceful islands, clean unpolluted beaches, untouched terrestrial flora and fauna, and scenery at fisherman's village. The result of the study indicated that the tourists were satisfied on environmental service quality on the island, however, the level of their satisfaction towards the services quality was lower than their expectation.

In this research tourists' perceptions on quality of experienced coral ecosystem has been questioned (Appendix 1). Based on the findings, majority of respondents agreed that the coral reefs are in desirable condition (Figure 4). Besides tourists perceived seawater quality mostly in good condition (Figure 5).

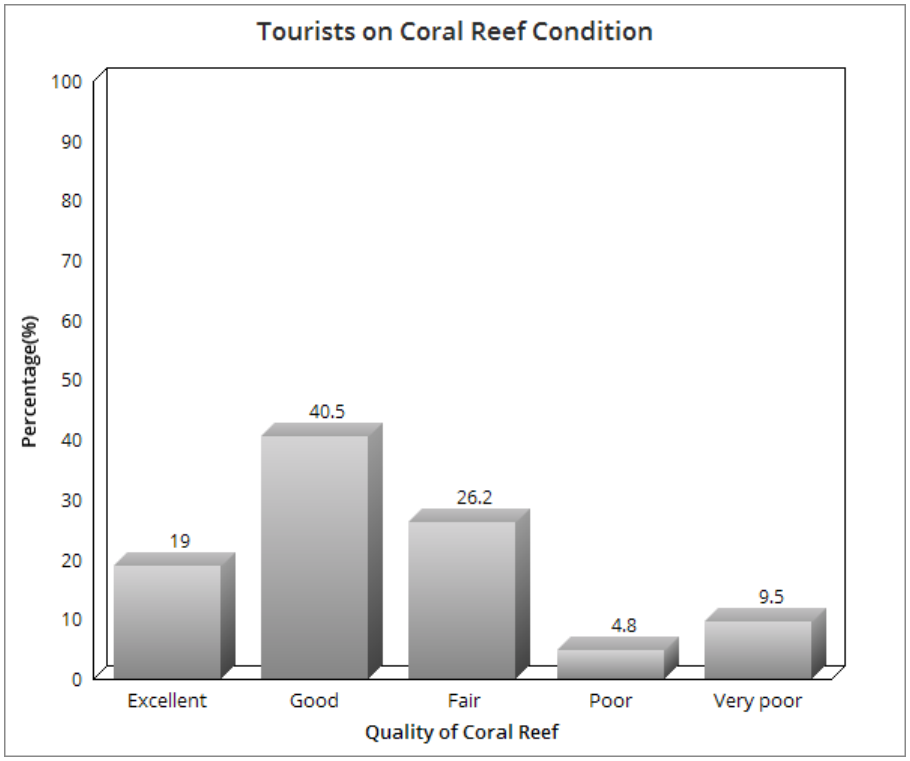

Figure 4: Tourists on Coral Reef Condition in Tioman Island

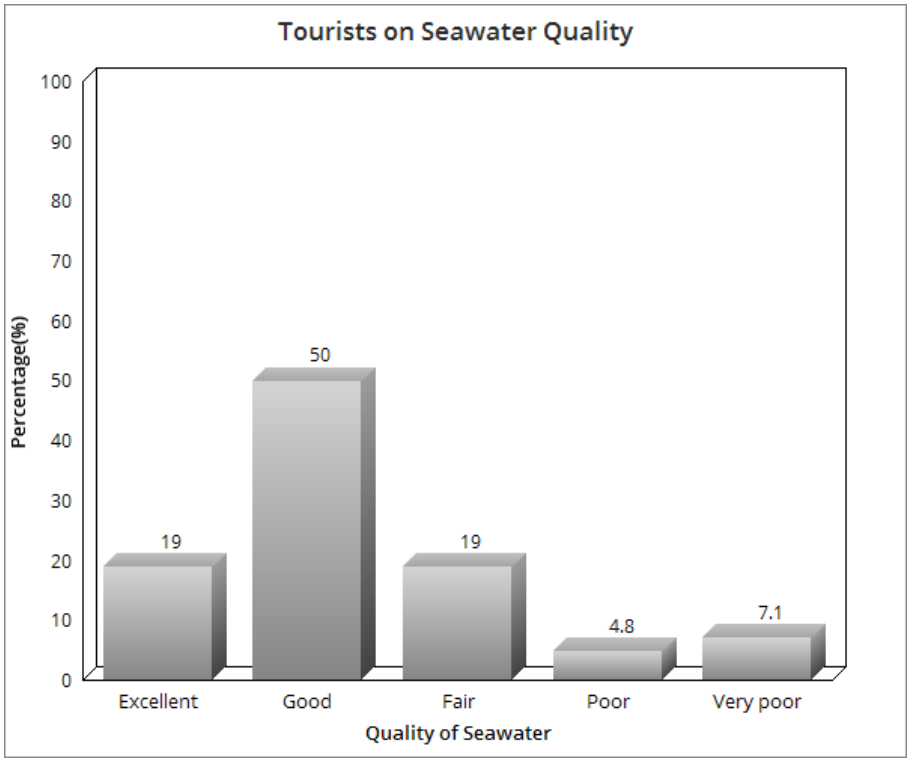

Figure 5: Tourists on Seawater Quality on Tioman Island

More than half of the respondents (56.1%) stated that they would recommend Tioman Island as a perfect destination for diving/snorkeling regarding its pristine marine ecosystem. 31.7% perceived some problem with coral condition or/and seawater quality, although they would recommend Tioman Island as a desirable destination for underwater activities. 9.5% of tourists would recommend Tioman because it is an affordable option. Only 2.4% would not recommend d Tioman because of poor condition of coral reef or/and seawater quality.

Reef Check Malaysia Annual Reports

2011: The coral reefs around Tioman Island, with 48.93% live coral cover, are in 'Fair' condition. The high record of RKC (3.27%) indicates the impacts of 2010 bleaching event, however the level of NIA (2.73%) was the lowest of all surveyed sites. The recorded level of RC (34.36%) was rather high. The highest number of recorded indicator fish were Butterfly fish, Parrotfish and Grouper respectively. Barramundi Cod and Humphead Wrasse were absent. There were no record of Banded Coral Shrimp, Pencil and Collector Urchins, Triton and Lobster. Abundance Diadema was high which would be problematic with bioerosion. Numbers of recorded Sea Cucumber (3.95) and Giant Clam (4.83) were high as well (Reef Check Malaysia, 2011).

2012: The coral reefs around Tioman Island, with 48.82% live coral cover, are in 'Fair' condition. Levels of RKC (0.67%), NIA (1.55%) and SI (0.26%) show some improvements from 2011. The recorded level of RC (34.36%) was rather high. The highest number of recorded indicator fish were Snapper and Parrotfish respectively. Barramundi Cod, Humphead Wrasse and Bumphead Parrot were absent. There were no record of Pencil Urchin, Collector Urchin, Triton, and Lobster. Abundance Diadema was high which would be problematic with bioerosion. Numbers of recorded Sea Cucumber (3.33) and Giant Clam (2.34) were low (Reef Check Malaysia, 2012).

