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THE APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS IN DETERMINATION OF POTENTIAL AREAS FOR ECOTOURISM DEVELOPMENT : A CASE STUDY OF KOH KRED (KRED ISLAND), NONTHABURI PROVINCE, THAILAND

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Prisana Mutchima

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PRISANA MUTCHIMA : THE APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS IN DETERMINATION OF POTENTIAL AREAS FOR ECOTOURISM DEVELOPMENT: A CASE STUDY OF KOH KRED (KRED ISLAND), NONTHABURI PROVINCE, THAILAND. THESIS ADVISORS : THANAKORN UAN-ON, Ph.D., KASEM KULPRADIT, M.Sc., THAVIVONGSE SRIBURI, Ph.D. 135 P. ISBN 974-664-381-9

The objectives of this study are to apply Geographic Information System (GIS) in determination of potential areas for ecotourism development and to propose ecotourism development guidelines in Koh Kred (Kred Island), Nonthaburi by using ArcView GIS Version 3.1. Potential Surface Analysis (PSA) and Linear Combination Method is used in the study to evaluate the potential of tourist facilities in the areas and the potential of ecotourism areas as well as to determine potential areas for ecotourism development.

In the potential evaluation of tourist facilities areas, various factors were studied including port, road/path, canal, public telephone, and institutional land are considered according to the importance of each factor. The determination of distance from factor can be divided into 2 cases: 50 m and 100 m. In case 1 (50 m), the high, moderate and low potential areas occupy 0.084, 0.659 and 2.929 km^2 or 2.29, 17.95 and 79.76% of the study area, respectively. In case 2 (100 m), the high, moderate and low potential areas occupy 0.579, 1.642 and 1.452 km^2 or 15.77, 44.71, and 39.52% of the study area, respectively.

As for the potential evaluation of ecotourism areas, various factors including culture and customs of the community, history and archaeology, art, scenery, naturalness, and accessibility. The result shows that the tourist attraction in Koh Kred can be classified as those of high, moderate and low potential. The findings indicate that as a pottery village, Poramai Yikawat Temple, and Sao Thong Tong Temple are high potential tourist attractions. Pailoam Temple, Chim Plee Temple and Palelai Temple are moderate potential tourist attractions while Salakool Temple and orchards are low potential tourist attractions.

Regarding the potential areas for ecotourism development, it is determined by overlaying the potential areas for tourist facilities and the potential areas for ecotourism. The study finds that in case 1 (50 m), the high, moderate and low potential areas occupy 0.071, 0.577 and 3.079 km^2 or 1.92, 15.47, and 82.61% of the study area, respectively. In case 2 (100 m), the high, moderate and low potential areas occupy 0.096, 1.843 and 1.786 km^2 or 2.58, 49.48, and 47.94% of the study area, respectively.

The ecotourism development guidelines proposed are varied according to the potential of area and the criteria of evaluation.

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ปริศนา มัชฌิมา : การประยุกต์ใช้ระบบสารสนเทศทางภูมิศาสตร์ เพื่อหาพื้นที่ที่มีศักยภาพสำหรับการพัฒนาการท่องเที่ยวเชิงอนุรักษ์ กรณีศึกษา : เกาะเกร็ด จังหวัดนนทบุรี (THE APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS IN DETERMINATION OF POTENTIAL AREAS FOR ECOTOURISM DEVELOPMENT: A CASE STUDY OF KOH KRED (KRED ISLAND), NONTHABURI PROVINCE, THAILAND). คณะกรรมการควบคุมวิทยานิพนธ์ : ธนากร อ้วนอ่อน, Ph.D., เกษม กุลประดิษฐ์, วท.ม., ทวีวงศ์ ศรีบุรี, Ph.D. 135 หน้า. ISBN 974-664-381-9

การศึกษานี้มีวัตถุประสงค์เพื่อ ประยุกต์ใช้ระบบสารสนเทศทางภูมิศาสตร์ในการหาพื้นที่ที่มีศักยภาพสำหรับการพัฒนาการท่องเที่ยวเชิงอนุรักษ์และเสนอแนวทางการพัฒนาการท่องเที่ยวเชิงอนุรักษ์ บริเวณเกาะเกร็ด จังหวัดนนทบุรี โดยการใช้โปรแกรม ArcView GIS 3.1 ในการวิเคราะห์ ด้วยหลัก Potential Surface Analysis (PSA) และ Linear Combination Method เพื่อประเมินศักยภาพของพื้นที่ด้านสิ่งอำนวยความสะดวกทางการท่องเที่ยว, ประเมินศักยภาพของพื้นที่เพื่อการท่องเที่ยวเชิงอนุรักษ์ และหาพื้นที่ที่มีศักยภาพสำหรับการพัฒนาการท่องเที่ยวเชิงอนุรักษ์

การประเมินศักยภาพของพื้นที่ด้านสิ่งอำนวยความสะดวกทางการท่องเที่ยว พิจารณาจากความสำคัญของปัจจัยต่างๆ ได้แก่ ท่าเรือ, ถนน/ทางเดิน, คลอง, โทรศัพท์สาธารณะและสถานที่ราชการ การกำหนดระยะห่างจากปัจจัยแบ่งเป็น 2 กรณี คือ 50 ม. และ 100 ม. ผลการศึกษาพบว่า กรณีที่ 1 (50 ม.) พื้นที่ที่มีศักยภาพสูงมีพื้นที่ 0.084 ตร.กม.(2.29%), พื้นที่ที่มีศักยภาพปานกลางมีพื้นที่ 0.659 ตร.กม.(17.95%), และพื้นที่ที่มีศักยภาพต่ำมีพื้นที่ 2.929 ตร.กม.(79.76%) กรณีที่ 2 (100 ม.) พื้นที่ที่มีศักยภาพสูงมีพื้นที่ 0.579 ตร.กม.(15.77%), พื้นที่ที่มีศักยภาพปานกลางมีพื้นที่ 1.642 ตร.กม.(44.71%), และพื้นที่ที่มีศักยภาพต่ำมีพื้นที่ 1.452 ตร.กม.(39.52%)

การประเมินศักยภาพของพื้นที่เพื่อการท่องเที่ยวเชิงอนุรักษ์ พิจารณาจากความสำคัญของปัจจัยต่างๆ ได้แก่ วัฒนธรรม ประเพณีของชุมชน, ประวัติศาสตร์และโบราณคดี, ศิลปกรรม, ทัศนียภาพ, ความเป็นธรรมชาติ และความสะดวกในการเข้าถึง ผลการศึกษาพบว่า แหล่งท่องเที่ยวที่มีศักยภาพเพื่อการท่องเที่ยวเชิงอนุรักษ์สูง คือ หมู่บ้านเครื่องปั้นดินเผา, วัดปรมัยยิกาวาส และวัดเสาธงทอง แหล่งท่องเที่ยวที่มีศักยภาพเพื่อการท่องเที่ยวเชิงอนุรักษ์ปานกลาง คือ วัดไผ่ล้อม, วัดฉิมพลี และวัดปานไลย์ แหล่งท่องเที่ยวที่มีศักยภาพเพื่อการท่องเที่ยวเชิงอนุรักษ์ต่ำ คือ วัดศาลากุลและสวนผลไม้

พื้นที่ที่มีศักยภาพสำหรับการพัฒนาการท่องเที่ยวเชิงอนุรักษ์ ได้จากการซ้อนทับระหว่างพื้นที่ที่มีศักยภาพด้านสิ่งอำนวยความสะดวกทางการท่องเที่ยวและพื้นที่ที่มีศักยภาพเพื่อการท่องเที่ยวเชิงอนุรักษ์ ผลการศึกษาพบว่า กรณีที่ 1 (50 ม.) พื้นที่ที่มีศักยภาพสูงมีพื้นที่ 0.071 ตร.กม.(1.92%), พื้นที่ที่มีศักยภาพปานกลางมีพื้นที่ 0.577 ตร.กม.(15.47%), และพื้นที่ที่มีศักยภาพต่ำมีพื้นที่ 3.079 ตร.กม.(82.61%) กรณีที่ 2 (100 ม.) พื้นที่ที่มีศักยภาพสูงมีพื้นที่ 0.096 ตร.กม.(2.58%), พื้นที่ที่มีศักยภาพปานกลางมีพื้นที่ 1.843 ตร.กม.(49.48%), และพื้นที่ที่มีศักยภาพต่ำมีพื้นที่ 1.786 ตร.กม.(47.94%)

แนวทางการพัฒนาการท่องเที่ยวเชิงอนุรักษ์มีหลายแนวทาง ขึ้นอยู่กับศักยภาพของพื้นที่และหลักเกณฑ์ในการวิเคราะห์

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CHAPTER I

INTRODUCTION

1.1 Background and Significance of the Problem

Important events in 1998 and 1999 are the biggest international sporting event in Asia, XIII Asian Games will be hosted by Thailand in 1998 and in the joyous 1999 Thailand will celebrate His Majesty The King's 6 cycle Royal Birthday (72 years). Well aware of these important events, Tourism Authority of Thailand has organized the Visit Thailand Year 1998 – 1999 project, better known as Amazing Thailand 1998 – 1999. It is expected that with in 2 years, 17 million tourists from all over the World will focus their attention to and bring 600,000 million Bath into Thailand.

If successful , the project would give Thailand a better image while offering back quality tourism for many foreigners to enjoy. More jobs will be created and the dollars from outside would enter the country. That would make solving Thailand's serious economical problem much easier.

However, tourism promotion, which exceedingly emphasizes on economic aspect with inadequate concern about environment usually leads to concerning environmental and social problems. Improper use of resources in tourism attractions created tremendous impact not only on the natural resources and environment but also social structure and cultural identity. To avoid such problems, any tourism promotion or development should be thoroughly planned and carefully carried out, taking into account the capacity of each tourist spot.

In Thailand, visitors can enjoy the splendor of numerous tourist spots. Among those is Nonthaburi, a province locating many tourism attractions, including Koh Kred (Kred Island). It is an island in the Chao Phraya River, well known as a riverside community with interesting historical background and the ways of life

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different from the area surrounding it. The ways of life of Koh Kred community is countryside social though it is in Bangkok Vicinity. Local people are closely and familiar with each other. But people that are on Pakkred district have the ways of life as city social, not community, each makes one's Getaway and communicate with money. Island's land use is classified in 9 types (1): residential areas 6.52%, agricultural 74.54%, industrial areas 2.17%, commercial areas, institutional lands 0.66%, schools 0.42%, temples 1.39%, uncultivated lands 12.64%, and other lands 1.66%. Most of the island's land is for agricultural use, especially fruit growing. So the whole island is covered with green vegetation, almost no air or noise pollution from any vehicles, except for some motorcycles. Because the paths on the island are only wide enough to walk or ride a bicycle, and most of all it doesn't have a bridge from mainland connecting to the island. Part of the population is Mon-Burmese is renowned for their unique tradition, culture and arts, especially the famous ancient Mon style pottery making skill.

Moreover, there are many tourist attractions on this island, such as pottery village and various ancient temples that each place has different attentions. Then many tourists travel this island. But it doesn't have suitable tourism development guidelines then it has problem, such as without information of tourist attractions, interpretive signs have not standard and complete, boat and port have not standard and security for tourists, not training local people about tourism (2).

Then this study will study potential area for ecotourism development which is one method, used ecotourism development planning (3) in order to determine policies, directions, and form of ecotourism that probable action, suitable and accord with characteristic of ecotourism. It is a traveling to natural places and cultural features which have unique geographical and relating to the ecosystem, with the purpose of studying nature, culture and history, sustainable management and participation of local community.

This study will apply geographic information systems (GIS) to determine potential area for ecotourism development because GIS is a tool that use computer for collecting, storing, updating, manipulating, analyzing and presenting spatial data that follow various objectives. Then it is a tool for making decision enabled effectiveness in analysis and planning (4).

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1.2 Objectives of the study

1.2.1 Determine potential area for ecotourism development in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province in Thailand by using Geographic Information System (GIS).

1.2.2 Propose ecotourism development guidelines, which suit and accord with area potential in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province in Thailand.

1.3 Scope of the Study

1.3.1 Study area is an island on Chao Phraya River in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province in Thailand. Koh Kred (Kred Island) is situated between 13° 45′ - 14° 15′ N and 100°15′ - 101°45′ E (5). It occupies an area of 4.008 km^2 (6) (figure 1.1)

1.3.2 Study Issue:

1.3.2.1 Evaluate potential of tourism facilities area in Koh Kred (Kred Island) in Pak Kred District of Nonthaburi Province in Thailand by using GIS software (ArcView GIS Version 3.1) for data analysis and presentation. Data analysis will use the Potential Surface Analysis technique (PSA) and Linear Combination Method. The factors that use to analyze as follows:

- Road/Path
- Canal
- Port
- Public Telephone
- Institutional land

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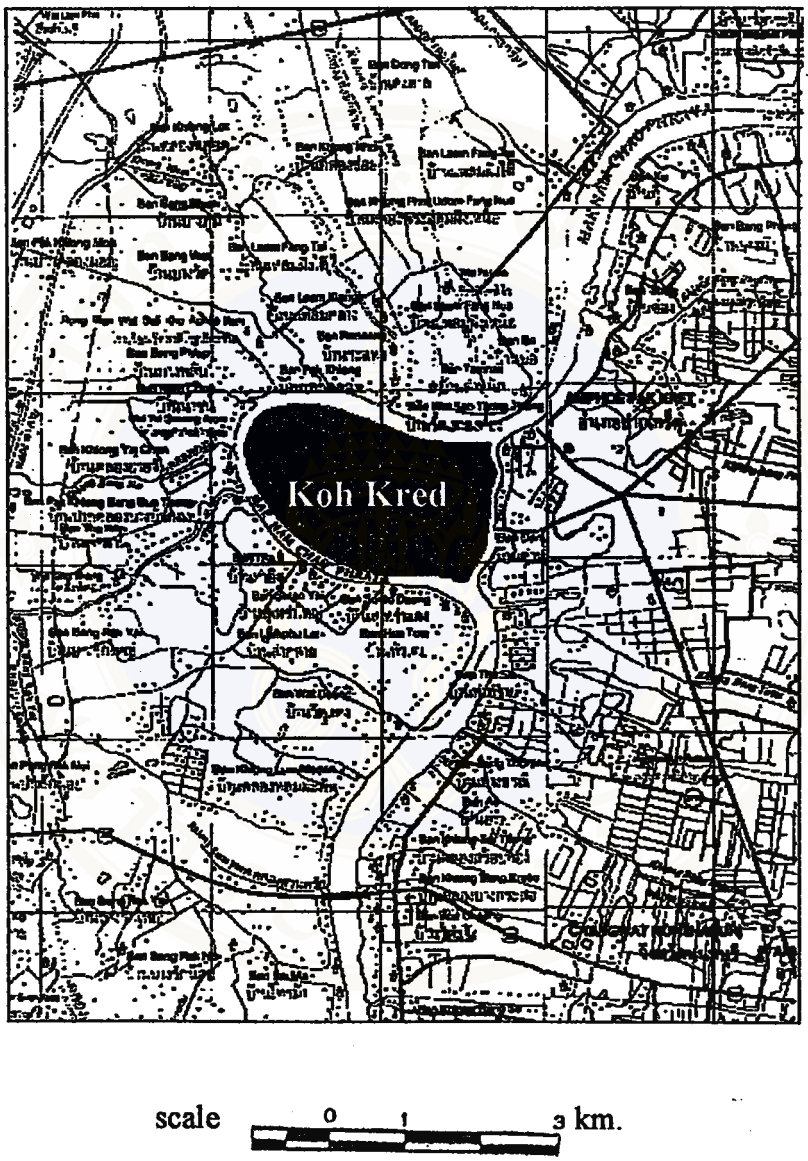

Figure 1.1 Topographic Maps of Study Area (Koh Kred Sub-district, Pak Kred District, Nonthaburi Province, Thailand)

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1.3.2.2 Evaluate potential of ecotourism area in Koh Kred (Kred Island) in Pak Kred District of Nonthaburi Province in Thailand by using questionnaires to ask for opinions from ecotourist to tourism attractions. The factors that use to analyze as follows:

- History and archaeology
- Art
- Culture and custom of community
- Naturalness
- Scenery / Landscape
- Accessibility

1.3.2.3 Determine potential area for ecotourism development by overlaying between Tourism Facilities potential area and ecotourism potential area.

1.3.2.4 Propose ecotourism development guidelines in Koh Kred (Kred Island) in Pak Kred District of Nonthaburi Province in Thailand.

1.4 Expected Result

1.4.1 Potential area for ecotourism development in Koh Kred (Kred Island) in Pak Kred District of Nonthaburi Province in Thailand.

1.4.2 Ecotourism development guidelines, which suit and accord with area potential in Koh Kred (Kred Island) in Pak Kred District of Nonthaburi Province in Thailand.

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CHAPTER II

LITERATURE REVIEW

2.1 Definition of Ecotourism

Ecotourism is one form of sustainable tourism. It was defined as nature tourism and described as: "Traveling to relatively undisturbed or uncontaminated areas with a specific objective of studying, admiring, and enjoying scenery and its wild plants and animals, as well as any existing cultural manifestations (both past and present) found in the areas"(7).

Ecotourism can be defined as "a visit to any particular tourism area with the purpose to study, enjoy, and appreciate the scenery natural and social as well as the life style of the local people, based on the knowledge about and responsibility for the ecological system of the area"(8).

Ecotourism means a traveling to natural places that have their own unique geographical or cultural features relating to the ecosystem, with the purpose of studying nature, culture and history. This should be done in a sensitive manner so as to avoid negative impacts on the ecosystem, while at the same time providing economic opportunities that would benefit the conservation of natural resources and enhance the living conditions of local residents. (9)

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2.2 Principles for Sustainable Tourism / Ecotourism (10)

2.2.1 Using Resources Sustainable

The conservation and sustainable use of resources-natural, social and cultural is crucial and makes long-term business sense. The tourism industry should:

- Prevent damage to the environmental resources, natural and human.
- Act as a force for conservation.
- Develop and implement sound environmental policies in all areas of tourism.
- Install appropriate systems for minimizing water and atmospheric pollution from tourism developments.
- Develop and implement sustainable transport policies, efficient public transport and walking and cycling to enhance and protect the environment.
- Adhere to the precautionary principle in all its operations and new developments.
- Research and establish the carrying capacity of a destination and then operate within the limits that this sets, respecting the precautionary principle.
- Respect the needs and rights of local people.
- Protect and support the cultural and historical heritage of peoples worldwide.
- Carry out its practices in a responsible and ethical manner.
- Actively discourage the growth of exploitative sex tourism.

2.2.2 Reducing Over Consumption and Waste

Reduction of over consumption and waste avoids the costs of restoring long term environmental damage and contributes to the quality of tourism. The tourism industry should:

- Reduce consumption and promote the reduction of inappropriate consumption by its customers.

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- Use local resources in preference to imports, but in an appropriate and sustainable manner.
- Only import goods when absolutely necessary, and ensure these are imported through local agencies and enterprises.
- Reduce waste.
- Ensure the safe disposal of waste produced from its tourism facilities.
- Implement waste disposal facilities, including support for local infrastructure where this is inadequate.
- Recycle waste to the benefit of the tourism industry and of the local community, where waste cannot be reduced.
- Invest in appropriate recycling schemes.
- Take responsibility for restoring damage arising from tourism projects.
- Avoid damage through proper pre-planning and constant monitoring.

2.2.3 Maintaining Diversity

Maintaining and promoting natural, social and cultural diversity is essential for long-term sustainable tourism, and creates a resilient base for the industry. The tourism industry should:

- Respect the natural, social and cultural diversity of destination areas.
- Ensure a pace, scale and type of development, which protects rater than destroys diversity, local culture and communities.
- Prevent the destruction of natural diversity by respecting each area's carrying capacity, taking steps to establish carrying capacities and adopting the precautionary principle.
- Monitor the impact of tourism activity on the flora and fauna of a destination area.
- Encourage social and economic diversity by integrating tourism within the activities of a local community and with their full participation.
- Prevent viable traditional accusations from being displaced by a tourism monoculture.

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- Actively discourage forms of tourism, which cause or contribute to social problems.
- Foster genuine cultural tourism that does not reduce the host culture to a commodity.
- Promote a region's unique features, rather than impose blanket standardization.
- Ensure that the scale, pace and type of tourism is such as to foster genuine hospitality and mutual understanding.
- Promote tourism in tune with local culture, welfare and development aspirations.

2.2.4 Integrating Tourism into Planning

Tourism development which is integrated into a national and local strategic planning framework and which undertakes environmental impact assessments, increases the long-term viability of tourism. The tourism industry should:

- Take into account both the immediate and future needs of hosts and tourists.
- Integrate all economic, environmental, social and cultural aspects of the local area in planning.
- Respect local, regional and national policy in other sectors, such as industry, agriculture, land-use, housing and welfare.
- Consider alternative strategies for development and options for land-use that takes environmental imperatives into account.
- Minimize environmental, social and cultural damage to host communities by carrying out comprehensive environmental impact assessments in consultation with local people and all relevant authorities.
- Continue to monitor positive and negative environmental and other impacts.
- Develop and introduce methodologies for improving environmental impact assessments undertaken by the industry.

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- Recognize that a pace of development in concert with local situations will provide time to properly plan, develop and monitor projects for long-term benefits.

2.2.5 Supporting Local Economies

Tourism that supports a wide range of local economic activities and which takes environmental costs and values into account both protects economies and avoids environmental damage. The tourism industry should:

- Take responsibility for maintaining improving the environment where this is a direct resource.
- Ensure that environmental costs are taken into account in all tourism projects.
- Integrate environmental considerations into all economic decisions.
- Operate within the limits set by local appropriate infrastructure and carrying capacity.
- Undertake full and regular environmental audits of every tourism project.
- Underpin economic diversity by developing tourism infrastructures that also benefit wider interests.
- Ensure that the type and scale of tourism is appropriate to local conditions.
- Prevent over exploitation of individual locations.
- Support local income generation and small business enterprises.
- Support the economies of destination countries by maximizing retention of tourist revenues within their economies.
- Invest in environmental protection technologies and in restoration of existing damage to the environment in relation to tourism.

2.2.6 Involving Local Communities

The full involvement of local communities in the tourism sector not only benefits them and the environment in general but also improves the quality of the tourism experience. The tourism industry should:

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- Respect the needs and aspirations of local people.
- Support the concept that local people should determine their own development.
- Actively encourage local community involvement in tourism projects.
- Promote the active partnership of local people and communities in tourism development.
- Involve the widest range of local associations.
- Actively support local enterprises and cooperatives, which provide services, goods and crafts.
- Support locally owned shops, restaurants and guide services.
- Involve local people through employment at all levels.
- Encourage the development of home-based tourism accommodation ad facilities.
- Prevent disruption to and the displacement of local people.

2.2.7 Consulting Stakeholders and the Public

Consultation between the tourism industry and local communities, organizations and institutions is essential if they are to work alongside each other and resolve potential conflicts of interest. The tourism industry should:

- Consult with and inform local residents about potential changes induced by the rapid growth of tourism.
- Consult with and inform local residents of the potential benefits of non-intrusive, sustainable tourism.
- Introduce measures at the planning stage to encourage greater local consultation.
- Hold workshops, meetings and other public form for consultation.
- Support the establishment of proper mechanisms for efficient local consultation.
- Consult with the widest variety of local associations, including non-governmental organization; in order to integrate public and private interests.

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- Fully inform and consult with local government and non-government bodies prior to and during the implementation.

2.2.8 Training Staff

Staff training, which integrates sustainable tourism into work practices, along with recruitment of local personnel at all levels, improves the quality of the tourism product. The tourism industry should:

- Integrate environmental, social and cultural issues into training programmes.
- Enhance the status of local staff at all levels as an essential part of the industry.
- Foster a sense of pride in the job and care for the destination and its people.
- Train staffs in understanding the complex nature of modern tourism.
- Explore the positive and negative impacts of tourism on host communities, during training.
- Train staffs to foster tourist responsibility towards the destination country.
- Encourage multi-cultural education and interchange programmes.
- Train local staff for managerial and leadership positions.
- Channel back profits from tourism into educational programmes, which encourage and appreciation of the environment and heritage.

2.2.9 Marketing Tourism Responsible

Marketing that provides tourists with full and responsible information increases respect for the natural, social and cultural environments of destination areas and enhances customer satisfaction, the tourism industry should:

- Ensure that the marketing of "green" tourism is not merely a selling ploy but reflects sound environmental policy and practice.
- Educate visitors in advance of arrival and give guidance on environmental "do" as well as "don't".

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- Dismantle racial, sexual, cultural or religious stereotyping within the industry.
- Use marketing strategies that respect the peoples, communities and environments of destination areas, and which are non-exploitative.
- Make tourists aware of their potential impact on and their responsibilities towards host societies.
- Provide tourists with full and fair information that enables them to understand all environmental and related aspects of holidays when selecting any destination or holiday package.
- Market holidays that correspond to the tourist product and experience offered.
- Provide information to tourists on respecting the cultural and natural heritage of destination areas.
- Not impose western mores on countries with different values.
- Encourage tourists to try new experiences, such as cuisine, cultures and ways of life.
- Promote tourism appropriate to the capacities of a destination in terms of the scale, numbers and types of tourist.
- Not encourage tourism to vulnerable ethnic groups or environments.
- Employ tour guides who attempt to portray societies honestly and dispel stereotypes.
- Provide customers with detailed pre-departure information that can be reinforced in flight.

2.2.10 Undertaking Research

On-going research and monitoring by the industry using effective data collection and analysis is essential to help solve problems and to bring benefits to destinations, the industry and consumers. The tourism industry should:

- Initiate, encourage and support research into prior assessment and monitoring techniques for measurement of environmental, social and economic impacts.

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- Carry out research into improving Environmental Impact Assessments and other project assessment techniques in relation to tourism.
- Conduct and support research into methods for anticipating the impacts of tourism, as well as reactive problem-solving techniques.
- Improve valuation techniques to ensure that analysis include wider environmental and social aspects.
- Ensure that the results of research and any relevant information are disseminated to the institutions and individuals responsible for tourism decision-making.
- Make the results of research and studies available to local and national authorities, tourism staff and to the general public.
- Carry out studies using local expertise, experience and opinions.

2.3 Definition of Ecotourism Development

Ecotourism Development is process of adjustment and changing tourism resources from old status become new status that suitable with requirement of tourists and local people and sustainable use of tourism resources (11).

Ecotourism Development should follow systematic management for tourism starting with (9);

- The management of tourism resources to accommodate tourists in a sustainable manner based on the physical and ecological carrying capacity of the tourism area.
- The management for sustainable marketing by attracting tourists in numbers that can be easily accommodated and sustain the level of tourist satisfaction gained from the tourism resources and services.
- The management of services to support ecotourism activities and provision of necessary facilities including interpretive programs.
- The sustainability of income generation for local coomunities.

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2.4 Objectives of the Ecotourism Development of TAT (8)

2.4.1 To develop tourism in Thailand to sustainable tourism.

2.4.2 To instill awareness and proper understanding of tourism in the public, so as to gain knowledge and develop a sense of responsibility.

2.4.3 To maintain the quality of tourism areas, as well as the quality of life of the local people.

2.5 Definition of Geographic Information System (GIS)

There are dozens of definitions for the term geographic information system (GIS), each developed from a different perspective or disciplinary origin. Some focus on the map connection, some stress the database or the software tool kit, and others emphasize applications such as decision support (12).

Geographic Information System (GIS) is a system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth (13).

