Local Community’s Perception of Mangrove Change Impact on Their Socioeconomic Condition in Johor, Malaysia

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Abstract. Mangrove forests across the globe have experienced remarkable rapid reduction over the recent few couple of decades due to land use changes and socioeconomic factors. These phenomena also have an impact on the socioeconomic condition of the local communities. This study was carried out to determine the impacts of mangrove changes on local community’s socioeconomic condition at the surroundings of Sungai Pulai Mangrove area in southwest Johor, Malaysia. A total of 360 respondents were interviewed by using a questionnaire. The perceived impacts were both negative and positive. As negative impacts, the respondents perceived ‘species and habitat loss’ followed by ‘coastal erosion’, ‘reduction of mangrove production and income’, biodiversity threatened’, ‘increase of migrants’ and ‘increased risk of livelihood’. However, as positive impacts, they perceived ‘new infrastructure developed for useful purpose replacing mangroves’ followed by ‘improved communication system’ and ‘increased the overall quality of living standards. The study concluded that the mangrove change in the study area negatively affecting to their mangrove dependency for livelihood activities whereas positively improving their living quality.

Keywords: community perception, mangrove change, negative impact, positive impact, socioeconomic condition

Introduction
Mangroves, the coastal ecosystem has been recognized and accepted as the most productive and diversified ecosystem among the other terrestrial ecosystem. Besides various production functions i.e. food, feed, wood, fuel, non-timber forest products etc. mangroves
maintain the ecological balance by sequestering carbon [1-2], conserving biodiversity (serving as shelter for various ecological and economic important species), and protecting the shoreline from erosion, strong waves, floods by acting as a natural physical barrier or bio-shield to the coastline [3-12].

Due to various functions, people are concentrating on the coastal area and around half (44%) of the world’s total populations live just within 150 km of the coastline [13]. The increasing human population in the coastal area is a threat to the mangroves [13-18].

Johor state has a huge coastline due to its exposure to both South China Sea and Strait of Malacca. Mangroves abundance in the west coast of Johor is more dominant than the east coast as the waves are stronger at the east coast than the west coast. According to the DOSM report, during current few decades, the population density and average income of state Johor are always higher than average population density or average monthly income in whole Malaysia [19].

The southern coast of Johor is considered as one of the fastest growing national special economic regions in Malaysia and going through a rapid urbanization process. Mangroves are being cleared for many new developments for industries, city development or waterfront projects. [20] monitored mangrove cover change in the Iskandar Malaysia region in south Johor during 1989 to 2014 by processing of satellite imageries and reported that the area has lost about 33% of mangrove coverage with annual deforestation rate 1.32% which is quite alarming. Ref. [21] also found the similar results in Johor between 1990 and 2010. The author mentioned that about 6120.70 ha of mangroves have been lost during this period. At the southwestern Johor from Tanjung Piai to Kukup about 128.88 ha or 14% of mangrove area has decreased from 1995 to 2005 due to shoreline change and erosion [22].

Local communities concentrated to the mangroves are depended either directly or indirectly to the ecosystem for their livelihood activities. The change of the mangrove ecosystem affects (both direct and indirect) the services that are provided by the mangroves to the locals. The change also affects their source of livelihood or socioeconomic development. Researchers reported that local communities are to be more affected by any event such as deforestation or climate change in any area due to their strong connections to that ecosystem [23-24]. Mangrove loss can deteriorate the invaluable diversified ecosystem that was supported by the mangroves. Loss of different species is obvious that depended on the ecosystem as an obligatory basis.

Ref. [25] mentioned that mangroves being very sensitive and highly vulnerable in the coastal zone and thus conversion of mangroves to other land use such as developments, agriculture and aquaculture could cause a serious threat to the ecosystem. Ref. [23] reported that forest communities are negatively impacted by the deforestation due their strong connections with the ecosystem. Local community is reported having a holistic perception of the mangrove ecosystem [26]. Local community’s perception study is an important strategy to establish successful risk management programs [27]. Therefore, this study was conducted to determine the impacts of mangrove changes on the socioeconomic status of the local community by their perception study in southwest Johor.
Materials and Methods

Study area

The study area located at the southwest Johor with geographical coverage of 1°15'48” to 1°33'54” N and 103°26'42” to 103°43'20” E. Total area was 527.89291 sq km. According to Ref. [28] suggestion, community dependence on any wetlands increases with physical proximity [12]. Therefore, all the six mukims surrounded the Sungai Pulai and associated mangroves were chosen for data collection. 19 villages within five kilometers (<5 km) periphery of mangroves and at least two from each represented mukims were selected considering the suitability of data collection, accessibility, availability of fund and time consideration. A total of 360 respondents data were used in the study.

