# CHAPTER 5

# DISCUSSION

## 5.1 Total Economic Value (TEV)

The TEV of Kuala Selangor mangroves was estimated to be approximately USD61,357/ha/yr. As compared to other TEV studies carried out in Indonesia, Thailand and Mexico (Table 5.1), it is the highest.

The studies in Indonesia, Thailand and Mexico estimated the TEV of mangrove forest in their respective sites to be in range of about USD2,700 to USD4,000. However, it should be noted that the studies by Meilani (1996) in Indonesia; Sathirathai (1998) in Thailand and Cabrera *et al.* (1998) in Mexico only valued a total of 4 or 5 components, while this study estimated 7 components of the TEV.

The type of TEV components valued by each researcher also differs. This study took into consideration the marine and riverine fisheries, aquaculture (excluding brackishwater pond aquaculture), mangrove resources and recreational components to form the direct use value. Meilani (1996) did not consider the riverine, aquaculture and recreational components while Sathirathai (1998) did not estimate the riverine and recreational components. Cabrera *et al.* (1998) only considered the marine fisheries and forestry to form the direct use value of the TEV.

carbon sequestration in the indirect use value, while Cabrera *et al.* (1998) only considered water filtration service as the indirect use value.

Preservation values consisting of option, existence and bequest values were also estimated in this study while Meilani (1996) only considered option and existence values. Sathirathai (1998) did not include any of these values into his estimation, concentrating only on the use values. Cabrera *et al.* (1998) only valued the biodiversity to represent the preservation value.

As the TEV is made from the aggregation of the use and non-use values, it is obvious that the TEV of an ecosystem will be higher if more components of the use and non-use values are considered. This can explain why the TEV of this study is the highest among previous studies such as Meilani (1996), Sathirathai (1998) and Cabrera *et al.* (1998) which only considered a total of 4, 5 and 4 components respectively.

One important factor that could also explain why the TEV varied between each study is that the mangroves at each study site may differ physically, chemically and biologically which in turn may result in different levels of biodiversity, productivity and economic activities. This is supported by the study of Ewel *et al.* (1998) where the three types of mangrove forests identified (fringe, riverine and basin) provide different degree of goods and services. Riverine mangroves are thought to be the most productive to animal and plant productivity. Basin mangroves are important in producing wood products while fringe mangroves are important for shoreline protection.

Apart from the difference in mangroves, the method of analysis adopted by each researcher in estimating TEV may also differ. Unlike science subject which have certain standard methods for analysis, economic analysis is more influenced by the underlying assumptions used. While estimating the local direct use of mangrove forest in Surat Thani, Thailand, Sathirathai (1998) based his estimation on a total of 38 respondents. Where data obtained were not satisfactory, he assumed a certain percentage of the locals to harvest different types of mangrove produce. In total, Sathirathai (1998) interviewed 62 villagers where 38 were used for estimation.

In contrast, Meilani (1996) interviewed 78 respondents to calculate the local direct use of mangrove forest in Mayangan Village, West Java, Indonesia. Data from all 78 respondents were used to establish the local direct use. It was not reported whether any of the 78 data were incomplete or rejected. In comparison, this study interviewed 199 respondents where 61 observations were used for calculation of the local direct use of mangrove forest. In this study, the estimation of local direct use was based on the data gathered from interviews with the local community. Only the complete data was used to estimate the local direct use.

Based on previous studies, it was observed that there is a considerable difference of mangroves usage pattern by the local community in different countries of the world. The studies in developing countries such as Malaysia (this study), Thailand (Sathirathai, 1998), Indonesia (Ruitenbeek, 1994; Aglionby, 1995 & Meilani, 1996), India (Ghosh & Santra, 1995) and Nigeria (Eaton & Sarch, 1997) acknowledged the local direct use of mangrove forest by including this component in their estimation.

However, studies in United States (Costanza *et al.*, 1989) and Mexico (Cabrera *et al.*, 1998) did not really estimate the local direct use of mangroves. Most of the local direct use value of mangroves was already absorbed in the fishing and forestry activities. Gathering of mangrove products such as nipa palms, honey and firewood, and hunting for wildlife such as birds for subsistence purpose were not recorded in the studies in United States (Costanza *et al.*, 1989) and Mexico (Cabrera *et al.*, 1998).