A geographic information system (GIS) consists of computer, software, hardware, and peripherals that transform geographically referenced spatial data into information on the locations, spatial interactions, and geographic relationships of the fixed and dynamic entities that occupy space in the natural and built environments (14).

A geographic information system (GIS) is an organized collection of computer hardware, software, and geographic data designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information (15).

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2.6 Components of GISs (4)

GIS components divided 4 major components:

2.6.1 Data / Information

2.6.1.1 Spatial Data is data, which can be related to specific location on the earth.

- Point: A 0-dimensional object that specifies geometric location specified through a set of coordinates.
- Line: A 1-dimensional object that is a direct line between 2 end points.
- Polygon / Area: A 2-dimensional object bounded by at least three 1-dimensional line segments.

2.6.1.2 Non-spatial Data or Attribute Data is data, which identifies other properties of the object apart from its location.

2.6.2 Hardware

2.6.2.1 Central Processing Units (CPU) carries out program instructions; comprises an arithmetic logic unit (ALU), a control unit (CU) and a memory unit (MU).

2.6.2.2 Disk Drive Storage Unit: The basic storage device of a computer system. The hardware device which transfers data between a disk and main memory.

2.6.2.3 Digitizers are devices that convert analogue data, like data on ordinary maps, into digital data, as used in GIS.

2.6.2.4 Plotters and Printers are output devices. Plotters produce continuous lines. Printers produce characters or text.

2.6.2.5 Visual Display Unit (VDU) controls computer and peripheral.

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2.6.3 Software

GIS software divided into 4 basic groups:

2.6.3.1 Data Input and Verification converts analogue data, like data on ordinary maps, into digital data by using digitizer. Before geographic data can be used in a GIS, the data must be converted into a suitable digital format. The process of converting data from paper maps into computer files is called digitizing. Modern GIS technology can automate this process fully for large projects using scanning technology; smaller jobs may require some manual digitizing (using a digitizing table). Today many types of geographic data already exist in GIS-compatible formats. These data can be obtained from data suppliers and loaded directly into a GIS.

2.6.3.2 Data Storage and Database Management stores geographic information that may be spatial data and non-spatial data (position, topology, and attribute). For small GIS projects it may be sufficient to store geographic information as simple files. However, when data volumes become large and the number of data users becomes more than a few, it is often best to use a database management system (DBMS) to help store, organize, and manage data. DBMS is nothing more than computer software for managing a database. There are many different designs of DBMSs, but in GIS the relational design has been the most useful. In the relational design, data are stored conceptually as a collection of tables. Common fields in different tables are used to link them together. This surprisingly simple design has been so widely used primarily because of its flexibility and very wide deployment in applications both within and without GIS.

2.6.3.3 Data Manipulation represents the whole spectrum of techniques available for the transformation of the digital model by mathematical means. It is likely that data types

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required for a particular GIS project will need to be transformed or manipulated in some way to make them compatible with your system. For example, geographic information is available at different scales (detailed street centerline files; less detailed census boundaries; and postal codes at a regional level). Before this information can be integrated, it must be transformed to the same scale (degree of detail or accuracy). This could be a temporary transformation for display purposes or a permanent one required for analysis. GIS technology offers many tools for manipulating spatial data and for weeding out unnecessary data.

2.6.3.4 Query and Analysis. GIS provides both simple point-and-click query capabilities and sophisticated analysis tools to provide timely information to managers and analysts alike. GIS technology really comes into its own when used to analyze geographic data to look for patterns and trends and to undertake "what if" scenarios. Modern GISs have many powerful analytical tools, but two are especially important.

Proximity Analysis:

How many houses lie within 100 m of this water main? What is the total number of customers within 10 km of this store? What proportion of the alfalfa crop is within 500 m of the well? To answer such questions, GIS technology uses a process called buffering to determine the proximity relationship between features.

Overlay Analysis:

The integration of different data layers involves a process called overlay. At its simplest, this could be a visual operation, but analytical operations require one or more data layers to be joined physically. This overlay, or spatial join, can

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integrate data on soils, slope, and vegetation, or land ownership with tax assessment.

2.6.3.5 Data Output and Presentation involves the export of data from system in computer or human-readable form (e.g. map, table, and graph, etc.). For many types of geographic operation the end result is best visualized as a map or graph. Maps are very efficient at storing and communicating geographic information. While cartographers have created maps for millennia, GIS provides new and exciting tools to extend the art and science of cartography. Map displays can be integrated with reports, three-dimensional views, photographic images, and other output such as multimedia.

2.6.4 Users / People may be classified in 2 groups :

2.6.4.1 Operators who do not use the data themselves but process it for end-users. In many cases, operator tasks may be compared to those of conventional cartographers or file clerks. GIS simplifies operator tasks and makes them more efficient.

2.6.4.2 End Users and Primary Users who make decisions based on GIS products.

2.7 Elements of Aerial Photographs Interpretation

An interpretation is made as to the physical nature of objects appearing in the photos. Success in photo interpretation varies with the training and experience of the interpreter, the nature of the objects being interpreted, and the quality of the photographs being utilized. Most applications consider the following seven basic characteristics or variations of them: shape, size, pattern, shadow, tone, texture, and site (16).

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- **Shape** refers to the general form, configuration, or outline of individual objects. The shape of some objects is so distinctive that their images may be identified solely from this criterion.
- **Size** of objects on photographs must be considered in the context of the photographic scale.
- **Pattern** relates to the spatial arrangement of objects. The repetition of certain general forms or relationships is characteristic of many objects, both natural and constructed, and gives objects a pattern that aids the photo interpreter in recognizing them.
- **Shadows** are important to interpreters in tow opposing respects: (1) the shape or outline of a shadow affords a profile view of objects (which aids interpretation), and (2) objects within shadows reflect little light and are difficult to discern on photographs (which hinders interpretation).
- **Tone** refers to the color or relative brightness of objects on the photographs.
- **Texture** is the frequency of tonal change on the photographic image. Texture is produced by an aggregation of unit features that may be too small to be discerned individually on the photograph, such as tree leaves and leaf shadows. It is a product of their individual shape, size, pattern, shadow, and tone. As the scale of the photograph is reduced, the texture of any given object becomes progressively finer and ultimately disappears.
- **Site** or location of objects in relation to other features can be very helpful in identification.

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2.8 Potential Surface Analysis (PSA)

PSA is a technique for systematically assessing the potential of an area to accommodate a particular type of development or land-use and presenting the findings in an easily understood way which con be manipulated to show the effects of changing assumption and objectives (17).

PSA is a combination of many methods including potential model, Linear equations, Sieved maps and design method.

PSA is as follows: (18)

1) Identification the factors related to the study.
2) Set method of measurement for each factor.
3) Scoring each factor according to the set up criteria.
4) Input scores of each factor into maps.
5) Considering the significant level of each factor to be assigned into the manipulation process (Weighting System).
6) Manipulation of maps.

As far as mathematical procedures of PSA are concerned, the main problem is how best to combine the scores for the factors. Since these factors are usually incommensurable, it is frequently necessary to normalize them. Since most objectives are normally expressed in term of maximizing or minimizing opportunities, scores for each surface are put in the range 0-10 irrespective of their omit of measurement using the following with Equation (2.1)

$$P_{ij}^{*} = \frac{P_{ij} - P_i^{min}}{P_i^{max} - P_i^{min}} * K \qquad \text{----------(2.1)}$$

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Where

Pij = raw sore of factor i in zone j

Pij = normalized score of factor i in zone j

Pi min = minimum or least score of factor i for all zone j

Pi max = maximum of largest score of factor i for all zone j

K = range of scale

The Advantage of PSA method (18) can be summarized as follows:

1) It is used to identify potential in a positive way and to grade the suitability of areas for the form of development concerned, thus enabling location priorities to be established.
2) It allows policy assumptions to be separated from technical considerations and it can be made specific to a particular type of development.
3) It is adaptable in such a way that changed weighting factors or objectives can be incorporated as policy change. With this adaptability, the effects of changing assumptions and values can be easily calculated and seen through simple experimentation.
4) With its versatility, the technique can be used to monitor changes and to economically predict situations about factors that contribute to the surface.
5) It allows the community impacted by planning policies to participate in the initial stages of the planning process by formulating and weighting the objectives.
6) It identifies areas of potential, which need more specific appraisal.
7) It can be use at differing scale of planning for the same area using the technique on the basic of small area units and more detailed objectives and indices.
8) It can be used at either the generation or evaluation stage of the plan-making process.
9) The whole process is a goal oriented one, thus allowing for flexibility in the ranking of objectives.

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However, there are a few limitations of the application of this technique.

1) It requires value to be put on factors where values are elusive.
2) It requires comparative values to be put on factors, which are difficult to compare.
3) A high level in another factor can compensate for the complete absence of a very low value for one factor.
4) All factors are considered to be independent and capable of being substituted one for another.
5) The technique does not take account of the competition for the same piece of land by different activities.
6) The socio-economic factor cannot be either input or mulnipulated properly on maps due to their unit of measurement, which often differ from physical factors. For instance, the momentary system, number of people who use a certain place or economic status of the community cannot be indicated on maps in two dimension. Therefore the PSA Technique has to modify these factors inputting into maps in order to yield the acceptable result.

The main reasons for the selection of PSA to be used in this study are:

1) PSA has been satisfactorily developed and applied in many sub-regional studies.
2) From past experience and by the nature of the technique, PSA has been found suitable for sub-region scale application, which is consistent with the scale of application required in areas adjacent where problem area very challenging.
3) No limitation in incorporating characteristics of factors for study.
4) The data structure setting for each objective can be combined together as information system for the future study.

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2.9 Linear Combination Method

Linear Combination Method is the procedure best suited for suitability analysis. It employs equal or unequal weights of importance to each criterion considered where the final suitability or impact is deduced as weight sum of several factors (19). The types within each factor are rated on separated interval scales. Then, the multiplier (often identified as an importance weight) is assigned to each factor. The ratings for each type are multiplied by the weight for the factor. The suitability rating for a particular region is then the sum of the multiplied rating, or in mathematical terms, the linear combination.

The equation of linear combination is:

$$Rs = \sum_{i=1}^{n} (Wi \times Si) \qquad \text{----------(2.2)}$$

Where:

Rs	=	score of land suitability
Wi	=	weight of the parameters
Si	=	score of the parameters
i	=	number of parameters

The effect of multiplication by the weights is merely to change the unit of measure of the rating on each factor by the ratio of the multipliers so that all of the ratings are on the same interval scale (same value unit).

In GIS application uses the ArcView Software, one of the best operation is to overlay the maps to assess the land suitability. To analyze the suitability of the maps overlaid, one of the methods that can be used is linear combination. According to the equation of linear combination, there are two variables that will be calculated in this equation, these are weight and score. Weight variables, is determined from the calculation of the Analytic Hierarchy Process (AHP), whereas the variables of score values are defined from the level of the suitability criteria.

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The weakness of the linear combination method is that it cannot deal with the situation where the relative suitability for a given land use type in terms of on one factor depends on the type of any of the other factors. Despite its inability to handle the interdependence among the factors, the linear combination approach is still frequently used to generate the land suitability maps (20).

2.10 Relevant Research

Trisurat (21) used ERDAS and ARC/INFO Software for management zone of Phu Rua National Park that agricultural area was attack. The weighting score was initially designed to obtain from questionnaires distributed to experts and people concerned. The land-use / cover map dealt with the technique for using satellite image interpretation associated with aerial photo interpretation acquired in 1982 and by checking ground truth. This research provided five management zones and corrected data for decision and development plan.

Ofren (22) selected land utilization in Nong Luang Watershed, Amphoe Umphang, Tak Province and provided area for agriculture development and conservative area. Planning methodology starts from analyzing the situation and identification of problem. The data for analysis like satellite data, soil, topography, geological material and climate information. It was found out that the causes of soil erosion problem were deforestation. They were recommended for immediate reforestation.

Shrestha (23) studied about the suitability of land for pasture development at Muaklek, Saraburi Province by using GIS. The method employed was based on FAO framework for land evaluation to analyze the suitability both physically and socio–economic. Parameters combined land-use map, topography, and geological map. The findings of the study indicate that on the basis of physical suitability the Muaklek area, which is obviously not suitable for upland cultivation, has only 4.1% area suitable for intensive pasture production.

Indrapidool (24) designed database for tourism which tourists may query for information about tourist attractions in Kanchanaburi Province by using ARC / INFO

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Software and dBASE IV, including Vthai for Thai language queries. It is designed such that tourists can retrieve information through series of menus, the output in maps and texts will be display on the computer monitor of printed on paper. The graphic data disclose locations of 69 tourist attractions, 135 accommodations, 58 restaurants and other tourist's facilities together with governing districts and routes of transportation on maps of Kanchanaburi. The text informs more details for decision of the tourist.

Pumpitakkul (1) used statistical theory and city plan for recommending the development guidelines for Koh Kred (Kred Island), Nonthaburi Province. The study has recommended the future land-use plan. The target of the plan are to conserve the green area, provide the fully supplied of infrastructures to the community, raise the quality of life and encourage Koh Kred (Kred Island) to be the tourist attractions.

Muansudjai (25) applied GIS for land use planning on tourism development of Chang Island, Trat Province. The soil erosion, physical, biological and management factors were analyzed for zoning as development zone, conservation zone and preservation zone by using the overlay technique. The result shows that the area of preservation zone 77.65% that should not use land because rate of soil erosion very high. Conservation zone11.74% that have middle soil erosion then activity should be good managed in this area, and development zone 10.61% that can develop for tourism because rate of soil erosion very low and infrastructure suitable for tourism development.

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CHAPTER III

STUDY AREA

3.1 Historical Background (1)

In the past, Koh Kred (Kred Island) was a land/cape that stretch from Pak Kred Sub-district in Pak Kred District of Nonthaburi Province. The Chao Phraya River flowed to curve of cape then it was named "Ban Lam" (Cape Village). King Thay-Sa of the Ayutthaya Period dig canal for shortcut afterwards then it was named "Klong Lud Kred" (Lud Kred canal). The people used it for agriculture and consumption. But the current changed flowing direction, canal enlarged then Lud Kred canal had changed to "Lud Kred River". Ban Lam had changed to island (surrounded by water). Then it was named "Koh Salakool" (Salakool Island) followed temple's name on island. When Pak Kred District was organized, Salakool Island had changed to Koh Kred Sub-district.

The people have lived in this island since the last Ayutthaya Period. The Mon is the old nationality that prospects over 3,000 years. It has language, literature and various cultures that still preserved and inherited it to the present.

The Mon settled in the North of India and immigrated to Indo-China at the Golden Land, the Western of Erawadee and Salawin basin that Satherm and Hongsawatoi were capital. Raman country established in 725. King Alaungphaya, a Burma leader, drove the Mon out of upper Burma from Ava and regained other lost territories. By 1757 he defeated the Mon and annexed the Mon Kingdom of Hongsawatoi. The Mon has ever since become a people without a country. Then they immigrated to other country and into Thailand in part. They lived peacefully in their newly adopted home and sometimes helped fight Thailand's enemies.

The first, they migrated to Pak Kred District from 1767 to 1782 of King Taksin, the first King of the Chakri dynasty, Rama I. They scattered in Muang

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District in Nonthaburi Province to Samkok District in Pathum Thani Province. The second, they migrated in 1815 of Rama II again and settled at Sao Thong Tong temple to Chim Plee temple (Moo.1,6 and 7).

3.2 Location and Administration

3.2.1 Location

Study area is an island on Chao Phraya River in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province, Thailand. Koh Kred (Kred Island) is situated between 13° 45′ - 14° 15′ N and 100°15′ - 101°45′ E (5). It occupies an area of 4.008 km^2 (2,489 rai) (6), only 2 kilometers from the Amphoe Pak Kred Office. It shares borders with Klong Phra Udom Sub-district (Pak Kred District) to the North in Tha-It Sub-district (Pak Kred District) to the South in Pak Kred Sub-district (Pak Kred District) to the East in Aom Kred Sub-district (Pak Kred District) to the West.

3.2.2 Administration

Koh Kred is a sub-district in Pak Kred District of Nonthaburi Province. It consists of 7 villages: Ban Lud Kred, Ban Salakool Nok, Ban Salakool Nai, Ban Klong Sa Num Aoi, Ban Thanum, Ban Sao Thong Tong and Ban Ong Ang (Figure 3.1).

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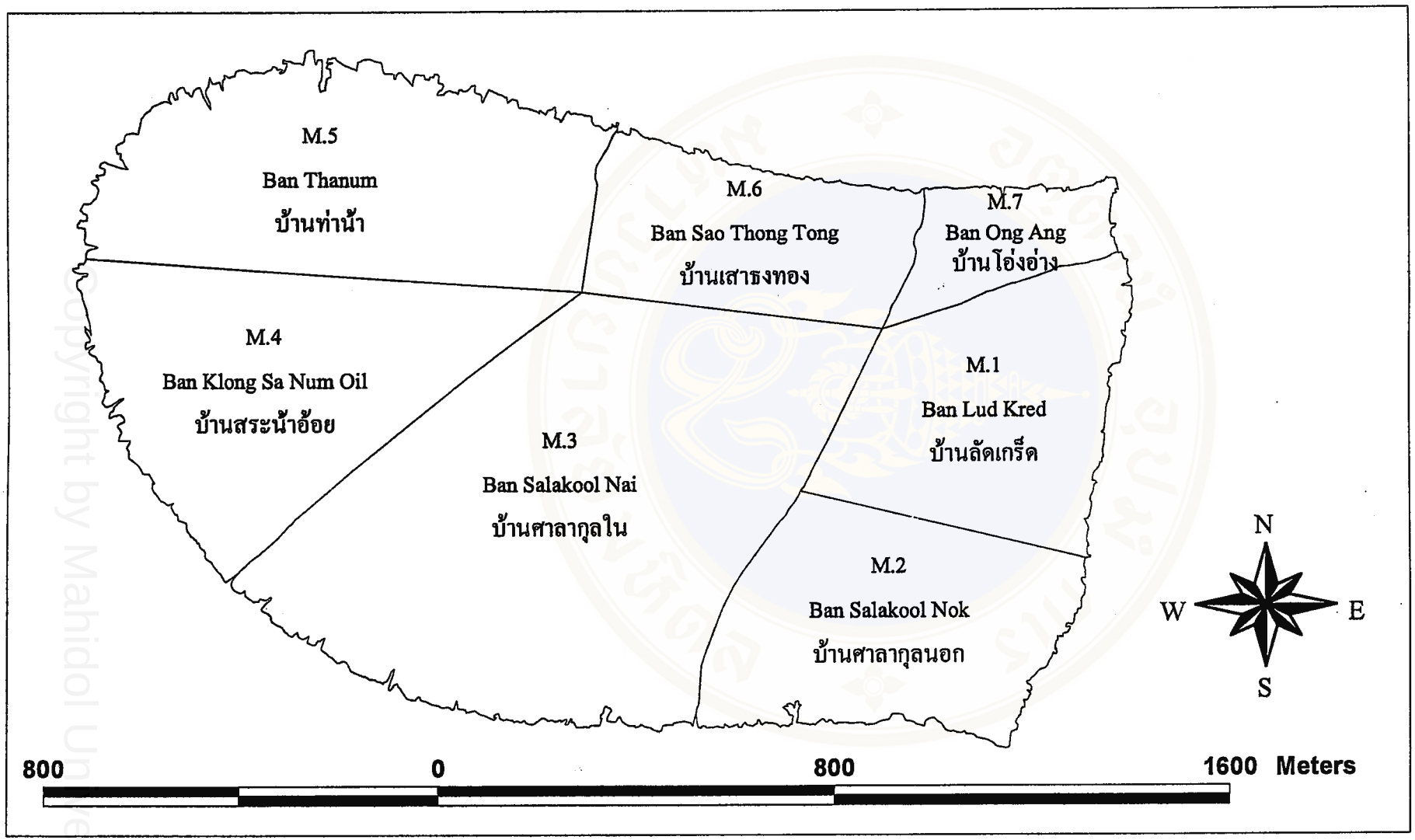

Figure 3.1 Map of administrative boundary in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province

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Table 3.1 Details of administration in Koh Kred Sub-district in Pakkred District of Nonthaburi Province.

Village	Area (rai)	No. of Households (1994)	No. of Households (1996)
M.1 Ban Lud Kred	380	174	198
M.2 Ban Salakool Nok	280	158	220
M.3 Ban Salakool Nai	739	146	167
M.4 Ban Klong Sa Num Aoi	307	98	99
M.5 Ban Thanum	540	205	207
M.6 Ban Sao Thong Tong	53	142	142
M.7 Ban Ong Ang	190	75	81
Total	**2,489**	**998**	**1,114**

Source: Office of the National Economic and Social Development Board, 1999.

3.3 Physical Characteristics

3.3.1 Topography

Koh Kred is surrounded by water (river), the Central Plain then suitable for agriculture that most land are orchard. The central land is plain that has been paddy field. The land is near river, low-lying then flooded from about September to November of every year.

3.3.2 Climate

Koh Kred lies within the humid tropics and remains hot throughout the year.

- **Temperature**

The average temperature is between 25.3-29.5 °c. Temperatures are highest in March and April and lowest in December and January.

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- **Monthly Relative Humidity (%)**

  The average Relative Humidity is about 69%(Minimum = 49% and Maximum = 87%). (Source : Office of the National Economic and Social Development Board, 1999)

- **Annual Rainfall**

  The average Rainfall is about 1333.0 Millimeter/Year (Source: Office of the National Economic and Social Development Board, 1999). The rainy season starts from May to October. Rain dissemination is about 110 mm. That highest rain occurs September.

- **Wind**

  Monthly mean wind speed (knots) and prevailing wind is between 3.9-7.0 knots (Source : Office of the National Economic and Social Development Board, 1999), Calm-Light Breeze. There are northeastern monsoon from November to February and southwest monsoon from May to September. Moreover, there is wind from a sea of South China to the Gulf of Thailand to the South or Southeast from February to April.

3.3.3 Soil Characteristic (26)

The main soil series in Koh Kred are:

3.3.3.1 Bangkok

It is the central of island, bad drainage, high water absorption and very fertile. It suits rice growing but there is a problem about drainage because it is clay and high ground water level that endangers to root.

3.3.3.2 Thonburi

It is up the riverside or plain near river, bad drainage, high water absorption and moderate fertile. It suits for orchard, vegetable-growing.

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3.3.4 Water Resources

The Chao Phraya River in Koh Kred (the Central Chao Phraya River from Muang District of Nonthaburi Province to Muang District of Ayutthaya Province) is the third class water quality for agriculture, consumption but must sterilize it before consume (27).

There are about 16 canals in this island (Figure 3.2):

1) Wat Chim Plee Canal
2) Chom Poo Lai Canal
3) Tayod Canal
4) Wat Salakool Canal
5) Tawang Canal
6) Tachit Canal
7) Thao Dum Canal
8) Tahuai Canal
9) Sa Num Aoi Canal
10) Wat Chan Canal
11) Yaipin Canal
12) Pramong Canal
13) Wat Makamtong Canal
14) Wat Sao Thong Tong
15) Wat Pailoam Canal
16) Wat Poramai Canal

The ground water source is water well at Moo. 6 and 7.

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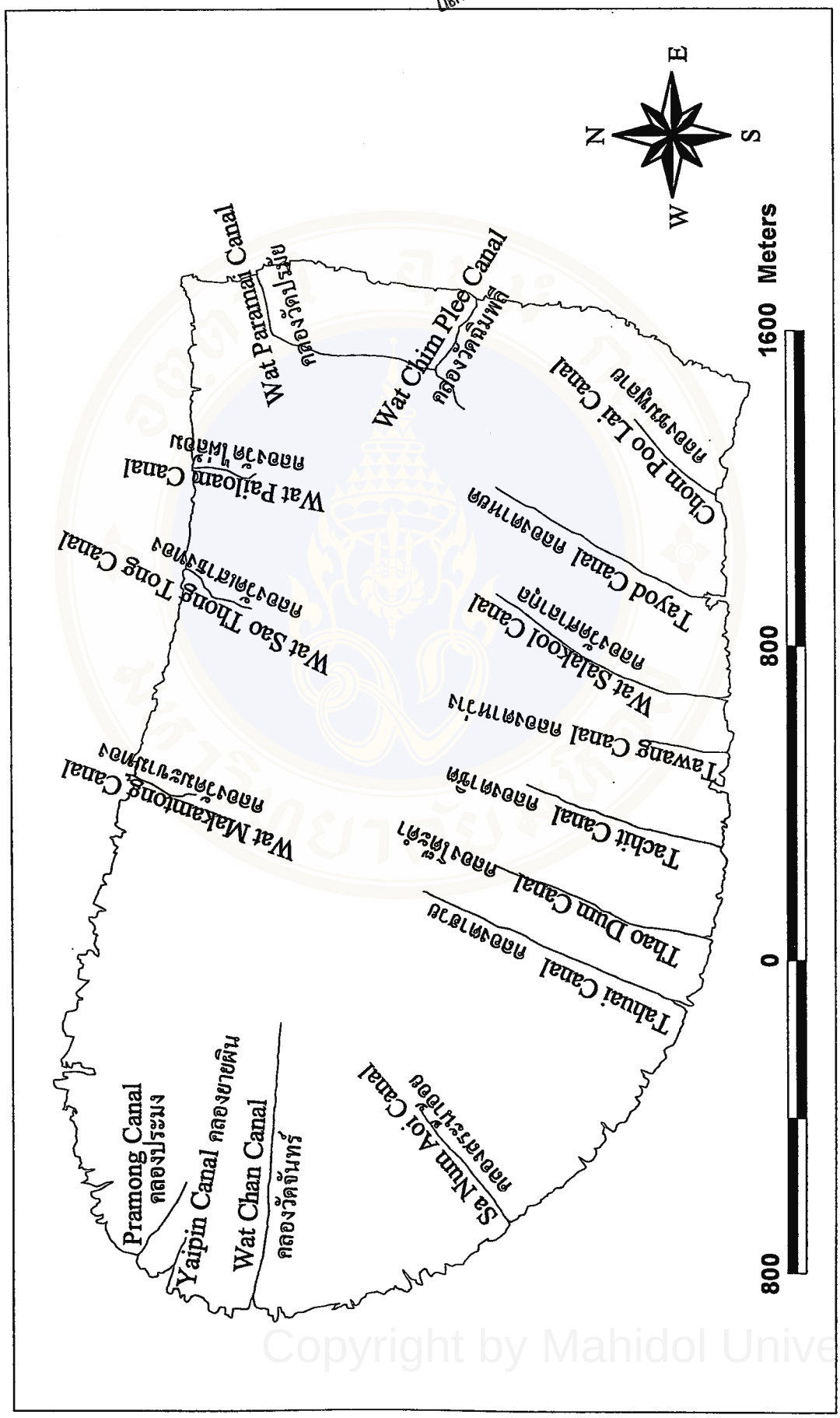

Figure 3.2 Map of canals in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province.

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3.3.5 Communication and Accessibility

This island is accessed by travel to Pak Kred Port (the end of Jangwatthana Road) by bus; No.32, 51, 52, 150, 104, 356, 367, and Airbus; No.5 and 6 or by Chao Phraya Express Boat that destination is Pak Kred Port too. Next, transfer to ferryboat at Sanam Nua Temple or Kang Kred Temple Port or long-tail boat at Pak Kred Port.

You are Travel by foot inside this island. The walkways/paths are about 1.5-3 meters in width, built about in 1977 that paralleled with the Chao Phraya River and very close the riverside in Moo.1, 5, 6 and 7 then the motor car cannot drive except bicycle and motorcycle. Most local people will go to the places on this island by foot.

