

ORIGINAL ARTICLE

Participatory mangrove forest management in the Carey Island, Malaysia

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In past 20 years, where there has been widespread degradation of mangroves, there are also cases where communities and governments have successfully restored their degraded mangroves. Researchers have emphasized on participatory models of management in mangrove forests. The present research aims to formulate a participatory management strategy to conserve mangrove forests in the Carey Island, Malaysia. The major management tool is a SWOT matrix analysis. For this purpose, the analysis of the data collected from 31 in-depth interviews with indigenous people living in the area of research as well as the information from the researchers' observation resulted in identification of a series of internal and external factors in the targeted area in terms of conservation of the mangrove forest. The factors were then scored using a SWOT questionnaire filled by 312 respondents, and later, sixteen strategies were considered using SWOT matrix and pairwise matching for the conservation of the mangrove forests. Later, the Qualitative Strategic Planning Matrix (QSPM) was used and four prioritized strategies were determined. As a conclusion, the four prioritized strategies were all related to capacity building, involvement and participation of stakeholders in the process of the mangrove forest conservation. Therefore, mangrove forest management in Carey Island requires a participatory approach in a way that not only the mangrove harvesting would be sustainably controlled, but stakeholders, especially villagers, will be simultaneously empowered and take responsibility of the sustainable conservation of their habitat and its biodiversity.

Keywords: Strategy formulation; strategic planning; sustainable conservation; SWOT method; QSPM

Introduction

Mangroves generally grow at the interface of the land and sea, in loose, wet soils, saltwater and are periodically submerged by tidal flows along protected coasts, estuarine and riverine areas within tropical and subtropical latitudes (Albert and Schwarz, 2013;). Mangrove forests have great adaptation to survive in the high salinity conditions (Nehru and Balasubramanian, 2016), extreme tides (Kathiresan and Bingham, 2001), tropical storms (Blanquespoor et al., 2016) and high temperatures (Noor et al., 2015). That's why they have created a productive ecosystem (Jia et al., 2015; Walters et al., 2008) while they are significant for ecological and socioeconomic reasons. They support fisheries production, coastline protection and water quality while they provide a nursery and breeding habitat for birds, mammals, fish, crustaceans, shellfish and reptiles (Albert and Schwarz, 2013).

Mangrove forests are threatened for various reasons. Jia et al. (2015) believed that they were decreasing "at an alarming rate". Certain researchers have referred to "global warming" as a threat to mangroves (DasGupta and Shaw, 2017a), others to aquaculture industry and agriculture (Richards and Friess, 2016), lime production (Scales et al., 2017), salt extraction (Liingilie et al., 2015), heavy metals contamination (He et al., 2014), oil pollution (Dilmaghani et al., 2011), continued harvesting for fuelwood (Lee et al., 2014) and urbanization in various forms (Garcia et al., 2014). That is why the management of mangrove forests is vital, especially for protecting and revival of mangrove resources. Also, protection of mangrove forests around the world as the most important centres of biodiversity hotspots have been emphasized.

Various methods have been introduced for sustainable management of forests. Sustainable forest management can have different meanings for different people, however, two principles are common: the ecosystem can renew itself; and the forest resources are conserved (MacDicken et al., 2015). However, Yamaki (2016) suggested that "public participation was crucial for sustainable forest management". Wadsworth et al. (2014) analyzed stakeholders' engagement as a key component in planning activities for forest management. In fact, people living around the forest or those who profit from the forest, are among stakeholders. In a decentralized model of forest management, the local communities have their own traditional rights that are recognized by the government (Siraj et al., 2016). People are allowed to participate in decision-making to solve the

essential problems and these are the people who control the solutions in the forest (Siraj et al., 2016). Various models of participatory forest management have emerged: Joint forest management in India (DasGupta and Shaw, 2017b; Kumar and Kant, 2016), collaborative forest management (Mohammed et al., 2017) and community forest management (Pinyopusarerk and Tran, 2014; Rasolofoson et al., 2015; Takahashi and Todo, 2012). Scheba and Mustalahti (2015) studied the role of experts and bureaucracy in participatory forest management in Tanzania and concludes that a policy of less reliance on experts and allowing local communities to have ownership and control over their forest resources. Researchers have also studied about the participatory models of management in mangrove forests. Ha et al., (2014) conducted a research in four communities in Vietnam and concluded that for a solution in favor of everyone and in line with conservation of the mangrove forest, it was needed that the farmers could have access to timber markets. In another research by Nguyen (2014), it was shown that the key for a successful mangrove conservation in Vietnam was a clear policy with emphasis on rights, responsibilities and benefits of local people. On-prom (2014) studied a case in Thailand on participatory mangrove management and showed how villagers through their community forest committee were involved in planning and management of their mangrove forest. Roy and Gow (2015) studied sustainable mangrove forest management in Bangladesh and stressed on the community level institutions for achieving sustainability. DasGupta and Shaw (2017a) reviewed various models of participatory mangrove forest management and mentioned that a participatory management regime was helpful in "contributing to social inclusion, community empowerment and sustainable development". Hema and Devi (2013) examined an institutionalized participatory management of Kerala mangrove forests in India, and suggested a series of recommendations for a sustainable management and conservation of the related forests; they emphasized on awareness rising activities, inter alia, targeted at the general public for the conservation and management of mangrove forests. Iftekhar (2008) reviewed the mangrove management strategies in three countries of Bangladesh, India and Sri Lanka and, among other things, recommended that a revision of the existing laws regarding mangrove conservation, clear definition of the mangrove forest, inclusion of common species among the wildlife conservation, inclusion of people in decision-making processes, zoning and market issues were necessary. The present research takes the Carey Island in Malaysia as a case and uses an analytic tool to evaluate the factors affecting the mangrove forest in the Island. It is not only an endeavor to contribute to the existing literature on mangrove forest management but it can be used in management strategy formulation for participatory and multi-stakeholder conservation of the forest in the Carey Island. The participatory approach can be regarded as one effective way for forest management in a country like Malaysia where there are extensive mangrove forests (about 645,000 ha.) on the one hand and there are the coastline people who are depended on mangrove forest and its habitat on the other hand.