The methods used in estimating certain components of the TEV of mangroves may eventually influence the overall TEV. For example, in this study, the replacement cost of structural embankment was used to reflect the value of coast protection by mangroves. Other methods that can be used as a proxy to coastal protection is the value of property protected by these mangroves. If the property happened to be some high-class hotel, or an historical site, the value will be very high and eventually increase the TEV.

Due to various factors influencing the estimation of TEV in all the studies (i.e. the components valued, the different productivity and functions of mangroves, the method of analysis and assumptions used), it is very difficult to make direct comparisons on the value of mangrove forests from different parts of the world based solely on the TEV. One has to examine in more detail, the mangrove forest, socio-economic pattern of the local population and the methodology of analysis before a convincing comparison can be made.

## 5.2 Analysis on Components of Total Economic Value

The high TEV value of this study could be explained by looking into the detailed components as shown in Table 5.2 where preservation value contributed the highest percentage (54.7 %) of the total TEV followed by coastal protection (22.6 %) and aquaculture (12.9 %).

**Table 5.2: Detailed Components of Total Economic Value (TEV) Analysis**

| TEV Components | Productivity (kg/ha/yr) | Value USD/ha/yr (RM/ha/yr) | Percentage (%) |
|---|---|---|---|
| **Use values** | | | |
| Fisheries resources | 3,750 | 4,991 (12,477.50) | 8.13 |
| Aquaculture production | 12,965 | 7,918 (19,794.38) | 12.90 |
| Mangrove resources | 61.8 | 102 (254.81) | 0.16 |
| Riverine resources | 8.8 | 35 (87.07) | 0.06 |
| Recreational benefits | | 915 (2,286.80) | 1.49 |
| Coastal protection (structural) | | 13,842(34,605) | 22.6 |
| **Sub-total** | | **27,803 (69,507)** | **45.3** |
| **Non-use values** | | | |
| Preservation value (option, existence, bequest values) | | 33,554 (83,884.85) | **54.7** |
| **Total Economic Value** | | **61,357 (153,392)** | **100.00** |

## 5.3 Preservation Value

Barbier (1994) suggested a different approach to estimate the non-use value of TEV, that is, by valuing option, bequest and existence values separately. However, if these values are aggregated, then, `double counting' will occur. Since preserving a certain

area of mangroves will ensure that the option, bequest and existence values will be included simultaneously, this value was used instead of separating the three values. The preservation value was highlighted by Munasinghe & Lutz (1992) in Barton (1994). According to them, the values (option, quasi-option, existence and bequest values) originate from the same environmental asset and therefore their estimation may be inter-linked.

Aggregation will increase the preservation value and make the TEV seems more valuable, when in fact, this is not the real case. Therefore, in this study, all three non-use values were averaged to produce preservation value.

Preservation value in this study incorporates the option, existence and bequest values. All three values are non-use values where valuation comes from non-usage of the resource. As such, there is no ***physical*** product that is harvested, produced or marketed in non-use values. In deriving the non-use values, respondents expressed their WTP for the option of using the mangroves in the future (option value), just to know that the mangroves exist (existence value) and also to ensure that the mangroves are inherited by the future generations (bequest value).

The non-use value is not readily explained by conventional motives of maximizing the utilization of goods but is based on some form of altruism; meaning caring for other people or beings (Pearce & Turner, 1990). This altruistic drive is supported by different motives such as sympathy, human or animal rights and stewardship motives. Sympathy is common in societies where there are people who are willing to pay to preserve the habitats for sentient beings including humans that occupy the

habitat. In our modern day living, this can be likened to people who donate to orphanages because of compassion.

People with rights motive believe that non-human beings have the rights to exist and live. This has promoted the effort to protect and conserve natural resources including wildlife. In Malaysia, there are many non-governmental organizations that campaign for protection of wild animals such as Sahabat Alam Malaysia (SAM), World Wildlife Fund (WWF), Malaysian Nature Society (MNS) and Wetlands International. These organizations receive monetary supports from its members and other sources.

The stewardship motive is based on the idea that the Earth is far greater than the people or beings that it supports. As such, it becomes the responsibility of the population to see that it survives. Earth has always been reflected as a planet with limited fuel or natural resources. The life of earth is dependent on how fast its fuel is being used up or in other words, how fast we used up our natural resources.