2013: The coral reefs around Tioman Island, with 55.81% live coral cover, are in 'Good' condition. Comparing to 2012, the levels of RKC (1.34%), NIA (2.18%) and RB (10.69%) increased indicating recent storms damages in the island. The highest number of indicator fish recorded were Butterflyfish, Parrotfish and Snapper respectively. Barramundi Cod was the only absent fish species. The record of other indicators were as low as less than 1 ind./500m3. Tioman was the only surveyed island of the Sunda Shelf region where presence of Barramundi Cod and

Humphead Wrasse was recorded. There were no record of Pencil Urchin, Collector Urchin, Triton, and Lobster. Diadema recorded by far the highest number of indicator invertebrate. Thanks to regular clean up by diver around Tioman, the number of Crown of Thorns maintained within the natural range. Some damage caused by natural phenomena such as storms and Crown of Thorns predation was recorded. Besides impacts of human activities such as fish nets, trash and boat and anchor were also present. The scale of the damage is considered low but it indicates the ongoing illegal fishing inside the Marine Park. On the other hand, at several sites, some rare animals such as black tip reef sharks and turtles were reported (Reef Check Malaysia, 2013).

2014: the result of survey in 19 sites are as follow: 27% in excellent condition. 32% in good condition, 36% in fair condition, and 5% in poor condition. The coral reefs around Tioman Island, with 60.40% live coral cover, are in 'Good' condition. The high record of RB indicates intrusions in Tioman. For seven reefs sites RB were higher than 10%.The highest number of indicator fish recorded were Butterflyfish, Snapper and Parrotfish respectively. Barramundi Cod was only species that were not present. The record of other indicators were low. There were no record of Pencil Urchin, Collector Urchin, Triton, and Lobster. Diadema recorded by far the highest number of indicator invertebrate. Thanks to regular clean up by diver around Tioman, the number of Crown of Thorns maintained within the natural range. Impacts of warm water bleaching were recorded at SS3.12 Labas, SS3.2 Renggis North and SS3.5 Soyak North. In addition impacts of drupella predation, boat anchor damage, discarded fish nets, and trash recorded on some of the coral reef sites. On the other side, there were high number of turtles observed. Sea snake and shark's egg were also recorded during surveys (Reef Check Malaysia, 2014).

2015: the result of survey in 18 sites are as follow: 28% in excellent condition. 50% in good condition, 17% in fair condition, and 5% in poor condition. The coral reefs around Tioman Island, with 61.39% live coral cover, are in 'Good' condition. The high record of RB indicates intrusions in Tioman. For four reefs sites RB were higher than 15%, it was particularly high at SS3.12 Labas(71.88%) with considerable increase compared to last year. NIA recorded high as well. The highest level was at SS3.16 Nayak by 23.13%. The highest number of indicator fish recorded were Butterflyfish, Snapper and Parrotfish respectively. Barramundi Cod and Humphead Wrasse were only species that were not present. The record of other indicators were low. There were no record of Pencil Urchin, Collector Urchin, Triton, and Lobster. Diadema recorded by far the highest

number of indicator invertebrate. Thanks to regular clean up by diver around Tioman, the number of Crown of Thorns maintained at the natural range. There were record of boat anchor damage and discarded fishing nets. The presence of shark and turtle within a two survey sites were recorded (Reef Check Malaysia, 2015).

2016: the result of survey in 18 sites are as follow: 17% in excellent condition. 55% in good condition, 22% in fair condition, and 6% in poor condition. The coral reefs around Tioman Island, with 59.48% live coral cover, are in 'Good' condition. The high record of RB indicates intrusions in Tioman. For six reefs sites RB were higher than 15%, it was particularly high at SS3.12 Labas(56.88%). NIA recorded high as well. The highest level was at SS3.13 Teluk Dalam by 25%. The highest number of indicator fish has recorded for Butterflyfish, followed by Parrotfish. Barramundi Cod and Humphead Wrasse were not present. The record of other indicators were as low as less than 1 ind./500m3. Bumphead Parrotfish recorded at SS3.12 Labas and SS3.13 Teluk Dalam. There were no record of Pencil Urchin, Collector Urchin, Triton, and Lobster. Diadema recorded by far the highest number of indicator invertebrate, followed by Sea Cucumber. During the Survey, boat anchor damage, discarded fish nets, and trash were observed. Also impacts of warm water bleaching on some reefs were recorded. There was record of shark at one survey site (Reef Check Malaysia, 2016).

2017: the survey conducted in 17 sites in Tioman, the results are as follow: 41% in excellent condition, 41% in good condition, and18% in fair condition. There is no record of reefs in poor condition. The coral reefs around Tioman Island, with 66.36% live coral cover, are in 'Good' condition. There is an increase in the level of RB comparing 2016. Records of RB level from five reefs sites were higher than 20%, it was particularly high at SS3.12 Labas by 50.63%. The highest number of indicator fish has recorded for Butterflyfish, followed by Parrotfish. Humphead Wrasse is the only specie that was not observed. The record of other indicators were as low as less than 1 ind./500m3. Banded Coral Shrimp, Pencil Urchin, Triton and Collector Urchin were not present during the survey. Diadema recorded the highest number followed Sea Cucumber. Crown of Thorns with record of 0.2-0.3 ind./100m2 is what a healthy reef can support.

There was record of boat anchor damage, discarded fishing nets, and trash. In addition warm water bleaching and disease impacted some of the coral reef. On the other side, presence of shark and turtle within a few survey sites were recorded (Reef Check Malaysia, 2017).

2018: the statue level of Tioman coral reef from 18 surveyed sites are as follow: 39% in excellent condition, 33% in good condition, 22% in fair condition, and 6% in poor condition.
The coral reefs around Tioman Island, with 62.60% live coral cover, are in 'Good' condition. Comparing to 2017 the level of RB has decreased, however, it is still high. Especially in three of the survey sites where the level of RB is more than 35%. In SS3.12 Labas it has recorded 51.25% and 45% in SS3.4 Soyak South. The highest number of indicator fish has recorded Butterflyfish, Snapper and Parrotfish respectively. Barramundi Cod and Humphead Wrasse were only species that were not present. The record of other indicators were as low as less 1 ind./500m3. Banded Coral Shrimp, Pencil Urchin and Triton (targeted for curio trade) as well as Collector Urchin and Lobster (Banded Coral Shrimp, Pencil Urchin and Triton) were not recorded during the survey. Diadema recorded the highest of invertebrate indicator, followed by Sea Cucumber. Crown of Thorns with record of 0.2-0.3 ind./100m2 is what a healthy reef can support. There were record of discarded fishing nets, trash, impacts on reefs, and overgrowth of sponge. On the other side, presence of shark and turtle within a few survey sites were recorded (Reef Check Malaysia, 2018).

The data from surveys conducted on Tioman since 2011 show some variation in live coral cover. The overall condition of the coral reefs surveyed around Tioman has been generally good. Since then, live coral cover has been above 50% except in 2011 with 46.79% cover indicating the impacts of the 2010 bleaching.
The level of RB in Tioman has remained high in the range of 8 to 10% over the first three years. In 2014 and 2015, the RB level has risen to over 13%. The level continued to increase as high as 17.66% in 2016 and 19.43% in 2017. RB level dropped to 15.63% in 2018. Soyak South and Labas with RB level over 45% are the sites at alarming level, followed by Fan Canyon, Tekek House Reef and Teluk Kador. The level of RKC and NIA have been high especially in 2016. It finally dropped in 2017, however close monitoring is still required (Reef Check Malaysia, 2018).