Materials and methods of research

Study area: The Carey Island (Pulau Carey) is one of the Mangrove protected areas in Malaysia which is situated on the west coast of peninsular in the Selangor state and near the south west of Kuala Lumpur on 2.8605° N, 101.3658° E (Figure 1) with the total area of 16,187 hectares of which 11.5% is mangrove forest (1,876 hectares) and 65% is under plantation with oil palms (Rozainah et al., 2014). It is an initial settlement area for Mah Meri who is one of the major aboriginal tribes of Malaysia (Affandi et al., 2010; Yong, 2009).

Ramli and Fauzi (2016), divide the island into six habitats: Three of them belong to oil palm plantations (young, matured and old oil palm plantations), mangrove forest, housing area (houses and villages) and other habitats (Sime Darby Birds Sanctuary, roads, etc.). Mangrove tress are mostly on the edges of the Island. To prevent the sea-water intrusion into the plantation area, the Island is protected by a coastal bund and a system of water drainage since it is two metres below sea-level during high-tide. There is no management plan for the mangrove forest in the Carey Island while the existing forest act like a buffer zone especially for the palm oil plantations in the Island managed by Sime Darby. The Company supports research on mangrove forests as part of its corporate social responsibility and it has run a research centre on mangrove forest. Siti et al. (2009) have studied the biodiversity of the island and has concluded that mangroves have contributed to the richness of biodiversity in the Island since they function as nurseries and feeding area for the fish and crustaceans. Saraswathy et al. (2009) reported that the Carey Island has 16 species of mangroves from five families and most of these have significantly degraded.

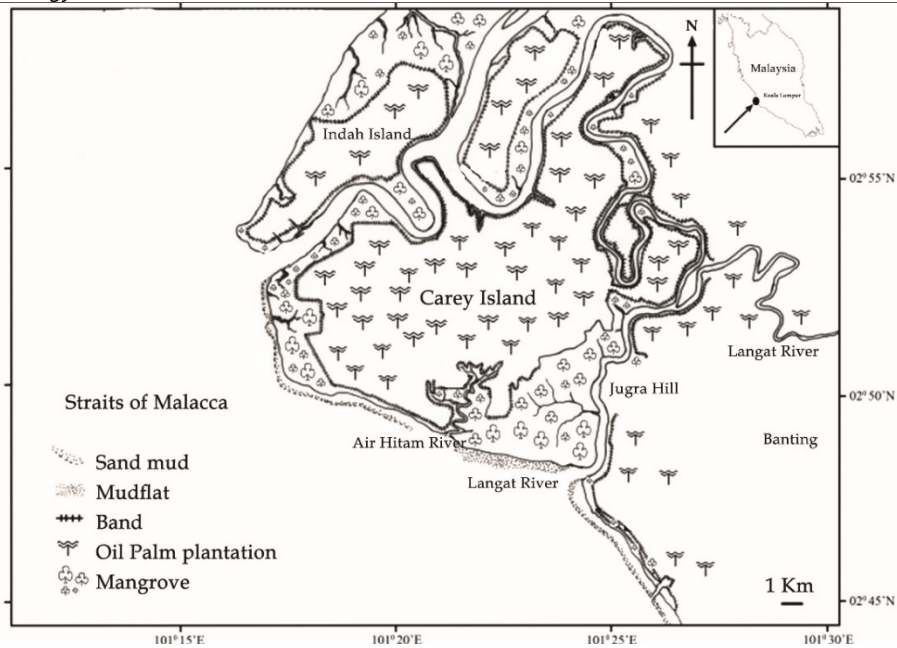


Figure 1. Carey Island.

