GIS APPLICATION IN IDENTIFYING TOURISM RESOURCES IN SOUTHEAST ASIA

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ABSTRACT

The purpose of this paper is to describe and explain GIS capabilities and potentials in identifying tourism resources and assisting planners in decision making. This paper will further discuss a case study in which GIS application was applied in identifying resources in Pulau Pangkor, Malaysia and several methodological limitations in applying this application. With the aid of GIS technology, it is believed that sustainable development, which is the main concern today, can be implemented in not only Pulau Pangkor and but also in other countries in Southeast Asia. With its usage, many tourism resources in this region could have proper development plans in minimizing negative impacts on not only the resources but also local communities. Southeast Asia is rich of many different cultures, heritage and environment which are worth preserving.

Keywords: GIS, tourism, sustainable development, decision making, and local communities

INTRODUCTION

Tourism is one of the highest generating income industries in the twenty-first century. The number of international tourist arrivals has increased tremendously. According to the World Tourism Organization (WTO), in 2005, in spite of various tragic events such as tsunami, terrorism bombings and public unrest in many tourist destinations, international tourism continues to sustain a sharp increase beginning 2004. Initially it was forecasted that international arrivals would be 700 million in 2004. However, the number has exceeded 800 million, an increased of 5.5% worldwide (World Tourism 2006)[1]. Earnings through tourism industry were predicted to grow to USD 621 billion in 2004. WTO forecasted that tourist arrivals and earnings will reach 1 billion and 55 trillion respectively by 2010.

International arrivals in Southeast Asia have been increasing substantially especially in developing countries which comprises of Cambodia, Indonesia, Lao P.D.R., Malaysia, Myanmar, Philippines, Thailand and Vietnam. Table 1 shows statistics of international tourist arrivals in this region. Southeast Asia is a very unique region. It comprises of mixed nations. Moreover, the region is rich of multiple products which are not limited to beaches and highlands but also numerous cultural backgrounds. These features have attracted foreigners. Table 2 illustrates the international tourist arrivals according to countries in this region.

Table 1. International tourist arrivals in Southeast Asia region (000)[2]

Region	1990	1995	2000	2002	2003	2004
Southeast Asia	22,469	29,173	37763	42859	37,034	48,309

(Source: World Tourism Organization, 2006)

Table 2: International tourist arrivals (000)[3]

Region	1990	1995	2000	2002	2003	2004
Brunei Darussalam	377	498	984	..	..	..
Cambodia	17	220	466	787	701	1,055
Indonesia	2,178	4,324	5,064	5,033	4,467	5,321
Lao P.D.R.	14	60	191	215	196	236
Malaysia	7,446	7,469	10,222	13,292	10,577	15,703
Myanmar	21	117	208	217	206	242
Philippines	1,025	1,760	1,992	1,933	1,907	2,291
Singapore	4,842	6,422	6,917	6,997	5,705	..
Thailand	5,299	6,952	9,579	10,873	10,082	11,737
Vietnam	250	1,352	2,140	2,628	2,429	2,972

(Source: World Tourism Organization, 2006)

TOURISM TREND

Patterns of travelling among tourists have changed dynamically. In the 1950s and 1960s, most popular destinations for developed nation tourists were other developed nations.[4] However, as time past, tourists have become more interested in making intercultural excursions. They search for adventure and for something that can't be offered at home. Their curiosity has turned international tourism into the most important economic industry in the world.

New adventures and unique experiences can only be found in developing and less developed countries such as in Southeast Asia. Most of tourism resources in these countries are still in preservation. However, these will not stay long as the influx of tourists into these countries increases annually and this event would create more demand for development. In search of quick and substantial economic gains provide no alternative to developing nations but to develop resources rigorously and without proper planning. Furthermore, most of these nations lack financial resources to properly plan their tourism development. Thus, these nations should be encouraged and aided by international funding agencies to use a planned approach to tourism development. Few approaches have been used in planning for tourism development and one of them is through GIS application.

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

Geographic information system which is also known as GIS, is gradually being recognized widely in Southeast Asia as a valuable tool for managing, analyzing

and displaying large amount of different formats of data which are applicable to many local and regional planning development activities. In the field of tourism planning which covers complex issues, GIS would serve as a potential step forward in assisting planners in decision making. Tourism and geographic information system share a common characteristic. Both areas progress beyond their boundaries of application. GIS application is necessary in disciplines such as geography, urban planning, and environmental studies. Tourism, on the other hand, is becoming an important subject in the world particularly in Southeast Asia which is mostly developing countries. Economic drivers have affected these countries to develop tourism resources without conducting thorough impact assessment studies on social and environmental issues. Virgin forests and sea fronts are developed to meet the demand created by influx of tourists into the countries concerned. With the increase of domestic and international tourism, new and existing destinations are being developed or enhanced. However, a number of these destinations were developed without proper planning. As such, many of these sites turned into white elephants after being left unattended due to poor management or maintenance. The thought of "planned to fail" or "failed to plan" has agonized related government agencies. Tragically many of these white elephants were developed using public funds. The public are now querying governments and its agencies over the management of public funds for such purpose. Manual planning process might take a longer time to be completed. With the aid of technology, planning process can be shortened and analysis can be carried out more effectively. The use of geographic information system (GIS) can be utilised for such purpose. Its capabilities in carrying out spatial analysis are excellent.

GIS has been studied and implemented for various types of applications and offered solutions to improve the traditional practices and techniques. It is an important application in tourism industry. It is seldom used in tourism web page due to its complex architecture. McAdam (1999)[5] in his study concluded that the lower level of GIS utilization among tourism planners in tourism sector was due to several reasons. Among them include unfamiliarization of GIS application and its benefits, lack of skills and simply refuse to use it. Kilical, F. & Kilical, A. (2004)[6] viewed GIS as an invaluable tool in providing spatial information as well as images, maps, and text documents. The two scholars created The Tourism Information and Promotion Systems for Turkey Tourism Office in Washington. The said model is "an on-line computerized system that minimizes the cost of serving potential travelers while maximizing data accuracy and integrity."[7]

GIS is basically a computer system for acquiring, storing, interpreting and displaying spatially organized information. It integrates common database operations such as query and statistical analysis with unique visualization and geographic analysis benefits offered by maps. GIS consists of five major components which include software, hardware, data, people and data management and analysis procedures. Figure 1 shows the components of GIS. These components are necessary in carrying out any GIS projects.

Figure 1. Components of GIS
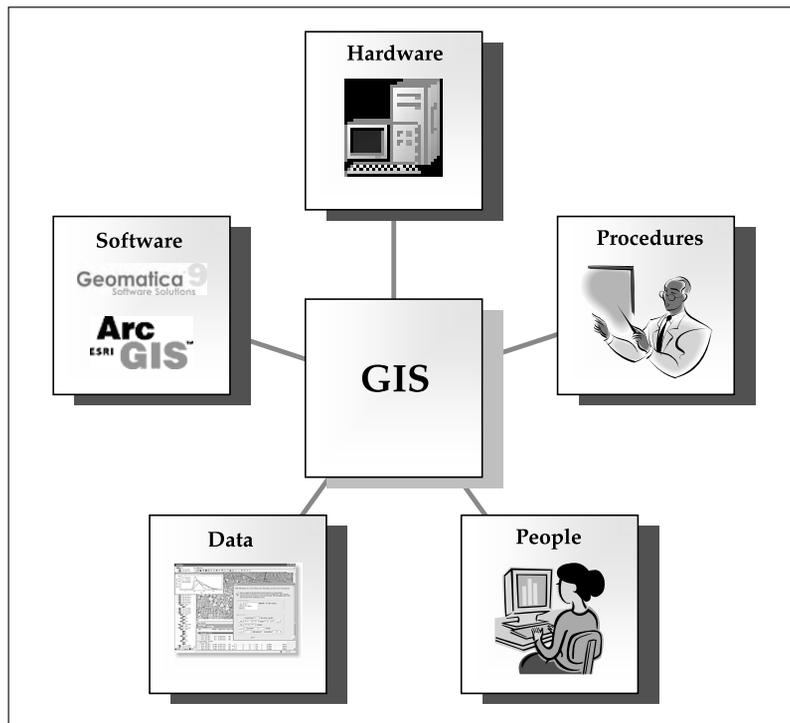
(Source: Heywood, I. Cornelius, S & Carver, S., 2002)

Software
Since it was first started, GIS software has gone through a number of revisions. Today, a number of leading GIS developers have produced GIS software with advanced features with cheaper prices as compared to several years ago.[8]

Hardware
These are mainly the computer system with its operating system. This system ranges from portable personal computer to supercomputer. Burrough (1986)[9] as mentioned in Heywood, I et.al outlined several elements that are essential in carrying out GIS operations. The elements include:

  (a) a computer processor (CPU) with sufficient memory power to run the software.
  (b) ample storage capacity for high volume of data
  (c) high resolution colour graphics monitor or LCD
  (d) input devices such as scanner, mouse and keyboard

Data
GIS data consists of spatial and aspatial data. These data are kept in databases for easy accessibility. Spatial data are important due to its features of being digital and geo-referenced. It mainly shows digital map with geo-referenced features. Spatial data, in addition, is divided into two types. These types include raster and vector. Figure 2 shows the elements of GIS data.
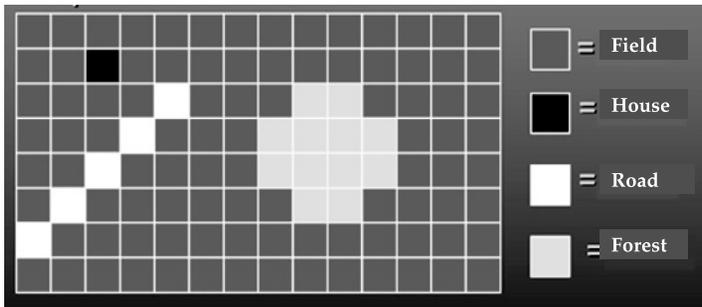
Figure 2. Elements of GIS data
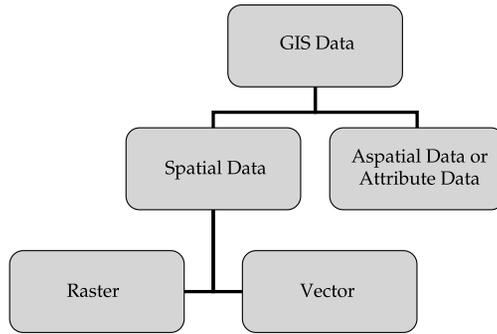
(Source: Heywood, I. Cornelius, S & Carver, S., 2002)

Raster data model is made up of cells. A good example of raster data would be images in jpeg and gif format. This data type gets distorted when it is enlarged to a certain extend. Figure 3 shows a sample of raster data.
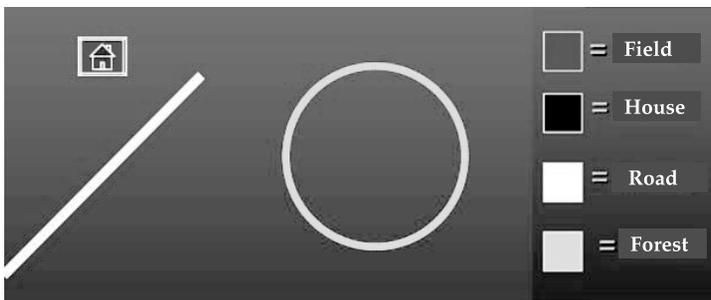
Figure 3. Raster data model

(Source: Ivan Farayi Muzondo, 2005)

Vector data model uses two dimensional Cartesian (x,y) coordinates to store the shape of spatial entities. Vector data consists of line, polygon and point. Figure 4 shows a sample of vector data.
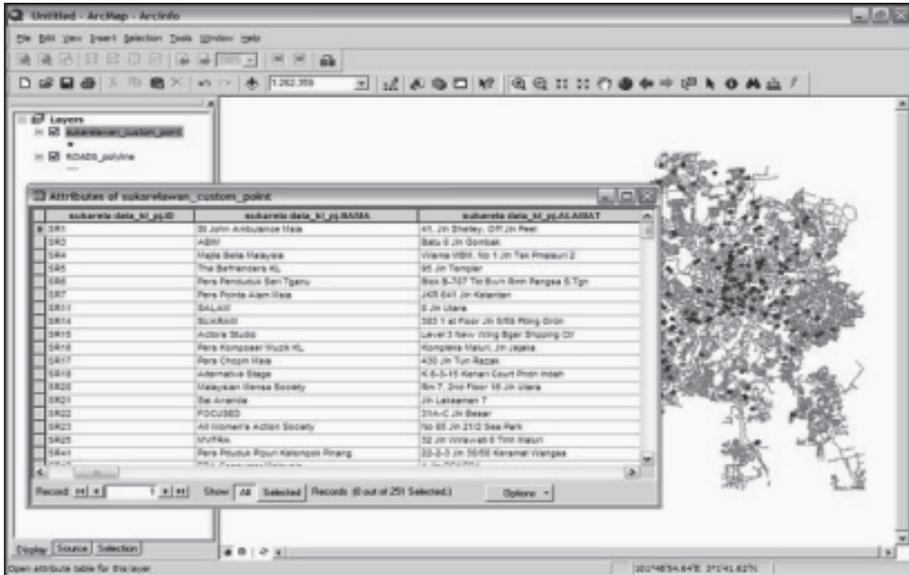
Figure 4. Vector data model

(Source: Ivan Farayi Muzondo, 2005)

Aspatial data or also known as attribute data, likewise consists of features attached to a specific point on a digital map. Figure 5 shows a list of attributes in one of GIS project.

Figure 5. Examples of attribute data of a GIS project

(Source: Research on voluntary level among Malaysians, 2005)

People

People are needed to plan, implement and operate GIS projects. The number of people ranges from one person to a project team. They are made of users and developers.

Data management and analysis procedures

GIS system should be able to perform data input, storage, management, transformation, analysis and output. Heywood, I. et.al (2002)[10] argued that data input and updating are the most expensive and time consuming part in GIS projects and should not be underestimated. Almost 80% of duration of any GIS project is spent on data input. Furthermore, the cost of constructing a database could cost five to ten times more than the cost of GIS software and hardware.[11] GIS is able to perform analysis when ever is required by users. Aronoff (1989) as mentioned in Heywood, I et.al (2002)[12] classified GIS analysis procedures into three types and they are as follows:

    (a)   Those that are used for storage and retrieval. This is to display distribution of any required matter. A good example would be distribution of popular tourist's destination in Shah Alam City

    (b)   Constrained queries which allow user to look for pattern. This will reply to any query requested by user. For example, a tourist would like to search for hotels in Shah Alam City. Result of the query will highlight all the hotels located in the city.

(c) Modeling functions or procedures for prediction purposes. A good example would be finding the shortest path from one point to another.

All the GIS components are crucial to the existence of any GIS project. If one element is missing or unavailable, the project might not be able to be completed.

GIS in Tourism
Geographical Information System also known as GIS in short has been studied and implemented for various types of applications and offered solutions to improve the traditional practices and techniques. It is an important application in tourism industry. It is seldom used in tourism sector due to its complex architecture. McAdam (1999)[13] in his study concluded that the lower level of GIS utilization among tourism planners in tourism sector was due to several reasons. Among them include unfamiliarization of GIS application and its benefits, lack of skills and simply refuse to use it. GIS is viewed as an invaluable tool in providing spatial information as well as images, maps, and text documents.

GIS application is required in the planning and maintenance process. Although a number of tourism planners do not agree in utilizing GIS application in the planning process, this application is crucial. Their arguments against its use are primarily due to the high cost of software or application acquisition. Today, due to the advancement of technology there are many reasonably priced solutions available to cater for multiple needs and budget. Many of them have not realized that new sophisticated GIS software has cost less than before.[14]

GIS capabilities in tourism planning and development should be explored and practiced. Table 3 illustrates the capabilities of a GIS application and in relation to tourism planning and development outlined by Bahaire and Elliot-White (1999).[15]

Table 3. Capabilities of a GIS

Examples of functional capabilities	Examples of basic questions that can be investigated using a GIS (after Rhind, 1990)		Examples of tourism applications
Data entry, storage and manipulation	Location	What is at?	Inventories of tourism resources
Map production	Condition	Where is it?	Identifying most suitable sites for development
Database integration and management	Trend	What has changed?	Measuring tourism impacts
Data queries and searches	Routing	Which is the shortest route?	Visitor flows
Spatial analysis	Pattern	What is the pattern?	Analyzing relationships associated with resource use
Spatial modeling	Modeling	What if…?	Assessing potential impacts of tourism development
Decision support	Alternatives	How to decide?	Decision making

(Source: Baharie, T. and Elliot-White, Martin, 1999)

These capabilities were further explored by Bahaire and Elliot-White (1999)[16]. Problems of tourism were addressed to investigate the potentials of GIS. Table 4 illustrates the relationship further.
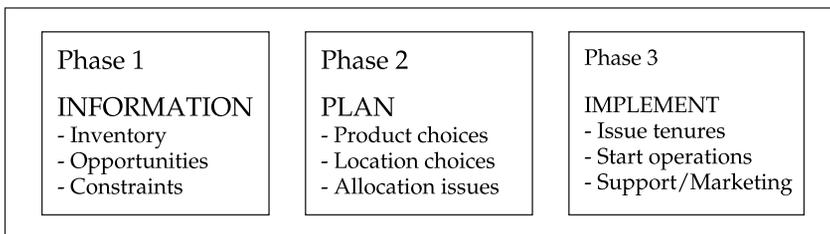
Table 4. Problems of tourism and potentials of GIS

Problems of tourism (after Butler, 1993)	Nature of problem	GIS application
Ignorance	Of dimensions, nature, communities	Systematic inventory of tourism resources and analysis trends
Lack of ability	To determine the levels of sustainable tourism development	GIS can be used in monitoring and controlling tourism activities. By integrating tourism, environmental, sociocultural and economic data, GIS is able to identify and monitor the indicators of sustainable development
Lack of ability	To manage and control development	GIS can be used to identify suitable locations for tourism development, and identify zones of conflict or complimentary
Lack of appreciation	Impacts of tourism which cannot be easily reversed	GIS can simulate and model spatial outcomes of proposed development
Lack of agreement	Over levels of appropriate development, control and direction	GIS functions as decision support system

(Source: Baharie, T. and Elliot-White, Martin, 1999)

These potentials were later incorporated in real planning task. Whyte, B. & Nicholson, D. (2005)[17] used three-step process, in implementing GIS in tourism planning in Nootka Sound. The first step is to assemble information of all tourism resources inventory, second is to conduct planning process and the final step is to implement the tourism plan. Figure 6 shows the three-step process.

Figure 6. Steps in tourism development planning

Phase 1	Phase 2	Phase 3
INFORMATION - Inventory - Opportunities - Constraints	PLAN - Product choices - Location choices - Allocation issues	IMPLEMENT - Issue tenures - Start operations - Support/Marketing

(Source: Whyte, B. & Nicholson, D., 2005)

Although it is seldom discussed in tourism sector, GIS application is widely used by planners concerned with landuse, socioeconomic development and environmental management issues. GIS can be an effective tool in managing and monitoring tourism resources which cover not only physical elements but also sociocultural elements.

A CASE STUDY OF PANGKOR ISLAND

Pangkor, an island located on the West coast of Peninsular Malaysia, is one of the popular island destinations for local and international holiday makers. It is located about 85 kilometers south-west of the Perak state capital of Ipoh. Pangkor may have obtained its name from the Thai word *Pang Ko* meaning *beautiful island.* However, others believed it may have been a memorial to *Pang Kui* a legendary Chinese adventurer who had lent his seamanship's skills to the bands of pirates who resided in this island. During the British colonial period, the famous treaty of Pangkor was signed here. In the 60's and 70's , the name 'Pangkor' was synonymous with salted fish, ikan bilis produce, dried shrimps, shrimp paste and others. Today, Pangkor is a popular island destination not only because of her dried seafood products but also her beaches. Figure 7 shows the location of Pulau Pangkor in relation to Peninsular Malaysia.

Figure 7. Map of Pulau Pangkor in relation to Peninsular Malaysia

(Source: Tourism Perak, 2006)

With a population of 10,971, Pulau Pangkor consists of three distinct townships and four settlement areas. The small settlements are referred as villages or "kampong". Most of these are fishing settlements and they are located on the

eastern side of the island. Kampong Teluk Nipah on the other hand is located on the west coast. Eastern side of the island is facing the town of Lumut and Teluk Batik which has calmer waters of Manjung Channel as compared to the western side. Some of these settlements can be seen by tourists while on the 40-minute ferry ride from Lumut to Pulau Pangkor. The ferry will stop at the main settlements of Sungai Pinang Kecil and Sungai Pinang Besar before landing at Pangkor town. Figure 8 shows the three jetties in Pangkor. The common jetties are at Sg Pinang Kecil and Pangkor town. There is only one main street that connects all the places in the island. Figure 8 shows the main street in yellow. The road circulates the island and it is quite steep and narrow in certain areas.

Figure 8. Map of Pangkor

(Source: abcmalaysia.com, 2006)

Pangkor tourist population has always exceeded her population by hundred over thousands during peak season. During this season, there are over 2000 tourists on the island daily. Table 5 shows population distribution of Pulau Pangkor in census collected in 1999.

Table 5. Pangkor Island Population Distribution in 1999

Type of Residents	*Total Number*
Permanent residents	6260
Working residents	2992
Local tourist residents	289,581
International tourists residents	278,667

(Source: Manjong Municipal Council, 1999)

Places Of Interest

Pangkor's tourism products can generally be divided into five major components which include fishing settlements, beaches, resort amenities, seafood and historical monuments. The two famous Pangkor beach areas are Pasir Bogak and Teluk Nipah. Both offer scuba diving, snorkeling, wind-surfing and fishing attractions. The former is much more developed as compared to the latter. Other attraction beaches include Pantai Puteri Dewi, Teluk Belanga and Teluk Cempedak.

Tourists can also have an experience of observing activities at the fishermen settlements. There are three main fishermen villages namely Sungai Pinang Kecil, Sungai Pinang Besar and Kampong Teluk Kecil. Figure 8 shows the location of the three villages along the Main Street. Many of the houses are traditional and some are built in the sea on stakes. Most of Pangkor villagers rely on fishing and boat making for living. Figure 9 shows the boat making area in Sg Pinang Besar. The only fish factory available which will never be missed by tourists is Hai Seng Hin Satay Fish Factory located in Sungai Pinang Kecil. Figure 10 shows the factory's location.

Figure 9. Boat making area in Sg Pinang Besar

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Figure 10. Hai Seng Hin Satay Fish Factory

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Pangkor was once first colonialized by the Dutch and later by the British when after the signing of the Pangkor Treaty which turned the state Perak into a British colony. The Dutch left two historical monuments which are quite significant. One is the Dutch Fort and the other is Batu Bersurat (Sacred Stone). The Dutch Fort which was built in 1670 is located at Teluk Gedung. It was built as a strong point and a tin storage area. Although it was destroyed by the locals in 1690, the Dutch managed to protect it until 1743 in which they lost to a local warrior named Panglima Kulub and his followers. To avoid it from deterioration, the National Museum undertook its construction to restore as much as possible the remains of the fort in 1973. This is to benefit the new generations and the tourists. Figure 11 to 14 show the fort area which has been restored.

Figure 11. The Dutch Fort area

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Figure 12. The Dutch Fort

(Source: pulau-pangkor.com, 2006)

Figure 13. The Dutch Fort remnants

(Source: pulau-pangkor.com, 2006)

Figure 14. Original Dutch canon placed in front of Dutch Fort

(Source: pulau-pangkor.com, 2006)

A few meters away from the fort is the Batu Bersurat (Sacred Stone). It is a large granite boulder which bore the inscription of "1743 I.F.CRALO" with an initial "VOC" which stands for Veerenigde Oostindische Compagnie (The Dutch East India Company) and an image of a tiger biting a child. There is a story behind the image of the tiger and the child. Figure 15 shows the Batu Bersurat. It is located about three meters away from the main street. Figure 16 is an extract from the main stone.

Figure 15. The Sacred Stone

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Figure 16. Details of the Sacred Stone

(Source: pulau-pangkor.com, 2006)

Pangkor is mostly populated by the Chinese. Fu Lin Kong Chinese Temple is not only popular among the local Chinese but also among tourists. There is also a mini Great Wall of China built beside the temple.