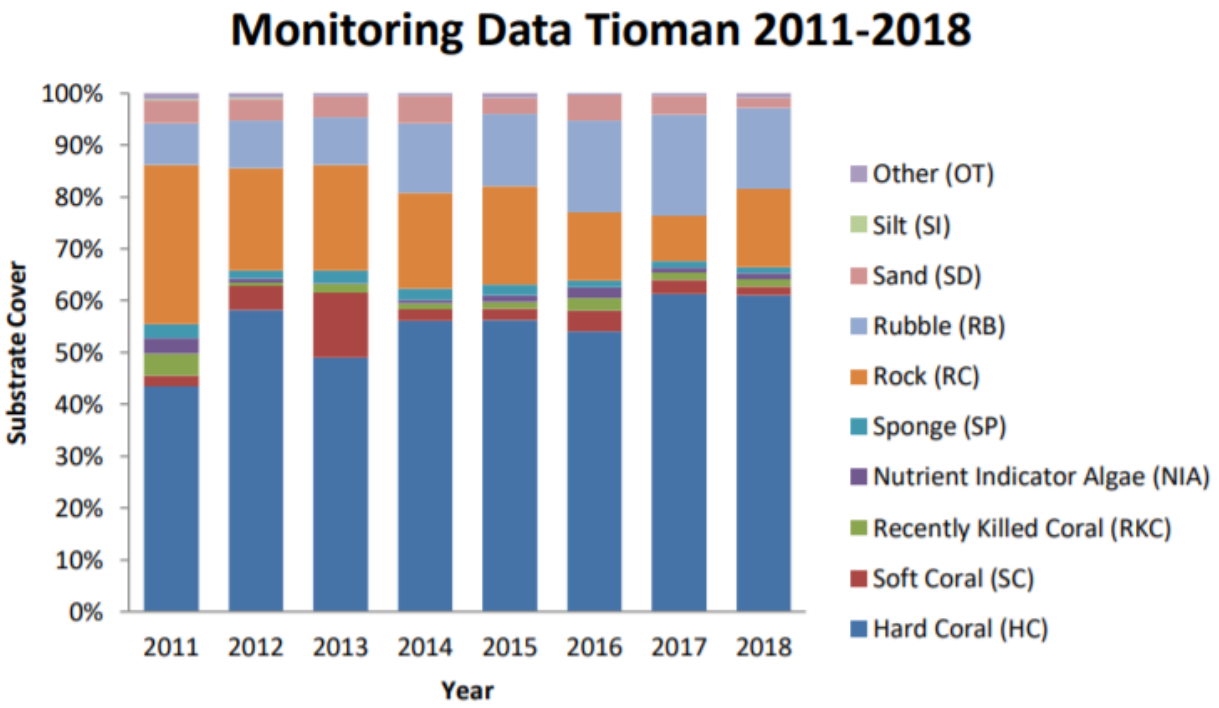

Figure 6: State of Coral Reef on Tioman Island 2011-2018 (Reef Check Malaysia, 2018, pg.75)

5.4. Impact

Impact element describes the environmental and economic impact of changes in the state of the environment result from pressure. The impact reflects the changes in quality of the ecosystem functions (Kristensen, 2004). Put the matter another way, impacts reflects changes in social benefits associated with environmental condition for instance loss of recreational bathing beach value due seawater pollution (Bowen & Riley, 2003). An attractive healthy environment is a must for the tourism industry to keep on prospering (Harriott, 2002).

JTP representative on tourism impact on coral reef of more popular villages:

> *"Corals here (Juara village) are resilient. More than probably other places that the RCM assessed last few years. People comes here (Juara village) they say corals here are very nice. ABC like Genting where there is for example huge pressure from diving and snorkeling and the corals have very very damage. Or the west coast of Tioman has more development, this coast is more damaged than east coast for example. Go up on the east coast of Tioman, kinda pristine. Because nobody goes there for diving or snorkeling. Most of the development are in the west coast and in the south".* (Interview, April 2109).

Weng(2009) studied ecotourism and conservation efforts in three small islands of Malaysia including Tioman. Based on his conclusion, the environment in Tioman is still attractive and can be ranked as a one of the most precious islands in the east coast of Malaysia. However the island is threatening by rapid development of tourism and inadequate conservation efforts. In previous decades to the study, tourism had been flourishing due to establishment of more infrastructure, resorts, improved transportation, and government promotion.

There is paucity of natural resources to meet the growing demands. Tioman has water scarcity problem especially during the dry season which also is the peak season for tourism. The demand for fresh water is high and the existing resources must be shared with tourists (Chia et al., 2018).

> *"Every year we have drought. The water goes off. During high season in June, July we gonna have no water. People have to build wells because we have no water. No fresh water. We have literally have nothing coming from the main supply. It has dried up. And after that we built another pipeline and that supplies us and three other resorts. It happens again. We have drought. I feel we gonna have drought. I think Island cannot have more tourist. Everyone planning to have well and getting groundwater."* A business owner said (Interview, April 2109).

5.5. Responses

To address undesirable impacts, responses are established in the form of institutional efforts. Response element indicates the mechanisms which can aim at any level of the network from driver to impact (Kristensen, 2004). "In the DPSIR framework, Responses are actions taken by groups or individuals in society and government to prevent, compensate, ameliorate or adapt to changes in the state of the environment"(Bradley & Yee, 2015, pg.18).

In Tioman, response mechanisms include different actors as local government, NGOs, Business owners, and local community.

5.5.1. Cintai Tioman

According to CT representative, in 2007, RCM registered in Malaysia as a non-governmental organization. Since then it has followed its main mission which is monitoring health of coral reef

around peninsular Malaysia including Tioman Island. In 2009, RCM started an education program called "Rainforest to Reef" working with schools in three islands one is Tioman. The programs provided education about coral reef ecosystem, impacts of human daily activities on coral reefs, and day trips to coral reefs. In 2010, RCM initiated its reef rehabilitation programs due to damages caused by at time bleaching event. In 2014, got full- time staff on the Tioman Island and started its special program for the island which is "Cintai Tioman". The main mission of the program is to build Reef Resilience.

> *"There are two kind of threats against coral reefs: global threats (climate change, rising sea temperature etc.) and local threats (destructive fishing, pollution and unsustainable tourism). The global threats are out of control of a local NGO but when you remove local threats as much as possible, there is more chance for reef to be resilience against global threats."* (Interview, April 2109)

CT's mission is not only addressing coral reef issues but also having an eye on social sustainability.

Addressing environmental issues:

CT efforts on managing waste and sewage include:

- Establishing first recycling project in Tioman. The project involves collecting plastic bottle, cans, metal, aluminum, and cardboard separately, packing and sending out to the mainland.

Recycling Project by Cintai Tioman (Atefeh Zeighami, April 2019)

- Since glass waste is not taken by the mainland, in 2018, CT managed to get the funding of RM 20.000 to buy a glass crushing machine from New Zealand. Before most glass waste were buried.
- There is no facility to compost food waste and organic materials in Tioman. The only way to handle this type of waste is to incinerate them. CT has got funding to buy the only incinerator in Tioman.
- Education and raising awareness programs for primary and secondary schools covering environmental topics such as how to minimize trash, impacts of trash on ecosystems and alike. Besides CT raises awareness through social media, newsletter, and posters for islanders and tourists. Since March 2019, CT has started a new awareness raising project known as “Nature and Culture Night” hosted by Cabana Tioman. Every Monday sessions around relevant environmental issue on the island is provided and follows with a Q&A and a discussion. The program is in English and attendance is free. It is designed for all kind of audiences such as locals, business owners, and tourists.

- In 2014, water quality was tested and the result reported to the authority. In 2015, septic tank was desludged by the government representatives. However, they have not came back since then. The government has announced a sewage treatment system but to date nothing has happened.
- CT organizes once a month (roughly) a cleanup day by help of volunteers, local and tourists. The biggest clean-up day is held in 3rd Saturday of September-International Coastal Clean-up Day- with corporation of dive centers, resorts, schools, islanders and all sort of stakeholders. Clean-up days are mainly organized for weekends and announced through social media and resorts (Interview, April 2109).

