CHAPTER II
LITERATURE REVIEWS

The objective of this research paper is to assess the abandoned areas in Phuthamonthon district, Nakhon Pathom province. The conceptual framework applied to this study involved concepts of abandoned area, Object-based image analysis, spatial characteristics, characteristics of remote sensing data in vegetation study, and Image-Operation focusing on vegetation data. The details are as follows:

2.1 Abandoned Area

2.1.1 Concepts and Characteristics of Abandoned Area

The abandoned area is the unused area that was continuously unutilized for at least 1 year or over (Bureau of Natural Calamity and Agricultural Risk Prevention, 2006). The abandoned area can be the land that is unused, unsuitable for cultivation, or uncultivated land. The abandoned land can be either long-term or temporary unutilized land (Giedre, 2011). The characteristics of abandoned area can be defined broadly. The abandoned areas can be small areas with unusual shape, undeveloped land. This is due to its physical limitation such as steep slope/landslide area, flooded area, or reserved area for urban expansion or immigration, land speculation, which is often situated in specific areas and located nearby institutions or public areas. The land development project of abandoned areas required substantial fund (Northham, 1971). The Common Agricultural Policy (CAP) stated about Agricultural land that “In case, there is no cultivation or economic activities after 3 consecutive years, the land may consider as an abandoned area” (Thomas, 2009). The abandoned area is unused or uncultivated land for at least 2 consecutive years, or land that is abandoned for a long period with no time limitation. The law stipulated that abandoned land is uncultivated land in the latest season as well as in the early of harvesting season. The abandoned

area can also be the abandoned agricultural land, which lack of land management or maintenance (Margarida, 2011).

The abandoned agricultural land in the Central and Eastern Europe had become an important phenomenon for over 15 years. The abandoned agricultural can be classified into several categories as shown below:

(1) The partially used land by its owner or landlord: With high moisture and fertile soil, the abandoned area can transformed its ecosystem into forest with shrubs and herbs. With dry soil in the Eastern Europe, on the other hand, the abandoned area can changed its ecosystem into grassland. The plant in grassland can survive for many years without necessity of land management.

(2) The used land with low quality soil: The land was used by its landlord or occupant. However, the land management is difficult due to its quality of soil. Such land can be called “Nearly abandoned land” or “Abandoned land”. The land is unofficially abandoned and may be reformed for future usage such as tourism or agriculture. However, the development of the land is mostly correlated with its economic return.

(3) The permanent or temporary abandoned land: The land is abandoned due to the failure of land reformation project. This may also resulted from the insufficient financial support for the project.

Each writer defined the word “Abandoned” in different context. However, the agricultural officer of Central Europe defined it as “The land that has not been cultivated for agriculture for two years (Pratik, 1978).

In rural area, the land is mainly used for agriculture such as cultivation and animal husbandry. Institute of Research Development and Prevention of Desert and Caution, under the Land Development Department, classified all types of abandoned area outside forest including abandoned paddy field, abandoned farm, grassland, copse or shrub, marsh or swamp, and abandoned coal mine.

Since the 1960s, there are studies of the abandoned areas phenomenon in modern city, as well as, its terms and definitions for instance lost space, Waste space, Dead space, and urban void. There are some common characteristics of these abandoned areas. The abandoned areas can be a fraction of neglected city area, unused or unutilized land, and has differed physical characteristic from surrounding area. The

abandoned area has differed characteristics, unlike public open space such as park, walking street, and pedestal. The public open space is a space outside building and is useful for public events or activities in the city (Niramon, Mor. Por. Por). The public open space can also be vacant land. The two types of vacant land are 1) vacant space located in front of a building, and 2) natural areas such as marsh, swamp, grassland, open space, and park. The vacant space improves air veneration and helps reduce congestion. The public park can be as large as 100 square meters or as small as a small garden, which can be spread throughout the city especially in the town square. The vacant areas can be decorated, which create a nice landscape for the city. The vacant area can also be used as a backup space for further urban expansion or can be a service facility such as vacant building for at least 2 years or over. The vacant land can be publicly, privately owned land or become vacant due to other factors. Vacant land may be sufficient for recreation and leisure activities such as park, playground, stadium and forest conservation. Such land may be vacant but not necessary to abandon. This is because its nature will provide a positive influence to community or region (Jose M. Rey Benayas, 2007)

In conclusion, the abandoned or likely to be abandoned area can be defined as the areas that are continuously covered by grass, herb, and shrubs with no evidence of significant cultivation or economic activity, as well as, the development in context of cultural landscape by its surrounding.