Research design and instrument

Quantitative research design selected with cross-sectional survey approach using a structured questionnaire. The questionnaire was prepared based on field visit, key informants information, secondary data and partly adapted and modified from [24]. The questionnaire was prepared to have two sections. Those were section A (respondent’s socio-demographic information such as age, gender, race, religion, family size, education level, monthly average income) and section B (negative and positive perception on impacts of mangrove change).

The questions for section B were measured using five-point Likert scale responses ranging from Strongly disagree to Strongly agree with scored 1 to 5 [24]. The five-point Likert scale is a commonly used scale. The advantage of using Likert scale (ordered scale) is it informs the degree of agreements rather than simply yes or no answer. It is a balanced scale having two positive and two negative statements.

Data collection

Data were collected through the household survey, field observations and discussion with key informants. Primary data were collected through several field visits during February/2015, November/2015, April/2016 and November/2016. Secondary data were collected from printed reports and from local authorities as well as mukim heads (Pengulu), village heads (Ketua Kg.) and head of fishermen community as key informants. Data were analyzed using the Statistical
Package for Social Science (IBM-SPSS 20) software. Descriptive statistics was used to analyze the data.

Results and Discussion

Socioeconomic information

Respondents’ socioeconomic information is shown in Table 1. Among the surveyed 360 respondents 76.7% were male while the rest 23.3% were female. Respondents’ mean age was 44.78 years. Three-fourth (75.3%) of the respondents was between 31 to 60 years. Only 15.3% respondents were below 30 years and 9.4% were above 60 years old. Age distribution showed that majority of the respondents were middle aged which indicated that majority of them are in working age.

Table 1 Demographic profile of the respondents

| Variables                    | Attribute/Value       | Number (n) | Percent (%) | Mean & SD   |
|------------------------------|-----------------------|------------|-------------|-------------|
| Gender                       | Male                  | 276        | 76.7        |             |
|                              | Female                | 84         | 23.3        |             |
| Age                          | 18-30 yrs             | 55         | 15.3        |             |
|                              | 31-40 yrs             | 77         | 21.4        |             |
|                              | 41-50 yrs             | 111        | 30.8        |             |
|                              | 51-60 yrs             | 83         | 23.1        |             |
|                              | > 60 yrs              | 34         | 9.4         |             |
| Race                         | Malay                 | 330        | 91.7        |             |
|                              | Chinese               | 4          | 1.1         |             |
|                              | Orang asli            | 26         | 7.2         |             |
| Religion                     | Islam                 | 353        | 98.1        |             |
|                              | Christian             | 2          | 0.6         |             |
|                              | Buddha                | 5          | 1.4         |             |
| Educational level            | No formal education   | 33         | 9.2         |             |
|                              | Primary school        | 122        | 33.9        |             |
|                              | Secondary school      | 167        | 46.4        |             |
|                              | College/university    | 38         | 10.6        |             |
| Family size                  | 1-3                   | 52         | 14.4        | 5.46 & SD 2 |
|                              | 4-6                   | 212        | 58.9        |             |
|                              | 7 and above           | 96         | 26.7        |             |
| Number of children in college/university | No | 279 | 77.5  |             |
|                              | 1-3                   | 74         | 20.6        |             |
|                              | 4-6                   | 7          | 1.9         |             |
| Duration of living in this village | <10 yrs  | 61         | 16.9        | 35.06 yrs SD 19.16 |
|                              | 10-25 yrs             | 57         | 15.8        |             |
|                              | 26-40 yrs             | 83         | 23.1        |             |
|                              | 41-55 yrs             | 112        | 31.1        |             |
|                              | >55 yrs               | 47         | 13.1        |             |
| Income                       | No income             | 36         | 10          |             |
|                              | Below RM1000          | 76         | 21.1        | RM1695.25 & SD1339.57 |
|                              | RM1001-RM3000         | 215        | 59.7        |             |
|                              | RM3001-RM5000         | 26         | 7.2         |             |
|                              | RM5001-RM7000         | 6          | 1.7         |             |
|                              | RM7001 and above      | 1          | 0.3         |             |