3.4 Socio-Economic and cultural (1)

3.4.1 Settlement

It is divided in 2 types:

3.4.1.1 The houses were built near the river, walkways around the island and important places; temples, schools and pottery plants. Some houses are food shop, grocery and souvenir shop, etc.

3.4.1.2 The houses have spread cultivated land because most careers are agriculture.

3.4.2 Population

Koh Kred has a population of about 6,063 (Male = 2,923 and Female =3,140). Average of Population Density is 1,513. Persons / sq.km.

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Table 3.2 Male and female population in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province in 1996.

Village	No. of Male Population(persons)	No. of Female Population (persons)
M.1 Ban Lud Kred	528	584
M.2 Ban Salakool Nok	525	588
M.3 Ban Salakool Nai	477	523
M.4 Ban Klong Sa Num Aoi	256	246
M.5 Ban Thanum	525	537
M.6 Ban Sao Thong Tong	452	472
M.7 Ban Ong Ang	160	190
Total	**2,923**	**3,140**

Source: Office of the National Economic and Social Development Board, 1999.

Settlement and nationality divide the population (28):

1) Population about 38.2 % of all number of households is the Mon race at Moo. 1, 6 and 7.
2) Population about 15 % of all number of households is the Muslim at Moo. 4.
3) Population about 61.8 % of all number of households is the Thai race and Chinese at Moo. 2, 3, 4 and 5.

3.4.3 Occupation

3.4.3.1 Agricultural Pursuit

- Planting fruit

Planting fruit is original occupation of the local people. The orchard has spread every village, expect Moo.6 and 7 because those villages were small areas and they produce pottery.

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In 1996, there are 258 households (190 rai) that plant fruit. Income per Household is 45,600 Baht/Year (Table 3.3).

Table 3.3 Number of households and income per household of local people that plant fruit in 1996

Village	Number of Households	Area (Rai)	Income per Household (Baht / Year)
M.1 Ban Lud Kred	9	80	40,000
M.2 Ban Salakool Nok	64	20	50,000
M.3 Ban Salakool Nai	90	30	40,000
M.4 Ban Klong Sa Num Aoi	72	40	50,000
M.5 Ban Thanum	50	20	48,000
Total	**285**	**190**	**228,000**

Source: Office of the National Economic and Social Development Board, 1999.

- Fishery

It is divided in 3 types:

1) Breeding fish in the pond.

Most breeding fish is side occupation that will breed it in the pond or bed of house. There are 13 households, 5 villages and 3,063 m^2 that breed it. Most fish are carp, and catfish.

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Table 3.4 Number of pond fish in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province

Village	No. of Households	Area (m^2)	Number
M.1 Ban Lud Kred	1	400	1,000
M.2 Ban Salakool Nok	3	420	7,200
M.3 Ban Salakool Nai	7	1,733	28,000
M.4 Ban Klong Sa Num Aoi	1	450	5,000
M.7 Ban Ong Ang	1	60	400
Total	**13**	**3,063**	**41,600**

Source : Office of Fishery in Pak Kred District of Nonthaburi Province.

2) Putting the sharp bamboo into the fish.

The fisherman put the sharp bamboo into the fish that near the riverbank that must ask for permission from Office of Fishery in Pak Kred District of Nonthaburi Province.

3) Floating net the central of river.

Float net the central of river by boat that often illegal.

3.4.3.2 Hired Labor

It is divided in 2 types:

- Working into this island.

1) General Labor

- Agricultural Labor: take care of orchard, harvest product, mow the grass, etc. The average income per day is 80 Baht. Most labor is the old mans that the age over 40 years old.
- Navigate (drive boat) in order to transport agricultural product and passenger.

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2) Artisan

- Mould mortars, flowerpots and Mon-Style pottery. Most labor is male that works in pottery industry. They are divided in 2 types:

A. Most artisan are Mon race, original people in this island, the average income 200 Baht / Day. Now, the number of artisan decrease because their descendants do not very look up to make it as they think that it don't have honor and income depend on firing a price of dealers. Some artisan old age.

B. Labors prepare soil and sand for mould pottery. Most labors come from Northeast. They have income about 2,000 Baht / Month.

- Working outside this island.

Most labors, which work outside this island, are employee and someone is government official. In 1992, number of all labor are 4,426 persons, number of labors that work outside this island are 3,499 persons (79.05%).

3.4.3.3 Manufacture Pottery

Manufacture Pottery, namely mortars, flowerpots, Mon-Style pottery (e.g. the ancient pots) that is home industry, inherited from ancestors. In 1992, there are 28 factories that mould flowerpots 16 factories (Table 3.5).

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Table 3.5 Number of pottery factory and income of producer in 1992.

Village	Number of Factory	Income (Baht/Year)
M.1 Ban Lud Kred	10	48,000
M.2 Ban Salakool Nok	1	80,000
M.5 Ban Thanum	2	100,000
M.6 Ban Sao Thong Tong	12	120,000
M.7 Ban Ong Ang	3	100,000
Total	**28**	**448,000**

Source: Office of Community Development in Pak Kred District of Nonthaburi Province.

Table 3.6 Type of products in pottery industry in 1992

Village	Type of Products			
	Mortar	Flowerpot	Mon-Style Pottery	Mix
M.1 Ban Lud Kred	0	4	0	1
M.2 Ban Salakool Nok	0	1	0	0
M.5 Ban Thanum	0	2	0	0
M.6 Ban Sao Thong Tong	1	6	3	2
M.7 Ban Ong Ang	1	2	0	0
Total	**2**	**15**	**3**	**3**

Source: Office of Community Development in Pak Kred District of Nonthaburi Province.

3.4.3.4 Sale

Sell food, groceries and souvenirs into their house that spread to walkway around this island.

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3.4.4 Education

Education Levels of people are elementary, lower secondary, upper secondary and higher education (Table3.7).

Table 3.7 Number of people that have finished elementary, lower secondary, upper secondary and higher education

Village	Elementary	Lower Secondary	Upper Secondary	Higher Education
M.1 Ban Lud Kred	797	132	147	130
M.2 Ban Salakool Nok	766	194	137	62
M.3 Ban Salakool Nai	735	94	72	27
M.4 Ban Klong Sa Num Aoi	279	118	49	24
M.5 Ban Thanum	745	113	102	98
M.6 Ban Sao Thong Tong	671	116	122	102
M.7 Ban Ong Ang	270	38	74	27
Total	**4,263**	**805**	**703**	**470**

Source: Office of the National Economic and Social Development Board, 1999.

There are 3 elementary schools as follow (Figure 3.3):

1) Wat Poramai Yikawat School at Moo. 7. There are 18 teachers, 230 students.
2) Wat Sao Thong Tong School at Moo. 6. There are 13 teachers, 138 students.
3) Wat Salakool School at Moo. 3. There are 9 teachers, 72 students.

The school for baby (3-6 years old) is Baby Development Center of Rural Development Department, Ministry of Interior at Moo.7. There are 2 teachers and 35 students.

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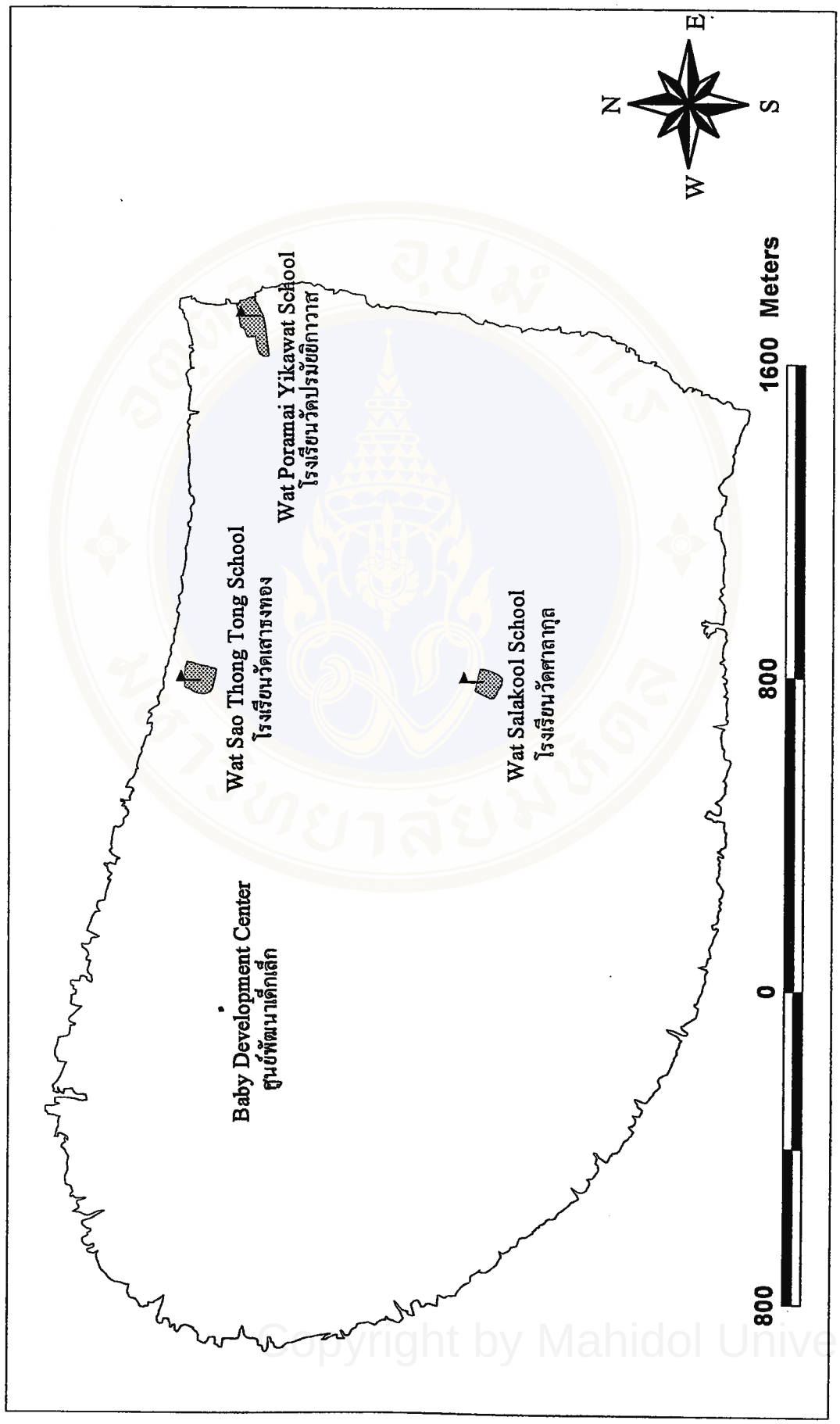

Figure 3.3 Map of schools in Koh Kred Sub-district in Pak Kred Kestrict of Nonthaburi Province

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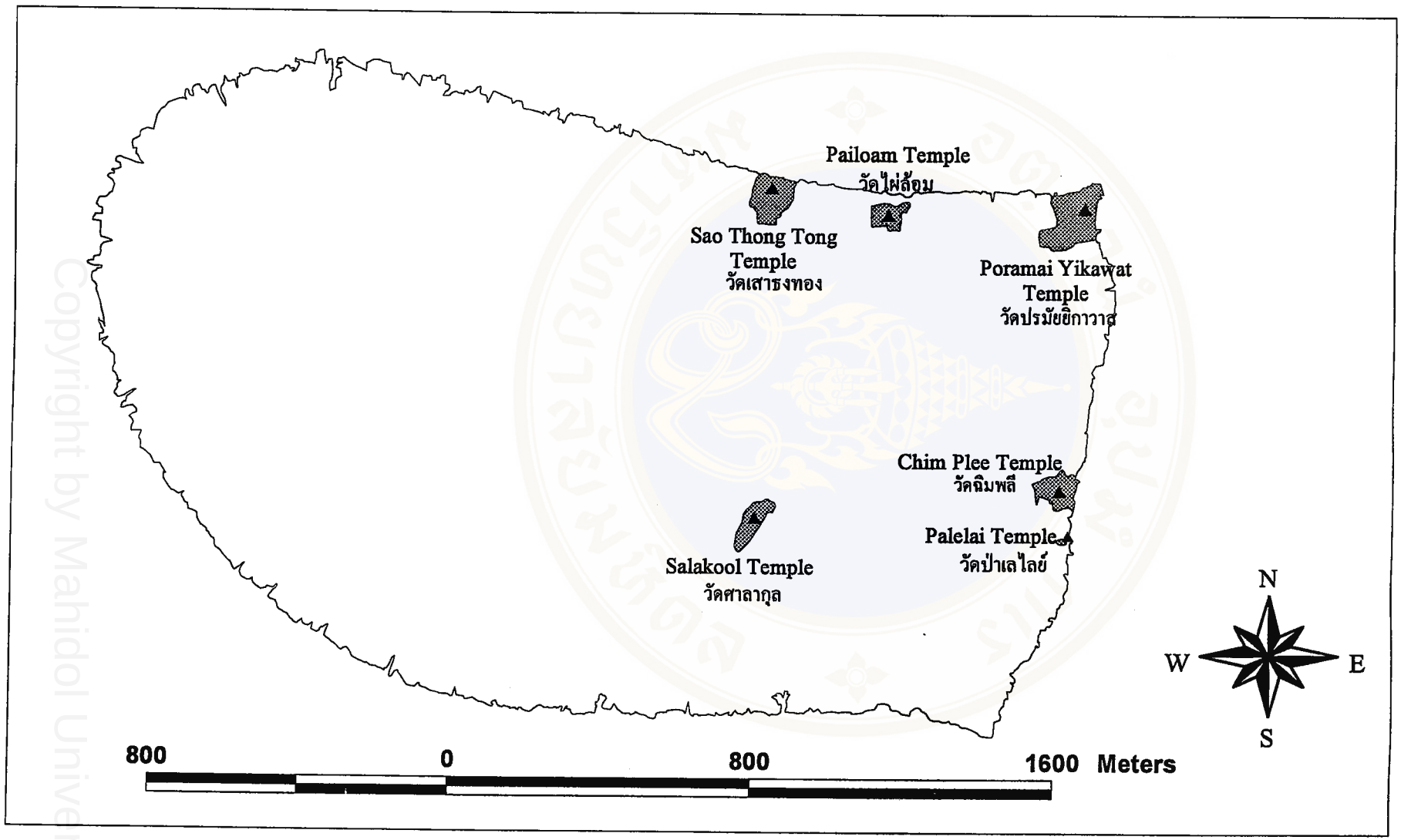

Figure 3.4 Map of temples in Koh Kred Sub-district in Pakkred District of Nonthaburi Province

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3.4.5 Religion

Population about 97 % are Buddhists, while about 3 % are Muslims (Moo.4).

All temples were built in the end of the Ayutthaya period and mostly renovated in the Ratanakosin era. There are 6 temples as follow (Figure 3.4):

1) Poramai Yikawat Temple is located at Moo.7.
2) Pailoam Temple is located at Moo.6.
3) Sao Thong Tong Temple is located at Moo.6.
4) Chim Plee Temple is located at Moo.1.
5) Palelai Temple is located at Moo.1. Now, it is deserted monastery and combined with Chimplee Temple.
6) Salakool Temple is located at Moo.3.

3.4.6 Culture and Tradition

3.4.6.1 Songkran Tradition

The Songkran Festival of Koh Kred begins on April 13 and ends on the early May. The first tree days are devoted to religious rites and a merit-making ceremony called "Hoong Khao Chae". The rite is considered the highest form of worship. Each household selects the best rice for "khao chae" which is given as alms to monks. The rice is brushed and rinsed seven times before being drained. As Mon people believe the rice must be totally pure, none of the cooking is done under the roof of a house where people live. The rice and other food are cooked in an open door in front of the house. Five dishes of food to accompany the rice are prepared. They are fried noodles, fried preserved turnips with eggs, dried fish fried with sugar, salted eggs and salted meat boiled in coconut milk. *Khao Chae* is believed to bring good luck and prosperity.

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The religious rites are carried out in the same manner for four days. Each household can choose a day convenient for them. The last three days, the youngsters pay respect to the elderly and sprinkle lustral water. After that everyone joins in various folk performances.

Some participate in "*Tayae Mon*" which is similar to Thai's *pleng rua*, where men and women play a courtship game using songs. The only difference is the language used.

For the Mon, the Songkran Festival serves as a family reunion. Descendants who live or work far away from home return to pay repect to the elderly. The ceremony is usually carried out in the space under the house. Scented water in sprinkled by the young over the hands of the elderly who in turn give them blessing. After the ceremony is over they talk in leisurely fashion. In this way the Non maintain their strong family ties.

The whole family then goes to the temple with a bowl of lustral water and flags made from paper and visit the Pagoda housing their a castor's relics. Every year at this time the *Pagoda* is cleaned repainted and wrapped with a piece of cloth. They pray, sprinkle the scented water and decorate the Pagoda with flags to show their respect.

3.4.6.2 End of the Buddha Lent Tradition of Mon People

Mon people are strict Buddhists and believe in a religion very much. Then they arrange great end of the Buddha Lent, annual festival. They will stir Krayasart (Sart Festival's sweetmeats), brew flour of Khanomgene (Thai vermicelli eaten with peppery curry), decorate and clean house and temple. The Pagoda is wrapped with a piece of red cloth.

The end of Buddha Lent Tradition stars on the 15th day of the waxing moon of the 11th lunar month (November)

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and ends on the first day of the waxing moon of the 11th lunar month. They will give alms, cover with gold leaf and prostrate oneself before the Buddha by rotation 1 temple per day. After they gave alms in the morning, they will arrange food tray to the temple to give to the monks. After the monks ate food, they will go to Ubosot (Buddhist sabbath). The local people will give joss stick to them.

3.4.6.3 Chao-Khao Song

Chao-Khao is native song of Mon people in order to invite people give alms together, particularly in perform the ceremony of presenting yellow robes to the Buddhist monks at the end of the Buddhist Lent. They will invite by boat and singing.

3.4.6.4 Mon Dance (Figure 3.5)

It is an ancient dramatic art of Mon people in joyous occasion, celebration ceremony as well as funeral arrangement of monk. They will prevail dancing in front of corpse because boundless beneficence. In funeral arrangement, the head of a family will dance too.

3.4.6.5 String Running Rocket Lighting Tradition (Figure 3.6)

It is lighted with fireworks in funeral arrangement of Mon monk.

3.5 Public Health Service

There are 2 health stations at Salakool Temple and Moo.5 (Makamtong Temple) (Figure 3.7).

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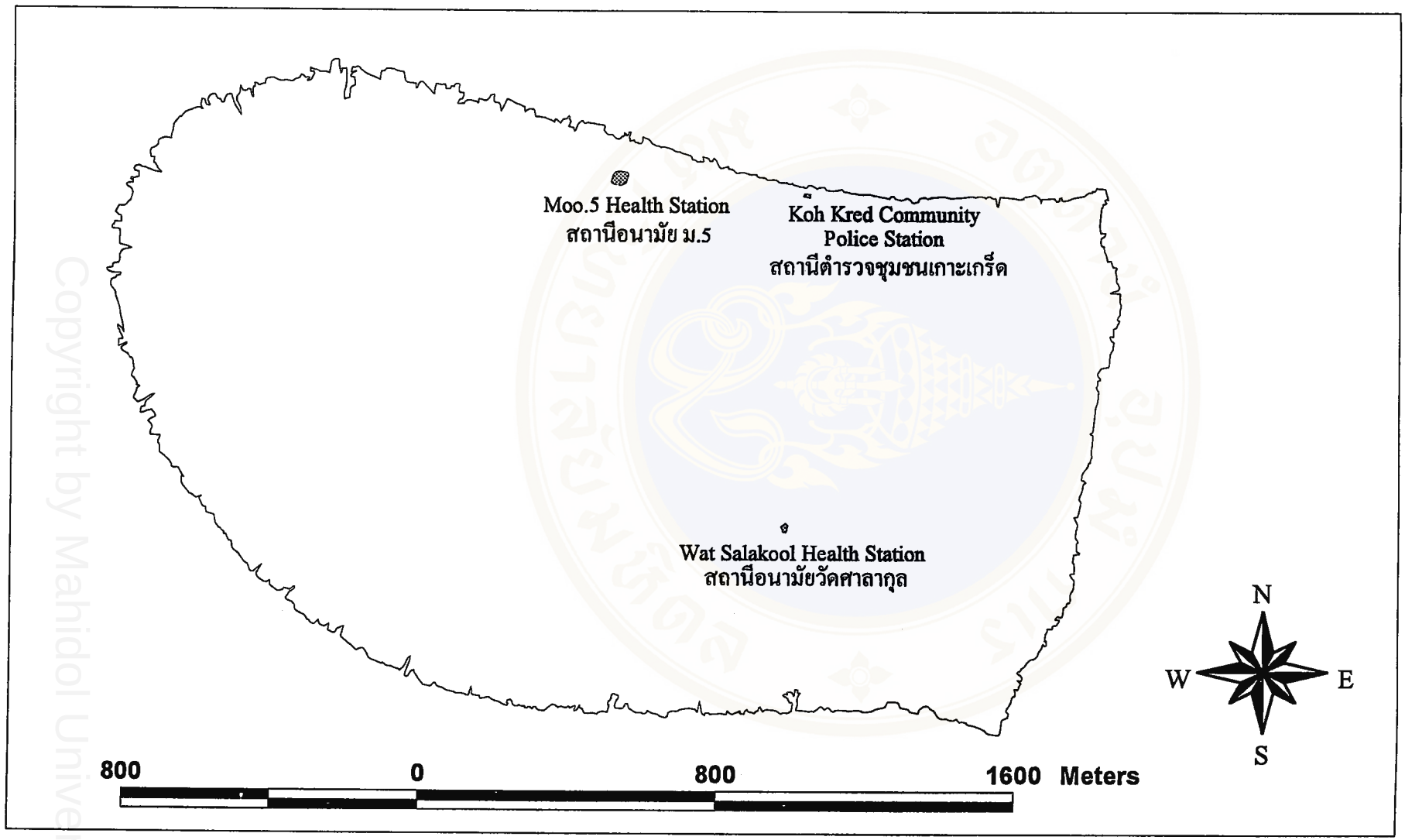

Figure 3.7 Map of health stations and police station in Koh Kred Sub-district in Pakkred District of Nonthaburi Province

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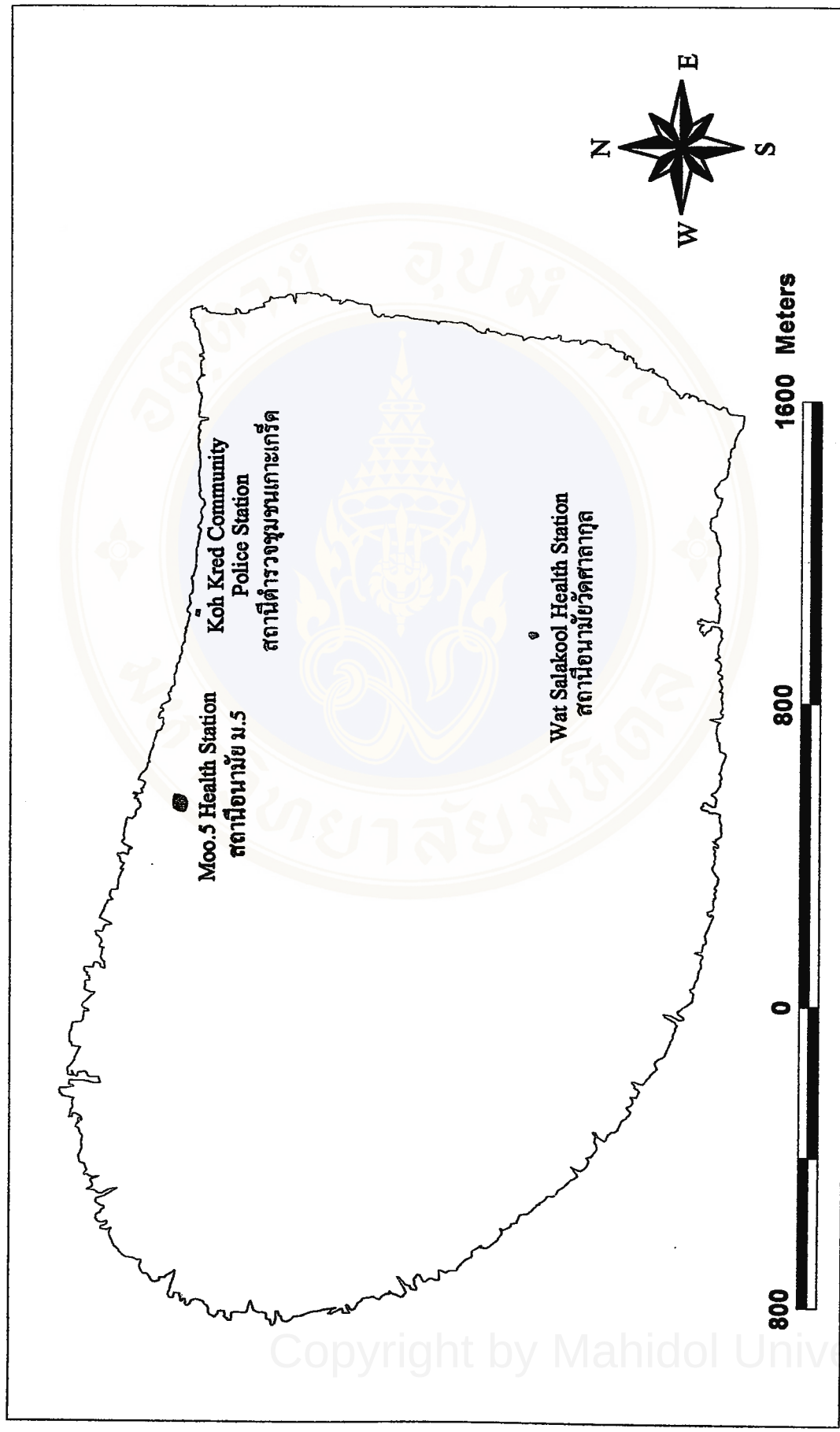

Figure 3.7 Map of health stations and police station in Koh Kred Sub-district in Pakkred District of Nonthaburi Province.

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3.6 Security

There is 1 police station at Sao Thong Tong Temple (Figure 3.7).

3.7 Infrastructure Facilities

3.7.1 Power Supply

This island is in service area of The Metropolitan Electricity Authority. All households have power supply now.

3.7.2 Water Supply

In the past, they pumped water from Chao Phraya River for consumption. Now, there are 2 groundwater because have a large population and Chao Phraya River decayed.

3.7.3 Communication

This island has telephone since 1989.

3.8 Property in land and Land-use

3.8.1 Property in land

Property in land is divided in 3 types as follow (28):

3.8.1.1 About 740 households have lands belong to them.

3.8.1.2 About 90 households have some lands belong to them and rent some lands for making a living.

3.8.1.3 About 160 households rent lands because they don't have it belong to them. Most tenants are original people in this island. They sold land inheritance or poor when they can't make a living other places. Then they return to this island.

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3.8.2 Land use

Land use (1) is divided in 9 types as follows (Figure 3.8):

3.8.2.1 Residential areas are about 0.24 km^2 (23.937 Hectares) or 6.52%.

3.8.2.2 Agricultural areas are about 2.74 km^2 (273.840 Hectares) or 74.54%. Some trees such as mangoes, durians, bananas, pomeloes, coconuts, jambu and betel palm.

3.8.2.3 Industrial areas are about 0.08 km^2 (7.972 Hectares) or 2.17%. Products are mortars, flowerpots and Mon Style pottery.

3.8.2.4 Commercial areas are not obvious because its are only small shops in their house that sell food, groceries, and souvenir about 45 shops.

3.8.2.5 Institutional lands are about 0.024 km^2 (2.429 Hectares) or 0.66%such as health station, Ban Kred Trakarn, Police Gooth and Office of Koh Kred Sub-district Administrative Organization.

3.8.2.6 Schools are about 0.016 km^2 (1.560 Hectares) or 0.42%.

3.8.2.7 Temples are about 0.051 km^2 (5.099 Hectares) or 1.39%.

3.8.2.8 Uncultivated lands are about 0.464 km^2 (46.42 Hectares) or 12.64%.

3.8.2.9 Other lands are about 0.061 km^2 (6.10 Hectares) or 1.66%.

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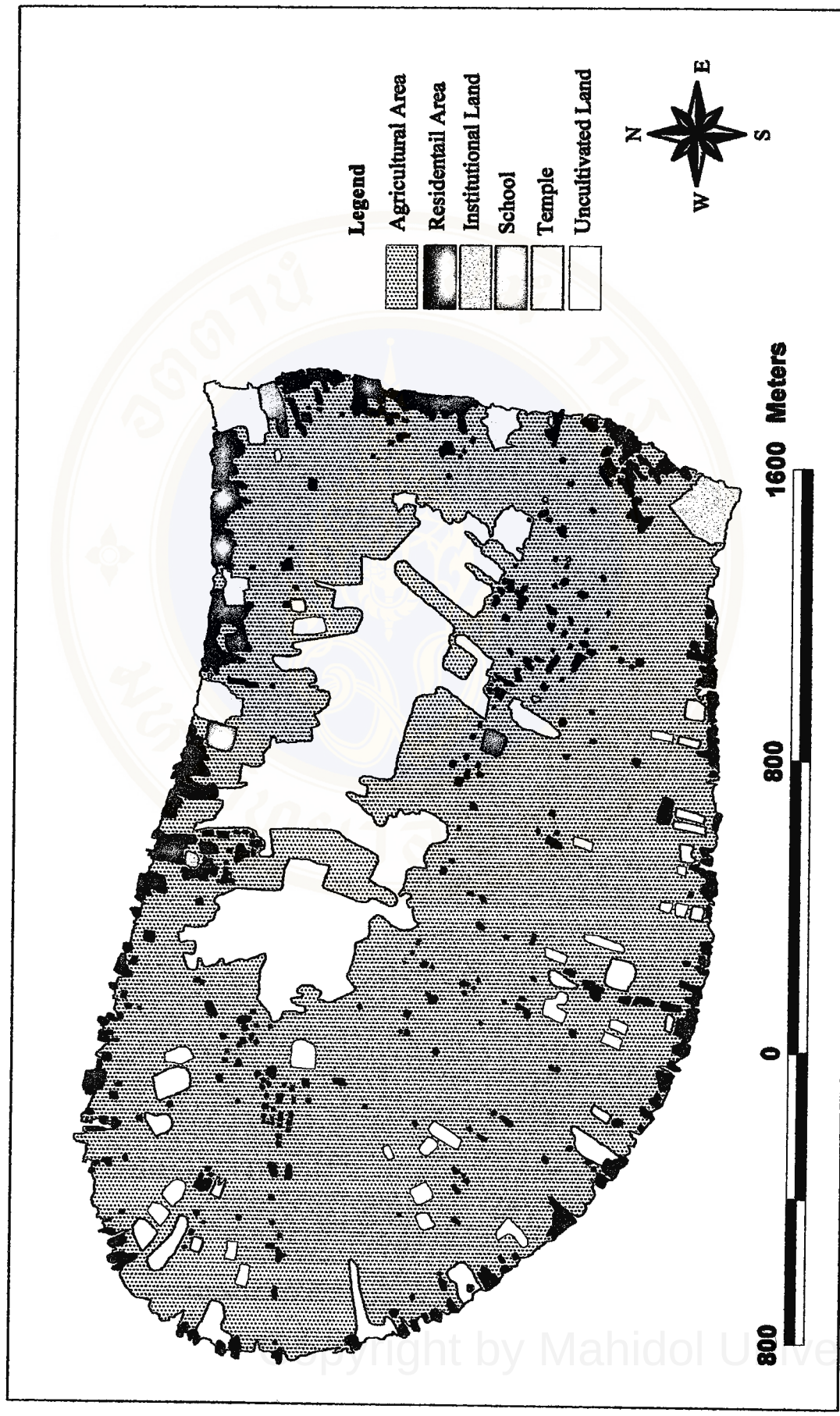

Figure 3.8 Map of land use in Koh Kred Sub-district in Pakkred District of Nonthaburi Province.

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3.9 Tourist Attractions (Figure 3.9)

3.9.1 Poramai Yikawat Temple

It was built in the Ayutthaya period and renovated in the reigns of King Rama IV of the Ratanakosin era that graciously confer temple's name "Poramai Yikawat" in stead of "Pak Auo".

It is one of ancient temple of Mon people, over 200 years old. Sacred objects that were built in the Ayutthaya period such as sleeping Buddha, pulpit, movable pavilion with pointed roof and Raman Pagoda (Figure 3.10) that Mon people copied from Shawedagon Pagoda in Burma. Raman Pagoda is located at riverside, the North of Temple.

Sacred objects that were built in the reigns of King Rama V such as Buddhist Sabbath (Ubosot) (Figure 3.12) that has mural painting, principal Buddha image sitting cross-legged with it right hand on the lap. Great Raman Pagoda (Figure 3.11) is at the back of Ubosot, copied from Mutal Pagoda in Burma in order to contain relics of Buddha.

In addition, Mon Language Tripitaka (Three Baskets) is preserved in the temple's museum, only 1 set in Thailand. Buddha image of Nonthaburi Province and biggest water jar are in this temple too.

3.9.2 Pailoam Temple (Figure 3.13)

The beautiful Ubosot was built in the Ayutthaya period that has flower carven pattern of garble, sustained stand and the head of a pillar lotus that were repaired and renovated in part. The Mon Style Pagoda is at the back of Ubosot. The 2 medium Mon style pagodas are in front of Ubosot. Its have strange shape, square base and 12 angles.

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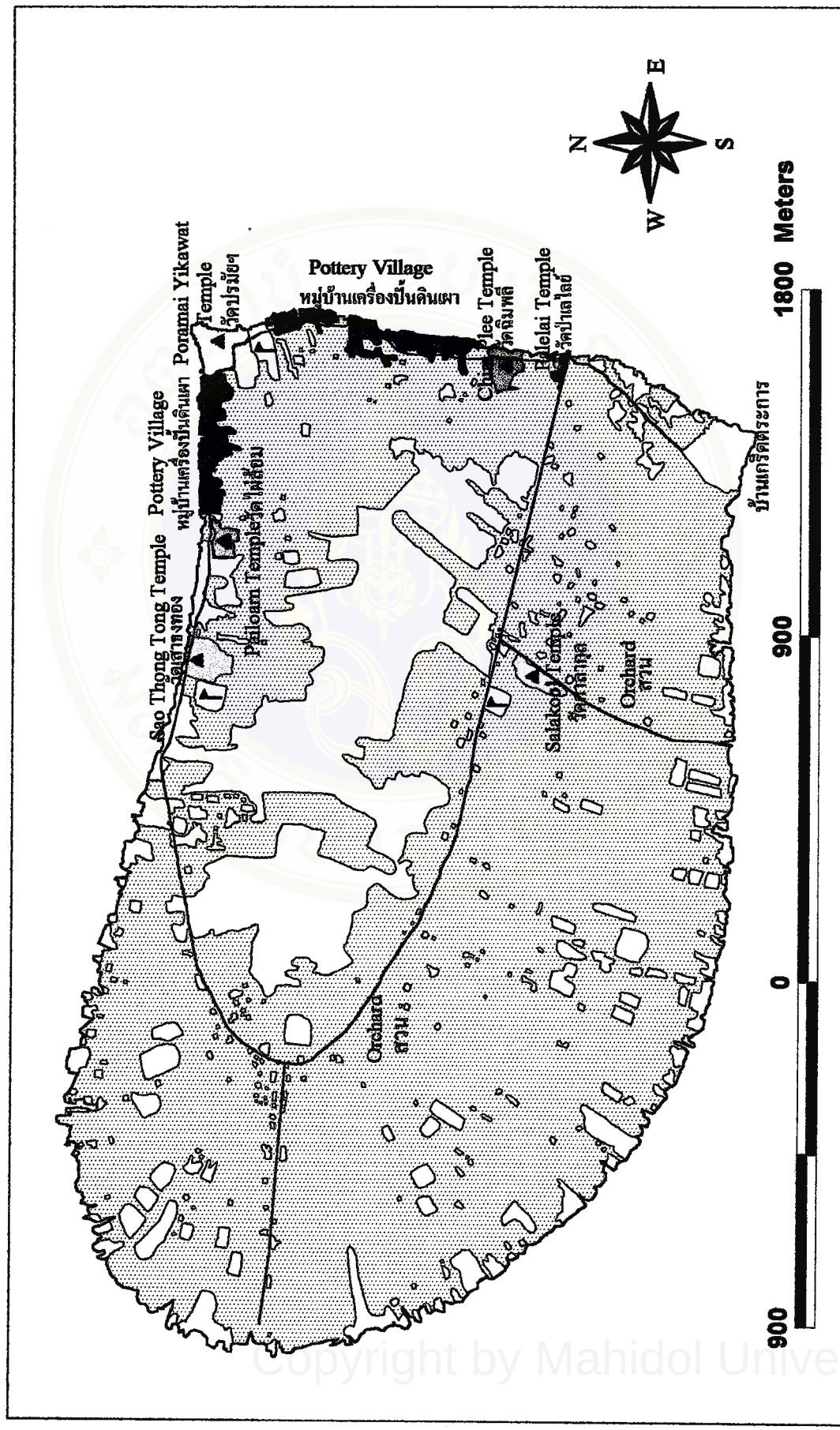

Figure 3.9 Map of tourist attractions in Koh Kred Sub-district in Pakkred District of Nonthaburi Province

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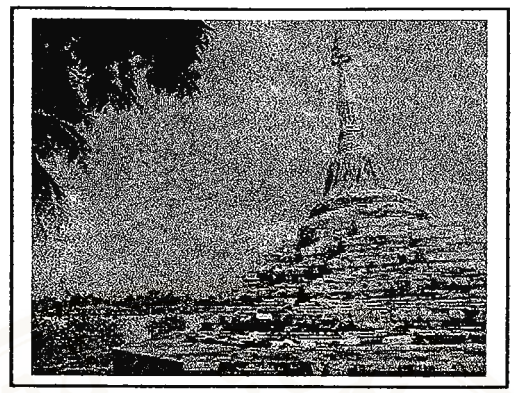

Figure 3.10 Raman Pagoda of Poramai Yikawat Temple

Figure 3.11 Great Raman Pagoda of Poramai Yikawat Temple

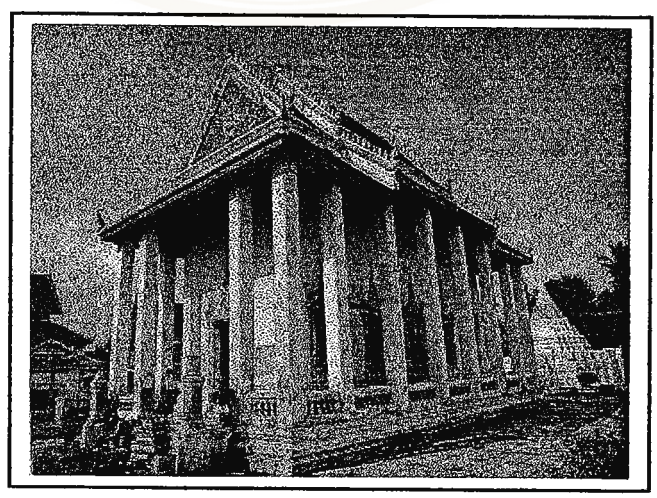

Figure 3.12 Buddhist Sabbath (Ubosot) of Poramai Yikawat Temple

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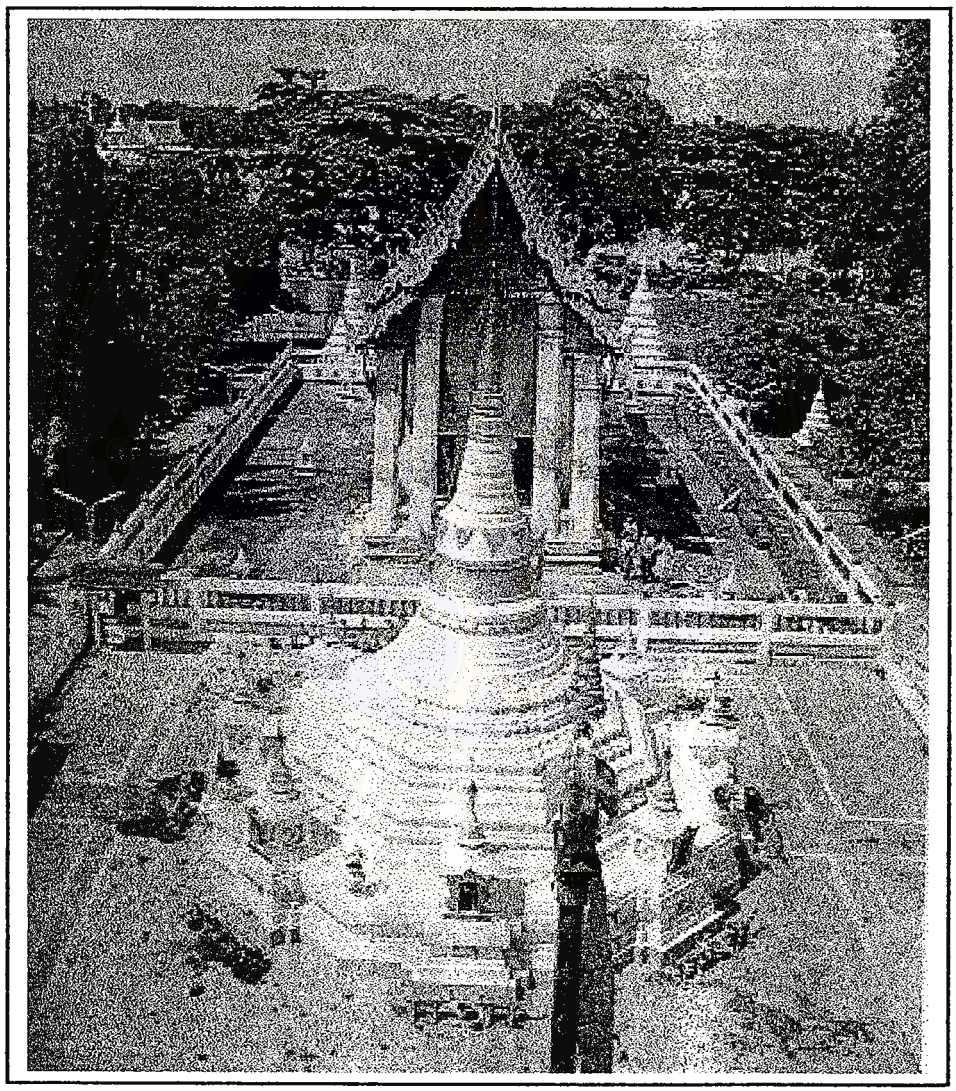

Figure 3.13 Pailoam Temple

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3.9.3 Sao Thong Tong Temple

The old name's temple is "Suan Mak". The biggest pagoda of Pak Kred District is at the back of Ubosot that has 12 angles. The 2 great pagodas are side of Ubosot: round bell shape and strange shape . Ubosot was repaired until it was not original, especially arched door (Figure 3.14) and window. The ceiling design inside of the Ubosot is made of the gold with conical designs the edge that it is very beautiful. The chapel and monk's cells are made of wood that scrollwork in Mon Temple Style. Moreover, there are beautiful mural paintings (Figure 3.15), windows and door of temple that lacquer with China doorkeeper. The first secondary school of Pak Kred District ever been located this temple in 1904. The first school building was built in 1908 that it is public library now. Higest Dipterocarpus turbinatus of Nonthaburi Province (Figure 3.16) are in this temple.

3.9.4 Chim Plee Temple

It was built in the Ayutthaya period and renovated in the reigns of King Rama III. The old name of temple is "Pa Fay". The historic spots inside of this temple have an influence from China. There are beautiful small Ubosot (Figure 3.17) that base bend like junk, flower carven pattern of garble, arched door, and arched window. This Ubosot is still original condition. There is a big pagoda (Figure 3.18) in the North of Ubosot that has strange shape and 12 angles. It is surround by 4 small pagodas and decorated with color glass. All pagodas are on square base. There are 2 big China dolls (doorkeeper), big stone pillar and ancient tree in this temple.

3.9.5 Palelai Temple

Now, it is deserted monastery and combined with Chimplee Temple. There are one Ubosot (Figure 3.19) and two pagodas (Figure 3.20). The ceiling and door design of Ubosot were made of the gold that disappears now.

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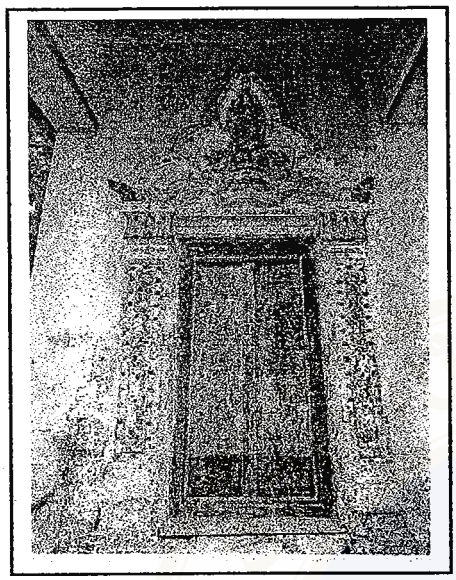

Figure 3.14 Arched door of Ubosot of Sao Thong Tong Temple

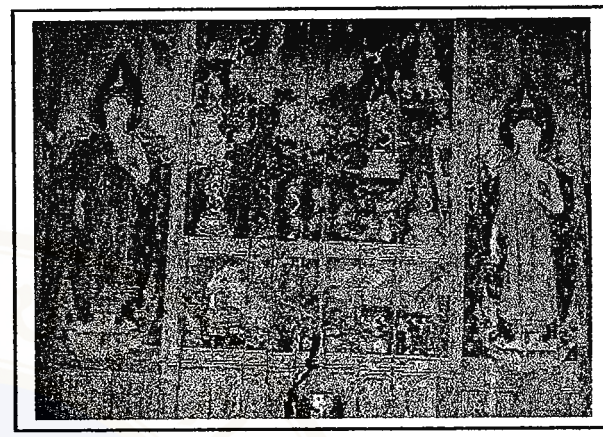

Figure 3.15 Mural paintings of Ubosot of Sao Thong Tong Temple

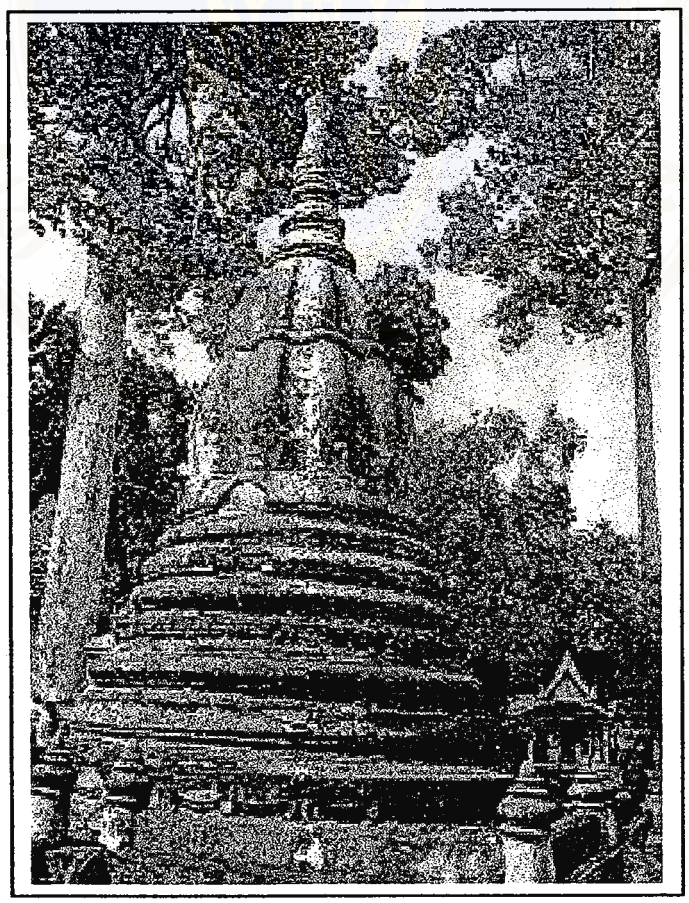

Figure 3.16 Great pagoda of Sao Thong Tong Temple and higest Dipterocarpus turbinatus of Nonthaburi Province

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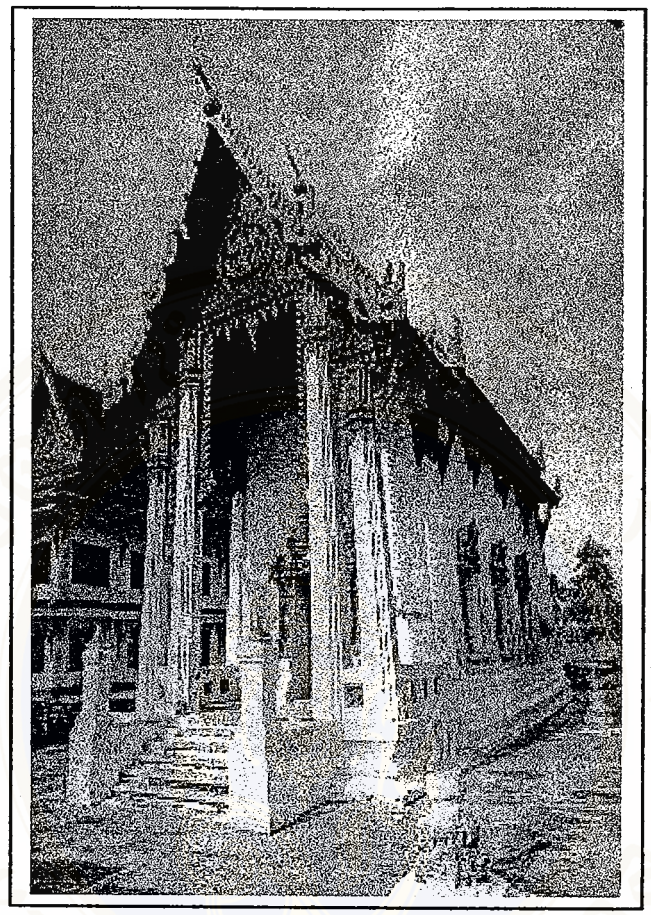

Figure 3.17 Ubosot of Chim Plee Temple

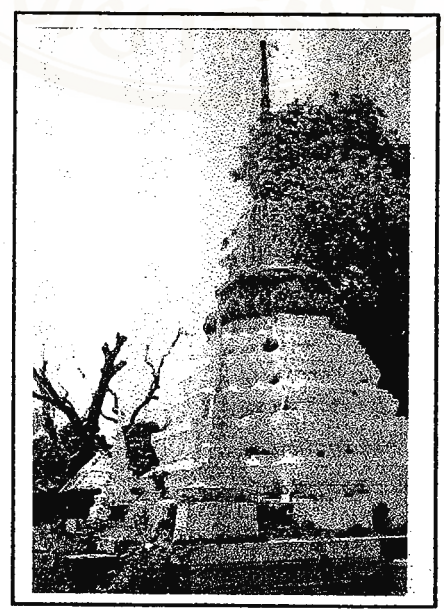

Figure 3.18 Pagoda of Chim Plee Temple

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Figure 3.19 Ubosot of Palelai Temple

Figure 3.20 Pagoda of Palelai Temple

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3.9.6 Salakool Temple (Figure 3.21)

It was an old temple. But all buildings are modern now. There is a big pearl altar-table, glassware and pearl coffin in this temple.

3.9.7 Pottery Village

It is located on the left and right side of Poramai Yikawat Temple at Moo.1 and 7. It is biggest and oldest pottery production source of Nonthabuuri Province.

- Koh Kred Cultural Center (Figure 3.22)

  It is called "Kwan Aman Pottery Center" that located the left side of Poramai Yikawat Temple, about 100 meters from this temple. It is a place that showing ancient Mon style pottery and moulding method. Moreover, tourists can purchase artistic pottery.

- Pod Moon House

  Some ancient Mon style pottery is collected here. The tourists can purchase artistic pottery, visit pottery production procedure and ancient kiln that not use.

- Mortar House (Figure 3.23)

  The tourists can purchase cheap mortar and visit mortar production procedure. Moreover, there is artistic pottery too.

- Flowerpot House

  It is big flowerpot house that produces only flowerpot. The tourists can visit flowerpot production procedure.

- Pot House

  It produces various pottery, normal and artistic pattern. The tourists can purchase anything and visit production procedure.

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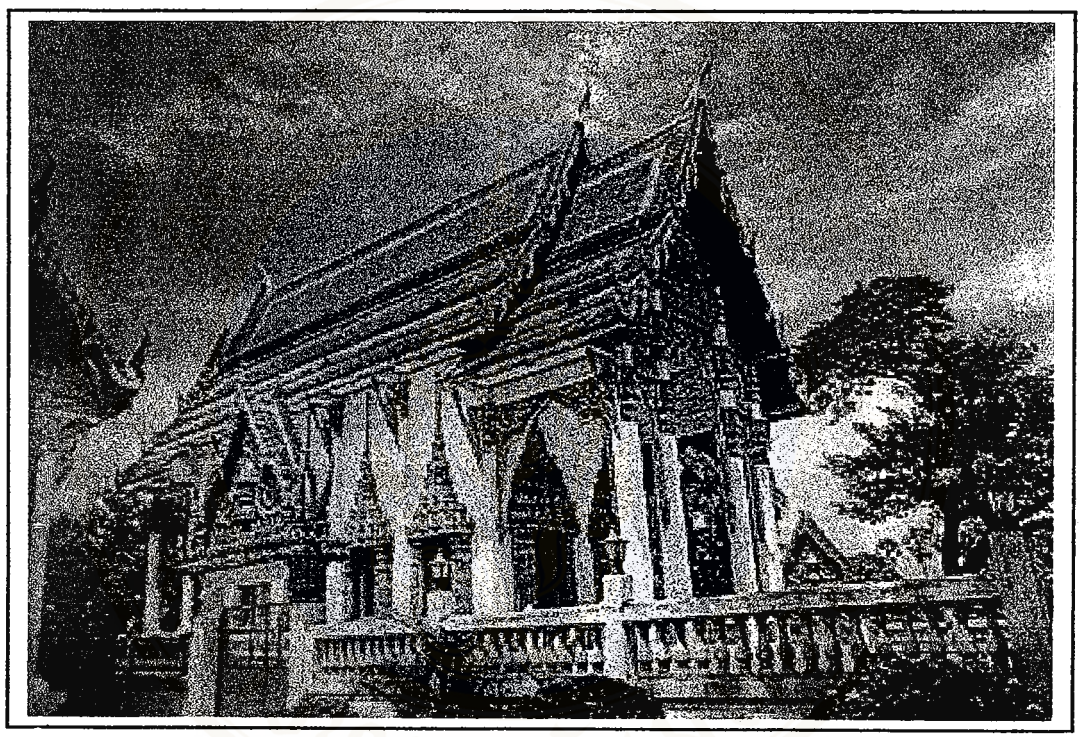

Figure 3.21 Salakool Temple

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Figure 3.22 Koh Kred Cultural Center (Kwan Aman Pottery Center)

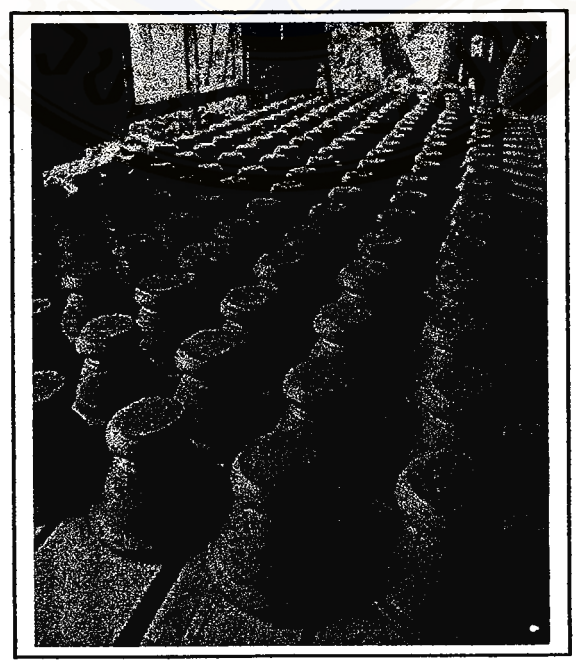

Figure 3.23 Mortar House

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3.9.8 Orchard (Figure 3.24)

Most area of Koh Kred is orchard because original occupation of local people is agriculture. In the past, there are many durian fields on this island. But there are few now because flooding in 1995. Then they grow other plants such as bananas, mangoes and coconuts. So this island is covered with green vegetation, suit for tour and entertainment.

Figure 3.24 Orchard

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CHAPTER IV

METHODOLOGY

4.1 Data Collection

This study used spatial data and non-spatial data that were collected from 2 sorts of data as follows:

1) Primary data from field: interview, questionnaires, and observation.
2) Secondary data: documents / reports, maps, aerial photographs.

Data used:

Data	Data Sources
1. Location and Topography	- Topographic Map Scale 1:50,000 from Ordnance Survey Department
2. Land-use	- Aerial Photographs, 1995 scale 1:20,000 - Department of Land Development
3. Socio-Economics (village basic data)	- Office of the National Economic and Social Development Commission - Institute for Research and Development (Thammasat University)
4. Administrative Boundaries / Villages	- Administrative Boundaries Map from Department of Provincial Administration
5. Infrastructure (electricity, tap water, and telephone)	- The Koh Kred Sub-district Administrative Organization
6. Communication/Transportation	- Harbor Department

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4.2 Factors Identification

Potential area is value and importance of area in various fields. It can attract tourist's attention, make appreciate and satisfy the needs of the tourist that will study and find experiences from natural and culture area without causing a negative impact. Moreover, it makes economic chance, positive conservation of tourism resource and benefit of local people.

Potential area is considered from facilities, attract tourist's attention, and accessibility. It will be divided in 2 groups that have different analysis method. Because facilities characteristic are specific that can make spatial data. But attract tourist's attention and accessibility characteristic is abstract then this study use questionnaire for analysis.

4.2.1 The potential evaluation of tourism facilities area

Facilities are basic service places or buildings that is essential to tourism. Moreover, public utility systems that tourists can use it are facilities too (29).

Potential of tourism facilities area will be considered from important, convenience, nearness and far of each facility. This study defines factors of potential evaluation of tourism facilities area as follows:

4.2.1.1 Roads/Paths

The roads/paths on Koh Kred are only narrow sidewalk (can not drive car on it) but it has an influence over spread of residence and service, give facilities with tourist. They can tour by foot or bicycle.

4.2.1.2 Canals

The canals have very important with living of local people because the major transportation is the boat. The tourist can tour by foot and boat.

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4.2.1.3 Ports

Koh Kred can be accessed by only boat then the ports are important for travel and give facilities for tourist.

4.2.1.4 Public Telephones

Public Telephones have an influence over spread of residence and service and give facilities with tourist.

4.2.1.5 Institutional Land

Institutional land is place for service and give facilities with tourist; information, initial medical treatment when they get injured or meet with an accident.

4.2.2 The potential evaluation of ecotourism area

Factors for potential evaluation of ecotourism area are considered from physical and social setting of each tourist attractions. Each factors of such a place have high or low important and prominence. Factors for evaluation as follows:

4.2.2.1 History and archaeology

It is considered from value and importance of history and archaeology of tourism area.

4.2.2.2 Art

It is considered from decorative art of historic sites or building that tourism will be fine scenery and impressed by it.

4.2.2.3 Culture and custom of community

It is considered from original community, cultural or custom place, and center for pottery.

4.2.2.4 Naturalness

Evaluate the overall environmental condition of the tourism area consideration should be given to the degree of modification or change in the original natural state of the area.

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4.2.2.5 Scenery / Landscape

It is considered in terms of how attractive it is to look or view of a place as you see it.

4.2.2.6 Accessibility

It is considered from routes that tourist will access to tourism area, difficult or easy in access it and security of tourist.

4.3 Aerial Photographs Interpretation

Interpret aerial photographs, 1995 scale 1:20,000 with visual interpretation technique. (Aerial photograph is picture of topography obtained by using a camera and film that is sensitive to light.). This study used black and white aerial photography because it is cheaper than color aerial photography. Boundary for area classification is considered from different tone of grays (Gray-scale intensity value). Details of pictures or pixels define size and shape of area on it. Digital numbers of pixel are 0-255 (256 levels) (1).

4.4 Data Validation

Validate base maps that are interpreted from aerial photographs by compared with real area of Koh Kred by field observation.

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4.5 Data Storage and Database Management

Data storage: The factors (spatial data) are stored in layers while attribute data (non-spatial data) which describes spatial data is stored in database.

4.5.1 Spatial Data Input

Spatial Data were imported with a digitizer by using ILWIS Vesion 1.4 from base maps that are interpreted from aerial photographs. Data collection was segment (line) maps in file: *.CRG, *.SEG and *.SLG but point data collection was in file: *.PNT (eg. Layer of Port, Public Telephone).

4.5.2 Converting Segment Maps into Polygon Maps

Segment (line) maps were converted to polygon (area) maps such as layer of institutional land, tourism attractions, and land-use that details of feature type of each layer were in table 4.1.

Table 4.1 Details of feature type of each layer

Layer Name	Feature Type		
	Line	Point	Polygon
Road / Path	✓		
Canal	✓		
Port		✓	
Public Telephone		✓	
Institutional Land			✓
Tourism Attractions			✓
Land-use			✓

4.5.3 Attribute Data Input

Attribute data were collected in database/table (*.dbf) that designed by using Relational Database Management System (RDBMS).(Figure 4.1) Spatial data and attribute data were linked with field that was primary key.

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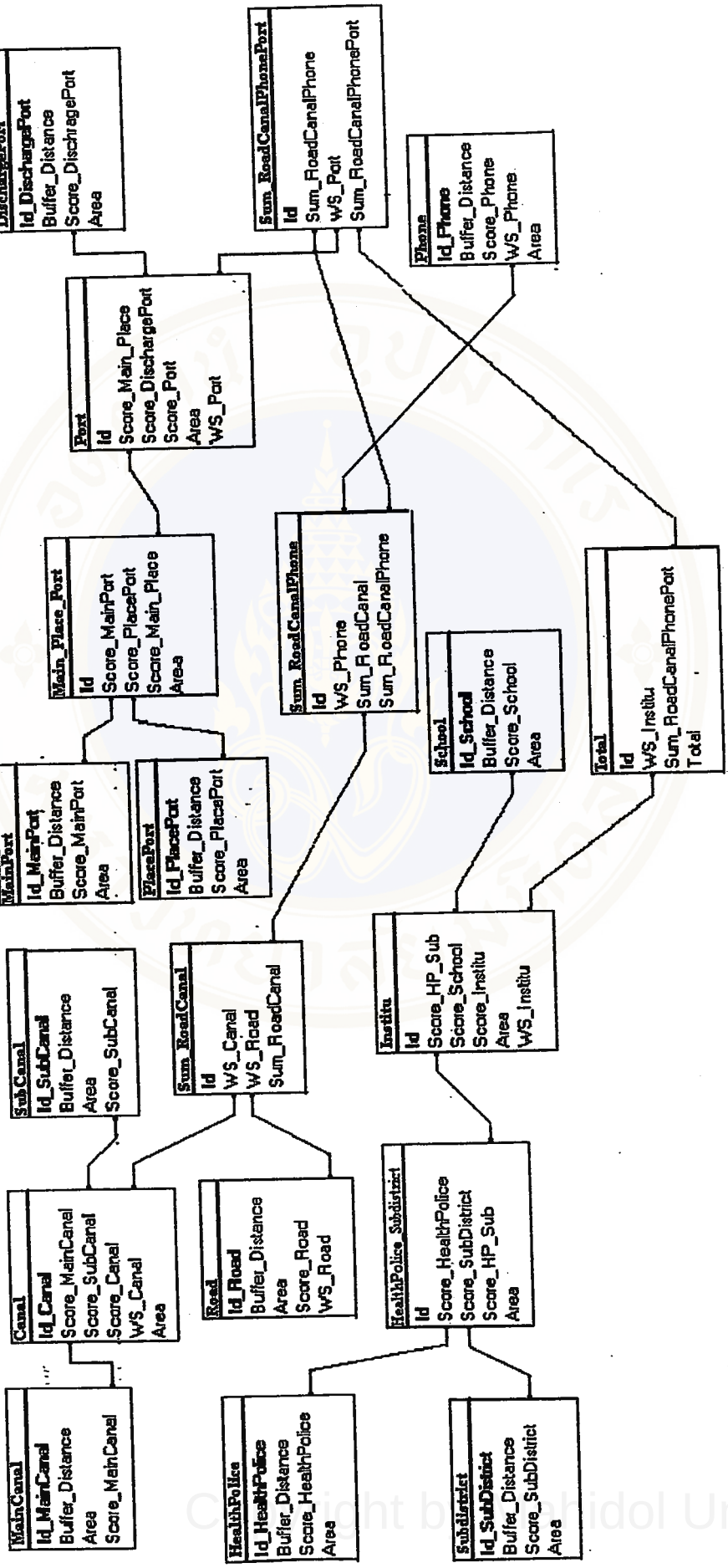

Figure 4.1 Database for determination of potential area for ecotourism development

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4.5.4 Converting file

To convert files that were collected by ILWIS Version 1.4 into files that use with ArcView GIS Version 3.1. Converting will use ILWIS Version 2.1.

4.6 Data Analysis

4.6.1 Evaluate potential of tourism facilities area.

Evaluate potential of tourism facilities area, by using "**the Potential Surface Analysis Technique (PSA)**". This method makes a map to show various characteristics representing levels of limitations ranging from minimum to maximum and assign priority weightings. If high limitation dictated low weighting; if low limitation dictated high weighting. If the land has high score of the suitability dictated high land use potential. (12) The weighting standard table will use principle of utility function, by using questionnaires to ask for opinions from experts, and officers concerned. Find weight by using formula as follow:

$$\bar{x} = \frac{\sum_{i=1}^{N} f_i x_i}{N}$$

Where:

$\bar{x}$ = mean of factor capacity

f_i = Number of populations that have opinion in level i

x_i = ranking score (0=Not important, 1=Low, 2=Moderate and 3=High)

N = Number of populations that answer questionnaires.

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Apply GIS Software to evaluate potential of tourism facilities area by overlaying all layers (factors) for calculating score of the suitability between weight and score by using "**Linear Combination Method**" (Equation 2.2).

Score of the suitability will be classified by using formula:

Width of the interval = (MAX - MIN) / the number of range

This study will divide area into 3 categories as follows:

High score	=	High potential area
Moderate score	=	Moderate potential area
Low score	=	Low potential area

This study will be divided 2 cases (criteria) as follows:

Case 1 : Distance from factor 50 m. (0-50, 50-100, 100-150, 150-200, and >200 m.)

Case 2 : Distance from factor 100 m. (0-100, 100-200, 200-300, 300-400, and >400 m.)

4.6.2 Evaluate potential of ecotourism area.

Evaluate potential of ecotourism area by using "**the Potential Surface Analysis Technique (PSA)**". Use questionnaires to ask for opinions from experts, and officers concerned in order to find weight of each factor. And use questionnaires to ask for opinions from ecotourists in order to find score of tourist attractions of each factor. Find mean of weight and score by using formula as follow:

$$\bar{x} = \frac{\sum_{i=1}^{N} f_i x_i}{N}$$

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Where:

$\bar{x}$ = mean of factor capacity

f_i = Number of populations that have opinion in level i

x_i = ranking score (0=Not important, 1=Low, 2=Moderate and 3=High)

N = Number of populations that answer questionnaires.

Evaluate potential of ecotourism area by calculating between mean of weight of factors and factor ability of each tourist attractions (score) by using **Linear Combination Method** (Equation 2.2).

Score of the suitability will be classified by using formula:

Width of the interval = (MAX - MIN) / the number of range

This study will divide area into 3 categories as follows:

High score = High potential area

Moderate score = Moderate potential area

Low score = Low potential area

4.6.3 Determine potential area for ecotourism development

Potential area for ecotourism development can be determined by overlaying between potential area of tourism facilities and potential area of ecotourism.

4.6.4 Ecotourism development guidelines

Considered from potential of tourism facilities area, potential of ecotourism area, and potential of area for ecotourism development.

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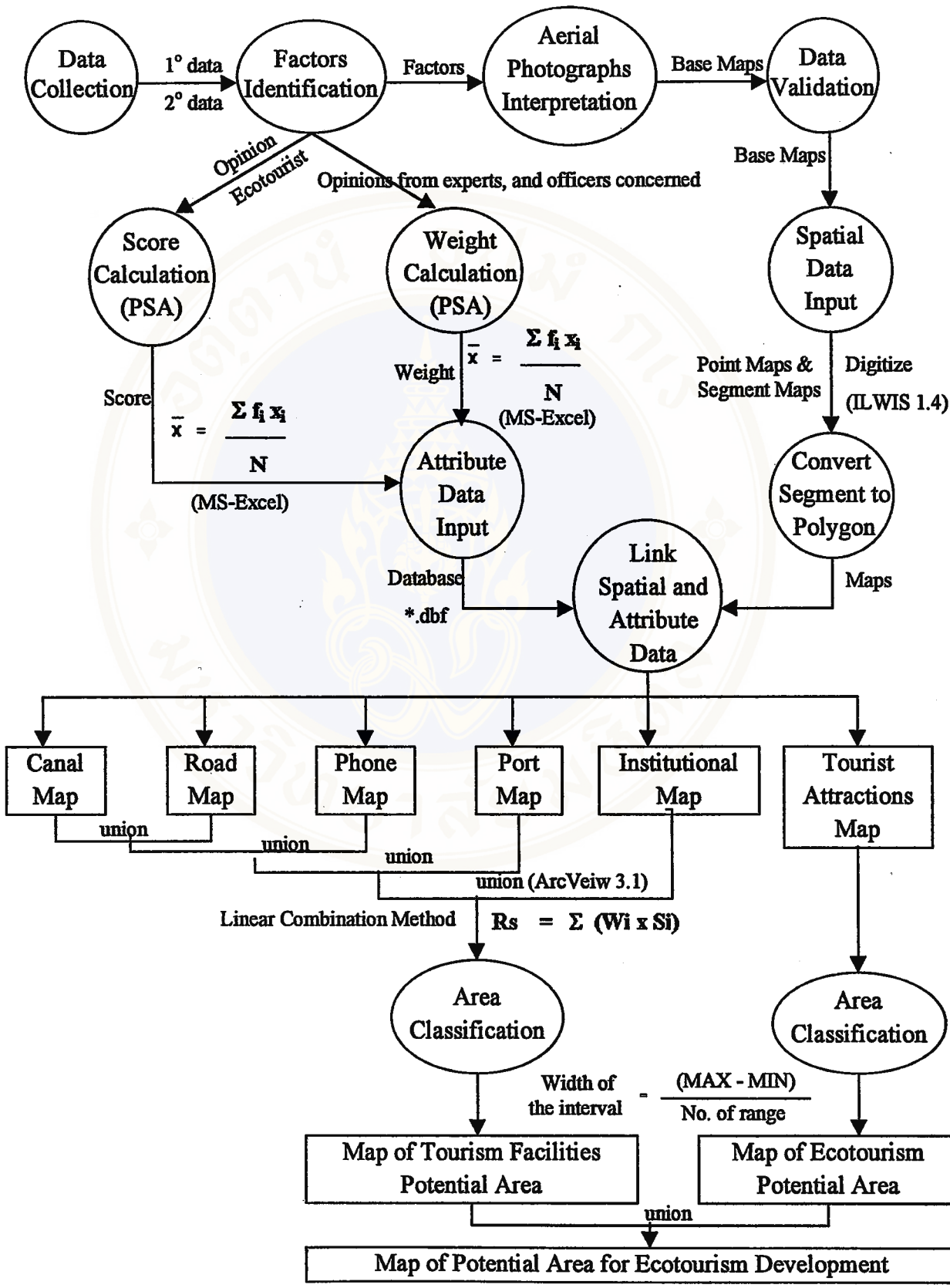

Figure 4.2 Chart of analysis method of potential area for ecotourism development

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CHAPTER V

RESULTS

5.1 The result of the potential evaluation of tourism facilities area

Significant of factor (weight) was calculated by using questionnaires (Appendix A) to ask for opinions from experts, and officers concerned (Appendix B) with Potential Surface Analysis Method. The average ($\bar{x}$) of ranking score of factor from questionnaires are weight that weighting calculation method is in Appendix C. Score was calculated by interval classification that scoring calculation method is in Appendix D. Potential area was calculated from weight and score of factor as table 5.1.

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Table 5.1 Details of weight and score for the potential evaluation of tourism facilities area.

Factors	Weight	Indicators			Score	Wi . Si
		Type of Factors	Distance from			
			CASE 1	CASE 2		
1. Port (Figure 5.1)	4.44	**Main Port or crossing**	0-50	0-100	5	22.2
			50-100	100-200	4	17.76
			100-150	200-300	3	13.32
			150-200	300-400	2	8.88
			> 200	> 400	1	4.44
		Specific port of a place	0-50	0-100	4	17.76
			50-100	100-200	3	13.32
			100-150	200-300	2	8.88
			150-200	300-400	2	8.88
			>200	> 400	1	4.44
		Port of discharge	0-50	0-100	2	8.88
			50-100	100-200	2	8.88
			100-150	200-300	1	4.44
			150-200	300-400	1	4.44
			>200	> 400	1	4.44
2. Road/Path (Figure 5.2)	4.11		0-50	0-100	5	20.55
			50-100	100-200	4	16.44
			100-150	200-300	3	12.33
			150-200	300-400	2	8.22
			>200	> 400	1	4.11
3. Canal (Figure 5.3)	3.44	**Main Canal**	0-50	0-100	5	17.2
			50-100	100-200	4	13.76
			100-150	200-300	3	10.32
			150-200	300-400	2	6.88
			>200	> 400	1	3.44
		Minor Canal	0-50	0-100	3	10.32
			50-100	100-200	2	6.88
			100-150	200-300	2	6.88
			150-200	300-400	1	3.44
			>200	> 400	1	3.44

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Table 5.1 Details of weight and score for the potential evaluation of tourism facilities area (Continued)

Factors	Weight	Indicators			Score	Wi * Si
		Type of Factors	Distance from			
			CASE 1	CASE 2		
4. Public Telephone (Figure 5.4)	3		0-50	0-100	5	15
			50-100	100-200	4	12
			100-150	200-300	3	9
			150-200	300-400	2	6
			>200	> 400	1	3
5. Institutional land (Figure 5.5)	3	**Health and police station**	0-50	0-100	5	15
			50-100	100-200	4	12
			100-150	200-300	3	9
			150-200	300-400	2	6
			>200	> 400	1	3
		Office of Sub-district Administrative Organization	0-50	0-100	4	12
			50-100	100-200	3	9
			100-150	200-300	2	6
			150-200	300-400	2	6
			>200	> 400	1	3
		School	0-50	0-100	2	6
			50-100	100-200	2	6
			100-150	200-300	1	3
			150-200	300-400	1	3
			>200	> 400	1	3

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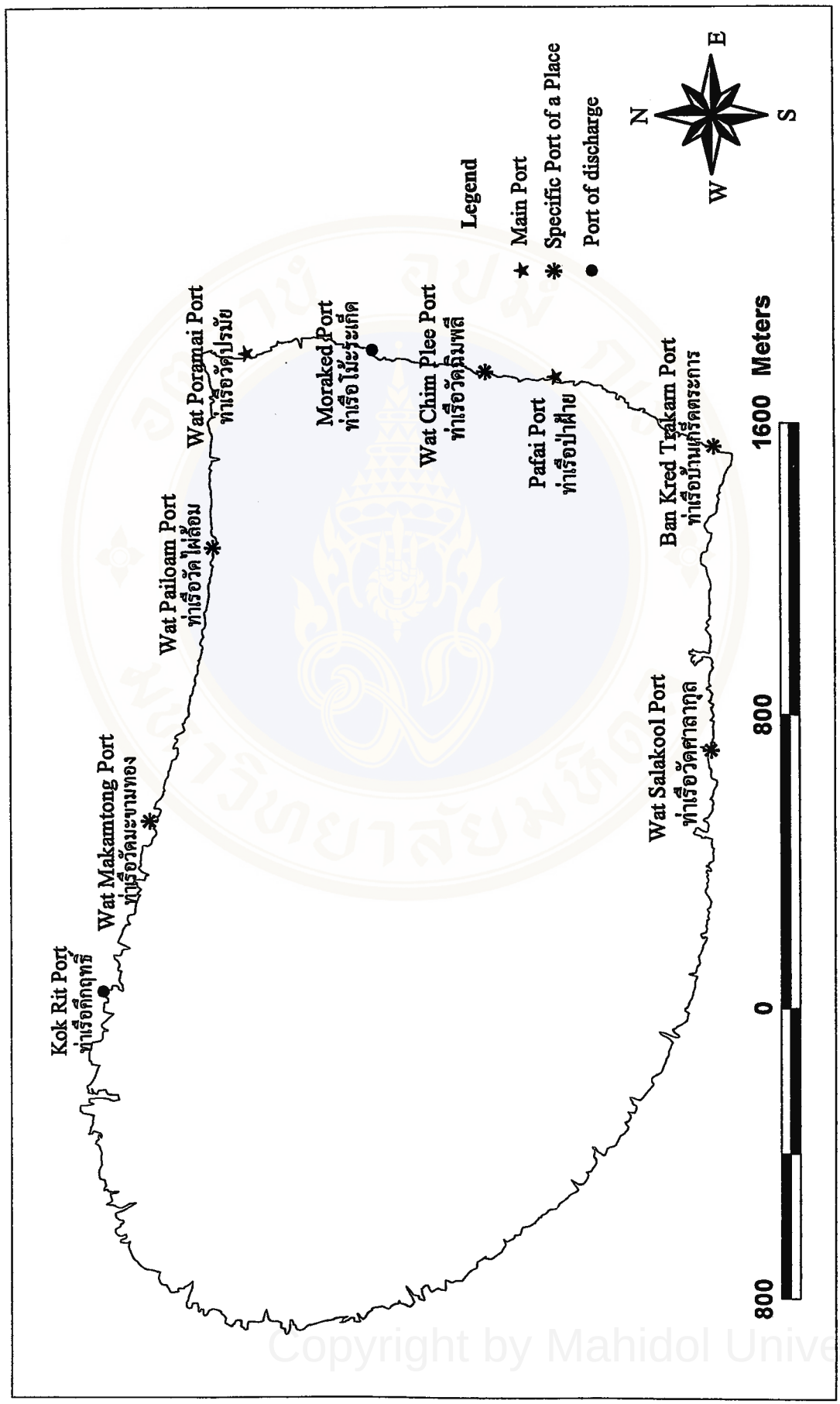

Figure 5.1 Map of ports in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province

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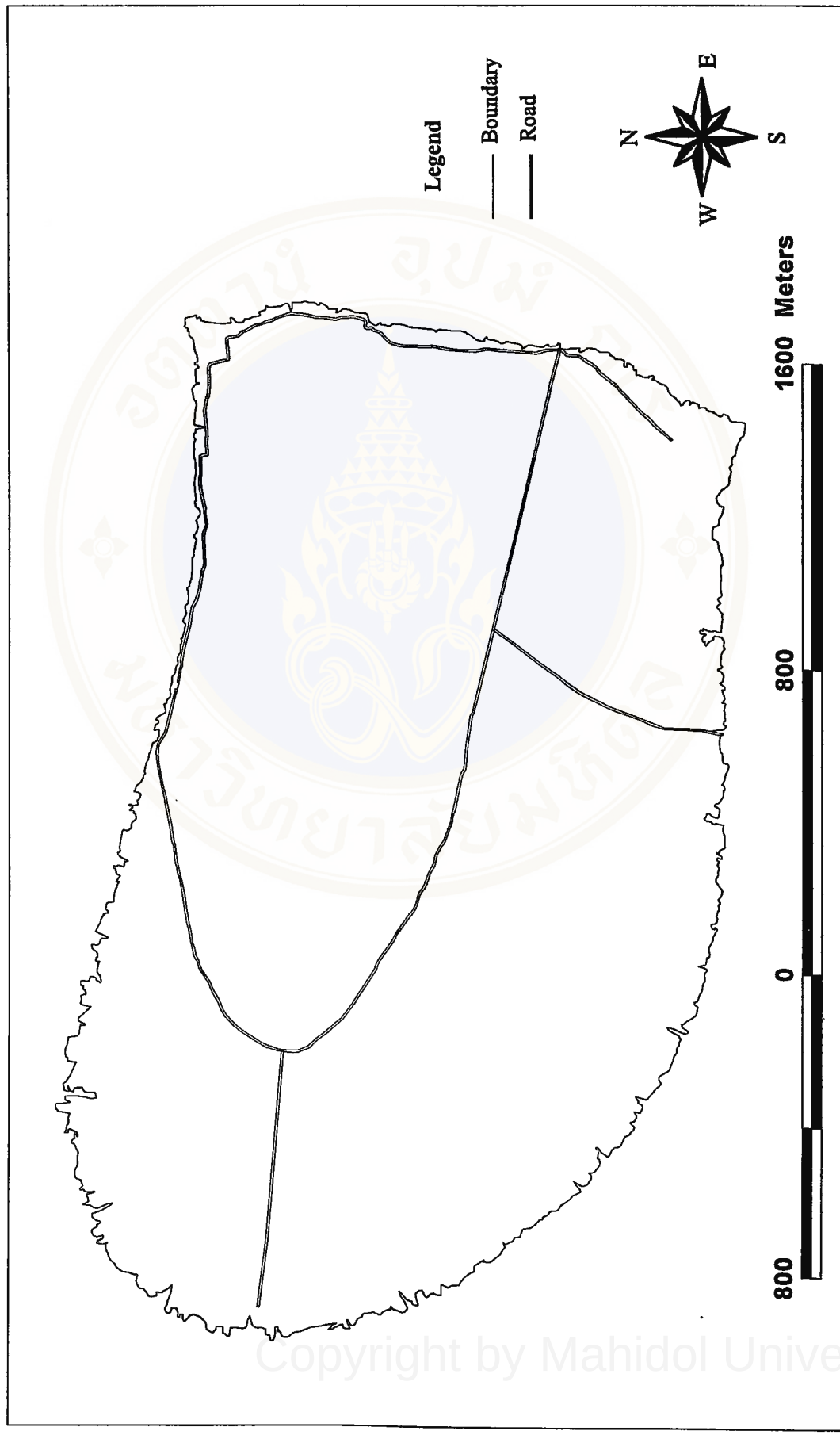