Since the negative impacts of tourism derived from three tourism products as snorkeling, diving, and resort. CT has specific efforts for each product to minimize the impacts.

Snorkeling: in Tioman, snorkeling is not practiced by an individual business, thus, mostly locals who has boat provide snorkeling service. CT offers training services to these locals based on standards of GF and ISO. Three days training course is designed to reduce main impacts of snorkeling including anchoring on reefs, fish feeding, catching and touching marine species. This training program has run in all Tioman villages for free. About 80 snorkeling tour operators (roughly ⅓) have joined the program and got the training. Snorkeling is the most popular activity in Tioman (Interview, April 2109).

Diving: There are 26 dive centers in Tioman. Since 2014, CT has been promoting GF membership to all dive centers. CT constantly promote GF to all 26 dive centers. To date eight dive centers are GF active members. There are some suspended members. The majority rest of dive centers have shown some interest but they afraid to get suspended and earn bad reputation. They claimed that, they will join GF as soon as they are confident enough to pass the assessment (Interview, April 2109).

In the quantitative survey of this study, tourists were asked to whether they were informed by the tour operators (snorkeling and/or diving tour) to adopt a responsible behavior toward marine ecosystem (Appendix 1). Only 11.9 % of respondents stated that they were asked to avoid damaging actions such as fish feeding, stepping on corals, and catching turtle. However majority of respondent (76.2%) stated that they act responsibly to the marine life as they are eco-conscious.

Resort: CT offers courses based on ASEAN Green Hotel Standard to help resort owners run their business more sustainably. ASEAN Green Hotel Standard is an eleven points criteria in different

aspect of sustainable hospitality accommodation. CT found ASEAN Green Hotel Standard as the best match for the type of resorts on Tioman. The first year CT assessed 60 resorts out of all 80 resorts in the island (20 of resorts has refused to cooperate) and all of them has failed to meet the criteria. Based on the most recent assessment, six resorts has met the criteria and got an ASEAN certificate (Interview, April 2109).

Rehabilitation Programme

In 2010, Reef Check initiated a reef rehabilitation program in Pangkor Island. The project embarked in Tioman and Perhentian in 2011(Chen et al., 2018). Reef rehabilitation is defined as "the act of partially or, more rarely, fully replacing structural or functional characteristics of an ecosystem that have been diminished or lost, or the substitution of alternative qualities or characteristics than those originally present with the proviso that they have more social, economic or ecological value than existed in the disturbed or degraded state. "(Edward, 2010, pg.6). Rehabilitation program can abate the coral decline rate as well as recover the coral reef ecosystem resulting increase in coral cover, however, the cost of such projects are considerably high. It must be noted that reef rehabilitation is pointless without addressing the local stressors causing coral reef decline. To restore coral reef, CT creates a "mini-ecosystem" consist of coral fragments known as "nubbins" which are planted together. In the first CT rehabilitation effort, a PVC plastic pipe frame was used to keep nubbins in a nursery stage prior to their transfer to rehabilitation site. However after this initial experiment, CT found out that for reef rehabilitation, PVC plastic pipe is not a good material and transferring nubbins to final site is not a proper approach. Subsequently CT decided to use eco-friendly/natural materials and shift the work site from the beginning of the project adjacent to damaged area. Moreover, the rehabilitation site should have following criteria: be attainable easily to reduce costs, absence of fine sediment areas to limit siltation, absence of strong currents (if possible), and far from damsel territory.

RCM choses the sites with declined reef area as a result of natural or human-induced disturbances. The nubbins used by CT are called "opportunity corals" which are broken or bleached coral fragments from the surrounding reefs. The result from these opportunity corals are more lucrative compared to the nubbins collected from farther sites. That is because nubbins from distant sites are stressed by the time they are attached to coral nurseries besides opportunity corals grow faster as they are better adapted to conditions at the nursery site.

Maintenance methods include brushing slit and algae from the nubbins and removing encrusting organisms (e.g. barnacles and oysters) on or around the coral fragments to avoid competition with the growth of nubbins. Maintenance conducted 2-3 times a week to reduce regularity as the nursery structure become established. Monitoring must be carried out monthly to evaluate the progress and monitor the success of the project. In addition, regular monitoring contribute to document observations which are important for further plans.

Aside from rehabilitating reef areas, CT's reef rehabilitation programme contributes to local community's involvement in the project and provide diverse education opportunities.

Siltation, bad weather conditions, and high mortality rates are among the challenges occurred to the programme by far, however, they came with lessons which lead to improvements. On the bright side, nubbins survival rate is increasing, corals are growing, many natural recruits are settling on the structures, fish and invertebrates are residing at rehabilitated sites, and the corals at the nursery are forming a natural 3-D reef structure. (Chen et al., 2018).

Coral Spawning Data Collection in Tioman Island

Coral can reproduce asexually and sexually according to the species. Over 60% of scleractinian corals, also hard corals, are hermaphrodites that reproduce by releasing their eggs and sperms, called 'gametes', simultaneously into the water. This reproductive method is known as 'broadcast spawning'. Understanding the timing and synchrony of coral spawning makes a major contribution in conservation and management action. Spawning is often occurs annually and mostly influenced by environmental factors. Chelliah et al. (2015) studied a multi-species coral spawning event from reefs around Tioman Island. According to their findings, the multi-species spawning in April 2014, took over five nights during the full moon involved with at least eight coral species from 3 genera. To monitor mass coral spawning, RCM was assisted by the diving communities and dive operators. In Tioman, data collection carried out by the corporation of not only dive operators but also local community as well as tourists (Reef Check Malaysia, 2014a).

Social Sustainability Efforts:

- CT has managed to get funding to provide the opportunity for boatmen to get the license which could result in better payment. Most of the boatmen in the island do not have a license.
- Resorts are all owned by local families who run their business without professional training. CT has organized hospitality training program with collaboration of Berjaya University College of Hospitality to train locals for hospitality and resort management.
- Training of those locals who are interested to do paid work with DMPM. The work include simple tasks such as beach clean-up, removing ghost nets, installing mooring buoys. This program was supported by DMPM but the collaboration discontinued in 2017. In late 2018, DMPM has moved to Agriculture and Agro-based Industry Ministry.
- CT has proposed co-management of Marine Park in order to involve locals in the process of decision making but by changing structure of DMPM and moving under Department of Fisheries all promises has been gone and wish for co-management has not fulfill yet. (Interview, April 2109)

Tioman Marine Conservation Group

Tioman Marine Conservation Group (TMCG) formed in 2015 as an attempt to empower local individuals who were interested in working within DMPM. In 2014, RCM conducted a study in which 100 of locals were interviewed. Based on the findings, the vast majority of islanders expressed their interest in working for DMPM. Locals felt they should be prioritized to take available jobs in DMPM. To qualify for such government positions, SPM certificate as well as training evidence are required. Majority of islanders do not meet these requirements. TMCG are a group of 18 locals who were selected to given specific training and experience to be able to recruit by DMPM. The tasks that identified by DMPM for TMCG are as follow: Mooring Buoy monitoring/maintenance, reef rehabilitation monitoring/maintenance, reef check monitoring/surveys, coral bleaching surveys, Crown of Thorns monitoring/ removal, reef clean ups, rapid response, liaison with tourism operators, snorkel guide training, assist in Marine Park organized programs, progress reporting. In period of 2016 to 2018, the group has shown lots of progress. Members managed to find the balance between their own full-time jobs and their training. They adopted to the tasks and built a nourishing relationship with tourism operators and

government agencies. This pilot project has proved the co-management of Tioman Marine Park would be successful with little support, small budget and basic training (Cintai Tioman Report).