Source: Field survey (2016)
More than 91% of the respondents were Malay and only 1.1% Chinese and 7.2% Orang Asli. This finding concurs with Ref. [29] who did a survey in Kg. Pendas Laut and Kg. TebingRuntuh in mukim Tanjung Kupang. Almost all (353) respondents (98.1%) were Muslim. Among the rest seven respondents, 2 (0.6%) were Christian and 5 (1.4%) were Buddhist. The Christian respondents were from Orang Asli minorities.

About 90.8% of the respondents had some level of education, while 9.2% had no formal education at all. Only 10.6% respondents had college or university level degree. Average family size at the study area was 5.46 and ranged from 1 to 14 persons with a SD of 2. More than three-fourth (77.5%) of the respondent’s children didn’t go to university level and only 22.5% respondent’s children were reported to go to university level degree.

Years of living in the village were related to the age of the respondents as most of the respondents reported living in their villages since birth. The average duration of living in the villages was 35.06 years. Only 16.9% respondents reported to live in their village <10 years and 15.8% respondents were living 10-25 years in their villages. The two categories of living <10 years and 10-25 years were mainly from the shifting villages. For example, Kg. Pendas that has shifted from the sea to the landwards side due to PTP project and renamed as Kg. Pendas Baru from Kg. Pendas Laut. Similarly, Kg. Pok Kecil, Kg. Pok Besar, and Kg. Desa Paya Mengkuang villages have been shifted to another place due to Forest City Project that was previously known as Kg. Pok.

Respondents’ average monthly household income was RM1695.25 with standard deviation 1339.57. This finding indicated a huge variation of the monthly income among them. More than half (59.7%) of the respondents was between income category RM 1001 to RM3000, followed by 21.1% below RM1000, 7.2% between income category RM3001 to RM5000. Only 2% respondents’ income were above RM5000.

About one-fifth of the respondents monthly income below RM1000 indicated that group of people in the study area were under poverty level according to the Economic Planning Unit Malaysia (EPUM). According to the DOSM, mean monthly income for rural population was RM3831 in 2014 and the median income for state Johor was RM5197. In the study area, majority respondents’ (above 80%) income was below RM3000 which indicated that those people were below mean national rural income or below state median income [30].

Perceptions of local community on negative impacts of mangrove change

Table 2 represents frequency, percent, total score and mean score of respondents perception on negative impacts of mangrove change.

The community perceived ‘species and habitats reduced’ as first and foremost (with mean score 3.74) impacts among the ten impacts statements list. The highest mean perception score of the statement indicates local community’s concern about the ecosystem. Many species already lost their habitats and become homeless due to mangrove loss in the study area. For example, the monkeys have lost their natural habitats and source of foods and migrated to human locality. Respondents from most of the villages complained that monkeys destroyed their young coconuts and other crops and thus the production reduced. Villagers also reported that sometimes their foods were stolen from households and household items were destroyed by monkeys. They had to cover their things or houses with nets to protect from monkeys’ attack.

‘Coastal erosion increased’ had a second highest mean score (3.70) from the communities’ perception. Though coastal erosion may occur slowly by natural forces but the pace and degree is enhanced by anthropogenic activities. Mangrove roots act as a natural barrier to the strong waves by reducing the wave energy and power thus reduce the erosive capacity of
Table 2 Perception of local community on negative impacts of mangrove change