2.1.2. The Causes of Abandoned Area

There are many reasons that caused the abandoned area, for example, structural changes in agricultural sector due to lack of fund and agricultural equipment, knowledge and advice, and government support on the market. Other factors, i.e. small area of land, social and economic factors, retirement of farmer without successor, changing land ownership, farmer leasing land for cultivation, disparity income between urban and rural area, lead to land abandon (FAO, 2006).

Influence of factors that affects the abandoned areas. The causes of abandoned areas is linked to natural factors such as unfertilized soil on steep slope area, acid soil, alkali soil, shallow soil with rocks, flood (Office of Land Usage Management and Development, 2006), sandy soil, mountainous area, arid plains, poor

irrigation and water shortage. And other economic and social factors such as concentration of land ownership, lack of competition, inaccessibility, unfavorable market, and policy factors (such as insufficient and incomprehensive policy framework), which makes agriculture unprofitable. The agriculture reduction also affects several activities such as abandonment of service economic activity (i.e. shop, healthcare service, etc.) especially in rural area. Therefore, the abandonment of land can lead to depopulation and degradation of ecological and devaluation of economic in the areas (FAO, 2006)

2.1.3 Impact of Abandoned Areas

The impact of abandoned areas can be classified into 2 types as followed:

2.1.3.1 Environmental impact: In case, the abandoned areas are grassland, the grassland can be endemic by non-local plants species and habitat for bird is declined. In case, the abandoned areas are arable land, the food sources of migration birds, such as corn field, is lost. Moreover, there are losses on small land area, genetic diversity of wildlife and threat of alien wildlife species.

2.1.3.2 Social and Economic Impact: This is resulted in loss of agricultural land, agricultural production, traditional habitation, and agricultural income. In case, the abandoned lands are major resources of Ecotourism, the farmers may lose their revenue from tourism (Utrecht, 2004).

2.2 The Application of Geo-Informatics System

Geo-Informatics System comprises of 3 main technologies including remote sensing, Geographic information system, and Global positioning system. The Geo-Informatics System is a science and technology dealing with surveying, recording, data storage, data analysis, and explanation of the relationship in the model space. The Geo-Informatics System is an important application of 3D visualizing, which uses Digital Elevation Model and Spatial analysis to obtain a result as a 3D visualizing map (Sura, 2003).

2.2.1 Remote sensing

Remote sensing is the acquisition of characteristics about objects without making direct physical contact with the objects. Remote sensing is the art and science of data acquisition on objects, area, or phenomenon without physical contact to objects by means of electromagnetic radiation. The quality of remote sensing data consists of 3 characteristics including Spectral, Spatial, and Temporal resolution. The application of remote sensing data can be used to study continuity of phenomenon such as changes in land usage, movement of typhoons, movement of polar ice, direction and expansion of wildfires in Indonesia, etc.

2.2.2 Geographic information system (GIS)

Geographic information system or GIS is the process of analyze spatial data using computer system. The computer system analyzes information and data that are correlated to spatial position. The data and maps in GIS database are shown in the form of data tables. In the GIS database, the spatial data can be analyzed to find the results or changes that are correlated with time (Sura, 2003).

2.2.3 Global positioning system

Global positioning system or GPS is a space-based satellite navigation developed by Ministry of Defence of the United States. The system was developed to specify coordinate for military purposes, and be able to work in any spatial conditions for 24 hours a day with accuracy. In the early stage, the system was used only for military purposes. Later on, the United States, however, revised their military policy and allowed civilian to use the system. The most common used by civilian is for airplane navigation, ship navigation and also vehicle navigation. GPS has been used in engineering area for survey, coordinate specifying, suppression, exploration and planning of natural resource and environmental management, agriculture, etc (Supetch, 2009).