5.5.2. Rumah Hijau

According to RH founder, Rumah Hijau (RH) meaning Greenhouse is an individual project started in 2010 in Kampung Tekek, Tioman Island. RH has been spread through the island and launched its branches in several other villages including Juara, Genting, and will be soon in ABC. All branches are independent and managed by local's enthusiasts. In 2011, RH started a project known as "Tioman Boat Riders Club" aiming to involve new generation of society in sport. In January 2011, RH initiated an annual surfing festival. This festival was the first event organized in the state of Pahang. The aim was providing a new tourism product in the island during Monsoon season. The project has been very successful. Tourism has been promoted in low season as well as got a sponsor to provide funding to train interested locals as athletes (Interview, April 2109).

Recycling Project: Before CT, RH was the first and only recycling center in the island. Plastics and glasses were recycled by a shredding machine which was manually built. When CT managed to provide a glass shredding machine, RH provided the room where the machine and recycling work are placed. Some of the glasses are reused in coral propagation (Interview, April 2109).

Rumah Hijau Workshop (Atefeh Zeighami, April 2019)

Rumah Hijau Workshop (Atefeh Zeighami, April 2019)

Tioman Glass Shredding Machine (Atefeh Zeighami, April 2019)

Coral propagation, processing and research: RH developed an experimental coral propagation. The aim of the project is to rehabilitate coral sustainably. So instead of using PVC pipes, RH reuses glass and try to find the best matched glass by trial and error. For replanting corals, RH collects corals pieces which are still alive rather breaking healthy corals (Interview, April 2109).

Coral Propagation Project by Rumah Hijau(Atefeh Zeighami, April 2019)

Community involvement: RH provides education programs for local kids.

> "*Program includes involving every kid in making coral pots. The future program will be involving kids to build a Marine Park that will be the first local school in Malaysia to make a Coral Park*." (Interview, April 2109)

RH has close collaboration with CT.

> *"CT efforts to empower locals to address the environmental issues was failed as CT could not persuade them for corporation. That time, CT was recognized under the name of RCM. I suggested for a local name, then community would be recognized the project as an*

insider and would work with you. Then CT started working with the local name "Cintai Tioman". It worked and people willingly involved in its projects" (Interview, April 2109)

5.5.3. Juara Turtle Project

Juara Turtle Project (JTP) is a conservation and research center started in 2006 in Tioman Island. JTP focus is on Sea Turtle conservation in Juara Kampung.

"*Turtle population comparing to the past it is declining because of human interference. But we hope that because of conservation efforts that has done for the past 12 years the population will increase but the thing is, it takes long to time to see the results. Because the long time that it is happen to introduce fertilize eggs so that is why right now we cannot conclude what we have achieved.* " (Interview, April 2109)

An Information Board by Juara Turtle Project (Atefeh Zeighami, April 2016)

Juara Turtle Project Office (Atefeh Zeighami, April 2019)

In 2017, JTP started coral propagation as a side project. JTP has a visitor center where tourists come for a turtle tour. JTP runs school programs where international schools come for volunteering for 4-5 days to learn about Sea Turtle. Moreover JTP has a volunteering program designed for people from all over the world who could come and learn and participate in the conservation.
JTP manages a recycling program in Juara (Interview, April 2109).

Recycling Project by Juara Turtle Project (Atefeh Zeighami, April 2019)

5.5.4. Green Fins in Tioman Island

In 2009, GF was introduced in Malaysia under the management of DMPM. In 2014, Tioman Island became GF member as RCM joined the management body. In 2016, RCM team in Tioman (CT) visited GF dive center members in Tioman for annual assessment. Besides they promoted GF to many other dive centers in the island. Those dive centers have become GF member adopt the COC to make certain their diving practices are green and sustainable. CT together with DMPM and Reef-World organized assessor training workshop. The training include GF introduction, its COC, diving skills, practical sessions and assessment methods (Reef Check Malaysia, 2016a). The following diving centers on Tioman Island are GF members: B&J Diving Centre Air Batang, Barat Dive Centre, Bayu Dive Centre, Blue Bubbles Scuba, Tiong Man Scuba, Scuba ACE, Tioman Dive Centre, UDive Berjaya Tioman. Based on the most recent assessment to date, Tioman Island has average score of 121 for its all GF members. Scores range from 0 meaning no impact to 330. The lower the score the better. The graph shows each COC average score. The higher weight of COC score represents the more environmentally destructive activities.

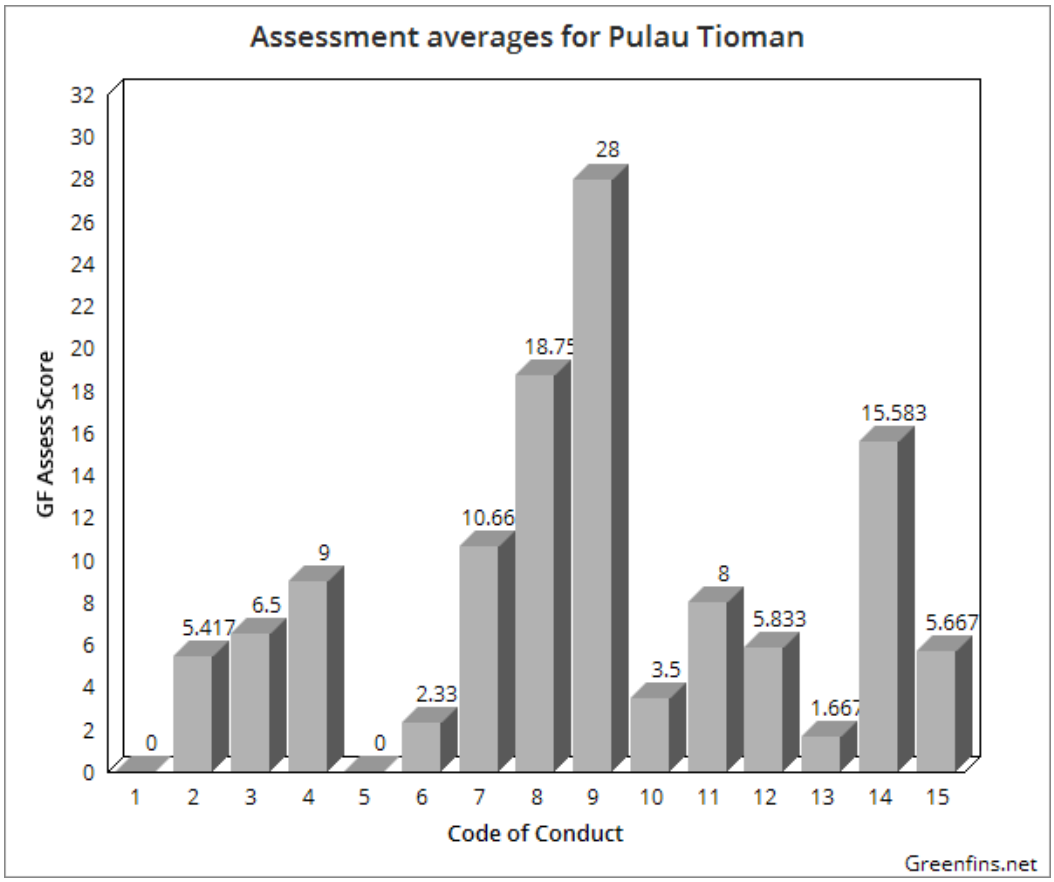

Figure 7: The Average Score of all the GF members in Tioman Island (Green Fins)

In the latest GF assessment two of Tioman dive centers were among top 5 of the most environmentally friendly dive center.