Research methodology

In the present research, SWOT (Strengths and Weaknesses, Opportunities and Threats) analysis has been used as an evaluation tool to study the internal and external factors affecting the mangrove forest in the Carey Island. The researchers have used a participatory approach for collecting the data through stakeholders' participation. The SWOT has helped the researchers to study the environment and to propose a series of strategies for the management of mangrove forest.

Comino and Ferretti (2016) who have used SWOT analysis for formulation of strategies for park protection, considered it a suitable tool since it distinguishes between the endogenous and exogenous factors while it is useful for formulation of management strategies. Devitt et al. (2016) believes that SWOT analysis is a "strategic management tool" and it can be used in policy planning and decision-making. For Madsen (2016), it is mostly an assessment framework to analyse resources and capabilities as well as the external situation. Scolozzi et al., (2014) who have used SWOT analysis in conservation planning, believe that it is a support for strategic decision-making and it has been recently used for environmental assessment and management. Yavuz and Baycan (2013) consider SWOT Analysis a participatory decision-making tool. For them it is a "convenient and promising" method for any situational assessment.

SWOT analysis tool has been successfully used since fifty years ago in fields such as watershed management (Bagherian et al., 2009; Groninger, 2016; Taena et al., 2016), river management (Budiasa and Kato, 2016; Yenil and Taner, 2014) forest management (Baycheva-Merger and Wolfslehner, 2016; Grošelj et al., 2016; Kazana et al., 2015; Marino et al., 2014; Segura et al., 2014); ecosystem services framework (Bull et al., 2016); as well as in mangrove forest management.

In this paper, SWOT analysis tool was combined with the Quantitative Strategic Planning Matrix (QSPM) which is a strategy formulation tool. SWOT helped the researchers to carry out an analysis of the external and internal factors, as part of a planning phase for forest management.

The QSPM is a managerial technique for prioritizing strategies through comparing their relative attractiveness (Hosseini Nasab and Milani, 2012). The QSPM tool has been applied by researchers in management of protected areas (Padash et al., 2016), formulation of strategies for ecotourism (Butarbutar et al., 2014; Ghorbani et al., 2015; Monavari et al., 2013; Nourbakhsh et al., 2013), planning for water management (Azarnivand and Banihabib, 2013; Banihabib et al., 2016) and coastal management (Baby, 2013).

Methodology design: The research was carried out in three stages using different tools for collecting the needed data. The process of the research methodology is illustrated in Figure 2. The figure clarifies how data was collected and used in formulation of strategies for management of Carey Island mangrove forest. Later, each stage is described and methods, outputs, number and kind of respondents or participants have been explained.

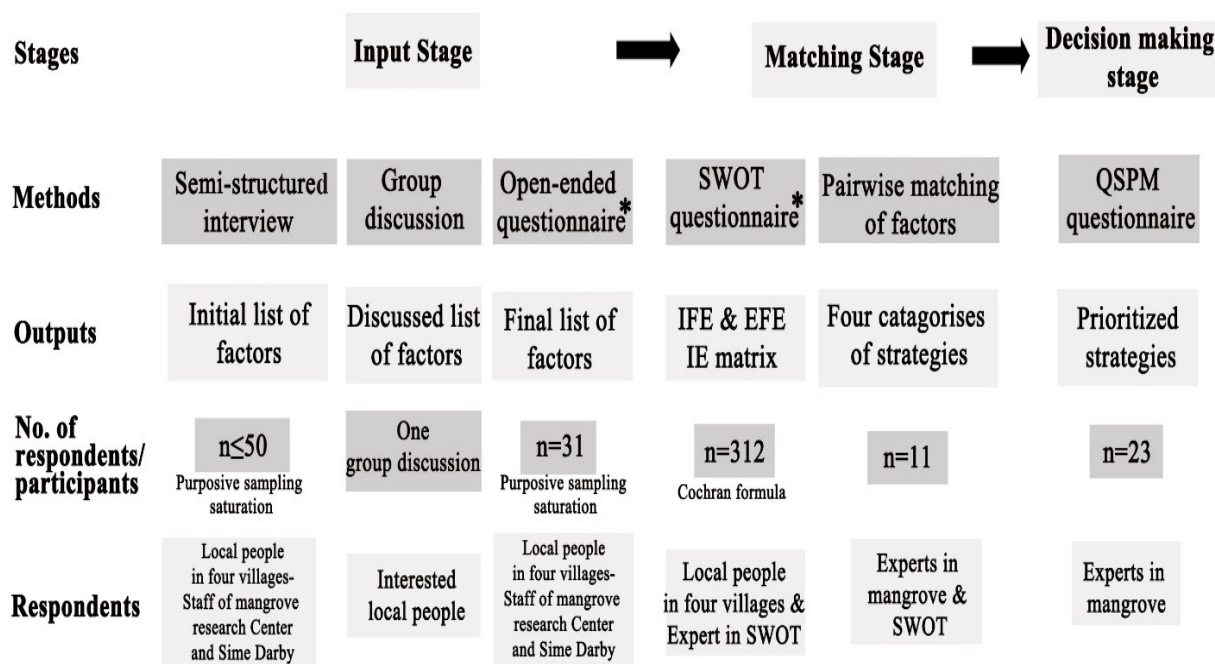


Figure 2. Process of the research methodology.

The process

The research was composed of three stages. The Input stage was the first one and three methods (phases) were used one by one: conducting semi-structure interviews; holding meetings of group discussion; and filling open-ended questionnaires. Conducting semi-structured interviews helped the researchers to prepare a preliminary list of opportunities and threats (or the external factors that affect the Carey Island mangrove forest) and strengths and weaknesses (or the internal factors). Before any interview starts, the researchers provided the respondent with information about the research and its objectives and then the four main questions about strengths, weaknesses, opportunities and threats were asked. Enough time was given to the respondents to think and the interviewer was open to any idea mentioned by the respondents. The target respondents were 312 (four villages and the staff of the Mangrove Research Centre). The distribution of these 312 respondents was as follows: Kampung Sungai Bumbun 123, Kampung Malayu 35, Kampung Sungai Judah 87, Kampung Sungai Rambai 42 and 25 from the staff of the Mangrove Research Centre. They were randomly selected based on the population of these four villages.

When the preliminary list of internal and external factors was ready, it was checked and tested in a discussion meeting with a group of respondents; based on the results from this meeting, the initial list was updated. Then for an indirect examination of the internal and external factors, an open-ended questionnaire was designed.

The respondents (n=31) were Orang Asli and Malay communities. The results from this questionnaire helped the researchers to finalize the list of factors. The first stage process lasted seven months (from March 2011 to October 2011).

The second stage took more than one year (October 2011 to November 2012). The SWOT questionnaire was prepared based on the inputs from the first stage, and later when the factors were finalized, the pairwise matching was done. A five-point Likert scale (very great extent, great extent, some extent, little extent, very little extent) was applied in the questionnaire to score the factor. For each factor, one question was designed. This questionnaire with 37 questions was filled by more respondents. The Cochran formula was applied to determine the sampling size (n) for the target villages. The calculated size was 312. In this case the level of confidence was 95% that equals to 1.96.

The results from the filled SWOT questionnaires helped the researchers to formulate strategies. At this time, two matrices were applied for a better understanding of factors: Internal Factor Evaluation Matrix (IFEM) and External Factor Evaluation Matrix (EFEM). It was necessary to give a weight to each factor before working with IFEM and EFEM. To do it, the sum of the scores by respondents to one factor (in SWOT questionnaire) has to be divided by total sum of all scores to all factors. As the total sum of all weights should be "1", then the weight for each factor was normalized between 0 and 1. Based on the methodology, the researchers were invited to give a rating of 1 to 4 to each factor as they were involved for a long time in data collection. For the rating, 1 was assigned for a major weakness or threat, 2 for a minor weakness or threat, 3 for a minor strength or opportunity and 4 for a major strength or opportunity. When the ratings of factors were done, then the rating number was multiplied by the weighted score for each factor. The sum of the results is called Internal Factor Evaluation (IFE) or External Factor Evaluation (EFE) (Ali Ahmadi, 2007; Almasi et al., 2011; Chang and Huang, 2006; David et al., 2009; Dilmaghani et al., 2011; Parsayan and Aarabi, 2009; Reihanian et al., 2012).

IFE and EFE results (between 0 and 4) are important in strategy formulation. These results were applied in another management tool called Internal-External matrix or IE Matrix. In fact, this two-dimensional matrix (IFE total weighted score on X axis and EFE total weighted score on Y axis) is an analysis of the internal and external factors. The weighted scores on each

axis will be divided in three regions (weak or low: between 1.0 and 1.99; middle or average: 2.0 and 2.99; strong or high: between 3.0 and 4.0). In fact, a matrix of nine cells is formed (see Figure 3). Also, three regions can be distinguished in this matrix. The first region is called "grow and build" and has three cells of 1, 2 and 4. Here, there is a need for intensive strategies. It means that the present situation has good strengths and opportunities. The second region is called "hold and maintain" and composed of three cells of 3, 5 and 7. The strategies for this region are mostly focused on keeping the existing situation. It means no change is needed. The planners may continue with the previous strategies. The last region (cells of 6, 8 and 9) is called the region of "harvest or divest". A change is needed in this case. The planners can continue with the previous strategies but they have to know that it is time for a change in their strategies.

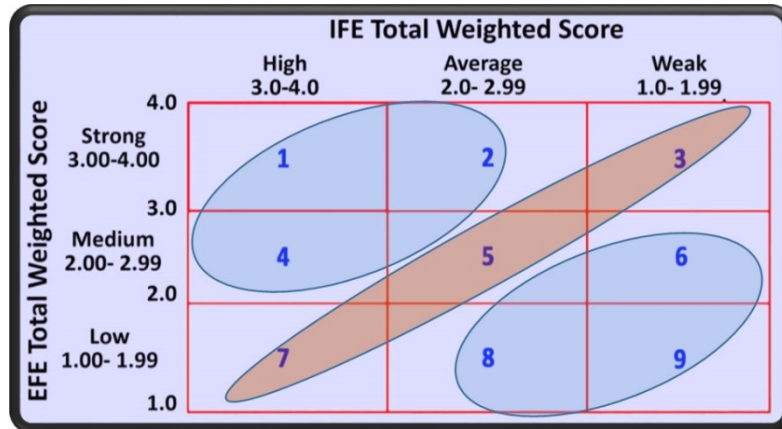


Figure 3. Internal-External (IE) matrix template.

The second phase is composed of pairwise matching of factors and forming SWOT matrix to formulate four groups of strategies (SO, WO, ST and WT). Some of the initiated strategies might be similar and therefore, it is needed to merge them. The third stage is to work on Quantitative Strategic Planning Matrix (QSPM) and to prioritize the strategies. A questionnaire is needed to be designed at this stage for weighing thirty-seven factors against sixteen strategies. An attractiveness score (from 1 to 4) has to be given to each of them and therefore 592 comparisons have to be done. As it was a complex questionnaire, therefore, it was required to be filled by experts (n=23) of mangrove conservation from related faculties and departments of University of Malaya (UM) and University Putra Malaysia (UPM) who cooperated with the researchers and put time to fill the QSPM questionnaire. Later, the mean scores for each factor was calculated. To calculate the relative attractiveness of each strategy, the mean scores for each factor is multiplied by the weight resulted from the SWOT questionnaire, and then the 37 results for each strategy were added. Those with higher sum are the more attractive strategies. The last thing is to rearrange the strategies based on the relative attractiveness.

Trustworthiness. Various methods were applied to guarantee the validity. The researchers did not start the interview since their first visit to the community. They tried to spend more time with the local people and to build trust. The trust is an important element for a fruitful interview. The researchers tried to be open and to share their experiences with the people in the target communities with an aim to build a sense of trust with the local people. The interviewee has to explain to the respondents that they can leave the interview or stop filling the questionnaire whenever they feel that they cannot continue (for any reason). This principle was observed by the researchers during interviewing or filling questionnaires. The language could be another challenge. A translator accompanied the researchers in Orang Asli communities to help them in trust-building. The researchers tested the data through their observations and contacts with other members of the communities as a step for the internal validity.

Triangulation was also applied (local people, Forestry Department staff and academic experts in mangrove management). It is important to add that experts were involved in "pairwise matching" and "decision-making" and therefore, the researchers used their experiences in forming the strategies and prioritizing them during the QSPM stage.

During the interviews and the group discussion, it was necessary to reduce researcher-based bias as much as possible and therefore, the researchers invited two facilitators to accompany them.

Results

The results can be categorized in five parts: 1) factors (resulted from stage one); 2) IFE and EFE results; 3) IE matrix result; 4) strategies (resulted from pairwise matching); 5) prioritized strategies (resulted from QSPM). Each of them is important to understand the existing situation and has to be discussed here.

Factors

The Internal and external factors were finalized in the stage one of the research process, as a result of interviews with local people in target communities. The list of the factors can be found in Tables 1 and 2.

IFE and EFE results

Based on the internal factors, IFE matrix was formulated and the result was 1.729. Also EFE was calculated as 1.226 and a review of the IFE and EFE for participatory mangrove management in the Carey Island, reveals that weaknesses dominate strengths (since IFE was less than 2.5) and threats dominate opportunities since EFE was less than 2.5 (Chang and Huang, 2006; Delavar, 2007;). It shows that in the Carey Island the potentials were not enough to conserve the Mangrove forest,

however the threats such as oil pollution, climate change, the highway and the bridge and the palm plantation were more powerful.

Table 1. IFE Matrix (S=strength, W=weakness).

| List of Strengths and Weaknesses | | Weight | Rating | Weighted score |
|----------------------------------|--|--------|--------|----------------|
| Strengths: | | | | |
| S1 | The villagers are familiar with Mangrove forest since their childhood. | 0.0339 | 3 | 0.1017 |
| S2 | The local people are aware of the Mangrove forest areas in Malaysia. | 0.0314 | 4 | 0.1256 |
| S3 | The villagers are aware of migratory birds in the Carey Island. | 0.0283 | 3 | 0.0849 |
| S4 | The villagers have not used Mangrove resources for any medical purpose. | 0.0287 | 3 | 0.0861 |
| S5 | The local people like to conserve the Mangrove forest. | 0.0308 | 4 | 0.1232 |
| S6 | The local people like to work in a group for conservation of the Mangrove forest. | 0.0303 | 4 | 0.1212 |
| S7 | Most local people in the villages are young. | 0.03 | 3 | 0.09 |
| S8 | The villagers harvest wood in areas that are more than 500 meters away from the edge of the Mangrove forest. | 0.0287 | 3 | 0.0861 |
| S9 | The local people go for harvesting less than 10 times in a month. | 0.0282 | 3 | 0.0846 |
| S10 | The villagers like to share their knowledge with others. | 0.031 | 3 | 0.093 |
| S11 | The local people have handicraft workshops in their village. | 0.0324 | 4 | 0.1296 |
| S12 | The local people sell handicrafts. | 0.0327 | 3 | 0.0981 |
| S13 | There are active women, members of a local group in their village. | 0.031 | 4 | 0.124 |
| S14 | The villagers select trees (for any possible use) when they are matured. | 0.0323 | 4 | 0.1292 |
| Weaknesses: | | | | |
| W1 | The villagers harvest Mangrove for wood, fire, fishing and hobbies. | 0.0211 | 1 | 0.0211 |
| W2 | The local people use Mangrove for making handicrafts. | 0.0201 | 2 | 0.0402 |
| W3 | The local people have not shared their knowledge with others. | 0.0188 | 2 | 0.0376 |
| W4 | The villagers have no accommodation facilities in their village. | 0.0186 | 2 | 0.0372 |
| W5 | The local people have no formal level of education. | 0.0199 | 2 | 0.0398 |
| W6 | The local people have no idea about what time tourists come to their village for visiting Mangrove forest. | 0.019 | 2 | 0.038 |
| W7 | Some villagers do not want to be in a group for conservation of Mangrove forest. | 0.0195 | 1 | 0.0195 |
| W8 | The local people do irregular fishing and harvesting | 0.0187 | 1 | 0.0187 |
| Total | | | | 1.729 |

To evaluate the external factors, opportunities and threats were first discussed and listed in Table 2. Based on the external factors, the EFE matrix was formulated (see Table 2).

Table 2. EFE Matrix (O=opportunity, T=threat).

| List of Opportunities and Threats | | Weight | Rating | Weighted score |
|-----------------------------------|---|--------|--------|----------------|
| Opportunities: | | | | |
| O1 | Tourists have some knowledge about Mangrove forest. | 0.0296 | 3 | 0.0888 |

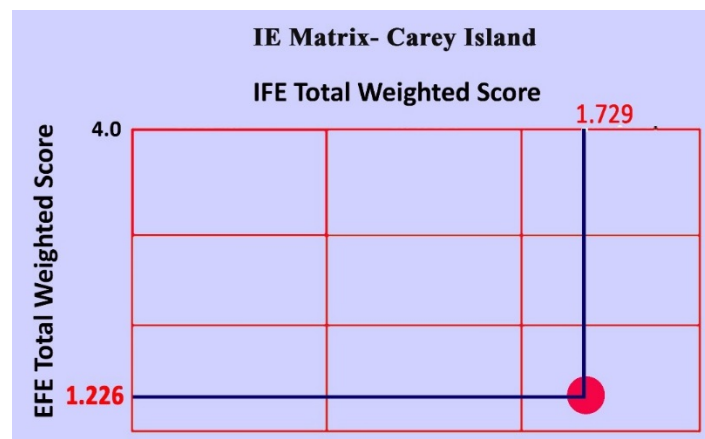
| | | | | |
|----|--|--------|---|--------|
| O2 | University of Malaya supports research on the mangrove forest. | 0.0322 | 4 | 0.1288 |
| O3 | Villages in the Carey Island have water supply. | 0.0353 | 3 | 0.1059 |
| O4 | Some villagers work for the Government. | 0.0305 | 4 | 0.122 |
| O5 | Tourists come to visit the Carey Island. | 0.0336 | 4 | 0.1344 |
| O6 | The local people have an annual celebration called Ari Muyang. | 0.0351 | 4 | 0.1404 |
| O7 | International agencies have some projects in the Carey Island. | 0.0312 | 3 | 0.0936 |
| O8 | Mangrove Research Center. | 0.0312 | 4 | 0.1248 |
| O9 | Academic Researchers. | 0.0311 | 4 | 0.1244 |

Threats :

| | | | | |
|----|---|--------|---|--------|
| T1 | Tourists do not share their knowledge with local people. | 0.0204 | 2 | 0.0408 |
| T2 | Palm Oil Plantation (Sime Darby) | 0.0211 | 1 | 0.0211 |
| T3 | Highway and bridges that pass through the middle of the forest. | 0.0217 | 1 | 0.0217 |
| T4 | Risk of the tsunami. | 0.0198 | 1 | 0.0198 |
| T5 | Oil pollutions from ships. | 0.0198 | 2 | 0.0396 |
| T6 | Climate Change (in general) | 0.0201 | 1 | 0.0201 |

Total**1.226****IE matrix result**

The red circle was in the third region (the region of harvest or divest). A change in policy and strategies is needed in the Carey Island according to the IE Matrix (Figure 4). People have been ignored and it seems a community-based mangrove management is necessary to be planned. There are various stakeholders that have to be involved in planning phases. It also reveals that for conservation of mangroves, we need a change into the existing decision-making.