2.2.4 Concepts of remote sensing data improvement

The preparation prior to data processing is mainly to improve quality of the data by improve the resolution of data details, especially in the focus area. The

improvement will enhance the interpretation of data. Image-Operation of multispectral band is a method to improve quality of data. The most useful tools to assess abandoned areas, in terms of images and shape using object-oriented approach, are Normalize Difference Vegetation Index, Water Index, and Brightness Index. The indices are used as conditions to identify objects. The formulas of the calculation are shown below (Geo-Informatics and Space Technology Development Agency (Pubic Organization, 2009)

1) Normalize Difference Vegetation Index (NDVI) can be used to as a tool to enhance the accuracy of classification because the index indicates the green vegetation areas. The index formulas are shown below:

$$NDVI = (NIR - RED) / (NIR + RED) \quad \text{Equation 2-1}$$

Where:

NDVI = Normal Difference Vegetation Index

NIR = Near-infrared regions (0.77 - 0.90 μm)

RED = Spectral reflectance measurements visible in red (0.62 - 0.69 μm)

2) Brightness Index (BI): The index is calculated as follows:

$$B = \sqrt{\frac{BLUE^2 + GREEN^2 + RED^2}{3}} \quad \text{Equation 2-2}$$

Where:

BLUE = Spectral reflectance measurements visible in blue (0.45 - 0.52 μm)

GREEN = Spectral reflectance measurements visible in green (0.53-0.60 μm)

RED = Spectral reflectance measurements visible in red (0.62-0.69 μm)

3) Normalize Deference Water Index (NDWI): The index is calculated as follows:

$$WI = \frac{GREEN - NIR}{GREEN + NIR}$$ Equation 2-3

Where:

GREEN = Spectral reflectance measurements visible in green (0.53-0.60 μm)

NIR = Near-infrared regions (0.77 –0.90 μm)

(Source: Geo – Informatics and Space Technology Development Agency (Public Organization), 2009)

2.2.5 Satellite image data

In this research paper, the images obtained from Thaichote satellite has been used for study. As the studies focus on the urban abandoned areas, which is isolated land and spread throughout many areas, using the images from Thaichote satellite can help to enhanced accuracy of the assessment. Image from Thaichote has spatial resolution of 15 meters for multispectral band, and 2 meters for black and white. With multispectral band, the image has higher spatial resolution compared to that of lower-spectral band. Moreover, the color aerial photographs obtained from Land Development Department, which taken in 2002 - 2003 with scale of 1:4,000, are also used in the data analysis. The photographs can help to enhance spatial details. The photographs are used in the fieldwork.

Characteristics of spectral band of satellite image data. Satellite image data is a data collected from remote sensing. The data is in numerical format, which shown spatial structure, spectral band, and spectral reflectance. The satellite image of Thaichote has 4 bands for multispectral band and 1 band for Black and White. The spectral band of Thaichote, including low, high, average, standard deviation, and characteristic of reflectance graph, are shown in the table below:

Table 2-1 Data Overview of Thaichote Satellite

Satellite Image Data	Thaichote	
Spectral Band	**Spectral Coverage**	**Spatial Resolution**
Visible in blue	0.45 - 0.52 micron	15 meters
Visible in green	0.53 - 0.60 micron	15 meters
Visible in red	0.62 - 0.69 micron	15 meters
Near-infrared region	0.77 - 0.90 micron	15 meters
Visible in blue Short-infrared region	0.45 - 0.90 micron (Black and White)	2 meters

Source: Geo-Informatics and Space Technology Development Agency (Pubic Organization)

2.3 Analysis of Images from Earth Resources Satellite

The analysis of remote sensing data can be ranged from data preparation, data quality improvement, to data classification. The process of data analysis depends on the objectives of the research paper. Therefore, each study is unique and different.

2.3.1 Data classification

To classify the data, the researcher must focus on the areas under the research objectives. To classify the data of abandoned areas, the remote sensing data has been used to examine the abandoned areas. In the study of Pinto studied about the distribution format of abandoned maritime area in Mediterranean from aerial photographs with scale of 1:25,000. Pinto also studied about key factors influencing changes of land cover in ecosystem and examined the dynamics of plants in ecosystem. The study approach of Pinto was to interpret aerial photographs and examine the changes in fieldwork. Pinto found that most of the abandoned areas are located in country border. However, such abandoned areas are interested areas as they are suitable for habitat and recreation. As a consequence of human activities, the abandoned areas were exploited and lead to soil erosion and flood. The process of soil decay was predicted to become faster due to severe climate changes. The changes of

landscape may also cause by area density, open-mine coal, political pressure, and agricultural activities. These led to traditional agricultural discontinued and agricultural land abandoned. In Pinto's study, the study of soil types let us know the direction of changes. In 2012, the covered plants have changed to pioneer plants, increasingly (Pinto, 2007).