| Statement                                         | Frequency and percent of respondents based on their responses | Total score | Mean score |
|---------------------------------------------------|-------------------------------------------------------------|-------------|------------|
|                                                   | Strongly disagree  | Disagree  | Neutral  | Agree  | Strongly agree |                      |                      |
| Strongly disagree                               | -  | 52(*14.4)  | 78(21.7)  | 190(52.8)  | 40(11.1) | 1298 | 3.61 |
| Disagree                                         | -  | 38(10.6)  | 75(20.8)  | 190(52.8)  | 57(15.8) | 1346 | 3.74 |
| Neutral                                          | 3(0.8)  | 76(21.1)  | 90(25.0)  | 170(47.2)  | 21(5.8) | 1210 | 3.36 |
| Agree                                            | -  | 45(12.5)  | 70(19.4)  | 203(56.4)  | 42(11.7) | 1322 | 3.67 |
| Strongly agree                                   | -  | 45(12.5)  | 67(18.6)  | 204(56.7)  | 44(12.2) | 1327 | 3.69 |
| Total score                                      | 7(1.9)  | 100(27.8) | 84(23.3)  | 157(43.6)  | 12(3.3) | 1147 | 3.19 |
| Coastal erosion increased (wave damage increasing and shoreline changing) | -  | 39(10.8)  | 72(20.0)  | 208(57.8)  | 41(11.4) | 1331 | 3.70 |
| Solid waste trapping to mangrove roots           | 2(0.6)  | 67(18.6)  | 106(29.4) | 160(44.4)  | 25(6.9) | 1219 | 3.39 |
| Risk of local livelihood (mangrove dependent) increasing | -  | 44(12.2)  | 91(25.3)  | 194(53.9)  | 31(8.6) | 1292 | 3.59 |
| Increase migration of people                     | -  | 48(13.3)  | 83(23.1)  | 193(53.6)  | 36(10.0) | 1297 | 3.60 |

* Figures in parenthesis indicate percent

the wave action. Mangroves also reduce the power of strong winds and reduce the destructive effects. Additionally, mangroves help to build land by accretion [31]. Ref. [32] reported that after the development of the PTP, the erosion was occurring in the surrounding mangrove areas in Kg. TanjungPiai. The coastline in the study area being faced erosion due to human activities from different sectors [33]. For example, firstly, mangroves in some areas had been cut for different development purposes like PTP, Tanjung Bin power plant and town development which caused direct impacts on the erosion due to mangrove loss. Secondly, the erosion had been enhanced by the wave action from the ships landing at the PTP that located at the eastern mouth of Sungai Pulai (Pulai river) in mukim Tanjung Kupang. When those large ships moved to the sea through the western side near the tip of TanjungPiai (the southernmost tip of mainland Asia is located in Kg. TanjungPiai in mukimSerkat) then the speed become higher resulted in stronger waves which affected the coastline and enhanced erosion. Thirdly, the fuel discharged from the ships had polluted the water by the oil spills and by the spreading of those waves the remaining mangroves and other aquatic species in that area were affected. The situation had been exacerbated when the tidal waves made wide spreading of those oil spills to the mangroves ecosystem. Mangrove roots were badly affected by those pollutants as they made an impermeable layer of oils above the mangroves roots (pneumatophores) resulted in a lack of respiration and finally, the tree died due to limited oxygen for respiration. MukimSerkat in Pontian was severely affected by the coastal erosion.

Mangroves act as a natural bio-filter and sink of waste-water borne pollutant. Different pollutants from domestic sources or factories deposited to rivers and later carried through river
water to the coast and affected the mangroves. Construction works near the coasts also enhanced soil erosion, polluted the water from the construction materials left which are non-erodible and made the coastal water turbid. These affected the mangroves and reduced the production of the ecosystem by reducing the photosynthesis of the underwater flora [34].