Figure 17. Fu Lin Kong Chinese Temple

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

**Figure 18. Mini of Great Wall of China**

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

ISSUES ON IMPROPER TOURISM PLANNING IN PANGKOR

Although Pangkor managed to attract many tourists to the island, its infrastructure facilities require upgrading. Tourism infrastructure is the element that is constructed to cater for visitors. It comprises of 'soft' and 'hard' infrastructure. The soft one implies the investment components whilst the hard covers the tourism facilities such as road, pedestrian walk way, bicycle lane and others. Typical components of tourist facility are shown in Figure 19. These are mainly the hard infrastructures.

Figure 19. Typical components of tourist facility
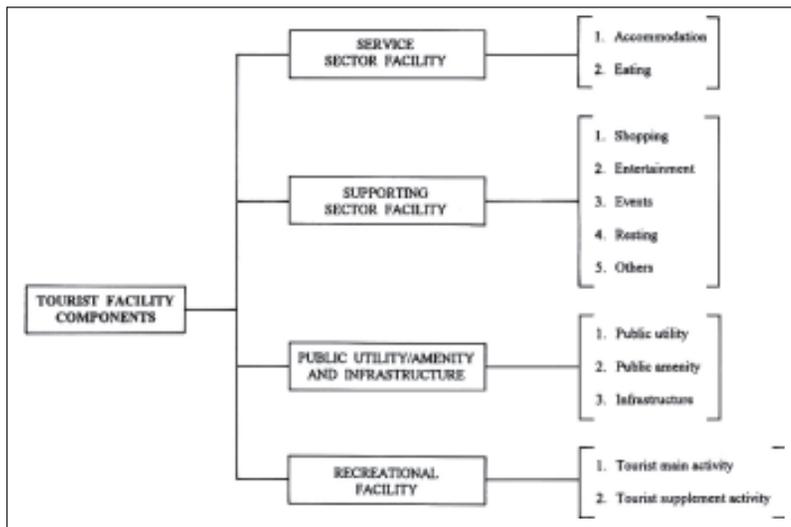
(Source: Whyte, B. & Nicholson, D., 2005)

Many of the tourism infrastructures in Pangkor are not properly planned. As an example once a tourist alights from the ferry at Pangkor jetty is unsightly view of the unkempt fishermen settlement. This could create a negative impression towards Pangkor status as a tourism destination. Figure 20 shows the condition of the fishermen village. Beautification is required to make the settlement presentable to tourists.

Figure 20. Fishermen settlement

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Pangkor has only one main street. It can barely fit two cars. Furthermore it does not provide any pedestrian walk way or bicycle lane. In many of its brochures, Pangkor promotes jogging and cycling to tourists. However, its infrastructure does not posses this. In addition, the road is neither in a straight line nor flat one. Children can be seen walking on the road near a sharp corner of the road. Tourist might not be able to enjoy cycling or jogging along the busy and narrow main street. Figure 21 show the Main Street of Pangkor.

Many of the tourist attractions are located near the main street. No parking area is provided. For example, the boat making area and the Sacred Stone is located about three meters away from the main street. There is no parking provision to these areas. This not only poses danger to the tourists but also to other motorists due to the unleveled road condition.

Fu Lin Kong Chinese Temple was built in a very secluded area. It is about 2 kilometers away from the main street. Tourists need to pass through residential areas to reach the place. The access road is very narrow and can barely fit one car. Figure 22 shows the access road to the temple. Proper planning needs to be upheld in generating tourism products.

Figure 21. Main Street in Pangkor

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Figure 22. Inappropriate access road to Fu Li Kong Temple