2.3.2 Concepts of Object-based classification

The classification of satellite image data by computer often classified the data based on the refraction of energy on pixel, called "Pixel based classification". Lately, the used of high resolution satellite image became more widespread as the image provide more details, especially on buildings. With the application of characteristics of Object-based, the classification may provide better accuracy result. The object-based classification is one of the best methods that helps classify high resolution satellite image (Ravilai and associate, 2007). The object-based classification consists of two process, including Image segmentation and Data classification (Xiaoting Sun, 2003).

1) Image segmentation: The segmentation helps extract the desired data out but the data must have similar characteristics to the sample data. The fundamental of segmentation is to determine the brightness of image for grey scale image and the different of colors for colors image. In addition, the scope of object-based and characteristics of image resolution must be considered. The variables of segmentation that must be determined are categorized as follows:

(1) Scale parameter: The parameter influences directly on size of the image. The parameter determines the value of differences in size of the image, where the low value represents data of the same height and the size of the image is small. On the other hand, the high scale value represents data with dissimilarity and the size of the object is large.

(2) Color/shape parameter: Color is the spectral band data. The color parameter influences directly on objects with the same texture and object with similar color is classified into the same category. The shape parameters help classify the shape of object.

(3) Smoothness/compactness parameter: The parameter emphasizes the important of shape of object.

2) Data classification: This classification uses the object image to statistically calculate the replacement of pixel with similar color in the scope of object. The area with similar characteristics of pixel, which has multi-reflectance, cannot be differentiated. The group of pixel that formed the object is occurred during segmentation process. When the image is segmented, it became group of pixel, which has different degree of similar object.

The study of classification and examination of abandoned area by remote sensing in Malada Boleslav, Czech Republic was aimed to manage and sustain the abandoned area, as well as prevent further expansion of abandoned area. The study applied the Object-based image analysis as well as other method, such as spectral reflectance, timing, context management with "Definiens Enterprise" software, to examine the abandoned area (Tomas Soukup, 2009).

For classifying data with object-oriented classification methods, a study of the Kressler et al., (2005) classify data from satellite IKONOS nearby Vienna, Austria using the method to group data by several characteristics such as size, shape and change in spectra band. After segmentation of the entire image, data classification is performed.

Similarly,Zhangand Feng (2005) which have also used satellite IKONOS data with the mix of mono and multi -band to provide high resolution and maintain variability of data to separate plants from other landscapes. This method of extracting plant has two steps. The first step is to divide data into plant and non-plant data. Group grasses and trees from plant data obtained from the previous step.

Fockelman (2005) examined the type of agriculture using software called Definiens eCognition. Geographic photos with 1-meter resolution and 3 spectrums of wave lengths such as visibly green spectrum, red spectrum, and infrared have been used to create image object. Then perform classification by two steps: the first step to divide areas into agriculture and non- agricultural areas. Classify photos with agriculture areas only into categories such as wheat, oak, barley, etc.

Other than the study on the result of data classification, there is the study on the result of comparison between object-based and pixel classification. For

instance, the study of Suda Suwannachart and associate (2009) about the development of object-based classification of rubber tress age in Na Mom district, Songkha, by Theos satellite. The study applied image segmentation by set the scale and compactness parameter. With the method, the age of rubber tree can be classified into 5 age range including 0-3 years, 4-6 years, 7-15 years, 16-25 years, and over 25 years. The study shows that the accuracy of the age of rubber tree is equal to 76, 64, 63, 70, and 71 percent, respectively.

Nowadays, many organizations paid attention to the study of abandoned area, which used satellite image to analyze the information. There are two major ways of classification of satellite image, including human interpretation and computer system interpretation (Somporn, 2010). For human interpretation, the method relied on the differences of color, shape and distribution format of each age range of rubber tree (Tirada and associates, 2010). For computer system interpretation (Suratman, 2003), however, it used supervised classification method by applying NDVI (Somporn, 2009).

