THE DEVELOPMENT OF THE STRUCTURAL EQUATION MODEL OF FACTORS AFFECTING SUCCESS FOR COASTAL EROSION MANAGEMENT AT THE UPPER GULF OF THAILAND

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ABSTRACT

Title of Dissertation	The Development of the Structural Equation Model of Factors Affecting Success for Coastal Erosion Management at the Upper Gulf of Thailand
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The research aims to 1) study direct and indirect effects of factors affecting the success in coastal erosion management in the upper Gulf of Thailand, and 2) develop and test the congruence of the measurement model and the structural equation model of factors affecting the success in coastal erosion management in the upper Gulf of Thailand with empirical data. The conduction of research was divided into two stages. The first stage was qualitative research through 1) document analysis and 2) in-depth interview. The second stage was quantitative research by survey questionnaires, a total of 420 samples. Data were analyzed by descriptive and inferential statistics, including the analysis of the structural equation model (SEM).

The results of this study showed that 1) factors relating to policies, strategic plans, and laws have a positive direct effect on the integrated coastal zone management of coastal erosion and people's participation, but has no statistically significant effect on success in coastal erosion management. The integrated coastal zone management of coastal erosion and people's participation has a positive direct effect on the success of coastal erosion management. For indirect effects, the success in coastal erosion management factor is indirectly influenced by policies, strategic plans, and laws through the integrated coastal zone management of coastal erosion and people's participation. 2) The developed model is found to be congruent with empirical data at a statistical significance level. Therefore, to successfully manage coastal erosion, those involved in coastal erosion management have to adopt sustainable development

concepts, maintain the value of the functional structure of the coastal environment, develop maximal economic efficiency, and concern about social equity.

This research suggests that 1) the government should encourage people to participate in coastal erosion management while shifting its role from an operator to a facilitator via some mechanisms, which may be applied in various forms, such as community-based management, cooperative management with some motivational measures, or having the private sectors to take parts in management. The enhancement of people's participation can help people to be well aware of the importance of the coast and stimulate their conscience for conserving and utilizing it worthily and sustainably. 2) It is important to have a mechanism for enabling those involved in coastal erosion management to be knowledgeable and understand the essentials of the integrated coastal zone management of coastal erosion, including having mechanisms to negotiate benefits by changing concepts towards all parties' benefits to achieve acceptance and cooperation in management, leading to truly integrated coastal zone management of coastal erosion. 3) The government sector must empower local personnel to be able to implement management plans, including regulating and monitoring coastal areas effectively.

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CHAPTER 1

INTRODUCTION

1.1 Background and Significance of the Problems

The coastal environments are important to human life, ecosystems, and the livelihoods of marine organisms that consist of various systems having a relationship and mutual benefit. It also has economic importance and the history of the Thai nation. Thailand has a coastline and maritime areas with the potential for high biological production. The coastal environment changes over time because of the influence of the wind waves that changed by seasons and also influenced by freshwater flowing from the upstream producing an area rich in nutrients for marine and coastal animals. It is also an important source of human occupation. Therefore, the coastline is a complex and fragile dimension of the ecosystem so it is easy to deteriorate and lose the environment. In addition, the coastal area is also an economic base for the production of many products and services such as industrial sites, communities, tourist attractions, aquaculture, and coastal fisheries. At the same time, developing various activities in the coastal areas will cause environmental and pollution problems in the Gulf of Thailand and Andaman coastal areas as well.

Thailand has a coastline of about 3,148.23 kilometers, covering 23 coastal provinces. The coast of the Gulf of Thailand has a length of 2,055.18 kilometers, covering 17 provinces. The length of the Andaman Sea coastline is 1,093.14 kilometers, covering 6 provinces. Coastal erosion is recognized that urgent remedies are needed because it affects people living in the coastal area of over 12 million people. The coastal area of Thailand is tidal flat, mostly mangrove forests, such as the upper Gulf of Thailand which is the accumulation of small sediments and the use of coastal areas as a living and shrimp farming community, causing the original mangrove forest to be destroyed causing this area to have severe erosion. In the area of the mainland beaches,

there is erosion along the beach because there is a building blocking the direction of the current.

Besides, coastal erosion is caused by the lack of sediment deposit as most of Thailand's coastal landforms are large and long plain, 0.5-4 meters above sea level. A large and long river flows through soft-soil wetlands from upstream mountains, transporting a huge amount of sediment into a river mouth and deposited along the coast. Sediment deposit can occur because of other factors: wave, wind, tides, and currents that bring offshore sediment to be deposited along the coast. On the other hand, the shortage of sediment deposit can be caused by lots of construction, i.e., bridges, roads, sand digging for construction along a river, etc., obstruct the water flow and thus decrease onshore sediment. Hence, they cannot sufficiently replace coastal sediment that is eroded, when wind and wave take away such sediment off the coast during the monsoon season. Another factor is the destruction of upstream forest and water source, which makes a river shallower increasingly, especially in combination with human activities along the river edge. All of these can also reduce the amount of sediment flowing into a river. Generally, coastal erosion causes problems and impact in several domains, which can be classified into four main domains as follows:

1) Economics

The directly affected business is tourism, by the eroded and deteriorated coast and the loss of beautiful beaches, especially the famous ones and the main destinations of tourists around the world. Thus, a huge amount of income and future investment are affected. On the other hand, a large number of resources and budgets have to be spent for preventing coastal erosion and protecting the expected benefits.

2) Environment

Coastal ecosystems, i.e., beaches, mangrove forests, seagrass, and coral, will be directly affected as the erosion and deposition changes of sediment lead to the loss of old beach line and the deposition of sediment on seagrass and coral reefs. Moreover, the eroded coastal mangrove forests cause deteriorating changes, especially to seagrass, coral reefs, and biological diversity, and the equilibrium of all ecosystems around those areas eventually.

3) Society

Owing to coastal erosion, nearby communities have to migrate from their hometown or native place to other places, and this destroys a community's ways of living and traditional culture. They might be homeless and jobless, or they cannot continue their normal occupation; thus, it yields a domino effect to the economic sector as well.

4) Quality of Life

The erosion-affected communities will lose their land and property and need to adapt their ways of living. Besides, they will be anxious about their new occupation. All of these effects may destroy their good psychological condition and family relationships, and worsen their quality of life.

The impact of the erosion is interlocked and interconnected with all parts of the society: economics, society, resources, and quality of life. Still, such an effect can be prevented or alleviated by well-planned preparation of the government sector, coastal communities, and people of all sectors.

The problem of coastal erosion is a global problem. The main cause is both natural and human. There are more than 20 forms of main methods for managing, preventing, and solving coastal erosion problems which are divided into 4 main methods as follows 1) No action, 2) Immigration moves to other areas or retreating, 3) Establishing the stability of the coastline without using engineering structures and 4) Creating stability of the coast by using engineering structures (Pilkey & Dixon, 1996; Pilkey & Hume, 2001). Considering any alternatives in the management and protection solutions are necessary to bring relevant information to complete the analysis by considering together with the appropriateness and feasibility of engineering, economy, society, and environment which will be different according to the location and time or situation (Department of Marine and Coastal Resources, 2011).

In Thailand, the problem of coastal erosion which the government recognizes is a serious problem that will intensify in the future. Especially in the case of climate change and sea-level rise as an additional factor resolving government problems is the only solution in areas that are eroded. By solving local problems, using local wisdom as a guideline, such as planting mangrove forests, etc. However, the government sector should consider having more strategic planning. By having to understand the causes

and problems that arise should consider whether the problem is caused by natural processes or human actions or both causes the solution should be implemented in accordance with the policy and must be developed systematically and continuously.

In general, solving the problem of coastal erosion is the responsibility of many agencies at many levels. Therefore, senior government officials have a major role in coordinating between the roles and responsibilities of various departments and can specify policies clearly that problems of erosion in the valuable and important coastal ecosystems must be solved by considering the effects of the solution to the coastal conditions, purpose, and direction of development, land use plan, tourism development and the level of risk of erosion that may occur in the future, for example, when developing urban communities in coastal areas that require high investment, coastal erosion prevention is a form that is more appropriate and consistent with the objectives of urban development rather than allowing the area to be per natural conditions.

The upper Gulf of Thailand has 5 consecutive coastal provinces which are Samut Songkhram, Samutsakhon, Bangkok, Samut Prakan, and Chachoengsao. 4 large rivers are flowing into the Gulf of Thailand, namely Mae Klong River, Tha Chin River, Chao Phraya River, and Bang Pakong River. The area is characterized by the sediment of the river mouth. The layer of the soil is about 19-21 meters thick, covered with abundant mangrove forest which is considered to be the largest in Thailand covering the entire coastline of 108 kilometers. Besides, it has always encountered the problem of coastal erosion for a long time, causing the coastline to be washed away in the sea by the waves about several meters per year. Some places may reach 10-20 meters per year. Severe erosion areas are considered critical areas such as coastal areas of Bang Khun Thian, Bangkok which has a sea boundary of approximately 4.7 kilometers has been eroded over a thousand Rai, coastal areas of Song Khlong Subdistrict, Bang Pakong District, Chachoengsao Province, and Khlong Dan Subdistrict, Bang Bo District, Samut Prakan Province also experienced severe coastal erosion as well causing economic and social losses including the coastal ecosystems in that area and still not being able to develop the land to its full potential in the upper Gulf of Thailand, so the coastal areas that have been eroded should be restored to grow mangrove forests to become public areas. However, in the past, some studies for coastal erosion have been conducted to solve the problem of coastal erosion.

There are many forms and different levels of government agencies to consider integrated coastal management, integration between departments with different powers and duties but operating in the same area, integration between coastal communities upstream and downstream, integration between past, present, and future concepts, international integration at different regions or integration of links between ecosystems, society, economy, traditions, and culture.

Management, prevention, and problem-solving of coastal erosion have been continuously developed both in terms of advanced engineering techniques to the extension of folk wisdom or local wisdom with a variety of styles that is effective and ineffective in some cases. There are impacts on the adjacent areas and decision-making conflicts when choosing methods or patterns to be used in solving problems. To ensure long-term coastal stabilization of the country's coastline, the proper approaches for the management of coastal erosion in Thailand are necessary.

Accordingly, the study of the factors affecting the success of coastal erosion management of Thailand is very crucial for providing essential approaches for managing effective marine environment, especially coastal erosion at the upper Gulf of Thailand towards the utmost benefits for the public and for the nation in the future.

1.2 Research Questions

1) What are the factors affecting the success of coastal erosion management in the upper Gulf of Thailand?

2) What are the direct and indirect effects of the factors affecting the success of coastal erosion management in the upper Gulf of Thailand?

3) Is the measurement model and the structural equation model of the factors affecting the success of coastal erosion management in the upper Gulf of Thailand congruent with empirical data and how?

1.3 Research Objectives

This study is aimed towards the following three research objectives:

1) To study policies, plans, strategies, and laws related to coastal erosion, including the integrated coastal zone management of coastal erosion and people's participation in managing coastal erosion that affects success in coastal erosion in the upper Gulf of Thailand.

2) To study the direct and indirect effects of the variables in the structural equation model that affect the success of coastal erosion management in the upper Gulf of Thailand.

3) To develop and test the congruence of the measurement model and the structural equation model of the factors affecting the success of coastal erosion management in the upper Gulf of Thailand with empirical data.

1.4 Research Hypothesis

The latent-variable measurement model and the structural equation model of the factors affecting the success of coastal erosion management in the upper Gulf of Thailand are congruent with the empirical data.

1.5 Scope of the Research

The scope of the research entitled, “The Development of Structural Equation Model of the Factors Affecting Success for Coastal Erosion Management in the upper Gulf of Thailand” is as follows:

Scope of the population: The population of this study is stakeholders in managing coastal erosion in the upper Gulf of Thailand, both public and private sectors, including entrepreneurs in the public sector that are an important part of the mobilization and other related sectors.

Scope of the area: This research is a study in the coastal area of the upper Gulf of Thailand covering 5 coastal adjacent provinces, namely Samut Songkhram, Samutsakhon, Bangkok, Samut Prakan, and Chachoengsao.

1.6 Operational Definitions

1) Policies, plans, strategies, and laws related to coastal erosion management mean a master plan of coastal erosion, strategic plans towards coastal erosion in the upper Gulf of Thailand, laws related to coastal erosion management, the implementation of all concerned policies, plans, and strategies, the enforcement of laws in the area under preventive and corrective measures that enable to drive the operations as planned successfully.

2) Integrated coastal zone management of coastal erosion in the upper Gulf of Thailand means the integration of spatial and resource management, i.e., the congruence of problem-solving of coastal erosion with terrestrial and marine areas, the allocation and utilization of resources, the integrated collaboration among concerned offices, and the integration of techniques and knowledge, i.e., knowledge on coastal erosion, causes of coastal changes, techniques for preventing coastal erosion, and measures and approaches in preventing coastal erosion problems, including mathematical and engineering models.

3) People's participation in coastal erosion management in the area means the involvement of people in managing coastal erosion in their area, starting from the initiation of projects or activities related to coastal erosion in the area, and participation in planning, running and evaluating those projects and activities.

4) Success in coastal erosion management in the upper Gulf of Thailand means methods and approaches for integrating various factors affecting coastal erosion in the upper Gulf of Thailand, such as policies, plans, strategies, laws, integrated coastal zone management, people's participation, the implementation of plans, and the evaluation of the outcome following management plans.

1.7 Expected Benefits

1) Academic benefits: The findings obtained from this research Has expanded the scope of knowledge related to managing coastal erosion in Thailand efficiently, which is proof of theoretical consistency and empirical data that policy and planning characteristics at a strategic level Techniques and knowledge of coastal erosion

management in the upper Gulf of Thailand. Investment, development, and protection of the beach, laws, rules, and regulations, and cooperation between agencies and the people sector All affect the success of coastal erosion management in the upper Gulf of Thailand, which found that these variables that predict the success of coastal erosion management in the Gulf of Thailand. The top of Thailand is not much. Scholars may use these findings to expand the concept of building success in coastal erosion management. Under the context of Thailand, the upper Gulf of Thailand

2) Administrative benefits: The findings from this research will benefit the management and those involved in coastal erosion management in Thailand, including the use of the findings to guide the development of coastal erosion in Thailand in other areas such as the lower Gulf of Thailand and the Andaman coast. Also, the management or related parties may use as approaches for determining education promotion plan or training for those involved in different sectors to have a deeper understanding of the effective management of coastal erosion as well as working behaviors that enhance management services by knowing why and how to affect success in managing coastal erosion under the context of Thailand in the upper Gulf of Thailand

CHAPTER 2

CONCEPTS, THEORIES, AND RELATED STUDIES

The research entitled, “The Development of the Structural Equation Model of Factors Affecting Success for Coastal Erosion Management at the Upper Gulf of Thailand,” applied the following concepts, theories, and studies as guidelines for the study:

2.1 Coastal Management Factors

2.1.1 Meanings of coastal management

2.1.2 Meanings of integrated coastal zone management

2.1.3 Development of coastal management

2.1.4 Coastal management in Thailand

2.1.5 Coastal erosion

2.1.6 Causes of coastal erosion

2.1.7 Effects of coastal erosion

2.1.8 Problems and obstacles of coastal erosion

2.1.9 Prevention and Solutions for coastal erosion

2.1.10 Guidelines for planning and implementing plans and projects for preventing and solving problems of coastal erosion.

2.1.11 Management Budgets for preventing and solving problems of coastal erosion

2.1.12 Organizations/ agencies participating in solving coastal erosion problems

2.2 Factors of Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management

2.2.1 Concerned national policies, strategies, and plans

2.2.2 The Constitution, laws, and resolutions of relevant Ministries or cabinet resolution

2.3 People’s Participation Factors

2.1 Coastal Management

2.1.1 Meanings of Coastal Management

Pernetta and Elder (1993) state that the original meaning of coastal management emphasized coastal engineering or hydrology, which meant the shoreline or coastal improvement or modification to be suitable for use or for protecting the coast from any damage caused by nature or a coastal process.

U.S.A. is the first country that declared the laws of coastal management and defines "coastal management," according to the U.S. Coastal Management Act in 1972, as plans conducted by the government sector for managing the utilization of the whole coastal area. On the other hand, United Nations (1995) defines it as "the governmental plans for managing resources, territories, or activities in the coastal areas, both land and marine."

French (1997) views coastal management as a process in protecting the coast from any damage or changes caused by any activities.

Besides, Kay and Alder (2005) define "management" as capabilities in coping or controlling the situation. Thus, coastal management means the control, regulation, and conduction of any activities, both land, and marine, as planned.

In short, coastal management means the regulation and conduction to reach the determined objectives, plans, or policies related to coastal management, which mostly emphasize the improvement of the deterioration of coastal resources by effective and efficient management, utilization, and conflict resolutions.

2.1.2 Meanings of Integrated Coastal Zone Management (ICZM)

In 1989, Coastal Area Management and Planning Network workshop was convened in South Carolina, U.S.A., attended by 28 representatives from 13 nations. From the workshop, they agreed to have a common definition of "integrated coastal zone management," as "a continual process in developing integrated strategies, which are practical, to allocate environmental, social, and cultural resources, including concerned agencies, towards the success in coastal conservation and utilization sustainably." (United Nation, 1995)

For White and Lopez (1991) ICZM means activities enable sustainable utilization and the management of coastal resources worthily in terms of economics and ecosystems, by considering the relationship among resource systems, and between human beings and the environment. Clark (1992) further explains that coastal management is the conduction of plans for managing coastal resources, in which all affected economically: the government agencies or private organizations, have to participate.

The Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) defines ICZM as "a continually changing process in which the government agencies, communities, science, management, and public benefits are inclusive for preparing and implementing the integrated plans to protect and develop an ecosystem and coastal resources." (GESAMP, 1996)

Furthermore, Sorensen (2002) cited ICZM as a compilation process of knowledge from diverse fields of study, including the collaboration of concerned agencies of the government and private sectors, to plan and implement plans for protecting and developing coastal resources sustainably. The main goal of ICZM is to improve the quality of life of a community that relies on coastal resources. On the other hand, such management must also respond to the needs of developing coastal resources

for the use, while the coastal ecosystem can still function normally. Besides, it helps to decrease expenses for protecting against natural disasters.

Chua (2006) explains the meaning of ICZM as “a conceptual framework for managing resources and environment through the use of an integrated or holistic approach. It is a planning process having communication or interaction to help reduce the complexity of coastal management.”

From the aforementioned definitions, it can be concluded that ICZM is an integrated management process among agencies and concerned plans, including beneficiaries or stakeholders, knowledge in science, society, culture, and economics, for the development planning and implementation towards sustainable utilization, in parallel to the conservation of coastal areas and resources.”

2.1.3 The Development of Coastal Management

Coastal areas are very important. Human beings have used coastal areas for more than a thousand years, i.e., for agriculture, fishery, aquaculture, water transportation, salt farming, etc. After the Industrial Revolution in Europe in the mid-nineteenth century, machines have played more significant roles in the industrial sector. Besides, they can also respond to the increasing numbers of the population. Accordingly, the use of coastal resources has been changed from human survival to commercial purposes. Plenty of machines have been adopted to achieve maximal benefits. On the other hand, urban communities have been expanded enormously from the increased numbers of the population. Such expansion also includes coastal areas. Accordingly, coastal habitat and ecosystems were destroyed and a lot of wastes incurred. (Brown,1997). The utilization from coastal areas in different ways, i.e., the exceeding exploitation of coastal resources, the increasing settlement of human beings in the coastal areas, a focus on economic growth without concerns and proper maintenance of the coast, etc. All of these factors deteriorate limited coastal areas and resources. In other words, coastal resources have deteriorated so much that the deterioration exceeds resources' capacity to restore themselves naturally. At the same time, conflicts occur among coastal users. Therefore, the said deterioration of coastal resources and conflicts in coastal usage require coastal management increasingly. The

management perspective must be shifted from focusing only on the exploitation of coastal resources or economic benefits.

2.1.4 Coastal Management in Thailand

Thailand has prosperous coastal resources, which are Thai's major sources of food and occupations, i.e., fishery, tourism, and industry. Thus, coastal areas become significant sources of national income as well and make urban communities invade coastal areas increasingly. Besides, the utilization of coastal resources in various activities causes deterioration and conflicts of interests over the areas like many other countries, which face the same problems and necessarily manage their coast.

Like other countries, coastal development was initiated by focusing on the utilization of the coast mainly. Later, more importance has been given to the environment and people have been encouraged to participate more in the coastal management in the areas since then. Still, despite the application of ICZM and the concept of people's participation, coastal management in Thailand has not yet achieved its goal as wished due to several obstructions, i.e., a lack of coordination and collaboration among concerned agencies and sectors, a shortage of budgets and management personnel, the enforcement of laws, rejection of changes, fear of losing power in coastal management, a lack of people's participation because of their poverty, etc. (Suvaluck Satumanatpan, 2011).

2.1.5 Coastal Erosion

The shoreline of Thailand is a crucial area with high potentials for national development, i.e., infrastructure, industry, agriculture, and tourism, all of which bring about national income and create jobs for people in the country greatly. On the contrary, the development of shoreline or coastal areas causes coastal changes that are incongruent with nature. For instance, some coastal areas turned to be resorts, high buildings adjacent to the sea, constructed deep seaport, huge piers, gigantic industrial factories, etc. Among all of these changes, rapid coastal erosion is one of the consequences (Siriporn Phannaphatkun, 2013) Coastal erosion and accumulation of sand sediments are natural phenomena and considered as one of the top-priority problems needed to be solved. Problems of coastal and maritime resources depend on

coastal waves and currents as main variables. Typically, the amount of erosion and accumulated sand sediments is unequal each year or each season. The area that has greater deposition than erosion will have the proliferation of land. On the contrary, if the rate of erosion is higher than the deposition or accumulation in the area, the surface runoffs will occur more. However, if the rate of erosion is equal to that of accumulation, then no change happens (Siriporn Phannaphatkun, 2013). Thus, erosion can come from several causes, i.e. the degree of wave' strength, the loss of sediments from a river mouth, a change of wave direction, mangrove deforestation, etc.

Thailand has a coastline of about 3,148.23 kilometers, covering 23 coastal provinces. The coastline is divided into Gulf of Thailand coastline of 2,055 kilometers, covering 17 provinces, (65.28 %), and the Andaman Sea coastline of 1,093.14 kilometers, covering 6 provinces (34.72%). At present, the coastlines throughout the country all face coastal erosion problems of a total of 830 kilometers. Specifically, erosion of 730 kilometers occurs along the Gulf of Thailand, divided into 502 kilometers of moderate-level erosion and 228 kilometers of severe-level erosion. For the Andaman Sea, coastal erosion of 100 kilometers, the erosion at the moderate level is 75 kilometers and 25 kilometers at the severe level. (Office of Official Information Board, 2020)

2.1.6 Causes of Coastal Erosion

Coastal Process is a process in which wind, waves, currents, and tides occur in the sea and coastal areas, which affects coastal environment changes. Factors incurring coastal erosion in Thailand vary in each area and season. Normally, erosion is classified into three types: 1) natural coastal erosion, i.e., waves, wind and storm, currents, tide, landforms, etc. 2) Coastal erosion caused by human activities, i.e., the development of coastal areas, mangrove deforestation, groundwater pumping, etc. 3) coastal erosion caused by natural disorders or disasters. (Coastal Area Management Division, 2018).

2.1.7 The Effects of Coastal Erosion

Coastal erosion can yield four main effects: ecosystems, economics, society, and people's quality of life and mental state. (Chanan Saengnapa, 2017).

1) The effects on ecosystems.

The coastline is considered as a major ecosystem, i.e., beaches, mangrove forests, etc. It is also an aquatic animal nursery. Coastal erosion deteriorates ecosystems along the coastline, reduces the fertility of aquatic animals, and decreases the areas for aquatic-animal nursery. (Chanan Saengnapa, 2017).

2) The effects on economics

Coastal erosion changes the physical condition of the coast, which affects the investment for developing the country in various sectors, i.e., industry, service, and tourism, including the household economy. People will lose their land from coastal erosion and cannot continue their traditional occupation; thus, their income decreases. Besides, the government sector, both central and regional, must lose a lot of budgets to solve the coastal erosion problems through the construction of coastal engineering, i.e., seawall, breakwater, groin, etc. (Chanan Saengnapa, 2017).

3) The effects on society

People living in the area of coastal erosion must move to a safer or less risky place. Sometimes, coastal erosion also damages their houses and land used for earning their living. For example, people living in Moo 11, Song Khlong Subdistrict, Bang Pakong District, Chachoengsao Province lost their entire village in 2005. They also lost their tradition or ways of life, adapted their old and adept occupations to new ones, which decreased their quality of life. (Chanan Saengnapa, 2017). The other example was the area of Ban Khoon Samut Cheen, Samut Prakan Province, which was eroded for a long time until they had to move and settle on a new area. The original 200 households in the old area were reduced to be 100 households in the new area. (Department of Marine and Coastal Resources, 2013).

4) The effects on people’s quality of life and mental state

Severe coastal erosion makes communities lose their land, their occupation, and their accommodation. They must alter their traditional ways of life and feel insecure about their land possession rights. All of these make them worried about their future living. Furthermore, migration to avoid erosion problems also affects people's relationships with their relatives and neighbors. They also have to work in other occupations at which they are not good. Hence, coastal erosion makes communities undergo a lower quality of life. (Sitawee Teerawirun, 2020)

2.1.8 Problems and Obstacles of Coastal Management

Coastal management can undergo multidimensional problems and obstacles: environment, society, economics, etc., which can be divided as follows: (Suvaluck Satumanatpan, 2011)

1) The management cannot catch up with the occurring deterioration. Primarily, coastal areas are fragile and sensitive to changes, while studies and the conduction of policies, strategies, and plans for coastal erosion management are relatively slower than coastal changes.

2) Due to poverty problems, people have to focus on earning their living to gain a higher income; thus, they tend to utilize coastal resources increasingly without concerning about the deterioration that might occur to coastal resources.

3) There is no collaborative management. As coastal areas cover from the watershed to specific economic zones, they are full of resources; therefore, lots of activities utilize such resources, while there are several concerning management agencies or organizations, including several groups of stakeholders. Accordingly, coastal management is complicated and complex.

4) Problems can also occur because of incorrect beliefs and attitudes. Coastal management requires collaboration from several sectors; however, concerned people or groups lack correct knowledge and understanding of the roles and impact of coasts. These people or groups also have incorrect beliefs and attitudes toward their roles in conserving the environment. Consequently, coastal management often fails or is not successful.

5) While coastal management needs to spend huge budgets for several parts of work, i.e., the procurement of related personnel, the procurement of office devices, and some necessary constructions, i.e., waste disposal systems, coastal engineering, etc., there are no sufficient budgets for coastal management.

2.1.9 Preventive Approaches and Solutions for Coastal Erosion

From the 1/2560 meeting on June 23, 2017, the Department of Marine and Coastal Resources, assigned by the National Marine and Coastal Resource Management Plans and Policies Committee to be responsible for establishing plans and projects to prevent and solve coastal erosion problems, submitted its assigned plans and

projects. The Department approved and accelerated its operations towards sustainable prevention and correction of coastal erosion problems, especially in the ways that accord with a coastal equilibrium by natural processes mainly. In general, preventive and corrective approaches towards coastal erosion can be categorized into four main approaches. (Coastal Area Management Division, 2018; Office of the Secretariat of the Prime Minister, 2018; Thai Environment Institute Foundation, 2019)

1) Coastal Equilibrium by Natural Processes is the stabilization of dynamic equilibrium or natural coastal processes to let coastal erosion happen and restore itself naturally. Measures for maintaining natural coastal fertility are issued with some restrictions against human activities that may interfere or disturb coastal stability. The examples of this approach are to take no action, but let nature adjust its equilibrium, to determine a setback zone to prevent the effects of coastal erosion on people, economics, and society, to issue measures for protecting coastal areas.

2) Coastal Erosion Protection is an operation of any activity to protect coastal areas from being eroded and to reduce the rate of erosion, including applying methods that are compatible with or can imitate nature, i.e., beach restoration, edging, coastal engineering (such as seawalls, breakwater, groins, etc.)

3) Coastal Erosion Solution is an operation of any activity to solve coastal erosion problems by accordant patterns with nature, nature imitation, or engineering structure. It also includes the solutions at the cause of problems, i.e., demolishment or modification of constructions that might obstruct the flow of coastal sediments, forestation, sand bypassing, etc.

4) Coastal Rehabilitation is an operation of any activity to restore the eroded coast to its old natural condition and to be used for ecosystem service, i.e., the rehabilitation by mangrove afforestation to create coastal stability, or by sand nourishment to make wave's strength diluted and decrease coastal erosion risks, etc.

2.1.9.1 Measures for Protecting and Correcting Coastal Erosion

The Ministry of Natural Resources and Environment proposed measures for protecting and correcting coastal erosion under the measures for protection and correction of coastal erosion of the Department of Marine and Coastal Resources, which are divided into three main measures into eight forms as follows:

Measure 1: White measures (1 form) are operations to decrease the impact of coastal erosion on people's life and property. The form used is the determination of "a setback zone" by determining a distance of buffer area or by determining the utilization activities that are compatible with the rate of coastal erosion to be able to carry coastal erosion problems in a manageable degree or to avoid so severe erosion that cannot be resolved. It includes the protection of coastlines that might be affected by other areas or that have a tendency to face coastal erosion in the future. This approach will be selected for coastal areas with no activities of high economic values since a setback zone can lose an opportunity to utilize the area while having high compensation costs. Thus, a setback zone might be operated with the demolishment of some structures, which are the cause of coastal erosion.

Measure 2: Green Measures (3 forms) are operations to maintain coastal stability without causing any side-effect to neighboring areas. This measure is suitable for closed coastal areas with small waves and low-slope coast. Three forms are used: forestation, beach nourishment, and edging.

Measure 3: Gray Measures (4 forms) are operations for maintaining coastal stability by engineering structure. This measure is appropriate for open coastal areas with big waves and high-slope coast. Four forms are used: revetment, groins, offshore breakwater, and seawall.

Therefore, when any measure will be selected for use to protect or correct coastal erosion, a proper approach and form should be considered by choosing the approach and form that disturbs natural processes the least since it can help to maintain coastal stability and ecological-system service, not to yield effects to the adjacent areas, and to keep the coastal potentials, especially for developing the area to be a tourism attraction with high income and coastal communities' stability. Particularly, during the storm period, such an approach can reduce damages with lower repairing costs than engineering structure. On the other hand, an operation can use mixed approaches, i.e., forestation and revetment, sand nourishment and groin, etc. Well-considered approaches will not only prevent or solve coastal erosion problems, but they can also reduce the structural impact, maintain natural fertility, and restore mangrove and beach forests over time with more nourished coastal areas and habitats for aquatic animals. (the Ministry of Agriculture and Cooperatives, 2018)

Figure 2.1 Measure for Preventing and Solving Coastal Erosion Problems
Source: The Department of Marine and Coastal Resources, 2018.

2.1.9.2 Recommendations for Preventing and Solving Coastal Erosion

Thai Environment Institute Foundation (2019) proposed guidelines for managing coastal erosion as follows:

1) Apply proper incentive compensation measures to persuade people to move their buildings or constructions to other areas or to determine a setback zone for buildings or constructions on the coastline that may face coastal erosion problems and to avoid property and constructions being damaged.

2) Protect coastal areas or beaches that have no constructions by specifying types or forms of prohibited constructions, while demolishing those with constructions invading coastal areas with coastal erosion to move sand towards equilibrium of nature.

3) Regulate and follow-up ICZM at the provincial level and enhance knowledge and understanding of sustainable coastal erosion solutions.

The later stage of coastal erosion problem-solving is to support the enforcement of measures for protecting and rehabilitating eroded coasts strictly by applying academic problem-solving genuinely, including studying the structure that will not cause any sequential impact from such protection and rehabilitation by explicit plans. Besides, laws and regulations related to coastal erosion should be improved and driven for enactment towards sustainable and balanced conservation, rehabilitation, management, and utilization. (Thai Environment Institute Foundation, 2019).

2.1.9.3 Forms of Measures for Protecting and Solving Coastal Erosion Problems

The protection and problem-solving of the coastal erosion must concern about both short-term and long-term impact; thus, thorough scrutiny of all possible effects, i.e., on economics, communities, environment, etc., needs to be paid high attention. The implementation must be correct based on academic principles and appropriate for the provided budgets. Generally, there are two kinds of coastal protective measures: soft and hard. The hard measures are groins, seawall, revetment, and offshore breakwater. The soft measures are beach nourishment, sand nourishment, mangrove afforestation, and a setback zone, etc. (Payom Rattanamanee, Kanungnit Limjirakhajorn, and Wisut Chotikasathien, 2008; Department of Marine and Coastal Resources, 2018).

1) Hard Measures

Hard Solutions of coastal erosion are breakwater to slow down the speed of waves before reaching the coast, seawall for protecting coastal areas and constructions in the area, groins in I-shaped, Y-shaped, and T-shaped to let sediments deposited on such structures, etc. The detailed protection of and solutions for coastal erosion through hard measures are as follows: (Payom Rattanamanee et al., 2008)

(1) Seawall is a kind of engineering structure constructed in parallel to the coastline for resisting the hit of waves when reaching the shore. Thus, it is the construction close to the shore that lies in parallel to both sand beach and tidal flat to protect houses and property on the coastal areas from coastal erosion.

(2) Revetment is the structure formed by piling medium-sized up to enormous-sized stones along the coastline to reduce the severity of the waves before reaching the shore to prevent the shore from being collapsed. At the base of the rock, synthetic fabrics are placed for splitting the weight and reducing shrinks. However, the disadvantages are that the lower part of the stone next to the sea might be eroded by waves. Besides, how well stone revetment can stand depends on the layer of soil condition in the area as well.

(3) Groin is the structure using stone, Ferro-cement, or reinforced concrete in a perpendicular position, built out into the water from a beach to trap and accumulate sand that would otherwise drift along the beach face and nearshore

zone under the influence of waves approaching the beach at an angle. Groins are for adding beach areas and reducing coastal erosion. Groins are often constructed sequentially with some spaces consistently along the coastline. Groins can be constructed in several shapes. T-shaped groins are like stone revetment that is used for decreasing wave amplitude and for trapping sand drifting along the coastline. The disadvantage of groins is the other side of the structure, in which sand sediments are trapped, cannot be moved; thus, it can cause sequential coastal erosion.

(4) Offshore Breakwater is the structure built offshore in parallel to the coast. The purpose is to reduce the energy of waves on the coast and enable the sedimentation behind the dam, which is built by using stone of various sizes and placed in parallel to the beach, but it is located offshore.

2) Soft measures

The examples of soft measures are “beach nourishment” by using a huge amount of sand to fill up the eroded area, “dune nourishment” by filling up the eroded area with a large amount of sand to make it a slope structure and growing some plants for trapping the sand blowing towards the shore, “mangrove afforestation” in the damaged area, and “a setback zone” to reduce the degree of damage of constructions on the beach areas by prohibiting any construction that is risky for coastal erosion. (Payom Rattananmanee et al., 2008).

(1) Geo-bag /Geo-tube /Geo-container is like the traditional stone dam, which is replaced by a synthetic-fiber object filled with sand. Geo-bags are placed along the coastline like sloped ladders for protection against waves and currents.

(2) Concrete pole or foundation pile. It is to hammer or drive concrete poles or foundation piles to be a wall on the sand layer beneath offshore puddle to reduce the energy of the waves damaging the coastline. However, it is appropriate for the area with not so high waves. Because of its transparency, seawater can pass through it, while sediments will be deposited behind the concrete piles' line.

(3) Edging is to create stability to muddy or muddy sand beaches by implanting bamboo poles, concrete poles, or other materials, to reduce the severity of waves, and the moving or disappearance of sediments from the shore. This results in sedimentation and helps mangrove forests to grow. Besides, it is also the habitat, nursery, and breeding place for aquatic animals. For instance, “bamboo

revetment" is to use bamboo piles for reducing the violence of the waves hitting the shore. Furthermore, it can increase and accelerate the sedimentation behind the coastline. Still, it is proper for the coastal area with not so high waves.

(4) Beach Nourishment is the building of a protection line by imitating the natural processes. Sand with similar quality to the eroded area is used to fill up the eroded area. Typically, sand can be from two sources: mainland sand, i.e., coastal sand bars, coastal flat, etc., and marine sand through dredging at the shallow water close to the shore, at the moderately-deep seaway, and at the deep channel. However, to take sand sediments from other sources requires consideration about the distribution of particle sizes and colors of sand for nourishing the beach mainly.

(5) Dune Nourishment is to cover up the eroded area by sand as high as the old dune and grow some plants on the dune to trap the blown sand from the shore.

(6) Mangrove Afforestation. To afforest mangroves or other plants suitable for the muddy coastal areas is to create coastal stability through the use of plants' roots in seizing soil, sediments, and sand. On the other hand, plants' leaves can protect wind and reduce the violence of waves. Thus, suitable areas should be tidal flats or mangrove forests. In the Gulf of Thailand, young plants of mangrove were planted to replace the damaged ones.

(7) Setback Zone is a strategic measure or policy for reducing the degree of damages to constructions on beaches by prohibiting any construction risky for coastal erosion on the area. This measure determines the utilization of coastal land with buffer zones to enhance the protection of a specific conservation area. Besides, activities of land utilization must be compatible with the rate of coastal erosion. This approach is thus appropriate for coastal areas with no activities of high economic value.

Both soft and hard measures are for solving specific-area problems. Typically, hard measures are suitable for the areas undergoing severe coastal erosion or crisis. However, such an approach can yield erosion of the adjacent areas. For soft measures, they are appropriate for the areas that need an integration of coastal natural resources and have no violent waves and wind. However, it is rather costly in maintenance. (Payom Rattanamanee et al., 2008).

Most solutions for coastal erosion emphasize the use of engineering structures, i.e., seawall, groins, breakwater, etc. However, these methods tend to cause side-effects to adjacent areas and continual erosion. Accordingly, the government must give importance to solving erosion by natural approach, i.e. beach nourishment, which draws sand to cover the eroded areas, dune nourishment, which fills up with sand to be high like the old eroded dune and covers it by some plants for trapping sand, etc. Besides, there are other methods, such as mangrove afforestation in the damaged areas, mangrove-forest rehabilitation, beach forest, coral reefs, Seagrass, etc., to create natural fertility despite possibly high budgets. (Sitawee Teerawirun, 2020).

Notably, the use of legal measures for regulating the coastal area utilization properly and effectively, i.e., a setback zone, as policies to lower the degree of damages of construction on beach areas also includes measures for protecting and maintaining the remaining coastal areas Moreover, there are other measures, i.e. rehabilitation of eroded and damaged coastal areas, the conservation, preservation, and rehabilitation of natural resources and environment along the coast, the creation of communities' participation in protecting and solving coastal erosion systematically. (Sitawee Teerawirun, 2020).

2.1.9.4 Guidelines for Considering Preventive Approaches Before Making Decisions

There are four key principles and concepts for considering methods and forms of protection and solutions of coastal erosion: (Suthilak Rawiwan, 2011; Silvester & Hsu, 1997; Pilkey & Hume, 2001; Pilkey & Young, 2009)

1) The assumption based on engineering structure for protecting and solving coastal erosion is to construct an engineering structure. However, the best principle and concept is to start with a method or form without any construction first. Then, if necessary, engineering structure can be considered as the next step, especially in the case that the main purpose is to conserve or rehabilitate coastline, not to prohibit any buildings or constructions on such areas.

2) If considering that beach nourishment, not engineering structure, should be the appropriate methods, then further consideration is whether they are worth to be operated since they are the alternatives that require high investment and

continuous operation for a long time consecutively. Furthermore, if necessary, a question is if it is possible to operate them with other methods or forms.

3) What should be considered thoroughly is what is needed to be conserved or protected, i.e., in the case that the beach of one national park, which is a natural beach without any residents nor any important places, if it is eroded without any protection nor solutions, will any damage occur? If it is impossible to move or demolish it, will engineering structure be necessary?

4) After the application of engineering structures to protect and solve coastal erosion problems, mostly a continuous operation is needed. Remarkably, when any engineering structure is constructed, such construction tends not to be demolished. On the contrary, it requires even bigger or more constructions since the construction of engineering structures to protect or solve problems of coastal erosion in one area often leads to erosion in another adjacent area. Hence, it is necessary to construct engineering structures by other additional methods or forms like a chain-like process all along the coastal line

In short, according to the fundamental principles and approaches, the protection and problem-solving of coastal erosion can be managed by one particular method or form, or by several methods complementarily, as follows: 1) no operation 2) migration to other areas or setback. 3) creation of coastal stability with no engineering structure, i.e. beach nourishment or rehabilitation, dune nourishment, the control of underground water level, plantation, bamboo revetment, geo-tubes, synthetic fabrics pads, geo-bags, etc. 4) creation of coastal stability by engineering structure, i.e., seawall, offshore breakwater, groins, revetment, gabion-boxes, concrete poles or foundation piles, etc. (Suthilak Rawiwan, 2011).

However, the protection and problem-solving of coastal erosion as mentioned above have both advantages and disadvantages. For instance, the construction of engineering structures is the best method for protecting and maintaining buildings or constructions safely; however, it causes coastal areas to be deformed. For moving buildings or constructions out of coastal areas, it is safer and less risky, while a setback zone can be the best method for maintaining the natural condition of coastal areas, but the coastal areas can still lose some areas further. (Pilkey & Dixon, 1996; Pilkey & Hume, 2001; Suthilak Rawiwan, 2011). Accordingly, whether only one single

form or several forms can be used to manage the protection and solutions for coastal erosion towards the highest effectiveness. Typically, it often depends on the area condition and causes of problems.

2.1.10 Guidelines for Implementing Plans or Projects for Protection and Problem-Solving

Charlier et al. (1998) propose guidelines for coastal erosion management by offering how to select preventive or adaptive measures, which depends on several factors, such as physical dimension (i.e., how large is the disappearing areas from the erosion? Is the degree of erosion severe? How long is the eroded areas?), social dimension (i.e., the social impact from the erosion), economic dimension (i.e., loss and preventive investment for coastal erosion), political dimension (i.e., domestic or international?) and environmental dimension (by adaptive or preventive measures?) Sometimes, it must be considered case by case, such as pressure from a community affected by coastal erosion, loss of occupation places or land, conflict resolutions of the need to use the area adjacent to the sea for development, etc. Still, there are three main principles of coastal management for managing coastal erosion:

1) Avoid developing in an area that is vulnerable to erosion and floods.
2) Make sure if natural processes can still work.
3) Protect lives and significant property, including activities with economic values.

Notably, the positioning of strategies for coastal area development projects should be parallel to the erosion protection based on the aforementioned principles. For the response or practices towards such principles, they can be classified into three levels:

1) Retreat: It means to leave the eroded area and settle on a new area. By principle, there should not be any further development of the eroded area since it is risky for losing the land. Although in some circumstances, the development is allowed, but it must tolerate possible damages or can be withdrawn from the area without difficulty. The roles of the government sectors in supporting activities or development should be terminated. Instead, they should let people be informed of the possible risks of coastal erosion, but should not give any assistance for any loss or damage. They

should also specify the city plan. Some countries chose to expropriate or purchase huge land and appointed it to be a national or regional park, and ordered no development on such area. By doing so, they could reduce expenses for protection plans. In India, Australia, U.S.A., and western countries specify new construction to have a setback zone from the eroded areas. In some cases, the government may let private enterprises or landowners decide about how to develop their land, while the government must have safety measures for the public who utilize such areas as

2) Accommodation. It means to adapt oneself or stay in the eroded area properly. To stay in the eroded area requires adaptation. For instance, any construction may be lifted high from the ground to avoid being eroded, activities that are risky for erosion, such as dune, filling up wetlands or mangrove forest, etc. must be prohibited to avoid increased erosion. However, when the cost of reclamation from the erosion is too high, it may encourage landowners to abandon or retreat from the land.

3) Protection. Structural protection comprises two types: hard or soft. The hard structure is the traditional way of coastal engineering to protect losing coastal areas. The soft structure is to nourish sand or to grow plants to maintain the coastline. However, in some cases, it is necessary to have combined structures, i.e., to have some hard structures to keep the old beach; otherwise, the beach must be nourished every year and it requires costly investments for protection. Consequently, it is necessary to study and propose an alternative suitable for each area and coastal condition before any implementation.

From the above information, concerned agencies can use it as guidelines and implement it concretely, including being able to evaluate the efficiency and effectiveness of the plans or projects. Nevertheless, it requires all parties or networks involved in mobilization have a process of coordinating information and collaborative meetings to enhance integrated operations in the area concretely and to respond to the needs of the area promptly. (Department of Marine and Coastal Resources, 2018). Primarily, they should concern the following principles:

2.1.10.1 The Enhancement of the Understanding of the Practice

The enhancement of the understanding in transforming the specified plans of erosion protection and problem-solving into practice is for concerned personnel of both internal and external organizations at all levels to have a common understanding

and be ready to participate in such transformation concretely by doing the following: (Department of Marine and Coastal Resources, 2018)

1) Establish a common understanding among all concerned agencies of all sectors to realize their roles and responsibilities in supporting and driving plans or projects into practice as planned.

2) Buoy up budget systems and the development of personnel's capabilities to be congruent with plans or projects by focusing on the outcome mainly.

3) Adjust planning and budget arrangement at each level by specifying a common target area and emphasize participation and benefits gained from the operations through the principle of AFP (Area, Function, and Participation)

4) Support all concerned agencies or offices to conduct action plans following the specified plans or projects, including enabling them to coordinate and evaluate their performance as assigned. By doing so, it can lead to organizational integrated resources support effectively.

5) Determine how to publicize or disseminate action plans and create participation for protection and problem-solving of coastal erosion via channels or activities continually, i.e., meeting, memorandum, PR through the internet or website, etc. to stimulate, encourage, and mobilize continual cooperation.

2.1.10.2 Implementation Through Integrated Collaboration

To transform approaches of plans and projects for protecting and solving coastal erosion into practice requires integrated collaboration by the following: (Department of Marine and Coastal Resources, 2018)

1) Examine the connection or congruence between the plans specified in the strategy and approaches and the missions of concerned agencies by

(1) Consider approaches specified in the strategy and plans to see what is each agency's mission or responsibility, which can be more than one.

(2) Consider which other agency or agencies involved in each mission. Notably, the mission may involve the roles and responsibilities of other institutes, not only the government sector, including those of people in the area.

(3) Specify missions, roles, and responsibilities of all concerned: government, private, civil sectors. Besides, plans, activities, or projects

must be integrated and accordant with the strategies and plans for coastal protection and problem-solving.

2) Make plans, projects, or activities, based on the following guidelines:

(1) Concerned agencies collaboratively consider and determine a mechanism for coordination. It might be in a form of a sub-committee for integrated management of coastal erosion, comprising representatives of every agency, including scholars and experts, who can function as a coordinator of conducting plans, projects, and activities. It should include coordination in the operational steps of each agency as well to ensure systematic working, reduce abundance, increase effectiveness, and induce continuality.

(2) The principle of AFP, namely Area, Function, and Participation should be focused on. The significant proposal in each domain: economic, social, and ecological, etc., should be considered with priority setting. New plans, projects, and activities should be added to carry missions towards intended goals efficiently and inclusively in all domains.

(3) Concerned agencies should jointly determine the target area by considering its appropriateness and the coverage of all coastal areas throughout the country. Budgets for operations from national budgets or other supporting sources should be considered. Regulations should be revised to be updated with the situation and can be enforced practically. In addition, criteria for determining indicators for evaluating the growth of plans and projects must be specified.

3) The presentation of guidelines for conducting plans and projects for coastal erosion protection and problem-solving.

(1) The Department of Marine and Coastal Resources as a secretariat of the Sub-Committee for Integrated Management of Coastal Erosion, presents drafted plans to the National Sub-Committee on Marine and Coastal Resources Management and the Cabinet respectively for their approval and support of operational budgets.

2.1.10.3 Driving Mechanisms towards Practices

Driving mechanisms for coastal erosion protection and problem-solving towards practices of concerned agencies at all levels, need to be raised as the national agenda, require a central office, or The National Marine and Coastal Resources Policy and Planning Committee, assigned by the Prime Minister or an appointed person by the Prime Minister, as the chairperson. The appointed committee is responsible for determining policies of marine and coastal resources management and giving approvals, including facilitating the implementation of approved strategies by appointing the Integrated Subcommittee on Coastal Erosion Management and Provincial Committee on Marine and Coastal Resources (Department of Marine and Coastal Resources, 2018).

1) The Integrated Subcommittee on Coastal Erosion Management is responsible for providing integrated strategies, action plans, and budget to the National Marine and Coastal Resources Policy and Planning Committee for approval and further implementation. Besides, it is responsible for giving recommendations, opinions, and academic consultation about regulations and other relevant subjects for supporting the administration of the National Marine and Coastal Resources Policy and Planning Committee and the Provincial Committee on Marine and Coastal Resources in driving strategies towards the concrete integrated operation.

2) Provincial Committee on Marine and Coastal Resources, chaired by the city governor, is authorized to prepare and propose policies and plans for marine and coastal resources management at the provincial level to the National Marine and Coastal Resources Policy and Planning Committee for approval and further implementation at the provincial level. Besides, it is responsible for the present evaluation of the operation, and situations on marine and coastal resources, including coastal erosion of the province.

Furthermore, there are Local Administrative Organizations (Provincial Administrative Organization, Municipality, Sub-district Administrative Organization, communities), including private organizations who will apply the measures and action plans specified in the strategic plans appropriately for each situation and area. However, they need to analyze and prioritize the problems of each area first before

determining any project or activity to be contained in the governmental action plans of each agency.

To ensure the effectiveness of the implementation (or the transformation from approaches or plans into practice), it is essential to specify the principal agency at the Ministry and Department level so that they can coordinate, mobilize, and establish a common understanding with other concerned agencies at all levels. The database is also organized for operating assigned work in the same direction and accomplishing the goals as specified in the plans.

2.1.10.4 Mechanisms for a Follow-up and Evaluation

A follow-up and evaluation, including specifying success indicators of the plans or projects to ensure their congruence with the coastal erosion plans and projects, the following should be done: (Department of Marine and Coastal Resources, 2018)

1) Coordinate to follow up, examine, and evaluate the outcome or performance to assure the same standard and interconnectedness, which can be used for integrating plans, budgets, and personnel systematically.

2) Support related agencies to follow up and evaluate by the specified indicators and evaluation systems.

3) Apply the results for continual improvement of plans and projects to achieve the objectives.

4) Develop knowledge and enhance understandings of how to follow and evaluate the outcome, including how to specify indicators for evaluation for concerned agencies to increase their skills in evaluation and ability to apply information for common benefits concretely.

5) Develop an information processing system to support the operations and problem solving continuously. Besides, networked coordination should be buoyed up for shared benefits at all levels, especially the development of a database for making plans and projects, and an evaluation system, which can lead to the management's decisions on coastal erosion protection and problem-solving.

6) Stipulate the timeline for a follow-up and evaluation of plans or projects for protecting and solving coastal erosion problems, i.e., every quarter or every three-month.

7) Enhance the potentials of the agencies responsible for plans and projects towards professional project management, and the ability to follow and evaluate the progress towards utmost effectiveness or up to the efficiency level.

8) Form a monitoring team to evaluate plans and projects of coastal erosion protection and problem-solving or so-called, “Strategic Assessor Team” (SAT), who is responsible for assessing the operation as planned. Typically, personnel will be selected, trained to possess more capabilities, and appointed formally.

2.1.10.5 The arrangement of plans or projects of coastal erosion protection and problem-solving

The Department of Marine and Coastal Resources (2008) studied approaches and measures for solving coastal erosion problems, which can be summarized into five approaches in sequence as follows: (Sitawee Teerawirun, 2015).

Approach 1: The development and revision of database systems on coastal areas used in a process of decision-making, planning, and operation.

1) Study, explore, and collect information related to the area condition throughout the country, including coastline changes from the past up to present

2) Compile and organize information systems related to economic, social, and environmental characteristics of communities in the coastal area, especially the crisis areas or areas risky for coastal erosion.

3) Organize information systems that are standardized and updated enough to be used for presenting the coastal situation of the country that helps to manage such areas, especially crisis areas or risky areas promptly.

Approach 2: Participation in managing and solving coastal erosion problems

1) Increase the effectiveness of public relations. Knowledge and understanding of coastal erosion and how to manage it should be provided.

2) Empower concerned agencies, institutes, and groups related to coastal erosion.

Approach 3: The preparation of master plans, and /or strategic plans for integrated coastal zone management. (ICZM)

1) Provide an opportunity for all concerned parties to participate in the process and the decision-making steps. Planning should be explained clearly to establish a correct understanding of all issues that might have continual effects and to encourage them to collaborate in achieving the desired goal.

2) Prepare ICZM plans all through the country and strategic management plans of crisis-and urgent-areas, which undergo coastal erosion, by concerning the congruence with the policies, strategies, and plans of national natural and environmental resources.

Approach 4: Protection, resolution, and rehabilitation of coastal area conditions.

1) Specify and classify coastal erosion areas or areas that might face erosion in the future for selecting proper measures of protection, resolution, and rehabilitation that are suitable for each type of area.

2) Conduct management strategies and action plans at the area level in collaboration with local offices and stakeholders who utilize coastal areas.

3) Resolve and rehabilitate eroded coastal areas towards the equilibrium of nature or can be utilized for national economic and social development with full potentials.

4) Protect coastal areas risky for erosion by conserving natural resources, maintaining coastal ecosystems, and developing proper socio-economic activities on the areas to ensure the utilization of the coastal areas for national economic and social development sustainably.

Approach 5: The development of regulation, monitoring, and control systems for coastal erosion management, including mechanisms for a follow-up and evaluation.

1) Revise existing and concerned laws to be more compatible and effective for enforcement, especially in a crisis or urgent areas.

2) Determine active measures for a follow-up and investigation of the situation and coastal changes, including conducting evaluation systems on the outcome of ICZM.

Approach 6: People’s participation in coastal management and marine resources utilization.

Bureau of Coastal Erosion Prevention and Coastal Area Management (2012) proposes a framework for coastal area management and coastal resources utilization. Since ecosystems of coastal areas are significant natural resources of communities and the nation, they are protection walls against any danger on habitats. However, coastal ecosystems are vulnerable to changes and deterioration. Especially, at present, due to the policy of developing more coastal areas to be economic bases for industries and exports, coastal areas are places which both the government and private sectors want to utilize. Accordingly, coastal resources are being used greatly without caution. Sometimes, the utilization exceeds the development capacity; thus, it brings about loss and deterioration inevitably.

Therefore, coastal areas must be utilized cautiously to yield the maximal benefits and facilitate sustainable utilization through well-planned protection, maintenance, and rehabilitation to inherit prosperous coastal resources as a valuable heritage for people of the next generation and righteousness of the local society. As stipulated in the Constitution of Kingdom of Thailand, “The State requires to promote and encourage people to participate in the preservation, maintenance and balanced use of natural resources and biodiversity, which promotes the conservation and protection of the quality of the environment based on the sustainable development, including regulating and eradicating polluted condition, which is harmful to people's health, welfare, and quality of life.”

Hence, to develop coastal utilization sustainably requires the maintenance of ecosystems towards sustainability as well by considering if economic and social factors are appropriate and can yield utmost benefits, including let local or indigenous communities participate in determining resource preservation plans. The state should also enhance the understanding and awareness of local people on the importance of marine and coastal resources thoroughly.

2.1.11 Budgets for Coastal Erosion Protection and Management

Coastal erosion protection and management needs expenditures, starting from enabling costs, capital costs, operation and maintenance costs, monitoring, and project evaluation costs, with details as following: (Department of Marine and Coastal Resources, 2018)

1) Enabling Costs: Expenditure for studying the concerned parts, i.e.,

(1) Research or survey on economics, society, and the environment of the areas.

(2) Preliminary study on the operation scope

(3) Study of designing details and cost evaluation

(4) Preparation for authorized documents complying with legal procedure, i.e., Environmental Impact Assessment (EIA) and Strategic Environmental Assessment, etc.

2) Capital Costs: Expenditure for construction or operations, such as

(1) Construction or activities implementation

(2) Land costs

(3) Compensation or expropriate payment, i.e., in case of the specification of a setback zone

However, this part of expenditure may vary by form, size, length, operational place, labor cost, and origin of materials, etc. Mostly, engineering structure requires higher cost than natural-imitation structure.

3) Operation and Maintenance Costs: Expenditure after the completion of a project, i.e.,

(1) Operation costs to ensure the effectiveness of the structure or activities for coastal erosion protection and solutions

(2) Repairs and maintenance to ensure the lifetime of the structure used.

Each structure Has a different method, frequency, and maintenance cost, i.e. seawalls have less maintenance than sand nourishment, so the maintenance cost is lower, etc.

4) Monitoring and Project Evaluation Costs: Expenditures after the completion of the operation or the use of structure or activities for coastal erosion protection, such as

(1) Expenses on the study, survey, and monitor coastal changes and all changes after the project or activity

(2) Expenses on the evaluation of impact and worthiness of the project, used as information for monitoring and modification if any impact occurs. The

obtained information will be useful for determining strategies, policies, plans, and projects, including for public relations and creating understanding to people.

(3) To increase the effectiveness of coastal erosion protection, budgets must be allocated to all parts properly. The above costs are for considering approaches and measures for coastal erosion protection and resolutions.

2.1.12 Agencies Participating in Coastal-Erosion Problem Solving

Coastal erosion problems cause several effects: economics, society, and environment, including quality of life and property of people on the coastline. Therefore, coastal erosion management can be successful and sustainable under the collaboration of all sectors through their integrated working. (Department of Marine and Coastal Resources, 2017). The examples of the agencies or offices responsible for coastal erosion management are as follows: (Thai Environment Institute Foundation, 2019).

2.1.12.1 Office of Natural Resources and Environmental Policy and Planning

The missions of the Office of Natural Resources and Environmental Policy and Planning are to regulate policies and plans of natural resources and environment, monitor the analysis of the impact on the environment and climate changes. Thus, it plays a role in driving action plans as specified in the provincial plans for environmental quality control, determining coastal areas risky for erosion as environment-protected areas, implementing measures of controlling environmental impact from activities that may cause coastal changes. (Department of Marine and Coastal Resources, 2017).

2.1.12.2 The Department of Marine and Coastal Resources

The Department of Marine and Coastal Resources plays a role in studying and preparing strategic plans, master plans, and action plans for protecting and solving coastal erosion problems for each coastal area throughout the country. It also classifies the level of erosion's severity and proposes alternatives for solving problems, including providing knowledge for central and regional government agencies, including general people. Moreover, it is the office responsible for coordinating and integrating the preventive ways towards coastal erosion. It also executes some action in protecting and

correcting coastal erosion problems in the muddy areas by bamboo revetment. At present, it operates the missions according to the authority specified in the Marine and Coastal Resources Management Promotion Act 2015, which requires the Department to report the erosion situations, to determine policies and plans for marine and coastal resources, and specify coastal zones under the erosion protection measures. Besides, the Department is responsible for providing knowledge and encouraging communities' participation in preserving, maintaining, and monitoring coastal changes. (Thai Environment Institute Foundation or TAS, 2019).

2.1.12.3 Department of Mineral Resources

The Department of Mineral Resources is a government agency that has direct responsibilities for geological preservation, conservation, rehabilitation, and management. Thus, it plays a role in studying, developing, supporting physical data and landforms, and exploring coastal changes, including the overall impact of the movement of sediments along the coastline of the country. (Department of Marine and Coastal Resources, 2017).

2.1.12.4 Department of Public Works and Town & Country Planning

The Department of Public Works and Town & Country Planning is responsible for protecting and solving coastal erosion problems throughout the country by conducting a study, a survey, a design, and a public hearing of people in the assigned project for selecting a proper structure for each area. (Thai Environment Institute Foundation or TAS, 2019).

2.1.12.5 Department of Local Administration

The missions of the Department of Local Administration as specified in Local Administrative Characteristics Act, B.E. 2551 (No. 11) and Regulations of the Ministry of Interior on the Preservation and Protection of Land in Public Domain for Shared People, B.E. 2553 are to surveillance, maintenance, and protection the public property for citizen's shared application and other public properties of the district, either by a natural condition of the shared utilization in the form of juristic act or by legal consequences. Such public domain is foreshore, land cemetery, waterway, public park, farm, and sub-district or village public places, etc. Therefore, it plays a role in constructing coastal erosion structures, i.e., revetment, seawall, etc. by coordinating with the Department of Marine and Coastal Resources in the responsible areas for

information collaboration, consultation, and other supports, if necessary. Especially, the techniques must be appropriate for each area, and the same or integrated techniques can be used. Moreover, it has to report any changes to concerned agencies at the local level, including to Coastal Erosion Protection Groups and nearby areas at the network level (Thai Environment Institute Foundation or TAS, 2019).

2.1.12.6 Marine Department

Marine Department is responsible for regulating, promoting, and developing transportation systems and merchant fleets. The main responsibility is to protect and solving coastal erosion by conducting a study, a survey, a design, and construct engineering structures, i.e., offshore breakwater, groins, revetment, seawall, etc., including rehabilitating the beach by beach nourishment. (Thai Environment Institute Foundation, 2019).

2.1.12.7 Department of Rural Roads

Although the Department of Rural Roads has no direct responsibility in solving coastal erosion problems, it also plays a role in protecting and solving coastal erosion to reduce the impact and damages to the land and property through several structures, i.e., seawall, revetment, etc. (Thai Environment Institute Foundation, 2019).

2.1.12.8 Provinces

Each coastal province has to regulate and monitor natural resources and the environment in the region and local areas in collaboration with other regional agencies, i.e., Regional Marine Department, Provincial Office of Public Works and Town & Country Planning, etc., to prepare a project for protecting and solving coastal erosion. (Department of Marine and Coastal Resources, 2017).

2.1.12.9 Other Agencies

Other concerned agencies are the Royal Irrigation Department, Department of Fisheries, Port Authority of Thailand, Department of Hydrography, Royal Thai Navy, etc. Despite no direct missions on coastal erosion problems, these agencies play some roles in protecting and solving coastal erosion problems to prevent impact and damage to their agency's land and property by different structures, i.e., seawall, revetment, etc. (Department of Marine and Coastal Resources, 2017).

2.1.12.10 Private sectors and affected people

Private sectors and affected people also perform their protection and coastal erosion problem-solving to protect and reduce the damage that might occur to their coastline residence and property in different structures, i.e., seawall, revetment, etc. (Department of Marine and Coastal Resources, 2017).

2.2 Policy, Plan, Strategy, and Legal Factors Related to Coastal Erosion Management

2.2.1 Concerned National Policies, Strategies, and Plans

From reviewing national policies, strategies, and plans related to coastal erosion, the following are found: Policies the government declared to the National Legislative Assembly (General Prayut Chan-o-cha), National Maritime Security Plans: 2015-2021, National Strategy: 2018-2037), Strategies for Coastal Erosion Protection and Solutions, Master Plan of Marine and Coastal Resources Management: 2017-2036, and the 12th National Economic and Social Development Plan, with details as follows:

2.2.1.1 Policies the Government Declared to the National Legislative Assembly

According to the policies that the government led by Prayut Chan-o-cha, in 2017, Thailand had a coastline of about 3,151.13 kilometers, 704.44 of which faced coastal erosion problems. 558.71 kilometers had been resolved, but 145.73 kilometers unsolved. The coastal erosion is divided into 42.17 kilometers of severe-level erosion, 7.64 moderate-level, and 95.92 mild-level. In 2017, it was found that the coastal erosion problems decreased from 2016, by over 8.35 kilometers. (Thai Environment Institute Foundation, 2019)

From the policy statement of the Cabinet led by General Prayut Chan-o-cha to the Parliament on Thursday, July 25, 2019, on the previous government's administration for developing the country toward peace, harmony, and generosity, including Thai people' better quality of life and readiness to pursue their living in the 21st century. Besides, it aimed to make Thai economics strong with increased competitive capabilities, while maintaining natural resources and the environment under the philosophy of sustainability. In short, the vision of driving the country of the

government is “Determined to make Thailand a developed country in the 21st century.” (Office of the Secretariat of the Prime Minister, 2019: online). The policies that are found to be related to “marine and coastal resources” are Policy 10, no. 10.4, which accords with the National Strategy for Building Growth on Quality of life and Environmental Friendliness, No. 2: To build sustainable growth on maritime socio-economics. (see details in the National Strategy: 2018-2037).

During the statement, the Minister of Natural Resources and Environment assured that the government gave the coastal erosion problems as one of the four top significant problems since they are issues connecting to economics, society, and the environment. Besides, the concerned agencies had imposed measures, both short-termed and long-termed, to manage the problems. For example, international coloration mechanisms were developed to have collaborative parties for joint management of marine and coastal resources. The solution approaches were divided into three levels: 1) severe erosion, 2) moderate erosion and mild erosion. (Kalaya Kongyungyuen, 2562: online; Office of the Secretariat of the Prime Minister, 2020: online, Office of the Spokesperson, the Secretariat of the Prime Minister, 2020: online)

2.2.1.2 National Maritime Security Plan: 2015-2021

National Maritime Security Plan: 2015-2021 is the principal plan for coastal erosion protection and to support the operations of the government and other sectors to jointly protect and maintain national maritime benefits. It focuses on the establishment of stability, security, liberty, and the environmental condition that facilitates all sectors' maritime activities sustainably. (Office of the National Security Council, 2018)

2.2.1.3 Policies for Resolving and Rehabilitating the Condition of Eroded Areas

The Ministry of Natural Resources and Environment reported that the policies for resolving and rehabilitating the condition of the eroded areas towards natural equilibrium are as follows: (Question 064/r, 2019):

1) For the eroded muddy areas of 49 kilometers, bamboo revetment has been used to decrease wave amplitude and trap mud sediments behind the bamboo revetment line. In the fiscal year 2019, bamboo revetment of 16 kilometers

long is planned to be implemented, in 2020 16 kilometers, and 2021 17 kilometers. For the fiscal year 2019, bamboo revetment of 1,000 meters long was implemented in the area of Pak Nakhon Sub-District, Muang District, Nakhon Si Thammarat Province. After the deposition of mud sediments behind the bamboo revetment line, the condition of mangrove forest was also rehabilitated by planting mangrove forest to restore the condition and be aquatic animal nursery sustainably.

2) For the eroded sand-beach area of 90 kilometers, knowledge and innovation for alleviating coastal erosion problems, rehabilitating, and maintaining the stability of the coastal beach was developed. For instance, a sand fence was used for both eroded and rehabilitated areas from the end effect to sustainable restored equilibrium. The next project that is being experimented with is the project for reducing erosion impact in the area at Thai Muang, which is the reduction of erosion impact from the end effect, and then its coastline behind the fence will be rehabilitated by trapping sand sediments back to the equilibrium.

The above plans and activities for coastal erosion protection and solutions of the Department of Marine and Coastal Resources were approved by the Cabinet on January 16, 2018. The purposes are to be used as management guidelines for concerned agencies to adopt them for their arrangement of the short-termed (1 year) and long-termed (5 years) plans, projects, and budgets for both protection and problem-solving purposes. Besides, proper mechanisms for coordination among concerned agencies were determined for collaborative and integrated working.

Guidelines for the protection, resolution, and rehabilitation of the eroded coastal areas towards natural equilibrium.

1) The study through a littoral cell, which considers the characteristics of the landform covering the area, to avoid circulation of sediments from one beach to the other adjacent one. For example, Hua Lam has a distinct landform occurring in the coastal area for a long time. Each beach has divided into littoral cells and named each coastal zone as follows:

(1) The eastern coast, covering the coastal areas of four provinces: Trat, Chanthaburi, Rayong, and Chonburi, is named “E-Littoral Cell.” The eastern coast composed of eight littoral cells and the symbols used are E1-E9.

(2) The upper Gulf of Thailand, covering the coastal areas of five provinces: Chachoengsao, Samut Prakan, Bangkok, Samutsakhon, Samut Songkhram, is named “U-Littoral Cell.” The upper Gulf of Thailand composes of only one littoral cell, so the symbol used is U.

(3) The southern coast, covering eight provinces: Petchaburi, Prachuap Khiri Khan, Chumphon, Suratthani, Nakhon Si Thammarat, Songkhla, Pattani, and Narathiwat, is named “S-Littoral Cell.” The lower Gulf of Thailand consists of 13 littoral cells, and the symbols used are S1-S13.

(4) The Andaman Sea, covering six provinces: Ranong, Phang-nga, Phuket, Krabi, Trang, and Satun, is named “A-Littoral Cell.” The Andaman Sea comprises 41 littoral cells, and the symbols used are A1-A41.

2) The analysis by the mathematical model is used for studying the physical characteristics of the coastal area and determining approaches for proper management. The related information to be analyzed is fundamental data, i.e., physical information of the area, current structure, the condition of problems and eroded areas, solution and construction plans in the future, and some additional information, i.e., types and volume of sediment representatives, data from wave and current measurement, etc.

3) Arrangement of a roadmap for coastal erosion protection and solutions.

4) The coastal erosion solution by engineering structure, which is to decrease wave amplitude properly, to facilitate the deposition of coastal sand sediments, and to maintain the coastal line, which is suitable for severely eroded coastal areas. Two kinds of engineering structures are used: “hard structure,” i.e., seawall, offshore breakwater, revetment, or groin, and “soft structure,” i.e., bamboo revetment, concrete poles, geo-tubes, sand nourishment, etc.

2.2.1.4 National Strategy: 2018-2037

The 20-year National Strategy: 2018-2037 is the first national strategy of Thailand declared in the Constitution of the Kingdom of Thailand for the implementation towards the vision, “Thailand will be a stable, prosperous, and sustainable developed country based on the sufficiency economy philosophy” within the specified timeframe for every Thai people's happiness. National Strategy is aimed

as the core strategy for driving the country and transmitting to other plans at various levels to bring about the actual implementation at the strategic, mission, and area-level towards the national stability, prosperity, and sustainability. The main content in the National Strategy related directly to coastal erosion is “national strategy for building growth on the quality of life that is friendly to the environment.” The details are as follows:

The guidelines contained in the National strategy for building growth on the quality of life that is friendly to the environment aim towards sustainable development in all dimensions: social, economic, environmental, good governance; and collaborative partnership of both domestic and international agencies and organizations. Strategies and plans are determined by “area criteria,” and all concerned parties are expected to participate directly as much as possible. To achieve so, operations must be based on the shared growth, i.e., economics, environment, and the quality of life, and all three dimensions have to be paid attention to creating equilibrium, leading to the sustainability for new generations in the future genuinely.

No. 2: “The building of sustainable growth on maritime socio-economic” focuses on the importance of the national growth from diverse maritime activities in parallel to the maintenance of all marine and coastal resources under the authority and benefits the nation deserves to gain for righteousness and reducing social inequality. The transfer of correct and sufficient marine knowledge is focused. Besides, it orients to increase maritime biological economy, improve and rehabilitate the whole system of marine and coastal resources, develop and increase the ratio of marine activities that are friendly to the environment.

Issue no. 4.2.3: The responsibility is to rehabilitate beaches as tourism attractions, to protect and resolve the whole coastal system, and to focus on holistic and integrated coastal management. All coastal areas in Thailand need to be protected and resolved by proper coastal management policies. The master plan is used to determine management approaches for each area throughout the country, while decreasing the eroded areas through proper protection and resolution structures, including protecting the areas having no problems yet.

2.2.1.5 Strategy for Coastal Erosion Management and Solutions

The Strategy for Coastal Erosion Management and Solutions was approved by the National Environmental Board on October 24, 2007, as proposed by the Ministry of Natural Resources and Environment. The main goal of the Strategy is to settle protection and prevention systems against coastal erosion for all coastal areas in Thailand within 2027, to develop information systems for coastal management, to integrate roles and responsibilities of concerned agencies, and to disseminate knowledge to all concerned and general public.

2.2.1.6 Master Plan of Marine and Coastal Resources Management: 2017-2036

The Department of Marine and Coastal Resources prepared policies and strategies based on the government's principles and conceptual framework, including the other related policies and plans, which is called “the Master Plan for Marine and Coastal Resources Management: 2017-2026. The objectives of the Master Plan are as follows: (Office of the Official Information Board, 2020) 1) To conserve and rehabilitate marine and coastal resources towards prosperity and sustainability. 2) To promote the integration and participation of all sectors in the balanced and sustainable marine and coastal resources management. 3) To bring about knowledge responsive to the marine and coastal resources management and to publicize it widely.

1) Operational Framework

The main concept of the Master Plan of Marine and Coastal Resources Management (2017-2036) emphasizes:

(1) the marine and coastal resources management towards integration by adhering and being congruent with laws, regulations, principles, policies, and development plans in various dimensions.

(2) the creation of realization of the importance of marine and coastal resources and the participation among concerned people, especially coastal communities with direct benefits from marine and coastal resources. Such participation adheres to the five levels of participation as follows:

(2.1) information provision level (i.e., exposing to information)

(2.2) listening for ideas level (i.e., participate in providing information and opinions

(2.3) involvement level (i.e., participating in planning operational processes)

(2.4) Collaboration level (i.e., participating in practicing and follow-ups)

(2.5) Decision-making level (i.e., authorized to participate in decision-making)

(3) Sustainable resources management principles, which accord with the international agreement in the meeting on "Sustainable Development," at Rio De Janeiro (so-called "Rio + 20"). The agreed principles are to use resources towards equilibrium without losing natural balance, such as the rate of resource utilization must be equal to the renewable resources, i.e., fishery resources, forestry resources, etc. Besides, the prudent and clever use of resources so that there will be sufficient resources remaining for the next generations. Examples of non-renewable resources are mineral resources, oil, gas, etc.

2) Problems and Challenges

To have operations achieve the goals as planned, it is important to concern about principles, problem conditions, situations, and tendencies in the future. From the situational analysis of the use of marine and coastal resources of Thailand, it was found that such uses are facing a crisis and tend to undergo several major problems, such as the exceeding exploitation leading to natural imbalance or non-equilibrium, the lack of sustainable development, and no sufficient knowledge for management. On the other hand, the participation of all involved or stakeholders leads to conflicts among different groups who use resources. Consequently, to set accordant strategies to solve problems precisely and effectively, some constraints and restrictions deteriorating resources should be thoroughly considered, as summarized below:

(1) Natural resources and the environment have deteriorated from the exceeding use beyond the production or creation of renewable resources. Thus, nature is imbalanced.

Globalization and capitalism economic development has become the predominant approach for national development. Although the economic

development policies of Thailand also focus on the growth that concerns environmental conservation and sustainable development, lots of entrepreneurs still lack concern about the impact on natural resources and the environment. Thus, it leads to rapid deterioration of natural resources and the environment.

(2) The lack of integration and participation in management

Typically, marine and coastal resources are managed and regulated by several maritime agencies, such as Royal Thai Navy, Marine Police Division, Immigration Division, Fine Arts Department, Department of Fisheries, Marine Department, Department of Public Works and Town & Country Planning, Department of Mineral Fuels, Department of Marine and Coastal Resources, etc., including many other agencies that will play more maritime roles in the future. However, such agencies, including local agencies or organizations, lack coordination and integrated operations, causing overlapping work and, in some cases, conflicts. The government agencies do not obtain participation from communities and other concerned agencies. Therefore, operations and plans are short of perspectives and opinions of stakeholders and concerned people, or those affected by the operations. As a result, conflicts occur and make resources management ineffective, leading to the loss of resources eventually.

(3) The lack of useful knowledge for making decisions and technologies used in management, including understanding personnel.

Generally, in marine and coastal resources management, personnel are not equipped with knowledge that can respond to the needs of practitioners and local communities. There is a lack of academic information, including local wisdom that is complete or useful enough for decision-making. Besides, there are no information technologies available for management, including personnel who can use such technologies.

2.2.1.7 The 12th National Economic and Social Development Plan

Strategy 4: Growth friendly to the environment for sustainable development. Strategy 4 came from the meeting agenda on the global sustainable development after 2015, which is the period from which the direction of the global sustainable development was stipulated fifteen years ahead (2016-2030), which might affect the national development in the future. The challenging issue of Strategy 4 is the

acceleration of the implementation of security of natural resources and people's quality of the environment to support the national growth that is friendly to the environment and people's quality of life. Particularly, environmental crises are accelerated to be solved to reduce pollution from human production and consumption. Transparent and righteous management systems are developed. Production and consumption friendly to the environment have been promoted widely. On the other hand, an urgent preparation and readiness to reduce greenhouse gas emissions, while increased adaptation to climate change, are strongly urged. It also includes management for decreasing natural disaster risks. Coastal erosion protection and resolutions are a part of natural resources maintenance and rehabilitation. Forestry areas for conserving economic and mangrove forests have to be expanded while decreasing the loss of biodiversity. Invasion of the state land must be resolved whereas land must be provided for the poor through shared ownership. (National Economic and Social Development Board, 2017).

Issue No.3.1.4 Marine resources protection and coastal and shore erosion prevention. The coastal area development needs to concern about the long-termed impact on the environment and sustainability. The policy conflicts between the development of infrastructure, tourism, fisheries, and communities' ways of living must be resolved through the classification of utilization zone of marine and coastal area that goes through the process of a public hearing, decision-making, and joint management of concerned parties. Management systems must be developed. Revenue collection from tourism in the marine, islands, and beach conservation areas must be spent on conserving and developing natural tourist attractions to maintain their fertility and beauty for good. National marine benefits have to be protected. Marine and coastal conservation areas must be determined, including measures for monitoring aquatic animal capture. Premature aquatic animals are not allowed to be captured. Illegal fishing tools must be prohibited, while local or traditional fishing must be preserved. River-bank and coastal erosion must be solved by realizing the dynamism of littoral systems. The concept of Littoral-Cell management concept must be applied to suit each type of landform. Protection systems and the reduction of wave energy must be decreased through the integration of each littoral cell to avoid having construction on the coastal areas that may affect the adjacent coastal areas.

2.2.2 Constitution, Laws, and the Cabinet's Resolutions

From reviewing the content in the Constitution, laws, and resolutions of the Ministers related to coastal erosion, the following was found: Constitution of the Kingdom of Thailand, B.E. 2560, the Promotion and Conservation of the National Environmental Quality Act, B.E. 2535, and Marine and Coastal Management Promotion Act, B.E. 2558, with details as follows:

2.2.2.1 Constitution of the Kingdom of Thailand, B.E. 2560

Chapter 3: Rights and liberties of the Thai people (Section 43: Individuals and communities can have rights in:

(2) managing, maintaining, and making use of natural resources, environment, and biodiversity in balance and sustainably by the ways stated in the laws.

(3) signing in a group for giving recommendations to the government agencies to do any operation that is beneficial for people of the community, or to restrain from doing any operation that may affect people's or communities' peaceful living, and in being informed quickly of the results of the consideration. Therefore, the government agencies have to consider those recommended statements, by letting concerned people participate in the consideration as specified in the laws.

Chapter 4: Duties of the Thai people, Section 50: individuals have a duty to

(8) Collaborate and support the conservation and protection of the environment, natural resources, biodiversity, and cultural heritage.

Chapter 5: Duties of the state, Section 57: the state has to

(2) Conserve, protect, maintain, rehabilitate, manage, use or support the use of natural resources, environment, and biodiversity in a balanced state and sustainably by encouraging concerned local people and communities to participate in the process and gain benefits from such operations as enacted.

Section 58 : In case of any state operation or any operation allowed by the state to be conducted by anyone, the state must operate a study and evaluation of the impact of such an operation on environmental quality and people' or communities' health, including organizing a public hearing from concerned people and communities first, when such an operation may cause any severe effect on the natural resources, environmental quality, health, sanitary, quality of life, or any stakeholders on the part

of people or communities. All of this prior information must be part of the consideration or approval as specified in the laws.

Individuals and communities have the right to acquire information, explanation, and rationale from the government agencies before any operation or approval as stated in paragraph 1.

In proceeding or approving any operation, according to paragraph 1, the state must be cautious to assure the least impact on people, communities, the environment, and biodiversity. Besides, the state must proceed to remedy the trouble and damages of the affected people or communities fairly.

2.2.2.2 The Preservation and Promotion of the National Environmental Act, B.E. 2535.

Part 2: Environmental quality management planning

Section 35: The concerned Minister was approved by the National Environment Board to conduct action plans entitled, "Environmental Quality Management Plans," to comply with the national environmental quality maintenance and promotion policies and plans, as written in Section 13 (1).

Environmental Quality Management Plan as specified in Paragraph 1 in the Royal or Government Gazette:

"Concerned government offices are authorized to comply with the Environmental Quality Management Plan. Besides, to achieve the determined objectives, the Ministry of Natural Resources and Environment* is responsible for providing recommendations for concerned government and state-enterprise offices for conducting plans or operations according to the said plan."

Part 3: Environmental Conservation and Protection Zone

Section 43: For any area, which is an upstream area, or having different natural ecosystems from others, or its natural ecosystems may be damaged or affected by human activities easily, or possessing natural or artistic value worth being conserved, but having been declared officially as a conservation zone, the concerned Minister under the consultation of the National Environment Board is authorized to issue ministerial regulations for determining such area as an environmental protection area or zone

Section 44: In issuing the ministerial regulations by Section 43, the following protection measures have to be contained in the ministerial regulations:

(1) The determination of the use on the area by maintaining natural condition without disturbing natural ecosystem or environmental art value.

(2) The prohibition of any action or activity that might be harmful or cause any change in the ecosystem of the area from its natural characteristics or affect environment art value.

(3) The specification of types and sizes of projects or activities of the government, state enterprises, or private sector that require any construction or operation on such an area. The report of the environmental impact assessment must be proposed.

(4) The specification of distinctive management methods for such an area, including assigning the scope of duties and responsibilities of concerned agencies.

(5) The determination of other protection measures that are appropriate for the condition of the area.

Section 45: For any area, that is determined to be a conservation zone, overall and specific town plan zone, specific urban-planning zone, industrial estate zone, or pollution-control zone as stipulated in the act, but is facing severe or critical problems of the environmental quality condition and needs urgent remedy, while the concerned offices have no authority to solve such problems, the Ministry by the approval of the National Environment Board through the Cabinet, has to ask an approval to enact any of several protection measures, according to Section 44, to control and resolve the problems in such areas, necessarily and properly.

After the Cabinet's approval by Paragraph 1, the Ministry has to declare in the Royal or Government Gazette to specify area zones, including details of protection measures and the timeline for implementing such measures in the area.

Time extension, according to the declaration in Paragraph 2, can be done through the approval of the National Environment Board and the Cabinet, by declaring it in the Royal or Government Gazette.

2.2.2.3 The Promotion and Conservation of the National Environmental Quality Act (No. 2), B.E. 2561

The content of The Promotion and Conservation of the National Environmental Quality Act (No. 2), B.E. 2561 was revised in the part of the preparation of the EIA report to make it more congruent with the Constitution of the Kingdom of Thailand, and some practical approaches were revised to catch up with changing situations to make it more standardized, acceptable, and accredited by all sectors, in maintaining environmental quality and natural resources, parallel to the well-balanced national development.

Section 3: To correct the original word, "Environment Impact Analysis," to "Environmental Impact Assessment" report.

Section 4: To add the definition of the word "governmental offices or agencies"

Section 5: To delete the statement in Part 4 in Section 46, 47, 48, 49, 50, and 51 in Chapter 5: Environmental Protection of the Promotion and Conservation of National Environmental Quality Act, B.E. 2535, ordered by the chief of NCPO, No. 9/2559: The amendment of the laws on the promotion and conservation of national environmental quality, on March 7, 2016. The following statements are to be replaced:

Section 46: "Environmental Impact Assessment" means the process of study and evaluation of the possible effect or impact that might occur during the operation of any project or enterprise of the state or of that approved by the state through the process of people's participation.

Section 47: In case that environment has been evaluated at the strategic level by any regulations or laws, the environmental impact assessment must concern about the impact on the environment previously evaluated at the strategic level as well.

Section 48: For enhancing and maintaining environmental quality, the Minister by the approval of the National Environment Board is authorized to declare governmental projects, activities, or any operation approved by the state to be projects, enterprises, or operations with environmental impact. The operators or applicants must prepare an environmental impact assessment (EIA) report.

Section 49: In case that the project, enterprise, or operation requires an EIA report according to Section 48 as the state's project or operation or joint operation with the private sector, which must be approved by the Cabinet, the government office or agency responsible for such project, enterprise, or operation, must prepare an EIA report and submit to the National Environment Board for the Cabinet's further consideration. Any project, enterprise, or operation that requires no prior approval or legal permission must prepare and submit an EIA report, complying with the criteria, methods, and conditions. For projects, enterprises, and operations on the transportation, irrigation, disaster prevention, hospitals, or residence, etc., which requires urgency, the private sector can apply and submit their request to the Cabinet first, while waiting for the Cabinet's approval. However, such prior approval cannot be legal obligations or acquires confirmed legal rights.

Section 50: For any project, enterprise, or operation required by Section 48 to get approval legally before starting the construction or operation, the operator or applicant must propose an EIA report to the authorized officials and the Office of Natural Resources and Environment Policies and Planning or any other offices assigned by the National Environment Board.

Section 51: The National Environment Board is required to appoint an expert committee to be responsible for considering EIA reports. Such a committee comprises experts or specialists in the related fields and officials who are authorized to approve the conduction of projects or operations as co-committees.

2.2.2.4 Marine and Coastal Management Promotion Act

Marine and Coastal Management Promotion Act, B.E. 2558 revised some legal structures related to natural resources and coastal area management in Thailand, which is a policy law rather than mandatory laws. (Avikarat Niyomthai, 2015). Thus, it is the determination of criteria for management, maintenance, conservation, and rehabilitation of maritime and coastal nature as a unified mission to yield the utmost benefits for the public. The main content is the promotion of collaboration between local communities and government agencies. Accordingly, it focuses on the preparation of laws related to natural resources management in terms of policies aimed towards genuine collaboration under coastal communities' ways of life. Besides, it contains the regulations and prohibitions with which people must comply, including both civil and

criminal penalties for regulating those who violate laws. (Coastal Area Management Division, 2018).

This act has been effective since June 24, (Avikarat Niyomthai, 2015), aimed to induce protection, conservation, and rehabilitation of marine and coastal resources through effective management, including plans, policies, and measures recommended by the Office of Natural Resources and Environmental Policy and Planning, facilitated by the Department of Marine and Coastal Resources, as the secretariat, which is responsible for coordinating all concerned offices towards common goals. (Coastal Area Management Division, 2018). Notably, this act is centralized and focuses on the roles of central government agencies rather than the civic sector or local communities. Furthermore, the concerned committees comprise government officials, most of whom are permanent secretaries of the Ministers. (Avikarat Niyomthai, 2015)

In general, the Marine and Coastal Management Promotion Act, B.E. 2558 contains content about “coastal erosion” explicitly as follows:

Section 3 of the Act

“Marine and coastal resources” means what exists or occurs by nature in the maritime and coastal areas, including low-land, wetland, Khu Phraek canals, lakes, and river-mouth area that is adjacent to or in contact with the sea or the influence of seawater, i.e., mangrove forests, beach forests, beaches, shores, islands, seagrass, corals, shellfish, aquatic plants, and animals, or any man-made creation to benefit the ecosystem, i.e., artificial coral reefs, wave-force reduction, or coastal erosion protection.

Chapter 1: Office of Natural Resources and Environmental Policy and Planning Committee

Section 9: The authority of the committee

(3) Consider approving each area zone to use coastal erosion protection measures.

(7) Submit a report related to marine and coastal resources situation and national coastal erosion to the Cabinet at least once a year.

Section 13: The authority of the Provincial Marine and Coastal Resources Committee

(3) Propose opinions to the Committee in considering the approval for each area zone to use coastal erosion protection measures.

(7) Submit a report on the operation of the Provincial Marine and Coastal Resources Committee of the province and the situation of marine and natural resources, including the coastal erosion of the province to the Committee at least once a year.

Section 15: To appoint the Department of Marine and Natural Resources to be Secretary Office Department of the Committee with the following authorities:

(3) Examine and specify zones that should be declared as the area using coastal erosion protection measures, including determining coastal erosion protection and solution measures.

(4) Execute and coordinate with concerned government offices related to coastal erosion protection and solutions.

Chapter 3 Marine and Coastal Resources Protection

Section 21: To prevent coastal erosion problems and damages to people's lives and property, the Minister by the approval of the Committee is authorized to issue ministerial regulations to determine zones for using coastal erosion protection measures. The ministerial regulation, according to Paragraph 1, must have a map showing the zones attached with ministerial regulations with the following specified measures:

(1) To prohibit any activities or operations that might affect or increase coastal erosion problems.

(2) To specify criteria for operating with the construction or activities within the determined area before the issuance of ministerial regulations, if they will be permitted to continue, restrain, or demolish such construction that may affect coastal erosion with appropriate compensation

(3) To specify criteria for making use of the declared areas.

(4) To determine other appropriate measures to protect coastal erosion.

Chapter 5: Penalties

Section 28: Any person who violates or does not comply with the marine and coastal resources protection measures as specified in Section 18 and 20, or coastal

erosion protection measures in Section 21, or does not comply with the officials' order according to Section 24 (4) are subject to no more than a one-year penalty or be fined of no more than 100,000 baht, or both.

After the issuance of the Marine and Coastal Resources Management Promotion Act, B.E. 2558, the Ministry of Natural Resources and Environment is authorized to establish approaches for protecting the coastal areas that are risky for erosion by the conservation of natural resources, maintaining the coastal ecosystem, and enhancing the sustainable use of the coastal area through the preparation of ministerial regulations drafts to prevent erosion on coastal area via the exercise of power as specified in Section 21. (Question No. 064/r, 2019).

2.2.2.5 Guidelines for Coastal Erosion Solutions following the Act

Coastal erosion protection solutions are for operating the coastal erosion management in accord with the Marine and Coastal Resources Management Promotion Act, B.E. 2558. Thus, the Department of Marine and Coastal Resources prepared a road map for coastal erosion protection and solutions, which are operational plans of six steps for the urgent period (within 6 months), moderate period (one year), and long period (more than one year). (Coastal Area Management Division, 2018), as follows:

1) Enhance the capability in coastal erosion protection and solutions (supporting Section 13 (7)).

2) Enhance the sediment balance and reduce the impact on the coastal ecosystem. (supporting Section 21 for proposing general measures)

3) Alleviate people’s trouble in the eroded coastal area. (supporting Section 21)

4) Protect and solve coastal erosion problems. (spatial littoral cells) (support Section 21 for determining specific measures)

5) Monitor and evaluate changes of coastal area situations according to the Marine and Coastal Resources Management Promotion Act, B.E. 2558 (supporting Section 13(7) and Section 16.

6) Study, research, and disseminate a body of knowledge, including creating collaboration networks for solving coastal erosion problems (supporting Section 16). According to the Marine and Coastal Resources Management Promotion Act, B.E. 2558, Section 21, and the master plan or road map of coastal

erosion protection solutions, it is very essential to issue measures and action plans to protect and solve both the overall and specific or spatial coastal erosion problems to ensure proper management that is compatible with geographic characteristics, local wisdom, economics, society, and problem condition, including limitations of each area.

2.2.2.6 The Cabinet Resolutions

1) The Cabinet Resolutions on August 26, 2008

The Cabinet approved coastal erosion protection projects through people's participation by having the Ministry of Natural Resources and Environment as the principal agency to conduct an integrated operation among concerned agencies to achieve efficient coastal erosion protection and solutions concretely as specified in the 20-year National Strategy by the following:

(1) The Department of Marine and Coastal Resources provides knowledge for people, community organizations, and local administrative organizations in the coastal areas of the country, including rehabilitating coastal lines by a natural process, i.e. mangrove and beach forest, etc.

(2) The Department of Mineral Resources develops and improves the database of coastal area information for the decision-making and planning process.

(3) The Office of Natural Resources and Environment Policy and Planning studies and specifies activities that may cause coastal changes through the study of the impact on the environment.

2) The Cabinet Resolutions on September 22, 2009

The Cabinet approved the guidelines for integrating the national coastal erosion protection and solutions as proposed by the Ministry of Natural Resources and Environment by having the Department of Marine and Coastal Resources operate the following:

(1) Accelerate the preparation of the 5-year integrated action plans for coastal erosion protection that accord with the 20-year National Strategy.

(2) Prepare the master plan and action plans for the Thai Gulf of Thailand coast. (from Pranburi river-mouth to Pak Phanang) and the Andaman coast.

(3) Study and research on the patterns and ways of protecting, maintaining, and rehabilitating the deteriorated mangrove and beach forests caused by erosion.

(4) Coordinate with Budget Bureau to compile statistics on the budgets spent on coastal erosion protection and solutions.

(5) Organize national and international conferences.

(6) Arrange plans for applying for education scholarships from the Office of the Civil Service Commission and the Ministry of Science and Technology (in the field of coastal engineering, marine engineering, oceanography or marine science, etc.)

3) The Cabinet Resolutions on April 20, 2010

The Cabinet approved the frame of the integrated budgets for coastal erosion management and solutions for 933 projects in 23 provinces, costing 19,580.8 million baht in the fiscal year 2011-2016, for six years, as proposed by the Ministry of Natural Resources and Environment, with details as follows:

(1) The Department of Marine and Coastal Resources is assigned for coordinating the implementation by following the frame of the integrated budgets.

(2) Budget Bureau is assigned for examining the budget allocation for concerned agencies.

(3) The Ministry of Interior is assigned for coordinating provinces in the coastal areas and local administrative organizations to inform coastal-erosion protection management plans to the Ministry of Natural Resources and Environment for additional integrated plans.

2.3 People's Participation Factors

2.3.1 The Concept of Participation

To conduct any activities needs to be improved and developed towards shared learning, namely both conductors and participants. Since shared learning leads to wisdom and energy for getting over some difficulties in solving problems and for creating new things to happen in society. All humans have the capability in developing themselves for the better if they have an opportunity to do so. Thus, the provision of opportunities, especially in education, can help the pull out some hidden or latent force to be used for public benefits. (Chaliew Bureephakdee et al., 2002). The distribution of development that can reach people widely enables everybody to participate in consuming the output of society, decision-making for initiating, operating, monitoring, and evaluating an activity or a project, including gaining shared benefits with their dignity and with an equal opportunity for everybody in any event or situation that affects members of such a society (Siriporn Phannaphatkun, 2013).

1) Meaning of participation

Participation means an opportunity given to people to participate in initiation, decision-making, performing, and being responsible in all matters that may cause any effect on them. Since every human being has a desire to live with others happily, to be treated equally and righteously, and be accepted by others, one will be ready for devoting oneself to community activities. On the other hand, human beings can be developed whenever they have a chance to do or to be guided correctly (Komson Waritt, 2002). Thus, the meaning of "participation" is diverse as follows:

UN Department of International Economic and Social Affairs (United Nations, 1981) defines community participation as the creation of opportunities to enable all members of a community to actively contribute to and influence the development process and to share equitably in the fruits of development by focusing on giving decision-making power to rural people.

Reeder (1974) defines people's participation as the participation in interactions, of both individuals and groups.

Yuwat Wuttimethee (1982) defines people's participation as an opportunity opening for people involved in initiation, decision-making, operating, and

being responsible for the matters affecting an impact on people. To have people participate in rural development for solving problems and bring about people's better living, a change agent must accept the philosophy, “every human being has a desire to live with others happily, to be treated equally and righteously, and be accepted by others, one will be ready for devoting oneself for communities’ activities. On the other hand, human beings can be developed whenever they have a chance to do or to be guided correctly”

Orathai Kokpol (2009) explains that public participation is the circumstance in which people participate in any activity of government agencies and local administrative organizations for public benefits, starting from people’s self-consciousness and self-perception as a part of the society to which they belong. It also includes involvement in thinking, planning, working, and evaluation, including gaining common benefits.

Pratchaya Wesarat (1985) defines people's participation in development as the involvement of people in trying to use or using some of their resources for conducting any activity towards community development.

Sheerawat Jitnate (1985) explains the meaning of people's participation as people's involvement or engagement in some public activities at all levels of the decision making: politics, management, economics, and society, through different ways, starting from voting, helping to improve the community's environment, having some roles or responsibilities in organizations or social agencies, i.e., industry, company, shop, governmental system, rural cooperatives, including people's collaboration in a religious organization, association, and other processes that influence people's social life.

Chaliew Bureephakdee et al. (2002) define participation as the ability of individuals to play a part in making decisions for determining development policies, which is the initial step of development planning after the objective and plans are jointly determined. Besides, it includes joint operation, utilization, monitoring, and evaluation of a project.

Sirikarn Kosum (1999) defines the meaning of participation by clarifying two ways of participation. The first way is general participation through individuals' voluntary involvement in making decisions, operations, monitoring, and gaining

common benefits. The second way is a specific way by focusing on the initiation and effort of being oneself in operating control over the utilization of resources on the competition.

Participation thus means the way people get a chance to involve in activities, starting from the joint initiation, decision-making, operation, responsibilities, and evaluation, including gaining joint benefits and being jointly responsible for what they do and what they gain. Besides, participation has three distinctive points: context, practice, and mind. (Sirikarn Kosum, 1999).

2) Factors facilitating participation

There are several factors enabling people to participate, i.e., initiation by a local community, a natural leader, a community leader, an assigned leader, who may not be the legitimate leader and may not be accepted by local people. A natural leader is a local philosopher, monk, village chief, or any others, depending on the situation. (Prawet Wasi, 1989). Individuals or communities will participate in any activity when they have some personal interest and worries, which, by chance, being congruent with others'. Thus, such interest and worries become shared interest and worries, or common trouble and dissatisfaction driven by the existing situation and leading to group formation, jointly planning, operations, and agreement towards the group or community changes. However, the joint decision must be strong enough to bring about the initiation for individuals or groups of doing something to respond to the agreement of the majority of people. (Sakon Sathitwittayanan, 1999)

3) The establishment of people's participation

There are three steps for establishing people's participation: decision-making, planning, and implementation as planned (Chutarat Chompunth, 2012). Generally, there are several levels of participation, as follows: (Chunida Rakvisitkul, 2009)

(1) The levels of participation

The levels of people's participation are in order from the most concentrated level of participating in any activities or projects, in which people can initiate policies, plan, and conduct activities or projects by themselves, to the lowest level or the first step of participation. (Chutarat Chompunth, 2012)

(1.1) Informing Level is the lowest level of participation in which the state or project owners provide relevant information to concerned people after any activity or project has been initiated. People have a right to access information only and there are no channels for them to express their opinions or make any decisions. Nevertheless, the level of people's and stakeholders' access to information is the starting point for opening an opportunity for people to participate. The dissemination of the information can be done through many channels, i.e., newspaper, exhibitions, brochures, etc.

(1.2) Information Provision Level is a higher level of participation. When people or stakeholders acquire information, they can search for causes of problems, analyze them and the necessity or needs of an activity or project, and scrutinize the advantages and disadvantages of alternatives better. At this level, the state or the authorized person will invite people or stakeholders to share their opinions towards such activity or a project so that the person who makes decisions can use their opinions for his or her further decision-making.

(1.3) Consultation Level is the level in which policymakers, project owners, affected people, and the general public can have a chance to communicate formally so that they can use the information or research findings to consult with people about the problems, alternatives, and solutions involving such policies or projects. People then can express their ideas, but it cannot be assured that such opinions or ideas will be brought up for consideration properly, or to what extent they can affect the decision-making. It can say that most of the rural participation in Thailand is at this level.

(1.4) Involvement Level is the level in which two-way communication with a broader scope is provided. Listening to people's feedback or public hearing will be opened, including encouragement of co-planning in project preparation and conduction. Especially, the opinions on the complicated or highly-argumentative issues leading to the reduction of conflicts or negative impact will be enhanced. Nevertheless, the authorized persons still have power in making final decisions. Therefore, at this level, the participation focuses on participation channels or methods, i.e., a participative planning meeting, a consultation group, etc.

(1.5) Partnership Level is the level at which those in authority and people can jointly prepare and implement policies and projects as planned to achieve the determined goal.

(1.6) Delegated-Power Level is the level in which people have the right to exchange their ideas with those in authority, including being able to monitor, audit, follow up, and evaluate if an activity or a project achieves the objectives or intended goals. People's participation in this level will be very beneficial for policy and project development, especially in the conservation of natural resources and the environment. People can surveillance, monitor, investigate, and warn when an activity or a project may affect people’s health, society, and environmental quality. The Monitoring and evaluation may be in the form of the establishment of a central committee, comprising stakeholders of every sector.

(1.7) Citizen-Control is the highest level of people's or public participation in which people can initiate, plan, and conduct an activity or a project from the beginning, while the state officials will play the role of facilitators or supporters only.

The levels or roles of people’s or public participation can be summarized, as illustrated in the below figure.

Diagram

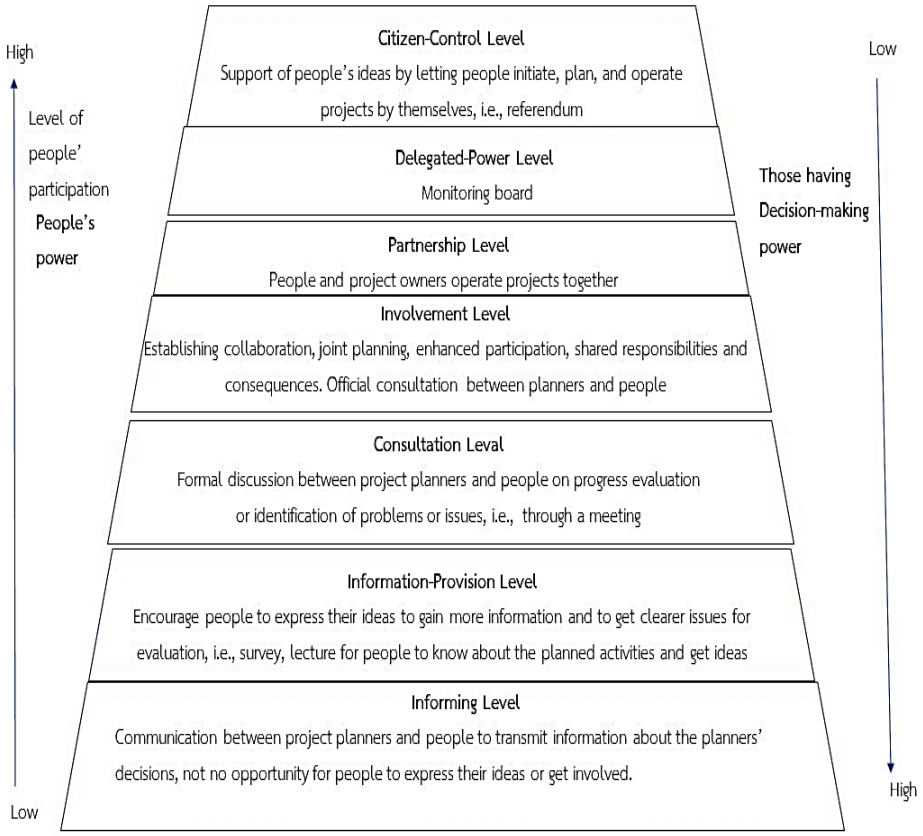

Figure 2.2 Level of People's or Public Participation

Source: Adapted from Arnstein, 1969; Burikul, 2009; Petts, 1999; Sinclair & Diduck, 1995; Chutarat Chompunth, 2012.

(2) Benefits of people's or public participation

Creighton (2008) and Siriporn Phannaphatkun (2013) specify the benefits of people's participation as follows:

(2.1) Better quality of decision-making. Since the consultation process with the general public helps clarify the goals and needs of a project or policy, people's participation often leads to consider some new alternatives, which may be the most efficient answer.

(2.2) Low cost and less delay. Despite taking more time with a higher cost than sole decision-making, the latter cannot cover people's genuine needs.

Besides, it might lead to opposition or charges, which will take even longer time and be costly, including causing more delay and possible failure of a project finally.

(2.3) Consensus establishment. People's participation will create agreement and engagement stably among groups of differences. It helps to enhance a better understanding among groups, reduce political conflicts, and yield righteousness for the government's decision-making.

(2.4) Easier application. To get involved in a decision- making process makes people have a sense of ownership of ideas. Once the decision is made, they would rather see how they are implemented, and sometimes they are eager to help to push them enthusiastically.

(2.5) Avoidance of the worst confrontation. Since opportunities are provided for people to express their needs and worries since the starting of a project, it helps to reduce chances of arguments and disunion, which are causes of violent confrontation.

(2.6) The maintenance of credibility and righteousness. Transparent decision-making and opportunities for people's participation increase creditability and righteousness, especially in making decisions on conflicting issues.

(2.7) Anticipation of public concern and attitude. Concerned officials or staff who work with the public in a participative process can perceive how the general public feels or concern about an organization's performance. Thus, it helps them to anticipate the responses of the general public on the organization's process and decision-making.

(2.8) Civil society development. One of the benefits of people's or public participation is to provide knowledge for people on the content of a project and the state's decision-making process. Besides, it can train leaders and make people learn the skills of working collaboratively for solving problems effectively in the future.

2.3.2 Coastal Communities and Coastal Erosion Protection and Solutions

From the study on the management of coastal erosion protection and solutions, it was found that communities along the national coastline are diverse by their traditional role, i.e., agriculture, fishery, etc. These communities made use of the coast ecosystem directly. For instance, most of them caught aquatic animals for household

consumption, and for commerce by different kinds of economic animals in each area. Another example was the use of wood from a mangrove forest for household consumption and for commerce from the use of wood or parts of plants, which can be processed, i.e., herbal plants. Furthermore, people also used coastal areas as a learning center and tourist attractions. (Siriporn Phannaphatkun (2013). Besides, from 12 case studies of Thai Environment Institute (2010 with traditional or indigenous communities with dispersing residence all along the coastline of the Thai Gulf of Thailand and the Andaman Sea, the coastal erosion protection and solutions management had three phases: initiation, calling for collaboration, and connecting coastal resources management with community development.

In short, the process of maintaining and enhancing the sustainability of coastal communities consists of the following:

1) Pressure. Pressure enables communities to initiate a group formation, i.e., mangrove-forest concession, shrimp farming, fishery by destructive tools, or the invasion of public mangrove forest of a community, etc. Such activities deteriorate natural resources and affect coastal communities' earning or occupations.

2) Initiator. An initiator is a person in the community, i.e., a village chief, religious leader, etc., who is respected by people in the community. Initiators of some communities can be natural leaders and are a major mechanism in persuading, stimulating, and providing information, which leads people to have group consultation.

3) Group formation. Mostly, a group is formed after some currents of natural resources through a community's participation have been accepted so increasingly that it can drive their problems to be contained in the Constitutional acts. In the case of group formation before any current, it often occurs because of some severe pressures that drive people to do something.

4) Community collaboration. Collaboration in a community occurs after group formation through continual knowledge provision. Some regulations were stipulated for controlling the use of natural resources. On the other hand, the community's awareness and participation must be continually supported as well, especially the youth. Activities must be conducted consistently and continually.

5) Connection of coastal resource management to community development, i.e., savings, occupational development, generating-income activities in

different forms, etc. Any beneficial coastal resources management can motivate people in a community to collaborate progressively while being more accepted by the government agencies too. Accordingly, the coordination with and support from external agencies can be done easily, i.e., budgets, training, etc. Thus, it reflects that communities still require collaboration and support from external agencies.

2.4 Success Factors for Coastal Erosion Management

For the integrated coastal zone management, it requires continual operation and appropriate adaptation to the situation of each area and time. Typically, in coastal management, persons who are policymakers, erosion-management planners, or practitioners must adapt the pattern of their management in congruence with the state of problems and political condition or governance of each area. Still, coastal erosion management may be long before reaching success explicitly.

2.4.1 The Success of Coastal Erosion Management

To manage coastal erosion successfully, the following should be concerned: (Suvaluck Satumanatpan, 2011)

1) Sustainable Development Principles. The main goal of coastal erosion management is its sustainable development by maintaining the environmental integrity of both structure and functions, including the concern on economic efficiency and social equity. Nevertheless, to apply such principles, the application should be managed to yield concrete or tangible outcomes through the use of tools, techniques, or mechanisms.

2) Integration Principles. Since the coast is the area in contact with land and sea, which is related to several agencies and stakeholders. Coastal erosion management requires integrated management, i.e., integration of resources, areas (land and sea), and concerned agencies and stakeholders, including the integration of knowledge and local wisdom.

3) Participation. Coastal erosion management is the surveillance, monitoring, and adaptation of human behaviors in their usage of coastal areas, which can cause an impact on lots of people, i.e., concerned agencies, stakeholders, etc.

Therefore, it is essential for those involved to participate in coastal management, starting from participating in identifying their problems planning, management implementation, and evaluation. Coastal management must be accordant with the needs, be transparent, and be accepted by all parties.

4) Implementation. One of the major causes making coastal erosion management of several countries fail is no implementation or only partial implementation. Primarily, coastal management plans must be supported with proper and sufficient budgets and personnel, including the empowerment of practitioners to be equipped with capabilities compatible for management plans to ensure smooth and continual coastal erosion management.

5) Evaluation. Evaluation is greatly critical for coastal erosion management as it can indicate the level of management success. Besides, it can bring about some lessons learned from past management. Therefore, it leads to an improvement of coastal erosion management and can extend to larger areas or other areas in the future.

2.4.2 Direction of Coastal Erosion Management in the Future

1) The integration between top-down and bottom-up approaches for management

In general, coastal erosion management is often initiated by the government sector, which will determine policies, strategies, or planning for managing coastal erosion, while local agencies will implement as planned. The management by this way is called “Top-Down Approach.” The advantage of this approach is the ability to see the situation or problems at the overview level and thus, management strategies can be posed for the whole system. However, its disadvantages are the inability to access problems insightfully, policies and action plans may not be appropriate for human resources in the area, and solutions may not respond to the needs of local people or communities. The other approach of coastal erosion management is that local communities or people identify their problems or needs and propose them to the central government. This approach is called the “Bottom-up Approach.” Despite a clearer view of problems and compatibility with local needs, such an approach also has some limitations. For instance, it takes a long time. Besides, policies initiated by the local

community seldom receive budgets from the central government. Accordingly, coastal erosion management in the future, including planning, policies, and strategies, must apply the integration of both approaches. Specifically, all stakeholders: the central government, local agencies, and communities, etc., must have shared roles since the stage of planning and policymaking.

2) Promotion of people's participation in coastal erosion management

As coastal resources are national and public property, to let only the government sector operate all the coastal erosion management without the collaboration of people, it might be impossible for the management to be successful. Therefore, the state should promote people to participate in coastal erosion management as their treasure and adjust the roles of the government sector from operators to facilitators and let people operate through various kinds of mechanisms, i.e., community-based management, co-management, the use of incentives (i.e., giving low-interest loans, tax measures, etc.) Besides, the private sector should be encouraged to be a management alliance. Moreover, to support people to play more roles in coastal erosion management will make them realize the importance of the coast while stimulating their awareness for conserving and making use of the coast worthily and sustainably in the future.

3) Promotion of genuine integrated coastal management

Integrated Coastal Management is in the currents nowadays; thus, many management projects like to use the word "integrated" in the projects. However, very often, such projects are not integrated genuinely since they lack knowledge and understanding of integrated management truly. Besides, some conflicts, either of the same agency or between agencies, occur during the operation, including conflicts among benefit groups since the management will always have both beneficiaries or benefit gainers and benefit losers. Accordingly, it is rather difficult to operate integrated management. Therefore, it is essential to have some mechanisms to provide knowledge and understanding of the necessity of integrated management. Some mechanisms should also be used for negotiating benefits towards a win-win approach or mutual benefits to persuade concerned people or groups to accept and collaborate in the management, leading to integrated coastal erosion management genuinely.

4) The empowerment of local capabilities

As aforementioned, coastal erosion management requires collaboration from local personnel since they are those who adopt or implement the plans. However, one of the most crucial problems is the lack of personnel's knowledge, capabilities, and experiences, both academic and management. The government sector thus needs to empower them to be able to proceed with the management as planned, including monitoring the coast effectively.

5) The establishment of coastal erosion management networks. The integrated coastal zone management is a process that brings about adaptation and learning by adopting experiences of coastal management, of both successful and/or unsuccessful, to be lessons and adapted properly for the condition and needs of each area. Therefore, the establishment of a coastal erosion management network will help to extend the outcome from one area to another area, until broader areas are covered from the village to sub-district, district, provincial, and national level. However, all of these extensions can be successful unless there is a mechanism for creating networks for coastal erosion management, supported by the government sector.

6) Public Relations and Dissemination of information.

Public relations and dissemination of information related to coastal erosion management are important and essential for coastal erosion management since people can be informed of strategic plans, action plans, projects, or activities related to coastal erosion management, that might yield both positive and negative impacts on people, especially stakeholders. Besides, people are encouraged to participate in coastal erosion management, which helps to promote coastal erosion management to be transparent and accepted by people. Accordingly, concerned agencies have to publicize and disseminate information related to strategic plans, action plans, projects, or activities related to coastal erosion management seriously to enhance effective and efficient planning and operation of coastal management.

2.5 Related Studies

2.5.1 Studies on Techniques and Knowledge about Coastal Erosion

From the studies on techniques and knowledge about coastal erosion, the following studies are found:

Payom Rattanamanee et al. (2008) studied the approaches of integrated coastal erosion protection by 1) the study on the effect of the structure of artificial coral reefs on tidal current changes and longshore current, including shoreline morphology by using the mathematical model for model prediction by comparing the information from the experimental laboratory with the model calibration. 2) The study by the physical model in the experimental laboratory was prepared by dividing into the test of artificial corals in the Wave Flume and those in the Wave Basin to study structural behaviors to wave action, beach protection efficiency, and shoreline change due to a construction project. 3) The study of a pilot study. After the study by the mathematical model and physical model of artificial corals, the next step was Detail Design. For the projects in the next phases, the experimented corals of approximately 400 - meters long at are placed in the pilot-study project at Samila Beach coast. The evaluation of the actual outcome was monitored and compared with the results from the test in the laboratory.