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Figure 23. Abandoned stalls

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Few stalls were constructed near Teluk Nipah to allow for the locals to carry out business activities to cater the tourists who occupy the nearby resorts. However the stalls were not occupied as planned. They would rather have their businesses at an unplanned area. Figure 23 shows the abandoned stalls which cost millions of Ringgit and Figure 24 shows where the businesses are conducted. The said area is located about 500 meters from the stalls originally built for them. Today the stalls are left unattended and have been turned into store rooms for jet ski operators. Figure 25 shows one of the abandoned stall turned into jet ski store.
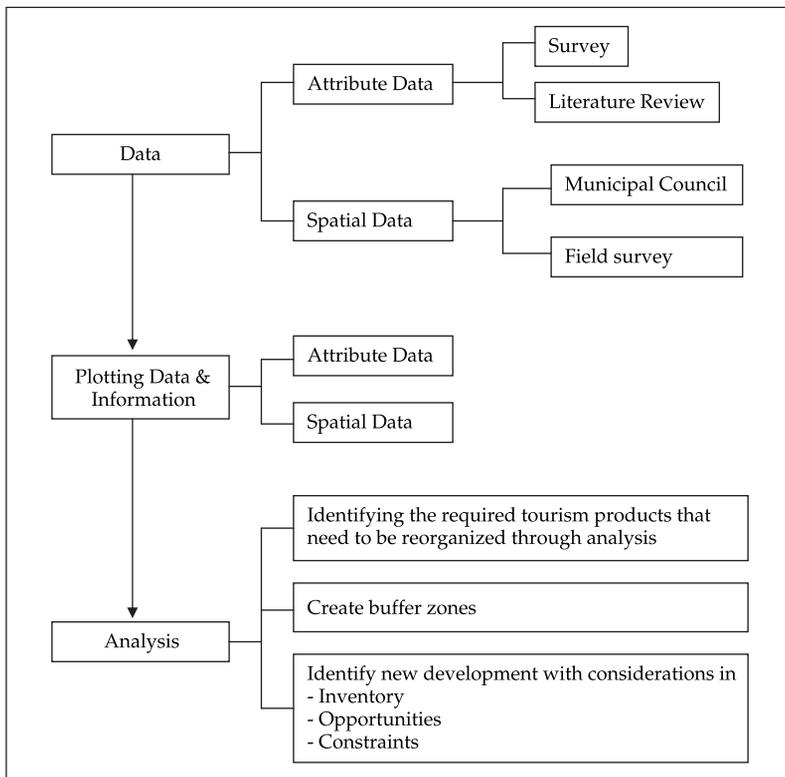
Figure 24. Unplanned stalls

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Figure 25. Jet ski store

(Source: Urban Studies & Planning Programme field study in tourism, 2005)

Figure 26. Steps in GIS application in Pangkor tourism planning

(Source: Baharie, T. and Elliot-White, Martin, 1999)

GIS APPLICATION IN TOURISM PLANNING IN PANGKOR

Before building up GIS application for tourism planning in Pangkor, the first step to be carried out was to conduct a survey among tourists and local communities on the satisfaction of four main aspects which include physical element, infrastructure available, accessibility and community supports. GIS relies on secondary data for spatial analysis.

Phases of GIS

Steps involved include data collection, data installation, and data analysis. Figure 26 shows the steps to be taken. The types of data required include attribute and spatial. The attribute data is gathered through two sources. One is from the survey conducted earlier and the other literature review of the tourism products available.

The collected data are plotted in GIS system using ArcGIS software. Layers created include tourism products, infrastructures available, land use zones, analysis and new development area. Once data are available in the system, GIS analysis is conducted. Every analysis layer that is conducted using different criteria will be saved as layer for its specific usage. The layers are then used to create new development areas. GIS model is able to suggest and answer questions of business-style site feasibility analysis on tourism products capabilities without disregarding local communities.

CONCLUSION

GIS offers a powerful tool in providing information to support decision making. It has been used in resource inventory, data integration and landuse planning. In tourism development, GIS would be a great aid in planning for sustainable development. Developing tourism products with minimal negative impacts on the environment and the local communities is the main objective in driving for sustainable development. However, it is hardly the case in developing countries in which tourism developers and planners have been focusing on the needs of the tourist in search of quick and substantial economic gains. Local communities and resources sustainability were often neglected in the planning process. Lack of funds was the main excuse of not being able to plan well. This should not be the case. Tourism products need to be planned well since they will be one of the major income generating sectors to the host country as a whole in a long run. Hosts can benefit significantly in promoting tourism to their localities. Other than increasing their standards of living, they also benefit from meeting new people of different backgrounds and lifestyles. That is not all, promoting one's life style to others is an excitement by itself.

ENDNOTES

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