As the area of mangroves reduced, the production from the ecosystem also reduced. The respondents perceived ‘mangrove production reduced’ as the third (mean score 3.69) and ‘income from mangroves reduced’ (3.67) as forth important impacts of mangrove loss in the study area. The communities who solely depended to the ecosystem for their livelihood such as fishermen reported that the production of the ecosystem has been reduced due to loss of mangroves. Mangroves are the important breeding ground of fishes including marine species, mangroves swamp is the habitat of many smaller fish, shellfish, crabs, or other species. The loss of mangroves also affected the life cycles of those species and thus caused reduction of production. The fishermen reported that before they could fish sufficient amount within the mangroves however in recent days, the production from the mangroves has reduced which increased the competition among the fishermen community. Some of the fishermen from Pontian side (Serkat) informed that sometimes unregistered fishermen from JB side (Tanjung Kupang) did fishing in their side which increased the competition among them. Some of the fishermen used to go to deep see beyond the mangroves ecosystem for fishing or looked for the alternative or secondary source of income to sustain their family. According to Ministry of Science, Technology and The Environment (MOSTE, [35]) of Malaysia about 20% losses of mangroves resulted in the loss of about 70,000 tonnes of prawn production which valued RM300 million (RM4500/tonne). Production and income are closely related. As the production reduced from the mangroves the income also reduced. The respondents (fishermen) reported that although the price of the products has been increased in recent days but their overall income reduced from the ecosystem due to limited production. Government also subsiding fuel costs (USD66) monthly basis to the fishermen to go to deep sea for offshore fishing [36].

The local community perceived ‘biodiversity is threatened’ as the fifth negative impacts of mangrove loss in the study area. These findings also supported by [37] who reported that mangrove loss leads to degradation resulting in loss of natural habitat of many important species. According to Ref. [38], in coastal areas, urban development is a major threat to the health, productivity, and biodiversity of marine ecosystem all around the world. Sungai Pulai wetlands combining with its associated seagrass beds, mudflats, and inland freshwater riverine forest represents one of the best examples of lowland tropical river basin that support a rich biodiversity which is dependent on mangroves [39]. Mangroves and seagrasses are closely connected to each other on complementary basis. Mangroves work as a water filter and maintain the health and water quality of near-shore ecosystems such as seagrass beds [40]. Seagrasses can trap sediment derivatives from mangroves and transient habitats for mangrove fishes [41]. In the Sungai Pulai estuary seagrass (*Enhalusacoroides* and *Halophila ovalis* are predominant) bed serves as nursery and habitat for many species [42] by providing suitable conditions for growth and abundance along with the adjacent mangroves which indirectly serving the local community’s livelihood [43]. According to Ref. [44], approximately 70-76 species of fish under 41 families have been observed in the TanjungAdang-Merambong seagrass beds and theadjacent mangrove areas among which 35 species having commercial importance [45]. The vulnerable seahorses species (*Hippocampus kuda*) are very demanded in the local market as well as Chinese traditional medicine [43]. The TanjungAdang-Merambong seagrass beds are reported as the feeding ground of vulnerable dugong (*Dugong dugon*), endangered green turtles (*Cheloniamydas*) and many birds [43]. Different development activities near the estuary affected the abundance of seagrass.
Sedimentation and turbidity from those activities causing a threat to the seagrass bed to survive resulted loss of natural habitat and food source of those mentioned species.

Last couple of decade west coast of Johor experiencing huge infrastructural development many of which being done by replacing mangroves [20]. Those development projects seeking a lot of workforce both skilled and unskilled. A number of migrants has increased both in-migration and migration from foreign countries. In Malaysia, mostly the construction workforce employed foreign workers. A huge number of imported foreign workers has employed in the study area for different development projects. Those people have different cultures from the locals and sometimes local community might be upset if their culture not respected by them [29]. Moreover, they need shelters and other daily services for their livelihoods which may affect the local socio-economic condition of the area. This massive migration may cause high pressure to the existing social services, may increase social conflicts and also may increase pollution [46] mentioned in Ref. [47].

Mangrove loss increased the risk of livelihood of some local traditional community (such as fishermen) who solely depended on the ecosystem since long before. As the production reduced their income also reduced and they need to change their traditional job or had to engage in the additional job to sustain their lives. Some of them are illiterate (9.2%) so it might be difficult for them to get a new job except engaging as a labour or worker. In Esmeraldas Province in Ecuador, mangrove loss caused a decrease of fish stocks in the ecosystem and replaced ex-fishermen to cockle gatherers [26]. A study by Ref. [48] about urbanization adjacent to a Ramsar site shows that around 53% of fishermen community in the Consolacion in Metro Cebu had to change their traditional job or to engage in alternative employments like factory workers. Fishing was ranked as a second primary source of income.