In the study of Matinfaretal (2007), there was a comparison between Object-oriented and Pixel-based classification. The study shows that the result of Object-oriented classification is more accurate to that of pixel-based. The objected-oriented is suitable for the classification on high-resolution satellite image (Patcharadee and Vichai, 2010; Perea et al., 2009; Walairat and Somjit, 2010).

2.4 Law Related to Land Use and City Plan

2.4.1 Comprehensive Planning Act of 2518 is the primary law used to control and to regulate land use and planning, according to comprehensive planning principles. Topography has been developed in the field of agriculture, commerce and industry.

2.4.2 Land Code 1954, Article 7 stipulates that the Director-General (Land Department) is responsible for surveying, classifying, and conducting census of land use in order to understand the richness of nature and the right to the benefits of public interest. The Ministry of the Interior has declared some areas as restricted area

such as places nearby mountains, valleys, and rivers to preserve the richness of nature without individual possession of those restricted areas.

2.4.3 Building Control Act 1979

2.4.4 Enhancement and Conservation of National Environmental Quality Act 1992, this Act is a law that primarily aims to promote and preserve the environmental quality. A part of this Act is related to land use and comprehensive planning, including Section 3 Part 3 Conservation and Environmental Protection.

2.4.5 Policy and legislation related to environmental management and community green space.

1) The Constitution of the Kingdom of Thailand in 1997.

2) Policy and plan for enhancement and conservation of National Environmental Quality Act in 1997 to 2016.

3) Policy and Strategy Ministry of Environment and Natural Resources

4) The Environmental Management Plan in 2002-2006.

5) Plan for National Economic and Social Development No. 11 in 2012 to 2016.

2.5 Study Area

2.5.1 History

The Ministry of Interior established Sub-district of Phuttamonthon on April 1st, 1991. The sub-district was split from 3 tambon, including Salaya, Klong Yong, and Klong Maha Sawat, in Nakhon Chai Si district, Nakhon Pathom. And the sub-district was promoted to Phuttamonthon district on December 5th, 1996. Phuttamonthon district is 1 of 7 districts in Nakhon Pathom and part of Nakhon Chai district. Phuttamonthon district is located on the east of Nakhon Pathom. The distance between the district to Nakhon Pathom is approximately 32 km. by Petchakaseam and Borommaratchachonnani Road or approximately 29 km. by Southern railway from Nakhon Pathom to Salaya statation.

2.5.2 Geography

1) Territory

Phuttamonthon district is located on the east end of its province. The district borders are formed by the following neighbor districts:

To the North - Bang Lean

To the East - Sai Noi, Bang Yai, Bang Kruy (Nonthaburi) and Taweewattana (Bangkok)

To the South –Sam Pran

To the West – Nakhon Chai Si

2) Area: Approximate of 76.329 square kilometers or 47,706.25 Rai

3) Topography: Lowland with small rivers and canals and often flood in rainy season

4) Climate

Summer: From February to Mid-May

Rainy Season: From May to Mid-October

Winter: From October to Mid-February

5) Administration: Phuthamonthon district is subdivided into 3 tambon, which are further subdivided into 18 villages including 6 villages in Salaya, 8 villages in Klong Yong, and 4 villages in Maha Sawat. The district is governed by its local administrations, which are Municipality and Tambon Administrative Organization. The two of municipality are Salaya and Klong Yong municipality and the two of Tambon Administrative Organization are Salaya and Maha Sawat Tambon Administrative Organization.

6) Demographic from Census Bureau as of January 31st, 2012

- Total population of 36,504 persons, which equals to 16,898 Male and 19,606 Female

- Total Households of 15,698 households (Average population of 2 persons per household

- Average of population density is approximately 475 persons per square kilometers

7) Economy

The main occupations are agriculture, including cultivation of rice vegetables, fruit, and flower especially orchid, merchant, industrial worker and office worker.

8) Soil Resources

In the district, the soil is a composition of the accumulated sediments over years, which caused by sediment of fresh water, seawater and brackish water. Most of the areas in the district are plain and lowland with low water drainage soil. Therefore, the land is suitable for paddy field. Moreover, there is physical soil improvement by building permanent bed, which suitable for growing fruit, vegetables and perennials (Noi, 1991).