**Figure 4.** IE Matrix - Carey Island.**Strategies**

At this phase based on a comparison of the internal and external factors, the SWOT matrix was shaped to generate strategies and sixteen strategies (St) were proposed as follow:

St1. The local people, tourists and academic researchers can share their knowledge on Mangrove in Malaysia.

St2. The local people can be involved as tour guides (general and professional).

St3. University of Malaya (UM) researcher, Mangrove Research Centre (MRC) and International Agencies (IA) can employ the local people as volunteers in their projects and academic research for conserving of the Mangrove forest.

St4. The local people can collaborate and participate with IA and researchers to protect the migratory birds in the Heritage Island.

St5. Increase the Women Active Groups (WAG's) knowledge and awareness about Mangrove Forest and its role to educate local people to protect the environment through holding a workshop by UM, MRC and IA.

St6. Increase awareness of the local people and tourists about conserving of Mangrove through the local celebration called "Hari Muyang".

St7. UM in cooperation with MRC and IA can increase the local people knowledge about mangrove through holding workshops.

St8. Local groups can do some activities to protect the Mangrove Forest to control any possible tsunami disaster.

St9. Control the oil pollution from the ships by the Government (GOV) and related Organization.

St10. Reduce the amount of Mangrove wood used by the local people.

St11. Change the livelihood of the villagers to use the natural resources in the Carey Island in a sustainable way by Non-Governmental Organizations (NGOs), GOV, SD, MRC and IA.

St12. Holding an exhibition in the Carey Island for selling handicrafts and fundraising to conserve the environment.

St13. Support the local people who are interested to continue their education by UM, SD, IA and GOV.

St14. Inform the local people about the negative effects of irregular fishing on the environment.

St15. Decrease the amount of harvesting to control the tsunami disaster.

St16. Decrease the amount of irregular fishing.

Prioritized strategies

After processing the QSPM questionnaires filled by the experts, the researchers could have a prioritized list of the above-mentioned strategies based on the scores four prioritized strategies are as follow:

- St1. The Local people, tourists and academic researchers can share their knowledge on Mangrove in Malaysia.
- St3. UM researcher, MRC and IA can employ the local people as volunteer in their projects and academic research for conserving of the Mangrove Forest.
- St7. UM in cooperation with MRC and IA can increase the local people knowledge about mangrove through holding workshops.
- St2. The Local people can be involved as tour guides (general and professional).

Discussion

A review of the four types of factors proves that most of them are related to the local people. Somehow, they are telling us a story: the local people like to conserve mangrove forest (S5), and for that, they would like to work in groups (S6); they harvest cautiously (S8, S9) and they select the trees that are matured enough (S14); they do not use mangroves for medical purposes (S4); there are interested young people (S7) while there are people who are familiar with the forest (S1, S2) and are aware of migratory birds (S3); there are active women who members of a local group (S13), they produce handicrafts in their workshops (S11) and are able to sell them (S12). They are ready to share their knowledge (S10).

It is clear that the local people in the Carey Island have a sense of ownership over the mangrove forest. They have considered the mangrove forest a community property and they have a common right over it.

Ostrom et al. (1990) consider forest a common pool resource. Especially in this case, this resource needs a set of rules to be well managed. According to the factors, these rules could be about conservation, sustainable harvesting, protecting the biodiversity, livelihood activities, and local knowledge sharing. That's why local people are referring to these factors as part of the management that the mangrove forest requires. In fact, they are demanding their collective right to management. Of course, for a common-property system, there should be a series of arrangements or preparations as proposed in Cole and Ostrom (2011) such as precise data about the condition of the forest, common understanding of the local people about potentials and risks, trust among them (as the necessary social capital), stability of the users, and the readiness of the people to stay and work in the area for a long period of time.

Respondents have referred to eight weaknesses. The villagers harvest Mangrove for wood, fire, fishing and hobbies (W1), and also they use it for producing handicrafts (W2) while they do irregular fishing and harvesting (W8). Some villagers do not want to be in a group for conservation of Mangrove forest (W7) and they have not shared their knowledge with others (W3). In fact, the local people have no formal level of education (W5). Regarding ecotourism, the local people have no idea about what time tourists come to their village for visiting Mangrove forest (W6) and they do not have accommodation facilities in their village (W4).

There are certain disparities between the strengths and the weaknesses. For instance, while they like to share their knowledge (S10), they have not yet shared the knowledge (W3). Also, while there are people who are not interested to be in a group to conserve mangroves, there are others who would like to work in groups (S6). This shows that these weaknesses can change into strength points if an appropriate strategy is adopted.