Tioman Dive Center

Tioman Dive Center (TDC) is a dive center based in Tioman Island offering different range of courses from Discover SCUBA Dives to the PADI DiveMaster Course. TDC received the 2018 GF award At ADEX Singapore. The award recognized TDC as the diving center with lowest environmental impact. TDC was selected from 500 GF members after a meticulous assessment (Helmy, 2019).

TDC manager and owner explained how won the first place in GF rank:

> "*I think it is for getting new engine. Previously we used two boats with three engine not environmentally friendly. The new engine use less fuel. Not direct impact on coral reef. Not*

littering, not fish feeding, using biodegradable washing liquids for washing the dishes and also washing our equipment, biodegradable plastic bags which are better than the alternatives, we are generally trying to include environmental awareness as much in our teaching and guiding as possible whether it is learning to dive or doing advance courses. Both are already certified. Trying to have elements of environmental awareness. Just in like in normal of chit chatting as well as in our teaching. I think it comes out with passionate about it …. We have lots of posters with lots of information of that. We just got reef safe sun creams, to introduce to customers to use and also buy it. And a little information about why, because it is not just about telling people what to do. It is about explaining. If someone knows what is going on, a hundred percent of time they will choose the good option. People are all just about knowledge you cannot blame people for not knowing. We just trying to help people along the way to know a little bit more without saying you have to do this, you have to use this, you have to be this way." (Interview, April 2109)

She expressed the eco-friendly approach of their services as a value added:

"I always consider that we are giving products. As I said in one of the Green Fins interviews when they asked what do you think Green Fins has brought to the dive center and I said well when I was at school my headmistress always used to tell me that being in school and then doing extracurricular activities, it gives you something called "value added" and I feel like being in Green Fins just having of a little bit value added. Value added of your product. This is your product but you have a little bit of more because we also have this influence over the others. I think it's a very good value added product." (Interview, April 2109)

B&J Diving Center

B&J is a PADI 5 Star Instructor Development Center, established in 1986, Tioman Island. B&J is the biggest dive center in Tioman and one of the largest in Malaysia. In 2018, B&J was ranked the second dive center with the lowest environmental impact in GF annual assessment. One of B&J manager said:

"We have a lot of rule and regulation by GF and RCM. Our target is to be number one, hopefully soon. We are working on it. We improving... I wanna see more coral propagation in Tioman. We can do more so I am hoping more coral propagation activities done in Tioman." (Interview, April 2109)

B&J runs a coral propagation project based on the technique developed by a NGO called Ocean Quest:

"Before, coral propagation used to use artificial reef. They used metal pipe or PVC pipe and they attached corals to it to give structure to the corals. So with that they found that it creates lots of problems. Fish will not feeding on it because the algae prevents the coral from growing healthily. So the fish normally feed on algae. They found that artificial structures are not fit into it. This NGO developed this method of propagating coral where initially they have small pieces of corals and they find rocks and they glued corals to the rock. They constantly adding to it. It is quite interesting, exciting development in the technology behind coral propagation. So this NGO got something new…. nursery here people do not notice it because it looks exactly like same the natural ecosystem. There is lots of science into it." (Interview, April 2109)

6. Conclusion

This study set out to determine the sustainability of marine tourism in Tioman Island. To evaluate the state of Tioman Island, both qualitative and quantitative approaches were applied. Semi-structured interviews and questionnaire as well as secondary sources were used to answer the research questions.

Over the past decades, growth of tourism demand has opened new opportunities for the island. Since then, tourism has been the major source of income and brought variety of economic and social opportunities to the local community. Most of the locals are employed in the businesses related to tourism. Before emergence of tourism the islanders mainly occupied in fishing, coconut plantation, and farming. Tourism is more environmentally sensitive practice relative to fishing which has huge destructive impact on the marine ecosystem. Although the declaration of island as Marine Park was the major contribution to put an end to commercial fishing. In addition, tourism on Tioman has not reached its peak yet, however, the carrying capacity of the island is close to exceed (water scarcity and sewage problem). After all, tourism is responsible for having damaging environmental impacts. Tourism causes pollution by producing tons of waste where the isolated position of Tioman as relatively distant island from the mainland, makes waste treatment challenging. In Tioman, the main threats to marine ecosystem issues from practicing snorkeling and diving.

As a Marine Park, there are rules and limitations set by local government to minimize the impacts. Besides there are active NGOs, enthusiast locals, and business owners who are working hand in hand to increase the sustainability of marine tourism. These conservation efforts have succeeded to some extent to control the impacts. Based on the RCM annual reports, coral reefs around Tioman Island are mainly in “Good” condition. Additionally, Tioman visitors receive the quality of marine environment fairly desirable and also stated that they would recommend Tioman.

Since Tioman popularity is due to its natural beauty, especially its impressive coral reef, preserving the healthy status of coral reef has economic and social significance. So it makes no wonder when local community support the conservation efforts. Not to mention the role of awareness campaign, brought by NGOs such as CT, on highlighting the importance of natural environment. As discussed in the finding section, in Tioman different stakeholders as NGOs, Dive centers and even local individuals involved in coral propagation, recycling and awareness raising projects which are growing and spreading among others.

However law number of tour operators and resort owners committed to lower-impact practices (about 1/3 of snorkeling tour operators, 8/26 of diving centers, and 6/80 of resorts joined the sustainable tourism project by CT), indicates that the preservation of marine ecosystem has not been fully understood and prioritized by the local community. People in charge of conservation projects find the solution in empowering local community to manage its own marine resources. These results are consistent with those of other studies (Omar et al., 2015; Chia et al., 2018; Weng, 2009; Hanafiah, Jamaluddin & Zulkifly, 2013; Ho et al., 2017; Ng et al., 2017), and suggest that to address sustainability issues in Tioman requires corporation between key stakeholders. On the other hand, all promises by the government on community involvement and co-management of the Marine Park has not fulfilled yet. The situation is now even more complicated as DMPM has been moved to Ministry of Agriculture. Therefore further research should be done to include the government side on tourism development and conservation of the marine resources.

References

Abdul, J. (1999). An introduction to Pulau Tioman. *Raffles Bulletin of Zoology*, *6*, 3-4.

ASEAN Secretariat, (2007).ASEAN Tourism Standard Book. *Ministry of Tourism and Sports of Thailand*

ASEAN Secretariat, (2016) .ASEAN Green Hotel Standard. *Ministry of Tourism and Sports of Thailand*

Azaruddin, O. (1994). Tourist industry in Tioman Island. *Malaysian Journal of Tropical Geography*, *25*(2), 59-67.

Bell, S., & Morse, S. (2001). Breaking through the glass ceiling: who really cares about sustainability indicators?. *Local environment*, *6*(3), 291-309.

Bossel, H. (1999). *Indicators for sustainable development: theory, method, applications* (p. 138). Winnipeg: International Institute for Sustainable Development.

Bowen, R. E., & Riley, C. (2003). Socio-economic indicators and integrated coastal management. *Ocean & Coastal Management*, *46*(3-4), 299-312.

Bradley, P., & Yee, S. (2015). *Using the DPSIR framework to develop a conceptual model: technical support document*. US Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division.

Bryant, D., Burke, L., McManus, J., & Spalding, M. (1998). Reefs at risk: a map-based indicator of threats to the worlds coral reefs.

Bryman, A. (2012). *Social research methods*. Oxford university press.

