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Sustainable Development Planning of Wetlands in Kuala Trengganu District Using Satellite Imagery

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Abstract

Wetland cover mapping is very important in the sustainable planning, identifying its areal extent and the rate of change over time. This study aims to map the areal extent and its rate of change in Kuala Terengganu district for its future sustainable develoment. Three Landsat^{TM} images, which dated on 15th October 1998, 14th July 2002 and 15th August 2005 were used in digital image processing by using a RGB band combination of 4, 5, and 2. The overall classification accuracies for the 1998, 2002 and 2005 images were 74.55, 82.42 and 90.91 percent, respectively. The United State Geology Survey (USGS) Classification Scheme was used to determine the wetland and the images were independently classified and total areas of wetland cover were compared between different dates of imageries. Surprisingly, there was an unexpected significant increase (from 102.35 to 381.35 ha) in the areal extent of wetlands in a seven year period of 1998 to 2005 with a rate of change of 0.84% increase per year. This study implies that the integration of remote sensing and Geographical Information System (GIS) may provide a useful tool for temporal studies in wetland cover and its rate of change in Kuala Trengganu district.

Keywords: Wetland, Remote sensing, Rate of change, Setiu

1. Introduction

Biodiversity can be defined as full range of variety and variability within and among living organisms and the ecological complexes in which they occur, and encompass ecosystem, species diversity, and genetic diversity. It is predicted that our country has a high biodiversity, as Malaysia lies in the tropics, where the climate is very suitable for a high number of species in the world that mostly inhabitants in the ecosystems of our country. Furthermore, Malaysia is also listed as one of the biodiversity hotspots in the world. Malaysia has been endowed with vast amount of natural resources including luxuriant wetland forest, which is one of the most diverse and complex ecosystems of the world. These natural resources have been identified to provide habitats for many species and providing important regional impacts, such as hydrological, biological and ecological roles in the ecosystem. Therefore, it is our responsibility to manage the wetlands well, as well as conserving them for the future.

Malaysia has a total of 96 wetlands sites approximately covered 0.34 million ha of peat swamp which was reduced almost half from 0.67 million ha in 1981 (Abdur-Rouf *et al.,* 2007). Malaysia needs to conserve these important ecosystems for addressing flood problems, mitigating el-nino effects, estimating national water budgets and conserving biodiversity. In example, Table 1 showed the richness and diversity Malaysia aquatic ecosystem.

<<Table 1: Aquatic ecosystems in Malaysia>>

Mapping wetland vegetation over larger regions has commonly been done using digital imagery obtained from satellites, and may be referred to as land cover mapping. Wetland cover mapping is actually providing critical information about the distributions of the species and vegetation types and "human land uses" surrounding it, thus, possible for biodiversity conservation planning, as the wetland cover classifications may link to a particular species composition and habitat types. In this case, wetland cover maps produced may provide the baseline measurements that allow the study of changes in a particular land cover over time and further discover the impacts of such changes on the biodiversity. Maps arranged according to their dates may reveal the patterns (Mitchell, 1999) and help the interpreters to infer the

relationship (Turner *et al*., 1994) between the maps studied. Meanwhile, statistics in table forms summarize the findings to specifically display the increment and reduction of total areas that changed over time.

In addition, most maps used by the ecologists are land cover maps (Burel and Baudry, 2003), created from the analysis of the satellite imageries, together with aerial photographs, and through field observations that has been done by the scientists from remote sensing fields. Often, landscape ecologists use the final products of GIS processing or the interpretation of spectral data to conduct their study, as many of them are not technically proficient in all the intricacies on spatial extents that are much larger than those traditionally studied in ecology (Turner *et al.*, 2001). Therefore, the objectives of this study are two-folds, namely (i) to map the wetland cover of Kuala Terengganu district and to determine its rate of change between 1998 and 2005, and (ii) to produce final wetland cover maps of Kuala Terengganu for each year of study

2. Method

The selected area of study was Kuala Terengganu district of Terengganu state, as shown in Fig.1. Kuala Terengganu is located between latitudes of 5° 27' 58.31" N and 5° 11' 42.36" N and longitude of 102° 57' 06.10" E and 103° 13' 18.69" E. The capital city of Terengganu state is located in this district. The total study area is approximately 60,528 ha, which covers 4.67 percent of the Terengganu district. Three sheets of 1:50,000 scaled topography maps were used as a reference to conduct the ground truthing process. Two softwares were used in this study. Erdas Imagine 8.7 was used in the digital image processing, while ArcView 3.2 was used for the GIS analysis.

Landsat^{TM} was acquired from scene 126/56 (path/row), with spatial resolution of 30 m. Images were obtained from Malaysian Center for Remote Sensing (MACRES). These images were taken on 15th October 1998, 14th July 2002 and 15th August 2005. The raw images of the study areas were shown in Fig.2 by using the band combination of RGB 4, 5, 2.

<<Fig.1 Location of the study area>>

<<Fig. 2 Raw image of Kuala Terengganu August 15, 2005>>

Multi-dates images of Kuala Terengganu district were used to initiate this task, which involved images of 1998, 2002 and 2005. A uniform interval was expected in order to determine the land cover changes rate, but unfortunately, a uniform three or four year's intervals are not available in the archive. The seven bands of each image were layer stacked to merge them together, before producing a single image. Geometric correction process was done based on the Ground Control Points (GCP) taken during the ground truthing. A total of 50 GCPs were registered for each image; they were resampled to produce the corrected imaged. All corrected images were justified based on Root Mean Square Error (RMS Error) of less than half a pixel (Lillesand *et al.*, 2004) by using the First Polynomial Order. The images used Rectified Skew Ortomorphic (RSO) Projection with Spheroid of Modified Everest and Kertau 1948 as the Datum. In unsupervised classification process, Iterative Self Organizing Data Analysis Technique (ISODATA) was applied to the 100 classes of unknown land covers with 30 iterations. This process is then followed by redefining the criteria for each class and classifying them again before producing the last output images of the unsupervised classification process. Wetland class was identified roughly based on the analyst's prior knowledge and from analyzing the topographical maps.

During the ground truthings, the actual wetland cover class involved was checked and identified. Global Positioning System (GPS) Garmin GPS 12 with accuracy 15m RMS was used to acquire the exact coordinates of study areas (GCP), while photographs of the wetland cover class was captured together with their details recorded. The images were then classified into wetland cover types. The analysis was done using data collected during the ground truthings with the aid of topographic maps to produce the output images of supervised classification. Next, they were filtered through the Statistical Filtering by using 7x7 modes. Mean Filter was applied for all these output images before recoding them according to the wetland class, in order to measure the areal extent of the wetland rate of change per the years studied. The output images for supervised classification process were assessed to determine the classification accuracy. Stratified Random Sampling was applied to each supervised classification images, where 30 random reference pixels were taken into account. The accuracy report was generated later that comprised the summary statistics of overall agreement percentage, together with user's and producer's accuracy. All the output images from the supervised classification were used in the GIS Analysis to determine the changes occurred amongst the temporal years under study. Each image was independently classified and registered before undergone the post-classification comparison. The rate of change was determined after calculating the total areas of wetland cover class. The changes in distribution of wetlands were shown in the generated wetland cover maps.

3. Results and discussions

Unsupervised classification was done to assist the ground truthing. Besides the wetland there were eleven other classes of land cover with uncertainties of the actual locations predicted during this process. The eleven classes are barren land, cloud, cloud shadow, forest land, oil palm, orchard, paddy, rubber, urban or built-up land, and water. They were nine

classes categorized including the wetlands which were confirmed using ground verifications. Land cover classes for supervised classification images include the cloud and cloud shadow, which appeared in the images. Fig. 3 shows the images that have undergone the supervised classification that was further subset to highlight only the study area, which is the Kuala Terengganu district. A summary of the total area for each land cover classes, especially the wetlands in every image were demonstrated in Table 2 according to their respective year of study to measure the rate of change for the three temporal years.

<< Fig. 3 Supervised classification image of K. Terengganu for 1998, 2002 and 2005>>

<< Table 2: Total areas of land cover and land use for 1998, 2002 and 2005 image of K. Terengganu>>

Based on the results, all Root Mean Square Error (RMS Error) obtained are less than a pixel. In this study, the spatial resolution of each data used is 30 m, which represented by a pixel. Therefore, the errors obtained should not be more than the image resolution, which means not more than 30 m. Furthermore, for the change detection analysis, a requirement of accurate spatial registration during geometric correction could bring an effective result for each dates of imagery. Ideally, the RMS Error should not be more than half a pixel.

3.1 Accuracy assessment

In accuracy assessment, a total of 330 stratified random sampling points was used to determine the accuracy for each output images of the supervised classification. The overall classification accuracy obtained for 2005 image is the best, which is 90.91%. The overall accuracy for 1998 and 2002 images can be considered as moderate, where the accuracies are 74.55 % and 82.42 %, respectively.

3.2 Geographical Information System (GIS) analysis

Arc View 3.2 software was used in the GIS analysis to enable determination of the total changes of areas for each class, when the images were compared. The arrangement of the classes was done by putting the priority, based on the highest to lowest increment of total area that changed from 1998 to 2005, and further followed by the highest to lowest changes reduction of the total area. For wetland class, distribution of the particular land cover is shown in Figure 4. In 1998, the total area is 2.18 %or 102.348 ha. The value decreased slightly in 2002 to be 2.15 % or 100.683 ha. Surprisingly, the value of total area of this class expanded in 2005 to be 8.13 % or 381.348 ha.

<<Fig. 4 Wetland covers type maps of K. Terengganu for 1998, 2002 and 2005>>

The total area of wetlands has increased to 5.95 % or 279 ha from 1998 to 2005. In 2005, the total area for wetlands was observed to be higher compared to the earlier years of study. This might be due to the inexperienced analyst, where the spectral reflectance of other land use cover such as rice paddy areas was misinterpreted as wetlands. Meanwhile, in 2005, the areas of Wetland class were observed in more detailed, as the ground truthings enable determination of the exact wetland cover involved in the area. Furthermore, seasonal peat swamps are included in this class, where this class is influenced by the water table to be mistakenly interpreted as the rice paddies class. Basically, the weakness in interpretation of this class is due to the lack of knowledge of the study area in the earlier years of study.

With the aid of ground truthing and further analysis of the ancillary data, it is observed that the wetlands of K. Terengganu district were found in Kampung Mengabang Panjang in Batu Rakit, Kuala Nerus subdistrict, Gong Badak industrial areas and Gelugur Raja, mainly associated with wetland floras of sea hibiscus (*Hibiscus tiliaceus*), nipah palm (*Nypa fruticans*) and mangrove fern (*Acrostichum aureum*). Forested wetland is dominant in Kuala Terengganu and most of the mangrove trees observed were Avicennia, Sonneratia, Rhizophora and Melaleuca genera.

Wetland areas have their own international importance, as they provide the natural protection to the coastal areas from the strong storms, as well as the sand erosion. They have a high biological diversity and traditionally utilized for food resources, firewood, charcoal and timber (Yousif *et al.*, 1999). Wetland has been recognized to be the breeding areas and refuges for many marine species, including prawns. Mangrove is also capable in preserving water quality and reducing the water pollutions by filtering suspended materials and assimilating dissolved nutrients. Since wetland areas protect the human and the human settlements, they are eventually have become our responsibility to take care of them, so that people do not have to worry too much about the disasters that might occur if these areas are eliminated.

4. Conclusion

Landsat ^{TM} images are capable of identifying the Kuala Trengganu District wetland cover class and its rate of change for its future sustainable development planning and management. Overall classification accuracy obtained for 1998, 2002 and 2005 images are 74.55 %, 82.42 % and 90.91 %, according to their respective years of study. These values show a moderate accuracy for 1998 and 2002 images, meanwhile, 2005 image has the best accuracy assessment. Wetlands sometimes confuse with rice paddies class. Generally, the integration between remote sensing and GIS in this study has proved its ability to determine the wetland cover classes, as well as the other land cover changes between the study periods. It is recommended that the satellite imageries with higher spectral and spatial resolutions be used for future wetland cover map production in order to improve the mapping accuracy.

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Table 1. Aquatic ecosystems in Malaysia

Habitat Peninsular Malaysia	**Area (km^2)**
Rivers including floods plains	9,111
Peat swamps	4,850
Reservoirs	1,600
Mining pools	164
East Malaysia	
Rivers including flood plains	8,487
Peat swamps	15,150
Reservoirs	22
Total	**39,384**

Source: Yusoff and Gopinath, 1995

Table 2. Total areas of land cover and land use for 1998, 2002 and 2005 image of K. Terengganu

Classes	**1998**		**2002**		**2005**	
	Ha	%	ha	%	ha	%
Barren Land	92.22	1.97	39.46	0.84	63.135	1.35
Cloud	204.96	4.37	140.87	3.00	66.321	1.41
Cloud Shadow	185.86	3.96	76.04	1.62	9.639	0.21
Forest Land	264.40	5.64	77.39	1.65	49.437	1.05
Oil Palm	58.46	1.25	238.19	5.08	382.329	8.15
Orchard	1612.14	34.39	1841.40	39.26	1274.049	27.16
Paddy	405.06	8.64	362.27	7.72	772.182	16.46
Rubber	534.94	11.41	478.84	10.21	1017.756	21.70
Urban or Built-up Land	1109.52	23.67	1214.33	25.89	500.328	10.67
Water	118.19	2.52	121.14	2.58	174.132	3.71
Wetlands	**102.34**	**2.18**	**100.68**	**2.15**	**381.348**	**8.13**
Total	4688.13	100	4690.65	100	4690.65	100

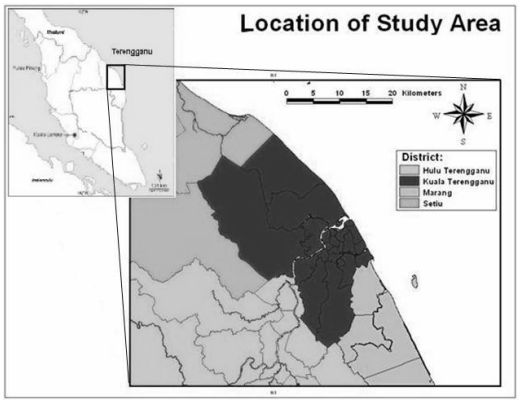


Figure 1. Location of the study area

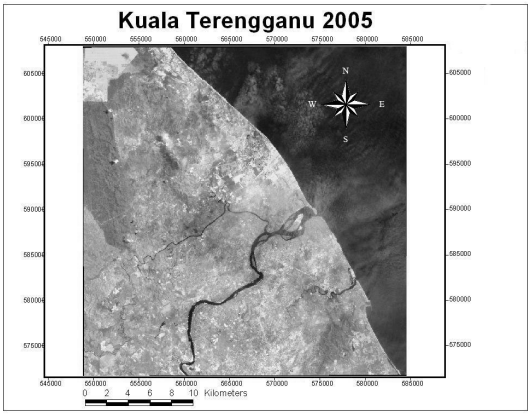


Figure 2. Raw image of Kuala Terengganu August 15, 2005

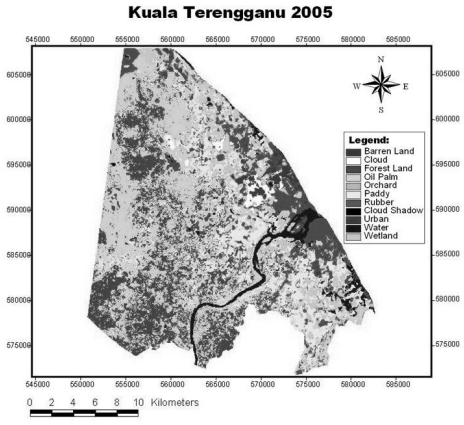
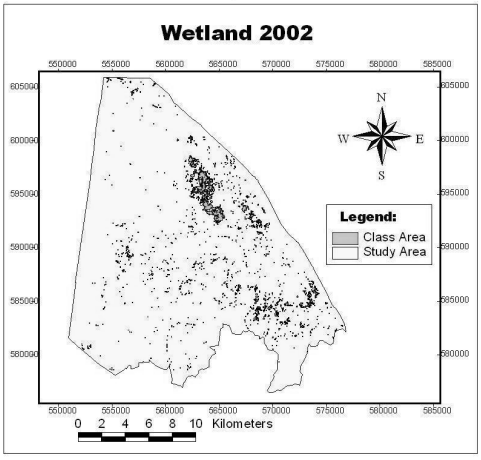
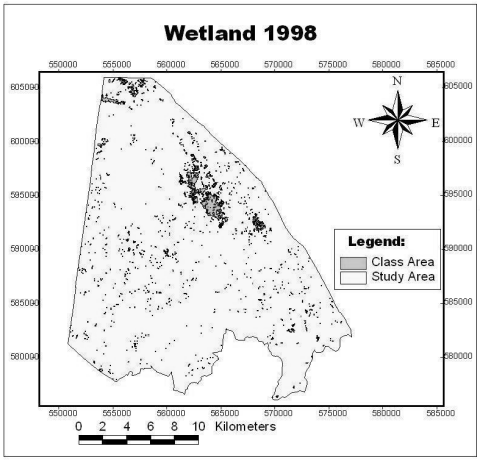


Figure 3. Supervised classification image of K. Terengganu for 1998, 2002 and 2005





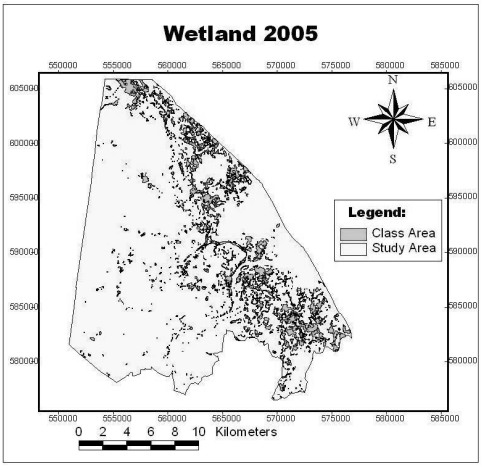


Figure 4. Wetland cover type maps of K. Terengganu for 1998, 2002 and 2005

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An Analysis of Externality Economy of Xinjiang Water Resource Development

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Abstract

By analyzing the externality of Xinjiang water resource development in perspective economy, this paper advances suggestions on how to develop and use water resources reasonably and how to protect and govern ecological environment.

Keywords: Water resource development, Externality, Ecological environment

Externality means the impacts of one person or enterprise on others' welfare. If the impact is harmful, it is "negative externality". If the impact is favorable, it is "positive externality". Externality is sorted into the externality in production and the one in consumption. Here, we mainly discuss the externality in production. In other words, the effect or cost generated in production directly influences certain economic subject without exchange in market.

1. External economy

1.1 Market equilibrium in external economy

External economic effect means the positive externality effect (the economic benefit) generated in production, not by exchange in market. In other words, although these economic subjects do not pay for the economic benefit, they can enjoy certain interests.

Next, we will discuss the diversified public welfare of ground water resource development.

In Xinjiang, around the downstream of one river or the nearby of ground water overflow, the soil is thin and the ground water has a small slope, where the water level is usually between 1 and 3 meters. The groundwater evaporation is strong. The groundwater is supplied horizontally and the exit is mainly evaporation. Due to the strong evaporation, the salt does not go with water. It stays in soils. As time passes, soils tend to be salinification. As a result, the soil is not good for plants. Therefore, the ecological environment there is worse in general. However, the groundwater resource is rich. Because this area is far from surface water resources, irrigation is hard in spring. And due to the effect of evaporation, the superficial groundwater is not right for irrigation. The developers develop commercial groundwater and sell them to farmers in order to gain more profits. Due to the commercial exploitation of groundwater, the critical depth of groundwater evaporation is lower than 5 meters. Because of the decrease of evaporation, salt comes with water and goes with water. As a result, the quality of soil will be improved. All residents and farmers benefit from this externality economic effect but not pay for it. It is impossible for developers getting profits from residents and farmers.

Figure 1 reflects that the market equilibrium in external economy is not the optimal state of resource allocation. In Figure 1, D is the demand curve of groundwater resource (the sum of all farmers' needs in water resource area and the downstream area). SD is the groundwater's social demand curve (it is equal to the social marginal valuation). S is the supply curve of groundwater resource. SD is above D because water resource can improve soils and ecological environment. It has external economy. The difference of SD and D in vertical axis means the quantity of external economy. D indicates that the price of groundwater changes along with the consumption of groundwater. Because the external economy is not valued by money in groundwater market or traded by market, the supply-and-demand balance in groundwater resource market is the point e where SD and D reach. In Figure 1, Q_1 is the quantity of groundwater resource in supply-and-demand balance. P_1 is the price of groundwater resource in supply-and-demand balance.

Next we discuss the condition of maximum social economic surplus including the external economy. Under this condition, the intersection point f determines the quantity of groundwater in exploitation, namely Q_2 (Figure 1). Here, the maximum social economic surplus including the external economy is the area acf, which is larger than the social

economic surplus in market equilibrium by an area def. In other words, the groundwater's market equilibrium can not achieve the social expected quantity of groundwater in exploitation. It is a "less production" phenomenon.

1.2 External economy and price policy

We still take the exploitation of groundwater as an example. By discussing the price policy, we hope to realize the optimal quantity of groundwater in exploitation as social expected. Next, we illustrate this point by Figure 2 (all characters, prices, quantities, and curves have same meanings with that in Figure 1).

(1) Price allowance policy

In Figure 2, in order to reach the exploitation quantity Q_2, the government applies a price allowance policy, providing allowances for groundwater developers. The allowance price is P_4 and the market price is P_3. The difference of price allowance and market price is P_4-P_3. The national allowance is the area P_4fiP_3. The groundwater developers' producer surplus is the area P_4fa. The consumer surplus is the area biP_3. The external economic effect is the area cfib. The social economic surplus caused by the implementation of price allowance is the area acf. Now, the social economic surplus reaches its maximum. However, we should notice that once the allowance price betrays away from the price P_4, the social economic surplus will decrease. The more it betrays, the more the decrease is.

(2) Unified purchases and sales at higher prices

The government applies the policy of unified purchases and sales at higher prices in order to improve the exploitation quantity of groundwater to Q_2. The purchase price is P_4. As the government fixes the price as P_4 as it allocates the resource to consumers, the producer surplus is the area aP_4f. The consumer surplus is the area P_4bh. The government financial burden is the area Q_4hfQ_2. The external economic effect is the area cfib. After applying this policy, the social economic surplus is the area of acf subtracting Q_4hiQ_2. Here, the social economic surplus is smaller than that in applying the price allowance policy. However, as the price of unified sales is equal to the market price, namely P_3, the policy of unified purchases and sales at higher prices and the policy of price allowance will generate equal social economic surplus.

2. External diseconomy

2.1 Market equilibrium in external diseconomy

External diseconomy means the "negative externality" mentioned above. Here, it mainly refers to the negative externality in production. In other words, the costs generated in production happen directly among economic subjects without market exchange.

For example, construct a reservoir in plain in Xinjinag, which will cause the oil salinification and swamping, worsening the agricultural ecological environment. The irrigation in upstream is rough, which increases the supply of groundwater in downstream, causing the rise of water level there. As a result, it drives the salinification and swamping, worsening the agricultural ecological environment. The long-term over exploitation in upstream makes the water level decrease in downstream, leading to desertification and land sedimentation.

All these issues concern the negative externality in water resource development, which makes the social costs of water resource development and use are larger than producers' costs. The social cost of producing each unit product includes the producer's "private cost" and the cost generated by the effect of water resource development on certain economic subject.

Figure 3 means the market equilibrium in external diseconomy does not reach the optimal state of resource allocation.

D is the demand curve. S is the supply curve. SMC is the social marginal cost including external diseconomy.

SMC is above the curve S because the supply curve S is the marginal cost (private marginal cost) taken directly by the water resource developer, excluding the cost of external diseconomy. SMC stands for the social marginal cost that includes the external diseconomy (because the worse agricultural economical environment). Therefore, the difference a between curve SMC and curve S in the vertical axis means the external diseconomy generated by the developer in developing water resources. The market equilibrium of water resources is determined by the intersection f between curve D and curve S. The price in supply-and-demand equilibrium is P_1, and the quantity in supply-and-demand equilibrium is Q_2. The consumer surplus is the area cfP_1. The external diseconomy (loss) is the area abgf. The social economic surplus is the part of the area bce subtracting the area egf.

Considering the existence of external diseconomy, the quantity of water resource exploitation is Q_1 as the social economic surplus reaches the maximum. Here, the social economic surplus is the area bce. In conclusion, at the state of market equilibrium, there is (Q_2-Q_1) exploitation surplus, which will cause the social economic surplus, namely the area cgf.

2.2 Countermeasures for external diseconomy

In order to depress the exploitation surplus generated in Figure 3 and the decrease of social economic surplus due to exploitation surplus, we must increase the producer's "private marginal cost". In other words, move the curve S upward as much as possible, being close or equal to curve SMC.

(1) Internalized the external diseconomy

The government can delete or reduce the external diseconomy by relevant laws, policies, and administrative regulations. For example, set restrictions on building reservoirs in plains and forbidden over exploitation of water resources in upstream area. By this way, water resource developers will have to increase their "private marginal cost". As a result, less water resources will be developed. To intake the social cost generated by external diseconomy into the production will turn into the "private cost". Therefore, it is named as the "internalization" of external diseconomy.

For example, in Xinjiang a developer wants to develop a new land. The developer builds a reservoir in the plain in upstream (if permitted) and makes agricultural production in downstream. In this area, the groundwater level is relatively higher: the upstream is about 3-8 meters and the downstream 1-3 meters. Soils contain more salt. After the construction of reservoir, the groundwater level will be higher due to the leakage of reservoir, worsening the agricultural production environment. The developer should build facilities to avoid the rise of groundwater level: construct a new water resource and exploit the groundwater. Along with the decrease of groundwater level and the decline of groundwater evaporation, the chance for generating more salts in oils will be few. Then, the soil and the ecological environment in this area will be improved, which increases the economic benefits of the developer.

(2) Set up the most appropriate restrict standards

To set up the most appropriate restrict standards, we must take the disappearance of oil salinification, desertification, and land sedimentation, the decrease of external diseconomy's expenses, and the decrease of external diseconomy's losses into consideration. In Figure 4, the lateral axis stands for the level depth. Suppose the level depth is h. For agricultural plants, the ideal value is h0. As this value is less than 5 meters, the marginal effect curve is the social marginal effect generated along with the rise of this value. As the value is equal to or higher than 5 meters, the marginal effect curve is the social marginal effect generated along with the decrease of this value.

In the example above, the developer is to develop a reservoir but not perform agricultural production. The developer must build a facility to decrease the groundwater level in area where the level depth is less than 5 meters: develop a water resource and exploit the groundwater. Along with the rise of groundwater level depth and the decrease of groundwater evaporation, less chance for oils obtaining more salts there. By this way, it improves the oils and ecological environment in the area. The developer's economic benefits will be rising. The marginal cost curve stands for the marginal cost generated by groundwater exploitation.

The most appropriate restrict standard is determined by the intersection of the marginal effect curve and the marginal cost curve, namely m. In Figure 4, h1 is the most appropriate restrict standard. For the developer, if the groundwater level depth in downstream area, he or she will be punished by the government.

Here we should notice that the most appropriate restrict standard is not necessary to make the external diseconomy in a "zero" state (the ideal groundwater level depth is h0). The pure social return generated by the most appropriate restrict standard h1 is the area jkm.

(3) Taxation

Impose more taxes on the developer who causes the appearance of external diseconomy, improving their costs for worsening the environment.

(4) The developer should pay for their exploitation, compensating the victims in the area and improving the worsening environment.

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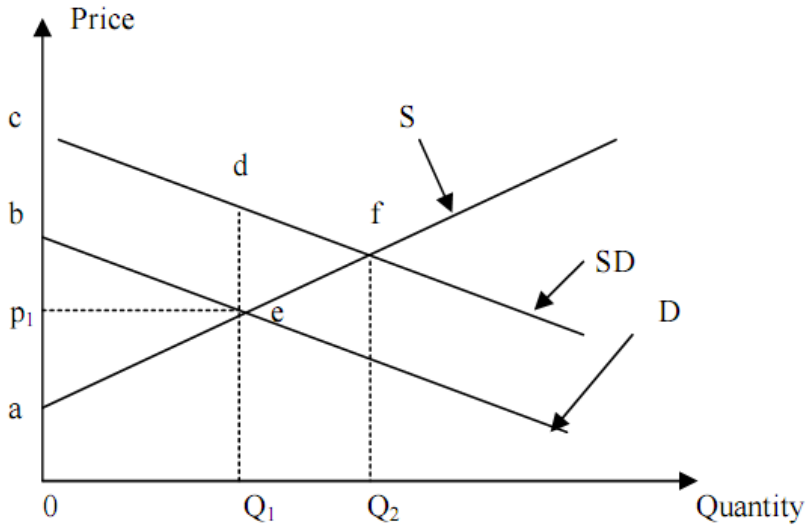

Figure 1. The Market Equilibrium in External Economy

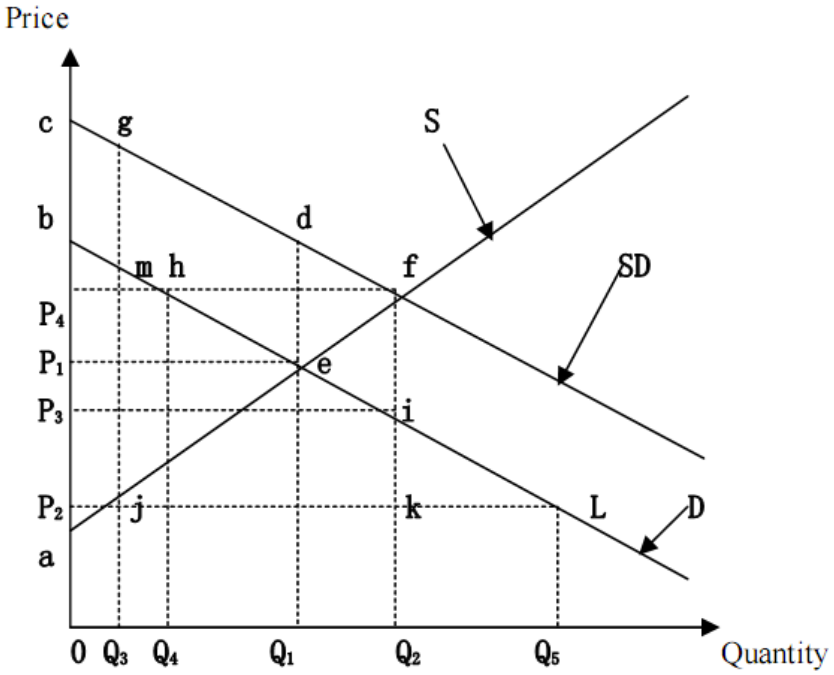

Figure 2. External Economy and Price Policy

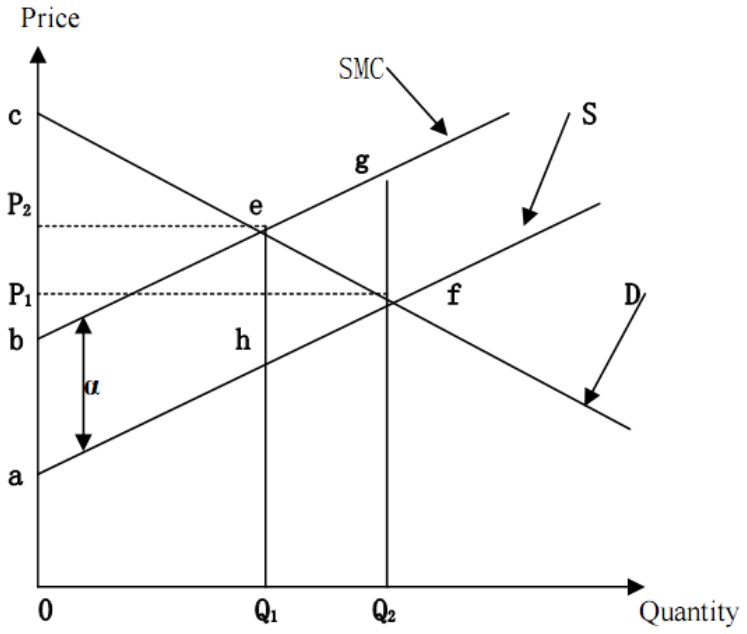

Figure 3. External Diseconomy and Market Equilibrium

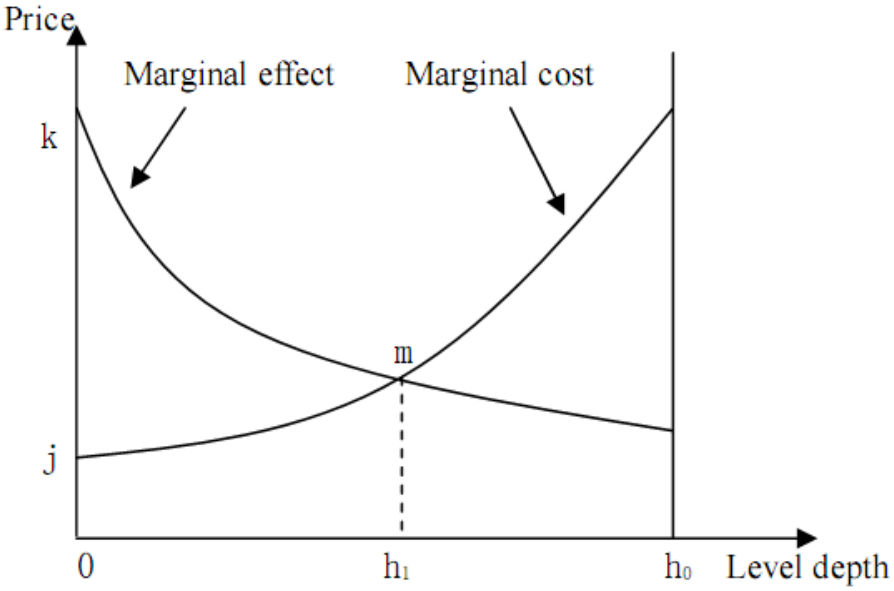

Figure 4. The Most Appropriate Restrict Standards

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Some Common Non-Timber Forest Products Traded by Indigenous Community in Sabah, Malaysia

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Abstract

The survey showed that a total number of 109 species of NTFPs were traded locally in the t*amu* (open market), comprising 35 species of wild edible plants, 32 species of medicinal plants, 8 species of orchids, 4 species of bamboos, 6 species of rattans, 8 species of fish, 8 species of wild fruit trees and 8 species of other products. This survey covered ten most common *tamu* and major ethnic groups in Sabah, mainly Kadazandusun, Rungus and Murut.

Keywords: Traded Non-Timber Forest Products, *Tamu* (open market), Indigenous community, Sabah

1. Introduction

Non-Timber Forest Products (NTFPs) play a major role in the lives of more than 30 million forest dependent people in Southeast Asia (de Beer & McDermott 1989). The situation is similar throughout the tropics, where people utilize NTFPs within the household and trade them for money and other products locally or in the region (Tiwari 1994). For many years, non-timber species such aromatic and medicinal plants, bamboo, rattan, fruits, nuts, resins, gums and mushrooms played important roles in the socio-economic development of Malaysia (Azizol & Appanah 1998).

Many of the NTFPs have provided useful and important products for the local people of the state of Sabah. There are about 84 species of rattans found in Sabah (Dransfield 1984). Sabah has at least seven genera of bamboos with an approximately thirty four species (Kulip 1992). There are more than 100 species used as medicinal plants to treat 34 ailments in the west coast and interior of Sabah. The main sources of medicinal plants in Sabah are from plants growing wild in the primary or secondary forests. Some commonly used plants are planted around houses (Kulip 1997). Lee & Gibot (1986) have reported on more than 200 species of native edible plants found in Sabah. Whilst, Wong (1992) reported that Sabah's tropical is home to about 155 species of freshwater fish and 1500 species of orchids.

The term NTFPs used in this study include all forest goods, except timber and the forest services. They are tangible objects of biological origin such as plants, animals and their products derived from the forest that traded in the *tamu*. *Tamu* or "Open Market" is a place where most of indigenous traders gather to buy, sell or barter their farm produce, NTFPs, handicrafts, traditional ware, musical instruments and etc. *Tamu* is also one of the tourist attractions. The main objective of this study was to identify the types of NTFPs collected and traded by the indigenous communities at the various *tamu* in Sabah, Malaysia.

2. Materials & Methods

Sabah, the second largest Malaysian state, has a land area of 7.3 million ha and a population of 2.45 million (Sabah Statistics Dept. 2000). The main indigenous communities are Kadazandusun, Murut, Rungus and Bajau. There are more than 50 ethnic groups in Sabah (Lasimbang and Moo-Tan 1997). The Kadazandusuns alone comprise more than 30 different groups (Tombung 1990). Other groups in Sabah include the Chinese, Bruneians and Indians.

The general approach of this study is to survey indigenous communities involved in the collection and selling of NTFPs at the selected *tamu* using a structured questionnaire. In each *tamu*, personal interviews were conducted with the sellers and the data gathered were analyzed to determine the types of NTFPs traded in the *tamu*. The survey was conducted in ten *tamu*, namely Tamu Kudat ($6^0$52.794'N,$116^0$51.128'E), Tamu Kota Marudu ($6^0$29.925'N,116^0 46.224'E), Tamu Tandek ($6^0$32.083'N,$116^0$51.197'E), Tamu Tenom ($5^0$07.268'N,115^0 56.580'E), Tamu Keningau ($5^0$20.333'N,$116^0$09.551'E), Tamu Tambunan ($5^0$40.250'N, $116^0$21.858'E), Tamu Kiulu ($6^0$03.527'N,$116^0$16.912'E), Tamu Tamparuli ($6^0$08.043'N, $116^0$16.097'E), Tamu Telipok ($6^0$05.372'N,$116^0$11.740'E) and Tamu Donggonggon (5^0 54.757'N,$116^0$06.085'E) (Fig 1).

A personal interview technique was used to collect desired information such as respondent background (this covers age, gender, races, education level, household and employment) and inventory of NTFPs traded by the respondent (this covers species, uses, price, sources, distance traveled). For big *tamu*, random survey was conducted with each seller of NTFPs and for small *tamu* a 100 percent survey was conducted with each seller of NTFPs. The survey was conducted during weekday and weekend, in the month of September until November 2004. In cases where the NTFPs were not identified in the field, they were bought and brought to the Forest Research Centre (FRC), Sepilok, Sandakan, where the specimens were identified by the botanists of the centre. This was to ensure that all the species collected and sold in the *tamu* were correctly identified.

3. Results and Discussion

The total number of respondent interviewed was 102 respondents, comprising 8 males and 94 females. The majority of the respondents were the Kadazan/Dusun ethnic group, followed by the Rungus and the Murut. The average age of the respondents was 46 years. Most of the NTFPs resources came from the forest with the average distance travelled of 2.1 kilometer by the indigenous traders from their house to the source.

From the surveys, the NTFPs were categorized into eight groups, namely, wild edible plants, medicinal plants, orchids, bamboos, rattans, fish, wild fruit trees and others (Table 1). The most common category of NTFPs traded in the *tamu* were wild edible plants (32.1 percent) and medicinal plants (29.4 percent).

The composition of various NTFPs species found traded in the *tamu* shows in Table 2. The total number of NTFPs species identified were 109 species, comprising 35 species of wild edible plants, 32 species of medicinal plants, 8 species of orchids, 4 species of bamboos, 6 species of rattans, 8 species of fish, 8 species of wild fruit trees and 8 species of others.

During the surveys, it were also observed that the most expensive NTFPs was Buah Mentayang (*Caesalpinia bonduc*) followed by Jerangau Merah or Akar Bumi (*Baesenbergia stenophylla*) and Lumut Gunung (*Usnea* sp.). All of these species belong to medicinal plants group of NTFPs. In addition, the most frequent of wild edible plants identified were Bungar (*Lasia spinosa*), Daun Sirih Hutan (*Piper betle*), Lamiding (*Stenochlyna palustris*), Pakis (*Cylosorus contiguous*), Tuhau (*Etlingera punicea*) and Tutan (*Solanum* sp.). The surveys also found that the most common species of orchid traded at the *tamu* ground was *Dendrobium* sp..

Acknowledgements

The authors would like to express our sincere gratitude and thanks to the Herbarium Cestion (Mr. John Sugau, Mr. Leopald Madani, Mr. Dewol Sundaling and staffs) of the Sepilok Forest Research Centre for their assistance in identification of the NTFP species, and to Mr. Azman Mahali, Mr. Matin Tuyok, Mr. M.A. Tajjudin Mustapha and Mr. Kasman Kasbi for their invaluable assistances in the interview of the local traders, and to Associate Professor Dr. Awang Abd. Ghani (Faculty of Forestry, Universiti Putra Malaysia) for his invaluable guidance and constructive comments.

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Table 1. Number of species of traded Non-timber forest products (NTFP's) in the *tamu*

No.	Categories of NTFPs	No. of species	Percent (%)
1	Wild edible plants	35	32.1
2	Medicinal plants	32	29.4
3	Orchids	8	7.3
4	Bamboos	4	3.8
5	Rattans	6	5.5
6	Fish	8	7.3
7	Wild fruit trees	8	7.3
8	Others	8	7.3
	Total	109	100.00

Table 2. List of traded Non-timber forest products (NTFP's) found in the *tamu*

a) Medicinal plants

No.	NTFPs sale (Local name)	Scientific Name	Family
1	Akar Bumi/Jarangau Merah	*Baesenbergia stenophylla*	Zingiberaceae
2	Akar Mengkudu	*Morinda citrifolia*	Rubiaceae
3	Akar Petai	*Parkia* sp.	Leguminosae
4	Bawang Hutan	*Scorodocarpus borneensis*	Olaceae
5	Binuang	*Octomeles sumatrana*	Datiscaceae
6	Buah Mentayang	*Caesalpinia bonduc*	Leguminosae
7	Dundurok	*Rhodomyrtus tomentosa*	Myrtaceae
8	Gangon	*Artabotrys roseus*	Annonaceae
9	Gingor	*Spatholobus* sp.	Leguminosae
10	Ginseng	*Renellia borneensis*	Rubiaceae
11	Kayu Panas	*Goniothalamus roseus*	Annonaceae
12	Kokos	*Dichapetalum gelonioides*	Diclapetalaceae
13	Kosob/Pinang	*Areca catechu*	Palmae
14	Kulat Merah	*Polystictus sanguineus*	Polyporaceae
15	Lalamba	(na)	(na)
16	Lautan Seribu	*Gnetum* sp.	Guetaceae
17	Lautan Seribu	*Smilax* sp.	Smilaceae
18	Lingzi	*Ganoderma* sp.	(na)
19	Lumut Gunung	*Usnea* sp.	(na)
20	Pako	*Angiopteris* sp.	Marattiaceae
21	Pakodita	*Alphitonia excelsa*	Rhamnaceae
22	Raja Kayu	*Koompassia malaccensis*	Leguminosae
23	Remunduk	*Tetrastigma* sp.	Vitaceae
24	Rosok	*Syzygium* sp.	Myrtaceae
25	Sapang	*Caesalpinia sappan*	Leguminosae
26	Sikat	*Bauhinia* sp.	Leguminosae
27	Sungkang Seribu	*Diospyros foxworthyi*	Ebenaceae
28	Tampan Kuning	*Tetracera akara*	Dilleniaceae
29	Tampan Merah	*Xylocarpus granatum*	Meliaceae
30	Tapako	*Drynaria* sp.	Polypodiaceae
31	Tapurau	*Enicosanthum* sp.	Annonaceae
32	Tongkat Ali	*Eurycoma longifolia*	Simaroubaceae

na = not available

b) Wild edible plants

No.	NTFPs sale (Local name)	Scientific Name	Family
1	Bunga Kantan	*Eugenia aromatica*	Myrtaceae
2	Bunga Keladi Hutan	*Alocasia* sp.	Araceae
3	Bungar Tanggara/Gungguripa	*Lasia spinosa*	(na)
4	Cendawan/Kulat Dilah	*Polystictus xanthopus*	Polyporaceae
5	Daun Sirih Hutan	*Piper betle*	Piperaceae
6	Bukaruk	*Schismatoglottis ahmadi*	Araceae
7	Garungang	*Goniothalamus* sp.	Annonaceae
8	Halia Merah	*Zingiber* sp.	Zingiberaceae
9	Hohombih	(na)	(na)
10	Kakatung	*Limnocharis flava*	Limnocharithaceae
11	Kemangi	*Oscimum basilicum*	Lamiaceae
12	Komburiong	*Pouzolzia* sp.	Urticaceae
13	Kulat Kodop/Batang	*Lentinus sajor-caju*	Polyporaceae
14	Kulat Galanut	(na)	(na)
15	Kunsui	(na)	(na)
16	Kuyo	*Piper umbellatum*	Piperaceae
17	Lamiding	*Stenochlyna palustris*	Blechiaceae
18	Lapak	*Physalis minima*	Solanaceae
19	Limposu	*Baccaurea lanceolata*	Euphorbiaceae
20	Molopook	*Opilia* sp.	Opiliaceae
21	Pakis	*Cylosorus contiguus*	Thelypteridaceae
22	Peria Hutan	*Momordica* sp.	Cucurbitaceae
23	Polod	*Arenga undulatifolium*	Palmae
24	Sang Ngob Tuan	*Cucumis* sp.	Cucurbitaceae
25	Sayur Pahit Kampung/Impipiton	*Solanum* sp.	Solanaceae
26	Sunsulak	*Alocasia* sp.	Araceae
27	Taraan/Ayaan	*Monochoria elata*	Pontederiaceae
28	Terung Hutan	*Solanum torvum*	Solanaceae
29	Terung Kampung	*Solanum* sp.	Solanaceae
30	Terung Pipit	*Solanum* sp.	Solanaceae
31	Tongkat Langit/Sesangah	*Helminthostachys zeylanica*	Ophioglossaceae
32	Tuhau	*Etlingera punicea*	Zingiberaceae
33	Tutan Hijau	*Solanum* sp.	Solanaceae
34	Tutan Hitam	*Solanum* sp.	Solanaceae
35	Wegang/Ular-ularan	*Armorphophyllus pendulus*	Araceae

na = not available

c) Orchids

No.	NTFPs sale (Scientific Name)	Family
1	*Dendrobium* sp.	Orchidaceae
2	*Phalaenopsis amabilis*	Orchidaceae
3	*Aerides* sp.	Orchidaceae
4	*Bulbophyllum mandibulare*	Orchidaceae
5	*Phaius* sp.	Orchidaceae
6	*Kingidium* sp.	Orchidaceae
7	*Coelogyne* sp.	Orchidaceae
8	*Renanthera bella*	Orchidaceae

d) Bamboos

No.	NTFPs sale (Local name)	Scientific Name	Family
1	Rebung Nipis	*Schizostachyum brachycladum*	Gramineae
2	Rebung Poring	*Gigantochloa levis*	Gramineae
3	Rebung Tambalang	*Bambusa vulgaris*	Gramineae
4	Rebung Tongkungon	*Bambusa blumeana*	Gramineae

e) Rattans

No.	NTFPs sale (Local name)	Scientific Name	Family
1	Rotan Lempinit/Lasun	*Calamus ornatus*	Palmae
2	Rotan Lesas	*Korthalsia hispida*	Palmae
3	Rotan Logong	*Calamus acuminatus*	Palmae
4	Rotan Menempun	*Calamus levigatum*	Palmae
5	Rotan Saga	*Calamus caesius*	Palmae
6	Rotan Tambarua(Umbut)	*Plectocomiopsis geminiflora*	Palmae

f) Wild fruit trees

No.	NTFPs sale (Local name)	Scientific Name	Family
1	Buah Kamansi	*Artocarpus komendo*	Moraceae
2	Buah Keras	*Aleurites mollucana*	Euphorbiaceae
3	Buah Panggi	*Pangium edule*	Flacourtiaceae
4	Buah Rambai/Kampod	*Baccaurea motleyana*	Euphorbiaceae
5	Durian Hutan/Sukang	*Durio oxleyanus*	Bombacaceae
6	Takob Akob	*Garcina parviflora*	Guttiferae
7	Lampun Belanda	*Annona muricata*	Annonaceae
8	Mapiu	(na)	(na)

na = not available

g) Fish

No.	NTFPs sale (Local name)	Scientific Name	Family
1	Ikan Belut	*Monopterus albus*	Synbranchidae
2	Ikan Haruan/Jalak	*Ophicephalus melanosoma*	Ophicephalidae
3	Ikan Karuk	*Anabas testudineus*	Anabantidae
4	Ikan Keli	*Clarias* sp.	Clariidae
5	Ikan Selap	*Puntius bramoides*	Cyprinidae
6	Ikan Sepat Kampung	*Trichogaster trichopterus*	Anabantidae
7	Ikan Sepat Siam	*Trichogaster* sp.	Anabantidae
8	Ikan Talapia	*Tilapia* sp.	Cichlidae

h) Others

No.	NTFPs sale (Local name)	Scientific Name	Family
1	Burung Keruak	*Amaurornis phoenicurus*	Rallidae
2	Daun Irik	*Phacelophrynium maximum*	Marantte
3	Labi-labi	*Amaurornis phoenicurus*	(na)
4	Lokan Kogis/bakau	*Geloina coaxans*	(na)
5	Madu lebah [1]	-	-
6	Siput Sungai/Singor	*Terebra* sp.	(na)
7	Rebung Nibong	*Oncosperma horridum*	Palmae
8	Umbut Luba/Tiwak	*Eugeissonia utilis*	Palmae

na = not available, [1] = honey

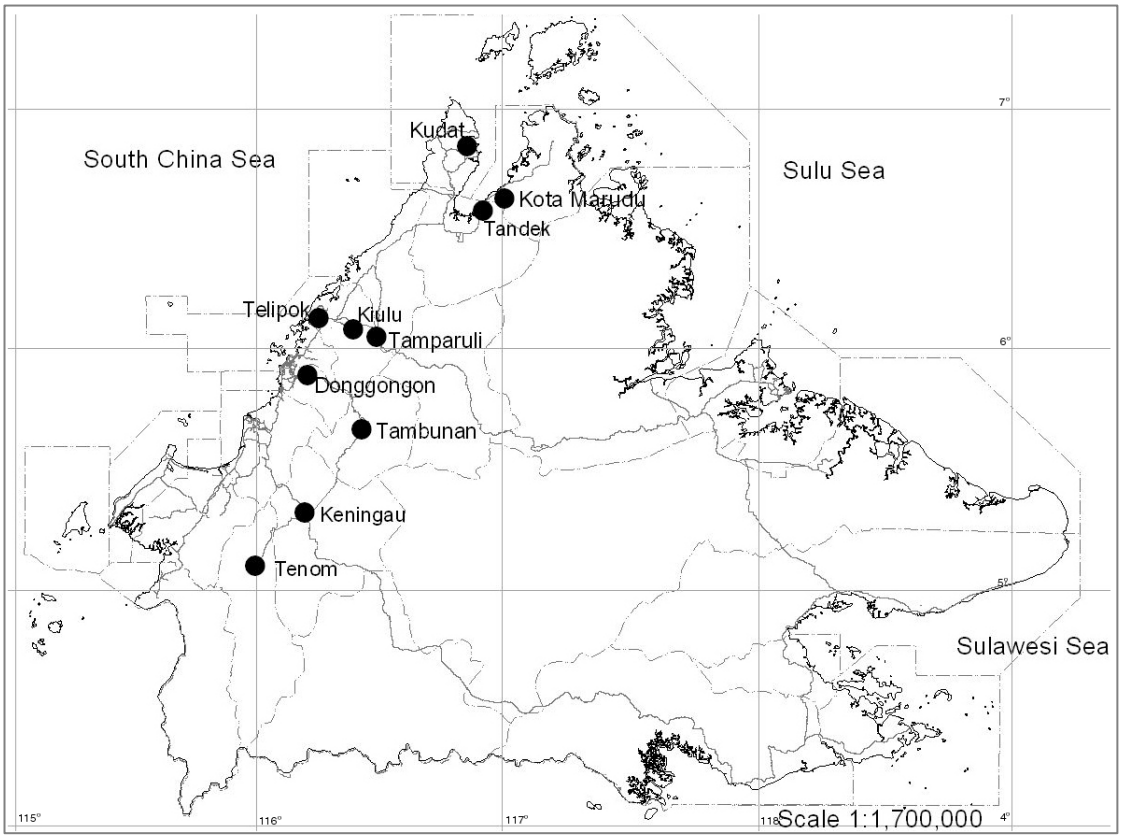

Figure 1. Distribution of locations of the NTFPs survey of ten selected *tamu* in Sabah

This figure shows the location of ten selected *Tamu* in this survey

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Study on the Composition of Regional Scientific and Technological Innovative Competence and its Upgrade Mechanism

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Abstract

At present, the world economy is shifting to the model of knowledge-based economy, knowledge and technology to economic growth has greatly exceeded the sum of the contribution of capital, labor and natural resources and become the most important economic factors, economic growth rely on scientific and technological progress than before, scientific and technological innovation is more important than ever before, it is becoming the main causes and the most direct driving force of a region or country's economic growth and development. This paper starts from the meaning of regional scientific and technological innovative competence; analyze the composition and upgrade mechanism of regional scientific and technological innovative competence.

Keywords: Regional scientific and technological innovative competence, Composition, Upgrades mechanism

1. Introduction

Since the Austrian-American economist - Schumpeter put forward the concept what is a kind of innovative changes in the production function for the first time in ” Economic Development Theory” which published in 1912, and particularly emphasizes on" economic changes, such as reduced costs, the economic balance broken, brutal competition and the economic cycle itself, should be mainly attributable to Innovation ", henceforth the innovation has been the hotspot of international study , but in different countries, different periods of time, it has been given to the different characteristics.

2. Meaning of Regional scientific and technological innovation

Regional scientific and technological innovation meanly that in the given region , under the regional context, science, technology, education, economy and other factors shape the incorporate development mechanism, is the regional system whose main body is enterprise and include local government, education and scientific research units, intermediary organizations. It relies on the strength of regional science and technology innovation, uses resources of regional scientific and technological innovation effectively, coordinates the inter-regional cooperation in science and technology and competition, and achieves efficient allocation of scientific and technological innovation resources (personnel, knowledge, inputs) and the structural optimization, promotes the extensive development of regional scientific and technological innovation and the application , promotion and popularization of innovative product. And then create and develop the competitive advantage to ensure regional economic development. Regional scientific and technological innovation system is the network which regional science and technology organizations, universities, business interact and develop together. This innovative system has the main features of the system, but is open. The System bear the task of putting the high-tech science and technology into the development of regional economic variables, promoting the regional industrial structure modernization and optimization, so as to ensure regional economic and social sustainable development.

From the practice of each regional economic development, the regional competitive ability especially the strength of sustainable competitiveness mainly depends on its scientific and technological ability.

3. Composing of Regional Scientific and Technological Innovative Competence

From the successful experience of developed countries, generally the regional scientific and technological innovative competence should have 8 parts, such as the capability of independent innovation, comprehensive utilization of extra-territorial technology, supply of the innovative system, open up new markets, management innovation, development of new resources, coordination and advanced thinking ability.

3.1 Capability of Independent Innovation

To understand independent innovation, first of all, is a direction. It emphasizes that we need innovative thinking, based on our own strength, innovation as much as possible. At the same time, do not rule out studying others.

Innovation can be divided into 3 categories: (1) integration independent innovation, it is the organic integration of a variety of related technologies to form products and industries with market competitive; (2) introduce or imitate innovation, based on the introduction of foreign advanced technology, to promote positively digestion, absorption and re-innovation; (3) originality independent innovation, that is, through their own new technology research and invention, and developed a new or next generation products. Their Common ground is the unique core technology which has the intellectual property and on the basis to form the value of new products. The capability of independent innovation is the region (enterprises) use effectively innovative resources, establish a new technology platform or change the core technology and achieve independent intellectual property, so that the region will continue to enhance its core competitiveness ability and obtain sustainable competitive advantage in the market competition, in the process of technological innovation to express organic colligation of various ability.

3.2 Capacity of Comprehensive Utilization of Extra-territorial Technology

Capacity of comprehensive utilization of extra-territorial technology mainly refers to the extraterritorial appropriate technology. The so-called appropriate technology, not high-tech necessarily, as long as suiting the stage of regional economic development, to make the region access to sustainable development capacity through using and popularization of technology.

Capacity of comprehensive utilization of extra-territorial technology indicates that the region under circumstances of lacking originality as individual, and attract the extraterritorial appropriate technology for its own using, the focus is on the basis of digestion and absorption, improvement and innovation or change the core technology to produce new products. However, because "partial" or "minor" changes, it is commonly difficult to apply to the patents and not have independent intellectual property rights. Comprehensive utilization of extra-territorial technology is a better choice, such as the backward areas implement "catch-up strategy".

3.3 Capacity of the supply of innovative system

Regional scientific and technological innovation required system collaboration of the whole society and can not be separated from regulation and control of system norms and policy guidance and support of government, such as a series of taxation, finance, industrial technology, personnel incentives. If no such systems and policies, technological innovations will no step. Mechanism is as shown in Figure 1.

3.4 Capacity to Open Up New Markets

Explicit manifestations of capacity of regional scientific and technological innovation are able to produce the high-tech, high value-added products which can meet market demand and consumers agree to accept, and then through market exchange to successfully realize the value compensation. And Japan's "low-volume, diversification" Toyota production model has been exceed America's "high-volume, low diversification" the new winter system, and its drawbacks are that the production scale is small and production cost is high. Therefore, opening up new markets and expanding market size are imperative to obtain economies of scale.

3.5 Capacity of Management Innovation

With the advent of a knowledge-based economy, science and technology change with each passing day, market competition is growing, complexity and difficulty of regional scientific and technological innovation is greater, so whether if can the government management system innovates with the time from the government-funded, creation purchase, nail down orientation, the patent system, tax incentives, direct investment, and integration innovation, continue to management innovation and strengthen policies to encourage scientific and technological innovation are particularly important.

3.6 Capacity to develop new resources

Resources are the basis for regional economic development, and agelong supply of resources is the basis for sustainable development of the region. Throughout the regional resources system, the vast majority of resources (in particular, non-renewable mineral resources) lack flexibility in supply in the near future. Therefore, continue to develop new resources to provide sustainable supply of resources to promote regional sustainable economic development is one of

main mission of regional scientific and technological innovation and also a main component of regional scientific and technological innovation competence.

3.7 Capacity of advanced thinking

In economic development, we say "the idea is everything", and in science and technology innovation, we believe that "advanced thinking decides everything." Since the difficulty of original innovation: firstly, rely on the accumulation of knowledge; secondly, rely on inspiration of a handful genius. Where does inspiration come from? In fact, it comes from the advanced thinking ability of scientists.

Scientists only have the advanced thinking ability can sudden blaze inspiration and to create original innovative, to produce a new product; scientists only have the advanced thinking ability to be possible to set a variety of existing technologies form integrated innovation, and developed new improved products; only have the advanced thinking ability can enhance its digestion and absorption capacity of imported technology, and on this basis to form introduction innovation, access to their own intellectual property rights.

If government does not have an advanced thinking ability , will not be able to formulate scientific strategies for regional economic development, but also impossible to provide system supply in favor of scientific and technological innovation, would be impossible to upgrade the capacity of regional scientific and technological innovation.

3.8 Capacity of Coordination

Regions itself is a complex economic and social system, inside and outside of the region have a variety of economic and interest actors, in the course of economic operation, if let the market mechanism to allocate freely, there would exist the case of market failure, such as externalities and public goods, especially in science and technology innovation system to promote regional economic development. In nature, science and technology is a kind of public goods of strong spillover effects, "free-rider" phenomenon is more likely appear; the external effects of scientific and technological achievements are also great and positive; R & D investment is great, but results and earnings are uncertainty, so it is a high-risk, high investment activity, only one or a few enterprises can not be completed. Therefore, the Government of the Organization Coordination ability is very important and necessary.

4. Upgrade Mechanism of Regional Scientific and technological innovation Competence

From economic development practice of developed countries such as the US and Japan, to keep the competitiveness of the regional economy than ever, using regional scientific and technological innovation to promote regional economic development. Therefore, we must form upgrade mechanism of regional scientific and technological innovation capacity. Learning from international successful experience, generally we should do the following four areas:

4.1 Construct the Regional Scientific and Technological Innovation System Which Main body is enterprises

Looking from outside mechanism, we must intensify system reforms; to achieve separation of political from capital, separation of government from enterprises, rely on preferential policies, legal protection and market incentives to turn enterprises into the investors, beneficiary, risk takers, main body of research and development, main body of decision-making of technological innovation,; analysis from internal mechanisms, we must implement modern enterprise system, through system innovation, such as property rights system, incentive systems, organizational systems, to promote technological innovation; through capital market to achieve enterprises' strategic restructuring and the survival of the fittest, accelerate the technological transformation of traditional industries, establish the benefits and risk-driven mechanisms of technological innovation, promote large and medium-sized enterprises to establish a sound scientific research and development institutions, as soon as possible to form a number of large-scale enterprises group with independent innovation ability and to match multi-national corporations; change the approach that state-owned enterprise managers appointed by the superior, and gradually establish and perfect the market selection and wash out mechanism of enterprise managers, establish an effective entrepreneurship motivation, discipline and supervision mechanism, bring into play fully the entrepreneurs' soul and core role in technological innovation.

4.2 Construct the Experts Community of Regional Economic Development

In the era of knowledge economy, knowledge is the first resources or key resources of regional economic development, and people are carriers of knowledge who use knowledge to innovate and change the world; we say "the idea determines everything, the idea is wrong and then all are wrong", the idea refers to that of government leaders and entrepreneurs; even if the region has more scientific and technological resources, if not to be organized reasonably and optimize the configuration, it can not form a strong scientific and technological innovation capacity of region to promote regional economic development, thus need the outstanding intellectual leader in knowledge fields. Therefore, in order to enhance the capacity of regional scientific and technological innovation, we must establish experts community of regional economic development.

4.3 Construct a harmony and unification management system

The key to harmony and unification management system is that government should strengthen communication and coordination. (1) Internal coordination problem of government departments. Government would understand more about the factors which affects capabilities of regional scientific and technological innovation and it's role in their own scientific and technological innovation system. Summarize the successful experience of the relevant bodies and generalize them at other agencies, utilize new or existing forum, among government, enterprises, colleges and research institutions to discuss the common problems to influence on regional scientific and technological innovation system development; (2) the problem of co-ordination between business and government. Try to recognize explicitly that there are partnership and common benefits between the support of regional science and technology innovation system of state-owned enterprises and the private sector, to enhance their mutual complementarily. At present, more and more activities of state-owned enterprises run out that of private sector. Therefore, it is necessary to strengthen the coordination between them so that they can only work together for regional technological innovation system to make their own contribution; (3) to strengthen regional people's understanding of scientific and technological innovation system. Try to let people know the importance of innovative activity, as well as the means by which the people to support innovation, improve the well-known degree of the award in the technological development field; (4) to reinforce inter-regional and international cooperation, to strengthen recognition of the excellent Technology Center to encourage inter -regional and even cross-border cooperation in science and technology.

4.4 Construct the perfect investment and financing system of regional scientific and technological innovation

The upgrade of regional scientific and technological innovation capability depends on a great deal of R & D inputs, no abundant risk capital, same as the car does not oil, the whole system of regional scientific and technological innovation are not functioning. And rely on financial investment only, capacity is limited, or there would be Chinese "Tsukuba" situation; if only rely on corporate investment, because the risks may be difficult to do so. Therefore, must be guided by government policies favoring to form a perfect, including government, financial institutions and non-governmental organizations, diversified, market-oriented, new-style risk investment and financing system.

5. Conclusion

In a word, each region should base on understanding of composition of regional scientific and technological innovative competence and its upgrade mechanism, combing with its own practice of regional economic development, to constitute the countermeasures to upgrade the competence.

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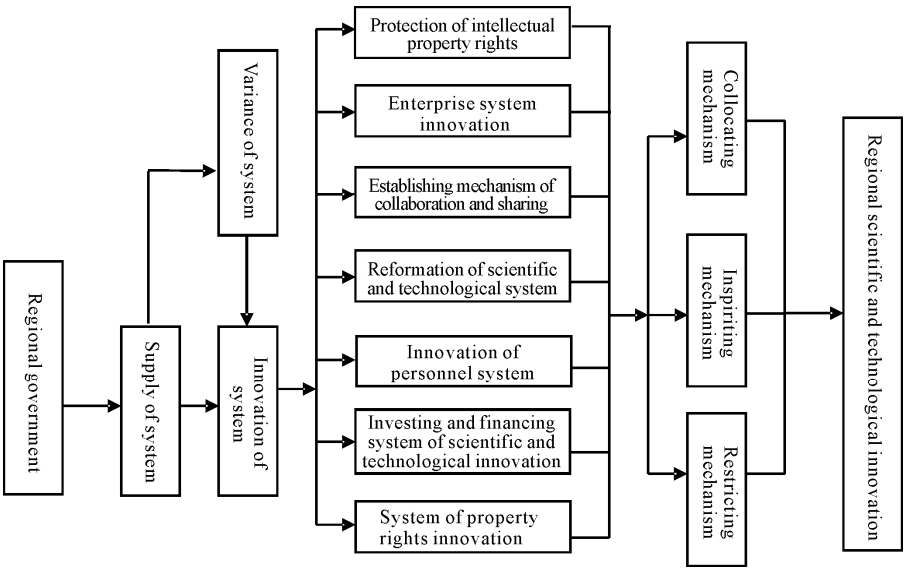

Figure 1. Supply of system of Regional scientific and technological innovation

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Optimization of Coagulation Process for Landfill Leachate Pre-Treatment Using Response Surface Methodology (RSM)

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Abstract

The effect of a coagulation process with ferrous sulfate as a coagulant on COD, apparent color and turbidity was evaluated using response surface methodology (RSM). A jar test method was used for the pre-treatment of mature landfill leachate of the Pulau Burung Sanitary Landfill, Malaysia. The results of response surface methodology (RSM) showed that ferrous sulfate was most efficient under alkaline conditions and with a coagulant dosage 10 g/l. At the optimum setting for coagulant dosage was 10 g/l and pH 11.7, resulted in maximum of (22%) in COD, (42%) in apparent color, and (31%) in turbidity. It was observed that the COD, apparent color and turbidity reductions decreased with pH and $FeSO_4$ levels beyond the optimum conditions. This paper illustrates the usefulness of experimental design in running experiments and optimization.

Keywords: Leachate, Response Surface Methodology (RSM), Coagulation, Ferrous Sulphate, Central Composite Design (CCD)

1. Introduction

A widely used method for treating municipal solid waste (MSW) is disposal landfill. Up to 95% of the MSW collected worldwide is disposed of in landfills (Fadel et al., 1997).

In a landfill, solid waste undergoes physico-chemical and biological changes. Degradation of the organic fraction of the wastes in combination with percolating rainwater produces a highly contaminated liquid called “leachate” (Kurniawan et al., 2006/a), which often is the most important point source of organic ground water contamination. Leachate from municipal, chemical or sanitary landfills are amongst the most contaminated polluted waters known (Oppenlander, 2003). Over 200 individual organic compounds have been identified in leachate, including cyclic and bicyclic compounds and aromatic hydrocarbons, at concentrations from < 1 μg/l to several hundred μg/l (Paxeus, 2000). The type of leachate depends on factors such as age and type of landfill, pH, and BOD_5/COD ratio. Leachate may be classified as young (or raw), and stabilized (mature).

To remove or reduce refractory pollutants in landfill leachate, several types of treatment have been adopted. Biological processes are the most cost-effective, but are not sufficiently effective if used as the sole treatment. Pre-treatment methods, usually physico-chemical processes, have been used to enhance leachate biodegradability (BOD_5/COD ratio). These physico-chemical treatments include ammonium stripping, chemical precipitation, coagulation–flocculation, ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO) (Kurniawan et al., 2006/b). Amongst these methods, coagulation-flocculation often is favored because it is cost effective, and easily accessible. Many researchers have studied landfill leachate treatment with various coagulants and objectives. A study found 55% and 42% COD reduction with $FeCl_3$ and $Al_2(SO_4)_3$ as a coagulant, respectively (Amokrane et al., 1997). Another study found 50-70 % color removal by combining activated carbon and coagulation (Zamora et al., 2000). A combination of coagulation and Fenton oxidation with $FeCl_3$ as a coagulant reduced COD by up to 90% (US Environmental Protection Agency, 2002). In another study coagulation pre-treatment by $FeCl_3$ effectively removed various large molecules from the raw leachate and aided subsequent treatment processes (Wu et al., 2004).

The objectives of this study were to evaluate the efficiency of ferrous sulfate ($FeSO_4$) as a coagulant on leachate generated from Pulau Burung Landfill Site (PBLS) located in Penang, Malaysia. Amongst the various coagulants, ferrous sulfate had been less under consideration in comparison with popular coagulants such as ferric chloride ($FeCl_3$) and aluminum sulfate ($Al_2 (SO_4)_3$);. The reduction of COD, apparent color and turbidity were the objectives of the study.

2. Materials and methods

2.1 Sampling

Samples of leachate were collected from the Pulau Burung sanitary landfill which is located in the Penang state of Malaysia and is classified as a semi-aerobic landfill site. This landfill receives an average of 500,000 metric tons of municipal solid waste annually and is equipped with two leachate storage ponds and aeration systems that facilitate further treatment processes. Samples were taken in September 2007 from pond LP1 and kept in plastic containers (high density polyethylene HDPE-volume of 40 litres), then transferred to the laboratory and held at 4ºC until used. Leachate was characterized for pH, COD, BOD_5, apparent color and turbidity. Analytical procedures of APHA (Standard method for examination of water and wastewater, 1992) and HACH standard methods (modification of APHA standard method as approved by United State Environmental Protection Agency (USEPA)) were followed.

The leachate obtained was classified as stabilized type based on leachate characterization.

2.2 Apparatuses

Apparent color and COD were measured by a HACH DR/120 portable datalogging spectrophotometer, (reported in units of Pt/Co and mg/l, programs 120 and 435, respectively). Apparent color units were calibrated based on the APHA recommended standard of 1 color unit being equal to 1 mg/l platinum as chloroplatinate ion (HACH Water Analysis Handbook, 1997). COD was measured with Dichromate Reactor Design, colorimetric, USEPA approved. BOD_5 was measured according to the standard method for examination of water and wastewater (reported in mg/l) with an YSI 5100 dissolved oxygen meter. pH was measured by HACH to adjust with a Senion pH meter with sulfuric acid (concentrated H_2SO_4) and sodium hydroxide (NaOH- 10M) was used for pH setup during experiments. Turbidity was measured with a HACH 2100 turbiditimeter (reported in NTU: Nefephelometric Turbidity Unit). $FeSO_4 \cdot 6H_2O$ supplied by Bedizen chemicals was used as coagulant.

Preliminary experiments were run using Jar test method, varying the coagulant dosage at an arbitrary dosage, and then varying the pH at the fixed coagulant dosage, in which the highest responses removals were achieved.

2.3 Experimental Design

Researchers in the field of engineering and technology often wish to determine the values of the process input parameters at which the responses reach their optimum. The optimum could be either a maximum or a minimum of a particular function in terms of the process input parameters. RSM is one of the optimization tools currently in widespread use in describing the performance of the coagulation process and to find the optimum of the responses of interest.

RSM is a set of mathematical and statistical tools that is useful for modeling and predicting the response of interest affected by a number of input variables with the aim of optimizing this response (Montgomery, 2004). RSM also specifies the relationships among one or more measured responses and the essential controllable input factors (Khuri and Cornell, 1996). When all independent variables are measurable, controllable and continuous in the experiments, with negligible error, the response surface can be expressed as:

$$y = f(x_1, \ x_2, \ ..., x_k) \tag{1}$$

where k is the number of independent variables. To optimize the response ''y'', it is necessary to approximate the functional relationship between the independent variables and the response surface. Usually a second-order polynomial Eq. (2) is used in RSM:

$$y = \beta_0 + \sum_{i=1}^{2} \beta_i x_i + \sum_{i=1}^{2} \beta_{ii} x_i^2 + \sum \sum_{i<j} \beta_{ij} x_i x_j \quad (2)$$

Where β_0, β_i, β_{ii}, and β_{ij} are regression coefficients, and x_i are the coded variables. The relationship between the natural variable ξ_i and the coded variables x_i is

$$x_i = \frac{\xi_i - (High\ level + Low\ level)/2}{(High\ level - Low\ level)/2}$$

3. Results and Discussion

A central composite design (CCD) (Montgomery, 2004; Khuri and Cornell, 1996) with two indepent variables was used. Thirteen runs were required to cover all possible combinations of factor levels. Data were collected as a 2^2 factorial design augmented by five (5) center points and four extra points (axial points or star points; Table1). The experiments were run in random order to minimize the effects of unexpected variability in the observed responses.

The experimental range for each independant variable was based on preliminary trials, coagulant dosage level were (8-10 g/l) and pH levels were (10-12).

The results of a 13-run CCD with two variables, coagulant dosage and pH, and three responses, COD, apparent color, and turbidity reductions, are given in Table 1. The percentage of COD, apparent color, and turbidity reductions were studied in their specified levels, coagulant Dosage (8-10 g/l) and pH (10-12). Response surface methodology was used to evaluate the effect of coagulant dosage and pH on the COD, apparent color, and turbidity reductions. Then a model that describes the behavior of each response in order to optimize the process by finding the best setting of coagulant dosage and pH that maximize COD, apparent color, and turbidity reductions was built. Second-order models for COD reduction, apparent color removal and turbidity reductions in terms of coded variable are given by Eq. 3, Eq.4, and Eq.5, respectively:

$$y_1 = 17.68 + 1.71\ x_1 + 4.6\ x_2 - 0.62\ x_1^2 - 1.82\ x_2^2 + 0.58\ x_1 x_2 \quad (3)$$

$$y_2 = 31.34 + 7.46\ x_1 + 221.60\ x_2 + 0.82\ x_1^2 - 12.95\ x_2^2 - 9.43\ x_1 x_2 \quad (4)$$

$$y_3 = 3.38 + 3.94\ x_1 + 47.13\ x_2 - .53\ x_1^2 - 33.65\ x_2^2 + 22.13\ x_1 x_2 \quad (5)$$

where x_1 and x_2 reperesent the coagulant dosage and pH, respestively, and y_1, y_2 and y_3 reperesent the responses COD, color and turbidity reductions, respectively.

The second-order regression models obtained for COD, apparent color, and turbidity reductions are satisfactory since the value of the coefficient of determination (R^2) is high and close to 1. The values of R^2 for COD, apparent color and turbidity reduction models are 0.93, 0.92 and 0.99, respectively. This indicates that 0.95 to 0.98 of the total variation is explained by the model and only (0.01-0.07) of the total variation is unexplained.

The results of analysis of variance (ANOVA) for the quadratic models summarize the analysis of each response and show the significant model terms. Table 2, shows the ANOVA for COD, apparent color, and turbidity reductions. The analysis of variance reveals that a second-order model adequately fits the experimental data for all responses. For COD reduction, It can be seen that linear effects of coagulant dosage (x_1) and pH (x_2) are significant. The quadratic contribution of coagulant dosage (x_1^2) and the interaction term between coagulant dosage and pH ($x_1 x_2$) does not have a significant effect on COD reduction although the quadratic contribution for pH (x_2^2) did. The linear and quadratic effects of pH and the linear effect of coagulant dosage on apparent color removal are significant, while the quadratic contribution of coagulant dosage is not. Interaction term was significant at less than 10%. Interaction between pH and coagulant dosage could be due to the acidic character of the ferrous ion causing the pH to decrease following the addition of the coagulant. Thus, adding coagulant to the leachate precipitates iron as $Fe(OH)_2$ and $Fe(OH)_3$ and decreases the pH. This result is consistant with previous research in which at high pH values, the precipitation of metal-hydroxides occurs mainly through co-precipitation (Tatsi et al., 2003). Another reason for the interaction between pH and coagulant dosage could be the presence of anionic surface agents in the leachate that have a negative charge at alkaline pH. Thus, the polar head of the surface molecule enters the double layer and stabilizes the negative colloids (Eckenfelder, 2000). The results of ANOVA for turbidity reduction showed that the linear effect of coagulant dosage and pH, quadratic effect over the linear effect of pH, and interaction term all were significant, while the quadratic effect for coagulant dosage was insignificant. The relative contribution of each factor to each response (COD, apparent color,

and turbidity reductions) was measured directly by the regression coefficient in the fitted model. A positive sign for the regression coefficient in the fitted model indicates the ability of the factor to increase the response, whilst the negative sign indicates the ability of a factor to decrease the response. The three-dimensional response surface for COD, apparent color and turbidity reductions are given in Figs. 1, 2, and 3, respectively, showing the effect of pH and coagulant dosage on COD, apparent color, and turbidity reductions. It can be seen that all responses exhibited a clear peak, which suggests that the optimum condition for maximum COD, apparent color and turbidity reductions are within the design boundary. Interaction plots between coagulant dosage and pH for COD, apparent color, and turbidity are given in Figs. 4, 5, and 6, respectively. It is evident that COD is not affected by the interaction (Fig.4) and the factors work independently, while Figs. 5and 6 show that the interaction between coagulant dosage and pH affect apparent color and turbidity reductions which indicate that the difference in apparent color and turbidity reductions at different levels of pH is not the same at all levels of coagulant dosage, and vice versa. Thus, the difference in apparent color and turbidity results mainly due to the interaction between pH and coagulant dosage.

4. Optimization of the experiment

Basing on the factorial experiment results we ran an optimization study to identify the optimal operating conditions for coagulant dosage and pH. In fact, once the models have been developed and checked for adequacy, the optimization criteria can be set to find out the optimum operating conditions. The maximum reduction for all responses was achieved at dosage 10 g/l $FeSO_4$ and pH 11.7. To validate the optimum combination of the process variables, confirmatory experiments were carried out. The selected combinations of the two variables resulted in 21.54% COD reduction (influent: 3520 mg/l, effluent: 2762 mg/l), 41.84% apparent color removal (influent: 6420 Pt.Co, effluent: 3734 Pt.Co), and 31.20 % turbidity reduction (influent: 118 N.T.U, effluent: 81.2 N.T.U). it can be said that COD, apparent color and turbidity reductions all had the same behavior (Maximum reduction) in the optimum range and decreased beyond it. This behavior suggests that all of the responses were mostly produced by the organic matters as the same source. This pattern in consistent with that of Azizi et al. (2007) who stated that "*color was mainly contributed by organic matters with some insoluble forms that exhibited turbidity and suspended solids readings"*.

5. Conclusion

Based on application of coagulation-flocculation with ferrous sulfate and anionic polymers, w concluded that the optimum conditions for pH and coagulant dosage are 11.7 and 10 g/l, respectively, resulted in 21.54% COD reduction (influent: 3520 mg/l, effluent: 2762 mg/l), 41.84% apparent color removal (influent: 6420 Pt.Co, effluent: 3734 Pt.Co), and 31.20 % turbidity reduction (influent: 118 N.T.U, effluent: 81.2 N.T.U). By adding coagulant to sample and after rapid mixing stage, the initial pH reduced, but still remained in alkaline range, suggesting that there was an effect of acidic characteristic of ferrous sulphate.

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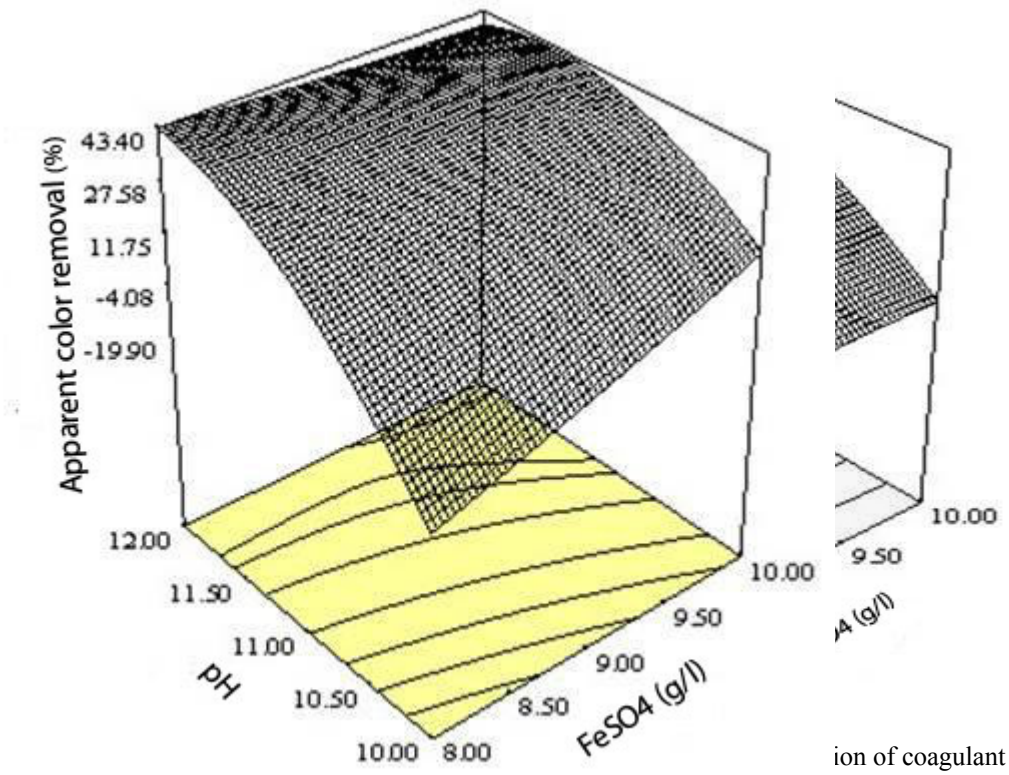
Table 1. Central composite design (CCD) in natural and coded variables with the experimental data and predicted values

Natural variable		Coded variable			Responses	
ξ_1	ξ_2	Dosage	pH	COD	apparent color	Turbidity
8	10	-1	-1	8.1	-24.3	-51.4
10	10	1	-1	10.4	25.2	-103.7
8	12	-1	1	16.6	33.8	-5
10	12	1	1	21.2	44.7	31.2
7.59	11	-1.41	0	15.2	32.6	9.2
10.41	11	1.41	0	20	32.1	-1.7
9	9.59	0	-1.41	9	-30	-131.7
9	12.41	0	1.41	21.4	39.6	6.7
9	11	0	0	18.5	32.1	1.7
9	11	0	0	18.9	32.3	2.5
9	11	0	0	16.8	32	5.9
9	11	0	0	16.5	30.8	3.4
9	11	0	0	17.7	29.5	3.4

Table 2. Analysis of variance (ANOVA) for COD, apparent color and turbidity reductions

a-COD reduction					
Source	Sum of Squares	DF	Mean Square	F-Value	P-value
Model	218.47	5	43.69	19.7	0.0005
Dosage	23.42	1	23.42	10.56	0.0141
pH	169.61	1	169.61	76.45	< 0.0001
Dosage × Dosage	2.68	1	2.68	1.21	0.31077
pH × pH	23.07	1	23.07	10.4	0.0146
Dosage × pH	1.32	1	1.32	0.6	0.4653
Residual	15.53	7	2.22		
Total	234	*12*			
b-Apparent color removal					
Model	5902.73	5	1180.55	15.60	0.0011
Dosage	445.41	1	445.41	5.88	0.0457
pH	3873.29	1	3873.29	51.17	0.0002
Dosage × Dosage	4.72	1	4.72	0.06	0.8100
pH × pH	1166.85	1	1166.85	15.42	0.0057
Dosage × pH	372.49	1	372.49	4.92	0.0620
Residual	529.86	7	75.69		
Total	12				
c-Turbidity reduction					
Model	27834.6	5	5566.93	745.53	< 0.0001
Dosage	124.15	1	124.15	16.63	0.0047
pH	17768.7	1	17768.7	2379.6	< 0.0001
Dosage × Dosage	1.94	1	1.94	0.26	0.6263
pH × pH	7878.2	1	7878.2	1055.06	< 0.0001
Dosage × pH	1958.06	1	1958.06	262.23	< 0.0001
Residual	52.27	7	7.47		
Total	27886.9	12			



ion of coagulant dosage and pH

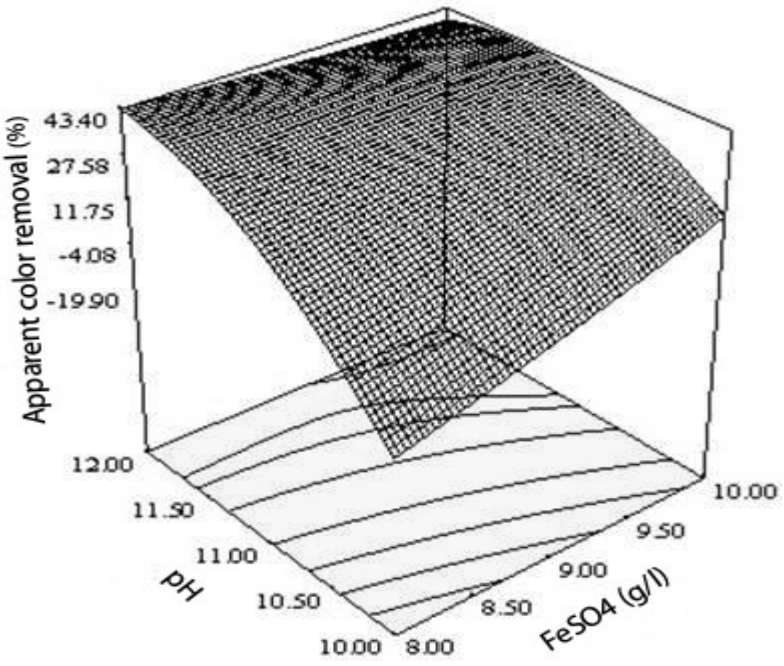


Figure 2. Three-dimensional response surface for apparent color removal as a function of coagulant dosage and pH

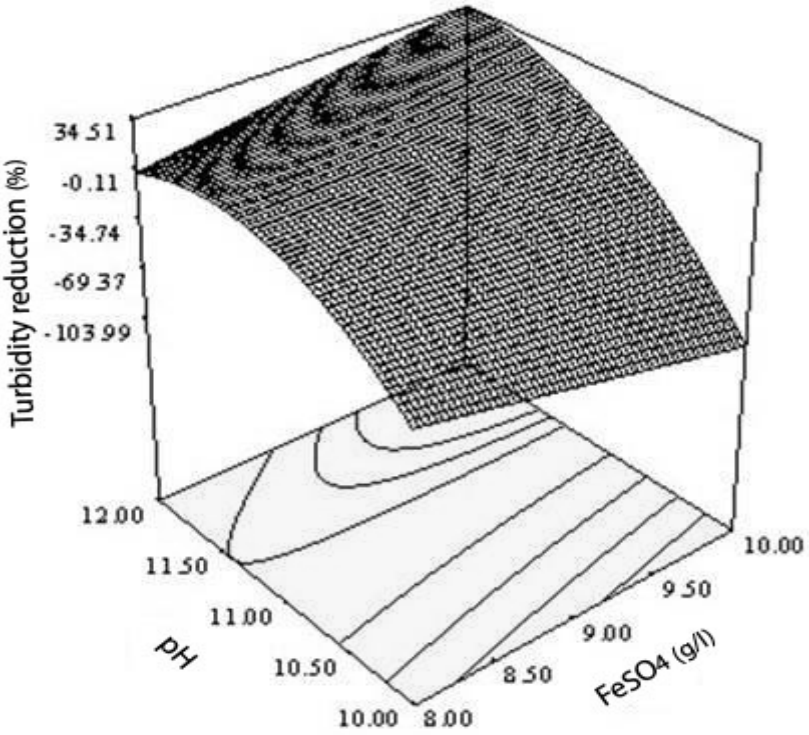


Figure 3. Three-dimensional response surface for turbidity reduction as a function of coagulant dosage and pH

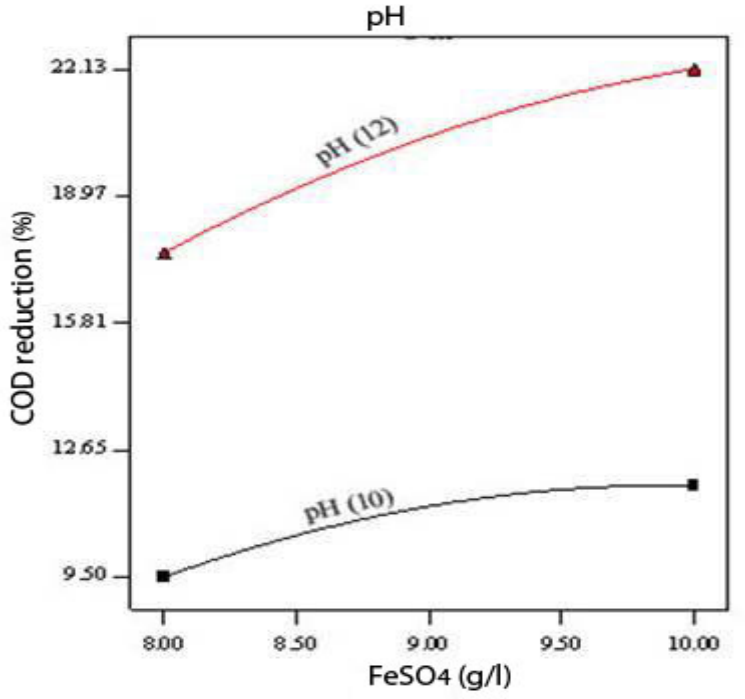


Figure 4. Interaction effect between coagulant dosage and pH on COD

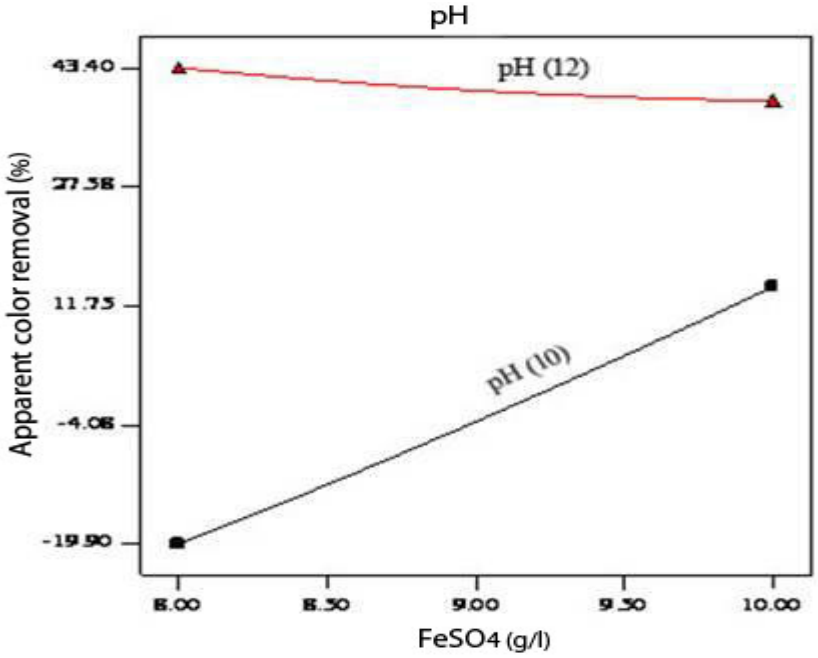


Figure 5. Interaction effect between coagulant dosage and pH on apparent color

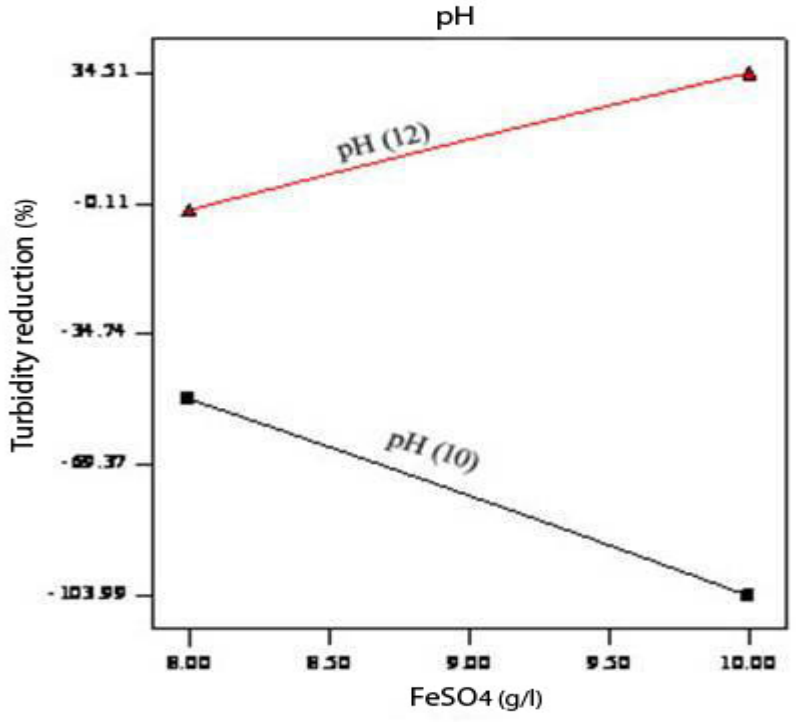


Figure 6. Interaction effect between coagulant dosage and pH on turbidity

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Study on the Management Factors of the Sustainable Development Environmental Governance Mechanism in Inner Mongolia

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Abstract

The sustainable development mode is the development mode integrating material civilization, spirit civilization and ecological civilization, and its connotation includes the sustainable growth of economy, the cycle utilization of resources, the harmonious intergrowth of society, the inheritance and extension of cultures, and the balance and evolvement of nature and zoology. The resource and environmental conditions and the actuality of social economic development of Inner Mongolia decide the indivisibility of the sustainable development and the environmental governance, and the working principle of the environmental governance mechanism should be explained from many management factors such as the environmental system, the environmental planning, the environmental monitoring, the environmental technology, and the environmental culture.

Keywords: Sustainable development, Environmental governance, Management factors

The sustainable development is the common development strategy to exactly process and harmonize the mutual relationships among population, resource, environment, economy and society for developed countries and developing countries in the 21st century, and it is the development which "not only can fulfill the demands of modern people, but will not harm the descendants' ability to fulfill their development requirements (World Commission on Environment and Development (WCED), 1997)". When emphasizing the developments of economy and society, the sustainable development must persist in improving the environmental quality and keeping the integrity of the earth zoology to promote the sustainable, stable and healthy development of the nature-economy-society composite ecological system.

1. Relationship between environmental governance and sustainable development

The sustainable development is the scientific development mode giving attention to environmental benefits and economic benefits. The environment is not only the necessary carrier and implementation approach of the economic benefit, but the part and embodiment of the economic benefit. Under the traditional production mode and the consumption mode, the environment is the supplier of the raw materials and the receptor of the industrial cycle wastes, and the increase of narrow economic benefit will always go with the decrease of the total environment benefit. Because the loss of the environmental benefit may be assumed by the whole system, or be showed after a while, so the changes of space and time will make the environmental benefit to be ignored intentionally or unconsciously in the snatching process of the narrow economic benefit. "The tragedy of the commons (Garrett Hardin, 1968)" is the absolutely proper explanation for the disagreements between the environmental benefit subjects and the economic benefit subjects.

The sustainable development and the ecological environmental protection have been the consensus of modern international society, and the basic national policy of China. After the 16th National Congress of Communist Party of China, CPC and Chinese government proposed the "all-round, coordinated and sustainable" Scientific Outlook on Development, and took "building a well-off society in an all-round way" as the strategic target to plan the harmonious development of people and environment as a whole. Therefore, Chinese State Planning Commission constituted "Program of Action for Sustainable Development in China in the Early 21st Century" with relative departments, and put forward the target, main domains and guarantee measures of the sustainable development in China, and took "eliminating environmental pollution, effectively protecting and reasonably utilizing natural resource, continually perfecting and effectively implementing the laws and regulations of the environmental protection, establishing stable and reliable ecological security guarantee system, and quickly developing the cycle economy" as the main measures to push the sustainable development and all-round enhance people's material and spiritual living levels.

2. Actuality of environmental governance in Inner Mongolia

Inner Mongolia which embodies into the inland is in the north of China, and 80% lands of this region are drought and half-drought regions, and local climate is very bad, and the water resource is far insufficient. Because many man-made unreasonable economic activities such as population explosion, over-developed resources, over-loading stock and

over-reclaiming have far exceeded the actual carrying capacity of the local ecological system, the weak ecological environment which has been impacted by the traditional agricultural policy and production mode for a long time becomes more and more weak. With the quickly pushing of the industrialization and urbanization of Inner Mongolia, the conflict between the development pressure of social economy and the continually aggravated environment becomes more and more serious. The environmental governance has been the key problem to influence the sustainable development of society and economy, and relate to the health of the public.

As viewed from the sources of the environmental problems, the environmental problems mainly include unreasonable industrial structure, coarse economic growth mode, high energy consumption of unit GDP, quick growth of industrial projects with high energy consumption, high discharge, high pollution and low benefit, very obvious conflict between large discharge amount of pollutions and the small environment capacity index, low harmless processing rate of living sewage and living garbage, lagged pollution governance establishments in many industrial enterprises, ascending tendency of main pollution discharge amount, serious atmosphere and water protection situation in key regions, very hard environmental governance tasks, aggravated agricultural source and breeding pollutions, bad living and production environment in countries and pasturing areas, weak ecological environment, weak ecological carrying and adjusting ability, ecological damages induced by the degenerated ecological function and out-of-order resource development, and multiple hidden environmental security troubles.

As viewed from he subjects of the environmental governance, the main problems include that the existing system and mechanism of environment management are not mature, the construction of the environmental infrastructure is lagged, the environmental institution is not mature, the consciousness of environmental protection is still deficient, the execution ability of the environmental protection is still weak, the environmental monitoring and emergency processing ability is in weakness, and the multi-environmental protection mechanism has not been completely established. To only pursue their own economic benefits, some enterprises often seriously get out of the environmental line in new projects, extended projects and rebuilt projects. Taking the situation of Alashan League as the example, in 210 built and building projects with over 1 million Yuan's investment, 135 projects lacked in the procedure of environmental evaluation, and this number occupied 64.3% of the whole amount (Tao, 2007), which fully indicated that the shortage of the environmental monitoring function and the austerity of the environmental governance situation.

3. Analysis of the management factors in the Inner Mongolian environmental governance mechanism

The key factors of the environmental governance mechanism include the constitution of environmental laws and policies, the implementation of the environmental planning, the construction of environmental management, evaluation and monitoring system, the research and application of environmental technology, the environmental education and drumbeating of the environmental protection. As viewed from the environmental management, above key factors can be generalized by the management of environmental systems, the management of environmental planning, the management of environmental monitoring, the management of environmental technology and the management of environmental cultures.

3.1 Management of environmental systems

The management of environmental systems is a kind of environmental management to adjust industrial structure, standardize the production behaviors of the enterprise, promote the technical reform and innovation of the enterprise, and harmonize the relationship between the technical and economic development and the environmental protection, and it includes the establishments and perfection of the environmental standards, laws and policies, and the setting and responsibility division of the environmental management organization institutions. The policies show managers' position, guideline and promise, and they should be consistent with environmental laws and regulations, and they are embodied in convenient or supported supplies of corresponding human sources, financials and technologies. The environmental management organization institutions are concrete main bodies to implement environmental laws, policies and plans. The requirements of the environmental system management are also embodied in strict procedures, criterions, prohibitions and maneuverability.

Quite part of Chinese environment and resource laws were constituted in the planed economic system before 1992, and many contents have not corresponded with the requirements to develop the socialism market economy obviously. At present, the measure to control the environmental pollutions such as waste water and exhaust gas is to impose the over-standard discharge fees, but the charges are always not complete and the charge standard is too low, and many enterprises and local governments often adopt many behaviors to avoid the pollution control because of their own benefits, so the control aim of the pollution discharge can not be realized, and most of the cost of environment pollution has been imputed to the society.

The existing implementation mechanism of environmental laws is not perfect, and many problems exist in it, for example, the administration right is extended and even begins to influence the legislation right, and it can not be directly restrained by the election system and the public politics, and part of administration right even contains the conciliation

and disposal right, but it obviously possesses the independence of judiciary. Though the environmental influence evaluation has been performed, but it is still hard to balance the economic benefits and the environment benefits in the local decisions, and it more easily slides to economic benefits for short-term target in practice. The admittance procedure and the entity status of the public opinions have not been regulated concretely, and the public participation still lacks in the support from legal procedure and the pressure from the legal responsibility.

3.2 Management of environmental planning

The management of environmental planning includes the adjustment of industrial distribution, the constitution of environmental governance aim, the design of project and corresponding indexes, the financing and use of environmental capitals, and the inspection and supervision of the implementation of environmental planning. The base and reference to constitute the environmental planning is the actuality of the environment and the environment management, and the emphasis of planning is the measure or scheme aiming at important factors influencing the environment.

The economic development mode of Inner Mongolia lays particular stress on planting and breeding, and the farming and animal husbandry always occupies large proportion in the economy of the autonomous region. In the GDP statistics of 2007, the proportion of the first, second and third industry was 11.7: 49.2: 39.1 (National Bureau of Statistics of the People's Republic of China, 2008), and this proportion in Inner Mongolia was 13: 51.2: 35.8 (Inner Mongolia Autonomous Region Bureau of Statistics & Inner Mongolia Survey Office of National Bureau of Statistics of China, 2008), and the proportion of the first industry in the Inner Mongolia was 11.11% higher than the national average level. The development of the farming and animal husbandry largely depends on natural resources such as infields and grasslands, and will consumes large resources, and the production and management mode of the farming and animal husbandry is relatively coarse, and the farming and animal husbandry still develops only depending on increasing the amount of livestock, and the planting depends on extensive cultivation to extend the reproduction, which will induce a series of serious consequences such as the retrogression of lands, deficient water resource, destroyed natural vegetation, over-stock and depredated ecological environment, so the sustainable development of the arming and animal husbandry is still in the corner.

The industrial layer of Inner Mongolia is still low, and the industrial structure gives priority to the heavy industry, and the energy industry, the coal industry and the steel industry occupy 60% of the gross of industrial economy in the whole region, and many enterprises still adopt lagged production technologies, and produce high consumptions of energy and resource, and the coarse growth mode with high investment, high consumption and high discharge has not been transformed at all, and the conflict between the quick development of the economy and the carrying ability of the environment is more and more serious, the environmental governances for the atmosphere pollution in key cities, the water pollution in key drainage areas are still very difficult.

The environmental governance and protection needs the support of the environmental technology, and the capital is the necessary basic resource for the innovation of the environmental technology. Because the economic capital of Inner Mongolia is still weak, and the economic accumulation is deficient, and the financing channel is limited, and the flow-in of talents, technologies and capitals is very difficult because of the influences from the capital economy, and the deficiency of capital is one of important factors to impact the environmental governance in Inner Mongolia.

3.3 Management of environmental monitoring

The management of environmental monitoring is a kind of environmental management which takes the environmental standard as the references, and takes the improvement of environment quality as the target, and takes the evaluation of environmental quality and the environment monitoring as the contents. It is a kind of standardized management, and it concludes environment survey, monitoring, research, information, communication, checking and evaluation.

First, the environment monitoring management should possess high-efficiency work mechanisms. The management department should establish the authority of the environmental law execution, strengthen the force to execute environmental laws, and strictly investigate and punish illegal pollution discharging behaviors which would pollute the environment and destroy the ecological environment. In the pollution governance of important drainage areas and regions, the relative governance should reduce the discharge grosses by the environment protection projects, and in the construction of urban environment establishments, the relative department should reduce the living pollution grosses by the pollution governance infrastructures, and in the environment protection works about key enterprises, the relative department should reduce the pollution discharge grosses by developing the clean production and cycle economy, and in the environment protection examination of construction projects, the relative department should use the increment to adjust the grosses, and scientifically and reasonably utilize the environment capacity and promote the optimization of industrial allocation. The daily work emphasis of the environmental monitoring management is to monitor the discharge index of main pollution source, and strictly perform the pollution discharge control system, and dispose the environmental illegal behaviors such as building before authorizing, illegal pollution discharging and pollution shifting from the headstreams.

Second, the environmental monitoring management needs the active participation of the public. The public participation is the essential impetus of the environmental governance, and the premise of participation is to confirm the legal character and legal status of the public participation, and define the public's delegacy of the public benefit. The guarantee of the participation is to establish the systematic public participation system and confirm the public right to information and decision-making, the supervision right, the consensus right, the association right, the judicial relief right, and the mutual support of procedures. In addition, the regulations of public participation should include the articles about the legal responsibility which could punish the subject who has the responsibility to assist and admit legal effect but reject his responsibility.

3.4 Management of environmental technologies

The management of environmental technologies mainly includes the researches about the environmental problems and environmental science and technology, the development and extension of environmental science and technology, the establishment of the environmental information management system, and the communication and cooperation of international environmental science and technology.

The realization of the environmental governance target is to strengthen the independent innovation ability of the environmental science and technology. The advancement of important environmental science and technology always bring the large development of environmental governance. The actuality and ability of the existing environmental science and technology in Inner Mongolia can not accord with the requirements of environmental protection well. First, the environmental management and decision lack in scientific work mechanisms, and many decisions about important environmental protection problems were made in a hurry before researching and demonstrating. Second, the systematic science and technology works of environmental protection in recent years dropped to large extents, and the amount of important research and survey projects is few, and the basic data are deficient, and part of results could not connect with the management well. Third, the technological repertory and communication of pollution prevention are deficient, and the transformation rate of science and technology results is very low, and the industrialization can not be formed. Fourth, the basic ability of environmental monitoring and law executing is weak, and the environmental protection standard system needs to be further perfected. Fifth, the quality of science and technology group should be further enhanced, and excellent young science and technology talents are deficient. Sixth, the investment of science and technology is very deficient, and the stable environmental science and technology investment mechanism has not been stabilized, and the basic condition of scientific research is still lagged.

3.5 Management of environmental cultures

The management of environmental cultures includes the methods and activities about the sustainable development cultural construction, the environmental education development and the environmental consciousness cultivation. The sustainable development culture is the concrete representation of material civilization and spiritual civilization in the natural and social ecological relationship, and is the culture about human and environment coexist harmoniously, survive continually and develop stably. Its differences with the traditional culture include its comprehensive character, system character, adaptability, continuity, and ecological relationship between part and whole, short-term and long-term, competition and intergrowth, development and compensation.

The sustainable development culture represents advanced culture, and it is not only the production of the sustainable development practice, but the cultural soil to cultivate and strengthen the environmental consciousness. Only continually enhancing people's environmental consciousness, they can give more attention to the environmental problems, deeply study these problems, adopt active actions, and bring the environmental protection concept into many domains such as the social value concept, the decision-making of government, the production activity of enterprise, and citizens' consumption habits.

To create and develop the sustainable development culture, the government should continually perfect the system running mode of the sustainable development from many aspects such as law, policy, economy, science and technology, and education, harmonize the relationship between environmental protection and economic development, establish and perfect the social supervision and consensus supervision mechanism, enhance the ability to participate in the environmental management for the public, make the public gradually establish specific value view, production view, consumption view and behavior view about the sustainable development, promote the enhancement of the overall national quality taking the ecological value concept and the environmental ethics as main contents, promote the large enhancement of the urban living quality taking active health and harmonious intergrowth between human and nature as the main requirements, and promote the large enhancement of the urban and rural civilization degree taking good social fashion, civilized public order and pretty environmental quality as the main signs.

4. Conclusions

Various management factors about the environmental governance form an organic integration under mutual functions, and the implementation of the target of environmental governance hangs on the comprehensive function of suited

hardware (capital, technology and equipments), software (system reform, complete legal system, comprehensively planning and system optimization), and the ability of behavior subjects. The optimization of the environmental governance mechanism in Inner Mongolia must persist in the Scientific Outlook on Development, comprehensively utilize multiple control measures such as law, policy, economy, science and technology, and education, quicken the transformation of economic development, promote the essential transformation of the economic growth mode, accomplish the adjustment and industrial updating of industrial structure, establish the ecological economic development mode with local characters, high-efficiently and reasonably allocate and continually utilize the natural resources, and realize the harmonious development of economy, society, population, recourse and ecological environment.

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Willingness to Pay towards the Conservation of Ecotourism Resources at Gunung Gede Pangrango National Park, West Java, Indonesia

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Abstract

The objectives of this study are to determine the visitors' willingness to pay for conservation of the resources at Gunung Gede Pangrango National Park (TNGP), and to determine the satisfaction of visitors towards the use of the ecotourism resources of the park. The dichotomous choice Contingent Valuation Method (CVM) was employed to determine the willingness to pay (WTP). A total of 423 respondents were interviewed face-to-face to collect the data. The results show that most visitors are satisfied with the ecotourism resources in TNGP, many of the visitors have come to TNGP more than once. In order to sustain the benefits derived from the resources at the park, the visitors agree that various organization involved must cooperate to conserve and protect the ecotourism resources. The economic benefit of conservation of the ecotourism resources at TNGP was measured using the visitors' WTP for higher entrance fee to the park. A logit regression model was used to determine visitors' willingness to pay. The results indicate that income, gender (male) and residential (urban) were the significant factors that influencing the visitors' WTP for the entrance fee to TNGP. The mean WTP is found to be RP 7629.77 per visit. It is estimated that in 2004 the benefits of conservation of the ecotourism resources in TNGP amounts to RP 452 million.

Keywords: Willingness to pay, Contingent Valuation Method, Sustainable Tourism, National park

1. Introduction

National park like other environmental resources and public goods used by humans can benefit in many different ways. Those environmental resources have many functions relating to the ecological functions. They also offer recreational resources to everyone who visits this park. National parks which are offered as ecotourism sites can enhance national income, and have economic impacts to society around the area of national park. Then, it can make up the national economic growth.

Currently, the popularity of national parks for recreational purposes in many countries is rising. As a selected place for ecotourism, national park covers both an opportunity and challenge, because although the tourism development can produce some economic benefits, it can also negatively impact the natural environments and socio-cultural circumstances. The opportunity is to offer the attractive view of national park resources for ecotourism that will provide visitors' satisfaction. On the other hand, the challenge is to realize the harmonizing component of the national park, which is to conserve the scenery and the natural resources, also the historic objects and the wildlife therein. This can prove to be complicated under conditions of high visitation to the national park. A strategy that could be formulated and implemented by the government and the private sector in managing the national park that would combine both the opportunity and challenge is by getting revenues from use of the resources by charging entrance or user fees.

Gunung Gede Pangrango National Park (TNGP) has long been recognized as a popular ecotourism site in Indonesia as illustrated by the large number of visitation at the park (Table 1). These large numbers of people may create a number of problems, where it will devastate the biodiversity of the park, due to the visitors' activities (Sjaifuddin, 2004).

In order to manage and maintain the ecotourism resources at TNGP, the management needs a large amount of budget which is currently supported by the government fund and visitors' user fees. Government fund for these national parks is limited, because of national economic aspect and other government allocations such as for infrastructure, education, healthcare, etc. Thus, the management of the park may have to obtain more revenues by increasing the visitors' user fees. At present, low entrance fee is charged to visitors who want to enjoy the TNGP resources, and this entrance fee has never been increased since 15 years ago (Management of TNGP). Due to this low fee, the number of visitors to TNGP has always been high.

The potential benefits from charging user fees and differentially pricing access to national parks are significant. As charging fees could lead to a more optimal market (Dixon and Sherman, 1991), it could provide the vehicle for capturing benefits of ecotourism which often accrue primarily to the private sector. It can also reduce visitation in areas that suffer from overuse and accompanying ecological damage. This study therefore attempts to assess the net economic values of recreational resource in this park by using a Contingent Valuation Method (CVM).

This paper is organized into five sections. Section one is the literature review, followed by section two which describes the location of study. Section three explains the methodology and sources of data used in study. The empirical results are presented in section four, while the last section offers some discussion and concluding comments with regard to non-market valuation works.

2. Sustainable Development of Ecotourism

The essentials for the planning, development and management of ecotourism are sustainable resource management and conservation of natural areas. Sustainable development in ecotourism implies that the natural, cultural and other resources are conserved to bring benefits to the present society without sacrificing the needs of the future. Ecotourism can help in justifying and paying for conservation of natural and cultural resources if the ecotourism resources are properly developed based on the concept of sustainability. Sustainable development is needed because ecotourism activities are related to the natural environment, historical heritage and cultural patterns of the areas. As a result, the adoption of the concepts and principles of sustainable development to ecotourism in protected areas has been widespread. These principles have been applied to the tourism industry, since ecotourism is related to the environmental management in protected areas (Butler, 1998).

IUCN (1994) define environmentally sustainable tourism as a "form of tourism that supports the ecological balance" and tourism which is developed and maintained in an area (community, environment) in such a manner and ecotourism on such a scale that it remains viable over an indefinite period and does not degrade or alter the environment. According to Boo (1990 and 1993), to be sustainable, tourism development must meet the needs of present tourists and host regions while protecting and enhancing opportunities for the future. IUCN (1994) and Honey (1999) identified seven points for sustainable ecotourism which:

i. Involves travel to natural destinations
ii. Minimizes impact
iii. Builds environmental awareness
iv. Provides direct financial benefits for conservation
v. Provides financial benefits and empowerment for local people
vi. Respects local culture
vii. Supports human rights and democratic movements

The National Ecotourism Strategy (Commonwealth Department of Tourism, 1994) defined ecotourism as "ecotourism is nature-based tourism that involves education and interpretation of the natural environment and is managed to be ecologically sustainable". It notes that ecotourism should be ecologically sustainable, provide visitor satisfaction, local benefits and be appropriate to its environmental and cultural setting. Ecotourism includes forms of tourism that are consistent with natural, social, cultural and community values. In ecotourism, 'greening' of tourism is important where environmental aspects are given high priority. To be considered as ecotourism, an activity or experience must positively contribute to the environment. Butler (1998) stated that "if the environment has not at least achieved a net benefit towards its sustainability and ecological integrity, then the activity is not ecotourism".

Wight (1993) has identified nine principles that should underpin sustainable ecotourism These are:

i. Develop the resource in an environmentally sound manner and not degrade it
ii. Provide first hand, participatory and enlightening experience;

iii. Involve education among parties i.e. local communities, government, non-governmental organizations, industry and tourists;
iv. Encourage all parties' recognition of the intrinsic values of the resource;
v. Recognition of limits and acceptable of the resource;
vi. Promote understanding and partnership between many players;
vii. Promote moral and ethical responsibilities and behaviour towards the natural and cultural environment;
viii. Provides long-term benefits and
ix. Ensures the underlying ethics of responsible environment are applied to external and internal.

Ecotourism depends on minimal impacts to the environment and therefore does not contribute to damaging it. It is not ecotourism if it damages the natural resources. Well (1997) stated that "ecotourism has by definition minimal environmental impact, since unspoiled natural environments are the attraction of this type of tourism". Finally, there is a need for governments to encourage good quality sustainable ecotourism and control poor quality ecotourism.

Ecotourism, with respect to sustainable development, is interpreted as relating to economic sustainability, ecological sustainability, the long-term viability of tourism, and accepting tourism as a part of an overall strategy for sustainable development and biodiversity conservation of a protected area (Butler, 1998). The development of ecotourism has demonstrated the economic value of natural areas for recreation and tourism itself, local economic development and socio-cultural development. The ecotourism generates and enriches visitors' experiences, and provides employment, income and other benefits to local communities. Even though ecotourism is sensitive to the qualities of the natural and human environment, it also has an impact on the environment.

In terms of sustainable tourism (or ecotourism) development, a good example study was conducted by Barke and Towner (2004), to investigate tourism development in Malaga, Spain in the context of sustainable tourism (ecotourism) development. They used a simple model for the assessment of sustainable tourism which included four elements: environment, economic, socio-cultural and political. When they compared the eastern coastal area with an older developed site (Costa del Sol), they found that the growth of the tourism development in terms of sustainable forms was superficial. Their findings of two other proposed tourism developments were that there were clear failures in the context of sustainable tourism development.

Ecotourism can be an effective means to achieve the conservation of biological diversity, both for the benefit of the tourism industry and for the intrinsic and economic values of biodiversity (WCMC, 1997). Ecotourism activities are directly related to natural resources and many of these activities take place in protected areas. That is why ecotourism has been identified as a key industry sector with a legitimate right and obligation to contribute to the policy and implementation of biodiversity conservation measures. Ecotourism practices in protected areas must be ecologically sustainable and management of these practices must lead to the long-term maintenance of ecosystems and species.

In order to develop and manage the ecotourism industry successfully in the country, the consideration of economic impacts (sometimes called economic benefits) must be well understood. The concept of sustainable ecotourism will be achieved if economic, environmental and social and cultural impacts are weighed together (Ross, 2002). Economic impact refers to the change in sales, income, jobs or other parameters generated by ecotourism. A common ecotourism goal is the generation of economic benefits whether they are jobs for society, revenue for the parks or profits for companies. The possible economic benefits of ecotourism are:

i. Income generated and its contribution to the Gross National or Domestic Product
ii. Foreign exchange from international tourism
iii. Generation of local employment through direct and indirect employment
iv. As a catalyst for other economic activities using tourist expenditure
v. Contribution to government revenues e.g. airport departure taxes

3. Literature review

Most environmental goods and services, such as clean air and water, ecotourism, healthy fish and wildlife populations, are not traded in markets. Economic valuation technique is a method that has been developed in valuing the environmental goods and services, and generally known as non-market valuation. This method can help economists, government, and society to predict the impact of economic decision and activities into environment and resources, and also to identify and estimate the monetary value of all economic benefits that a society derives from environmental resources.

The economic approach in valuing environmental changes is based on people's preferences for changes in the state of their environmental. The term value in economics has a precise definition, it is the price individuals are willing to pay in

order to obtain a good or service. The basic economic concepts of supply and demand are employed to estimate willingness-to-pay (called producer surplus and consumer surplus, respectively). Lipton et al. (1995) noted that economic value is a measure of what the maximum amount an individual is willing to forego in other goods and services in order to obtain some good, service, or state of the world. This measure of welfare is formally expressed in a concept called willingness-to-pay (WTP).

Economic valuation can be defined as the attempt to assign quantitative values to the goods and services provided by environment resources, whether or not market prices are available (Barbier *et al.*, 1997). The environmental resources are always faced with the problem of limited information about the price, costs, and quantity consumed. Therefore the benefits and costs of these resources are difficult to determine. Hence, using of the economic valuation process in finding WTP value could solve the problems.

Non-market values can be categorized as use values and non-use value. The use value of an asset is the value to society from the active use of the asset. This value involve direct use value (timber, firewood, hunting, fishing, ecotourism, research, and education), indirect use value (soil protection, flood control, and ecological functions), and option value (future direct and indirect uses). Non-use values reflect the value an individual or society places on an asset, even if they never intend to use this asset directly. This involve existence value (biodiversity, habitat, and endangered species), and bequest value (object, species, and environment for the future generation).

NOAA (2006) noted that environmental valuation is largely based on the assumption that individuals are willing to pay for environmental gains and, conversely, are willing to accept compensation for some environmental losses. The individual demonstrates preferences, which, in turn, places values on environmental resources. That society values environmental resources is certain; monetizing the value placed on changes in environmental assets such as coastal areas and water quality is far more complex. Environmental economists have developed a number of market and non-market-based techniques to value the environment. Figure 1 presents some of these techniques and classifies them according to the basis of the monetary valuation, either market-based, surrogate market, or non-market based.

Brandon and Margoluis (1996) in their paper of structuring ecotourism noted that the distinguishing feature of ecotourism is that it benefits biodiversity conservation. There is a set of five benefits to conservation which should be evident in any tourism activity which claim to be ecotourism. Therefore, Himayatullah (1999) stated that there are multivariate analyses to investigate empirically the WTP of the consumers for recreational services in two selected parks in Northwest Frontier Province (NWFP), Pakistan. The study use CVM to estimate WTP. A series of multivariate analyses were performed to explore the variation in different measures of visitor's WTP for improved recreational services of the two parks.

In order to understand the determinants of respondents' WTP responses and to see whether these determinants are consistent with economic demand theory, a series of multivariate analyses were performed with the survey data. The results indicated that total travel cost, income of visitor; distance, and quality of recreational services were found to be statistically significant 1 percent level. Other variables including education and age were significant at 5 and 10 percent significance level, respectively. Regarding demand elasticity, own-price, cross-price and income elasticity were also significant.

Loewen and Kulshreshta (1995) used travel cost method (TCM) and CVM to estimate the economic value of the recreation experience at the Prince Albert National Park (PANP) of Saskatchewan. The main purposes of their study are to estimate the economic benefit to society from recreation in the PANP and to analyze park user patterns and characteristics. A total of 79 respondents (PNAP visitors) have been collected in their survey, where the sample consisted of mainly day visitors, accommodation guests (both commercial and non commercial), and campers. The results in this study showed that the respondents spent on average $30 per person per day on their visit to PNAP. Analyzing the sample visitors types, day visitors, accommodation guest, and campers spent on average $27, $44, $13 per person per day, respectively. The TCM estimates the consumers' surplus was $24 per person per day, and CVM estimates the consumers' surplus was $13.68 per person per day. Thus, the total value of recreation in PNAP was estimated at approximately $16 million a year.

Arin and Kramer (2002) used CVM for an exploratory study on diver demand for visiting a marine sanctuary in the Philippines. In this study, an exploratory contingent valuation study was carried out among foreign and local tourists in three major dive destinations in the Philippines. The researcher noted that a charge an entrance fee to visitors is one way to finance marine reserves. This is also a way for local communities to capture the scarcity rent of their resource. Revenues thus collected would help cover maintenance and anti-fishing rule enforcement costs of a marine reserve. Furthermore, the entrance fee may be used as a tool to regulate the number of visitors to minimize diver damage. The maximum WTP was modeled as a function of age, gender, income, level of education, general interest in environmental protection, Philippines residency and type of diving (scuba and snorkel). Then, the maximum WTP of each diver was elicited through the contingent valuation question. The results suggested hat the average WTP is considerably higher on Mactan Island than in Anilao and Alona Beach, where the average WTP was US$3.7 in Anilao, US$5.5 on Mactan and

US$3.4 on Alona Beach. Based on the survey results, it showed a positive willingness to pay to enter marine sanctuaries where fishing, one of the major threats to coral reefs, is prohibited. Estimated annual potential revenues range from US$0.85 to US$1 million on Mactan Island, US$95 to US$116 thousand in Anilao and from US$3.5 to US$5.3 thousand on Alona Beach. These revenues could be used to support coral reef conservation and possibly the creation of alternative employment opportunities for locals, who would be barred from fishing.

Another study by Zhongmin *et al.* (2005) measure the total economic value of restoring ecosystem services in Enjina region, China. The CVM was used on their study to obtain estimates of WTP for restoring Enjina ecosystem services. To capture the respondents' willingness to pay, they used a payment card (PC) format and a 12 page survey booklet with maps, depicting the reasons why Enjina ecosystem deteriorated. In the PC format, respondents are confronted with an ordered sequence of bids where they choose the maximum amount that they are willing to pay. The result of this study indicate that respondents would pay an average of 19.37 (RMB) per year with 20.78 per household for the main river area, and 16.41 per household for the rest of Hei basin. The aggregate benefit to residents of the Hei basin is 8.84 million annually for 20 years. Taking into account an environmental discount rate calculated by using respondents' equivalent utility between periodical payments and lump sum payments, the present value of aggregate benefit of restoring Enjina ecosystem is 55.33 million.

Furthermore, Dumadisile *et al.* (2005) reports on tourists' WTP to view Cape clawless otters *Aonyx capensis* along the Eastern Cape Wild Coast, South Africa. Sampling was done in Dwesa Nature Reserve, which is situated on the Eastern Cape Wild Coast in South Africa. A survey procedure was used to assess if tourists at Dwesa would be WTP a trained guide to show them otters. In this research, a total of 120 questionnaires were handed out to tourists who come to Dwesa Nature Reserve. There were 30 questions which consisted of different structured questions including open questions, closed questions and rank ordering questions. Some of the questions were personal (such as gender, age, nationality, residency, level of education, income, reasons for visiting Dwesa). The researcher received 67 completed questionnaires. Many of the respondents did not respond to personal questions such as age, gender, residency, level of education and income. From five bid offered (<R50, R50-R100, R100-R150, R150-R200, and >R200), most of the respondents were WTP either less than R50.00 (US$8.00) or R50.00-R100.00 to view otters regardless of the chances of seeing them. The result found that number of respondents that would pay less than R50.00 to view otters, increased as the percentage chance of seeing otters decreased, while the number of respondents that would pay R50.00-R100.00 to view otters decreased as the percentage chances decreased.

Kim *et al.* (2004) assessing the economic value of a world heritage site and willingness-to-pay determinants at Changdeok Palace, using the CVM. The type of question that they used in this study is closed-ended (or dichotomous choice). Logit models in both linear and logarithmic forms were employed to identify determinants from the DC question. Based on the results of the pre-test, 10 price offers were given on the questionnaire.

The researchers compute the mean WTP values from the estimated coefficient of ech model through LIMDEP 8.0 program. The mean WTP values were 5706 Won ($5.70) in a log-linear model and 6005 Won ($6.00) in a log-logit model. Result show that the gap between the two mean WTP amounts was small. The computation of the user value requires an aggregation of average WTP for a specific quantity of public good by multiplying the sum of the mean WTP and current admission price, 2300 Won by the number of visitors. The number of visitors was 685,694 including foreign visitors of 443,772. As a result, aggregate use value from the log-linear model was estimated as approximately 1.93 million dollars, while aggregate use value from the log-logit model was estimated as 2.01 million dollars.

In a study conducted by Chen (1999), the CVM was used to measure the values of wetland in Taiwan. The study was conducted from ecological and economic points of view in the setting of a nature reserve of wetland in Taiwan. The ecological data (including area, habitat, ornithological diversity, ornithological rarity, population size, and representativeness) of 28 wetlands in Taiwan were collected, and factor analysis was used to regroup those attribute. From the 12 evaluation items analyzed with factor analysis, it is grouped into four categories: rarity factor, representativeness factor, diversity factor, and area factor.

The ecological valuation method and the results were introduced to the dichotomous choice with follow up (DCF) contingent valuation questionnaire. Cameron's expenditure function model and maximum likelihood estimation for DCF data were used to estimate WTP values for the residents of Taiwan. The result indicate that some ecological factor (relative weight of mix index list, rarity factor, representativeness factor, age, education, and occupation) are statistically significant, which shows the importance of combining ecological valuation and economic evaluation. The estimated median annual WTP is NT$1069.52.

4. Methodology

4.1 Data sources

This study used mostly primary data, which was gathered from the personal interview with the respondent (visitors). Surveys were conducted in June to August 2006 in TNGP. The primary data consist of visitors' socioeconomic

characteristics; visitor's perceptions about ecotourism resources, attitude, and their WTP to enjoy the ecotourism resources at TNGP.

4.2 Sampling area

TNGP is situated in the province of West Java, south of Jakarta. The TNGP constitutes the core area of the biosphere reserve. It includes two twinned volcanoes and mountainous rain forests with many Javan endemic species. Administratively, TNGP is shared among the regency of Bogor, Cianjur, and Sukabumi. TNGP comprises a variety of landscapes. This site has beautiful waterfalls, lakes and rivers, rugged volcanic landscape, quiet alms, montane swamp, and tropical mountain forest. The features of ecotourism area at TNGP are showed in Figure 2.

The interviews were carried out at the various locations which were popular among the visitors. Most of interviews were conducted at the main entrance gate and in the Cibodas botanic garden.

4.3 Sample size

The sample size for a study needs to be large enough to provide sufficient statistical power. It is very important that the sample be as representative as possible. In this study, a total of 500 respondents participated in this survey but only 423 respondents answered the questionnaire completely, thus the useable in this study was 423. The respondents were chosen at convenient since there was as records of the visitors to the park. The interview methods used in this research was face-to-face interview to the visitors. In order to avoid redundancy, only the leader of a group was chosen as the respondents.

4.4 Questionnaire design

CVM uses survey question to elicit the society's preference for public goods by creating a hypothetical market. CVM questionnaires can be designed to elicit WTP or willingness to accept (WTA) estimates for a change in the level of provision of a public good. Eventually, the decision to use WTP or WTA depends on the property rights of the good. However, WTA estimates are often biased upwards; therefore most of CV studies are designed to elicit WTP estimates (Mitchell and Carson, 1989).

The questionnaire for this research has been designed to gather primary information such as socio demographic profile, attitude, and visitors' willingness to pay for ecotourism resources at TNGP. The questionnaires consist of structured questions that were divided into two forms: dichotomous choice and multiple categories questions. Generally, the questionnaire will divided into four categories; (a) characteristic of visitors and society, (b) attitude of visitors in relation to sustainability of ecotourism resources at TNGP, (c) visitor's perception about ecotourism resources at TNGP, and (d) willingness to pay of visitor for TNGP entrance fee (bid price presented).

A dichotomous choice question offered just two answer choices, yes or no. Meanwhile, the multiple categories questions had more than two answers. Dichotomous choice is a single "take it or leave it (TIOLI)" bid offer presented to each respondent. This technique is simple and inexpensive to administer by mail. However, the information derived from the responses must be transformed into WTP or WTA estimates based upon a utility theoretic method which predicts the probability of a yes response.

A total of 180 domestic visitors were interviewed, but only 160 were used for the purpose of this analysis due to missing values. Information on socio-economic characteristics of the respondents obtained included race, place of origin, age, marital status, education, `size of family members, occupation, and monthly and supplementary gross income. The personal interviews were conducted on visitors at TNGP by filling the questionnaires at the chosen location. Each of the respondents was informed regarding the details on the purpose of preservation of island, facilities available and format used in Contingent Value techniques. Respondents were asked the following questions and required to respond either 'Yes' or 'No':

'If entrance fees are increased by RP x, would you willing to pay so that you could continue to use this recreational area?'

where x ranged from RP5000 to RP9000, representing a 'reasonable' additional amount of entrance fee to many privately managed recreational areas in Indonesia.

4.5 Willingness to Pay Estimation

Following recommendations from environmental literature (Arrow *et al*., 1993), the closed-ended (CE) WTP approach to estimate the benefits from the preservation the TNGP was used. Individuals were asked as whether they would pay specific additional fees amount for a given commodity, with possible responses being "YES" and "NO". The bid amount is varied across respondents and the only information obtained from each individual is whether his/her maximum WTP is above or below the bid offered.

Logistic regression technique was used to estimate WTP (Hanemann, 1984). Using this approach the probability of saying "YES" to a bid at different level of the independent variable is estimated as

$$P = (1 - e^{-x})^{-1} \quad (1)$$

Here, x is the "bid amount" (price), and P is the probability of accepting the price. Mean WTP is estimated as the area under this probability function. This area shows the proportion of the population who would consume the good at each price level, and their associated utility. The area under the curve is estimated by integration techniques and can be expressed as;

$$E(WTP) = \int_{L}^{U} (1 + e^{a + bPRICE})^{-1} \, dPRICE \quad (2)$$

where $(1 + e^{a + bPRICE})^{-1}$, are the probability of saying "YES" and U and L the upper and lower limits of the integration respectively.

Estimating mean WTP within this framework relies on making some assumption about upper and lower limits of the integral, i.e. knowing the price amounts at which probability saying "NO" is zero and probability saying "YES" is one. Bishop and Heberlein (1979) and Sellar *et al*. (1986) used the upper range for the integration of their price amounts as the upper limit for the integration. Hanemann (1984) argued that such an approach makes a certain assumption about the probability distribution for the unknown WTP in the sample. He argued that the upper limit should be infinity and that using the highest offered amount may be a poor approximation of the mean utility estimated when integrating between zero and infinity. In this study, zero was chosen as the lower limit of the integral and the maximum value as the upper limit. Confidence interval of WTP also calculated using the variance-covariance matrix and a technique adopted for dichotomous CVM by Park *et al*. (1991).

The ability to seek willingness to pay is represented by the dichotomous variable of WTP with values of 1 for those willing to pay the additional amount of entrance fee and 0 is otherwise. An OLS regression of the above relationship with WTP as the dummy variable is beset by several problems namely: (1) non-normality of the error term, (2) heteroscedasticity, and (3) the possibility of the estimated probabilities lying outside the 0-1 boundary (Gujarati, 1988). Since the dummy WTP is actually a proxy of the actual propensity or ability of willingness to pay, the probit and logit models guarantee that the estimated probabilities lie in the 0-1 range and that there are nonlinearly related to the explanatory variables. The difference between these two approaches is mainly in the distribution of the regression error terms. The logit approach assumes that the cumulative distribution of the error term is logistic while probit assumes that is normal.

5. Results and discussion

This section presents the summary statistics of the respondent's socio-economic characteristics, and also respondent's responses regarding their perceptions and attitudes.

5.1 socioeconomic characteristics

Visitors who come to TNGP Park can be grouped into two categories, local and international visitors. But, for this study the visitors that was selected was only local visitors only. To ensure that the selected sample was representative of the population, a number of questions were asked in relation to the socioeconomic characteristic of the visitors.

Information about respondents' profile included their age, gender, residential area, marital status, education level, occupation, and income. The socioeconomic variables of respondents, collected in terms of categorical variables, are summarized in Table 2. With respect to the age, the visitors who come to TNGP come from various levels of age. The results indicated that the respondents' ages ranged from 16 to 68 year old. Most of respondents interviewed are in the range of 21-30 years old (53 percent). This was followed by those in 31-40 years old (20.1 percent), below 20 years old (14.4 percent), 41-50 years old (7.8 percents), and the fewest of respondents interviewed was those above 50 years old (4.7 percent). This information showed that most of visitors who visit TNGP come from the middle age group. Activities in this park include climbing Mount Gede and Mount Pangrango, camping, and hiking, require physical activity and strength.

Most of visitors who visited the park come from cities around TNGP, such as Jakarta, and Bogor (Wiratno *et al.,* 2004). Usually, they come on the weekend for vacation, and enjoy the gorgeous view and fresh air in the park. The result showed that approximately 77.3 percent of respondents are from urban area and only 22.7 percent from rural area. This result indicated that people from urban area were more interest with the natural and ecotourism resources at the park because these conditions are hard to exist in urban area. On the other hand, the natural resources are common to the rural community. Moreover, there are many places like TNGP, especially in West Java.

The level of education shows that most of the respondents(61.2 percent) had diploma/university level. This was followed by senior high school level (33.1 percent), elementary level (4.0 percent), primary school level (1.4 percent),

and no education or the respondents never been go to school (0.2 percent). This implies that ecotourism at Gunung Gede Pangrango National Park tends to be monopolized by the middle and highly educated people. These groups of people value the ecotourism activities more than the other group (lower education level).

The categories of respondents' occupation in the questionnaire were divided into 10 groups. As shown in Table 2, there were 152 (35.9 percent) respondents who worked as a private employee, and followed by businessmen 83 respondents (19.6 percent), student 54 respondents (12.8 percent), and government sector 40 respondents (9.5 percent). These groups of people need more recreation to diminish their boredom due to their routine activities.

Usually, the income level of respondents is an important factor that will affect to their WTP for the fee which was charged to them. Generally, more income indicates that they would be willing to pay more for the entrance fee. Previous studies by Hanim (1999), Zhongmin *et al*. (2002), and Syakya (2004) have identified that income affect visitors' WTP. In this study, most respondents (54.6 percent) had average household income of between RP 750,001 – RP 1,500,000 per month. This is followed by respondents with income of above RP 1,500,000 (28.4 percent), and than the last is respondents' group with earned income below RP 750,000 (17.0 percent).

5.2 Willingness to pay analysis

This section discusses the WTP stated by the respondents. The analysis uses the dichotomous choice CVM. In the dichotomous choice CVM, each respondent is asked whether they would be willing to pay a particular price for the entrance fee to visit TNGP, letting them answer with 'yes' or 'no' to the price of entrance fee offered (bid). Bids between RP 5000 (RM 1.92) to RP 9000 (RM 3.46) have been assigned in this survey at the TNGP.

The distribution frequency of respondents' willingness to pay at each bid amount is shown in Table 3. Generally, there were 258 (61 percent) out of 423 respondents who were willing to pay for the given bid, and 165 respondents (39 percent) were not willing.

For the WTP analysis, the data were estimated using the logit analysis. The bids of RP 5000 to RP 9000 were offered to the respondents. Generally, it is found that 61 percent of the respondents were willing to pay the given bids, while 39 percent were not willing to pay. The results were consistent to the theoretical expectation; as the given bid is increased, the number of respondents willing to pay decreases. With a RP 5000 bid level given to respondents, approximately 27.5 percent were willing to pay and only 6.1 percent would not. When a RP 9000 of bid level was given, 33.3 percent of respondents were not willing to pay, and 11.2 percent was willing to pay for this given bid level.

The binary logit regression was used to analyze the probability of visitors' WTP for the entrance fee at TNGP. This analysis was also used to test if there was a significant difference in the variables of the socioeconomic factors, and to provide further information about the independent variables which influenced willingness to pay bids. The initial estimation of the models involved the visitors' socio-economic characteristics such as age, gender, marital status, residential area, and income level. The results of the parameter estimates of the linear logit are shown in Table 4.

Based on the results summarized in Table 4, the variables that were significant at 1 percent level were urban residency and income level. M gender was significant at 10 percent level. The goodness of fit for the regression is given by Nagelkerke R-Square of 0.563. The percentage of correct prediction is 79 percent. This analysis showed that the results were satisfactory.

The coefficient for price (bid) is negative as expected, at the value of -0.00122. It implies that the higher the bid offered, the less the number of respondents who are willing to pay the bid, it was significant at 1 percent confidence level.

According to the logit regression results, gender coefficient (male) illustrates a positive value (0.574). In the questionnaire given, 0 refers to male and 1 refers to female. The *odd ratio* of this variable is 1.775. Thus, as expected, males are willing to pay the bid price 1.775 times higher than the female visitors.

The residential variable (urban) was significant at 1 percent of level confidence, with a value of 1.408. It illustrated that urban visitors had a positive value for WTP. The *odd ratio* of this variable was 4.086, meaning that visitors from urban area were WTP the bid price offered 4.806 times higher than visitors from the rural area.

The single-bounded dichotomous choice contingent valuation (DC-CV) model was applied to examine the data. For the DC-CV model, two results are possible; either the respondent is not willing to pay for the bid level of entrance fee offered or the respondent is willing to pay for the bid level of entrance fee offered. *Bid price* is the dependent variable, where 1 = 'yes' and 0 = 'no' in response to the hypothetical referendum question. *Bid* represents price (Rp A) that the respondent will pay for the entrance fee. Based on the estimation results, equivalent WTP measures were calculated using logit regression models at mean price and income level. Program Mathematica 5.0 was used to calculate the actual value of visitors' willingness to pay. The result showed that WTP for entrance fee to TNGP was RP 7629.77 per visit.

From logit regression model, based on the value of visitors' WTP, the benefit or expected value of ecotourism resources at TNGP can be calculated. Since there is an increase in the total amount of visitors, the total benefits at TNGP also will

increase every year. Table 5 shows the expected benefits at TNGP that can be captured by the management for the year 1995 to 2004. The total value of ecotourism resources in TNGP was estimated at approximately RP 400 million a year.

6. Conclusions

The study used CVM to estimate how much visitors were willing to pay for the entrance fee at TNGP, as an indicator of the benefits of conservation of the ecotourism resources. Generally, visitors' willingness to pay for the entrance fee at the park was higher than the fee charge to them at the present (RP 4000). As a source of fund to support the development of ecotourism at TNGP, the management should consider increasing the entrance fee at TNGP, since it is currently at very minimum level and the fee has not increased for the last 10 years. The results of the study show that household income, gender, residential, and bid price level were the significant factors that influence the amount of the entrance fee that they willing to pay.

The successful development of ecotourism at TNGP in the future will depend on the visitors' satisfaction for the resources and their WTP the park. Generally, visitors are satisfied with the ecotourism resources at TNGP, but the management must protect this, and also enhanced the facilities and services offered to the visitors. Even though the management increasing the entrance fee, most of visitors would still come to the park, because they thought that TNGP is a most suitable place for their recreation and they enjoy their vacation in the park. The results of visitors' satisfaction for the ecotourism resources at TNGP represent important information about conditions of the park at present.

These findings can assist the management of TNGP to take advantage of the increasing entrance fee which can be used to keep the sustainability of its ecotourism resources. The authority of the park also must consider the people who visit the park. The demographic, socioeconomic characteristic and the opinion of the visitors could be important inputs in order to ensure successful of ecotourism programs. This result also should be helpful to assist the authority for the fee system and how much they can increase the new entrance fee charged to the visitors.

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Table 1. Visitor's purpose and numbers of individual visitors

Year	Visitor Profiles and Number of Individual Visitors						
	Research	Education	Recreation	Climbing	Camping	Other	Total
1995	44	2,016	15,123	15,622	1,118	122	34,045
1996	24	1,095	15,316	32,279	2,161	31	50,906
1997	73	2,335	20,178	16,173	2,212	521	41,492
1998	35	7,200	16,379	23,486	2,415	1,195	50,710
1999	352	2,450	15,534	41,564	2,264	225	62,325
2000	215	1,152	16,315	42,645	2,187	309	62,823
2001	124	2,108	16,779	42,848	2,265	610	64,734
2002	99	1,855	17,102	40,105	1,878	209	61,248
2003	115	1,156	16,420	39,520	1,850	934	59,995
2004	165	1,320	16,350	39,422	2,744	328	60.329
Total	1,246	22,687	165,496	333,664	21,094	4,484	548,607

Source: Management of Gunung Gede Pangrango National Park, 2005

Table 2. Socioeconomic profile of respondents

Characteristics	**Frequency (n=423)**	**Percentage**
Age		
< 20	61	14.40
21 – 30	224	53.00
31 – 40	85	20.10
41 – 50	33	7.80
51 >	20	4.70
Gender		
Male	234	55.30
Female	189	44.70
Residential Area		
Urban	237	77.30
Rural	96	22.70
Marital Status		
Single	237	56.00
Married	186	44.00
Education Level		
Never been to school	1	0.20
Primary	6	1.40
Elementary	17	4.00
High school	140	33.10
College/University	259	61.20
Occupation		
Businessmen	83	19.60
Private employment	152	35.90

Government	40	9.50
Teacher/ lecturer	23	5.40
Farmer/ fisherman	6	1.40
Housewife	22	5.20
Student	54	12.80
Pensioner	3	0.70
Unemployed	3	0.70
Other jobs	37	8.70
Income		
Less than 750,000	72	17.00
750,001 - 1,500,000	231	54.60
More than 1,500,000	120	28.40

Table 3. Visitors' willingness to pay

Bid Offered	**Willing to Pay (%)**	**Would Not to Pay (%)**
RP 5000	27.52	6.06
RP 6000	27.91	10.3
RP 7000	18.18	20.54
RP 8000	12.79	32.12
RP 9000	11.24	33.33

Table 4. Results of logit regression model

Variables	**Coefficient**	**Standard Error**
Constant	5.403	0.8220***
Bid	-.00122	0.000***
Male	574	.275*
Income	$2.0355x10^{-6}$	.000***
Urban	1.408	0.3440***
N	423	
Percentage of correct prediction	79.0 %	
-2 loglikelihood	338.724	
Cox & Snell R Square	0.415	
Nagelkerke R Square	0.563	

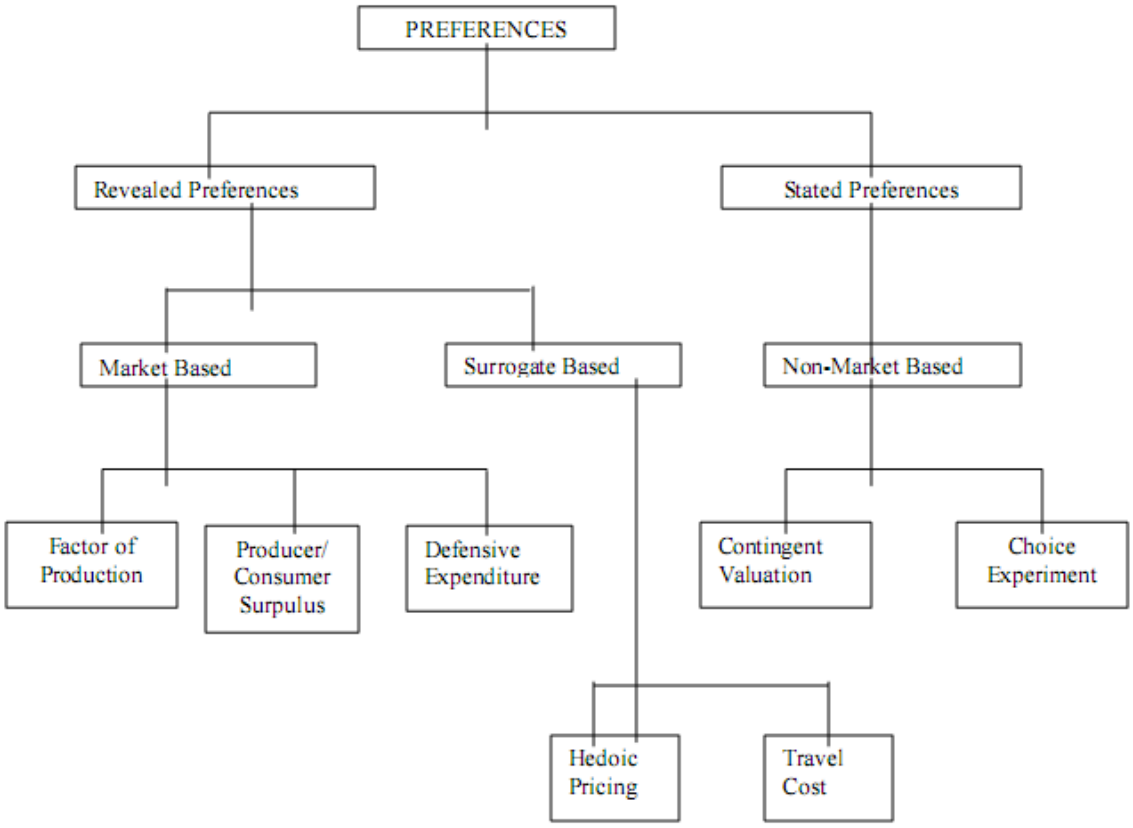
Source: Primary Data, 2006

Notes: *** Significant at 1 percent level

* significant at 10 percent level

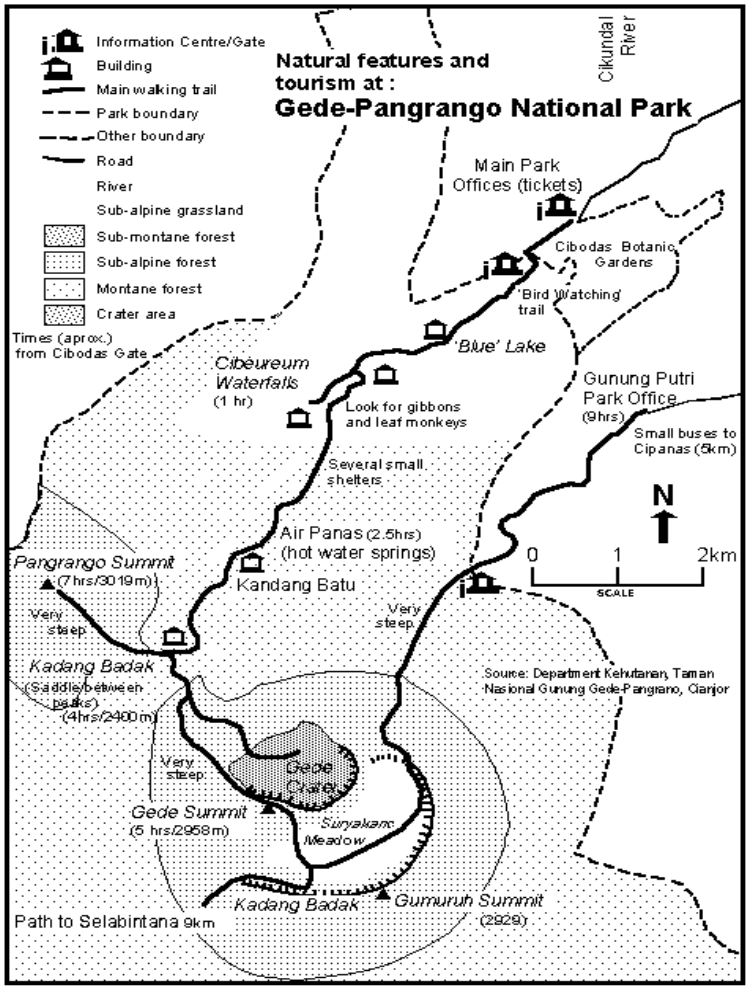
Table 5. Expected benefits of Gunung Gede Pangrango National Park

Year	Total Visitors per Year	Expected Benefits (Rp)
1995	34,045	259,775,519.6
1996	50,906	388,401,071..6
1997	41,492	316,574,416.8
1998	50,710	386,905,636.7
1999	62,325	475,525,415.2
2000	62,623	477,799,086.7
2001	64,634	493,142,554.1
2002	60,248	459,678,382.9
2003	58,795	448,592,327.1
2004	59.329	452,666,624.3



(Source: NOAA Coastal Services Center, 2006)

Figure 1. Environmental valuation methods



(Source: Indonesia Ecotourism Center, 2005)

Figure 2. Sampling area

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The Exploitation and the Development Perspectives of New Environmental Foliage Fiber

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Abstract

In this paper, the author reviewed the development of the natural fabrics, expounding the actuality of the exploitation on new type environmental natural fabrics, analyzing the production and the traits of the natural fabrics and the chemical fiber, and pointed out the significance of empoldering new environmental foliage fibers to meet the demand of textile machining. The author introduced several kinds of new environmental foliage fibers, and discussed making good use of the natural sources and the trash from the agriculture has been an obvious characteristic of developing green fiber and eco-textile in this paper as while. This paper further analyzes the development and market potential of the new environmental foliage fiber.

Keywords: Foliage fiber, Green fiber, Ecological textiles, Environmental protection

With increasing of people's living standards and the concept of consumption, the development of fibers and fabrics focusing on green and environmental protection for apparel will be based on natural fabrics. The orientation of aesthetic value of apparel returns to innocence, and tends to natural comfort, health, environmental protection and fashion. Since the 21st century, the "green" consumption of the world has risen rapidly, and green fiber and eco-textiles has become the developing trend of the textile industry. It is an increase in the synthetic high-performance, high function and the natural degradation of the study, at the same time people pay more attention to the development and application of new environmental plant fiber. The new environmental plant fiber has broad space for development and market potential.

1. Course of development of natural fiber

Natural fiber as an important textile material has been dominant from the human civilization. On October 27, 1938, the first synthetic fiber nylon was born in the world. In the middle of 20st century, the synthetic fiber was produced in the large-scale rapidly all over the world, and its production has risen dramatically. From the early 1990s up to now, amount of the synthetic fiber is more than natural synthetic fibers, becoming the main fiber raw materials used in textiles and clothing. At the same time, to make synthetic fibers possess function like natural fibers will develop to the researchers' starting point.

On the one hand, we ceaselessly changes the property of synthetic fibers and add their new features to make up the consumers' advanced psychological needs after their material needs were met; on the other hand, we would solve the embarrassing questions that the synthetic fiber couldn't naturally degraded nothing but strengthen development of new natural fiber. Therefore, we should save the non-renewable energy, at the same time we must adequately employ the existing natural resources, synthetically make use of the agricultural wastes, and accelerate the study of the renewable and green plants fiber. From the end of the 20st century to present, development of the new environmental natural fibers of our country shows an unprecedented developing vision.

Natural fiber is divided into plant fiber (cellulosed fiber), animal fiber (protein fiber) and mineral fiber. Plant fiber is one of most abundant natural polymer materials in nature. According to statistics, an annual resources existing in the form of cellulose totally reach 100 billion tons in nature, far exceeding the total of oil reserves in the earth. A large number of natural cellulose resources are not being used effectively in the biological cycle. According to statistics, the total of global fiber breakthrough 70 million tons in 2005, of which natural fibers achieve 32,200,000 tons (exception of

cotton, wool, silk in the natural fiber with 5.7 million tons), getting a 4.8 percent growth compared to 2004.

We can see the results of "Tenth Five-Year Plan" and planning objectives of "Eleventh Five-Year" from Table 1. With a steady growth of the national economy, per capita Chinese fiber consumption reach 16kg by 2010, the proportion of industrial textiles will continue to growth. The proportion of natural fiber and chemical fiber decreased in 2000 compared to that in 2005 from table 1. Because the range of rise of global synthetic fiber is much larger than which of natural fiber, the range of rise of global synthetic fiber was 6.1 percent, while natural fiber 2.2 percent. We also can see that the total of global natural fiber increase in the form of wave since 1980 from table 2. Due to the impact of oil prices, the average price of chemical fiber steadily increased. In addition, the production of global cotton declined both in 2005 and 2006. But the quantity demanded of cotton continuously increased, and only the short fall of Chinese cotton was nearly three million tons. Under such circumstances, expediting the development and application of Chinese new environmental plant fibers is impending.

2. The research several new environmental foliage fibers

With deeply developing the raw materials of textile industry and continuously improving science and technology, on the one hand, we can develop new environmental foliage fibers from exploring in nature; on the one hand, we can develop new environmental foliage fibers from recycling the agricultural waste. In this way, not only we can synthetically make use of the resources and improve the environment, but also farmers' real income can increase. At present, we have successfully developed natural colored cotton, bamboo fiber, apocynum fiber, pineapple leaf fiber, banana fiber, cotton stalk skin fiber, coconut fibers, "alpinia speciosa" fiber and mulberry fiber. This paper briefly introduces these new environmental foliage fibers in the following.

2.1 Natural Color Cotton

Natural color cotton is a kind of non-white cotton produced by biological genetic engineering. At present there are several kinds of color cottons, such as brown, green, purple, gray, orange and so on. These color cottons have property of natural color, lasting color, and texture soft. It fits health and environmental protection standards from cultivation to production and from processing to consumer products. China begun to plant color cotton in 1987, which is more 2O years later than abroad, but it developed at an alarming rate. At present there are 15 provinces, municipalities and autonomous regions in china carrying out planting, researching and producing, and the total area of color cotton is more than 26.4 million acre. After the United States china has become the second largest country of planting color cotton in the world. In recent years, the United States, Japan, India, Egypt and other countries expedited the research and development work of color cotton.

Natural color cotton in China is mostly medium cotton and less long-staple cotton. The cellulose content of natural color cotton fiber is only 85 to 90 percent and the rest is mainly wax composition. The production of color cotton is low and its relative quality is poor. Color cotton has defects in aspect of fiber fineness, strength and length, and its physical and mechanical properties are worse than that of the white cotton. We generally blend it with white cotton, synthetic fiber to spin to improve the quality of yarn, and we usually have three blend ratio, such as 75/25, 40/60 and 10/90.

Color cotton widely was used to produce underwear, women, infant and child clothing, shirts, T-shirts, casual wear, towels and bedding and other fields. In addition, because color cotton with high added value brought about a very substantial profit, it has become one of "green" potential natural fibers of 21st century.

2.2 Apocynum

Apocynum is a perennial herbaceous plant; it hosted in the saline lands, the sandy wastelands and the flood areas of Lop Nur. Apocynum has the common characteristics of moisture absorption, air permeability and higher strength with flax fiber. In addition, the fiber of apocynum is slender and soft, and its silk is smooth. Apocynum also has the antibacterial functions of health care, and it has obvious efficacy for hypertension and hyperlipidemia patients.

Apocynum fiber is a kind of bast fiber locating in the phloem tissue of stem, and its cellulose content is 54.8 to 58 percent. The cross section of apocynum fiber shows round or ellipse, and its vertical surface has vertical stria and bamboo cane. The length of apocynum fiber is 15 to 70 millimeter, the fineness of which is from 12 to 17 micron, the fracture strength is 7.4 centi-newton per dtex, and the elongation is 3.4 percent. The length of fiber is uneven, its amplexation strength is small, its elongation is low and its surface is smooth without curling. So we often spin by blending it with cotton, wool, silk and chemical fiber, such as the high-grade fabric of apocynum blended with cotton and tencel in market.

2.3 Bamboo fiber

Bamboo fiber is a green environment-friendly fiber materials successfully researched and designed by our country. Bamboo fabric was honored as "health materials most having development prospects in 21st century" relying on Chinese abundant bamboo resources and the function of hygroscopicity, drape, dye ability, "breathe" ability, anti-bacterial deodorizing and anti-ultraviolet by natural.

Bamboo fiber is divided into regenerative bamboo fiber and primary bamboo fiber. Regenerative bamboo fiber belongs to regenerative cellulose fiber, but primary bamboo fiber and the native is extracted directly from the bamboo fiber, which belongs to 100 percent natural plant fiber. The whole production process of bamboo fiber accords the green production standards, so it is a really green and environmental protection fiber in nature. However, the rigid of bamboo fiber is too large. So its spinning ability is not high. In addition, its contradiction between the linear density and length has also affected the fiber's quality and spinning performance in the production process.

The main components of bamboo fiber are cellulose, and also include hemicelluloses, lignin and a small amount of ash. Its cross section shows oval or waist round; it forms height "hollow" because of a lot of large and small gap in the fiber; its longitudinal surface has cross cane and a large number of micro-grooves; its distribution of fineness is uneven. Studies have shown that this special morphological structure of bamboo fiber will increase rapidly specific surface area and strengthen the wicking role of the capillary of fiber; moisture absorption and desorption improve; permeability of bamboo fiber is best in all types of fibers. In addition to, the bamboo fiber containing a variety of amino acid composition, and has the functions of good natural anti-bacterial, health care, anti-mildew, moth and anti-ultraviolet. And it is also a new type of natural plant fibers with vast potential of development. At present, the bamboo fibers are mainly used in the production of underwear, T-shirt, shirt, high-grade fashion, masks, bath towel, bathrobe, towels and bed clothes and other fields.

2.4 Cotton Stalk skin Fiber

Cotton stalk skin fiber, also known as cotton skin fiber or cotton stalk fiber, is a type of stem fiber belonging to seed plant. The resources of Chinese cotton stalks are rich, but generally they are only made paper or used as fuel use. The development of Chinese cotton stalk skin fiber is still at the starting stages. According to relevant information, the phloem cellulose content of external stem is up to 70 percent. Cotton stalk skin fiber inherits the basic performance of cotton, and even is better than cotton in some respects. Its average length is 34.38 millimeter, its length unevenness is 40.65 percent, its average strength 2.83centi-Newton per dtex, and its average elongation reaches 11.12 percent.

2.5 Pineapple leaf fiber

Pineapple leaf fiber is an evergreen perennial herb, and it is extracted from pineapple leaves. At present, India and Japan and other countries carried out more systemic research and development of the pineapple leaf fiber extraction, try spinning and weaving and making clothes. In 1990s, Chinese scientific research institutions carried out the relevant research of the materialization properties of pineapple leaf fiber, Degumming and spinning yarns, and successfully produced the fabrics of pineapple leaf fiber and cotton, chemical fiber blended spinning.

The surface pineapple leaf fiber is rougher, its longitudinal surface has gaps and holes, its transverse surface has nodes, and cross section shows ovoid or polygonal and has middle cavity. The length of Single-fiber is 7 to 8 millimeters, it width is 7 to 18 microns, its broken strength is 3.06 centi-Newtons per dtex, its elongation is 3.4 percent, and the density of fiber is 1.543 grams per cubic meters.

At present, pineapple leaf fiber can spin yarns of 19.4 to 7.3 tex, or produce the yarns of 53, 27.8, and 19.4 tex blended with cotton. And also it can spin by blending yarns of 36 and 25 tex with flax. The fabrics of pineapple leaf fiber are easy to print and dye, sweat-absorbent and breathable, hard and not wrinkling, and it has good antibacterial and deodorization performances. It fits to high grade suits, shirts, divided skirt, bed clothes and decorative fabrics and so on.

2.6 Mulberry fiber

Mulberry fiber is a pure natural plant fiber by the mean of modern biotechnology separation and extraction. It has the characteristics of solid, flexible, moderate density and plasticity. The fabrics of mulberry fiber have the function of breathable moisture absorption and strong dye ability, and also have health function of skin care, nourishing hair, and lowering blood pressure. So mulberry fiber also is a new health-care textile material. The development and utilization of mulberry fiber also is the development of the recycling process of agricultural wastes. Mulberry fiber can develop more high value-added new products when it spins blended or interwoven with cotton, hemp, silk, chemical fiber and other fiber, and it has broad market prospects and ecological benefits.

The development and application of Chinese mulberry fiber remains advanced level in the world. The domestic research institutions have systematically researched morphology, crystal structure, thermal properties of mulberry fiber and fiber production process, and developed a series product, such as T-shirt, underwear, sleepwear, scarves and so on. More and more attention is paid to these products by the domestic and foreign traveling trader. It indicated that China has possessed the independent intellectual property rights of the whole process from peeling mulberry fiber and mechanized production to merchandise, and is also a completely new breakthrough in the field of the development of Chinese new natural plant fibers.

2.7 Banana fiber

Banana fiber, also known as the banana stem fiber or banana leaf fiber, is a new type of natural plant fibers. The major

components of cellulose content of banana fiber is up to 60 to 65 percents, its single-fiber length is 80 to 200millimeters, its elongation is 3 percents, and its mechanical physical properties are similar to flax. Banana fiber has the property of more coarse and hard, high strength, small elongation and high initial modulus.

At present, there are two kinds of methods to make banana fiber. One is to extract the fiber using original manual method from the leaf sheath, and it is mainly used in coarse ropes, portable bags, carpets and so on; some countries have widely used the method, such as Philippines, Malaysia, Uganda and so on. Another is the industrial production of banana fiber, because the properties of fiber are similar to flax, so they carried out degumming treatment using the extraction of flax fiber methods for reference, and also used the methods of biological degumming and flash-explosion and so on. Japan, India and other countries have developed banana fibers, and have blended banana fiber with cotton in a certain proportions to spin coarse yarns of 83.3 to 48.6tex. Thus the jeans and tennis clothes designed by them have the characteristics of special luster, quick moisture absorption and release. And they further developed high-grade curtains, towels, bed sheets and so on.

2.8 "Alpinia speciosa" fiber

"Alpinia speciosa" belong to zingiber class perennial herb. It grows in the low elevation mountain areas of subtropical Southeast Asia, and is generally cultivated in Japan and Chinese Taiwan. Its height about between 1 and 3 meters, and its leaves is as long as 7O centimeters and has the function of insect bite control and anti-bacterial. "Alpinia speciosa" has been long used as mothproof agents, cosmetics and food packaging.

In recent years, Japanese manufacturers successfully developed fork "alpinia speciosa" fiber using new technologies after developing kenaf fiber, bamboo fiber and banana fiber. It is a new type of antibacterial natural fibers. It is made into fabrics which have the properties of good mode-holding, bright color and cool comfort. At present, they have developed "alpinia speciosa" fiber and cotton blended spinning yarn of 83.3 to 19.4 tex, and the content of "alpinia speciosa" fiber is 5 to 3O percent.

2.9 Coconut fiber

Coconut fiber is a natural plant fiber extracted from the fruits of coconut palm. It mainly grows in Asian India and Sri Lanka, and the output of coconut fiber of the two countries respectively accounted for 75 and 22 percent all over the world. Asia is famous coconut producing regions, but only a small part of the coconut palm fruits is used to the fiber production and the majority of which abandoned or used as fuel. Because of the limitations of the development extent and the products purpose, this material with the potential using value has been blindly wasted. Therefore, foreign research institution has relevantly researched the physical and mechanical properties of coconut fiber.

Coconut shell can be divided into four layers, and they can respectively extract the fibers of different physical properties. Coconut fiber is mainly used in the production of rugs, cushion mats, rope and filter cloth.

3. Conclusion

With the textile restructuring and an increase in investment in innovation, the scope of new foliage fibers are increasing each day. Whether colored cotton, bamboo fiber, venetum fiber and other natural plant fiber, or synthetic corn, soybeans and other regenerated cellulose fibers, all greatly enriched the extension and intension of textile fiber. In recent years, with the energy crisis and environmental increasingly serious degradation and the people's concept of environmental protection continually deepening, fully recycling the existing natural resources and increasing the comprehensive development of agricultural waste have become the imperative in the development of green fiber and eco-textiles.

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Table 1. The contribution of textile industry on the national economy and social development from 2000 to 2010

Project	**In 2000**	**In 2005**	**In 2010**
Per capita the consumption of fiber (kg)	7.5	13	16
The consumption of clothing(thousand million yuan)	3375	6826	
Natural fiber: Chemical fiber	41:59	35:65	
Clothing: Home textiles: Industrial textiles	68:19:13	54:33:13	50:33:17

Table 2. The statistics of global fiber production from 1980 to 2004 (unit: 10,000 tons)

Name	**In 1980**	**In 1995**	**In 2000**	**In 2001**	**In 2002**	**In 2003**	**In 2004**
Chemical fiber	1477	2600	3130	3389	3360	3593	3792
Natural fiber	1570	2108	2140	2048	2211	2157	2310

Source: the Statistics Center of Chinese National Textile Industry Council

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Military Expenditure and Economic Growth in Asean-5 Countries

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Abstract

In this study we employ the bounds testing procedure suggested by Pesaran (2001) and dynamic OLS (DOLS) proposed by Stock and Watson (1993) to test the robustness of the causal effect and long-run relationships between military expenditure and economic growth in ASEAN-5 countries from the year 1965 to 2006. Generally, our results suggest that: (1) there are only three (Indonesia, Thailand, Singapore) out of five countries analyzed exhibit long–run relationship between military expenditure and economic growth; (2) While for the case of Singapore, the causality is bidirectional, for Indonesia and Thailand it is unidirectional from military expenditure to economic growth; and (3) For the remaining countries, (Malaysia and Philippines), no meaningful relationship could be detected. The results are robust, producing similar results employing both Auto Regressive Distributed Lag (ARDL) and Dynamic Ordinary Least Square (DOLS).

Keywords: Military expenditure, Economic growth

1. Introduction

The relationship between military expenditure and economic growth has been widely debated among economists. However, there is no specific prediction of the direction of causation between the military expenditure and economic growth. In general, studies have found that military expenditure can influence an economy both positively or negatively. Results are mixed and often contradicting. Military expenditure can affect economic growth through a number of channels. For example, military expenditure can affect an economy either positively as per the finding of Hassan, Waheeduzzaman, and Rahman (2003), through an expansion of aggregate demand or through increase security, and negatively (Deger, 1986) through a crowding out of investment. On top of that, there are findings showing no meaningful relationship as found by Galvin (2003) and Yildirim et al. (2005). In some cases, the results are mixed as found by Kollias et al. (2004) and Dakurah et al. (2000).

Military expenditures can stimulate an economy through the Keynesian multiplier mechanism especially in the period of high unemployment. According to Keynes, expenditure may stimulate growth, i.e. when aggregate expenditure increases, aggregate demand also increases. This will further increase the utilization of capital stock which in turn lead to higher profit and may induce higher investment, thus generating short run multiplier effects and higher growth rates. (Benoit, 1978).

Benoit (1978) further argues that an increase of the military expenditure can promote economic growth by increasing human capital capabilities of the workforce through provision of education, especially in less developed countries where the military industries may provide valuable skill. There may be positive externalities through the development of the military sector on the civilian, for example the development of infrastructure (highway, airport, road and information technology) which can ultimately promote growth. Military expenditure provides protection to the nation citizen by maintaining internal and external security, thus creating positive trade and investment climate for domestic as

well as foreign investors. Though the finding of this study is interesting, we could not find any other studies supporting it.

On the other hand, adverse growth effects will arise by increasing the military spending. Deger and Smith (1983) argue that an increase of military expenditure can hinder economic growth. Increase in military expenditure will take the best capital equipment and technological innovations for consumption and investment that may be more growth-oriented than military expenditure. Military expenditure can create bottlenecks in a constrained economy. On top of that, it also slows down development through the fostering of a militaristic ideology. Furthermore, military can cause balance of payments problems if hard-earned foreign exchanges are used to purchase arms and defense hardware.

The main concern about the issue of military spending is that, we can see the world continuing to devote large amount of spending to the military sector. Higher military spending tend to correlate with higher economic growth and also as a protection to maintain the peaceful of the world. However, the public differ on this opinion in that the spending will lead to war. Besides, higher taxation needed to finance higher military spending, thus in long run, it will drag the economic growth down. This difference in arguments has led to different opinions on whether military expenditure has either positive or negative impact on economic growth. The intrinsic value of national security is perhaps the most important argument for defense spending. Definitely, national security allows for productive economic activities to be carried out without fear of foreign appropriation. Thus, defense spending is expected to provide national security and subsequently enhance economic growth in the long-run (Ram, 1996).

The objective of this paper is to examine the causal relationship between military expenditure and economic growth in the ASEAN-5 countries namely Malaysia, Indonesia, Singapore, Thailand and Philippines using annual data for the period 1965 to 2006. The paper is organized as follows. In the next section we discuss the trend of military expenditures in ASEAN countries. In section 3 we discuss the review of related literature. In section 4 we present the ARDL bound testing that will be used in this study. In section 5 we report the empirical results and the last section contain our discussion.

2. Trend of Military Expenditure in ASEAN Countries.

Military expenditure has been an important component in the fiscal budget of the ASEAN-5 countries (Sipri, various issues). Generally the ratio of military spending to GDP in ASEAN-5 is quite stable. However, as a consequence of financial crisis in 1997, there are significant decreases in military expenditure in year 1998 except for Singapore. Figure 1 shows the trend of military expenditure for ASEAN-5 at constant price (2005) from 1990 to 2006. Among the ASEAN countries, Singapore, despite being the smallest country in term of size; it has the highest level of military spending. Singapore has very capable, modern and well trained ground, air and naval force. National Services introduced in the year 1967 build up the required manpower resources in a relatively quick and cost-effective fashion by providing military education. Her military expenditure has shown a consistently upward trend from 1998 to 2007. As a matter of fact, since 1970, Singapore has allocated an average of 6 percent of its GDP to military expenditure.

As for the case of Thailand, military expenditure is maintained in the range of US$2000 million per annum since 2000(Sipri, various issues).. For the years prior to 2000, it can be observed that there are fluctuations in the military expenditure pattern. From year 1990 to 1995, military expenditure displays increasing trend but after 1995 it declines until year 2000. It is due to plummeting Thailand's GDP which consequently effected their budgeting, all because the after effect of 1997 financial crises. Since that crisis, Thailand relegates defense spending to a lower priority.

In Malaysia and Indonesia, the spending pattern is almost similar. From year 1990 to 1995 the trend is upward and after 1995, (Sipri, various issues) the military spending in this two countries decreases until year 1998. After year 1998, military expenditure has shown an upward trend but small quantum of increases from year to year until 2006. And for the Philippines, the trend for military spending is maintained from 1990 to 2006.

In general, military expenditure as a percentage of GDP is about 2.4 to 2.6 in Malaysia for the past 15 years. There are some efforts to improve the military forces by the Malaysian government. In early 1990s, Malaysia undertook a major attempt to expand and modernize its armed forces. In the year 2000, the Defense Minister announced a review of national defense and security policy to bring up to date. In early 2004, the Ministry of Defense initiated a compulsory National Services program for the selected secondary school leavers aged seventeen.

Table 1 shows the military expenditure as a percentage of gross domestic products in ASEAN-5 economies. As shown in Table 1, Singapore ranks the highest in the military spending from 1990 to 2005, followed by Malaysia. Philippines ranked 5th has only 1.4% military expenditure and the ratio decreases to 0.9% in year 2005. The main reason for the decrease is that Philippines had energy and financial crises.

3. Review of Related Literature

The studies on the nexus between military spending and economic growth have been conducted since the early 1970s. The study on this issue was pioneered by Benoit (1973, 1978). He found that there is a positive correlation between

military expenditure and economic growth for the 44 less-developed countries. Since then, there have been many studies attempting to assess the impact of defense expenditure on economic growth and *vice versa*. Nevertheless the result on how defense spending influence growth is lack of consensus. Empirical evidence tends to vary across countries and over time, and the results are sensitive to the underlying theoretical framework. Most common findings are that military spending has no significant impact, positive or negative, on economic growth.

Galvin (2003) and Dakurah et al. (2000) examined the case for developing countries. While Yildirim et al. (2005) studied on Middle Eastern countries. As for European Union (EU) a studies were conducted by Kollias et al. (2004), and South Asian Regional Cooperation Council (SAARC) by Hassan et al. (2003).

Deger (1986) found negative relationship between military expenditure and growth in the less developed countries (LDCs), citing that defense expenditure takes resources away from productive investments and fails to mobilize and create additional savings. Other empirical studies that found significant adverse relationship of defense spending on the economy include studies by Smith (1983), Deger and Smith (1983), Deger and Sen (1982, 1983) and Faini et al. (1984).

Dakurah, Davies and Sampath (2000) studied 62 LDCs and found 13 countries showing unidirectional causality from military expenditure to growth; 10 cases from economic growth to military expenditure; 7 countries suggest bidirectional causality and the rest 18 countries displaying no meaningful relationship. Kollias, Naxakis, and Zarangas (2004a) analysis on 15 EU countries also found mixed results in term of causal direction whereby majority of the countries showing unidirectional causality from economic growth to spending expenditure. They conclude that an EU government derives defense expenditure based on the economic performance. In another study, Kollias, Manolas and Paleologou (2004b) investigated the presence and direction of causality issue between growth and military spending focusing in the case of Cyprus covering the period 1964-1999. The empirical results suggest the presence of instantaneous bi-directional causality between the variables involved.

Hassan et al. (2003) examine the impact of the military expenditure on economic growth and FDI covering five of seven South Asian Regional Cooperation Council (SAARC) nations using panel data over the 1980-1999 periods. Interestingly the result suggests positive relationship between military expenditure and economic growth, and thus supporting the view that military expenditure can bring positive impact on growth.

By extending Barro and Sala-i-Martin model to account for the impact of military expenditure on growth for a cross section of countries, Aizenman and Glick (2006) studied the long-run impact of military expenditure on growth. They suggest that military expenditure induced by external threats should increase growth, while military expenditure induced by rent seeking and corruption should reduce growth.

Yildirim and Ocal (2006) examined the issue of arms race between India and Pakistan and its relation to each country's economic growth. They found that there is a unidirectional causal relationship between military expenditure of India and Pakistan. Reitchuler and Loening (2004) studied on Guatemala and they employed Feder-Ram model to determine linear versus non-linear function. They suggest that the linear model show insignificant effect on growth. However conclusion changes when using non-linear model. They found that at low threshold there is positive effect on growth and beyond the threshold, it turns negative. However, defense is less productive than the civilian sector.

Abu-Bader and Abu-Qarn (2003) found negative effect between military burden and economic growth in Egypt, Israel and Syria. They also found that civilian expenditure caused positive economic growth in Israel and Syria. In the context of Asia, Moon and Hyun (1992) found through disaggregated analysis the effect of heavy defense to have entailed negative implications for growth, distribution and economic stability. Chan (1992) suggests that military spending has not been the direct determinant of Taiwan's economic growth despite heavy burden on defense.

The study by Chowdhury (1981) on causal relationship between economic growth and defense spending which covers fifty-five developing countries and by employing the Granger Causality test and found that the relationships between defense spending and economic growth cannot be generalized across the fifty-five developing countries.

The studies on the causal relationship between military expenditure and economic growth in the Southeast Asian nation have been conducted by Frederiksen and LaCivita (1987), Frederiksen (1991) and Frederiksen and McNab (2001). Frederiksen and LaCivita (1987) explore the causality between defense spending and economic growth for the Philippines for the period 1956 to 1982. They found that causality runs from economic growth to defense spending and not the other way around that had been suggested by Benoit (1978). The study of Frederiksen (1991) on ASEAN-5 plus South Korea suggests mixed results, and the causal relationships differ from country to country. For Singapore and Indonesia the results indicate that defense spending Granger cause economic growth and in Malaysia, economic growth appears to be a determinant of defense spending; while in the case of Thailand, the result suggests a feedback relationship. For the remaining two countries, Philippines and South Korea, no meaningful relationship between defense spending and economic growth was uncovered. On the other hand, Frederiksen and McNab (2001) examine the relationship between defense spending and economic growth for Malaysia. They conclude that defense spending

Granger cause economic growth in Malaysia. They have extended the time series through 1999 and found that indeed a clear positive relationship exists from defense spending to economic growth.

4. Methodology

4.1 ARDL Approach to Causality Test

In order to test for causality between military expenditure and economic growth we utilized the autoregressive distributed lag model (ARDL) popularize by Pesaran et al. (2001). The ARDL has numerous advantages. Firstly, the ARDL approach is able to examine the presence of short run as well as long run relationship between the independent variables and the dependent variable. Secondly, the ARDL model takes a sufficient numbers of lags to capture the data generating process in a general to specific modeling framework (Laurenceson and Chai, 2003). Finally, the ARDL approach provides robust result in a small sample size. Since the sample size of our study is 39, this provides more motivation for this study to adopt this model.

The ARDL unrestricted error correction model (UECM) is shown below:

A.Model 1:

$$\Delta LMILEX_t = \alpha_0 + \alpha_1 LMILEX_{t-1} + \alpha_2 LRGDP_{t-1} + \sum_{i=1}^{m} \alpha_{3,i} \Delta LMILEX_{t-i} + \sum_{i=0}^{n} \alpha_{4,i} \Delta LRGDP_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta LRGDP_t = \beta_0 + \beta_1 LRGDP_{t-1} + \beta_2 LMILEX_{t-1} + \sum_{i=0}^{m} \beta_{3,i} \Delta LMILEX_{t-i} + \sum_{i=1}^{n} \beta_{4,i} \Delta LRGDP_{t-i} + \mu_t \quad (2)$$

B.Model 2:

$$\Delta LMILEX_t = \theta_0 + \theta_1 LMILEX_{t-1} + \theta_2 LRGDPK_{t-1} + \sum_{i=1}^{m} \theta_{3,i} \Delta LMILEX_{t-i} + \sum_{i=0}^{n} \theta_{4,i} \Delta LRGDPK_{t-i} + \gamma_t \quad (3)$$

$$\Delta LRGDPK_t = \delta_0 + \delta_1 LRGDPK_{t-1} + \delta_2 LMILEX_{t-1} + \sum_{i=0}^{m} \delta_{3,i} \Delta LMILEX_{t-i} + \sum_{i=1}^{n} \delta_{4,i} \Delta LRGDPK_{t-i} + \omega_t \quad (4)$$

whereby MILEX is the ratio of military expenditure to GDP, RGDP is real GDP, RGDPK is real GDP per capita , Δ is the first difference operator, L denote variables in logarithm and ε_t, μ_t, γ_t and ω_t are serially independent random errors.

To examine the long- run relationship, the bound cointegration test based on *F*-statistic taken from Pesaran et al. (2001) will be used. The long-run relationship between MILEX and RGDP are tested on the following null and alternative hypotheses:

For Equation (1):

$H_0: \alpha_1 = \alpha_2 = 0$ (No long-run relationship), $H_1: \alpha_1 \neq \alpha_2 \neq 0$ (A long run relationship).

For Equation (2):

$H_0: \beta_1 = \beta_2 = 0$ (No long-run relationship), $H_1: \beta_1 \neq \beta_2 \neq 0$ (A long run relationship).

For Equation (3):

$H_0: \theta_1 = \theta_2 = 0$ (No long-run relationship), $H_1: \theta_1 \neq \theta_2 \neq 0$ (A long run relationship).

For Equation (4):

$H_0: \delta_1 = \delta_2 = 0$ (No long-run relationship), $H_1: \delta_1 \neq \delta_2 \neq 0$ (A long run relationship).

The two asymptotic critical values bound provide a test for cointegration when the independent variables are *I(d)* (where $0 \leq d \leq 1$): a lower value assuming the regressors are *I(0)*, and an upper value assuming purely *I(1)* regressors. If the test statistic exceed the upper critical value, we can conclude that a long – run relationship exist regardless of whether the underlying order of integration of variable are zero or one. If the test statistics fall below the lower critical values we cannot reject the null hypothesis of no cointegration. However, if the statistic fall between these two bound, inference would be inconclusive.

In this study we estimate the long –run coefficient by using the dynamic OLS (DOLS) proposed by Stock and Watson (1993). We apply this method because it is more recent and more robust method, particularly for small samples. According to Stock and Watson, DOLS is also a parametric approach for estimating long run equilibrium in a system which may involve variables integrated of different orders but still cointegrated. The DOLS procedure which basically involves regressing any *I(1)* variables on other *I(1)* variables, any *I(0)* variables and leads and lags of the first differences of any *I(1)* variables.

4.2 Description and sources of Data

The data used in this study are annual data on GDP and Military expenditure based on five ASEAN countries from 1965 to 2006. These countries are Malaysia, Thailand, Singapore, Indonesia and Philippines. MILEX is measured by the military expenditure as a percentage of GDP. This data was obtained from various issues of SIPRI Yearbook and SIPRI online database. For economic growth, it is measured by real GDP (RGDP) and real GDP per capita (RGDPK) which were obtained from World Development Indicator 2004. The data for real GDP and real GDPK is in US$ and at 2000 constant price. All the data used in the study were transformed into logarithm.

5. Empirical Results

Before testing for causality, it is essential to determine the order of integration for each of the country's GDP and military spending series. We conduct the unit root test to determine the order of integration of the series. The Augmented Dickey-Fuller (ADF) tests are reported in Table 2 and Table 3, with series in levels is run with constant and trend, while series in first difference are run with a constant only. The null hypothesis of unit root cannot be rejected at the 5 percent level of significance for the series in levels, while for series in first difference, the null hypothesis of *I(1)* can be rejected at the 5 percent level of significance. In other words, the five ASEAN countries – MILEX, RGDP and RGDPK series achieve stationarity after first differencing.

Having determined that all series are integrated of order one *I(1)*, we proceed for the testing of cointegration in order to infer Granger causality by using the ARDL bound testing. The cointegration test under this bound test involves the comparison of the critical value and F-statistic. These results are shown in Table 4 and Table 5. When the dependent variable is military expenditure and independent variable is RGDP, two countries namely Indonesia and Singapore display meaningful relationship, as for the other three countries, no significant relationship could be detected. In Panel B of Table 4, when RGDP is the dependent variable, military expenditure is independent, only Singapore shows significant relationship.

In Table 5, when the dependent variable is military expenditure and independent is RGDPK, the results of F-statistic shows that there are 3 countries, namely Indonesia, Thailand and Singapore showing cointegration. However, when RGDPK is the dependent variable, again only Singapore is cointegrated. It can be safely concluded based on the results of this analysis, for the relationship between MILEX and RGDP. Indonesia display a unidirectional causality that runs from RGDP to MILEX, while for the case of Singapore, there are evidence of bidirectional relationship and when RGDPK is used against MILEX, Indonesia and Thailand display unidirectional causality from RGDPK to MILEX while again Singapore shows evidence of bidirectional relationship. As for Malaysia and Philippines, neither model shows any meaningful relationship.

In Table 6 to Table 9, we report the long-run elasticities based on DOLS. In Table 6, the RGDP affect the military expenditure for the case of Singapore and Indonesia with a negative relationship. It is consistent with the previous finding from our ARDL analysis. In Table 7, RGDPK affect the military expenditure for the case of Indonesia, Thailand and Singapore. It is again consistent with the previous finding from ARDL when RGDP and RGDPK are the dependent variables and military expenditure as the regressor, only Singapore are significantly influence the real GDP and real GDPK. So, we can safely conclude that Singapore has a bidirectional causal affect because military expenditure causes real GDP and real GDPK and *vice versa*. While, for Indonesia and Thailand are unidirectional causal because there are only one way relationship between MILEX and economic growth.

6. Conclusion

This study examine the relationship between military expenditure and economic growth for ASEAN-5 countries (Malaysia, Singapore, Thailand, Indonesia and Philippine). In this study we used the autoregressive distributed lag (ARDL) bounds testing procedure to examine the long-run relationship between military expenditure and economic growth using annual data for the period 1965 to 2006.

The result suggest that military expenditure and economics growth for all countries are stationary after first differencing using the unit root test. The cointegration analysis shows there are only 3 out of 5 countries are cointegrated. The presence of long-run negative causality relationship between military expenditure and economic growth is detected for Singapore, Indonesia and Thailand running from RGDP to MILEX. In other word, these countries are having peace dividend. Singapore shows bidirectional causal relationship because military expenditure affects economic growth and *vice versa* growth also affects military expenditure. While, for Indonesia and Thailand, there are unidirectional causal effect because only economic growth affects military expenditure. The results are in contradiction with Frederiksen (1991) who found unidirectional causality, but from military to growth for the case of Indonesia.

The important implication for this finding is that the respective government should take concern of their economic growth to improve their military expenditure. As for the case of Malaysia and Philippines, no meaningful relationship can be considered as a sign of good governance, or in other words, both these government plan their budget well without causing much impact either positively or negatively on other variables. For Malaysia, the result contradicts the

finding of Frederiksen (1991) and Frederiksen and McNab (2001). While Frederiksen (1991) found unidirectional causality from economic growth to military spending, Frederiksen and McNab (2001) had different results, which are unidirectional causality from military spending to economic growth.

For the case of Philippines, the results contradict with both Frederiksen and LaCivita (1987) and Benoit (1978). Benoit (1978) found that for the case of the Philippines, unidirectional causality running from defense spending to economic growth. The contradicting finding might be due to different period of study. While our study cover the period 1965-2006, Frederiksen and LaCivita (1987) analyzed data for 1956-1982. At the same time it is not an isolated finding, whereby Frederiksen (1991) found similar results, that is no meaningful relationship between military expenditure and growth in Philippines, contradicting with one of his earlier study.

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Table 1. Military expenditure as percentage of gross domestic product in ASEAN 5

Year	1990	1995	2000	2005
Indonesia	1.8	1.6	1.0	1.2
Thailand	2.6	2.3	1.4	1.1
Philippines	1.4	1.4	1.1	0.9
Singapore	4.9	4.4	4.7	4.7
Malaysia	2.6	2.8	1.7	2.4

Source: SIPRI year book, various issues.

Table 2. Results of Unit Root Test for Series in Level

ASEAN-5	LRGDPK		LRGDP		LMILEX	
	ADF *t*-statistic	Lag	ADF *t*-statistic	Lag	ADF *t*-statistic	Lag
Indonesia	-1.946	0	-0.440	0	-3.309	0
	[0.61]		[0.98]		[0.07]	
Malaysia	-2.082	0	-1.566	0	-2.658	0
0	[0.53]		[0.78]		[0.25]	
Philippine	-2.216	1	-2.554	1	-2.130	1
	[0.46]		[0.30]		[0.51]	
Thailand	-2.215	1	-1.593	1	-1.471	0
	[0.46]		[0.77]		[0.82]	
Singapore	-0.245	0	-1.902	0	-3.40	2
	[0.98]		[0.63]		[0.06]	

Notes: Asterisk (*) denotes statistically significant at 5% level. Figures in square brackets are p-value.

Table 3. Results of Unit Root Test for Series First in Difference

ASEAN-5	LRGDPK		LRGDP		LMILEX	
	ADF *t*-statistic	Lag	ADF *t*-statistic	Lag	ADF *t*-statistic	Lag
Indonesia	-4.427 [0.00]*	0	-4.547 [0.00]*	0	-5.706 [0.00]*	0
Malaysia	-5.283 [0.00]*	0	-5.272 [0.00]*	0	-6.602 [0.00]*	0
Philippine	-3.616 [0.00]*	0	-3.781 [0.00]*	1	-4.943 [0.00]*	0
Thailand	-3.764 [0.00]*	0	-3.645 [0.00]*	0	-4.475 [0.00]*	0
Singapore	-4.685 [0.00]*	2	-3.898 [0.00]*	0	-7.81 [0.00]*	1

Notes: Asterisk (*) denotes statistically significant at 5% level. Figures in square brackets are p-value.

Table 4. Bounds Test for Cointegration Analysis Based on the Equation 6 and Equation 8

Panel A

Dependent variable LMILEX, Independent variable LRGDP

Critical value	Lower Bound Value	Upper Bound Value
5%	3.937	4.523

Computed *F*- statistic

Countries	*F*-Statistic
Indonesia	15.224*
Malaysia	3.0991
Philippine	1.1772
Thailand	4.0662
Singapore	25.189*

Panel B

Dependent variable LRGDP, Independent variable LMILEX

Critical value	Lower Bound Value	Upper Bound Value
5%	3.937	4.523

Computed *F*- statistic

Countries	*F*-Statistic
Indonesia	2.3821
Malaysia	0.6314
Philippine	0.1216
Thailand	1.1634
Singapore	10.025*

Notes: Asterisk (*) denotes statistically significant at 5% level.

Table 5. Bounds Test for Cointegration Analysis Based on the Equation 7 and Equation 9

Panel A

Dependent variable LMILEX, Independent variable LRGDPK

Critical value	Lower Bound Value	Upper Bound Value
5%	3.937	4.523

Computed F- statistic

Countries	F-Statistic
Indonesia	5.6335*
Malaysia	3.4876
Philippine	1.2858
Thailand	7.2023*
Singapore	18.7371*

Panel B

Dependent variable LRGDPK, Independent variable LMILEX

Critical value	Lower Bound Value	Upper Bound Value
5%	3.937	4.523

Computed F- statistic

Countries	F-Statistic
Indonesia	1.1235
Malaysia	0.6039
Philippine	4.0044
Thailand	0.0078
Singapore	7.0262*

Notes: Asterisk (*) denotes statistically significant at 5% level

Table 6. Long – run coefficient based on DOLS

Dependent : LMILEX Independent: LRGDP	Indonesia	Singapore
Constant	5.7650	3.4220
	(5.9304)*	(9.5571)*
$LRGDP_t$	-0.4673	-0.1568
	(-5.7280)*	(-5.2539)*
$\Delta LRGDP_t$	1.3852	-0.9431
	(2.4926)*	(-1.7126)*
$\Delta LRGDP_{t-1}$	2.7106	-0.3990
	(4.2995)*	(-0.6831)*
$\Delta LRGDP_{t+1}$	0.1259	-0.5570
	(0.2101)	(-1.5433)*

Notes: Asterisk (*) denotes statistically significant at 5% level.

Table 7. Long – run coefficient based on DOLS

Dependent : LMILEX Independent: LRGDPK	Indonesia	Thailand	Singapore
Constant	5.3826	4.4104	2.7661
	(8.7412)*	(4.4844)*	(8.1835)*
$LRGDP_t$	-0.7851	-0.5252	-0.1279
	(-7.8329)*	(-3.8743)*	(-3.6063)*
$\Delta LRGDP_t$	0.5813	0.2054	0.3322
	(0.6878)	(0.2839)	(0.9941)
$\Delta LRGDP_{t-1}$	0.2901	2.1746	-0.0920
	(0.3978)	(3.2226)*	(-0.1561)
$\Delta LRGDP_{t+1}$	0.9773	0.8702	0.5070
	(1.3889)	(1.4306)	(1.1994)

Notes: Asterisk (*) denotes statistically significant at 5% level.

Table 8. Long – run coefficient based on DOLS

Dependent : LRGDP Independent: LMILEX	Singapore
Constant	16.8607
	(12.692)*
$LMILEX_t$	-3.9289
	(-5.1127)*
$\Delta LMILEX_t$	0.0286
	(0.0267)
$\Delta LMILEX_{t-1}$	-0.2168
	(-0.2843)
$\Delta LMILEX_{t+1}$	-1.9234
	(-4.1403)*

Notes: Asterisk (*) denotes statistically significant at 5% level.

Table 9. Long – run coefficient based on DOLS

Dependent : LRGDPK Independent: LMILEX	Singapore
Constant	14.5698
	(12.989)*
$LMILEX_t$	-3.3517
	(-5.0419)*
$\Delta LMILEX_t$	0.06225
	(0.0.0709)
$\Delta LMILEX_{t-1}$	-0.1741
	(-0.2972)
$\Delta LMILEX_{t+1}$	-1.7302
	(-4.3939)*

Notes: Asterisk (*) denotes statistically significant at 5% level.

Source: SIPRI year book, various issues.

Figure 1. Military expenditure in ASEAN 5 (constant price 2005)

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The Relationship between Marketization Level and Environmental Quality in China

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Abstract

Affected by the global financial crisis, China has proposed a 4-trillion-yuan stimulus package. To dispel the impact and balance the economic growth and ecological improvement, marketization may be an effective means. The article tries to explore the relationship between the two sides. By analyzing the impact of the mechanism between marketization and environmental quality, with the help of econometric model, the quantitative analysis has been made on the above basis. The result shows that with the rising level of Chinese national marketization, the pollution loads of Sulphur Dioxide and Chemical Oxygen Demand of gross industrial output value per 10000 yuan are both on the decline. By modeling SO_2 and COD of unit (per 10000 yuan) gross industrial output value and marketization level of 31 provinces in China, the results indicate that the higher the marketization level of a province, the lower emissions of either SO_2 or COD. Therefore, the marketization level will better the environmental quality. Relevant solutions are also proposed.

Keywords: Marketization level; Environmental quality; Pollution load

Given the ongoing world financial crisis, China has also been more or less influenced. How to balance the relationship between economic development and environmental (or ecological) improvement becomes a big challenge for policy makers. To fight the financial turmoil, China has proposed a 4-trillion-yuan stimulus package, whose purpose can be summarized as boosting domestic demands, ensuring economic growth, making structural adjustment and securing people's livelihood. To achieve the win-win goal between economy and environment, marketization may be an effective means.

1. Mechanism between marketization and environmental quality

Market mechanism can affect the environmental quality indirectly. According to statistics, the past decade marks the fastest marketization transition period for China economic institutional reform, during which the annual economic growth rate exceeded 8 percent, whereas, the main pollutant emissions reduced by 15 percent (Xie, 2002). Marketization, on the one hand, is in conflict with environment, but on the other hand, the two sides may be compatible with (Zhang, 2003, pp.142-143).The measure of marketization can be expressed either by the classical indicator like GDP, gross industrial output value, or by chief pollutant indicators which represent environmental quality such as Sulphur Dioxide (SO_2) and Chemical Oxygen Demand (COD).

1.1 Short-run impact analysis

In the short run, with the periodical or structural characteristics of economic growth, the environmental quality which is the byproduct of economic development might deteriorate, for instance, the current industrial progress accelerates the phase of heavy industrialization in China, with the rapid development of construction on urban infrastructure, the steel and chemical industries have been boosted. Because of long chain and long production period features, the heavy industry has a strong demand on energy and resources consumption, it can be ranked among high capital input and high energy consumption sectors, the heavy industrial characteristic inevitably will threaten to undermine the quality of economic development. Since 2000, Heavy industry has exceeded 60%, the rebound of industrial pollution in recent years is triggered by heavy industry development, which confirms the finding that China is still on the left side of the Environmental Kuznets Curve picture (CAS, 2001), and therefore, the task for China's energy-saving and emission-reducing still has a long way to cover.

1.2 Long-run impact analysis

In the long run, the rising level of Chinese marketization will help enhance eco-environmental quality. Main factors are

listed below.

1.2.1 The fundamental change of economic growth model

The change of economic development model is based on the transition of economic system. It is necessary to give full play to market mechanism in allocating resources, press ahead the resources allocation to transform from the way of non-marketization under planned economy system whose efficiency is low or void to market oriented economy whose efficiency is relatively high, thus, the approach of economic development can be shifted from extensive type to intensive type gradually (Li, Guozhu and Ma, Shucai, 2007, pp.61-68).

1.2.2 Marketization and environmental economic policy

In market economy, government tries to fulfill his goal of environmental protection by certain measures including stipulating decree, regulation, standards, bans, and permits (certificates), which have been proved effective by developed countries. Whether to employ current market or to create new market should be based on the real circumstances. The results of environmental policy depend on the level of marketization perfection. Given non-perfect market and false environmental information, the practical results might be of low efficiency or void. Presently during the course of environmental management, Chinese government takes market methods more often than not, and the level of marketization is becoming higher and higher, concrete methods such as rights of pollutant trading, tradable permits and ban on free plastic bag are widely used, particularly the ban on free plastic bag (or plastic limit order) on Jun 1st, 2008, is a good case in point. Together with the performance of the 11th five-year planning started from 2006, among which two specific goals to promote the energy-saving and emission-cutting—energy consumption of unit GDP being reduced by 20 percent and the decrease of chief pollutant emissions (SO_2 and COD) by 10% are included, market perfection and effects of environmental economic policy, the environmental quality can be bettered progressively.

1.2.3 Annual increase in environmental protection investment

According to China statistical yearbook in 2007, from the years 2001-2005, the yearly investment in China's pollution prevention and treatment accounted for 1.01%, 1.14%, 1.20%, 1.19% and 1.30 % of GDP respectively. On the whole, China is in the phase of effective pollution control, but the investment on environmental protection is increased year-on-year, which will guarantee the continual improvement of environmental quality.

1.2.4 The deepening of environmental protection concept of local governments and enterprises

With the deepening of environmental protection concepts, more and more local governments and far-sighted enterprises, come to realize that the environment quality is also a kind of production force, in effect, a more lasting competitive advantage. For example, in many Chinese mainland cities, which currently face the tough challenge of a new round of industrial restructure and technical update as well as the financial turmoil, local governments begin to raise threshold when attract investment from home and abroad. They not only pay attention to the economic benefits, but also make more efforts on environmental and social benefits, meanwhile, require new projects to pass both the environmental impact assessment and the energy assessment review. Only by so doing, can environment and development quality of regional economy be ensured. Scores of enterprises with a strong sense of social responsibility respond actively to enhance the level of environmental protection by means of technological innovation, for instance, some power plants purchase desulphurization equipment, and some manufactures of home appliances focus on improve the rank of China energy label.

1.2.5 Measures on energy-saving and emissions-reducing

With the construction of resources-saving and environmental-friendly society in China, particularly the current measures on saving energy and reducing emission, the environmental quality will be progressively enhanced, which can be confirmed by the figures announced by China Finance Ministry in 2008: 27 billion special funds were allocated to advance the process of energy-saving and emission-reducing. According to Xinhua news agency on Sep 10th, 2008, which reported that during the first half of 2008, the emissions of the two main pollutants: COD and SO_2, are both on the decline, of which the SO_2 emission is roughly 3.96% compared with the previous year, and that of COD is 2.48%, indicating the policies and measures of emission constraints do work to some extent. Of course, results achieved are also the joint contribution of engineering, structural and managerial emission reduction as well as the practice of circular economy.

1.2.6 The international consensus and cooperation on Climate change

The impact of environmental problems, especially climate change, is worldwide. To address the rising of global temperature, cutting carbon emissions is an available ways. The deepening of emission reduction activities of developed countries are the central topic for the new round of UN negotiation on climate change in Bangkok, and also the key to Copenhagen negotiation to be held this year, which will make arrangements for after 2012 corporation on global climate change. According to Kyoto protocol, how to effectively promote the technical and capital aid from developed countries, support developing countries to mitigate and adapt to the impact caused by climate change is another topic for the new

round negotiation. With regard to this issue, China proposed that developed countries input 0.5 percent of their annual GDP to help developing countries, while Germany put forward auctioning of emission rights and use the yields by such deal to realize cooperation. A statement which supports the use of market trading on CO_2 emissions was also passed in Bangkok (Qi, 2008, pp.68-70). The trading mechanism on carbon dioxide emissions aims to reduce greenhouse gases. According to the Kyoto Protocol, market participants can trade emission allowances to make reductions. With emission trading, emitters also face incentives to find innovative ways to reduce their emissions and thus sell excess allowances or reduce their need to buy allowances (Neuhoff, 2007,pp.175-176). As the atmosphere is a shared resource, all countries have responsibility to take action but industrialized countries should take the lead, given their dominant role in creating the problem. For the first commitment period of the Kyoto Protocol (from 2008 to 2012), countries with targets are required to reduce their greenhouse gas emissions to an average of 5 percent below their emissions in 1990. Most of the world developing countries are encouraged to take action to reduce emission under the Kyoto Mechanisms, in particular the Clean Development Mechanism (CDM), which allows carbon credits generated from emissions reduction projects to be used(habbitts,2007, pp.295-297).

2. Analytical methods and results

2.1 Model and results on national marketization level and ecological quality

2.1.1 Econometric model

Basic data include: China national index of marketization and that of the 31 provinces across China (Fan et. al, 2007, pp.6-8), SO_2 and COD of unit gross industrial output value from 2001-2005. The model function listed below is derived by comparing several estimated curves done by SPSS software, which indicates the link between pollutant load in unit gross industrial output value and marketization level.

$y=ae^{bx}$

Where

y annual SO_2 or COD emission in unit gross industrial output value

x marketization index of the corresponding year

a, b model coefficients.

2.1.2 Results analysis

The model result suggests that, with the rising of the maketization, pollutant loads of SO_2 and COD of unit gross industrial output value are both on the decline, and the values of R^2 exceed 0.8, which indicate that the model conforms well to the real situation. To be specific, the emission of SO_2 in the first half of 2008 reduced by roughly 3.96% compared to the same period of last year, while COD reduced by 2.48%.

Based on SO_2 and COD emissions in unit gross industrial output value at 2000 prices, Our preliminary calculation of unit SO_2 discharge has shifted from 0.036 ton in 2001 to 0.023 ton in 2005, while the COD has changed from 0.026 ton to 0.013 ton in the same period, during which Chinese marketization level has risen from 4.64 to 6.52.Obviously, to some extent, marketization approach plays an important role in promoting China economic growth, pressing the work of energy-saving and emission-reducing, and improving the quality of economic operation.

2.2 Model and results on marketization level and ecological quality in 31 provinces

2.2.1 Panel data Model

Basic data include: China marketization index of 31 provinces from 2001-2005(Fan et. al, 2007, pp.6-8), SO_2 and COD of unit gross industrial output value in corresponding years. Of which, the gross industrial output value and SO_2 or COD discharge are taken from China environmental yearbook. Using 2000 as a base, the original figures of 31 provincials' gross industrial output value were converted into the ones at 2000 prices to eliminate price impact.

The paper uses panel data model to further the analysis. Generally speaking, when choosing a model, we usually do model test by F statistic variable which is formulated from the residuals of constraint and unconstrained regression. By virtue of Eviews software and the F test, the paper then chooses the time-fixed effects model with changing intercept as suitable model to make relevant analysis (Zhang, 2007). Of which, the time-fixed effect model with changing intercept is listed below,

$$y_{it} = \beta_1 x_{it} + \alpha_1 + \alpha_2 D_2 + \alpha_3 D_3 + \cdots + \alpha_T D_T + \varepsilon_{it}, \; i=1, 2,\ldots, N$$

Where

$$D_i = \begin{cases} 1, \textit{for section } t,\ t = 2,\ldots,\ T \\ 0, \text{ other } \textit{cases} \end{cases}$$

y_{it} SO_2 or COD emissions of gross industrial output value per10000 yuan (or unit gross industrial output value) of individual *i* in the time of *t*

x_{it} Marketization level of individual *i* in the time of *t*

In either y_{it} **or** x_{it}, the subscripts assignment of *i* and *t* are,

i = 1,…,31

t =2001,…,2005

ε_{it} Random error

2.2.2 Results analysis of panel data model

The model results show that the rising level of marketization contributes to the continuous improvement of environmental quality in 31 provinces. To be specific, with every unit rising of marketization index, SO_2 emission of gross industrial output value per 10000 yuan will reduce by 7.5575 units. By further analysis, the conclusion is that the higher the marketization level, the lower the SO_2 emission in unit gross industrial output value. Take the marketization level in 2005 as an example, the top ten provinces are Shanghai(10.41), Guangdong(10.06), Zhejiang(9.90), Jiangsu(9.07), Beijing(8.62), Fujian(8.62), Tianjin(8.34), Shandong(8.21), Liaoning(7.84) and Hainan(5.54) in sequence, of which, Beijing and Fujian are of the same market level. Here, the figure between brackets represents the overall marketization level of each province, and moreover, the larger the figure, the higher the marketization level. When it comes to SO_2 emission in unit gross industrial output value—ton per 10000 yuan, the sequences of last ten provinces are Shanghai(0.004), Beijing(0.007), Tianjin(0.007), Hainan(0.007), Jiangsu(0.012), Fujian(0.012), Zhejiang(0.013), Shandong(0.017), Guangdong(0.017) and Liaoning(0.019), among which, Beijing, Tianjin and Hainan are of the same discharge level, Jiangsu and Fujian are of the same, Shandong and Guangdong are the same. Since the regression equation reflects the average characteristics rather than individual ones, the negative slope of the equation shows that there is a relation between marketization level and environmental quality, furthermore, the absolute value of the slope, with the figure of nearly 7.6, is relatively big, which demonstrates that the marketization level can quickly influence environmental quality.

So it is with the COD emission. To be specific, with every unit increase of marketization index, the COD emission per gross industrial output value will decrease by 1.0751 units. Further analysis shows that the higher the marketization level, the lower the discharge of COD in unit gross industrial output value—ton per 10000 yuan. Still take the marketization level in 2005 as an example, the top ten provinces are Shanghai, Guangdong, Zhejiang, Jiangsu, Beijing, Fujian, Tianjin, Shandong, Liaoning and Hainan in sequence. Of which, Beijing and Fujian are of the same level. With respect to the COD emission in unit gross industrial output value, the last ten provinces are Shanghai(0.003), Beijing(0.004), Tianjin(0.004), Shandong(0.006), Jiangsu(0.009), Zhejiang(0.009), Fujian(0.010), Liaoning(0.010), Guangdong(0.014) and Hainan(0.028) in sequence. Among which, Beijing and Tianjin are of the same emission level, Jiangsu and Zhejiang are the same, Liaoning and Fujian are also the same. Similar to the reason of SO_2, the minus slope of the equation shows that there is a link between marketization level and environmental quality. And moreover, the absolute value of the slope, being 1.08, demonstrates that the marketization level can influence environmental quality to a certain degree.

If compared with the pollution load on unit industrial output value of SO_2 and COD, it is clear that the level of SO_2 emission reduction is much larger than that of COD, and the former is roughly 7 times of the latter. The achievements cannot be made without strictly curbing projects with characteristics of high pollution, high energy consumption and low efficiency to be passed, strengthening desulphurization on newly industrial or technological projects, making stern environmental impact assessment and energy saving review. In the meantime, the reason behind the achievements also tells that it is necessary to adopt new advanced sewage treatment technology to improve the treatment rate, and strengthen the emission reduction on COD to a new level. Only by so doing can the eco-environmental quality be gradually improved and the ecological civilization be established.

In addition, environmental quality varies from year to year. Other than 2003, in terms of SO_2 discharge model, the individual time to total average condition appears to decrease gradually. And so it is with COD. The achievable results reflect that, to some degree, there is a beneficent cycle between marketization level and the improvement of environmental quality.

2.3 Conclusions and discussion

According to the above analysis, the following can be derived or be further proved.

(1) Since 2001, the pollution load of SO_2 and COD in gross industrial output value per 10000 yuan has shown the tendency of downturn. Especially in 2008, the main pollutant emission in China appeared dual decline, partly achieved

the binding targets set in 2006.

(2)Compared with industrialization countries, China's marketization level has unique characteristics: given a human population of 1.3 billion, the natural resources per person in China becomes very small, just because of the conflicts between huge population and resources scarcity, the environmental assets are virtually over consumed, the carrying capacities are outstripped. Meanwhile, China marketization progress is complicated and compressed: it is not directly shifted from natural economy, but changed rapidly from planned economy to market economy. As a result, it has features such as traditional institutional barrier, big transitional difficulty and high reform costs. To ensure the successful transition, great efforts need to be made accordingly. For instance, continuing to give full play to market mechanism, and increase the financial input on environmental protection.

(3)Marketization is helpful to China economic growth, the win-win goal between economic development and environmental protection is an exciting and worthy one both in theory and in practice. Currently, China has also been more or less influenced by the ongoing financial crisis. For instance, the economic growth rate for 2009 has to be customised and tailored to 8 percent or so. If compared with 2008, which was 9 percent, the figure is a little bit decrease. Other policies including boosting domestic demands and making structural adjustment are also been made to reverse the economic downturn. In this scenario, to fulfill the set targets on pollution control and emission reduction is not that optimistic. To minimize or dispel the mentioned unfavorable impact and achieve the win-win goal of economic development and environmental protection, stronger and more effective solutions must be taken in time.

3. Solutions

The win-win goal between economic and environmental cannot win overnight, certain measures encompassing continually moving forward the energy-saving & emission-reducing project as well as marketization reform, developing circular and low-carbon economy, adopting the integrated decision-making policy and some other concrete actions must be taken.

3.1 Advance the marketization process

Marketization is an effective means, and it can allocate resources more efficient in most cases. The economic achievements of China's reform and opening-up practice over the last three decades have well illustrated the role of market mechanism. The above discussion has indicated the close relationship between marketization level and ecological quality. Whether from the viewpoint of tackling the current financial crisis or from the perspective of promoting China's economic development and ecological quality, marketization is a rational option for furthering relevant reform in the long run.

3.2 Develop circular economy

China promotion law of circular economy has taken effective since Jan 1st, 2009. In practice, Chinese circular economy means to lead enterprises to take the newly industrialization way whose features include high value added of technology, high economic benefits, low resources consumption and giving full play to the advantages of human resources, and finally establish the desired economic model, namely, the circular economy by Chinese way. To our understanding, the Chinese circular economy model can be explained in three aspects: firstly, it means to consider every enterprise as a unit, encourage them to implement clear production, and build up small-sized recycling system. Secondly, it regards every industry or sector as a unit, requires each unit to extend industrial chain and set up medium-sized recycling system. And thirdly, the whole city or country should also be viewed as a unit, thus far, the circular economy is carried out across the whole society, which is the large-sized recycling system. And environmental management methods like the from-cradle-to-grave should also to be encouraged to promote the circular economy practice.

3.3 Implement the integrated decision-making mechanism of environment and development

The integrated decision-making mechanism of environment and development means that in the process of decision-making, the aspects of environmental, economic and social development should all be taken into consideration. In other words, when to make decision, the best equilibrium point among environmental, economic and social affairs cannot be found till all the three aspects are well balanced. Only by so doing, can the goals of economic development, social progress and environment protection be harmoniously fulfilled. Here, the word 'environment' in the mechanism actually refers to environmental protection, and development means the economic and social development. Only when environment and development are considered together, can the concept of sustainable development be understood correctly. At present, China is in the transitional period from traditional way of high economic growth and high pollution level to the sustainable one of high economic growth with low pollution level. According to the report of China national statistics bureau on Oct 27th, 2008, by the year 2007, with income per capita reaching $2360, China has entered the rank of lower-middle-income countries according to the income standard released by the World Bank and the gap between China and the recognized $4000-5000 per capita GDP which is the turning point of Environmental Kuznets Curve is continuing to narrow. The improvement of environmental quality may not be happened automatically with the rising of income level, for there are several other factors affecting the environmental quality, besides income,

other elements such as national or regional environmental policy, industrialization progress and social and natural factors are also crucial. In this case, the integrated decision-making mechanism should be strictly carried out, meanwhile, displaying the late comer's advantage fully and avoiding the way of polluting first and harnessing later are also of vital importance.

3.4 Increase investment in environmental protection

During the marketization process, in specific stage, the conflict of capital use between economic development and environmental protection is inevitable. According to the practice of developed countries, different environmental quality has different demand on environmental protection investment, to be specific, when the proportion of environmental investment of GDP accounts for 1%-1.5%, environmental pollution can be effectively controlled, and in the rage of 2%-3%, it can be bettered gradually, only when the number exceeds 3%, can it be improved fundamentally. As noted earlier, as a developing country, Chinese economy and environmental protection has a compressed character which is quite deferent from the developed country. Despite the global financial crisis, China should pay more attention to the quality of economic growth, whereas the continuous improvement of environmental quality is the important part. To ensure the ecological quality, certain investment must be injected to environmental protection. Meanwhile, the funds efficiency should also be raised. To dispel the impact caused by the global financial crises, China central government has put forward ten measures to expand domestic demands and guarantee economic growth. The 4-trillion-yuan stimulus package includes a 210-billion-yuan investment in energy conservation and ecological engineering, which will ensure the continuous improvement of environmental quality.

3.5 enhance the work of energy-saving and promote emission-reducing and develop renewable energy

Energy-saving and emission-reducing is the task for all humankind, and the technological innovation is the fundamental way out. The essence of environment problem nowadays is actually a development problem. The issue of energy-saving and emission-reducing means both challenge and opportunity. For China is in the phase of quick industrialization and urbanization, it is crucial to enhance the work of energy-saving and emission-reducing, which is not only the effective move to promote product update but also the good practice for pushing the ecological civilization as well as cultivating the public awareness of energy-saving and the construction of eco friendly society. The civil society calls for every enterprise and every society member to develop the habits of saving energy and protecting the environment. A concrete example in point is that, on March 28th, 2009, many Chinese big cities and its people taking responsibility willingly by turning off lights on 'earth hour' to save energy as well as to fight climate change. In addition, vigorously developing the renewable energy resources can also help better ecological quality and protect the ecosystem. In effect, whether to conserve energy, to cut emission or to develop renewable energy, they all contribute to sustainable development.

3.6 develop low-carbon economy and construct ecological civilization

The high-carbon economy will definitely hurt the future development, while the low-carbon one will be sustainable. To fight the global climate change, every country should control or cut emissions of CO_2 and other greenhouse gases, for atmosphere is a shared resource. International cooperation should also be strongly strengthened. As a responsible developing country, China has already taken concrete actions to climate change: the ongoing project for energy-saving and emission reduction which began in 2006 in the 11th five-year-plan is a good case in point. Let alone the successful 2008 Olympic Games held in China with slogans of green Olympics, scientific Olympics and humanistic Olympics. Currently, Chinese government calls for his people to build ecological civilization vigorously, which, in essence, is the same to the construction of resource-saving and environmental friendly society. The Chinese trading framework of carbon balance is one more meaningful work in resolving the conflicts between economic development and environment protection. By so doing, China can build up low-carbon economy and fulfill the goal of ecological civilization progressively.

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The Impact of Value Management Implementation in Malaysia

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Abstract

This paper reports on the findings of a study on value management (VM) applications in the Malaysian construction industry. A questionnaire survey of 7 pages was sent to 5581 numbers of registered developers, architects, engineers, quantity surveyors and project managers to seek their experience on VM applications. A return rate of 7.5 per cent or 411 numbers of respondents were received.

During the process of investigation on the evolution in Malaysia, it was discovered that the global evolution of VM did influence the Malaysian construction industry as majority of the public universities had ensured that VM methodology knowledge has been integrated into their syllabuses, thus the future construction industry practitioner has had the basic knowledge on VM methodology provided which should have equipped them for producing a better functionally, and better value for money construction projects.

Keywords: Value Management, Development, Questionnaire, Malaysia construction industry

1. Introduction

VM is 'a multi-disciplinary, team orientated, structured, analytical process and systematic analysis of function which seeks best value via the design and construction process to meet the client's perceived needs'(Jaapar, 2006; Jaapar & Torrance, 2005; Jaapar & Torrance, 2007), a proactive, creative, problem-solving service, using a multi-disciplinary team oriented approach to make explicit the client's value system, at targeted stages through the development of a project or the life of a facility" (Kelly & Male, 1993; Norton & McElligott, 1995), a means of group decision support

(Green, 1999), the most promising method in co-ordinating professionals from different disciplines (Shen, 1995) as well as a method to help the clients better achieve their goals (Connaughton & Green, 1996; Male, Kelly, Fernie, Gronqvist, & Bowles, 1998). The VM procedure also encourages the development of a value culture within the organisation which eases the path to accomplishing desirable change. Thus, it can be summarised as a goal-setting process that aims to satisfy the client's project requirements as well as it concentrates on improving the relationship between value and the client.

Internationally, VM is an emerging paradigm that focuses on continuously increasing the value provided to the client and is widely accepted as an important tool in recent management of construction projects (Ellis, Wood, & Keel, 2005). The construction industry is an important field for VM at the international level (Kelly, Male, & Graham, 2004) as it is also critical to the success of projects since it provides a basis for improving value for money in construction (Ashworth & Hogg, 2000). It focuses on value rather than cost and seeks to achieved an optimal balance between time, cost and quality (Kelly et al., 2004) as well as it provides a method of integration in the building process that no other management structure in construction can provide (Kelly & Male, 1991). It also explores the functional requirements and seeks overall optimisation accordingly(Shen, 1995). Norton and McElligott (1995) strongly advocated that VM should precede Cost Management effort which later was endorsed by (Liu, 2003) who emphasise the importance of VM practice in the construction industry as it has proven that it could provide significant benefits to clients if it is used correctly.

VM was first introduced in Malaysia in 1986 (Jaapar & Torrance, 2007). Currently there is evidence of some client organisations in Malaysia applying some concepts of VM in their project operations (Abdul Ghani, 2004; BERNAMA, 2002; Che Mat, 1999, 2002; Hussein, 1998; Karim, 1999; Ong & Yeomans, 2002; Sareh, 2003; Shamsuddin, 2002; Stevens, 1997; Sulaiman, 2000; Tamim, 2002; Yahya, 2003) It is clearly indicated that, in Malaysia, its application is still in its infancy(Abdul Ghani, 2004; Jaapar, 2000; Jaapar & Torrance, 2005; Ong, 2004a, 2004b) thus, to promote the application of VM in the industry, it is crucial to understand its current state of its application before a system of VM philosophy can be developed to suit the current local scenario.

Unfortunately, VM has not yet become widely practiced in the Malaysia. It was observed that due to some successful applications of VM in the Malaysian construction industry, hence actions should now be taken to exert its full potential to improve value for money for the clients of the industry. It is argued by Che Mat (1999), that the clients' understanding towards the VM concept is important as it is not just merely considering the cost but it considers the relationship between value, function, quality and cost in a wider perspective leading to the fundamental contribution of VM application whereby it eliminated the unnecessary cost which does not contribute to the project's value, system and facilities.

2. Problem Statement

The application of the VM concept, is widely accepted internationally especially in the USA, Japan, European countries, and other developing countries such as Australia. In Malaysia, its application is still in its infancy (Jaapar, 2006; Jaapar & Torrance, 2005; Jaapar & Torrance, 2007). Thus, to promote the application of VM in the industry, it is crucial to understand its current state of its application in the industry before a system of VM philosophy can be developed to suit the Malaysian construction industry scenario.

3. Objectives

This research aimed to achieve two objectives, which were to investigate the current development of VM and its benefits to the Malaysia construction industry and to investigate the current level of VM applications in the Malaysian construction projects.

4. Significance of the research

The major theoretical contribution of this research is, it explores the theory of VM and its applications in the Malaysian construction industry and to investigate the current level of applications.

5. Brief outline of research methodology

A questionnaire survey was designed, piloted and mailed to ensure information related to the implementation of VM in the Malaysia construction industry could be collected and the respondents' opinions in relation to suggestions, implementation processes and the obstacles with regard to the VM applications. The respondents consisted of the clients and the registered consultants of the construction industry.

5.1 Population Sample

A postal questionnaire of 5581 copies, which was developed to collect the level of VM application, was served to the expert clients and the registered consultants who were actively engaged in procuring, designing and construction in the Malaysia construction industry.

Two groups of respondents were involved in the survey. The respondents consisted of the developers (or the expert clients), and the professional consultants of the industry which were identified as the architects, the engineers, quantity surveyors and the project managers. They were selected to be the respondents due to their important involvement and their impact on the decisions made during the process of the construction project procurement.

The expert clients were very important due to their contribution to the development and growth of Malaysia as a developing country and it is for whom the value is generated. The second group of the respondents was the registered professional consultants of the Malaysian construction industry. These are the people that ensure that project execution proceeded smoothly. According to the WCGPM (2004) project consultants are the persons who provide specialized services based on their special qualifications, education or experience. In this case, the selected consultants were architects, the engineers, the quantity surveyors and the project managers. Only the registered professionals of each discipline were selected to be the respondents of the questionnaire.

The involvement of the clients and the consultants were important to the research since they are the key players who play an active involvement in order to produce the specified buildings and other facilities during the construction process. Therefore, their input must be considered through a thorough understanding of the outcome of the specified construction project. By analysing the information gathered from the various parties from the perspectives of VM, it would be able to enhance the VM services offered by the consultants to improve the clients' requirements in procuring the projects.

5.2 Sample Surveyed

According to de Vaus (2001) sample size creates a problem with any type of design. Due to its infancy development of VM (Jaapar & Torrance, 2005) it was even more important to ensure that as many respondents as possible were being reached so as to ensure that the questionnaire reached the respondents that had experienced with VM application locally. It was stated by Ahmad (2003) that only 2.5% the receivers of a questionnaire in Malaysia returned the questionnaire received and this low rate is supported by Jaapar, Torrance, & Yusuf (2004) in which the response rate received was 5%. There were some elements that were considered thoroughly during the process of deciding the sample size of the respondents. If a sample size of 2000 respondents were to received the questionnaires, a rate of returned of 50 respondents was to be expected. This number may constitute too small a sample since the objective of the research was to discover the number of respondents who have applied VM to their projects, which could be a small percentage of the total respondents.

Due to the reasons stated above, it was decided that all of the potential respondents were to receive the questionnaire. The exception was the registered engineers, due to economic reasons; only 20% (1582 numbers) of them were to receive the questionnaire due to their total population being 7,919 numbers of engineers. The 20% percentage was decided based on it matching with the other categories of respondents, which 1353 number of registered developers, 1675 number of registered architects, 878 number of registered quantity surveyors and 93 number of registered project management companies with the Ministry of Finance.

Thus, in order to ensure its construct validity, 5581 numbers of questionnaires were mailed to all the registered developers and registered consultants of the Malaysia construction industry. This was an extremely wide coverage of potential respondents involved with the Malaysia construction industry.

5.3 Research Methodology

According to Emory & Cooper (1991), in order to obtain the research objectives stated, research design is used to plan the overall programme and structure of the problem under investigation, thus empirical evidence can be discovered. Thus, the choice of research methodology employed depends on the nature, features and context of the research. This research aimed to investigate the current development of VM and to discover the level of VM applications in the construction projects in Malaysia. Therefore, it involved discussion on factors related to the construction industry in order to be able to give a holistic view of its impact on the local construction industry.

5.4 Research Design

The need for research design stems from a skeptical approach to research and a view that scientific knowledge must always be provisional. Its purposed is to reduce the ambiguity of much research evidence. It is contended by Yin (1989) that research design deals with a logical problem and not a logistical problem and Fellows & Liu (2003) added that research methods and styles are not usually mutually exclusive, although only one, or a small number of approaches, will normally be adopted due to resource constraints on the work. The different approaches focus on collection of data rather than examination of theory and literature. The methods of collecting data impact upon the analyses which may be executed and, hence the results, conclusions, values and validity of the study (Fellows & Liu, 2003).

The decision to use the questionnaire method in the study was mainly because the nature of the Malaysia construction

industry which covers the overall geographical area of Malaysia, thus techniques such as snow balling were not appropriate due to this study being exploratory in nature. After an extensive literature review search on the area, there was no such study which had been conducted in the local context. The questionnaire survey methods also made it possible to contact more subjects in a limited time in comparison with other methods, such as interviews, would have permitted.

6. Data Analysis

The data analysis process was conducted by using SPSS version 12 and several types of statistical analysis were applied such as frequency analysis, cross-tabulation, Chi-square test of association, Levene's test and one-way ANOVA. Table 1 presents the summary of results of data analysis conducted in the study.

As for the questionnaire, it was designed to tap the demographic information on education level, job title, and organization background of the respondents as well as their years of experience in the local construction industry. The survey also asked the related questions on the details of the VM application as well as the suggestion for future implementation of VM.

6.1 Assessing the Internal Consistency of the Instrument

There were two sections in the questionnaire (instrument) which required respondents to respond to each item based on a 5-Likert scale response format (1 = Strongly agree to 5 = Strongly disagree). The sections were perceptions of the constraining factors for applying VM and suggestions to ensure better implementation of VM in the Malaysian construction industry. Each section had five variables involved, namely the perception of public level, higher institutions, implementation purposes, client's level and consultant's level.

To ensure the reliability or the accuracy in measurement of the questionnaire, which indicated that it was consistently measured and helped to assess the goodness of a measure, the interitem consistency reliability method was employed to test the consistency of respondents' answer to all the items measured (Sekaran, 2003). Therefore, Cronbach's Alpha coefficient (α) was used to measure the internal consistency of the instrument. Alpha's coefficient ranged in value from 0 to 1. It was used to describe the reliability of the instrument for multi-point formatted scales (i.e., 1 = very dissatisfied to 5 = very satisfied). The higher the value, the more reliable the instrument was. Firstly, the consistency of respondents' answers to all items was assessed. The coefficient of 0.9113 which indicated that the internal consistency for the entire scale was good as it was above 0.7. Then, the internal consistency for each variable in both sections was assessed and the results are summarised in Table 2 and Table 3 respectively.

The Alpha coefficient for all constraining factor variables ranged from 0.7234 to 0.8181 hence indicated that all the variables were highly reliable and consistent. For suggestion variables, the coefficients ranged from 0.7998 and 0.8708 except for the client's level which was 0.6910. Thus, it was excluded for further analysis since it had a poor reliability.

7. Findings of the research

The Survey succeeded in gathering the information and details on the current practice of VM in the Malaysian construction industry from both sectors of the industry which were the clients as well as the registered consultants. By sending the questionnaire to the registered consultants, a perspective of the Malaysian construction industry was able to be gathered from the practitioners who practiced in the both sides of the public and private sectors of the construction industry. Thus, the findings provided a holistic view of the VM application and experience was gained from the outcome of the survey.

It was concluded that the quality of the respondents of the survey was very high, due to them being highly educated and experienced as well as they had high powers of authority in decision making processes in their organisations as well as their experience which was more holistic due to their considerable experience and knowledge.

The analysis confirmed that the longer duration of their involvement in the construction industry, the higher the chance that they came across the term VM. This indicated that the awareness of VM was already established in the industry as 78% knew what VM is but only 16% of the respondents understood the VM term very well based on the training and exposure they had received. It was also found that the knowledge of the job plan had also no significant association with the type of organisation and the respondent's working experience in the construction industry.

It was also discovered that the most common source of VM knowledge was from the books/journals/articles, personal experience, seminars/courses, VM seminar/talk (74), university (67), VM workshop (41) and lastly VM training course (31). This indicated that promotion of VM should be more aggressive especially in producing publications, seminars and training course in VM.

The number of respondents who had formal training on VM still can be considered very low as it was only 14.0% and most of them had completed an Introductory Course to VM rather than completed the Module 2 of VM training. Despite the low percentage on the formal training, it was encouraging to discover that the majority of the respondents (75%) knew the VM methodology irrespective of types of organisation the respondents represented and their working

experience in the construction industry.

The main reason why VM was applied in the first place, was due to the client being able to achieve value for money, followed by it is a useful and efficient method to reduce unnecessary costs as well as it is a value enhancing tool. This is an interesting point to note that it was confirmed by 99% of the respondents who agreed that VM was applicable to the Malaysian construction industry. This indicated that the respondents strongly felt that the current construction industry needed the input from the VM concept and it is very relevant to the Malaysia construction industry.

The result also confirmed that the majority (51%) of the respondents did not practice the VM methodology in their working environment and a large number of organisations had no experience in any workshop in the application of VM study in the construction projects procured despite that 99% of the total respondents agreed that VM is applicable to the local construction industry. Seventy five per cent (75%) of the respondents confirmed on the matters pertaining to the job plan as they agreed with the stages of the job plan listed on the questionnaire and they recognised it as stages involved in the VM study.

Among the criteria which indicated the practice of VM in the current scenario of the Malaysia construction industry, the majority of the projects which had applied the VM methodology were in the region of RM11m and RM50m of project value. It was also found that more than half of the projects (57%) used in-house facilitators to facilitate the VM workshops rather than hiring an independent VM facilitator. The types of formal VM approaches used were mainly the concurrent study and 2-3 days of VM workshops.

Based on the analysis conducted, the majority of the construction projects in Malaysia which had applied VM workshops which were attended by less than 10 participants, during the process of less than 3 days. They were conducted within their work environment and dominated by the clients and the consultants of the project. Most of the projects applied the VM methodology during the outline proposals stage followed by during the briefing concept of a project and 64% had not used the FAST diagram during the process of VM.

It is also encouraging to note that 18% of the respondents were extremely satisfied and 60% of them were satisfied concerning the output of the VM studies. Fifty two per cent (52%) of 149 VM projects recorded the saving of the initial cost of projects of up to 10%, while 25% stated they managed to saved up to 30% of the initial cost of projects after VM workshops implementation.

Among the highest reasons detected on why the processes of VM were applied to the respondents' construction projects were to ensure better value for money as well as to eliminate the unnecessary costs; to seek alternatives as well as to review the existing design and to ensure that clearer focus on project's objectives and to enhance better value. The respondents also stated that the application of VM in their projects was due to the purpose that they wanted to fulfill the clients' requirement and to encourage creativity. Only 18 respondents stated that one of the reasons why VM methodology was carried out in their construction projects was because to pursue management fashion.

It is also important to note that the most important benefits gained from the VM applications, according to the respondents, were that VM was able to eliminate unnecessary costs, it produced a better value in a project, lowered construction cost, the clients' requirements were better met, as well as the project outcome produced a better functionality. All these elements produced a more satisfied client and the respondents realised that the VM process improved the decision making process as well as better team working was produced as a result of the process. These were among the important criteria that the respondents stated they gained from the VM process.

It is confirmed that lack of VM knowledge and practice were the main problems faced during the VM workshop; the resistance to change by the involved parties during the VM workshops sessions as well as the conflicting objectives of the project by different parties. It was also discovered that many related parties involved in the exercise tended to have negative mindsets towards the VM process which resulted in poor team working. Another contributing factor to the problem faced was due to lack of input from the related specialists' as well as poor facilitation skills during the VM workshops.

8. Conclusions

The development of VM in the Malaysian construction industry should be continuously research and monitored in the future in order to ensure its further development and for the construction industry to benefit further as the industry moves from the developing country stage. Based on the findings, further research on VM is required to ensure further insight and evidence on why and how VM methodology was applied, whether there was a need and room for the VM applications in the future of the Malaysia construction industry. Due to the positive outcome of the research in the area of VM application in the current situation of the Malaysian construction industry, it is hoped that the details of VM practice could be probed further by conducting interviews to the selected respondents who have applied VM. By doing so, comprehensive details can be obtained to confirm its practice was as according the VM methodology.

It was concluded that there was an encouraging result towards the future of VM in the Malaysia construction industry

when more than 80% of the respondents from various segments of the industry stated they were interested to integrate the VM application in their future projects. The analysis also revealed that the project manager was voted to be the best person to be a VM facilitator in Malaysia followed closely by the quantity surveyor. It was also discovered that the majority of the respondents wanted VM as the tool to reduce the cost. Beside that, many respondents also needed a VM so as to clarify the need for a project as well as to review the design and to develop a better project brief. They also require VM in order to ensure that they could have better involvement in the projects.

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Table 1. Summary of Results of Data Analysis

<table>
<tr><th>Types of Statistical Analysis Used</th><th>Purpose</th><th>The result</th><th>Analysis</th></tr>
<tr><td>Descriptive Statistics</td><td>Descriptive statistics on demographic profile of the respondents were carried out.</td><td>Summary of respondent's designation from two groups of respondents, i.e. clients/developers and professionals consultants
<table>
<tr><th>No</th><th>Consultant</th><th>Number of respondents</th><th>Percentage (%)</th></tr>
<tr><td>1.</td><td>Architecture</td><td>79</td><td>32.0</td></tr>
<tr><td>2.</td><td>Engineering</td><td>78</td><td>32.0</td></tr>
<tr><td>4.</td><td>Project Management</td><td>16</td><td>7.0</td></tr>
<tr><td>5.</td><td>Quantity Surveying</td><td>71</td><td>29.0</td></tr>
<tr><td colspan="2">Total</td><td>244</td><td>100</td></tr>
</table></td><td>The majority of respondents responded to the survey were from professional consultants.
The majority of the respondents (66%) possess Bachelor Degree
The majority of respondents posses more than 10 to 20 years of working experience in the industry</td></tr>
<tr><td>Chi-square test of association</td><td>• To determine whether there was a significant association between understanding of VM term (knowledge and level of understanding) and others variables such as qualifications, working experience etc.
• To determine whether there was a significant association between the practicing the VM methodology and job title.
• To determine whether there was a significant association between the organisation experience and VM application</td><td>• There was no significant association between qualification and knowledge (p-value = 0.180)
• There was a significant association between working experience and knowledge (p-value = 0.039)
• There was no significant association between qualification and level of understanding of VM (p-value = 0.416)
• There was no significant association between working experience and level of understanding of VM (p-value = 0.444)
• There was no significant association between the practice of the VM methodology and job title (p-value > 0.05)
• There was no significant association between type and the experience of organisation and VM application (p-value = 0.588)</td><td>• The longer duration of involvement in construction industry, the higher the chance that they had aware the term VM.
• This indicate that the existence of VM awareness is already widespread
• Irrespective their title, many of them had not practiced the VM methodology
• More than half of the respondent had no experience in VM application</td></tr>
</table>

Table 1 continue

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Parametric Test</td><td>• Sample size 411 (if sample more than 30, data is approximately normally distributed)
• Levene's Test: To test the equality of variance assumptions</td><td>• The p- value of the Levene's Test result is greater than α = 0.05 as shown below
<table><tr><td></td><td>Levene Statistic</td><td>p- value</td></tr><tr><td>Public awareness</td><td>1.693</td><td>0.151</td></tr><tr><td>Education</td><td>1.383</td><td>0.239</td></tr><tr><td>Implementation</td><td>0.783</td><td>0.537</td></tr><tr><td>Client</td><td>2.790</td><td>0.260</td></tr><tr><td>Consultant</td><td>0.609</td><td>0.656</td></tr></table></td><td>• The variances are approximately equal
• It is appropriate to conduct the parametric test</td></tr>
<tr><td>One-way ANOVA</td><td>To compare means of 3 or more groups of populations

The null hypotheses (H_0) being tested using one-way ANOVA were as follows;
1. (H_0): There is no significant difference for perception of public awareness as the constraining factor between titles.
2. (H_0): There is no significant difference for perception of implementation as the constraining factor between titles.
3. (H_0): There is no significant difference for perception of consultant as the constraining factor between titles.</td><td><table><tr><td></td><td>F- Statistic</td><td>p- value</td></tr><tr><td>Public awareness</td><td>1.139</td><td>.338</td></tr><tr><td>Implementation</td><td>.325</td><td>.861</td></tr><tr><td>Consultant support</td><td>.231</td><td>.921</td></tr></table>
There was no significant difference of perceptions between job titles and public awareness towards VM, implementation elements and consultants supports.</td><td>Since the p- value were greater than 0.05, the null hypotheses failed to be rejected.

All respondents irrespective their titles agreed that public awareness towards VM, implementation elements and consultants supports as the factors to ensure better implementation of VM in Malaysia</td></tr>
</table>

Table 2. Summary of Result of the Reliability Test (Constraining Factors)

Variables	No. of items	Alpha coefficient
Public level	3	0.7234
Higher institutions	2	0.8027
Implementation purposes	5	0.7667
Client's level	6	0.7774
Consultant's level	8	0.8181

Table 3. Summary of Result of the Reliability Test (Suggestions)

Variables	No. of items	Alpha coefficient
Public level	3	0.8708
Implementation purposes	6	0.8553
Client's level	2	0.6910
Consultant's level	3	0.7998

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Application of the Nonwoven Filter Bag in the Field of Environment Protection

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Abstract

The growing importance of controlling the pollution with respect to ecological acceptability and need for non-polluting processing technologies. The nonwovens, was the best choice with the demand for a higher degree of dust collection in the field of Environment Protection because of its more simpler and less production cost. The needle punching and thermal bonding combination process is a useful method for manufacturing of bag filter media. We prepared needle punched and thermal bonded nonwovens using a nonwoven pilot plant in KITECH, and studied the various manufacturing conditions to prepare the bag filter media. The differential pressure of the bag filter media was decreased, and the collection efficiency was increased with increasing main-needling strokes, respectively. The most of made filter media were perfectly filtrated to standard test dust having above 2 μm diameter. The increase in needling strokes resulted in the increase of average pore size, and the average value of all the samples was about 40 μm. In the result of the mechanical properties test, the web formation was randomized with increase the main-needling strokes. Finally, we evaluated the lifetime durability of the products according to the reliability assessment standard RS K 0001. The arriving time up to 100 cycle of the prepared media with 1200 main-needling was longer than that of the other media. It revealed that many needling strokes resulted in lower differential pressure and longer lifetime of filter.

Keywords: Nonwoven Filter Bag, Environment Protection, Needle Punching

1. Introduction

Today environmental protection becomes more and more of a political issue, but of particular note is that treatment of waste has gained great importance, Such as avoidance of waste formation and the recyclability of waste materials. A goal of U.S. industry, in particular the textile industry, is to process waste and low-grade materials into economically viable consumer products. This need is driven by both the economy and environment. In the textile industry, the America Textile Manufacturers Institute (ATMI) has defined environmentally improved textile products (EITP) as anything made from organic or transitional cotton, naturally colored cotton, recycled or reprocessed fibers, Tencel, stone-free denim, or unbleached or undyed products(Li Jianqiang, Luo Jinyin and Wang Jiazhl.1998).

The development of new nonwovens under the heading of optimum recyclability is therefore being pursued already. Recently, various air filtration systems have been installed in many fields such as manufacturing factories, offices, buildings, houses, and various types of filtration materials (V. H. MORCOS.1996; J . M. KIM, 1996) were practically used.

For a long time, the filter bag has been used in the dust collector and its media has been developed with improvement of the dust collector. In the early stage of dust collector, mostly filter bag media were woven fabric which was comprised of cotton, wool, and synthetic fibers. The various filter bag media were prepared by a nonwoven pilot plant coupled with the needle punching and thermal bonding combination processes. Particularly, bag filters, used in a dust collector, are in the market. In present, the bag filter media can be manufactured by natural fibers (cotton or wool) or synthetic fibers (polyester, polyamide, or polypropylene), occasionally manufactured with glass fiber or natural fiber. Woven fabrics are used in reverse-flow bag filter media, while nonwovens, more simply prepared, are often used in reverse-pulse filter media. The production methods of nonwoven for bag filter media were spunbonding, stitching, needle punching, and etc.(B. P. DEREK,1996; T. C. DICKENSON,1997). Among those, the needle punched nonwoven, which prepared from polyester, polyamide, and polyolefin, was in general superior to the other bag filter media as point of price competition and filtration performance.

The filtration performance of bag filter was generally divided by collection efficiency and differential pressure(S . J . KIM, J. Y. WOO, B. S. JEON and D. H. LEE.1990; G. J. I. IGWE.1987). The differential pressure of filtering has to be minimized at the maximal possible collection efficiency of the bag filter. The collection efficiency and the differential pressure are directly related to the durability of bag filter media. For estimation of accuracy lifetime of manufactured filters, the bag filter media must be objectively analyzed by a reliability assessment method. Reliability meant that the product maintains its properties under a given condition for specialized period of time without any failure, which it called Mean-Time-To-Failure (MTTF). The assessment standard of reliability is very important to advancement of manufacturing technology and competitive goods.

This paper explains the effect of the nonwoven fabrics on treatment for dust filtration. In this work, we made bag filter media using a nonwoven plant coupled with needle-punching and thermal bonding processes. The combined manufacture method, needle punching and thermal bonding process, is a very effective one for manufacturing the bag filter media. We studied the effects of processing condition on the filtration performances of nonwovens for bag filter media. Finally, we evaluate the filtration performances of the prepared bag filter media according to the reliability assessment standard method, RS K 0001, Bag filter media for environmental cleaning dust collector, which known as a method to assess the lifetime durability of bag filter media(W. ALBRECHT, H. FUCHS and W. KITTELMANN.2003; C. J. HONG, 1997).

2. Experimental

2.1 Preparation of nonwovens

For nonwoven manufacturing, two polyester staple fibers were used in this study, which were supplied by PGI in china. One fiber was regular polyester staple fiber and the other fiber was lowmelting polyester staple fiber. The characteristics of materials were shown in Table1.

The nonwoven manufacturing processes were shown as the follow description: Opening →Mixing →Carding →Cross Lapping →Needle Punching →Heating →Winding. Those fibers were opened and dosed by a bale opener and a fine opener. After opening, the fiber blend made with 70 % regular polyester and 30% low melting polyester in mix tank. In process of web forming, the blended fibers were carded using two 60 inch roller carding machines. For the randomizing orientation, the fibrous web was perpendicularly laid against movement direction by two cross lappers coupled with horizontal carriage laying machine.

The two laid webs from two cross lappers were united by delivery conveyors and then needled by two needle-punch machines. The frequency of the pre-needling was 300 strokes per one minute and the main-needling was 0,400, 800, and 1,200 strokes, respectively. All the needles used in this study were felting needles made by PGI Co. The needling density of the pre-needling was 2,500 piece/m^2 and main-needling was 5,000 piece/m^2. The needled web was thermo-bonded by a flat-bed laminator at 180◦C. The overall working speed was 2 m/min, the width of the produced nonwoven was 1000 mm, and the weight was about 300 g/m^2.

2.2 Measurements of the filtration performances

The differential pressure and the collection efficiency were measured by testing system for air filter with standard test dust of ISO 12103-1. The differential pressure was measured at 100–600 m3/h of air flow and, the collection efficiency was measured with the test dust of 0.2–110 μm size under condition of standard laboratory. The pore size and the pore size distribution of the as-made filter media were measured with a special tester. According to the situation, and we used it as a wetting agent. The pore size distribution was calculated with the obtained results under wet state and dry state at 0.8 psi. The calculation equation of the pore size distribution is follows;

$$\text{Pore Size Distribution} = \frac{\text{Filter Flow}_{\text{current}}\,(\%) - \text{Filter Flow}_{\text{previous}}\,(\%)}{\text{Diameter previous} - \text{Diameter current}}$$

The air permeability measurement of the bag filter media was conducted using a permeability tester (FX3300,

TEXTEST) at 100 Pa. The specimen size used in this test was prepared to 17×17 cm then it was measured according to KS K 0570.

$$\text{Air Permeability(cm3/cm2/ sec)} = \frac{\text{Flow volume(cm3)} \bullet \text{g(1/hr)} \times 0.2777}{\text{Area of suction head(cm2)}}$$

2.3 Measurements of the physical properties

For the shrinkage ratio test of the filter media, the specimen size was prepared to 20×20 cm and was heated in normal dry oven at 150◦C during 2 h then cooled down to room temperature. After cooling, specimens length of both the machine direction and the cross direction were precisely measured and calculated by follow equation.

$$\text{Ratio of Shrinkage (\%)} = \frac{\text{length before test - length after test}}{\text{length before test}}$$

The tensile strength and the elongation of the filter media were measured using universal testing machine (Hounsfield H100KS_R) according to KS K 0520. This test was conducted with 2.5 kNf load cell, 50 mm/min of elongation speed, and 75 mm of gauge length. For the observation of the filter media surface, we used to scanning electron microscopy (JSM-6400, JEOL) at 20 kV.

2.4 Reliability assessment of bag filter media

The bag filter media for environmental cleaning dust collector were selected among of the prepared nonwovens, their reliability were assessed to according to the method of Reliability Standard, RS K 0001 which was created by Agency for Technology and Standards, China. The differential pressure of the as-made filter media at time cycle were measured using the cleanable filters under operational conditions according to VDI 3926 type 2. It shows the scheme of reliability testing system of bag filter media used in this experiment. In this measurement, filter face velocity was 180 m/h, dust concentration at the filter face was 5 g/m^3, pressure loss before cleaning was 1200 Pa, number of filtration cycles was 100, and the test dust was aluminum oxide.

3. Results and discussion

3.1 The effects of processing condition on the filtration performances

Fig. 1 shows differential pressure of the filter media against time at 180 m/h when filtration cycles are 100 and Fig. 2 shows that against air flow volume. The axis of ordinate is the differential pressure between front and back of the total filter in this apparatus. The differential pressure of filter is high then collection efficiency is low, that is, the two parameters are inverse proportion. The bag filter media have to proper the differential pressure and the collection efficiency for end use. According to the RS K 0001, the differential pressure must be below 120 mmAq when filter face velocity is 180 m/h. All the differential pressure of the prepared bag filter media was smaller than the standard. In the Fig. 2, the differential pressures of the prepared filters were increased with the air flow volume but they were decreased with increasing the frequency of main-needling. It was implied that the fibers interlocking in web was increased with addition the needling then the web was oriented at random. The collection efficiency of the prepared bag filter media was shown in Fig. 3. According to standard, the collection efficiency at 0.9 μm must be above 50%, and that of the specimen are high values,95–99%. All the specimens showed generally similar collection behavior and they showed perfect collection activity above 99% when dust size was above 2 μm diameter.

3.2 The effects of processing condition on the structure and surface

The pore size was measured with a capillary flow porosity tester. Fig. 4 shows (a) pore size distribution and (b) average pore sizes of the prepared bag filter media. The pores in all the samples were mainly distributed over 10–80 μm without correlation of the main-needling strokes. The average pore size and the pore size at bubble point of all the samples were about 36 and 85 μm, respectively, and those slightly decreased with increase of main-needling strokes. The bubble point means generally the maximum pore diameter in the filter media. It was revealed that the width of pore size distribution for the prepared nonwoven by higher needling strokes was smaller than that of the other filter media.

Air permeability of the prepared bag filter media was shown in Fig. 5. The air permeability is one of important properties in bag filter media and in proportion to main-needling strokes. In the result of thermal shrinkage test, the shrinkage ratios of all the samples were lower than 0.5% against machine direction and cross direction. Fig. 6 shows microphotographs of the thermally bonded nonwovens at 180◦C. Though the nonwovens were thermal bonded at 180◦C, the temperature was slightly low to perfectly melt for the bag filters.

3.3 The effects of processing condition on the tensile properties

Ordinary needle punched nonwovens are physically bound web to form a fabric by puncturing the web with an array of barbed needles. So, the mechanical properties of the needle punched nonwovens with the porosities are very important and closely a relationship with process conditions and parameters, such as speed and depth of needle strokes, speed of

web transfer, binding ratio, and temperature at thermal bonding. Fig. 7 shows the tensile properties of the prepared bag filter media by a universal tester. In the results of tensile test, the tensile strength of the prepared specimen without the main-needling had big difference between values against the machine direction and the cross direction. The tensile strength increased to the machine direction and decreased to the cross direction with increase the main-needling strokes, respectively. In other words, the strength gap of machine and cross direction continuously decreased as increase the main needling strokes. This phenomenon revealed that the orientation of web was randomized with increase the main-needling strokes. In this needle punching with randomizing mechanisms, the fibers in the web have a non-emphasized position under ideal conditions, that is, random orientation. The elongation of the bag filter media were appeared similar behavior with the result of strength. For irregular filtration performance of bag filter, it needs perfect random web forming and high interlock ratio, that is, many needling strokes require during the nonwoven manufacturing(Mark R, Timmins and Robert W Lenz,1994; Robey M J, Field G, Styzinskl M,1989).

3.4 The assessments of the lifetime durability according to the reliability standard

In the Fig. 1, the filtration cycling time is very important and it is closely related lifetime of bag filter. In this machine, the shake method was air pulse jet type. Increasing at a given pressure, the specimen was carried out one shake, that is, one filtration cycle. The arriving time at 100 filtration cycles was closely related with Mean-Time-To-Failure (MTTF). MTTF is average value of operating time from initial state to breakdown of a product or a system, that is, it is equal to the lifetime durability. In the testing of filter media for cleanable filters under operational conditions, the finished time at 100 filtration cycles of the as-made bag filter without main-needling was 114 min and that of the made bag filter by 1,200 main-needling strokes was 154 min (Fig. 1). It was revealed that the lifetime of the many interlocked and randomized filter media by needling was longer than the other filter media.

4. Conclusion

We made the bag filter media utilizing a nonwoven pilot plant coupled with needle punching and thermal bonding combination processes. The prepared filter media were evaluated for the bag filter media for environmental cleaning dust collector by the reliability assessment standard (RS K 0001). Most of the made filters were satisfied with the various standard which comprised of the filtration performances for cleanable filters under operational conditions, the air permeability, the pore size and distribution, the shrinkage of textiles, the nonwovens determination of breaking strength. Increasing the main-needling, the durability and the air permeability increased, but the differential pressure and the average pore size decreased, and also the web forming in the filter media were randomized by high interlocks. According to the result of the reliability assessment, the lifetime durability of the as-made filter media with high needling strokes was superior to that of the other filter media. Therefore, for the bag filter media including good quality, optimum manufacturing condition is following; the ratio of low-melt fiber is 30%, the main-needling stroke is 1200/min, the process speed is 2 m/min, and the thermal bonding temperature is 180◦C. The Nonwoven Filter Bag have survivor development for the purpose of the environment protection.

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Table 1. The characteristics of raw materials

Properties	Regular polyester	Low-melting polyester
Density (g/cc)	1.38	1.38
Linear density (denier)	3.2	4.3
Length (mm)	50.5	50.5
Melting point (◦C)	265	110
Strength (g/d)	5.80	3.5
Elongation (%)	32.0	48.0
Crimp degree (%)	17.5	13.0

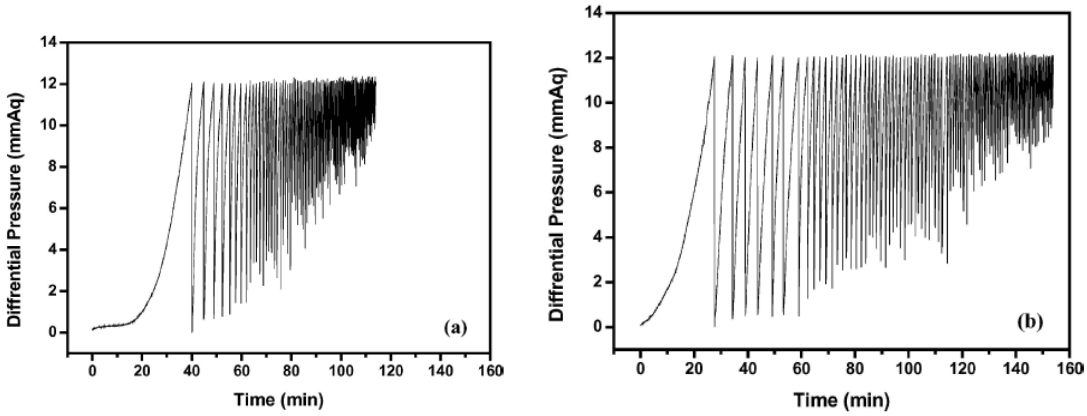

Figure 1. The differential pressure against time; main-needling strokes (a) 0 and (b) 1200

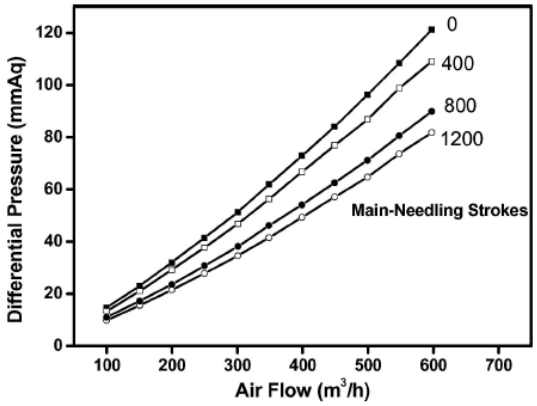

Figure 2. The differential pressure of the bag filter media during increase increase main-needling strokes

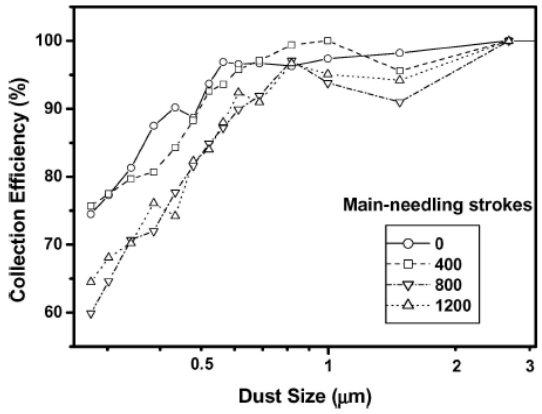

Figure 3. Change of collection efficiency with main-needling strokes against test airflow

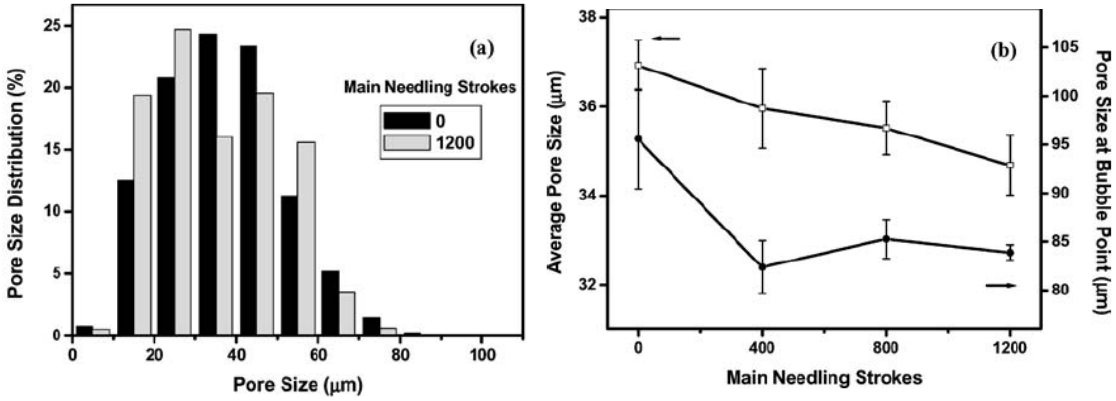

Figure 4. (a) The pore size distribution and (b) the changes of pore size (left) and bubble point (right) according to the main-needling strokes.

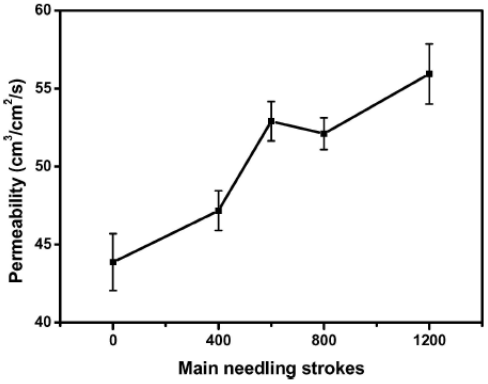

Figure 5. Air permeability with increasing main-needling strokes perminute

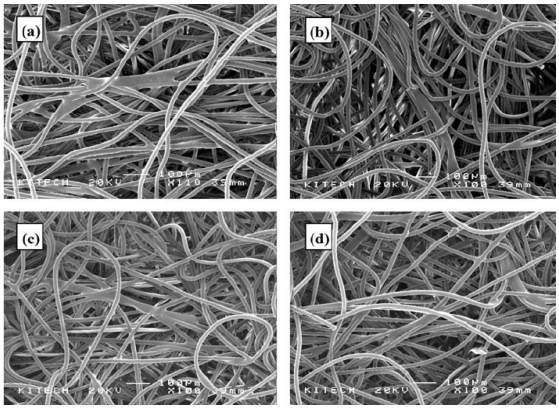

Figure 6. SEM images of the bag filter media with increase main-needling strokes
(a) 0, (b) 400, (c) 800, and (d) 1200

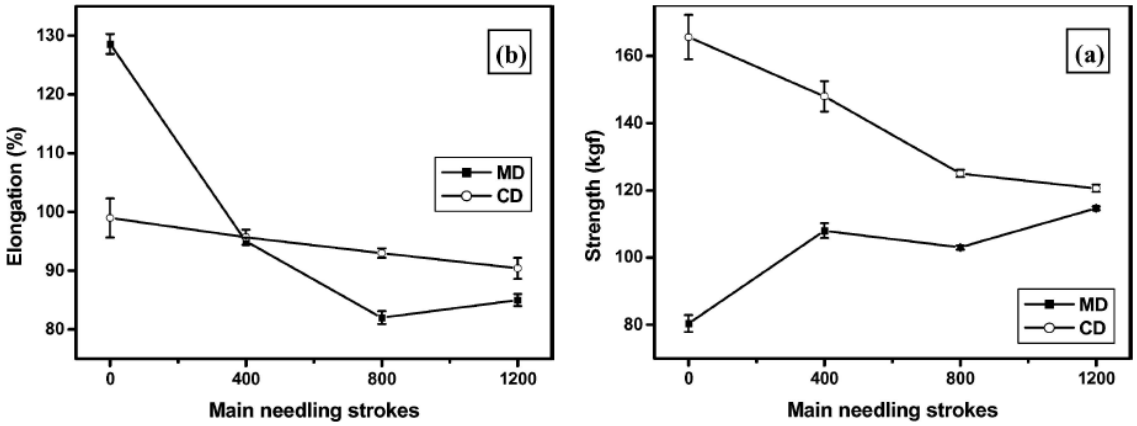

Figure 7. Tensile strength and elongation at break of the bag filter media

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