Bequest value stems from the idea of willing a supply of natural environments to one's heirs or future generations. To be able to leave the mangroves to future generations, we must be able to protect it. Based on current development scenarios, protection means some form of monetary support to manage it well and defer it from being exploited or even destroyed.

According to Barton (1994), values derived from non-uses such as option, existence and bequest values (preservation values), depend on the number of people, their

awareness of the resource, their level of information and their preferences for the resource and its characteristics.

Based on this study, there was a positive trend on education level and WTP for the preservation value (Figures 5.1). The percentage of respondents who were willing to pay increased with higher levels of education (secondary or tertiary level) for the option, existence and bequest values. As compared to groups with lower education level (not educated and primary education), the trend was not conclusive.

There was also a tendency for all groups of respondents to place a higher WTP to bequest value, followed by option and existence values. This shows that they regard the mangroves more as a valuable piece of natural resources to be inherited by the future generations than to keep it for their own use.

Two significant factors that could influenced the WTP are income and education level. Figure 5.2 shows the relation between income and willingness to pay for this study. People can afford to pay more when they have more money. However, whether they want to pay more or less depends on their preferences of a particular subject; in this case, mangrove forests. Willingness to pay may be influenced by their level of awareness. On the other hand, the level of awareness of each respondent, may be greatly influenced by his or her level of education.

The GDP per capita purchasing power parity for developing countries in Southeast Asian region such as Indonesia, Thailand and Malaysia are USD4,600, USD8,800 and USD10,750 respectively (based on 1996 estimates as cited from

http://www.odci.gov). The literacy level in all three countries varied from 83.8%, 93.8% and 83.5% for Indonesia, Thailand and Malaysia respectively (based on 1995 estimates as cited from http://www.odci.gov).

With regards to different GDP in various countries, there were some concerns that this will influence individual's WTP. Data on WTP for mangrove forest in Indonesia (Meilani, 1996) was used against the WTP for this study (WTP data for Thailand's mangrove forests was not available). Both countries are considered developing countries. Although Malaysia's GDP is 2.34 times higher than Indonesia's (USD10,750 compared to USD4,600), the total WTP for preservation value was found to be 18.8 times higher (USD33,554 compared to USD1,785). Based on this simple comparison, it could be concluded that other factors, apart from GDP may play an important role in determining the WTP for preservation value of mangrove forests in each country.

Compared to a developed country in Asia, such as Japan, the GDP per capita purchasing power parity of Japan is very much higher, at USD24,500 with 100% literacy level (1996 estimates as cited from http://www.odci.gov). A study of WTP for headwater conservation of the Tanagawa river basin, Japan by Yoshida (1997), found that the average WTP/household/yr was USD925/household/yr (RM2,312 or ¥7,708). As compared to this study, the average WTP per household for the present study was very low, at about USD8/household/yr. Based on this scenario, it is thought that the WTP could be influenced by the income and education levels of the respondents.

Further analysis was carried out to confirm whether income level and education level play a big role in influencing the WTP in this study. The WTP for preservation value were used for this purpose. Income and education levels were plotted against WTP for preservation value as shown in Figures 5.1 and 5.2 respectively to observe whether there is any trend or pattern between both parameters.

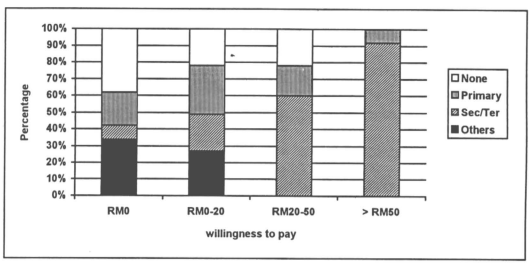


**Figure 5.1: Relation Between Education Level and Willingness To Pay for Preservation Value**

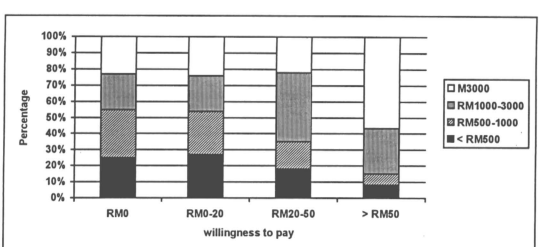


**Figure 5.2: Relation Between Income Level and Willingness To Pay for Preservation Value**

Based on Figure 5.1, it could be seen that there was an increase of WTP as the level of education ascended from `not educated' to `tertiary education'. The same positive trend could be seen in Figure 5.2 between level of income and WTP. However, it is not as obvious as compared to the relation between education level and WTP. Based on both Figures 5.1 and 5.2, it could be concluded that education level played a role in influencing the WTP of respondents in this study.

The CVM method used in this study did not consider the effect of multiple-destination visitors on the WTP due to limitation in technical knowledge. It is also not the objective of the study to conduct a very detailed analysis on this aspect. However, a study by Sorg *et al.* (1985) (cited in Beal, 1998) indicated that multiple destinations visitor placed higher value than single destination visitor.

## 5.4 Aquaculture

In this study, aquaculture resources contributed about 13% of the total TEV, amounting to about USD7,918/ha/yr (RM19,794.38/ha/yr). Based on the data acquired (see Section 4.2), cockles contributed to about 99.7% of the total aquaculture production and captured 98.5% in total value of aquaculture in Kuala Selangor. It must be noted that the Kuala Selangor-Sg. Buloh water areas is home to the second largest cockle bed in the country.

Cockle culture is an important sector in Kuala Selangor mainly due to the availability of natural spatfall beds in the coastal area of Kuala Selangor. Between 1995 to 1997, Kuala Selangor produced about 65-70% of the total cockle production

in Selangor worth USD2.6 - USD3.6 million/yr (RM6.5-9.0 million/yr) (DOF Selangor, 1996 & 1997; DOF Selangor, 1998 (in press)). In 1996, cockle production in Kuala Selangor supplied almost 10.0% of the total cockle production in Malaysia (DOF Malaysia, 1998 (in press)). It should be noted that Malaysia is one of the biggest exporter of cockles in the world.

Aquaculture activities in Kuala Selangor focus mainly on the culture of tiger shrimp (*Penaeus monodon*), sea bass (*Lates calcarifer*) and cockles (*Anadara granosa*). In this study, brackish-water pond aquaculture was not included in the TEV estimation as it is considered not compatible with mangrove forests. However, with growing interest in co-existing brackish-water pond aquaculture (mainly shrimp farming) and mangrove forests, in time to come, brackish-water pond aquaculture may be considered as a component of the total value of mangrove forests.

In view of the need to balance compatible aquaculture activities and mangrove forest, Sasekumar & Lim (1994) has recommended pond culture operations to be on an extensive scale (low stocking density). It should utilize abandoned reclaimed land or located on the landward side of mangrove forest rather than clearing existing mangrove forests.

### 5.5 Marine, Riverine and Mangrove Forest Resources

Although the marine fisheries resources contributed only 8.13 % of the total TEV of Kuala Selangor mangrove forest, it is important in terms of employment. There was a total of more than 1,000 licensed fisherman in Kuala Selangor although the number decreased from 1,086 in 1995 to 1,012 in 1996 (DOF Selangor, 1996 and

1997). It was observed that there were some part-time unlicensed fishermen in the areas and if added up to the number of licensed fishermen in Kuala Selangor, the total figure could be higher.

Other good examples to show the importance of mangrove forests in providing employment are the Matang Mangrove Forest Reserve (MMFR) in Perak and the Sarawak Mangrove Forest Reserve (SMFR) in Sarawak, Malaysia. The MMFR supported at least 1,944 fishermen (with license). The total number of fishermen in MMFR area is expected to be higher as there are fishermen operating without licence (Lim, 1996). In 1991, SMFR provided employment to about 3,000 people with an additional 1,500 working in downstream industries such as seafood processing (Bennet & Reynolds, 1993).

Riverine and mangrove forest resources do not really contribute much to the total TEV (less than 0.3%). The reason could be that fishing and harvesting activities in rivers and mangrove forests are more for subsistence rather than commercial exploitation.

However, based on the income gained from harvesting mangrove resources, which was estimated at USD7,243.10/household/yr (RM18,107.73/household/yr), the average monthly income from harvesting mangrove forest resources was calculated to be about USD603.6/month (RM1,509/month) for each household. This figure is considered high as compared to the average fisherman's income in the west coast of Peninsular Malaysia which was estimated at USD444/month (RM1,110/month) for commercial fisherman and USD257/month (RM642/month) for traditional

fisherman (LKIM (Fisheries Development Authority or Lembaga Kemajuan Ikan Malaysia), 1998).

## 5.6 Recreational Benefits

Recreational benefits estimated in this study was found to be USD915/ha/yr (RM2,287/ha/yr) for both KSNP and Kg. Kuantan. Recreational benefits for each of the site was calculated at USD285/ha/yr and USD630/ha/yr respectively. There were 2 studies on consumer surplus carried out earlier in KSNP (Zuraidah, 1996 and Mohd Esa, 1997). However, consumer surplus estimated by both studies was very far apart. Mohd Esa (1997) estimated an annual consumer surplus of USD612/ha/yr (RM1,530/ha/yr) while Zuraidah (1996) estimated a very low value, at only USD5/ha/yr. This study also estimated a low consumer surplus value of USD285/ha/yr.

The major reason for the differences in all three studies could be due to the slightly different methods used to analyze the data. Although all three studies used the TCM in principle, Mohd Esa (1997) used a model where the visitation rate was a function of the travel cost, income, age, education level, time spent in recreational area etc.

Zuraidah (1996) used a modified travel cost demand function where visitation rate was a function of travel cost and income. The modified travel cost demand function was compared with the Gum-Martin approach. The difference between the two is the former approach computed consumer surplus using predicted values of visit per

capita while the latter used the actual individual visits per capita. This study used only the travel cost as a function of visitation rate to the recreational area.

Kennedy (1998) and Beal (1998) discussed the effect of length of time spent by visitors in a national park and their travel cost. The TCM assumed that visitors from a further zone of origin incurred a higher travel cost to a recreational area compared to a visitor from a nearer zone. However, it was found that visitors staying for a longer period of time (a few days) may actually incur less travel cost than daily visitors.

The other reason could be due to the low number of respondents sampled in this study (59 respondents). Mohd Esa (1997) based his estimation on a total of 96 local tourists as respondents while Zuraidah (1996) based her estimation on 121 respondents (105 locals and 16 foreigners).

### 5.7 Coastal Protection

The cost of embankment construction estimated in this study, USD13,842/ha/yr (based on data provided by DID Kuala Selangor) made up a substantial 22.6 % of the TEV. However, it is considered quite low (USD130,667/km/yr or RM326,667/km/yr) as compared to a figure of USD470,000/km/yr - USD637,200/km/yr (RM1,175,000 - 1,593,000/km/yr) as estimated by Hiew & Lim (1994). The estimation by Hiew & Lim (1994), was based on the cost of construction and maintenance of SAUH and Rock revetment in the state of Selangor. SAUH is a Malay name for anchor. It is actually made of concrete slabs

designed to interlock with each other, creating a concrete cover on erosion prone area. It is usually used for coastal erosion. This study used the cost of construction and maintenance of rip-rap structure which is actually rocks placed in an interlocking manner. This structure is much simpler compared to SAUH revetment.

## 5.8 Major Socio-economic Indicator of Respondents from the Local Coastal Community in Kuala Selangor

In general, the socio-economic pattern of the local coastal community in Kuala Selangor reflects those of the commercial fishing communities in the west coast of Malaysia. Majority of the local community recorded higher income and received higher education as compared to the overall fishermen in the country.

In terms of age, majority of the respondents were in the 30 - 50 years. Majority of the commercial fishermen in the west coast of Malaysia were aged between 26 to 50 years. However, most of the traditional fishermen were found to be between 26 to more than 55 years old (LKIM, 1998).

The average household size of the respondents was 5.7 which was found to be slightly larger than the average household size of the fishing communities from the west coast of Peninsular Malaysia, which was reported to be 5.4 (LKIM, 1998).

The average income of USD519.3/month (RM1,298.35/month) estimated in this study was found to be higher than the average income for both the national's traditional and commercial fisherman. Both recorded an average of USD228.5 and USD394 (RM571.3 and RM985) per month respectively (LKIM, 1998). However,

according to Lim & Parid (1998), the monthly income of fishermen from MMFR in Perak is higher, at USD492 to USD1,093 (RM1,230 - 2,733).

It is noted that the average fisherman's income in the west coast of Peninsular Malaysia is the highest compared to the east coast of Peninsular Malaysia and Sarawak (LKIM, 1998). The average income of the traditional and commercial fisherman of the west coast of Peninsular Malaysia are USD257 and USD444 (RM642 and RM1,110) per month respectively (LKIM, 1998). The traditional and commercial fisherman from the east coast of Peninsular Malaysia earns an average monthly income of USD180 (RM451) and USD338 (RM846) respectively (LKIM, 1998).

In terms of education, the percentage of respondents who received up to primary and secondary education was higher than the overall education level of fishermen in Malaysia. It was found that 60% of the local community received primary education as compared to 33% of the total fishermen in Malaysia. Based on the survey for this study, a total of 30% of the local community received secondary education as compared to 15% of the total fishermen in Malaysia (LKIM, 1998).

### 5.9 Current Development in Kuala Selangor

At the time of this report, there is a proposal by the Selangor State Government to build a dam upstream of Sg. Selangor. Based on the Environmental Impact Assessment (EIA) report, the consultant team felt that there are no foreseeable

negative impacts to the mangroves and fireflies community downstream (SMHB, 1999).

These claims however, were not well supported in the report itself as it was noted that there were only minimal studies carried out on the possible effects and impacts of the dam to the downstream ecosystems. As such, due to uncertainty of the effects and impacts to the ecosystems downstream, and the discovery of such valuable mangrove ecosystem in Kuala Selangor (USD61,357/ha/yr), further studies should be carried out to ascertain the consultants' claim before the project proceeds.

This is because if there are impacts to the mangrove ecosystems in Kuala Selangor, then, the loss of USD61,357/ha/yr (RM153,392/ha/yr) mangroves in Kuala Selangor will be a loss not only to the people of Kuala Selangor, but to the country as well. It must be noted that the firefly community in Kuala Selangor may or may not survive the impacts and these impacts may be irreparable.

Consideration should be given to other related studies such as Loh (1998) which identified water extraction from the Selangor River as one of the significant threats to the ecosystems and habitats of Kuala Selangor besides mangroves cutting and pollution problems. According to Loh (1998), water extraction could further reduce the current water level in the river. This will result in saltwater intrusion further inland, affecting agriculture and also the firefly habitat. Further loss of *Sonneratia* trees and reduced nutrients reaching the mudflats are anticipated. The current water extraction at Rantau Panjang and Sg. Darah for Kuala Selangor and the Klang Valley respectively, is expected to remove up to one-fifth of the river water by 2001.

If the proposed dam was to be carried out, only 5% of the current river flow will remain (Loh, 1998).

Loh (1998) suggested that the river water should not be reduced below its maintenance flow (approximately 1700 million litre/day) and salt intrusion levels should be monitored.

An earlier study by Bann (1996) identified pressures on the firefly ecosystem when there were plans to develop the firefly viewing area in Kg. Kuantan into a relatively huge tourist complex by building a handicraft complex, some new food stalls, chalets and car parks. All these facilities were provided with bright colorful lights. Bann (1996) expressed her fear that all these facilities may invite more tourists and the bright lights may affect the firefly ecosystem.

At the time of this report (1999), the handicraft complex, foodstalls, car parks and bright lights are already in place facing directly to the jetty where visitors queue to board sampan (small boat). To date, there is no study carried out as to whether the population of firefly has decreased due to such pressure. However, tourism activities have increased as there is already a new firefly resort operating in Bukit Belimbing. The new resort is located downstream of Kg. Kuantan and is less than 10 km from the Pasir Penambang Village (Figure 3.1). The resort provides similar firefly viewing tour for tourists using an engine-powered boat while the firefly operator in Kg. Kuantan uses human-paddled boat.

With these current developments in Kuala Selangor, the mangrove forests are under more stress. While the authorities and the locals are trying to maximise economic profits from mangrove ecosystems, scientists are striving to protect these invaluable resources. It is hoped that both interests will be balanced justifiably.

This study acknowledged that there are many sources of errors, limitations and caveats in valuing the mangrove ecosystem. The main problems in valuing the TEV of mangrove forests in Kuala Selangor are listed below. These limitations were also expressed by Costanza *et al.* (1989) and Costanza *et al.* (1997).