Carr, E. R., Wingard, P. M., Yorty, S. C., Thompson, M. C., Jensen, N. K., & Roberson, J. (2007). Applying DPSIR to sustainable development. *International Journal of Sustainable Development & World Ecology*, *14*(6), 543-555.

Chelliah, A., Amar, H. B., Hyde, J., Yewdall, K., Steinberg, P. D., & Guest, J. R. (2015). First record of multi-species synchronous coral spawning from Malaysia. *PeerJ*, *3*, e777.

Chen, S.Y., Chelliah, A. J., Lau, C. M., Nadhirah, R., \& Hyde, J. (2018). Reef Rehabilitation Experiments Edition 2: A Review of Various Approaches. Reef Check Malaysia. 28p.

Chia, K. W., Ramachandran, S., Ho, J. A., & Ng, S. S. I. (2018). CONFLICTS TO CONSENSUS: STAKEHOLDER PERSPECTIVES OF TIOMAN ISLAND TOURISM SUSTAINABILITY. *International Journal of Business & Society*, *19*.

Clarke, J. (1997). A framework of approaches to sustainable tourism. *Journal of sustainable tourism*, *5*(3), 224-233

Creswell, J. W. (2013). Steps in conducting a scholarly mixed methods study.

Diedrich, A. (2007). The impacts of tourism on coral reef conservation awareness and support in coastal communities in Belize. *Coral Reefs*, *26*(4), 985

Edwards, A.J. (ed.) (2010). Reef Rehabilitation Manual. Coral Reef Targeted Research \& Capacity Building for Management Program: St Lucia, Australia. ii + 166 pp

Fernández, J. I. P., & Rivero, M. S. (2009). Measuring tourism sustainability: proposal for a composite index. *Tourism Economics*, *15*(2), 277-296.

Galletta, A. (2013). *Mastering the semi-structured interview and beyond: From research design to analysis and publication*. NYU press.

Green Fins, (n.d.). Green Fins Members. [online] Available at: http://www.greenfins.net/en/members

Hanafiah, M. H., Jamaluddin, M. R., & Zulkifly, M. I. (2013). Local community attitude and support towards tourism development in Tioman Island, Malaysia. *Procedia-Social and Behavioral Sciences*, *105*, 792-800.

Harriott, V. J. (2002). *Marine tourism impacts and their management on the Great Barrier Reef* (No. 46). Townsville: CRC Reef Research Centre.

Helmy, S. (2019).Green Fins Award Goes To Tioman Dive Centre. [online] Available at: https://www.deeperblue.com/green-fins-award-goes-to-tioman-dive-centre/

Ho, J. A., Chia, K. W., Ng, S. I., & Ramachandran, S. (2017). Problems and stakeholder responsibilities in island tourism: The case of Tioman Island in Malaysia. *Journal of Hospitality & Tourism Research*, *41*(4), 445-474.

Ho, J. A., Chia, K. W., Ng, S. I., & Ramachandran, S. (2017). Problems and stakeholder responsibilities in island tourism: The case of Tioman Island in Malaysia. *Journal of Hospitality & Tourism Research*, *41*(4), 445-474.

Hunt, C. V., Harvey, J. J., Miller, A., Johnson, V., & Phongsuwan, N. (2013). The Green Fins approach for monitoring and promoting environmentally sustainable scuba diving operations in South East Asia. *Ocean & coastal management*, *78*, 35-44.

Kristensen, P. (2004). The DPSIR framework. *National Environmental Research Institute, Denmark*, *10*.

Liu, Z. (2003). Sustainable tourism development: A critique. *Journal of sustainable tourism*, *11*(6), 459-475

Lonely Planet, (n.d.). Pulau Tioman in detail. [online] Available at: https://www.lonelyplanet.com/malaysia/pulau-tioman/in-location/activities/a/nar/7c85de8b-0638-43f0-86e3-73a254a3c428/357000

Lozano-Oyola, M., Blancas, F. J., González, M., & Caballero, R. (2012). Sustainable tourism indicators as planning tools in cultural destinations. *Ecological Indicators*, *18*, 659-675.

Moberg, F., & Folke, C. (1999). Ecological goods and services of coral reef ecosystems. *Ecological economics*, *29*(2), 215-233.

Muda, A., Omar, C. M. C., Ponrahono, Z., Shamsuddin, K., Chung, D., & Gambaris, A. T. K. (2011). Tioman as international tourism island: In perspective of planning development management and guidelines. In *Contemporary Environmental Quality Management in Malaysia and Selected Countries*. UPM press.

Ng, S. I., Chia, K. W., Ho, J. A., & Ramachandran, S. (2017). Seeking tourism sustainability–A case study of Tioman Island, Malaysia. *Tourism Management*, *58*, 101-107.

Omar, S. I., Othman, A. G., Mohamed, B., & Bahauddin, A. Z. I. Z. I. (2015). Coastal resort life cycle: An overview of Tioman Island, Malaysia. *Tourism Planning & Development*, *12*(3), 266-280.

Reed, M. S., Fraser, E. D., & Dougill, A. J. (2006). An adaptive learning process for developing and applying sustainability indicators with local communities. *Ecological economics*, *59*(4), 406-418.

Reef Check Malaysia . (2011). Status of coral reefs in Malaysia, 2011. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/129-rcm-annual-survey-report-2011

Reef Check Malaysia . (2012). Status of coral reefs in Malaysia, 2012. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/130-rcm-annual-survey-report-2012

Reef Check Malaysia . (2013). Status of coral reefs in Malaysia, 2013. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/172-rcm-annual-survey-report-2013

Reef Check Malaysia . (2014). Status of coral reefs in Malaysia, 2014. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/224-rcm-annual-survey-report-2014-summary-by-state

Reef Check Malaysia . (2015). Status of coral reefs in Malaysia, 2015. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/231-rcm-annual-survey-report-2015

Reef Check Malaysia . (2016). Status of coral reefs in Malaysia, 2016. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/242-rcm-annual-survey-report-2016

Reef Check Malaysia . (2017). Status of coral reefs in Malaysia, 2017. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/247-rcm-annual-survey-report-2017

Reef Check Malaysia . (2018). Status of coral reefs in Malaysia, 2013. [online] Available at: https://www.reefcheck.org.my/reports-downloads/annual-survey-reports/251-rcm-annual-survey-report-2018

Reef Check Malaysia, (2014a).Reef Check collects data to understand coral spawning. [online] Available at: https://www.reefcheck.org.my/reports-downloads/press-releases/178-reef-check-collects-data-to-understand-coral-spawning

Reef Check Malaysia, (2016a).Growing Fins in Malaysia: Meeting the Aichi Biodiversity Targets. [online] Available at https://www.reefcheck.org.my/reports-downloads/press-releases/238-growing-green-fins-in-malaysia-meeting-the-aichi-biodiversity-targets

Reef Check, (2015). What is Cintai Tioman. [online] Available at: https://www.reefcheck.org.my/cintai-tioman/about

REEF-WORLD Foundation, (n.d.). Green Fins. [online] Available at: https://reef-world.org/projects#green-fins

Ross, R. (2018). What Are Coral Reefs?. [online] Available at: https://www.livescience.com/40276-coral-reefs.html

Saarinen, J. (2006). Traditions of sustainability in tourism studies. *Annals of tourism research*, *33*(4), 1121-1140.

Salleh, N. H. M., Othman, R., Sarmidi, T., Jaafar, A. H., & Norghani, B. M. N. (2012). Tourist satisfaction of the environmental service quality for Tioman Island Marine Park.