These findings indicated that mangrove change (more clearly the reduction of area coverage by mangroves) has caused reduction suitable habitats of many species which might affect the biodiversity. Due to the reduction of mangrove resources, the production from this ecosystem reduced and caused the reduction of income of the community who depended on this ecosystem for their livelihood. They would have to seek an alternate income source to sustain their family.

Perception of local community on positive impacts of mangrove change

The mean perception scores of all the statements were above 3 (Table 3). The first three statements considered as impacts due to the mean score of above 3.5. Among the positive impacts that community perceived is ‘new infrastructures developed for useful purposes’ (mean score 3.84) as the number one impact as a result of ongoing developments and forest change in the study area. The respondents informed that their villages were being improved. Almost all the villages were facilitated with electricity, water supply, paved road, primary school, market, religious buildings and meeting hall. Some of the villages had children parks, secondary school, clinic and agama school. Some of the village heads informed that they had free wi-fi facilities for the villagers within 100 metres radius of the meeting hall. The villagers informed that their villages were being managed properly by the village heads and supporting committees. There were some other committees like JKKK, youth association (Persatuan Belia), fishermen’s association (Persatuan Nelayan), UMNO village branch which together helped the village head for managing the village properly. The villagers were quite happy with the management system.
Table 3 Perception of local community on positive impacts of mangrove change

| Statement                                                                 | Frequency and percent of respondents based on their responses | Total score | Mean score |
|---------------------------------------------------------------------------|---------------------------------------------------------------|-------------|------------|
| Source of Income increasing                                               | Strongly disagree (9, 2.5) Disagree (84, 23.3) Neutral (88, 24.4) Agree (168, 46.7) Strongly agree (11, 3.1) | 1168        | 3.24       |
| Income increasing (from other sources by creating new job opportunities) | Strongly disagree (9, 2.5) Disagree (76, 21.1) Neutral (78, 21.7) Agree (184, 51.1) Strongly agree (13, 3.6) | 1196        | 3.32       |
| Overall quality of living standard increasing                             | Strongly disagree (3, 0.8) Disagree (47, 13.1) Neutral (97, 26.9) Agree (182, 50.6) Strongly agree (31, 8.6) | 1271        | 3.53       |
| Communication system improved                                            | Strongly disagree (7, 1.9) Disagree (33, 9.2) Neutral (58, 16.1) Agree (199, 55.3) Strongly agree (63, 17.5) | 1358        | 3.77       |
| New infrastructure developed for useful purpose replacing mangroves       | Strongly disagree (6, 1.7) Disagree (28, 7.8) Neutral (55, 15.3) Agree (200, 55.6) Strongly agree (71, 19.7) | 1382        | 3.84       |

* Figures in parenthesis indicate percent

The community ranked ‘communication system improved’ (3.77) as the 2nd positive impact. There were paved roads in all the villages and villagers could easily travel from home to workplace through the paved road. The Singapore-Malaysia link way and national highway went through the mukim of Tanjung Kupang in the study area. Students from Johor who admitted to Universities in Singapore and service holders from Johor easily could travel from their house to university or workplace every day. Some of the villagers enjoyed free Wi-Fi from the government or used the internet on payment basis which was also an indication of the better communication system.

Overall quality of living standard had improved (3.53) was ranked as the 3rd impact from the community’s perception. In 2009, a vulnerability analysis was conducted by Ref. [29] of the proposed IM development in two fishermen villages (Kg. Pendas Laut and Kg. TebingRuntuh) in Gelang Patah, Johor where about 89% of the respondents were reported as coastal fishermen and among the respondents about 66% perceived that the IM project would benefit them by creating new job and business opportunities, new construction of infrastructures including roads, drainage, sewerage, amenities and other utilities.

Ref. [48] and Ref. [49] mentioned some advantages of developments of Shenzhen Special Economic Zone (SEZ) located at southern coastal China that connected to Hong Kong. Like Shenzhen, the state of Johor enjoyed huge opportunities for large foreign investments (such as IM, Forest city projects) due to its geographical location, being a port city and connected to the Singapore.

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