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The Study of Participatory Mangrove Forest Ecosystem Management in Malaysia, the Case of the Matang Mangrove Forest

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ABSTRACT

Community-based mangrove forest management with the involvement of various stakeholders could be an effective way for the conservation of the rich ecosystem of mangrove forests. This participatory approach in management has not been well addressed in the literature on mangrove forests management in Malaysia. This study aimed to codify a participatory management strategy in the Matang mangrove forest reserve located in the state of Perak, Malaysia through a SWOT analysis and applying the Quantitative Strategic Planning Matrix (QSPM) as a management tool. The local communities living in proximity of the Matang forest were the target group for collecting data. It was concluded that the participation of local communities in the management of the Matang forest is the key element of the priority strategies.

Keywords: *Strategy formulation, Strategic planning, Sustainable conservation, SWOT method, QSPM.*

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1. INTRODUCTION

Management of mangrove forests is of great importance, for the main reasons that these forests support various ranges of fauna and flora and are significant breeding lands for a vast array of animals and plants (Jusoff and Taha, 2008; WWF 2012), provide wood for sustainable harvesting (Roy et al., 2013), have aesthetic values and can be used as sites for ecotourism (Latiff and Faridah-Hanum, 2014; Roy et al. 2013), provide fishing resources for local communities (Macintosh et al., 2012; Roy et al., 2013), act like a buffer and protect coastlines against strong erosive waves, winds, and tsunamis (Dat and Yoshino 2013; Macintosh et al. 2012; Nguyen 2014; Nguyen et al. 2013; Ong and Gong 2013; Talaat et al. 2012; WWF 2012), act like a barrier preventing salt water from passing into rivers (Latiff and Faridah-Hanum 2014; WWF 2012), keep nutrients and filter toxicants (Talaat et al. 2012; WWF 2012), provide resources for coastal communities who depend on the plants for timber, fuel, food, medicinal herbs and other forest products (Macintosh et al. 2012; WWF 2012), have educational values (Latiff and Faridah-Hanum 2014) and last but not least, play a major role in sequestration of atmospheric carbon dioxide (Ong and Gong 2013). In Peninsular Malaysia, mangrove forests are under control of the Forestry Department in all states, while it should be admitted mangrove forests in this part of the world are more diverse than other places in the world (Baba et al., 2013; Khoon and Eong, 1995; WWF 2012). After Indonesia and Thailand, Malaysian mangroves are the third largest mangrove forest in the Asia-Pacific region (Juliana et al. 2014). Despite such importance, mangrove forests, especially in Malaysia are facing threats due to climate change like sea-level rise (Jeofry and Rozainah; 2013), human activities, urban reclamation, deforestation, agricultural development and irregular fishing and harvesting (Chong, 2007; Dilmaghani et al., 2011; Ong and Gong, 2013; Talaat et al., 2012; UNEP, 2012). Since 2000, certain projects have been funded by UNDP in Malaysia to support local people to carry out activities for conservation of mangrove forests in Penang, Sabah, and Sarawak (SGP-Malaysia; 2012). Involvement of local communities in the forest management along with the collaboration of other stakeholders has been claimed to be more sustainable (Agrawal and Gibson, 1999; Badola et al., 2012; Datta et al., 2012), while the community management in Malaysia seems to be weak possibly because of the strong governmental structure (Nasuchon, 2009). Gill et al. (2009) even recommended a decentralized forest policy in Malaysia since the existing policies have brought about forest degradation.

While there are research endeavors showing the effectiveness of different models of participatory management of the mangrove forests ecosystem (Ha et al., 2014; Macintosh et al., 2012; On-prom, 2014), this has not been well addressed in studies on mangrove forests in Malaysia. Jusoff and Taha (2008) in their academic paper on sustainable mangrove forests management in Malaysia showed that public awareness was recently increased, while still there are people who do not know much about the role of mangroves. They emphasize that

the national policies in Malaysia regarding mangrove forests have to be revised "from time to time" to guarantee sustainable and perpetual management (Jusoff and Taha, 2008). They did not discuss the participatory management of mangrove in their paper. Chong (2006) in his research on fisheries and mangrove, did not study the role that could be played by local communities involved in fishing or benefiting from mangrove forests. Also, Ahmad (2009) who worked on the recreational values of mangroves, especially in the mangrove forest of Larut Matang, emphasized on people's participation in mangrove recreational activities but did not study the role that local people in the conservation of mangroves and only referred to the lack of policies to improve the conservation of the forest. There are certain exceptions. Siry (2006) in his comparative study of the management of coastal zones in both Malaysia and Indonesia argued that Malaysia has gone through different phases from reactive and problem-based approaches before 1980 to take specific measures for zoning and resource management and a series of management documents arising out of international commitments. In conclusion he referred to the fact that the government system in Malaysia contradicts the decentralized coastal zone management. He proposed more sustainable needed approaches such as co-management and community-based involvement in coastal zones management with collaboration of the major stakeholders (Datta et al., 2012; Fraser et al., 2006; Pomeroy, 1995; Saenger, 2011; Sheppard, 2005).

Gill et al., (2009) conducted research on the need for participatory forest management in Pahang Malaysia. Their research showed that the related case study (Kampung Simpai) can be a model for engaging partners in conservation. The rural people have found the resources they have used are threatened and therefore, they feel they should start a series of activity for conservation. The intervention by UNDP/GEF helps the people to document their local knowledge and this would support the local management of the forest (Gill et al., 2009).

Talaat et al., (2012) studied three frameworks of legislation, administration, and policy-making for management and conservation of mangrove forests in Malaysia and concluded that the existing policies are unclear, the laws are segmented, and there are certain administrative jurisdictions for conservation or management of mangrove forests that overlap each other and therefore, all in all, hamper a more sustainable management of mangrove. There are two important points regarding the participatory management of mangrove forests in policies in Malaysia: 1) the National Policy on the Environment adopted in 2002, which in its paragraph one refers to the involvement of all sectors including the community, and 2) the National Policy on Biological Diversity adopted in 1998, which in its Principle VII, it refers explicitly to the role that local communities may play in conservation and management. However, no clear mechanisms have been recommended for facilitating the process of people's participation.

The present paper studied the Matang mangrove forest as a case. The Matang came under management since 1908 and it is now managed by the Forestry Department. The research used a managerial analytic tool to evaluate the factors affecting the forest through the participation of various stakeholders. The result of the present research can help us to understand the priority strategies in terms of protection of the mangrove forest ecosystem.

2. MATERIALS AND METHODS

Studied area: Matang mangrove forest with an area of 40,466 ha is located in the west part of peninsular Malaysia in the state of Perak between the latitude 4° 15'N – 5° 1'N and longitude 100° 2' – 100° 45'E (Fig. 1). Matang is among the best sustainable and intensively managed for the production of fuelwood and charcoal (Amir 2012; Chong 2006; Chowdhury 2008). It is managed by the Forestry Department of Perak and is the largest mangrove forest in Peninsular Malaysia (with 40% of the total mangrove forest in the peninsular). Maximizing production of green wood for pole and charcoal wood is the main objective for mangrove economic utilization in the Matang Working Plan (Ahmad 2009; Chong 2006).

Matang mangrove forest is rich in various species of mangroves and it has been claimed that there are about 28 true mangrove species and 13 associate species, while 85 percent of the total forest area is *Rhizophora apiculata* and *Rhizophora mucronata* (Alongi 2002).

A total of 74% of Larut Matang mangrove forest is gazetted as productive forests for the purpose of logging and regeneration while 24% has been designated as a protective area for ecotourism activities and another 1% is kept as virgin jungle reserve for research purposes (Ahmad 2009). The Larut Matang mangrove ecosystem includes the surrounding village communities, which in one way or another, are dependent on the forest. The Malay and Chinese communities are mostly involved in agricultural, forestry, and fishing sectors (fish, prawn, and crab catching and cockle farming). The mangrove forest in Larut Matang provides employment to almost 12500 villagers in the forestry and fisheries sectors.

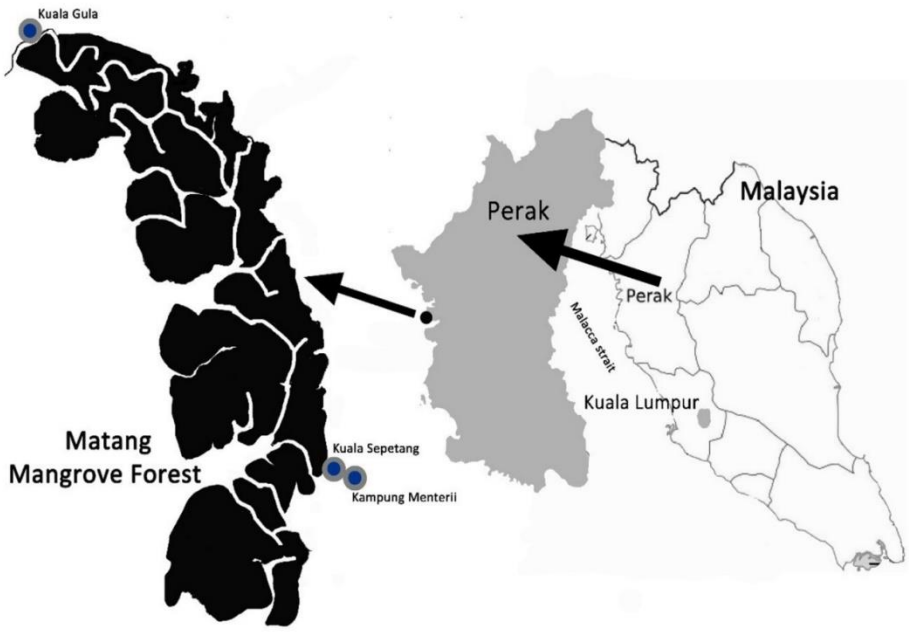

Figure 1. Map of Matang Mangrove Forest Reserve

Charcoal is Matang Mangroves' primary economic timber product. In addition to its usage as fuel, charcoal is also further processed into other products such as soap, cigarette filters, shoe soles, and water filters.

The mangrove forest of Larut Matang is a well-known place for bird watching. It is a rich habitat for migratory and local forest birds (Jasmi et al., 1992). More than 58 species of migratory birds have made stopovers in mudflats of the mangrove forest. Storks and terns are the main attraction for bird watchers in the location (Malaysia, 2009).

Research methodology: The research used a managerial analytical tool (Chang and Huang, 2006) based on a participatory approach that went through three stages of data gathering. SWOT is an analytical model of planning used for an entity or an environment as a management tool, which proposes a series of categorized strategies by listing, evaluating, and matching strengths and weaknesses (as the internal factors) and opportunities and threats (as external factors) through the participation of stakeholders.

SWOT analysis was used in coastal management (Horigue et al., 2014; Nouri et al., 2008; Panigrahi and Mohanty, 2012; Siaosi et al., 2012), in the evaluation of regulations (Panigrahi and Mohanty, 2012), in environmental evaluation (Lee and Lin, 2008); forest research and management in general (Dwivedi and Alavalapati, 2009; Guiang et al., 2001; Masozera et al., 2006; Mendoza and Prabhu, 2005; Pykäläinen et al., 2007; Rauch, 2007) and in particular in mangrove forest management (Dilmaghani et al., 2011) as well as in tourism and ecotourism management (Hong and Chan, 2010; Jie, 2008; Sariisik, et al. 2011) and last but not least in participatory community-based management and stakeholders' analysis (Margles et al., 2010; Mendoza and Prabhu, 2005; Robins and Dovers, 2007; Srivastava et al., 2005; Suh and Emtage, 2005).

Finding priority strategies for managing a mangrove forest can be a major part of managerial decisions that might be considered in the planning phase of forest management. It is a part of the management process (including an analysis of the external and internal environment, strategy formulation, implementation, monitoring, and evaluation). In fact, SWOT can be used as the analysis tool and the *Quantitative* Strategic Planning Matrix (QSPM) is used as a strategy formulation tool.

Quantitative Strategic Planning Matrix (QSPM) or strategies attractiveness matrix is a managerial technique used along with SWOT in the decision-making stage for prioritizing strategies through comparing their relative attractiveness (Nasab and Milani, 2012). The QSPM tool has been used in coastal flood management (Vafaei and Harati, 2010), mangrove forest management (Dilmaghani et al., 2011), coastal ecotourism (Monavari et al., 2013; Nourbakhsh et al., 2013; Tabibi and Rohani, 2011), and protecting coastal landscape resources (Baby 2013).

Methodology design: This work was conducted through three stages using various methods and tools for data collection. Fig. 2 illustrates the process of the research methodology and shows how they were used to produce data for finding management strategies of the Matang Mangrove Forest Reserve.

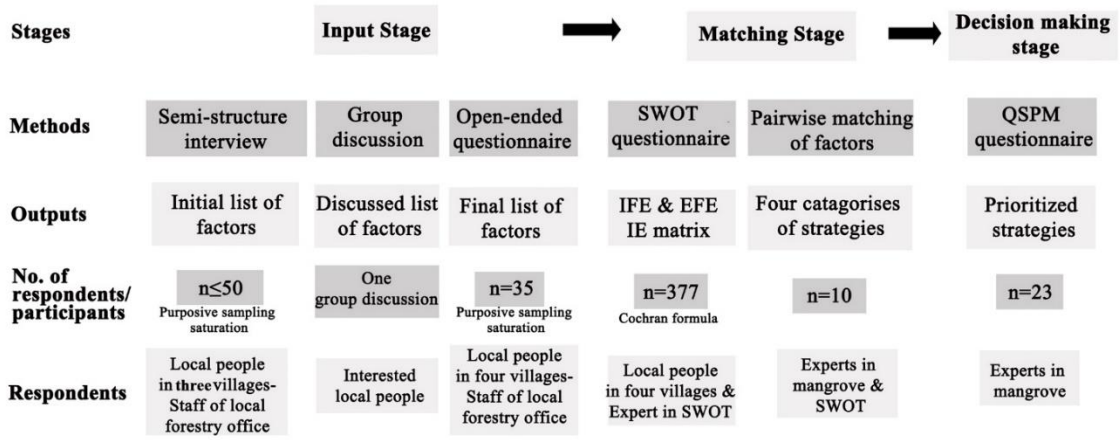

Figure 2. Process of the research methodology

The Process. The research methodology process had three stages. It started with the Input Stage that was composed of three phases: i. Semi-structure interview, ii. Group discussion, and iii. Open-ended questionnaire. The first phase was the "semi-structured interview" that aimed at preparing an initial list of opportunities and threats (as the external factors affecting the mangrove forest in Matang) and strengths and weaknesses (as the internal factors). Each interview started with a summary of what the research was about through which the interviewee was encouraged to think about the forest and respond the four main questions (arising from the SWOT method) regarding the factors, while the interviewer was open to the ideas to be raised during the interview. The main sources of data came from the three selected local communities and the Forestry Department local office staff (13 people). The selected villages were on the periphery of the Matang forest reserve: 1. Kuala Sepetang (previously called Port Weld), a Chinese fishing village with a population of 5500, 2. Kampung Menteri with a population of 1300, located next to Kuala Sepetang, 3. Kuala Gula located in the northwest of the Matang with a population of 7100. The villages affect the Reserve and use it as a resource in different forms. It is important to note that the Global Environment Centre (GEC) – a non-governmental organization - has facilitated the process of forming a local group (*Sahabat Hutan Bakau* or the Friends of Mangrove Forest) in Kuala Gula since 2008. The group is responsible for promoting and encouraging mangrove rehabilitation.

When an initial list of factors was prepared out of the interview contents, the second phase of the first stage started. The list was checked in a discussion group with a number of respondents during the next field trip; based on these discussions, the initial list was revised. In the next phase, an open-ended questionnaire was prepared to indirectly examine the factors. The respondents (n=35) were Chinese (47%), Malay (46%), and Indian (7%); also 67 percent of them were men and 33 percent women. The majority of the respondents (76%) lived there for more than ten years and more than 70% of them were from the young generation (between 20 and 40 years old). Based on the results of this questionnaire, the list of factors was finalized. The whole process of the first stage took about seven months (from March 2011 to October 2011). The researchers traveled to the villages several times.

The second stage lasted more than one year (October 2011 to November 2012). It built upon the inputs from the first one and consisted of two phases: the SWOT questionnaire and the pairwise matching. For the questionnaire, the factors were scored on the basis of a Likert scale from 5 to 1 (very great extent, great extent, some extent, little extent, and very little extent). For each factor (Strengths, Weaknesses, Opportunities, and Threats), there was one question (in total 50 questions). This questionnaire was required to be filled with more respondents. That was why the Cochran formula was used to calculate the sampling size for the selected villages (Hafeznia 2009).

The formula gave the researchers a total sample size of 377 as required. The respondents were from the three selected villages with 65% men and 35% women. It is worthwhile to mention that during filling the questionnaires, (and even during the time when the open-ended questionnaire was filled at the previous stage), most of the time, people in local communities talked to each other about the questions. This was important because, in this way, they were certain what they were responding.

Based on the results of analyzing from SWOT questionnaire, the main content to codify strategies was determined. Then the internal factor evaluation matrix (IFEM), as well as the external factor evaluation matrix (EFEM), were used to give a deeper understanding of all the involved factors. After identifying the strengths and weaknesses as the main content of IFE and EFE matrix, a weight was assigned from 0.00 to 1.00 to each factor. The weight is the sum of the scores by respondents to one factor (in SWOT questionnaire) divided by the total sum of all scores to all factors. Therefore, it is a number between 0 and 1 and the total sum of all weights should be 1. A rating of 1 to 4 was assigned by the researchers to every factor due to their long engagement in data collection and their familiarity with the Matang Forest. For the factor, illustrating a major weakness/threats, rating (1), a minor weakness/threats rating (2), a minor strength/opportunities rating (3), or a major strength/opportunities, rating (4) was assigned. The result of the multiplying of rating by the weight would be a weighted score for each factor and the sum of the weighted score is IFE

or 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).

The results from IFE and EFE – which were between 0 and 4 – were helpful in strategy formulation and were used in the Internal-External (IE) matrix. This matrix is another management tool for the simultaneous analysis of both internal and external factors. This tool gives us a better insight into the status quo in the study field based on the results from EFE and IFE. It is a two-dimension matrix in which the IFE total weighted score will be shown on the X-axis and the EFE total weighted score on the Y-axis. If both scores are between 1.0 and 1.99, they show a weak internal status; if between 2.0 and 2.99, they are considered middle; and if between 3.0 and 4.0 they prove a strong position. When the two-dimension matrix is illustrated, it can be divided into nine cells with three major regions and different strategy implications (Fig. 3). The first one is composed of the cells 1, 2, and 4 and it is called the "grow and build" region. There is a need for intensive or integrative strategies, which means the present status quo has a good basis. You can move forward and "grow" your work. The second one is named "hold and maintain" and has three cells of 3, 5, and 7. Here, there is a need for strategies that keep the status quo on-going; it means that there is no need for change. You may continue with the previous strategies. The last one is composed of the cells 6, 8, and 9 and it is called the region of "harvest or divest". It means that a change of policy is needed; you might continue with the existing strategies but it is time to change to another policy, as the conditions do not support the present strategies.

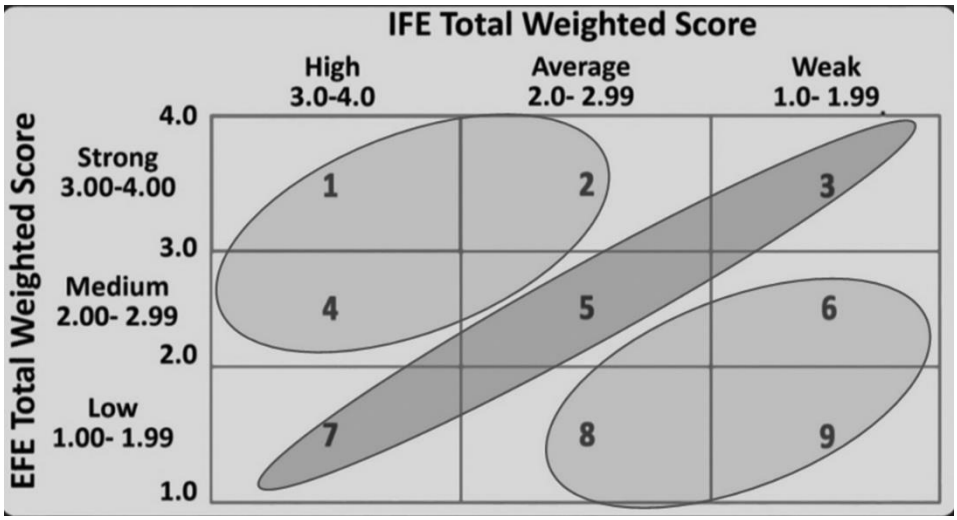

Figure 3. Internal-External (IE) matrix template

The second phase of the second stage is to shape the SWOT matrix to generate four groups of strategies (SO, WO, ST, and WT). Usually, there will be similarities among the resulted strategies and in certain cases, we can merge the strategies.

The third stage of the research methodology focused on decision making where the Quantitative Strategic Planning Matrix (QSPM) was used for prioritizing strategies (Ali Ahmadi, 2007; Almasi et al., 2011; Dilmaghani et al., 2011; Nouri et al., 2008; Piran, 2003). A third questionnaire was designed for weighing fifty factors against sixteen strategies by giving an attractiveness score of 1 to 4 – which meant 800 comparisons had to be made. This was a complex questionnaire, filled by experts in mangrove ecosystem conservation (n=23). The data were entered into SPSS for the calculation of the mean scores for each factor. Later, for each strategy, a table of factors was drawn in which the attractiveness scores were multiplied by the weight, previously calculated based on the data from the SWOT questionnaire, and then all the fifty results for one strategy were added up. This sum was the relative attractiveness of each strategy. Higher sums signify a more attractive strategy while to produce these scores we have considered all the relevant external and internal factors that might influence the strategic decision. At this point, the strategies were re-arranged.

Trustworthiness, which is validity in qualitative research, was obtained through different techniques in this research. First of all, the researchers spent some time, before starting the data collection, through organized interviews or filling the questionnaire with local communities trying to build trust between them. The site visits and spending a long time with the local communities, using their boats to seal over the rivers and communicating with them during the trips as well as contacting to the local Forestry department prepared a friendly atmosphere to collect trustful data from the communities.

The researchers started the interviews only when they were certain that the ice between the participants and the researchers has been broken and a sense of trust was established between them. They were free to leave the interview or stop filling the questionnaire whenever they felt they could not give accurate information. Moreover, they entered the Chinese community in the Matang with a Chinese-Speaking citizen who could facilitate the processes of ice-breaking and trust-building. To be certain about the internal validity, the researchers checked the collected data through observations and interviews with the members of the targeted local communities. Also where necessary, triangulation was used (local people, local Forestry Department staff, and the academic experts in mangrove conservation) the use of experts

in two stages of "matching" and "decision-making" was helpful in applying the existing experience on mangrove in generating the strategies and prioritizing them.

To decrease researcher-based bias during the data collection phase, the researchers used other experts (one anthropologist and one community facilitator) to accompany and help them during the interviews and the FGD session.

3. RESULTS AND DISCUSSION

Factors: As a result of the three phases of stage one (interviews, group discussion, and filling in open-ended questionnaires), 19 strengths, 16 weaknesses, 10 opportunities, and 5 threats were generated (the list of factors has been included in the IFE and EFE matrices; see Tab. 1 and 2). All the sentences of the nineteen strengths started with "villagers" or "local people" and that means that great potential of people's participation and involvement has already been ignored. Also, their interest to know, and share knowledge or their willingness to cooperate for conservation are important issues that can directly affect the mangrove forest in a positive way. The weaknesses were also in the local people. Some were related to their activities (such as the use of wood for fuel, harvesting, and fishing) and others were related to their lack of knowledge about mangroves or the wildlife, especially the birds.

The opportunities were various stakeholders that may contribute to the conservation of the mangrove forest such as tourists, people who work for the government, academic teachers and even Malaysian universities, and other related national agencies. The threats were specified as earthquake, tsunami, climate change, oil pollution, as well as the tourists who do not share their knowledge with the local people. Local people have clearly referred to the climate change as a threat while researchers such as Ellison (2014) recently studied the vulnerability of mangrove forest to climate change too. She believes that there has been a loss of about 50% during the past 20 years. Among various impacts of climate change, the sea-level rise affects the mangroves due to the longer periods of inundation.

Results of IFE and EFE: When IFE and EFE matrices were formed and calculated, it was found that the total weighted score of IFE and EFE were 2.192 and 1.386, respectively. Both scores were below 2.5. In this case, weaknesses and threats were superseding strengths and opportunities, respectively. It means that the existing management system is internally weak while communities have potentials and at the same time, the existing strategies are not appropriately designed to meet the external opportunities and protect the forest against threats (*Table. 1 and 2*).

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

	List of Strengths and Weaknesses	Weight	Rating	Weighted score
Strengths:				
S1	Most of the local people have been living here above 10 years	0.0271	3	0.081
S2	The villagers have a formal level of education	0.0235	4	0.094
S3	The villagers are familiar with the Mangrove forest since their childhood	0.0261	4	0.104
S4	The local people know that the Mangrove Forest can control the effects of erosion	0.0263	4	0.105
S5	The villagers' life is related to the Mangrove Forest	0.0247	3	0.074
S6	The local people know about the function of the Mangrove	0.0254	4	0.101
S7	The villagers have accommodation facilities in their villages	0.0247	3	0.074
S8	The local people know about what time tourists come to their villages for visiting the Mangrove Forest	0.0239	3	0.071
S9	The villagers are interested in the conservation of the Mangrove forest	0.0247	4	0.098
S10	The villagers are interested to share their knowledge with others	0.0242	3	0.072
S11	The local people like to share their knowledge about birds with others	0.0244	3	0.073
S12	The local people like to protect the environment	0.0250	4	0.100
S13	The villagers know that the Mangrove Forest can control the tsunami effects	0.0262	4	0.104
S14	The local people are interested to know more about the Mangrove Forest	0.0238	4	0.095
S15	The local people are aware of the Mangrove forest areas in Malaysia	0.0240	4	0.096
S16	The villagers have not used Mangrove resources for any medical purpose	0.0226	4	0.090
S17	The local people like to work in a group for the conservation of the Mangrove forest	0.0233	4	0.093
S18	The local people go for harvesting less than 10 times in a month	0.0204	4	0.081
S19	The villagers select trees (for any possible use) when they are matured	0.0221	4	0.088
Weaknesses:				
W1	Some of the local people did not know about the Mangrove Forest	0.0237	2	0.047
W2	The villagers are fishing and harvesting anywhere from the Mangrove	0.0122	2	0.024

W3	The local people do harvesting near the Mangrove Forest	0.0126	2	0.025
W4	Selling is the most important purpose of harvesting for villagers	0.0122	2	0.024
W5	The villagers use the Mangrove wood for fuel	0.0122	1	0.012
W6	The local people did not share their knowledge with others	0.0230	2	0.046
W7	The villagers didn't know about the Matang, which has the best plan for conserve the Mangrove in the world	0.0119	2	0.023
W8	The local people are not familiar with the Forestry House in the Matang	0.0126	2	0.025
W9	The villagers are not familiar with bird watchers	0.0121	2	0.024
W10	The local people are not interested to share their knowledge about birds with others	0.0126	2	0.025
W11	The villagers have no idea about the high season for bird watching	0.0128	2	0.025
W12	The local people did not know about the wildlife in the Matang	0.0127	2	0.025
W13	The mere existence of charcoal factories	0.0123	2	0.024
W14	Some villagers do not want to be in a group for the conservation of the Mangrove Forest.	0.0126	2	0.025
W15	The local people do irregular harvesting	0.0127	2	0.025
W16	The villagers' life is related to the Mangrove Forest	0.0122	2	0.024
	Total Weighted Score			2.129

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

	List of Opportunities and Threats	**Weight**	**Rating**	**Weighted score**
	Opportunities:			
O1	Tourists have some knowledge about the Mangrove Forest	0.124	4	0.490
O2	Tourists like to share their knowledge with the local people	0.115	4	0.046
O3	The Forestry Department of Perak	0.104	4	0.042
O4	People who work for the Government	0.113	4	0.045
O5	The existence of the Forestry House	0.140	4	0.056
O6	The mere existence of a management plan for the Matang Mangrove Forest	0.132	4	0.053
O7	Academic researchers	0.245	4	0.098
O8	Malaysian universities	0.249	4	0.100
O9	Tourists who come to visit the Matang	0.253	4	0.102
O10	International agencies have some projects in the Matang Mangrove Forest	0.253	4	0.102
	Threats:			
T1	Tourists do not share their knowledge with local people	0.252	2	0.050
T2	The threat of Earthquake	0.251	2	0.050
T3	Climate Change (in general)	0.249	2	0.050
T4	Risk of the tsunami	0.258	2	0.051
T5	Oil pollutions from ships	0.257	2	0.051
	Total Weighted Score			1.386

Strategies from Pairwise Matching: The result of the SWOT matrix was produced as a list of 36 strategies. These strategies were compared and merged and, as a result, the following sixteen strategies were proposed.

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

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

St3. The Forestry Department of Perak (FDP) and International Agencies (IA) can employ local people as volunteers in their projects for the conservation of the Mangrove Forest

St4. The local people can collaborate and participate with IA and researchers to protect the migratory birds in the Matang mangrove forest

St5. Educate and help villagers to make a group to protect the Mangrove Forest

St6. Increase the villagers' knowledge and awareness about Mangrove Forest and its role to control the Tsunami effects through holding a workshop by FDP, Malaysian Universities (MU) and IA.

St7. Reduce the effects of erosion by FDP and IA in cooperation with the local people

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

St9. Reduce the amount of Mangrove wood used by the local people

St10. FDP should make a document to show the places where local people can go fishing or harvesting

St11. Change the livelihood of the villagers to use the natural resources in the Matang in a sustainable way by FDP, Government (GOV), non-governmental organizations (NGOs), and IA.

St12. Support the local people who are interested to continue their education by MU, FDP, GOV, and IA.

St13. FDP should inform the local people about the negative effects of irregular fishing in the environment

St14. FDP should supervise on charcoal factories in the Matang

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

St16. Decrease the amount of irregular fishing.

Results from QSPM: 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 calculated by SPSS software (*Table. 3*).

Table 3 Prioritized strategies

Priority Order	Strategies	Score	Score Percentage
1	**St1.** The Local people, tourists, and academic researchers can share their knowledge on Mangrove in Malaysia	2.440	7.17
2	**St4.** The local people can collaborate and participate with IA and researchers to protect the migratory birds in the Matang mangrove forest	2.436	7.16
3	**St2.** Local people can be involved as tour guides (general and professional)	2.429	7.14
4	**St15.** Decrease the amount of harvesting to control the tsunami disaster	2.397	7.05
5	**St5.** Educate and help villagers to make a group to protect the Mangrove Forest	2.327	6.84
6	**St12.** Support the local people who are interested to continue their education by MU, FDP, GOV, and IA	2.162	6.36
7	**St13.** FDP should inform the local people about the negative effects of irregular fishing on the environment	2.148	6.31
8	**St3.** The Forestry Department of Perak (FDP) and International Agencies (IA) can employ the local people as volunteers in their projects for the conservation of the Mangrove Forest	2.135	6.28
9	**St6.** Increase the villagers' knowledge and awareness about Mangrove Forest and its role to control the Tsunami effects through holding a workshop by FDP, Malaysian Universities (MU), and IA.	2.124	6.24
10	**St16.** Decrease the amount of irregular fishing.	2.101	6.18
11	**St14.** FDP should supervise on charcoal factories in the Matang	2.017	5.93
12	**St7.** Reduce the effects of erosion by FDP and IA in cooperation with the local people	2.000	5.88
13	**St9.** Reduce the amount of Mangrove wood used by the local people	1.950	5.73
14	**St10.** FDP should make a document to show the places where local people can go fishing or harvesting	1.865	5.48
15	**St11.** Change the livelihood of the villagers to use the natural resources in the Matang in a sustainable way by FDP, Government (GOV), non-governmental organizations (NGOs), and IA.	1.790	5.26
16	**St8.** Local groups can do some activities to protect the Mangrove Forest to control any possible tsunami disaster.	1.694	4.98
	Total	34.015	100.00%

Factors: All the strengths are about the potentials of people in local communities. It shows that they know mangrove forest (S3, S4, S6, S8, S10, S11, S13, and S15) and are interested to know more (S14), be involved in conservation (S9 and S17), ecotourism (S7, S8, and S11).

Weaknesses are again about the behavior of local people regarding the mangrove forest. It refers to harvesting wood for various purposes (W2, W3, W4, W5, W13, and W15), their little knowledge about the forest (W1), forestry (W7 and W8), bird-watching (W11), and wildlife (W12).

There are certain apparent disparities between strengths and weaknesses. For instance, while we have this statement that "the villagers are familiar with the Mangrove forest since their childhood" (S3) as a strength, there is another similar statement among weaknesses that mentions: "Some of the local people did not know about the Mangrove Forest" (W1). The same is with this statement "the villagers are interested to share their knowledge with others" (S10) among strengths, and the statement "the local people did not share their knowledge with others" (W6) as a weakness, and also S11 and W10 (regarding sharing knowledge about birds). In fact, they are not contradictory; they complete each other. For instance, while the villagers are familiar with the forest, some of them do not know about it. It helped that the statements of strengths lose their absolute tone and a more realistic picture of the situation arise.

Tourists (O1, O2, O9), Forestry Department (O3, O5), management plan (O6), government (O4), researchers (O7), universities (O8) and international agencies (O10) are among the opportunities for the Matang forest management, while the respondents have referred to five threats: tourists may not share their information with local people (T1), three natural threats of earthquake, climate change, and tsunami (T2, T3, and T5), and the oil pollutions from ships (T5).

It is important to remind that the average score in the IFE and EFE matrices is 2.5 (within a range from a low score of 1.0 to a

high score of 4.0). In an IFE matrix, a total weighted score below 2.5 refers to weak internal factors and a score above 2.5 indicates that strong internal factors are involved. In the present case, based on the results from the IFEM and EFEM review, weaknesses override strengths (since IFE is less than 2.5) and threats supersede opportunities since EFE is less than 2.5 (Chang and Huang 2006; Delavar 2007). It means that there are not enough internal strengths and opportunities to protect the Mangrove forest since the threats such as climate change, oil pollution, and risk of the tsunami were more powerful. However, the list of strengths and opportunities showed that there were potentials to act on.

As it was explained in the methodology, the researchers used the scores from IFE and EFE in an IE matrix (Fig. 4). The point in this matrix referred to the third region, which belongs to the strategies of "harvest or divest". It indicated that a change in policies has to be decided. The result from this matrix was used by the researchers in pair matching of the strategies, trying to focus on the strategies of change – more or less moving from the existing top-down planning to bottom-up planning. Most of the positive factors (in particular strengths and some of the opportunities) referred to the involvement of local people.

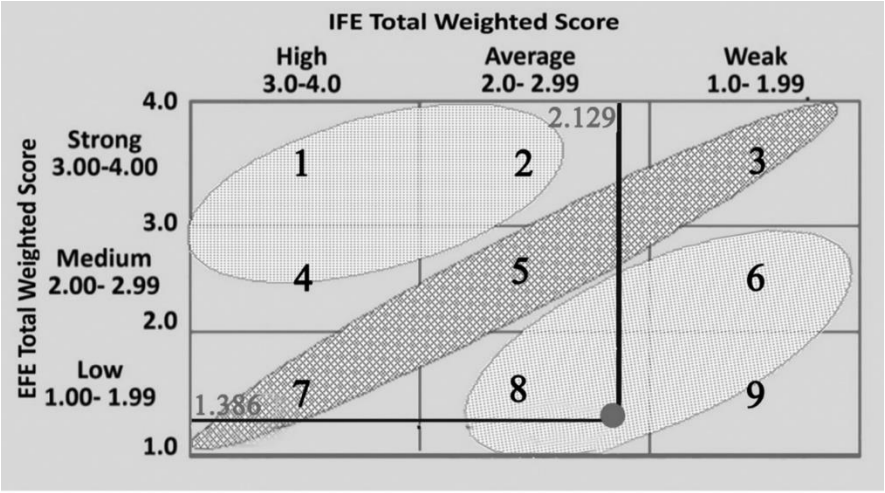

Figure 4. IE matrix-The Matang Mangrove Forest Reserve

Strategies: These strategies can be categorized into three groups: (a) strategies focused on protective measures such as those related to the use of wood (St3, St5, St9, St10, St14), fishing (St13, St16), migratory birds (St4), erosion (St7), and tsunami (St8, St15); (b) the second group consisting of two strategies on sustainable ways of using mangrove forest that promotes alternative livelihoods (St11) and ecotourism (St2); (c) there are two strategies regarding the awareness-raising that refer to the strategy for information sharing (St1), increase of knowledge among locals (St6) and education (St12). The strategies can also be divided based on the involvement of various stakeholders (local people, local groups, the Forestry Department, the government, Malaysian universities, non-governmental organizations, and the International agencies). As the whole SWOT process started with local people, they are involved in most of the strategies. There are two strategies that propose the establishment of a community group for the conservation of mangrove forest (St5 and St8).

The results at this stage proved an approach based on stakeholders' involvement, which has to be applied in any future planning for the Matang. In this approach, various stakeholders can be involved while the local people living around the Matang Reserve play a major role; the government, especially the local government as well as the local Forestry Department can work hand in hand with local people. A series of mobilization activities are needed with an aim to establish one local group from among interested people. This is while Malaysian universities and non-governmental organizations can be involved and fill the gap of academic research for the conservation of mangrove as well as involvement in alternative livelihood and training of people for eco-tourism in the Matang. International agencies such as the United Nations (GEF/SGP) can be involved as supportive bodies in such a community-based endeavor. A review of the whole sixteen strategies showed that all in all, they are helpful for generating community-based planning for the management of the Matang Mangrove Forest. In the Matang Working Plan, there is no reference to community-based conservation while there are defined zoning based on the plan with a productive forest (for timber and charcoal production) and a non-productive forest for the purpose of biodiversity conservation, and of course, the local community's needs have been considered (Azahar and Nik 2003).

Prioritized strategies: The first priority strategy is knowledge sharing about Mangrove among stakeholders. An approach of stakeholders' involvement could be applied since any change in the management plan of the forest requires all involved groups to come together and find out how they can contribute. Seemingly, such knowledge sharing can be helpful since the locals are much interested to know more (S14) and share knowledge (S10, S11, and S15) while there have been specific research activities by universities on various fauna and flora species, and the local Forestry Department has been involved in the forest management since a long time ago.

The next priority strategy referred to the participation of the local people in projects carried out by the international agencies and researchers to conserve the migratory birds as one of the most important wildlife in the Matang mangrove forest. As the Matang is a wintering site for migratory birds, the third strategy encouraged local people to be trained as tour guides, especially for bird watchers. There are certain tour guides in the area, however, it could be institutionalized as a livelihood while there is a relationship between this strategy and the fifth one regarding the formation of local groups. These local groups could be both protection groups for mangrove and the wildlife while they can be involved in eco-tourism. The fourth strategy was to decrease the amount of harvesting by local people to control the tsunami effects. This may need a series of local mobilization activities so that the people themselves decide to change their behavior and decrease logging.

In the present research, to formulate the strategies for the participatory management of the Matang Mangrove forest in Malaysia, the SWOT method was used and QSPM was applied for prioritizing the achieved strategies.

According to the results, the priority strategies highlight the role of people's participation in the conservation of Mangrove forests. This is clear in the results gained from the questionnaires, however, there is no place for local communities in decision-making processes for Matang forest while the Malaysian National Policy on the Environment encourages "effective participation". The priority strategies show that local people's role is necessary and serious in conservation. An approach of stakeholders' involvement, as Siry (2006) emphasized, can be applied in any future planning for Matang forest. Local people living around the Reserve, the local government, the local Forestry Department, forestry departments in Malaysian universities, and environmental non-governmental organizations can be among the major stakeholders.

As both IFE and EFE have been less than 2.5 (weaknesses override strengths and threats supersede opportunities) and based on IE Matrix, there is a need for a policy change in the management of Mangrove forests. Since most of the positive factors (in particular strengths and some of the opportunities) referred to the involvement of local people, and based on the priority strategies, the future planning could be a bottom-up activity where local people and other stakeholders would play a major role.

A participatory approach for conservation has to be considered in the management policies. As Jusoff and Taha (2008) showed, awareness of people is the major factor and as it is clear from the priority strategy (St.1. regarding knowledge sharing among local people, researchers and tourists), people who know more, will participate deeply in the process of knowledge sharing. Therefore, training of local people and their empowerment and mobilization can lead to a more highlighted role not only in knowledge sharing but also in forest management and decision-making especially on the issues of conservation of the forest, eco-tourism, use of wood, fishing, protection of migratory birds and bird watching activities, erosion, and Tsunami.

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