Scerri, A., & James, P. (2010). Accounting for sustainability: combining qualitative and quantitative research in developing 'indicators' of sustainability. *International Journal of Social Research Methodology*, *13*(1), 41-53.

Schianetz, K., & Kavanagh, L. (2008). Sustainability indicators for tourism destinations: A complex adaptive systems approach using systemic indicator systems. *Journal of Sustainable Tourism*, *16*(6), 601-628.

Shahbudin, S., AKMAL, K. F., Faris, S., Normawaty, M. N., & Mukai, Y. (2017). Current status of coral reefs in Tioman Island, Peninsular Malaysia. *Turkish Journal of Zoology*, *41*(2), 294-305.

Sharpley, R. (2000). Tourism and sustainable development: Exploring the theoretical divide. *Journal of Sustainable tourism*, *8*(1), 1-19.

Shida, I. O., Abdul, G. O., & Badaruddin, M. (2013). Evolution of beach resorts in Tioman Island, Malaysia. In *The Proceedings of 1st World Conference on Hospitality, Tourism and Event Research and International Convention and Expo Summit 2013, Bangkok, Thailand, 25th-28th May 2013* (pp. 416-428). International Program in Hotel and Tourism Management, Siam University.

Singh, R. K., Murty, H. R., Gupta, S. K., & Dikshit, A. K. (2012). An overview of sustainability assessment methodologies. *Ecological indicators*, *15*(1), 281-299.

Smeets, E., & Weterings, R. (1999). *Environmental indicators: Typology and overview* (p. 19). Copenhagen: European Environment Agency.

Smith, C., Papadopoulou, N., Barnard, S., Mazik, K., Patrício, J., Elliott, M., ... & Moncheva, S. (2014). Conceptual models for the effects of marine pressures on biodiversity. *Deliverable*, *1*, 82.

Spalding, M., Spalding, M. D., Ravilious, C., & Green, E. P. (2001). *World atlas of coral reefs*. Univ of California Press.

Stanners, D., Bosch, P., Dom, A., Gabrielsen, P., Gee, D., Martin, J., ... & Weber, J. L. (2007). Frameworks for environmental assessment and indicators at the EEA. *Sustainability Indicators–A Scientific Assessment*.

Swarbrooke, J. (1999). *Sustainable tourism management*. Cabi

The Sun Daily, (2017).New airport can boost Tioman tourism.[online] Available at: https://www.thesundaily.my/archive/new-airport-can-boost-tioman-tourism-YTARCH499265

Tioman Ferry, (n.d.). Tioman Conservation Fee. [online] Available at: http://www.tiomanferry.com/tioman_conservation_fee.html#axzz5kDK9ifxG

Toda, T., Okashita, T., Maekawa, T., Alfian, B. A. A. K., Rajuddin, M. K. M., Nakajima, R., ... & Terazaki, M. (2007). Community structures of coral reefs around Peninsular Malaysia. *Journal of Oceanography*, *63*(1), 113-123.

Tongco, M. D. C. (2007). Purposive sampling as a tool for informant selection. *Ethnobotany Research and applications*, *5*, 147-158.

Torres-Delgado, A., & Saarinen, J. (2014). Using indicators to assess sustainable tourism development: a review. *Tourism Geographies*, *16*(1), 31-47.

United Nations Environment Programme. Division of Technology. (2005). *Making tourism more sustainable: A guide for policy makers*. World Tourism Organization Publications.

UTUSAN, (2019).Alam Flora urus sisa pepejal di Tioman. [online] Available at: http://www.utusan.com.my/berita/wilayah/pahang/alam-flora-urus-sisa-pepejal-di-tioman-1.854398

UW360, (2016). Reef Check Malaysia: Bringing a Community Together for Conservation. [online] Available at: https://www.uw360.asia/tioman-conservation-diving/

Veron, J. E. N., Hoegh-Guldberg, O., Lenton, T. M., Lough, J. M., Obura, D. O., Pearce-Kelly, P., ... & Rogers, A. D. (2009). The coral reef crisis: the critical importance of< 350 ppm CO2. *Marine pollution bulletin*, *58*(10), 1428-1436.

Wei, J., Zhao, Y., Xu, H., & Yu, H. (2007). A framework for selecting indicators to assess the sustainable development of the natural heritage site. *Journal of Mountain Science*, *4*(4), 321-330.

Weng, C. N. (2009). Ecotourism and environmental conservation in small islands in the East Coast of Peninsular Malaysia. *Malaysian Journal of Environmental Management*, *10*(2), 53-69.

White, V., McCrum, G., Blackstock, K. L., & Scott, A. (2006). Indicators and sustainable tourism: Literature review. *The Macaulay Institute. Aberdeen*.

Wonderful Malaysia, (n.d.). Tioman Island. [online] Available at: http://www.wonderfulmalaysia.com/tioman-island-malaysia.htm#attractions

World Tourism Organization. (2004). *Indicators of sustainable development for tourism destinations: A guidebook*. WTO.

WWF, (n.d.). Coral Reefs. [online] Available at: https://wwf.panda.org/our_work/oceans/coasts/coral_reefs/

Zakai, D., & Chadwick-Furman, N. E. (2002). Impacts of intensive recreational diving on reef corals at Eilat, northern Red Sea. *Biological Conservation*, *105*(2), 179-18

Appendix1: Tourist Questionnaire

Tioman Island Tourism

Participation in this survey is completely anonymous. This survey conducted only due to research purpose.

* Required

1. **What is/are the main reason for traveling to Tioman island?** *
   Check all that apply.

   - [ ] Snorkling
   - [ ] Scuba diving
   - [ ] Other forms of diving
   - [ ] Surfing
   - [ ] Kayaking
   - [ ] Paddleboarding
   - [ ] Hiking
   - [ ] Other: _____

2. **How do you perceive seawater quality in term of cleanness?**
   Please keep answering following questions if you have involved in any form of diving and/ or snorkeling activity in Tioman Island.
   Mark only one oval.

	1	2	3	4	5	
Excellent	◯	◯	◯	◯	◯	serious pollution

3. **How do you perceive quality of Coral reefs (coverage, diversity, condition) around Tioman Island?**
   Mark only one oval.

	1	2	3	4	5	
Excellent	◯	◯	◯	◯	◯	Poor

4. **Have you consider to adopt responsible behavior towards the marine ecosystem (Coral Reef) while doing snorkeling/diving (ex. not stepping on corals, fish feeding, catching turtles)?**
Mark only one oval.

- ◯ No. I dont care
- ◯ No. I have not been informed about this idea
- ◯ Yes. I am always always respectful to natural ecosystems
- ◯ Yes. I have been informed and asked to be responsible by Diving Center/ Tour operator
- ◯ No. I am aware of responsible behavior but I take it easy when I am on holiday
- ◯ Other: _____

5. **Would you recommend Tioman Island to others as a favorable diving/snorkeling destination?**
Mark only one oval.

- ◯ Yes. Tioman Island is a perfect place for diving activities regarding its pristine marine ecosystem
- ◯ Yes. although there is some problems with seawater quality/coral reef condition, diving on Tioman Island is a worthwhile experience
- ◯ Yes. although there is some problems with seawater quality/coral reef condition, Tioman Island is an affordable destination for diving.
- ◯ No. The seawater quality is too poor
- ◯ No. the coral reef condition is not desirable
- ◯ Other: _____

6. **If you have choose other reason please specify?**

_____

7. **Any comment?**

_____

_____

_____

_____

_____

Norges miljø- og biovitenskapelige universitet
Noregs miljø- og biovitskapelege universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway