THE SUSTAINABILITY OF A SUNSET INDUSTRY IN MALAYSIA: A CASE STUDY ON KHAY HOR CHARCOAL FACTORY

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DECLARATION

I hereby declare that the project is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other master degree at USM or any other institutions.

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LIST OF KEYWORDS AND ABBREVIATION

COMTRADE	United Nations Commodity Trade Statistics
^{o}C	Degrees Celsius, Temperature unit
FAO	Food and Agriculture Organization, United Nation
FCPA	Firewood and Charcoal Producer's Association
FRIM	Federal Forest Institute Malaysia
Ha	Hectare, measurement unit for the land area, (10,000 m^2)
KG	Kilogram
%M	Mass, moisture content (MCw) of a substance
RM	Ringgit Malaysia
SMEs	Small and Medium Industries
USD	United States Dollar
WWF	World Wildlife Federation

ABSTRAK

Perusahaan arang di Matang, Perak, merupakan satu industri yang berkembang pada awal tahun 1930-an, tetapi kini ia sedang menghadapi cabaran hebat mengakibatkan kecerunannya dari segi jumlah hasilan dan jualan. Oleh itu, segmen industri ini telah dijenamakan sebagai 'industri matahari terbenam'. Kajian kes ini meneroka isu-isu industri arang di Matang, di mana 70% daripada arang yang dieksport oleh Malaysia dihasilkan di sini. Dalam segi sumbangan ekonomi, Malaysia mengeksportkan arang sejak abad awal sehingga hari ini kepada negara-negara maju seperti Jepun, Hong Kong dan Jerman dengan hasil tahunan sebanyak RM29.7 juta.

Demi kajian kes ini, beberapa sesi temu-bual telah dijalankan dengan pemilik kilang arang, pekerja kilang, Pegawai Jabatan Perhutanan Perak, renjer hutan dan pihak peruncit. Ini adalah untuk menyokong fakta bahawa cara pengeluaran tempatan yang masih menggunakan kaedah tradisional untuk pengeluaran arang, dan ini merupakan faktor utama yang mengakibatkan industri ini semakin kehilangan daya persaingan di kalangan antarabangsa.

Analisis masalah telah dijalankan untuk memahami sebab-sebab, dan menyediakan penyelesaian strategik untuk mengatasi isu-isu yang terlibat. Selain itu, penyelidikan ini juga meneroka dan mencari peluang perniagaan baru untuk menarik peserta baru ke dalam industri ini. Kajian ini selain daripada mengkemukakan isu-isu yang sedia ada, seterusnya memberi contoh penyelesaian dan menetapkan kawalan dan mencadangkan penyelesaian untuk mengembangkan semula industri ini. Untuk mencapai matlamat terakhir kes ini, ia adalah penting untuk mengkaji peranan yang dimainkan oleh kerajaan dan sektor swasta, bersama-sama dengan pengeluar arang, memainkan peranan yang penting untuk mengekalkan daya persaingan industri arang di Malaysia.

ABSTRACT

Charcoal production in Matang, Perak, was once a booming industry in the early 1930s, but now it has declined steeply in volume produced and sales revenue. Thus, this segment of the industry has been branded as a 'sunset industry'. This case study explores the issues of charcoal industry in Matang, since 70% of the charcoal in Malaysia is produced here. In term of economics contribution, Malaysia has been exporting charcoal since earlier century until today to developed countries such as Japan, Hong Kong and Germany with annual revenue of RM29.7 million.

This case study conducted a couple of interview sessions with the owner of factory, the factory worker, state forestry department officer, ranger and retailer. This is to support the facts that local manufacturers still operate in charcoal production in traditional method, which is the key factor for losing the competitiveness.

A problems analysis is performed to understand the causes, and provides strategic solutions to overcome the issues. Furthermore, this research also explores and seeks new business opportunity that attracts new entrant into the industry. Hence, this study provides the existing issues have been overcome and set control, and at the same times proposing solutions to grow and sustain the industry. Towards the end, also reviewed the roles played by the government and private sectors, together with the charcoal producers, equally owned an important role in sustaining the competitiveness of the charcoal industry.

CHAPTER 1 - INTRODUCTION

1.0 INTRODUCTION

A “Sunset” industry is defined as an older industry that continues to be important to an economy but is losing favor with investors due to its steadily falling on generation capacity and profits, and also caused by comparatively higher environmental costs (http://businessdictionary.com) and the “Business Sustainability” is the ability of a business to survive and thrive over the long term by balancing the economic, social and environmental considerations, and managing risks and seizing opportunities associated with the disruptions (Laverdure & Conn, 2010).

The case study highlights the sunset industry that already exists for the past 80 years – The Charcoal Production. The industry has passed its booming period and currently facing multiple issues that hindering its growth. Ironically, as a country that producing charcoal, Malaysia has to import charcoal from nearby countries in order to fulfil the local demand. Therefore, it is essential to study the potential of this industry and suggest needs to change in order to sustain it. Thus, this case study also considers the economy, social and even political impacts of sustainability-related changes in the business landscape. As Kotler (1999) mentioned “The ability to change has become a competitive advantage”.

This Matang district in Perak is the prime focus in this research because it is among the many states that still heavily involved in charcoal production, due to its location surrounded by greenwood forest which is the main source of material to produce good quality charcoal (Kant, 2005). The value of forest produced in the form of charcoal was estimated at RM29.7 million annually. Together, it expected to be able to harvest up to 167,610 tonnes of greenwood, which in turn will be able to produce up to 45,255 tonnes of charcoal. Price of

charcoal at retail is approximately about RM 600 per tonne in year 2000 (Muda & Mustafa, 2003).

The objective of this research is to review the current issues faced, examine the problems and recommend long term strategic solutions to accelerate the growth of charcoal industry. Its contribution to the economy of Malaysia should not be ignored.

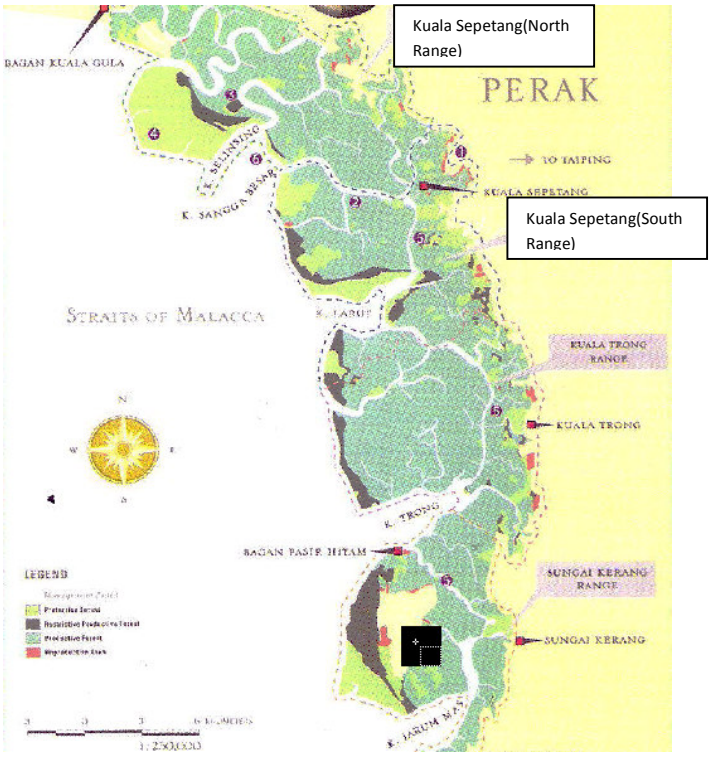

Figure 1-1: Location of Matang District in Perak State, Malaysia (Extracted from State Forestry Brochure)

1.1 BACKGROUND OF THE CASE

This case study looks at Matang's charcoal industry which was once a rapidly growth industry during the 30s in Malaysian history. Presently, there are over 100 charcoal makers with 380 kilns in Matang (Muda & Mustafa, 2003). It produced 70% of charcoal from overall Malaysia export of RM29.7 million, followed by other states such as Kelantan and Sarawak (Spalding et al., 2010). Today, this industry is claim as a "sunset" industry due to its constant

declining revenue and market shares. Therefore, the study area focuses at Matang charcoal production and its contribution to the rural areas from which the charcoal is manufactured.

Today, Malaysian charcoal industry has been given a boost by the Japanese customers, who are responsible for importing more than half of the country's charcoal output in recent years, rejuvenating what was once a sunset business. Despite the many issues related to charcoal production such as pollution, deforestation and competition, several containment activities have been in place to resolve it.

In this case study, a long term strategic solutions are recommended in order to sustain the industry where the government and public sector play an important role in achieving all the key factors of the strategy. The successful story of Matang could eventually become an ideal business model that able to imitate to other states that also producing charcoal.

1.2 PROBLEM STATEMENT

Charcoal industry in Matang runs on traditional facilities and equipments with low productivity. The production releases carbon dioxide (CO_2) that considered as hazardous to local community and environment. With deforestation and air pollution issues circling the charcoal industry, it is likely that the country is sacrificing its natural capital for charcoal production. Charcoal use today is being subsidized by future generations or even by the present generation in a few years to come. It is being produced at a cost to society in terms of its present and future ability to meet its needs for woody biomass for exporting and converted into other purposes such as beauty and medicinal products, and in the degradation of habitat and heritage held in by the present generation (The True Value of Charcoal, 2002).

Thus, this study provides an overview of current status of charcoal production, what have been done and in long run, how to overcome these issues strategically without adding burden

to the next generation, to become more environmental friendly and to stay competitive with other international competitors.

1.3 RESEARCH OBJECTIVES

The case study is to perform a data analysis on the Khay Hor charcoal factory in Matang and recommend ways to sustain its business. This includes data collection about the current charcoal industry in Malaysia, evaluates the performance of local and foreign competitors and identifies the differentiation between their operations and highlights the opportunity that will help it to stay competitive. On top of that, the research also includes series of interview sessions with the forestry officer and wholesaler to understand the trends and issues associating with the charcoal industry. A holistic view of the problems is provided in order to understand the constraint of its development.

Recommendations are suggested in the last chapter to improve and rectify the issues highlighted. It covers the different roles and possible activities played by different parties that contribute to the sustainability of the charcoal industry.

1.4 RESEARCH QUESTIONS

Typically for this study, it attempts to provide the underlying investigation of current situation, and giving clues to how to resolve the problems and issues currently faced by major charcoal manufacturers in Matang. Below are the 3 research questions to be answered:

1. What are the main issues that lead to sunset industry?
2. What have been done?
3. What are the further actions to be taken to sustain the business?

Several tools to analyze the situation will be used partnering with the interview result to derive the final recommendation and conclusion. Internal analysis tool involved SWOT Analysis (Strength, Weaknesses, Opportunity and Threats) and Portal's 5 Forces to ensure continuous operational excellence in order to help the firm to win its competitors. External analysis tool - TOWS will be used on situational analysis to derive the strategies, tactics and actions to overcome the external threats (Heinz, 1982).

1.5 DEFINITION OF KEY TERMS

1.5.1 *RHIZOPHORA*

Scientific name for high quality Mangrove tree or local name as green wood (Locally recognized it as "Bakau Minyak"). It is the largest species that grow naturally at the Matang Reserve Forest, commonly found in swamps, especially at river mouths. The formation of the species centered at the Matang forest was due to the estuary and coastal type soil along the coastline that make up to 80% of the soil content. On top of that, the temperature of the area which reached averagely 30^{o} Celsius throughout the year and all year round with warm humid climate would actually formed the great natural habitat for the Mangrove tree (Muda & Mustafa, 2003).

1.5.2 BRICK KILN

Charcoal kiln was made out of an igloo size dome that use for baking the mangrove billets, the process is called combustion. The kiln could be built as high as 7 meter in height and with diameter of 6.7 meters (Timber Malaysia, 2009). Traditional kiln was built by using of raw materials such as soil, clay and bricks. It has 2 opening, on at the ground to load the lots and another on the top to release the smoke. A particular kiln can last for 8-10 years before it needs to rebuild. Number of kiln in

Matang is under licensing control. Each factory can only own a certain number of kilns for production purpose in Matang.

Traditional kiln (Figure 1-2) as compared to modernized kiln (Figure 1-3)

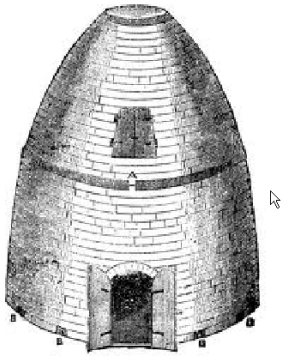	
Figure 1-2: Traditional kiln used in Matang. (Source : http://chestofbooks.com/crafts/scientific-american/sup3/images/KILN-FOR-BURNING-CHARCOAL.png)	Figure 1-3: Typical industrialized kiln found in China. (Source: http://www.satglobal.com/comp_p10s.jpg)

1.6 SIGNIFICANCE OF STUDY

The research paper reviews the business sustainability of charcoal industry in Matang and provides findings on how it would break-through and find it ways out from a sunset industry. This may involved a revolutionary change in the way the charcoal is manufactured and also execution of marketing plan in order to be stay competitive. The study will gain understanding about the common usage of charcoal today – not only for barbeque or fuel energy, it has reached out to become an important element for production of cosmetic, medication, odor absorption product, etc.

Malaysia is gifted with many natural resources, apart from petroleum, natural gas, rubber, palm oil, timber and probably in years to come, charcoal can become a next main source of income for the economy. By studying into the process of making the charcoal and understand the true potential of charcoal industry, it explores the possibility of this business model to be applied to other area in the country and serves as an eye-opener for local entrepreneurs to start seeking way to venture into and explore the business opportunity resulted from the charcoal industry.

1.7 SCOPE AND LIMITATIONS OF THE STUDY

The study covers the current issues facing by the company. The limitation of this study is the difficulty in collecting financial information on Matang factory during the course of study because none is publicly listed. Local factories tend not to enclose their data to the public and therefore most of the facts presented are results from the interview session. At the same time, all statistical data are based on the literatures or research papers from the respective authors.

1.8 OVERVIEW OF CASE STUDY

This thesis covered eight chapters and each individual chapter explained details and discussion as below:

- **Chapter 2 – Research on Charcoal Production**

It is essential to understand the traditional methods that still applied in the conversion of Mangrove trees into a raw, high quality charcoal. Within the processes, we are able to identify opportunity for improvement and understand the current strength and weaknesses. This will cover in chapter 7 and 8 under recommendations.

- **Chapter 3 – Industry Analysis**

This chapter discussed generally how charcoal been formation into different products and its application sectors. It shows the other faces of charcoal, no merely to produce heat and energy, but also display a series of potential opportunity for local entrepreneurship or SME to explore and seek new business opportunity.

- **Chapter 4 – Literature Review**

This chapter started with reviewing other countries' manufacturing process as comparison and tool of analysis. It continues with the review of how charcoal production would bring harmful to the environment and how to overcome this issue. Part of the review also discloses how other countries are doing in supporting their charcoal industry, the green projects involved and new technologies of charcoal production that eliminate the harmful factors to the environment.

- **Chapter 5 – Research Methodology**

In this chapter, it reviews the data collection process and methods, which covered all the data gathering process, tools for analysis, and justification of research. A table of linkages is shown to review all of the research questions and to describe the resources and justification of each question.

- **Chapter 6 – Company Profile**

This chapter discussed about the Khay Hor factory's background and history of running the business. Besides, it explained in detail about the issues related to charcoal production, highlight key concerns on the future of business and roadmap to sustain its business. Also covers are the business strategy and future risks, which will be reviewed in this chapter.

- **Chapter 7 – Case Analysis**

The chapter used both data analysis tools (SWOT and Porter Five-Forces model) to analyze Khay Hor's business environment and external analysis tool which consists of TOWS analysis to identify all the strengths, weaknesses, opportunities and threats facing by Khay Hor factory.

- **Chapter 8 – Recommendations and Conclusion**

The last chapter of the thesis concluded with recommendations for Khay Hor's future roadmap and how situation can be improved through several alternatives. This chapter concludes the case study by providing the final result of analysis, with high recommendation on the potential marketing plan and possible business strategy.

CHAPTER 2 - PROCESS OF CHARCOAL PRODUCTION

2.0 INTRODUCTION

This chapter introduced the production processes of charcoal in Khay Hor Holdings and explained in detail its methods and tools during the production. It covered the exploration of charcoal substances, threat of charcoal burning to the human, forest, eco-system and overseeing the impact of the industrialized charcoal. Apart from that, this chapter also reviews the current mitigation solutions that have been implemented to resolve the threats to the environment and also sharing the benefits that the charcoal industry is bringing to the community in Kuala Sepetang.

2.1 WHAT IS CHARCOAL?

Charcoal is a formless mass of carbon and can be made from high carbonaceous materials. It is one of the oldest man-made fuels and has been used to generate energy for a thousand of years. Charcoal is the solid residue remaining when wood is "carbonised" or "pyrolysed" under controlled conditions in a closed space such as a charcoal kiln (FAO, 1987).

Charcoal is created from all sorts of random components, and when burned, can result in 105 times more carbon monoxide (CO) than propane and can emit hundreds of volatile organic compounds (pollutants). When a test by the uses of carbon dioxide (CO_2) output of the two fuels, propane actually produced 5.6 pounds of CO_2 per hour, whereas charcoal produced 11 pounds (Chong, 2006). Therefore, charcoal burning did generate more than 2 times CO_2 compared to other source of energies because of its content rich in carbon and residue reaction with oxygen during the burning cycle.

Charcoal is still a major source of energy throughout the world, especially in the under-developed countries. The demand for charcoal is fairly large and it is increasing rapidly. Worldwide consumption is estimated at 40.5 million tonnes annually (Timber Malaysia, 2009).

2.2 TRANSFORMATION OF CHARCOAL

Matang Mangrove forest started to exploit charcoal production since 1930 with the introduction of the brick charcoal kiln (Oo C.W., 2008). The industry was booming because of high demand for cooking, and fuel energy for supporting various transportation such as steam-engine train and automotive. In 1950-70s, it was mainly exported to Singapore and Hong Kong, but has declined as a result of increase in increase in standard of living where natural gas started to replace it.

In 1990s, Matang charcoal found a new overseas market where Japan demands for quality charcoal as the raw material for its manufactured products. The export has seen a steady increase from 300 tannes on 1991 to 12,000 tonnes in 2000, almost a 30% of the charcoal produced annually from Matang Mangrove (Muda & Mustafa, 2003).

2.2.1 HARVESTING THE LOGS

It all started with harvesting the mangrove trees. The activity took place at the authorized zones in the forest boundary with close monitoring from the Forestry Department to avoid illegal felling of immature trees. The trees need approximately 15-20 years before it reaches its economic life span. When an area is harvested, new trees are planted after 2 years and that area is not open for harvesting for the next 30 years (Muda & Mustafa, 2003). The evolvement of operations and refinement of

techniques in Matang Mangroves are an ongoing process and its ultimate goal is to produce a fully stocked forest for the next rotation.

Each contractor is given 2.2 ha forest for harvesting in a year, according to the license agreement. The tree is then chopped with chopper or jigsaw by an outsourced resource, mostly are foreigner workers.

Figure 2-1: *Rhizophora* trees commonly grow along the river mouth

2.2.2 TRANSPORTATION OF THE LOGS

The factory has come up with a practical way of transporting the logs from the mangrove forest. Instead of hauling the logs over uneven terrain, small canals are dug which act as a channel of transporter when the tide is high. The water is fed from the river mouth and the logs are transported during the high tide into the factory through a canal along the river. The tide started in the afternoon where the tree trunks are loaded onto the canal and is transferred to the river bank just beside the factory. The logs are

transferred to the factory by workers with hands, each with an average weight of 25 kg per log.

Figure 2-2: Transferring the log to the factory along the river without engaging modern equipments

However, there are several days in a month where low tide in river will stop any activity on transportation of logs. The workers are then allocated to other mode of processing such as cutting and moving the lots to the kiln.

2.2.3 CUTTING THE LOGS

The trees cannot begin the baking process with the thick layer called “bark” at the surface of the log. Therefore the workers would have to skin off the layer with a special skinning instrument and cut into standard size of 1.5 meters long and in uniform diameter. The logs are exposed under hot sun for several days in order to get rid of the humidity from the forest before it is moved into the kiln. The logs are then transferred to the kiln that looks like an igloo were the baking process starts. The bark

is sometimes sold to the farmer as an agricultural fertilizer, which is a by-product of charcoal manufacturing.

Figure 2-3: The barks are removed manually using a sharp skinning blade

The kilns are all handmade without any architecture drawing design. It has a standard height of 7 meters and width of 6.7 meters, using of 22,000 bricks mixed with fire sand and mud. According to Mr Chuah from the Khay Hor factory, it costs up to RM 100,000 to build one kiln and it only last for 8-10 years. Each kiln built is controlled under State Forestry Department and required ownership of a license before it is allowed to build.

In Kuala Sepetang, Khay Hor owned 7 kilns under the approved licenses, the second largest after the Syarikat M.I.H Sdn Bhd. Each kiln is allowed for 8 burns per year as part of the control (Muda & Mustafa, 2003, pp.210). Each kiln is built by a skilled master where there only left two in Kuala Sepetang today.

Figure 2-4: The builder based on their experience to construct a new 7.0 X 6.7 meter brick kiln

The logs are moved to the kiln and are stacked vertically upright along to the pathway, and it is sorted in the order so that air circulation can take place. Each burn took around 40 tonnes of greenwood logs. It required experienced workers to stack and align all the logs in position in order to maximize the output and at the same time will not over –burn the logs into ashes.

Figure 2-5: Each pole is transferred to the kiln and sorted according to a designated sequencing and positioning to allow air circulation and avoid cases of over-burned.

2.2.4 COMBUSTION PROCESS

The logs are brought in manually and are all stood up inside the kiln. The kiln is almost closed using clay with small hole where a fire is loaded and starts the burning process. When the fire heats up the kiln and water will start to vaporize from the logs. The temperature is constantly maintained at around 220°C and is well taking care of by experienced workers. The process sounds very simple, but it can be complicated because it is all about the accurate temperature at the right time, hence the process has to be monitored 24 hours a day. A slight shift in temperature or overheating a few degrees can cause all the logs to be destroyed in processing.

The transformation of wood into charcoal involves a three-phase heterogeneous process: ignition, carbonization, and cooling (Gouvello et al., 2008). It takes 6–12 hours to initially heat and ignite the kiln. Once the ignition process is started, it is kept going via a small amount of air allowed into the kiln chambers until completion which signalled the beginning of carbonization. Carbonization begins when the kiln temperature reaches 180ºC. Most of the exothermic heat is released during the carbonization phase, further increasing the kiln temperature.

The first stage of this process took around 8 to 10 days. The logs condition inside the kiln is determined by the flow of output smoke that exposed out from the top hole. A headman is stationed 24 hours to examine the vaporized water in order to understand the condition of the log.

For the first ten days, roaring fire is used. More air is fed into the opening of the kiln. As they progress, air intake is reduced by sealing the opening of the kiln. Temperature plays a major role in carbonization and is the key to the charcoal conversion achievable. After 2–3 days of carbonization, the fire will be slowly

reduced and the kiln is fully sealed to permit cooling. Steam will come out of a vent at the top and is collected as a useful by-product.

After the next 10 days, the kiln is completely covered off by clay. The baking process continued on a temperature of around 83°C and waited for another 12 to 14 days to complete. The logs are cured by sealing the kiln mouth altogether for a week. The temperature of the steam that came out from the vent will be used as an indication of the readiness of the charcoal. As the cooling process started, it took another 8 days before the hole in the kiln is opened by breaking the clay at the front open. All the water is now vaporized out of the wood and left over with the charcoal that showed a shiny black colour. Finally, the rods of charcoal are collected and ready for packing.

Each burn took around 28 days and required a week to settle down (Malaysia Timber, 2009). The output conversion rate would come to between 10-20% because many may smashed into pieces or cracked, hence unsuitable for export.

Figure 2-6: The kiln is still in the first baking process, the worker is adding wood to control the fire

2.2.5 PACKING PROCESS

Once it is fully cool down, the worker will hammer open the front open by breaking the clay. The remains of the charcoal are accumulated and it is sorted according to its quality and length. The complete and intact pieces are carefully selected and packed for exporting. The broken pieces and bits are put in bags in multiple weighted packs for local consumption. The packing are done according to market demand of 5-20 kgs.

It is not common for producers to store their charcoal for any length of time at the production site. The pressure to generate income forces them to sell their product immediately.

Figure 2-7: Packaging process is manual and without proper protection to workers

Figure 2-8: Final Product – high quality charcoal, with shinning surface and whitish surface at the body

2.2 THREATS OF CHARCOAL PRODUCTION

All excessive usage of natural resources would come with a price. In this case, mangrove forest has become the main source of raw material for wood charcoal production in Matang. If unsustainably planned and managed continue to take place at the forest, it can lead to uncontrolled deforestation and to pollution of coastal waters, damaged or totally destroyed coastal ecosystems and the loss of the services and benefits provided by mangroves.

2.2.1 DEFORESTATION

As physical structures, mangrove forests act as buffers against tropical storms and coastal erosion. Unfortunately, it is under increasing pressure from overexploitation, development and pollution. Loss of mangrove area worldwide has been drastic. According to Chong, the loss of mangrove forests in Thailand, Philippines and Vietnam has exceeded 60% and in Malaysia, although the overall loss amounts to about 16%, some states had lost as much as 30-70% of their original areas (Chong, 2006).

Timber produce derived from final felling in Matang Mangrove is primarily being used for the manufacture of charcoal. It is fuelled by the continuing strong demand especially in the export markets. The direct environmental impact of charcoal production is caused by the felling of trees to produce charcoal.

Over felling of Mangrove trees or cutting the tree to its root will cause severer soil erosion and limiting agricultural activity. The problems associated with felling trees that are not replaced by regeneration or reforestation activities are causing the depletion of water sources and water catchment areas; reduction of carbon sinks and loss of habitat and biodiversity (The True Value of Charcoal, 2002). The forest supplies the source of income for a total of 5,300 households with estimate population of 31,800 who are mainly engaged in Mangrove related activities (Muda & Mustafa, 2003). Illegal cutting of Mangrove trees not only reduced the coverage area of the Mangrove forest in the region, but also severely affect the ecosystem and will putting at risk of the people living in it.

2.2.2 AIR POLLUTION

Charcoal combustion emits carbon monoxide (CO) and nitrogen oxides (CH_4) (The True Value of Charcoal, 2002). Carbonization generates substances which are proven to be harmful through the gases produced by the process. It carried high volume of carbon dioxide (CO_2) gas which is hazardous if excessive amount of the gas inhaled into the breathing system. Therefore, when working around the kiln or pit during combustion process or when the kiln is opened for unloading, proper procedure to ensure ventilation mechanism is provided to allow the carbon monoxide, which produced during unloading process of charcoal and while spontaneous ignition of the hot charcoal, to be dispersed (FAO, 1987). The tars and pyroligneous liquor

from the residuals of the production processes can also a type of seriously contaminate streams and affect drinking water supplies for humans and animals.

Long exposure to smoke that contains high degree of CO may cause acute lower respiratory infections (e.g. pneumonia) in children and chronic bronchitis or chronic obstructive pulmonary disease in women. Smoke from wood fuels has also been linked to other conditions such as low birth weights, prenatal mortality, asthma, tuberculosis and laryngeal cancer (The True Value of Charcoal, 2002).

2.2.3 IMPACT TO THE ECOSYSTEM

The Mangrove trees help to balance the entire ecosystem at the coastline. It reduces the temperature and producing natural housing for many animals and plants. As a result of deforestation and air pollution, the entire ecosystem would collapse and causing the extinction of many rare creatures and species of plants.

Many researches has come and study the river content and found the toxic organic level has increased tremendously from year to year due to pollution and industrial wastage dumped into the river. Many living species have vanished from river, according to research done by Japan Agriculture Research team. They have reviewed that high Acid Volatile Sulfide and low oxidation-reduction potential values were observed in the surface sediments of the river that would be harmful to the forest ecosystem (Kazumaro, et al., 2010).

2.3 WHAT ACTIONS HAVE BEEN TAKEN?

Malaysia's mangroves presently cover 577,558 ha, with 341,377 ha (59%) located in Sabah, 132,000 ha (23%) in Sarawak and 104,181 ha (18%) in the peninsular part of Malaysia. The planning of sustainable forest management should be at the local and national levels (Chong, 2006). Regular monitoring is thus necessary and may contribute to their conservation, but also to sustainable use of mangroves as a source of wood, food, income and recreational areas for present and future generations.

2.3.1 CONTROL OF AIR POLLUTION

Multiple precautions have been taken to reduce the risk of air pollution. Housing areas are located few kilometers away from the location of kilns in order for prevailing winds to relocate the smoke from charcoal operations. Besides that, green plants are allocated surrounding the factory as part of the deal of contract given to the owner of the kiln which act as a buffer to absorb the emission of CO_2 gas.