Figure 5.2 Map of road in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province

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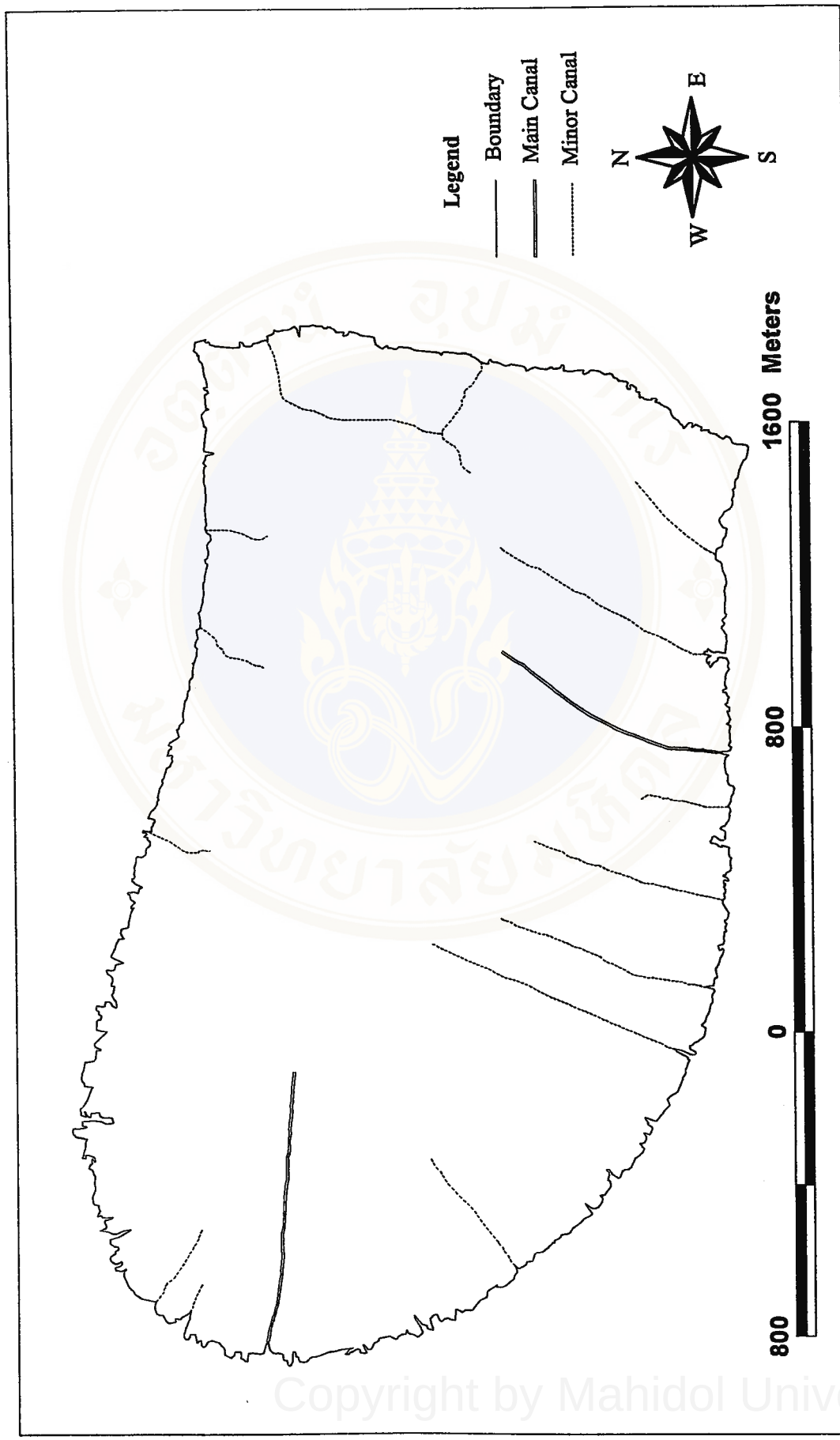

Figure 5.3 Map of main and minor canals in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province

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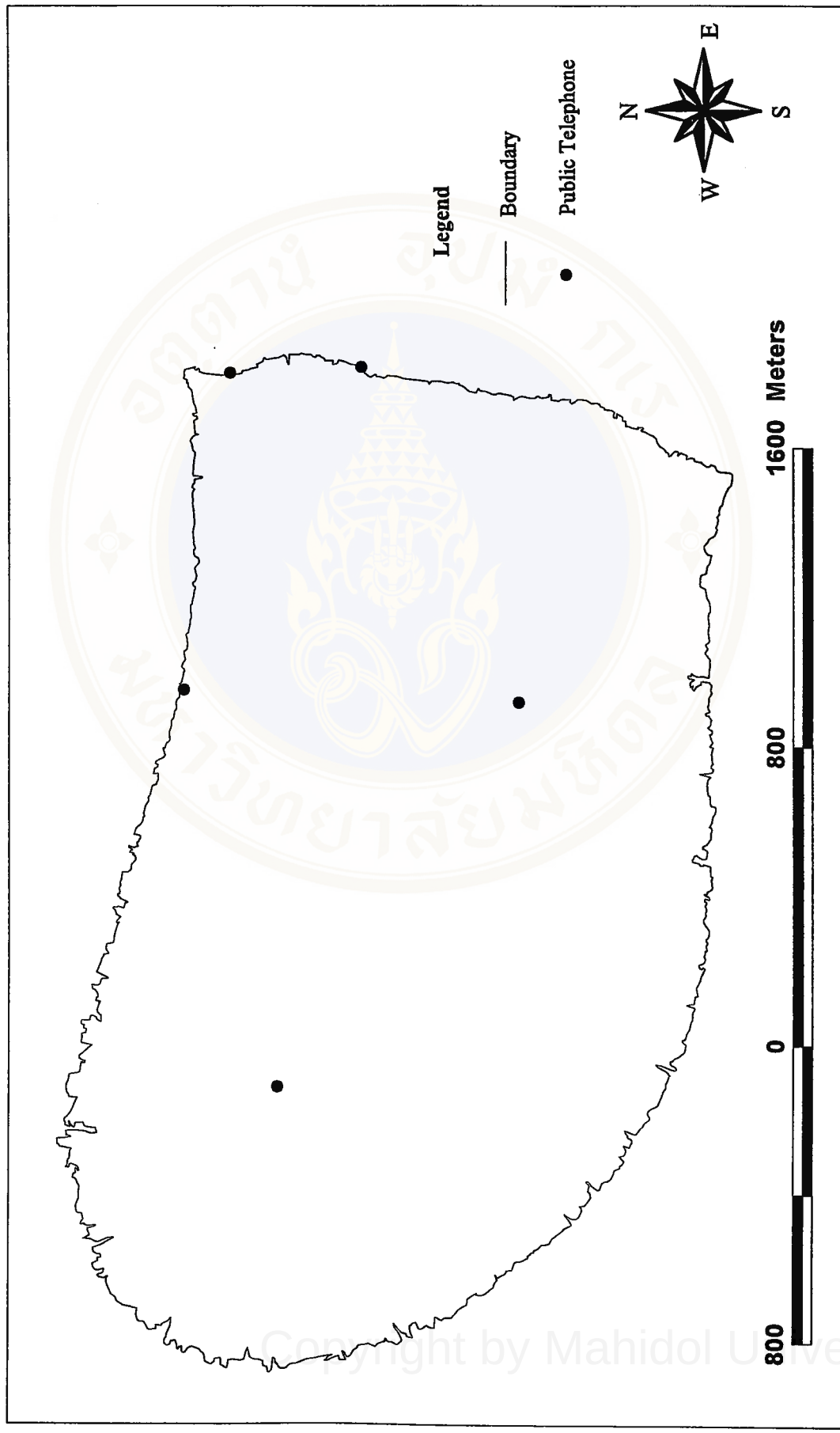

Figure 5.4 Map of public telephone in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province

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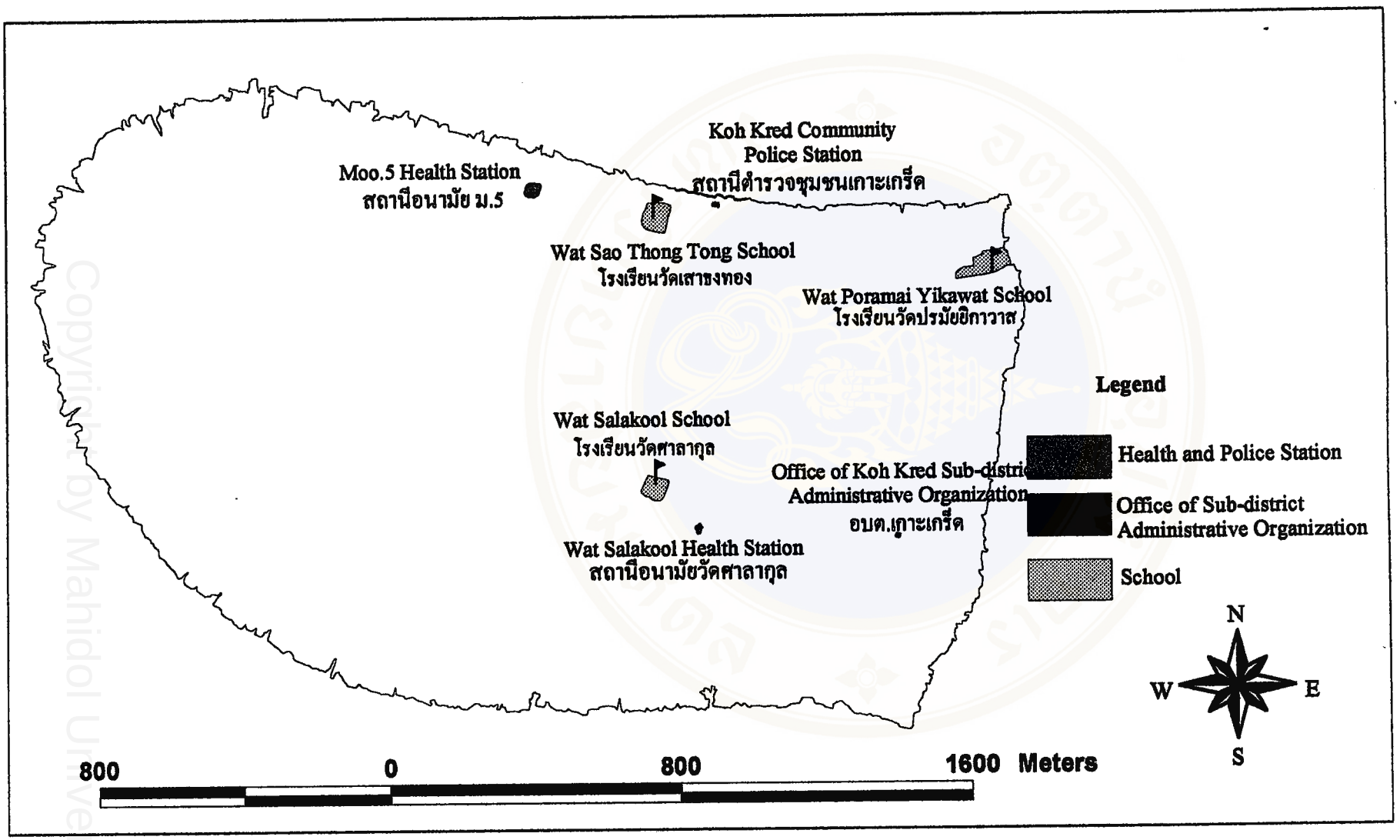

Figure 5.5 Map of institutional land in Koh Kred Sub-district in Pak Kred District of Nonthaburi Province

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Calculate score of potential area by overlaying (union) all layers with linear combination method (Equation 2.2).

CASE 1 : Distance from factor 50 m.

The result was classified into maximum and minimum as 68.08 and 17.99 that will be divided 3 groups as follows: (Figure 5.6)

I. High Tourism Facilities Potential Area

Score of potential areas are more than 56 to 75. Areas are about 0.084 km^2 (8.41 Hectares) or 2.29%. High tourism facilities potential areas are:

- Main port or crossing (Wat Poramai Port) that is near road/path and public telephone.
- Nearby institutional land (Wat Salakool Health Station), public telephone and main canal (Wat Salakool Canal) that small boats can access and road/path runs paralleled with it.
- Nearby main canal (Wat Chan Canal) that small boats can access, road/path runs paralleled with it and public telephone.
- Nearby Koh Kred community police station that is edge of road/path and there is a public telephone in these parts.
- Nearby Wat Makamtong port and Moo.5 health station that edge of road/path.
- Nearby Wat Salakool port and and main canal (Wat Salakool Canal) that small boats can access and road/path runs paralleled with it.

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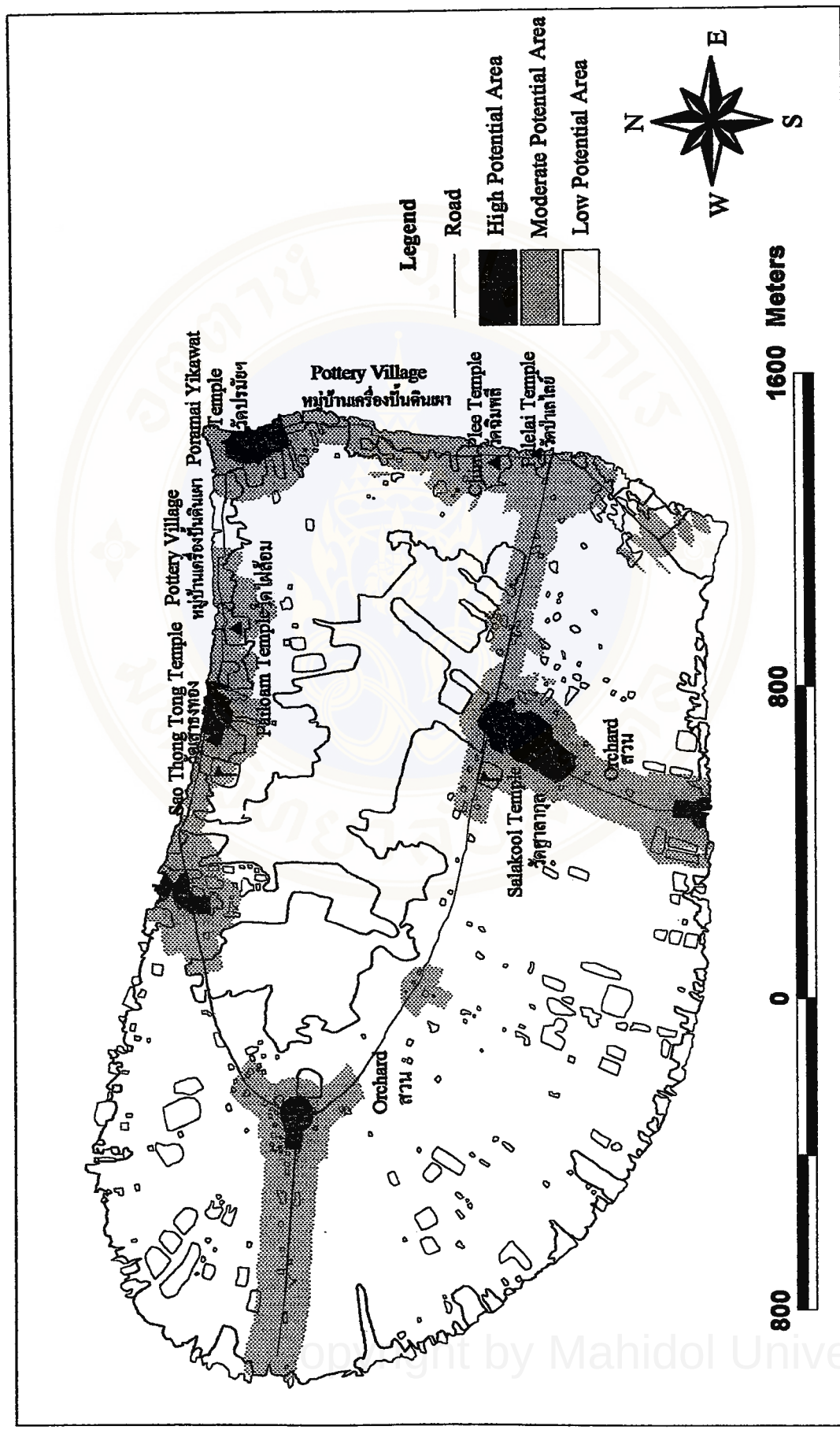

Figure 5.6 Map of the tourism facilities potential area (CASE 1)

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II. Moderate Tourism Facilities Potential Area

Score of potential areas are more than 37 to 56. Areas are about 0.659 km^2 (65.954 Hectares) or 17.95%. Moderate tourism facilities potential areas are:

- Nearby specific port of a place (Wat Pailoam Port).
- Edge of road/path that is near Pafai port, Moraked port and office of Koh Kred sub-district administrative organization.
- Nearby Wat Salakool canal that road/path runs paralleled with it. But it is far from Wat Salakool port and Wat Salakool health station.
- Nearby Wat Chan canal that road/path runs paralleled with it. But it is far from public telephone.
- Edge of road/path that is near Tahuai Canal.

III. Low Tourism Facilities Potential Area

Score of potential areas are more than 18 to 37. Areas are about 2.929 km^2 (292.989 Hectares) or 79.76%. Low tourism facilities potential areas are:

- Port of discharge (Kok Rit Port) that is very far from road/path.
- Nearby road/path but far from port, institutional land, public telephone, and main canal.
- The areas that are far from road/path, port, institutional land, public telephone, and main canal.

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Range of score, area and percent of each level of tourism facilities potential area (CASE 1) may be summarized as table 5.2

Table 5.2 Tourism Facilities Potential Area (CASE 1)

Level of Potential	Range of Score	Area		Percent (%)
		(km^2)	(Hectares)	
High	56 – 75	0.084	8.41	2.29
Moderate	37 – 56	0.659	65.954	17.95
Low	18 – 37	2.929	292.989	79.76

CASE 2 : Distance from factor 100 m.

The result was classified into maximum and minimum as 17.99 and 74.07 that will be divided 3 groups as follows: (Figure 5.7)

I. High Tourism Facilities Potential Area

Score of potential areas are more than 56 to 75. Areas are about 0.579 km^2 (57.972 Hectares) or 15.77%. High tourism facilities potential areas are:

- Nearby main port or crossing (Wat Poramai Port) that is near road/path and public telephone.
- Nearby institutional land (Wat Salakool Health Station), Wat Salakool port, public telephone and main canal (Wat Salakool Canal) that small boats can access and road/path runs paralleled with it.
- Nearby main canal (Wat Chan Canal) that small boats can access, road/path runs paralleled with it and public telephone.
- Nearby Koh Kred community police station that is edge of road/path and there is a public telephone in these parts.

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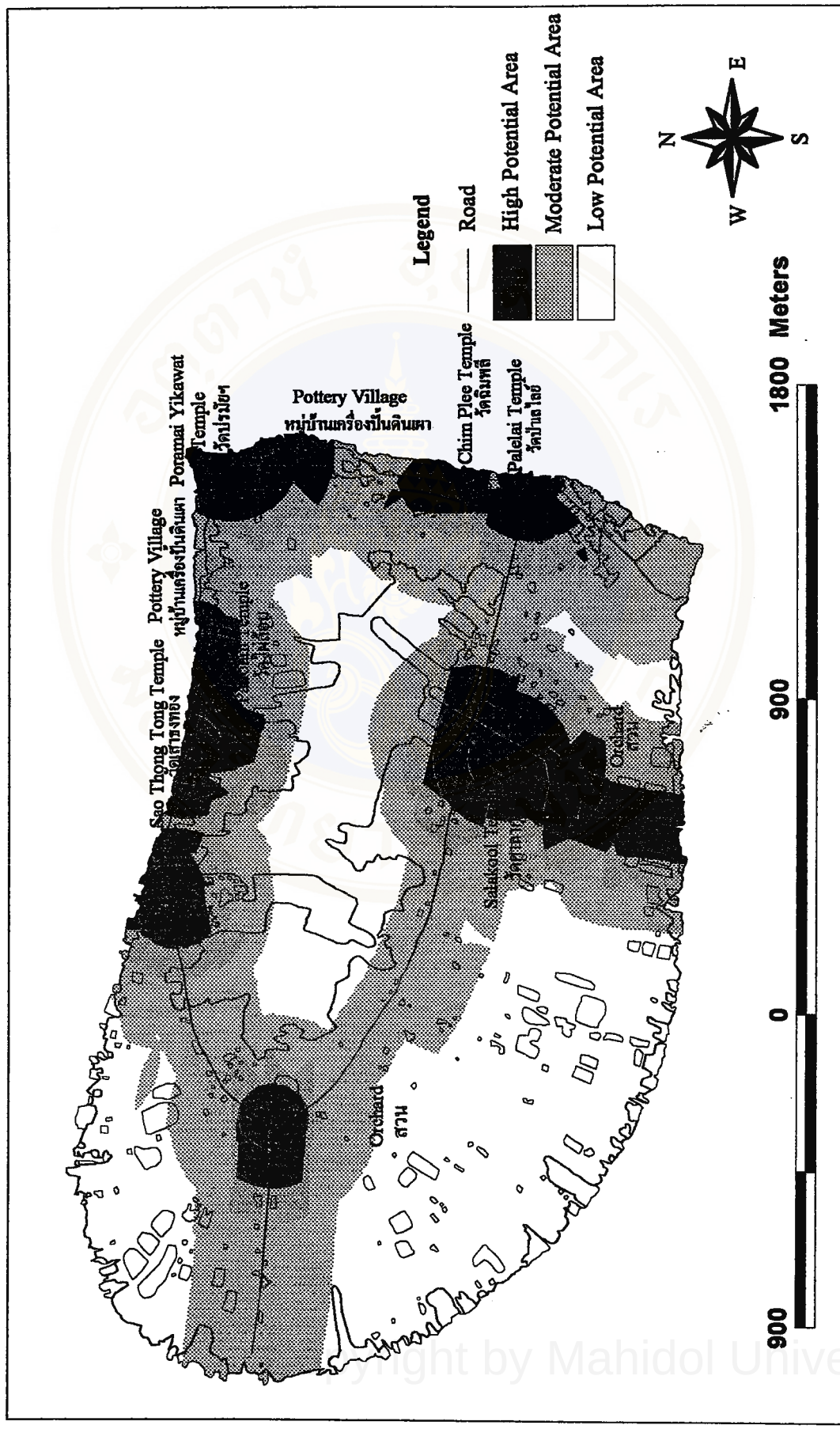

Figure 5.7 Map of the tourism facilities potential area (CASE 2)

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- Nearby specific port of a place (Wat Makamtong Port) and Moo.5 health station that edge of road/path.
- Nearby specific port of a place (Wat Pailoam Port) that edge of road/path.
- Nearby main port or crossing (Pafai Port) and specific port of a place (Chimplee Temple Port) that edge of road/path.

II. Moderate Tourism Facilities Potential Area

Score of potential areas are more than 37 to 56. Areas are about 1.642 km^2 (164.225 Hectares) or 44.71%. Moderate tourism facilities potential areas are:

- Edge of road/path that is far from port, institutional land, public telephone, and main canal.
- Nearby Wat Chan canal that road/path runs paralleled with it. But it is far from public telephone.

III. Low Tourism Facilities Potential Area

Score of potential areas are more than 18 to 37. Areas are about 1.452 km^2 (145.157 Hectares) or 39.52%. Low tourism facilities potential areas are:

- Port of discharge (Kok Rit Port) that is very far from road/path.
- The areas that are very far from road/path, port, institutional land, public telephone, and main canal.

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Range of score, area and percent of each level of tourism facilities potential area (CASE 2) may be summarized as table 5.3

Table 5.3 Tourism Facilities Potential Area (CASE 2)

Level of Potential	Range of Score	Area		Percent (%)
		(km^2)	(Hectares)	
High	56 – 75	0.579	57.972	15.77
Moderate	37 – 56	1.642	164.225	44.71
Low	18 – 37	1.452	145.157	39.52

5.2 The result of the potential evaluation of ecotourism area

The potential evaluation of ecotourism area used questionnaires (Appendix E) in order to define factor capacity (score) of each tourist attractions (Appendix F). To answer the question by ecotourist that travel around this island. Number of ecotourist is about 240 persons/month (from asking local people and surveying). Number of sample population that reliable, statistic significant and save cost and time are 10% of number of all population. Then number of sample is 24 persons (2 foreigners). Sampling on January 2000.

Significant of factor (weight) was calculated from questionnaires (Appendix G) to ask for opinions from experts, and officers concerned (Appendix B). Weighting calculation method is in Appendix H.