Nine opportunities were proposed as factors by tourists (O1, O5, O6), University of Malaya (O2), the Government (O4), International agencies (O7), Mangrove Research Center (O8) and academic researchers (O9). A stakeholders' influence can be seen here. This issue was discussed in dealing with strategies in this section. Meanwhile, these opportunities might help the local people to be more involved in conservation and find practical solutions for their livelihood needs.

The threats are about the tourists who do not share their knowledge with the local people (T1), and issue of palm oil plantation managed by Sime Darby (T2) and the existence of highways and bridges in the forest (T3), risk of the tsunami (T4), oil pollution from ships (T5) and the climate change (T6). Some of the threats are challenging such as the case of tourists that can change into an opportunity if an appropriate strategy is adopted. Some of the strategies such as finding solutions for tsunami or the climate change need actions by the government at national level. Others need suitable strategies by various stakeholders such as the oil pollution from ships or the issue of palm oil plantation.

A closer look at the strategies, reveals that they are about "conservation of mangroves", "ecotourism", "local economy and livelihoods", "awareness raising, knowledge sharing and education", "oil pollution", "tsunami effects", "fishing", "harvesting" and "migratory birds". While in all strategies local people have a major role, the issue of "conservation of mangroves" is more important. It repeats in various strategies (St3, St4, St8, St9, St10, St11, St12, St16), and it can be realized through various activities: research activities for conservation of mangroves (St3); protection of migratory birds (St4); protect mangroves against tsunami (St8); decreasing irregular fishing (St16) and protection against oil pollution (St9); change in livelihoods (St11 and St12); and through reducing the wood used by locals (St10). In fact, local people have depicted the various aspects of conservation of mangrove forests in the Carey Island.

The strategies can be categorized in four groups: a) the strategies referring to conservation of mangrove forests (St3, St4, St8, St9, St10, St11, St12, St16); b) the strategies referring to sustainable livelihood and sustainable use of forest (St2, St4, St6, St9,

St10, St11, St12, St14, St15, St16); and c) the strategies on protection against tsunami (St8, St15); and d) the strategies on knowledge sharing, awareness raising and education (St1, St5, St6, St7, St13 and St14).

The resulted strategies can also be divided, in a different way, according to the involvement of various stakeholders: local people; local groups; women's active group in Sungai Bum Bun; international agencies; the government, Malaysian universities especially UM; NGOs; SD; tourists; MRC; and academic researchers. Therefore, it is important to consider a stakeholder-influence theory in any future attempt for the management of the forest in Carey Island. Forest is a complex resource system (Memon and Thepa, 2016) and therefore, it would be good for the planners to consider the various expectations by the local communities as well as the other important stakeholders. Also, an involvement of various stakeholders is a pre-condition for any planning for conservation of mangroves in the Carey Island. Any stakeholder may play a different role, however if they can come together and define common vision for the area and a participatory planning can be organized, the solutions for a better conserved area, based on the existing capacities and potentials among stakeholders, can be suggested.

Regarding the prioritized strategies, the first important strategy is about knowledge sharing on Mangrove. It seems this strategy can contribute to the protection of environment by locals and tourists, since they have to be aware of the knowledge produced by the researchers. The second important strategy refers to the involvement of the locals as volunteers in research and academic activities. The third strategy to follow is about the training of local people to increase their knowledge about mangrove (that could be done by UM in cooperation with MRC and IA); in fact, if the people know more about the importance of mangrove and their habitat, then there will be more possibility that they may change their behaviour. Moreover, based on existing local knowledge on birds, local people can be involved as tour guides (general or professional); and that will be appropriate enough to pave the way for people to have more tenure on the Carey Island and its environment.

In fact, these strategies confirm that people have to feel that they are the real owners of mangrove. In other words, the local villagers must consider mangrove forest an exclusive natural resource of the Carey Island, which belongs to the next generation as well. This is in line with what Gill et al. (2009) recommended in their paper that a decentralized forest policy was a must in Malaysia. Also, Badola et al. (2012) and Datta et al. (2012) believe that participation of local communities in the management of forest is more sustainable. Since 2000, a series of projects were funded by UNDP in Malaysia to support local participation in conservation of mangrove forests in Penang, Sabah or Sarawak (SGP-Malaysia, 2012).

Conclusions

According to the results of this study, irregular fishing and harvesting by local people, lack of formal education among villagers, palm oil plantation, oil pollution and climate change are among the weaknesses and threats. For the conservation of the mangrove forests and inhibition of deforestation in the Carey Island, an effective and comprehensive planning and management that gives priority to the contribution of stakeholders should be followed.

Based on the analysis of the strengths, weaknesses, opportunities and threats, sixteen management strategies were designed, among which all four "important" strategies were related to capacity building and involvement and participation of stakeholders in the process of the conservation of the mangrove forest. This study clarifies that mangrove forest management in Carey Island requires a participatory approach in a way that not only mangrove harvesting would be sustainably controlled, but stakeholders, especially local villagers and groups, will be simultaneously empowered and take concern of the conservation of their habitat and its biodiversity in a sustainable way.

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