In terms of air quality control, the Department of Environment (DOE) has constantly monitored the air quality and to make sure the control leveling of hazardous gas being emitted from the charcoal production. DOE have its own standard of air quality emission and they are ensuring that the gas emission from the kilns do not exceed the limit set by DOE.

A Continuous Air Quality Monitoring (CAQM) machine has setup at the industrial side of Taiping, which is about 5-8 km away from Kuala Sepetang. The machine collects the data continuously 24 hours a day during the monitoring period and reporting back to the director of DOE.

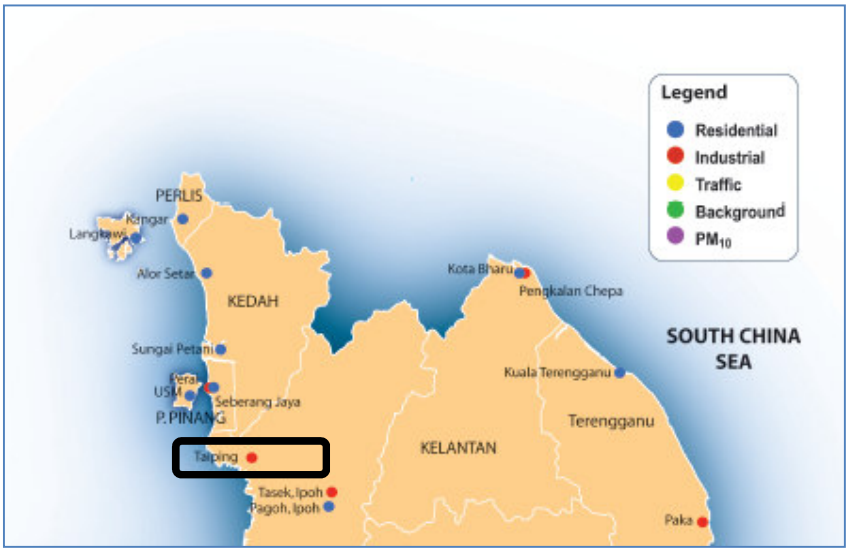

Figure 2-9: Location of Continuous Air Quality Monitoring Stations, 2008 (Source : DOE Air Quality, http://www.doe.gov.my/files/u1/AIR%20QUALITY.pdf)

2.3.2 MATANG MANGROVE RESERVATION PLAN

The Mangroves come under forest "reservation" in year 1902 (Kant, 2005). The evolvement of operations and refinement of techniques in Matang Mangroves are an ongoing process and are governed by the State Forestry Department and their rangers. The primary objective is to sustainable production of quality greenwood, for charcoal production, on a sustained yield basis, with provision for conservation and protection of the environment.

The 30-years rotation plan is the product of protecting the forest and its ultimate goal is to produce a fully stocked forest for the next rotation. The Forest Reserve has been acknowledged as the best-managed mangrove forest in World. They won the Ministry of Primary Industries Green Award in 1996 for the best sustained and managed Mangrove forest (Muda & Mustafa, 2003).

Yield regulation serves to ensure a constant supply of greenwood as raw material for the charcoal industry in the state, which is concentrated in the Kuala Sepetang district. It also ensures that only economically productive areas are harvested. At the same time, it provides assurance to contractors that areas allocated to them yield a minimum volume of greenwood (Timber Malaysia, 2009).

The control of operation which involved the filling up of numerous forms, preparation of reports and licensing documents, updating and recording of information, inclusive of monitoring, recording and evaluation procedures before the falling permit is issued. The allocation of final felling to charcoal contractors is maintained at 2.3 ha/kiln per year (Muda & Mustafa, 2003). It is important that the contractors are required to work and remove all utilizable timber from their existing felling blocks before moving to the replacement areas.

2.3.2.1 FORESTRY LEGISLATION AND POLICY

The National Forestry Policy of 1978 aims to ensure that forestry resources, including mangroves, are utilized sustainably and managed in an orderly manner. The specific objectives of the NFP are (Chong, 2006):

(i) To create sufficient forest areas as Permanent Forest Estates (PFE) that will ensure a protective forests plan, safeguard water supplies, soil fertility and environmental quality, and mitigate damage caused by floods and erosion. It also make sure a continuous productive forests to a supply of forestry products in perpetuity for economic purposes, and conservation of forest areas for recreation, education, research and biodiversity protection