(i) There are still many categories of services, which have not yet been adequately studied. As more and better information become available, the TEV of mangroves are expected to increase.

(ii) The non-use values are based on the current WTP of individuals for ecosystem services. It must be noted that these invididuals may be ill-informed and their preferences may not incorporate social fairness, ecological sustainability and other important goals.

(iii) Inter-country comparison of valuation are affected by various factors including income, socio-economic and cultural differences. The different and dynamic exchange rate could also influence the TEV estimation. A product can have different value in a different country.

(iv) Estimation of TEV actually only represents a static `snapshot' of a complex, dynamic system. To get a more accurate value, economists normally use net present value (NPV) to discount for the future. Discount rate used is normally based on savings rate. However, as the future is unpredictable, savings rate can change. For example, during the economy crisis in Southeast Asia, savings rate in Malaysia inflated from 5% to about 12%.

(v) Discounting may allow individuals to give too little weight to the future and thus help to set the `social trap'.

Given all these limitations, some studies can have distorted results if not carefully designed, such as the study by Janssen & Padilla (1996). The study assessed management options for Pagbilao Mangrove Forest in the Philippines and concluded that aquaculture is the best option in terms of economic returns to the area. In valuing the management options, Janssen & Padilla (1996) assumed that the option (aquaculture) is sustainable based on stocking density, types of feed used, number of crops/year and rotation between shrimp and milkfish for intensive aquaculture. The assumption of these factors raised questions whether sustainability can be determined by such limited factors.

The Pagbilao Mangrove Forest is located adjacent to some islands, covered by an extensive cover of corals. Pagbilao Bay is one of the richest natural marine areas in Southern Luzon (Janssen & Padilla, 1996) and supports a total of 2,048 fishermen in the area. Both ecosystems (mangrove and coral) may have been supporting the

fisheries industry as mangroves and corals are known to be one of the most productive ecosystems in the world.

It is obvious that Janssen & Padilla (1996) did not give due consideration to the effects of aquaculture activities to the existing mangroves and coral ecosystems and the impacts to the fishing industry. Such valuation could give a `wrong' signal that mangrove forest should be converted to other activities for a `sustainable' economic gain. Such is the effect of `social trăp' as described by Costanza *et al.* (1989):

> "We go through life making decisions about which path to take based largely on `road signs', the short-run, local, reinforcements that we perceive most directly. These short-run reinforcements can include monetary incentives, social acceptance or admonishment, and physical pleasure and pain. Problems arise, however, when the road signs are inaccurate or misleading. In this case, we can be trapped into following a path that is ultimately detrimental because of our reliance on the road signs."

At the moment, valuation techniques are not really well developed and are still evolving. In terms of mangrove linkages, there are still a lot of missing links not understood by scientists, thereby affecting valuation methodology. Only when we have an established ecological basis and links of an ecosystem will the economic valuation methodology based on scientific evidence can be strengthened. As quoted from Ruitenbeek's (1994) study of evaluating Bintuni Bay in Irian Jaya, Indonesia:

"....there is still considerable uncertainty in the dynamics of specific mangrove ecosystems. This study has demonstrated that *if we know* the nature of these interactions, an economically optimal strategy can be selected. The analysis also demonstrates that *if we do not know* the nature of the interactions, an incorrect guess can have substantial economic penalties."

As such, there should be more research on the ecological aspect of mangrove ecosystem as well as improving current methods so as to produce a more accurate result. Both scientific and economic researches are important as they may affect the scale of impacts on the environment when a certain option of management is undertaken. There are already studies linking ecological and economics aspects of mangrove ecosystems (Ronnback, in press). This is a step further in balancing the ecological and economics aspects of the mangrove ecosystem.

Malaysia, through the Department of Fisheries Malaysia is preparing a series of Responsible Codes of Conduct for the aquaculture industry (Choy, 1999). At the same time, Sabah and Sarawak are preparing their own aquaculture masterplan (Biusing, 1999; Chang, 1999). It is most appropriate that due consideration be given to mangrove forests at this early stage of the respective masterplans so as to avoid imbalanced decisions and underestimation of the value of mangrove land in Malaysia.