Calculate score of potential area from weight and score with linear combination method (Equation 2.2) as follows table 5.4. The result was classified into maximum and minimum as 62 and 34 that will be divided 3 groups as follows: (Figure 5.8)

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Table 5.4 Details of weight and score for the potential evaluation of ecotourism area

Tourist Attractions		History and archaeology			Artistic			Culture and custom of community			Naturalness			Scenery / Landscape			Accessibility			SUM
		w	s	w*s	w	s	w*s	w	s	w*s	w	s	w*s	w	s	w*s	w	s	w*s	Σw*s
1.	Poramai Yikawat Temple	4.33	2.58	11.19	4.22	2.42	10.20	4.78	2.38	11.35	3.78	2.21	8.35	4.11	2.42	9.93	3.44	2.58	8.89	59.90
2.	Pailom Temple	4.33	2.17	9.38	4.22	2.13	8.97	4.78	2.17	10.36	3.78	2.00	7.56	4.11	2.17	8.91	3.44	2.25	7.74	52.91
3.	Sao Thong Tong Temple	4.33	2.46	10.64	4.22	2.42	10.20	4.78	2.13	10.16	3.78	2.33	8.82	4.11	2.38	9.76	3.44	2.17	7.45	57.04
4.	Chim Plee Temple	4.33	2.13	9.20	4.22	2.29	9.67	4.78	2.04	9.76	3.78	2.17	8.19	4.11	2.13	8.73	3.44	2.04	7.02	52.58
5.	Palelai Temple	4.33	1.88	8.12	4.22	1.83	7.74	4.78	1.63	7.77	3.78	2.13	8.03	4.11	1.75	7.19	3.44	1.96	6.74	45.58
6.	Salakool Temple	4.33	1.58	6.86	4.22	1.46	6.15	4.78	1.88	8.96	3.78	1.63	6.14	4.11	1.71	7.02	3.44	1.75	6.02	41.16
7.	Pottery Village	4.33	2.46	10.64	4.22	2.83	11.96	4.78	2.79	13.34	3.78	2.13	8.03	4.11	2.21	9.08	3.44	2.63	9.03	62.08
8.	Orchard	4.33	0.38	1.62	4.22	0.33	1.41	4.78	1.38	6.57	3.78	2.58	9.77	4.11	2.29	9.42	3.44	1.50	5.16	33.95

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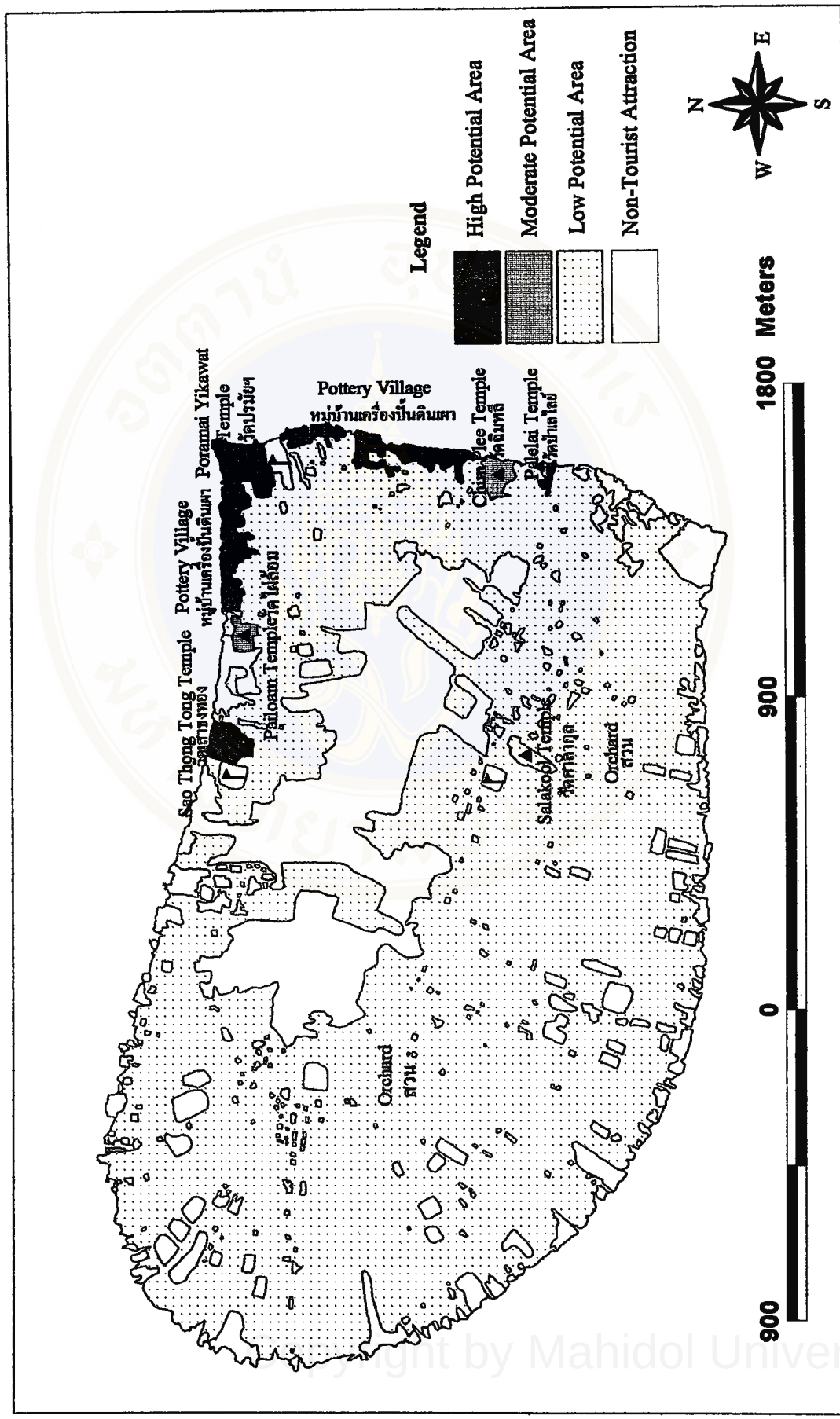

Figure 5.8 Map of the ecotourism potential area

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I. High Ecotourism Potential Area

Score of potential areas are more than 53 to 63. High ecotourism potential areas are:

- Pottery Village

  Ecotourists considered that pottery village has high valuable and important art, high valuable and important culture and custom of community, and high accessibility but moderate valuable and important history and archaeology, moderate naturalness and moderate beautiful scenery.

- Poramai Yikawat Temple

  Ecotourists considered that Poramai Yikawat temple has high valuable and important history and archaeology and high accessibility but moderate valuable and important art and culture and custom of community, moderate naturalness, and moderate beautiful scenery.

- Sao Thong Tong Temple

  Ecotourists considered that Sao Thong Tong temple has high valuable and important history and archaeology but moderate valuable and important art and culture and custom of community, moderate naturalness, and moderate beautiful scenery and moderate accessibility.

II. Moderate Ecotourism Potential Area

Score of potential areas are more than 43 to 53. Moderate ecotourism potential areas are Pailoam temple, Chim Plee temple and Palelai temple. Ecotourists considered that Pailoam temple, Chim Plee temple and Palelai temple have moderate valuable and important history and archaeology, art and culture and custom of community, moderate naturalness, and moderate beautiful scenery and moderate accessibility.

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III. Low Ecotourism Potential Area

Score of potential areas are more than 33 to 43. Low ecotourism potential areas are:

- Salakool Temple

  Ecotourists considered that Salakool temple has moderate valuable and important culture and custom of community, moderate beautiful scenery and moderate accessibility but low valuable and important history and archaeology and art, low naturalness.

- Orchard

  Ecotourists considered that orchard doesn't have valuable and important history and archaeology and art and low valuable and important culture and custom of community but high naturalness, moderate beautiful scenery and moderate accessibility.

5.3 The result of the potential determination of area for ecotourism development

Determine the potential of area for ecotourism development by overlaying between tourism facilities potential area and ecotourism potential area.

By:

Score of High Tourism Facilities Potential Area	=	3
Score of Moderate Tourism Facilities Potential Area	=	2
Score of Low Tourism Facilities Potential Area	=	1
Score of High Ecotourism Potential Area	=	3
Score of Moderate Ecotourism Potential Area	=	2
Score of Low Ecotourism Potential Area	=	1

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CASE 1 : Distance from factor 50 m.

The results were classified into maximum and minimum as 6 and 1 that will be divided 3 groups as follows: (Figure 5.9)

I. High Potential Area for Ecotourism Development

Score of potential areas are 5 to 6. Area is about 0.071 km^2 (7.158 Hectares) or 1.92%. High potential areas for ecotourism development are:

- Poramai Yikawat Temple that has **high** ecotourism potential and **high** tourism facilities potential.
- Sao Thong Tong Temple that has **high** ecotourism potential and **high** tourism facilities potential.
- Pottery Village that has **high** ecotourism potential but **moderate** tourism facilities potential.

II. Moderate Potential Area for Ecotourism Development

Score of potential areas are 3 to 4. Area is about 0.577 km^2 (57.661 Hectares) or 15.47%. Moderate potential areas for ecotourism development are:

- Chim Plee Temple that has **moderate** ecotourism potential and **moderate** tourism facilities potential.
- Pailoam Temple that has **moderate** ecotourism potential and **moderate** tourism facilities potential.
- Palelai Temple that has **moderate** ecotourism potential and **moderate** tourism facilities potential.
- Salakool Temple that has **low** ecotourism potential and **high** tourism facilities potential.
- Some Pottery Village (Moo.7) that has **high** ecotourism potential and **moderate** tourism facilities potential.

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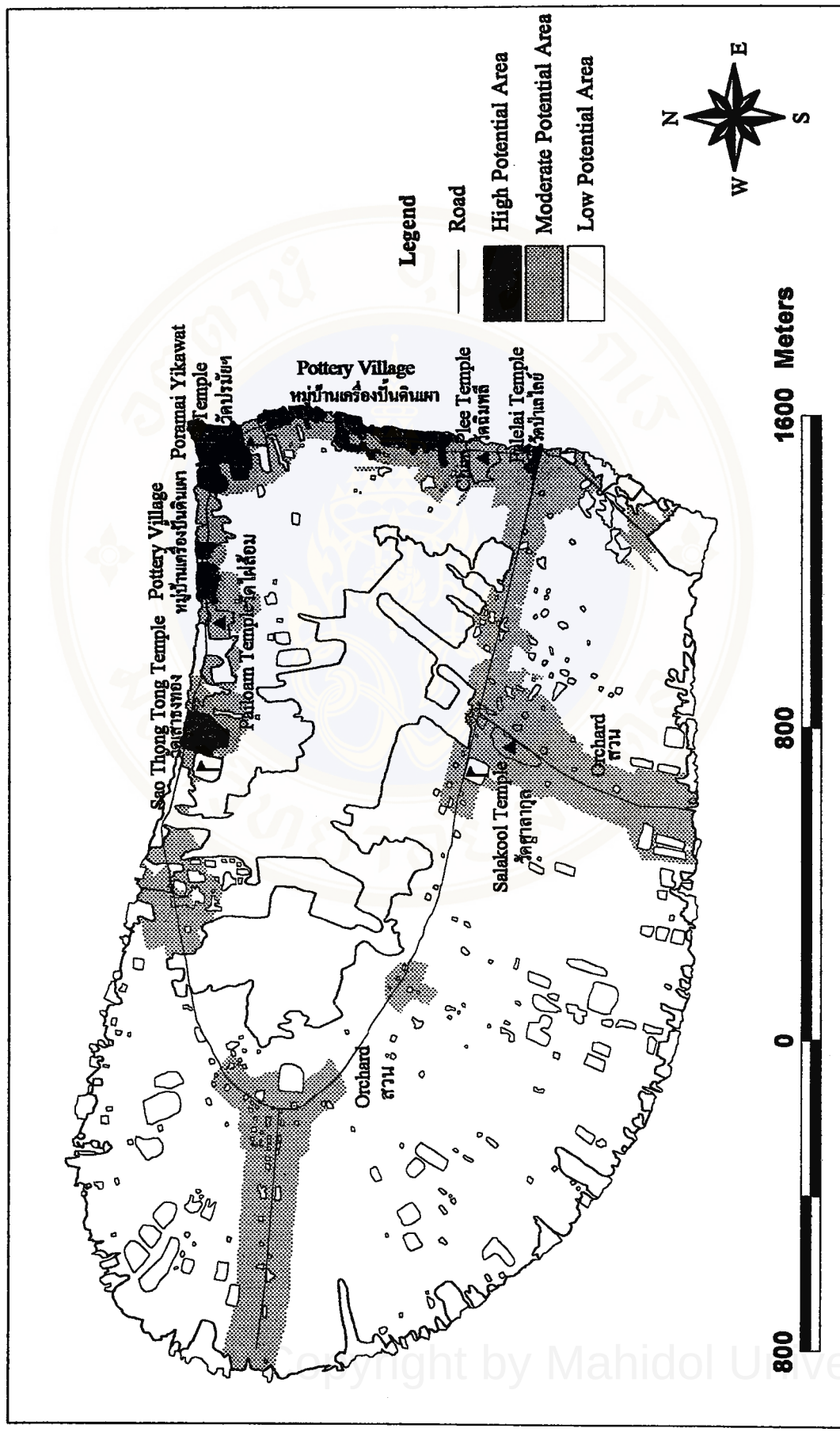

Figure 5.9 Map of the potential area for ecotourism development (CASE 1)

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- Some orchard that is near main canal (Wat Salakool Canal and Wat Chan Canal), road/path and main port or crossing (Pafai Port) that has **low** ecotourism potential and **moderate** tourism facilities potential.
- Nearby Sao Thong Tong Temple that has **low** ecotourism potential and **moderate to high** tourism facilities potential.
- Nearby Moo.5 health station and Wat Makamtong port that has **low** ecotourism potential and **moderate to high** tourism facilities potential.
- Nearby Wat Chan canal that road/path runs paralleled with it that has **low** ecotourism potential and **moderate to high** tourism facilities potential.
- Nearby Wat Salakool canal that road/path runs paralleled with it that has **low** ecotourism potential and **moderate to high** tourism facilities potential.
- Edge of road/path that is near Pafai port and office of Koh Kred sub-district administrative organization that has **low** ecotourism potential and **moderate** tourism facilities potential.
- Nearby Pottery Village that has **low** ecotourism potential and **moderate** tourism facilities potential.
- The areas that have moderate facilities tourism potential except non-tourist attraction.

III. Low Potential Area for Ecotourism Development

Score of potential areas are 1 to 2. Areas are about 3.079 km^2 (307.916 Hectares) or 82.61%. Low potential areas for ecotourism development are:

- Orchard that is far from facilities that has **low** ecotourism potential and **low** tourism facilities potential.
- Non-tourist attraction, such as uncultivated land and residential area.

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Range of score, area and percent of each level of potential area for ecotourism development (CASE 1) may be summarized as table 5.5

Table 5.5 Potential Area for Ecotourism Development (CASE 1)

Level of Potential	Range of Score	Area		Percent (%)
		(km^2)	(Hectares)	
High	5 - 6	0.071	7.158	1.92
Moderate	4 – 3	0.577	57.661	15.47
Low	2 - 1	3.079	307.916	82.61

CASE 2 : Distance from factor 100 m.

The results were classified into maximum and minimum as 6 and 1 that will be divided 3 groups as follows: (Figure 5.10)

I. High Potential Area for Ecotourism Development

Score of potential areas are 5 to 6. Areas are about 0.096 km^2 (9.552 Hectares) or 2.58%. High potential areas for ecotourism development are:

- Pottery Village that has **high** ecotourism potential and **moderate to high** tourism facilities potential.
- Poramai Yikawat Temple that has **high** ecotourism potential and **high** tourism facilities potential.
- Sao Thong Tong Temple that has **high** ecotourism potential and **high** tourism facilities potential.
- Pailoam Temple that has **moderate** ecotourism potential and **high** tourism facilities potential.
- Chim Plee Temple that has **moderate** ecotourism potential and **high** tourism facilities potential.

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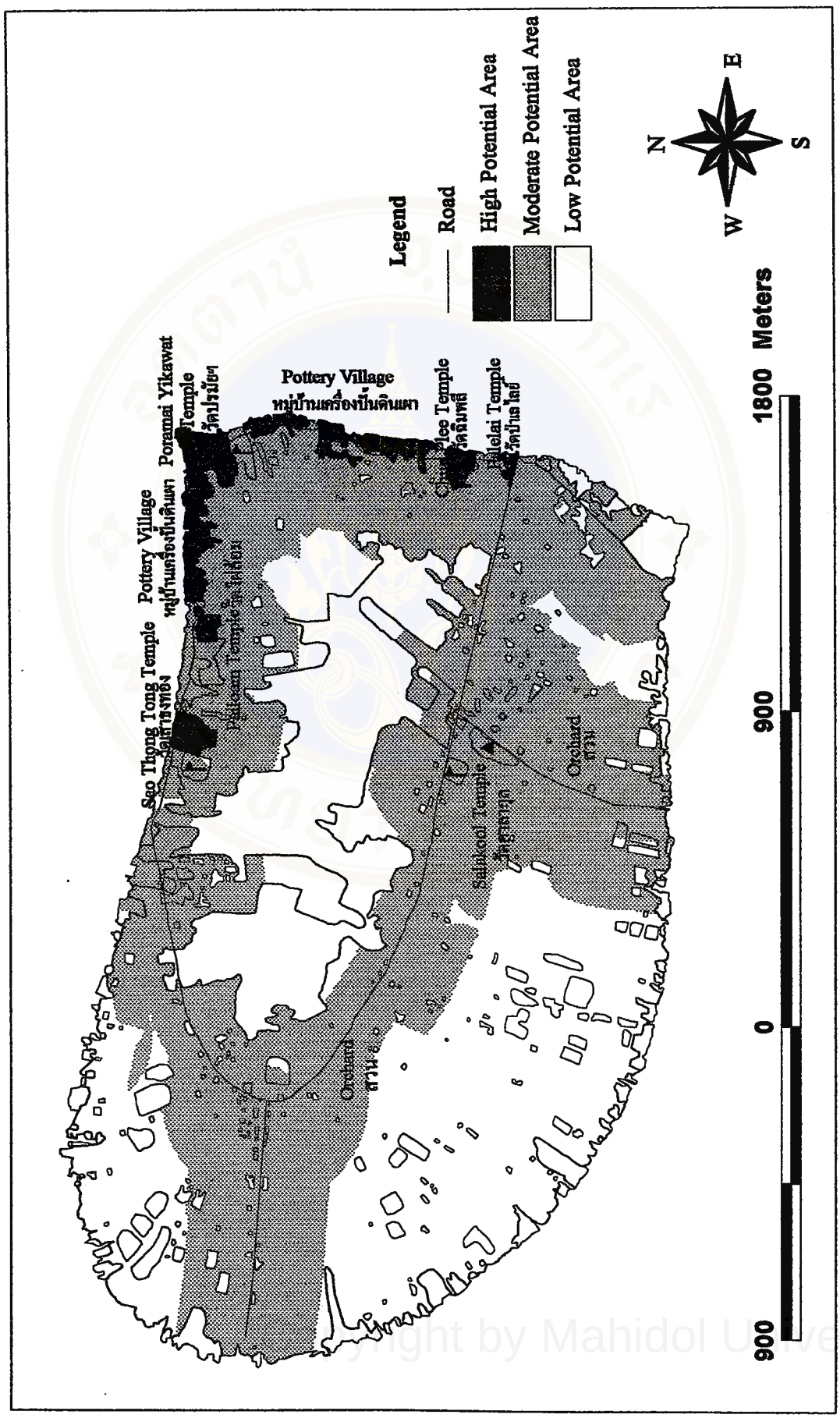

Figure 5.10 Map of the potential area for ecotourism development (CASE 2)

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- Palelai Temple that has **moderate** ecotourism potential and **high** tourism facilities potential.

II. Moderate Potential Area for Ecotourism Development

Score of potential areas are 3 to 4. Areas are about 1.843 km^2 (184.330 Hectares) or 49.48%. Moderate potential areas for ecotourism development is:

- Salakool Temple that has **low** ecotourism potential and **high** tourism facilities potential.
- Some orchard that is near main canal (Wat Salakool Canal and Wat Chan Canal), road/path and main port or crossing (Pafai Port) that has **low** ecotourism potential and **moderate to high** tourism facilities potential.
- Nearby Poramai Yikawat Temple, Sao Thong Tong Temple, Pailoam Temple, Pottery Village, Chim Plee Temple and Palelai Temple that has **low** ecotourism potential and **moderate to high** tourism facilities potential.
- The areas that have moderate facilities tourism potential except non-tourist attraction.

III. Low Potential Area for Ecotourism Development

Score of potential areas are 1 to 2. Areas are about 1.786 km^2 (178.609 Hectares) or 47.94%. Low potential areas for ecotourism development are:

- Orchard that is far from facilities that has **low** ecotourism potential and **low** tourism facilities potential.
- Non-tourist attraction, such as uncultivated land and residential area.

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Range of score, area and percent of each level of potential area for ecotourism development (CASE 2) may be summarized as table 5.6

Table 5.6 Potential Area for Ecotourism Development (CASE 2)

Level of Potential	Range of Score	Area		Percent (%)
		(km^2)	(Hectares)	
High	5 - 6	0.096	9.552	2.58
Moderate	4 – 3	1.843	184.330	49.48
Low	2 - 1	1.786	178.609	47.94

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CHAPTER VI

DISCUSSIONS

From the result of studying potentail area for ecotourism development: a case study of Koh Kerd (Kred Island), Nonthaburi Province by using Geographic Information System (GIS), Potential Surface Analysis Technique (PSA) and Linear Combination Method. Discussions are:

6.1 The tourism facilities potential area

From the results of study (Table 5.1), experts, and officers concerned that **port** is the most important factor of tourism facilities because this island can be accessed by only boat as it is island in the Chao Phraya River, doesn't have a bridge from mainland connecting to it. Secondary important factor is the road/path that tourists use it for traveling around this island by foot or bicycle. Third important factor is the canal because there are only 2 canals that boats (small boat) can access; Wat Chan and Salakool canal as for other canals narrow and shallow then can not use for communication. The least important factor is the institutional land and public telephone because health station and police station are too far and not in tourist attractions as for public telephones have not suffice for the needs of tourists.

The results of potential evaluation of tourism facilities area of both cases (distance from factor 50 m. and 100 m.) as expected:

High potential areas are near tourism facilities, 3 factors at least.

Moderate potential areas are near tourism facilities, only 1-2 factors.

Low potential areas are very far from tourism facilities.

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The results of criteria identification, distance from factor 50 m., were high potential areas have very little area (2.29%) that like spot and low potential areas have too much (79.76%). Even if the areas that were edge of road/path, its have low potential. Then this study area shouldn't be identified distance from factor 50 m. but it should be identified distance from factor more than 50 m. such as 100 m. (CASE 2).

6.2 The ecotourism potential area

From the results of study (Table 5.4), experts, and officers concerned that **culture and custom of community** is the most important factor for ecotourism. Because part of the population is Mon that have unique culture and custom and inherit to the present that attract tourist's attention, especially ecotourists, which motivate to study culture and custom of the locality. The secondary important factors are history and archaeology, art, scenery, naturalness, and accessibility. Accessibility is the least important factor because ecotourists usually prefers to travel to tourist attractions, often in difficult and challenging circumstances, then they are normally unconcerned with conveniences.

The results of potential evaluation of ecotourism areas as expected:

High potential areas are tourist attractions that have moderate to high value and importance of ecotourism that are pottery village, Poramai Yikawat temple, and Sao Thong Tong temple.

Moderate potential areas are tourist attractions that have moderate value and importance of ecotourism that are Pailoam temple, Chim Plee temple and Palelai temple.

Low potential areas are tourist attractions that have low to moderate value and importance of ecotourism that are Salakool temple and orchard.

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6.3 The potential area for ecotourism development

The results of study the potential areas for ecotourism development of both cases (distance from factor 50 m. and 100 m.) expected:

High potential areas have **high** ecotourism potential and **high to moderate** tourism facilities potential.

Moderate potential areas have **moderate** ecotourism potential and tourism facilities potential. Or the areas have **low** ecotourism potential and **moderate to high** tourism facilities potential. Or the areas have **high** ecotourism potential and **low** tourism facilities potential.

Low potential areas have **low** ecotourism potential and tourism facilities potential.

Recommendations of Ecotourism Development Guidelines :

CASE 1 :

I. High potential area

- Reorganize ports and boats, increase standard and security, particularly main port or crossing (Wat Poramai Port and Pafai Port). But it shouldn't be created too big because will go against scenery. That the sub-district administrative organization will reorganize it in Thais style, which match with Thai environment cultures. Officer concerned should cooperate with boat-owner to install increase lifesaving that appropriate with number of passenger, besides they should check lifesaving and boat regularly. Moreover, they should find volunteer for looking after tourist's security when go up and down boat.
- Install public telephone at pottery village (M.1 and 7).

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- Establish first aid station and security station at Poramai Yikawat Temple that it is tourism center on this island.
- Reorganize visitor center at Poramai Yikawat Temple. Find permanent officers to it for information and make brochure/leaflet in order to give out it to tourist. Make booklet in order to lend tourist it or sell moderate a price.
- Install main interpretation sign at Poramai Yikawat Temple. It shows position of various tourist attractions by making standard permanent chart. Details of sign consist with attentions and virtues of various tourist attractions in order to facilitate to tourists.

II. Moderate potential area

- Reorganize specific port of a place, namely Pailoam Temple Port and Chim Plee Temple Port in order to anchor boats that take tourists travel around this island, they will be able to visit places of interest and get knowledge about history, art and culture. So that Pailoam Temple and Chim Plee Temple have increase ecotourism potential.
- Install interpretation signs at Pailoam Temple and Chim Plee Temple. Its interpret history, art and attentions or virturs of each place for tourist's studies.

III. Low potential area

- Support bicycle-riding activity around this island for increase convenience of tourists. They can access far tourist attraction.
- Establish first aid station at bicycle route that is orchard.

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CASE 2 :

I. High potential area

- Reorganize ports and boats, increase standard and security, particularly main port or crossing (Wat Poramai Port and Pafai Port). But it shouldn't be created too big because will go against scenery. That the sub-district administrative organization will reorganize it in Thais style, which match with Thai environment cultures. Officer concerned should cooperate with boat-owner to install increase lifesaving that appropriate with number of passenger, besides they should check lifesaving and boat regularly. Moreover, they should find volunteer for looking after tourist's security when go up and down boat.
- Install public telephone at pottery village (M.1 and 7), Pailoam Temple and Chim Plee Temple.
- Establish first aid station and security station at Poramai Yikawat Temple and Chim Plee Temple.
- Reorganize visitor center at Poramai Yikawat Temple. Find permanent officers to it for information and make brochure/leaflet in order to give out it to tourist. Make booklet in order to lend tourist it or sell moderate a price.
- Install main interpretation sign at Poramai Yikawat Temple. It shows position of various tourist attractions by making standard permanent chart. Details of sign consist with attentions and virtues of various tourist attractions in order to facilitate to tourists.

II. Moderate potential area

- Reorganize canal for the convenience of tourists that would like to travel orchard by boat.

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- Reorganize port, which is near orchard (Salakool Temple) in order to anchor boats that take tourists travel around this island. And organize Ago-tourism activity so that tourist will come into contact with nature, taste some fruit from orchard directly and buy cheap fruit. So local people have increase income.

III. Low potential area

- Use of uncultivated land that is center of this island, Local Culture Square in order to preserve and spread culture of community.

From the pervious development guidelines, when criteria changing, different development guidelines. Such as different distance from factor for potential evaluation of tourism of tourism facilities area, potential area for ecotourism development of each level changes.

Then application geographic information system for evaluation so that save time for working. When criteria changing, it can analyze data more rapidly, correctly and efficiently than manual systems.

This study uses analysis method and study area like study for learning EGTI 672 (GIS), semester 2, academic 1998, Technology of Information System Management, Engineering Faculty, Mahidol University. That is "The applications of GIS in determination of suitable area for tourism development: a case study of Koh Kred, Nonthaburi Province". The analysis of both studies uses Potential Surface Analysis (PSA) and Linear Combination Method. Study area of both studies is Koh Kred, Nonthaburi Province. But both studies identify different factor. The study for learning EGTI 672 (GIS) divided 7 factors as follows: temple, pottery village, road, port, agriculture, community and institutional land and determined distance from road and institutional land 25 meter. So that the result of high suitable area for tourism development is 0.56% that like spot, spread tourist attractions, namely Poramai Yikawat temple and pottery village, which likes result of this study (CASE 1: distance form facility factor 50 m.).

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The study for learning EGTI 672 (GIS) didn't asked opinions of tourist in order to evaluate ecotourism potential of tourist attractions so that the result was too support tourism.

This study was divided 2 cases in order to learn of difference of result, development guidelines and benefits of analysis with GIS when change criteria. But the study for learning EGTI 672 (GIS) compared analysis between GIS Software and manual system. That both methods were close result. But GIS Software can analyze data more rapidly than manual systems.

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CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The objectives of this study are determination of potential area for ecotourism development by using Geographic Information System (GIS) and propose ecotourism development guidelines, which suit and accord with area potential in Koh Kred (Kred Island) in Pak Kred District of Nonthaburi Province in Thailand. The study of potential area for ecotourism development is one method, which used ecotourism development planning.

Potential area for ecotourism development can be determined by overlaying between potential area of tourism facilities and potential area of ecotourism. Factors of potential evaluation of tourism facilities area are ports, roads/paths, canals, public telephones and institutional land. It was divided 2 cases (criteria) as follows:

CASE 1 : Distance from factor 50 m. (0-50, 50-100, 100-150, 150-200, and >200)

CASE 2 : Distance from factor 100 m. (0-100, 100-200, 200-300, 300-400, and >400)

Factors of potential evaluation of ecotourism area are history and archeology, art, culture and custom of community, naturalness, scenery/landscape, and accessibility.

Weight of factors was calculated by using Potential Surface Analysis (PSA) from opinions of experts and officers concerned. Score of each factor of potential evaluation of ecotourism area was calculated by using Potential Surface Analysis (PSA) from opinions of ecotourist.

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Potential area for ecotourism development was calculated by overlaying (union) with Linear Combination Method between potential area of tourism facilities and potential area of ecotourism by using ArcView GIS Version 3.1.

The result of **the potential evaluation of tourism facilities area** was divided 2 cases as follows:

CASE 1 : Distance from factor 50 m.

High potential areas are about 0.084 km^2 (8.41 Hectares) or 2.29% that are Wat Poramai port, Wat Salakool port, Wat Makamtong port and Moo.5 health station, Wat Salakool health station and Koh Kred community police station.

Moderate potential areas are about 0.659 km^2 (65.954 Hectares) or 17.95% that are Wat Pailoam port, nearby Wat Salakool canal and Wat Chan canal, edge of road/path that is near Pafai port, Moraked port and office of Koh Kred sub-district administrative organization.

Low potential areas are about 2.929 km^2 (292.989 Hectares) or 79.76% that are Kok Rit Port, nearby road/path but far from other facilities and the areas that are far from various facilities.

CASE 2 : Distance from factor 100 m.

High potential areas are about 0.579 km^2 (57.972 Hectares) or 15.77% that are Wat Poramai port, Wat Salakool port, Wat Makamtong Port, Wat Pailoam Port, Pafai Port, Chim Plee Temple Port, Wat Salakool Health Station, Wat Salakool Canal, and Koh Kred community police station.

Moderate potential areas are about 1.642 km^2 (164.225 Hectares) or 44.71% that are Wat Chan canal, Edge of road/path that far from port, institutional land, public telephone, and main canal.

Low potential areas are about 1.452 km^2 (145.157 Hectares) or 39.52% that are Kok Rit Port, and the areas that are far from various facilities.

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The result of **the potential evaluation of ecotourism area** as follows:

High potential areas are tourist attractions that have **moderate to high** value and importance of ecotourism as pottery village, Poramai Yikawat temple, and Sao Thong Tong temple.

Moderate potential areas are tourist attractions that have **moderate** value and importance of ecotourism as Pailoam temple, Chim Plee temple and Palelai temple.

Low potential areas are tourist attractions that have **low to moderate** value and importance of ecotourism as Salakool temple and orchard.

The result of **the potential determination of area for ecotourism development** was divided 2 cases as follows:

CASE 1 : Distance from factor 50 m.

High potential areas are about 0.071 km^2 (7.158 Hectares) or 1.92% that have **high** ecotourism potential and **high to moderate** tourism facilities potential that are pottery village, Poramai Yikawat temple, and Sao Thong Tong temple.

Ecotourism development guidelines: reorganize main ports and visitor center, install public telephone at pottery village and main interpretation sign at Poramai Yikawat Temple, and establish first aid station and security station at Poramai Yikawat Temple.

Moderate potential areas are about 0.577 km^2 (57.661 Hectares) or 15.47% that have **moderate** ecotourism potential and tourism facilities potential that are Pailoam temple, Chim Plee temple and Palelai temple. Or the areas that have **low** ecotourism potential and **moderate to high** tourism facilities potential that are Salakool Temple, Some orchard, and nearby Sao Thong Tong Temple, Moo.5 health station, Wat Makamtong port, Wat Chan canal, Wat Salakool canal, Pottery Village and edge of road/path. Or the areas

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that have **high** ecotourism potential and **low** tourism facilities potential that are some Pottery Village (Moo.7).

Ecotourism development guidelines: reorganize Pailoam Temple Port and Chim Plee Temple Port and install interpretation signs at Pailoam Temple and Chim Plee Temple.

Low potential areas are about 3.079 km^2 (307.916 Hectares) or 82.61% that have low ecotourism potential and tourism facilities potential that are orchard, which far from facilities and non-tourist attraction.

Ecotourism development guidelines: support bicycle-riding activity around this island and establish first aid station at bicycle route that is orchard.

CASE 2 : Distance from factor 100 m.

High potential areas are about 0.096 km^2 (9.552 Hectares) or 2.58% that have **high** ecotourism potential and **moderate to high** tourism facilities potential that are pottery village, Poramai Yikawat temple, Sao Thong Tong temple, Pailoam Temple, Chim Plee Temple and Palelai Temple.

Ecotourism development guidelines: reorganize main ports and visitor center, install public telephone at pottery village, Pailoam Temple and Chim Plee Temple and main interpretation sign at Poramai Yikawat Temple, and stablish first aid station and security station at Poramai Yikawat Temple and Chim Plee Temple.

Moderate potential areas are about 1.843 km^2 (184.330 Hectares) or 49.48% that have **low** ecotourism potential and **moderate to high** tourism facilities potential that is Salakool Temple, Some orchard and nearby Poramai Yikawat Temple, Sao Thong Tong Temple, Pailoam Temple, Pottery Village, Chim Plee Temple and Palelai Temple.

Ecotourism development guidelines: reorganize canal and port, which is near orchard and organize Ago-tourism.

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Low potential areas are about 1.786 km^2 (178.609 Hectares) or 47.94% that have **low** ecotourism potential and **low** tourism facilities potential that is orchard, which is far from facilities.

Ecotourism development guidelines: use of uncultivated land as Local Culture Square.

This study shows that if criteria changing, different development guidelines. The benefits of using GIS are quick, correct and efficient to analyze data.

7.2 Recommendations for Further Study

7.2.1 Develop program by writing script (AVENUE Language) for automatic analysis because this study used many analysis procedures. Then if it has many factors and data, it is complicated. Such as analysis by overlaying (union) factor concerned, program that uses analysis in this study can union 2 layers per time if further study write script in order to union all layers per time so that it will be reduced procedure and time for analysis.

7.2.2 Weight of factor of this study used questionnaire to ask for opinions from experts and officers concerned that emphasized group of environmental officer, Division of Natural and Art Environmental Conservation, Office of Environmental Policy and Planning. Then further study should ask increase other experts such as town plan officer, EIA scientist and economist, etc.

7.2.3 The potential evaluation of ecotourism area should ask for opinion from local people in order to accord with principle of ecotourism.

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APPENDIX A

QUESTIONNAIRES FOR WEIGHTING FOR THE POTENTIAL EVALUATION OF TOURISM FACILITIES AREA

แบบสอบถามเพื่อประเมินศักยภาพด้านสิ่งอำนวยความสะดวกทางการท่องเที่ยว

ท่านคิดว่าปัจจัยต่างๆต่อไปนี้ มีความสำคัญด้านสิ่งอำนวยความสะดวกทางการท่องเที่ยว บริเวณเกาะเกร็ด จ.นนทบุรี เพียงใด

ปัจจัย	ลำดับความสำคัญ				
	มากที่สุด (5)	มาก (4)	ปานกลาง (3)	น้อย (2)	น้อยที่สุด (1)
1. ถนน (ทางเดิน)					
2. คลอง					
3. ท่าเรือ					
4. โทรศัพท์สาธารณะ					
5. สถานที่ราชการ เช่น สถานีตำรวจ, สถานีอนามัย, อบต. เป็นต้น					

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APPENDIX B

DETAILS OF EXPERTS AND OFFICERS CONCERNED

Table B.1 Details of experts and officers concerned that answer questionnaires for potential evaluation of tourism facilities area and ecotourism area.

ชื่อ-สกุล	ตำแหน่ง	สถานที่ทำงาน
1. นางอุษา เกียรติชัยพิพัฒน์	นักวิชาการสิ่งแวดล้อม8ว.	กองอนุรักษ์สิ่งแวดล้อมธรรมชาติและศิลปกรรม สำนักงานนโยบายและแผนสิ่งแวดล้อม
2. น.ส.กิ่งดาว รอดภัย	เจ้าหน้าที่วิเคราะห์โครงการวิจัย	กองอนุรักษ์สิ่งแวดล้อมธรรมชาติและศิลปกรรม สำนักงานนโยบายและแผนสิ่งแวดล้อม
3. นายนพพร เอียดเงียง	นักวิชาการสิ่งแวดล้อม4	กองอนุรักษ์สิ่งแวดล้อมธรรมชาติและศิลปกรรม สำนักงานนโยบายและแผนสิ่งแวดล้อม
4. ดารารัตน์ แก้วขันตี	นักวิชาการสิ่งแวดล้อม4	กองอนุรักษ์สิ่งแวดล้อมธรรมชาติและศิลปกรรม สำนักงานนโยบายและแผนสิ่งแวดล้อม
5. สุกัลยา ปัณฑะจักร์	นักวิชาการสิ่งแวดล้อม	กองอนุรักษ์สิ่งแวดล้อมธรรมชาติและศิลปกรรม สำนักงานนโยบายและแผนสิ่งแวดล้อม
6. นางกุลปราโมทย์ วรรณะเลิศ	หัวหน้างานวิชาการอนุรักษ์ด้านการท่องเที่ยว	กองอนุรักษ์ การท่องเที่ยวแห่งประเทศไทย
7. นายเอิบลาภ ศรีภิรมย์	พนักงานพัฒนาการท่องเที่ยว 5	กองอนุรักษ์ การท่องเที่ยวแห่งประเทศไทย
8. นายสมชาย ทัดชัง	ปลัดองค์การบริหารส่วนตำบลเกาะเกร็ด	องค์การบริหารส่วนตำบลเกาะเกร็ด อ.ปากเกร็ด จ.นนทบุรี
9. นายวัชรชัย โฉมอินทร์	กำนันเกาะเกร็ด (ประธาน อบต. เกาะเกร็ด)	องค์การบริหารส่วนตำบลเกาะเกร็ด อ.ปากเกร็ด จ.นนทบุรี

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APPENDIX C

WEIGHTING CALCULATION FOR THE POTENTIAL EVALUATION OF TOURISM FACILITIES AREA

Count number of experts, and officers concerned that have opinion in each factors from questionnaires of the potential evaluation of tourism facilities area in order to calculate weight by using formula as follow:

$$\bar{x} = \frac{\Sigma f_i x_i}{N}$$

Where:

$\bar{x}$ = mean of factor capacity

f_i = Number of populations that have opinion in level i

x_i = ranking score

N = Number of populations that answered questionnaires

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Table C.1 Number of experts, and officers concerned that have opinion in each factors and mean of factor capacity (weight) for the potential evaluation of tourism facilities area

Factor	Level	Ranking Score (x_i)	Number of populations (f_i)	Weighting Score
1. Port / Path	Highest	5	5	25
	High	4	3	12
	Moderate	3	1	3
	Low	2	0	0
	Lowest	1	0	0
	SUM		**9**	**40**
	AVERAGE			**4.44**
2. Road	Highest	5	3	15
	High	4	4	16
	Moderate	3	2	6
	Low	2	0	0
	Lowest	1	0	0
	SUM		**9**	**37**
	AVERAGE			**4.11**
3. Canal	Highest	5	2	10
	High	4	2	8
	Moderate	3	4	12
	Low	2	0	0
	Lowest	1	1	1
	SUM		**9**	**31**
	AVERAGE			**3.44**
4. Public Telephone	Highest	5	0	0
	High	4	3	12
	Moderate	3	3	9
	Low	2	3	6
	Lowest	1	0	0
	SUM		**9**	**27**
	AVERAGE			**3.00**
5. Institutional land	Highest	5	0	0
	High	4	1	4
	Moderate	3	7	21
	Low	2	1	2
	Lowest	1	0	0
	SUM		**9**	**27**
	AVERAGE			**3.00**

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APPENDIX D

SCORE FOR THE POTENTIAL EVALUATION OF TOURISM FACILITIES AREA

Table D.1 Details of score for the potential evaluation of tourism facilities area

Factors	Indicators		Ranking Score	Multiple of Score	Score
	Type of Factors	Distance from factor (m)			
1. Port	**Main Port or crossing** (3)	0-50	(5)	15	5
		50-100	(4)	12	4
		100-150	(3)	9	3
		150-200	(2)	6	2
		>200	(1)	3	1
	Specific port of a place (2)	0-50	(5)	10	4
		50-100	(4)	8	3
		100-150	(3)	6	2
		150-200	(2)	4	2
		>200	(1)	2	1
	Port of discharge (1)	0-50	(5)	5	2
		50-100	(4)	4	2
		100-150	(3)	3	1
		150-200	(2)	2	1
		>200	(1)	1	1
2. Road / Path		0-50	(5)	5	5
		50-100	(4)	4	4
		100-150	(3)	3	3
		150-200	(2)	2	2
		>200	(1)	1	1
3. Canal	**Main Canal** (2)	0-25	(5)	10	5
		25-50	(4)	8	4
		50-75	(3)	6	3
		75-100	(2)	4	2
		>100	(1)	2	1
	Minor Canal (1)	0-25	(5)	5	3
		25-50	(4)	4	2
		50-75	(3)	3	2
		75-100	(2)	2	1
		>100	(1)	1	1

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Table D.1 Details of score for the potential evaluation of tourism facilities area. (Continued)

Factors	Indicators		Ranking Score	Multiple of Score	Score
	Type of Factors	Distance from factor (m)			
4. Public Telephone		0-50	(5)	5	5
		50-100	(4)	4	4
		100-150	(3)	3	3
		150-200	(2)	2	2
		>200	(1)	1	1
5. Institutional land	**Health and police station** (3)	0-50	(5)	15	5
		50-100	(4)	12	4
		100-150	(3)	9	3
		150-200	(2)	6	2
		>200	(1)	3	1
	Office of Sub-district Administrative Organization (2)	0-50	(5)	10	4
		50-100	(4)	8	3
		100-150	(3)	6	2
		150-200	(2)	4	2
		>200	(1)	2	1
	School (1)	0-50	(5)	5	2
		50-100	(4)	4	2
		100-150	(3)	3	1
		150-200	(2)	2	1
		>200	(1)	1	1

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APPENDIX E

QUESTIONNAIRES FOR SCORING FOR THE POTENTIAL EVALUATION OF ECOTOURISM AREA

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แบบสอบถามเพื่อการประเมินศักยภาพของพื้นที่ด้านการท่องเที่ยวเชิงอนุรักษ์

ท่านคิดว่าแหล่งท่องเที่ยวแต่ละที่ มีความสำคัญทางประวัติศาสตร์และโบราณคดี ศิลปกรรม วัฒนธรรม ประเพณีของชุมชน ความเป็นธรรมชาติ ความสวยงามของทัศนียภาพ และความสะดวกในการเข้าถึง มากน้อยเพียงใด

แหล่งท่องเที่ยว	ประวัติศาสตร์และโบราณคดี				ศิลปกรรม				วัฒนธรรมประเพณีของชุมชน				ความเป็นธรรมชาติ				ทัศนียภาพ				ความสะดวกในการเข้าถึง			
	มาก	ปานกลาง	น้อย	ไม่มี	มาก	ปานกลาง	น้อย	ไม่มี	มาก	ปานกลาง	น้อย	ไม่มี	มาก	ปานกลาง	น้อย	ไม่มี	มาก	ปานกลาง	น้อย	ไม่มี	มาก	ปานกลาง	น้อย	ไม่มี
1. วัดปรมัยยิกาวาส																								
2. วัดไผ่ล้อม																								
3. วัดเสาธงทอง																								
4. วัดฉิมพลี																								
5. วัดป่าเลไลย์																								
6. วัดศาลากุล																								
7. หมู่บ้านเครื่องปั้นดินเผา																								
8. สวนผลไม้																								

Chiang Mai University

APPENDIX F

SCORING CALCULATION FOR THE POTENTIAL EVALUATION OF ECOTOURISM AREA

Scoring Calculation for the Potential Evaluation of Ecotourism Area

Count number of ecotourist that have opinion in each factors from questionnaires of the potential evaluation of ecotourism area in order to calculate score by using formula as follow:

$$\bar{x} = \frac{\Sigma f_i x_i}{N}$$

Where:

$\bar{x}$ = mean of factor capacity

f_i = Number of populations that have opinion in level i

x_i = ranking score

N = Number of populations that answered questionnaires

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Table F.1 Number of ecotourist that have opinion in each factors and mean of factor capacity (score) for the potential evaluation of ecotourism area

Tourist Attractions	Ranking Score (x_i)	History and archaeology		Art		Culture and custom		Naturalness		Scenery / Landscape		Accessibility	
		f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$
1. Poramai Yikawat Temple	High(3)	14	42	10	30	11	33	7	21	11	33	15	45
	Moderate(2)	10	20	14	28	11	22	15	30	12	24	8	16
	Low(1)	0	0	0	0	2	2	2	2	1	1	1	1
	None(0)	0	0	0	0	0	0	0	0	0	0	0	0
	SUM	24	62	24	58	24	57	24	53	24	58	24	62
	AVERAGE	**2.58**		**2.42**		**2.38**		**2.21**		**2.42**		**2.58**	
2. Pailom Temple	High(3)	6	18	5	15	5	15	2	6	6	18	7	21
	Moderate(2)	16	32	17	34	18	36	20	40	16	32	16	32
	Low(1)	2	2	2	2	1	1	2	2	2	2	1	1
	None(0)	0	0	0	0	0	0	0	0	0	0	0	0
	SUM	24	52	24	51	24	52	24	48	24	52	24	54
	AVERAGE	**2.17**		**2.13**		**2.17**		**2.00**		**2.17**		**2.25**	

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Table F.1 Number of ecotourist that have opinion in each factors and mean of factor capacity (score) for the potential evaluation of ecotourism area (Continued)

Tourist Attractions	Ranking Score (x_i)	History and archaeology		Art		Culture and custom		Naturalness		Scenery / Landscape		Accessibility	
		f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$
3. Sao Thong Tong Temple	High(3)	12	36	11	33	6	18	9	27	11	33	9	27
	Moderate(2)	11	22	12	24	15	30	14	28	11	22	10	20
	Low(1)	1	1	1	1	3	3	1	1	2	2	5	5
	None(0)	0	0	0	0	0	0	0	0	0	0	0	0
	SUM	24	59	24	58	24	51	24	56	24	57	24	52
	AVERAGE		**2.46**		**2.42**		**2.13**		**2.33**		**2.38**		**2.17**
4. Chim Plee Temple	High(3)	5	15	8	24	6	18	6	18	8	16	6	18
	Moderate(2)	17	34	15	30	13	26	16	32	12	24	14	28
	Low(1)	2	2	1	1	5	5	2	2	3	3	3	3
	None(0)	0	0	0	0	0	0	0	0	1	0	1	0
	SUM	24	51	24	55	24	49	24	52	24	43	24	49
	AVERAGE		**2.13**		**2.29**		**2.04**		**2.17**		**2.13**		**2.04**

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Table F.1 Number of ecotourist that have opinion in each factors and mean of factor capacity (score) for the potential evaluation of ecotourism area (Continued)

Tourist Attractions	Ranking Score (x_i)	History and archaeology		Art		Culture and custom		Naturalness		Scenery / Landscape		Accessibility	
		f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$
5. Palelai Temple	High(3)	3	9	2	6	3	9	5	15	2	6	4	12
	Moderate(2)	15	30	16	32	10	20	17	34	16	32	16	32
	Low(1)	6	6	6	6	10	10	2	2	4	4	3	3
	None(0)	0	0	0	0	1	0	0	0	2	0	1	0
	SUM	24	45	24	44	24	39	24	51	24	42	24	47
	AVERAGE	**1.88**		**1.83**		**1.63**		**2.13**		**1.75**		**1.96**	
6. Salakool Temple	High(3)	1	3	2	6	3	9	3	9	2	6	3	9
	Moderate(2)	12	24	7	14	15	30	9	18	13	26	12	24
	Low(1)	11	11	15	15	6	6	12	12	9	9	9	9
	None(0)	0	0	0	0	0	0	0	0	0	0	0	0
	SUM	24	38	24	35	24	45	24	39	24	41	24	42
	AVERAGE	**1.58**		**1.46**		**1.88**		**1.63**		**1.71**		**1.75**	

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Table F.1 Number of ecotourist that have opinion in each factors and mean of factor capacity (score) for the potential evaluation of ecotourism area. (Continued)

Tourist Attractions	Ranking Score (x_i)	History and archaeology		Art		Culture and custom		Naturalness		Scenery / Landscape		Accessibility	
		f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$	f_i	$f_i x_i$
7. Pottery Village	High(3)	14	42	20	60	19	57	7	21	7	21	16	48
	Moderate(2)	8	16	4	8	5	10	14	28	15	30	7	14
	Low(1)	1	1	0	0	0	0	2	2	2	2	1	1
	None(0)	1	0	0	0	0	0	1	0	0	0	0	0
	SUM	24	59	24	68	24	67	24	51	24	53	24	63
	AVERAGE	**2.46**		**2.83**		**2.79**		**2.13**		**2.21**		**2.63**	
8. Orchard	High(3)	0	0	0	0	4	12	15	45	10	30	1	3
	Moderate(2)	4	8	2	4	4	8	8	16	11	22	11	22
	Low(1)	1	1	4	4	13	13	1	1	3	2	11	11
	None(0)	19	0	18	0	3	0	0	0	0	0	1	0
	SUM	24	9	24	8	24	33	24	62	24	54	24	36
	AVERAGE	**0.38**		**0.33**		**1.38**		**2.58**		**2.29**		**1.50**	

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APPENDIX G

QUESTIONNAIRES FOR WEIGHTING FOR THE POTENTIAL EVALUATION OF ECOTOURISM AREA

แบบสอบถามเพื่อการประเมินศักยภาพของพื้นที่ด้านการท่องเที่ยวเชิงอนุรักษ์

ท่านคิดว่าปัจจัยต่างๆต่อไปนี้ มีความสำคัญด้านการท่องเที่ยวเชิงอนุรักษ์ บริเวณเกาะเกร็ด จ.นนทบุรี เพียงใด

ปัจจัย	ลำดับความสำคัญ				
	มากที่สุด (5)	มาก (4)	ปานกลาง (3)	น้อย (2)	น้อยที่สุด (1)
1. ประวัติศาสตร์ และโบราณคดี					
2. ศิลปกรรม					
3. วัฒนธรรม ประเพณีของชุมชน					
4. ความเป็นธรรมชาติ					
5. ทัศนียภาพ					
6. ความสะดวกในการเข้าถึง					

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APPENDIX H

WEIGHTING CALCULATION FOR THE POTENTIAL EVALUATION OF ECOTOURISM AREA

Count number of experts, and officers concerned that have opinion in each factors from questionnaires of the potential evaluation of ecotourism area in order to calculate weight by using formula as follow:

$$\bar{x} = \frac{\Sigma f_i x_i}{N}$$

Where:

$\bar{x}$ = mean of factor capacity

f_i = Number of populations that have opinion in level i

x_i = ranking score

N = Number of populations that answered questionnaires

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Table H.1 Number of experts, and officers concerned that have opinion in each factors and mean of factor capacity (weight) for the potential evaluation of ecotourism area

Factor	Level	Ranking Score (x_i)	Number of populations (f_i)	Weight
1. History and Archaeology	Highest	5	3	15
	High	4	6	24
	Moderate	3	0	0
	Low	2	0	0
	Lowest	1	0	0
	SUM		**9**	**39**
	AVERAGE			**4.33**
2. Art	Highest	5	4	20
	High	4	3	12
	Moderate	3	2	6
	Low	2	0	0
	Lowest	1	0	0
	SUM		**9**	**38**
	AVERAGE			**4.22**
3. Culture and custom of community	Highest	5	7	35
	High	4	2	8
	Moderate	3	0	0
	Low	2	0	0
	Lowest	1	0	0
	SUM		**9**	**43**
	AVERAGE			**4.78**
4. Naturalness	Highest	5	2	10
	High	4	3	12
	Moderate	3	4	12
	Low	2	0	0
	Lowest	1	0	0
	SUM		**9**	**34**
	AVERAGE			**3.78**
5. Scenery / Landscape	Highest	5	3	15
	High	4	4	16
	Moderate	3	2	6
	Low	2	0	0
	Lowest	1	0	0
	SUM		**9**	**37**
	AVERAGE			**4.11**

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Table H.1 Number of experts, and officers concerned that have opinion in each factors and mean of factor capacity (weight) for the potential evaluation of ecotourism area. (Continued)

Factor	Level	Ranking Score (x_i)	Number of populations (f_i)	Weight
6. Accessibility	Highest	5	1	5
	High	4	3	12
	Moderate	3	4	12
	Low	2	1	2
	Lowest	1	0	0
	SUM		**9**	**31**
	AVERAGE			**3.44**

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APPENDIX I

TABLE (DATABASE) OF FACTOR FOR DATA ANALYSIS

Main_canal

Id_MainCanal	Buffer_Distance	Area	Score_MainCanal
1	400.0000	476496.687	2
2	300.0000	424774.791	3
3	200.0000	374207.277	4
4	100.0000	315379.973	5
5	0.0000	2082678.948	1

Sub_canal

Id_SubCanal	Buffer_Distance	Area	Score_SubCanal
1	400.0000	458551.542	1
2	300.0000	776891.438	2
3	200.0000	1051721.899	2
4	100.0000	1194059.228	3
5	0.0000	192313.569	1

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Phone

Id_Phone	Buffer_Distance	Area	Score_Phone	W*S_Phone
1	400.0000	650187.982	2	6.00
2	300.0000	481044.087	3	9.00
3	200.0000	320200.516	4	12.00
4	100.0000	112017.300	5	15.00
5	0.0000	2110087.791	1	3.00

road

Id_Road	Buffer_Distance	Area	Score_Road	W*S_Road
1	400.0000	482433.515	2	8.22
2	300.0000	692344.807	3	12.33
3	200.0000	893536.283	4	16.44
4	100.0000	1136740.807	5	20.55
5	0.0000	468482.263	1	4.11

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MainPort

Id_MainPort	Buffer_Distance	Area	Score_MainPort
1	400.0000	163735.438	2
2	300.0000	124202.978	3
3	200.0000	82796.762	4
4	100.0000	28944.470	5
5	0.0000	3273858.026	1

PlacePort

Id_PlacePort	Buffer_Distance	Area	Score_PlacePort
1	400.0000	479430.133	2
2	300.0000	358676.593	2
3	200.0000	216344.423	3
4	100.0000	72764.280	4
5	0.0000	2546322.246	1

DischargePort

Id_DischargePort	Buffer_Distance	Area	Score_DischargePort
1	400.0000	203309.362	1
2	300.0000	146322.449	1
3	200.0000	90000.399	2
4	100.0000	25359.006	2
5	0.0000	3208546.459	1

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Health & Police Station

Id_HealthPolice	Buffer_Distance	Area	Score_HealthPolice
1	-100.0000	1781.973	5
2	400.0000	411902.766	2
3	300.0000	331602.202	3
4	200.0000	231586.546	4
5	100.0000	104800.511	5
6	0.0000	2591863.678	1

Sub_district

Id_SubDistrict	Buffer_Distance	Area	Score_SubDistrict
1	-100.0000	153.831	4
2	400.0000	153132.647	2
3	300.0000	139604.376	2
4	200.0000	97010.243	3
5	100.0000	35395.451	4
6	0.0000	3248241.127	1

School

Id_School	Buffer_Distance	Area	Score_School
1	-100.0000	15606.523	2
2	400.0000	436047.906	1
3	300.0000	367188.106	1
4	200.0000	267470.729	2
5	100.0000	154213.740	2

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Tourism Attractions

Id	Type	Area	Score
1	orchard	2738399.548	1
2	temple1	18955.695	3
3	non_tourism	884151.778	0
4	temple5	8357.713	2
5	temple6	344.526	2
6	temple4	6674.464	1
7	temple3	11417.859	3
8	temple2	5235.787	2
9	pottery village	51385.215	3

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BIOGRAPHY

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