The findings from the model indicated that the use of artificial coral reefs is an undercurrent breakwater, which is an integration of knowledge on coastal erosion protection that has been operated in many areas in foreign countries. Besides, from the evaluation of the project, it was found that it was successful since the use of artificial coral reefs for coastal erosion protection has several strengths.

Rawadee Jarungrattanapong (2008) studied the adaptation of households or families affected by coastal erosion in the Bang Khun Thian District, Bangkok, by documentary analysis, focus group interviews with stakeholders of coastal erosion in the study area, and survey of the families in two villages, namely Bang Khun Thian Coastal Community and Sao Thong Community. The findings showed that due to the impact of Bang Khun Thian coastal erosion problems, families tried to cope with the problems by adapting themselves in two ways: immediate solving and separate protection, i.e., embankment or rock-filled dams, embroidered bamboos or placement of bamboos, reinforced or heightened walls or slopes of soil, concrete piles or sediment

traps, a setback zone, and house- building or repair. It indicated that households in the study area or Bang Khun Thian coastal area had a need to protect and solve the coastal erosion. The adaptation way found the most was the protection of each household or family separately. Besides, most households used several adaptation ways, not only one way, if they had sufficient earnings. The average cost of each household's adaptation is approximately 107,587 baht yearly. Furthermore, from the study, the following three notions were given: 1) The adaptation by each family's separate protection might not be an effective way since it might yield a negative impact to the neighboring areas if such areas exerted no adaptive operation. 2) Households with a low level of education and no occupational skills tended to be willing to pay for the adaptation higher than household incomes. 3) Coastal erosion could not be solved by local administrative organizations but required the collaboration of concerned government agencies, both central and local.

Kannigah Asavadorndeja (2009) studied strategic planning for coastal erosion solutions in the upper Gulf of Thailand and found that there were seven causes of coastal erosion in the study area: the decreased area of mangrove forest, wave during monsoon, and wave caused by fishing and tourism boats, shrimp farming, dam building, sediment dredging, and groundwater pumping. Opinion leaders or mainstays of the communities experimented to find ways to solve coastal erosion problems in their communities, in combination with collaborating with people and concerned agencies, both government and private, and found that because of people’s familiarity with their area, they were willing to collaborate to solve coastal erosion problems fully. Besides, four main problems and obstacles in the operation: a lack of budget, no collaboration from concerned government officials, a lack of people's academic knowledge and understanding and collaboration, and conflicts between people in the area and opinion leaders or mainstays. Besides, successful coastal erosion solutions were bamboo revetment, electric piles, artificial coral reefs, and revetment. Moreover, it was found that village heads as community leaders could solve coastal erosion problems successfully from the collaboration of people in the form of village meetings. Furthermore, Sub-District Administrative Organizations were agencies the communities expected to play a role in solving coastal erosion problems the most.

Theerawut Onda (2009) studied the possibility of a protection project against coastal erosion in the Bang Khun Thian Coastal area, Bangkok, for preparing alternatives, protection, and solution methods that are suitable for the condition. Besides, the causes of problems concerning communities' and the adjacent areas' ways of living were studied to find approaches, communities' process, and the roles of the government sector in managing the occurring problems collaboratively. Moreover, the study also aimed to analyze the cost-effectiveness by economic and financial analysis of the projects from analyzing yearly costs. The findings showed that under the principle of the lowest cost or the efficiency of costs based on economic and financial analysis of the project, bamboo revetment was the approach approved by people in the area and was the project that used costs per year lower than T-shaped groins projects. Besides, from the economic analysis, T-groin caused more severe coastal erosion to the adjacent area of 2.5 rai within the diameter of two sides of the coast. Thus, the total eroded areas increased to 50 rai throughout the project. Besides, bamboo revetment was found to yield no negative impact on the community and environment since it used natural material. Moreover, it added no increased eroded area to the neighboring area. Therefore, bamboo revetment was an important alternative that helped to protect the erosion of the Bang Khun Thian coastal area effectively.

Wutthichai Sriprasertkul (2010) studied the impact of coastal erosion on community changes: a case study of Ban Khunsamutchin Community, Samut Prakan Province, and found that coastal erosion had an impact on the community’s ways of life, economics, and society. Regarding occupations, some parts of the community changed their occupations, especially those who moved to a new place tended to change their occupation. Regarding accommodations, most of them moved their house 3-4 times up to 11 times. In terms of ownership, most residents in the community had to rent the land for a living. The public services that had been affected were schools, health centers, and electricity systems. However, the relationships of people in the community and local traditions and activities were not affected. Concerning the existence of the community in the future, every family or household had no idea to change its residence, except if necessary, i.e., the loss of their residence or land because of coastal erosion problems.

Department of Marine and Coastal Resources (2011) studied “the Monitoring and Evaluation of Coast Ecosystem Restoration by Using Bamboo Planting for Slow-Wave: A Case Study of Samutsakhon, Samut Songkhram, Samut Prakan, and Chachoengsao. It found that coastal erosion was one of the causes of migration problems, especially in the area of Bang Krachao District and Phan Thay Norasing District, Samutsakhon Province, which had been eroded for 30-40 years. The major impact was the collapse of soil, migration, no land for earnings, and decreased fertility of fishery resources. Besides, the following was found: 1) From the study on the coastal erosion solution by bamboo planting, it was found that the roles of bamboo revetment in reducing or slowing waves and in trapping sediment could not be summarized clearly as there were other coastal erosion protection projects in the study area, i.e., geo-bags and revetment, including human utilization of the coast. 2) For the impact of bamboo revetment for slow-wave on biological resources and environment, it was found that 2.1) bamboo revetment made the area turn black and have the smell of Hydrogen-Sulfide. 2.2) Bamboo revetment increased the proportion of silt and clay particle while the proportion of sand decreased. 2.3) Bamboo revetment yielded the biological production and fishery capacity in the area at a high level. 3) To establish a community society still faced some restrictions because a community perceived it as only a form without having opportunities to make a process of public hearing for opinions and suggestions. Thus, a community could not have a chance to participate in monitoring and evaluating the operation of a project.

Nittharat Paphawasit (2011) studied the monitoring and evaluation of the coast ecosystem restoration by using bamboo planting for slow-wave in Samutsakhon, Samut Songkhram, Samut Prakan, and Chachoengsao and found that coastal erosion occurred at a severe rate. Mangrove forests that used to absorb energy and protect the coast became resources fragile for being eroded. The increased erosion was based on the assumption that 1) the decreased amount of coastal deposited sediment, 2) the decreased number of young trees to replace the eroded forest (The forest lacked fertility, so it yielded the slower rate of production of surviving trees, 3) a change in tide ranges since the water was not overwhelmed as before as a result of deposition and adaptation of mangrove forest and the surrounding area, and 4) the shrinking of the land. Besides, it was found that bamboo revetment helped to reduce wave energy behind the bamboo

revetment line increasingly. When considering the impact of the information surveyed from the water surface in deep water, it was found that sediment was deposited immediately behind the bamboo revetment line. Thus, it was suggested that to operate any coastal erosion protection and solutions need collaboration among the government and private agencies, including communities. Coastal erosion is very complex and requires scientific knowledge from several fields of study to enhance understanding of true causes to solve problems accurately. It is thus essential to evaluate communities' potential in participating in coastal erosion problems management by studying communities' perception, gratification, and acceptance. Besides, it is important to provide the possibility of local communities to participate in any activity by letting people in the communities assess their potential, strength, weakness, opportunities, and obstacles by themselves. The assessment of communities' potential will help to know the strength and readiness level of a community to participate in coastal erosion problems management by the civic sector.

Boonchuay Attawattana (2012a) studied coastal erosion solutions by bamboo revetment for slow-wave: a case study of the establishment of community networks in Samutsakhon Province. The study found some changes in a coastal area in Samutsakhon Province as it was found that sediment had been swift to be deposited in the eastern-western direction of Tha Chin river-mouth. In the past, the coastline was covered by mangrove forest, but recently it was transformed to be a shrimp-farming farm, salt field or farm, and residence. Mangrove forests had been destroyed enormously. From assessing the damage cost of the eroded area at the minimal level from present to 2030, if nothing related to coastal erosion prevention is operated.

From the assessment of approximated damage cost of eight sub-districts, namely Phan Thay Norasing, Khok Kham, Bang Ya Praek, Bang Krachao, Ban Bo, Bang Thorat, Kalong, and Na Koke, the eroded area falls between 32,742.60 – 1,639,915.20 square meters, or the damage cost is between 34,175,089 – 1,711,661,490 baht. For the methods, appropriate for coastal erosion solutions in the past, the communities perceived that mangrove forest was the most appropriate method, followed by bamboo revetment, concrete-pile planting, revetment, seawall/ concrete piles/ sheet piles, and sand sausages respectively.

Pichsinee Muadhama. (2011) studied economic and social changes caused by coastal erosion problems: a case study of Ban Bo It Community, Moo 8, Kho Taew, Muang District, Songkhla Province, and found that the erosion situation in the Ban Bo It Community was severe. The erosion started from Ban Puk and Ban Bo Shone, and gradually moved to Ban Bo It coast. The erosion damaged houses near the coast. Later, the consequence of breakwater eroded nearby coasts and cut transportation roads of the communities. Thus, people who used to travel by these roads could not use the old route, so they urged the local administrative organization to be responsible by repairing the roads back to the old condition. Then, the Department of Rural Roads repaired the roads, built a concrete wall in the long line between beaches and edges of the roads to protect erosion of coastal roads, and built offshore breakwater additionally. Such constructions decreased the fertility of the coastal ecosystem and were expected to have a stronger wave erode the coast increasingly.

Orawan Thitnun. (2011) studied crisis factors affecting the construction of coastal erosion protection dams in Nakhon Si Thammarat Province. It was found that designers lacked expertise and experience in design so people opposed the construction since it could change the coastal ecosystem. For the construction stages, it was found that the construction foreman had low management capabilities; thus, it caused the work delayed. Moreover, problems may be caused by natural phenomena and obstruct the working process. All mentioned factors were signs for warning erosion problems that might occur during the design or the construction stages.

Surachai Claythong. (2011) studied the impact of coastal erosion problems on Ban Chai Tha Lae Community, Phan Thay Norasing Sub-District, Muang District, and Samutsakhon Province, and found that coastal area in Phan Thay Norasing Sub-district had been facing severe coastal erosion for many years, which affected the community's economics in three aspects: 1) decreased income from a fishery, while some parts of the community changed to a new occupation with which they were not familiar, i.e., working in a factory, or general hireling, etc. 2) loss of agricultural land, 3) loss of money for spending on their accommodations. Furthermore, there were four aspects of social impact: 1) moving to a new place farther from the coast or to the nearby area. 2) More distant relationship between family members and relatives because members had to find jobs out of town, 3) disappearance of local culture and tradition, including

communities' ways of life. Religious places were damaged, i.e., religious shrines of the community, etc. 4) Lower quality of life as a result of people's new occupations. Moreover, there were four aspects on ecosystem and environment: 1) increased severity of wind and currents, 2) increased level of seawater, 3) deteriorated mangrove forest as it was changed to be shrimp farms and natural disasters, and 4) decreased numbers of forests and aquatic animals. For ways of living, erosion affected mental state in two aspects: 1) fear of erosion disasters, and 2) anxiety of losing earning area, residence, or home. For the coastal erosion solutions, there were four approaches related to land and houses of people in the community: 1) Geo-bags, 2) heightened berms, 3) throwing stones, and 4) bamboo revetment. At present, a bamboo revetment is used as a protection line against temporary coastal erosion as it is a soft structure and can immediately be constructed. However, for permanent coastal protection, no clear conclusion was found.

Suvimol Saelim and Sawanya Suelueam (2011) studied the impact of coastal erosion problems on a local community: a case study of Kao Seng Community, Songkhla Province, by documentary research and in-depth interviews with villagers and the community leader. The results showed that coastal erosion caused physical changes in Kao Seng Beach, the loss of coral reefs, and a decreased amount of sea animals. Besides, it was found that the social impact was caused by the migration and changes of local tradition and culture, while the economic impact was caused by the loss of tourism incomes, occupation changes, and the expenses of repairing damaged houses and construction. Besides, it affected people's quality of life caused by their stress and anxiety from the loss of property.

Pipat Leeladee (2012) studied the impact of coastal erosion on a coastal community: a case study of Chai Tha Lae Bang Khun Thian, Tha Kham Sub-district, Bang Khun Thian District, Bangkok, and found that coastal erosion affected ecosystems of the community in three aspects: 1) Loss of coastal land, aquatic - animal nursery, and loss of land and houses, 2) destruction of mangrove forests, and decreased number of aquatic animals. It caused an economic impact in two aspects: expenses on land protection and fixing houses and 2) decreased income from natural aquatic animals and nursery. For social impact, the effect was four aspects: 1) retreat from the original residence zone, 2) decreased relationships among family members, 3) conflicts of

people in the community, and 4) decreased traditions. Moreover, it also yielded an effect on people's quality of life, i.e., a feeling of insecurity in occupations and ways of living and on their mental state because of their fear of natural disaster and anxiety because of possible loss of land in the future. It was found that the community protects coastal erosion by making heightened soil slopes, geo-bags, revetment, and bamboo revetment at the coastal edge.

Sawanya Thamma-apipon. (2012) studied the impact of coastal erosion on a coastal community in Khok-Kham and Phan Thay Norasing Sub-districts, Muang District, Samutsakhon Province, and found that coastal erosion affected the economics of the community in 4 aspects: 1) loss of land value, 2) loss of earning income, 3) loss of money for repairing their house and construction, and 4) loss of money for protecting their house and construction. Besides, it caused a social impact in two aspects: 1) retreat and migration from the land, and 2) changes in the community's ways of life. Also, it yielded environmental impact in four aspects: 1) loss of soil resources, 2) deterioration of mangrove forests, 3) decreased number of aquatic animals, and 4) damaged coastal scenery. From the study, it was found that the community adapted itself by retreating towards the coast, adapting their house-building and construction for protection. The concerned organizations responsible for erosion protection and solutions were Sub-District Administrative Organizations, The Second Center of Marine and Coastal Resources Conservation (Samutsakhon Province), and the Natural Resources and Environmental Conservation Learning and Action Center *(*Mahachai East Coast), Samutsakhon Province.

Sukhothai Thammathirat Open University (2013) conducted a study on the evaluation of the efficiency of coastal erosion solutions by bamboo revetment. The study found that

1) Coastal erosion solutions by bamboo revetment caused both geological and biological impact. For geological impact, it increased the level of soil sediment along the bamboo revetment line. Consequently, it also increased the number of aquatic animals. However, planted bamboos might damage the scenery. Parts of them were swift towards the coast; thus, it created some barriers against the community’s occupations. For biological impact, the number of mangrove forests increased behind the bamboo revetment line; therefore, it affected changes in the types, amount, and

growth rate of aquatic animals; the diversity of benthic animals and reptiles; and the diversity of seedlings at the moderate level and tended to be higher. Moreover, some parts of the community earned their living by hiring to plant bamboos. Besides, it also yielded social impact in the way that people talked, consulted, and made an understanding of coastal erosion solutions, bamboo revetment, the maintenance, and the emergence of community networks.

2) Participation of the community in coastal erosion protection management. The community participated in the preparation, consultation with leaders in some communities for specifying areas for bamboo revetment, and publicizing information to people to be informed. Besides, people also participated in bamboo revetment with some appropriate compensation. Moreover, they are jointly responsible for the quality of bamboos. By doing so, it created people's engagement in coastal erosion solutions by bamboo revetment. In the maintenance of the bamboo revetment line, some communities would collaboratively supervise, monitor, warn, and prohibit any action or activity that could cause any damage to the planted bamboos or bamboo revetment line. Some communities extended their outcome by growing mangrove forests behind the bamboo line. Besides, external people and agencies were also allowed to participate in management activities by the village committee. However, no clear pattern was found. Some communities assigned entrepreneurs near the bamboo revetment line to be responsible in monitoring and evaluating damages of the bamboo revetment line. However, there had been no repair yet owing to the lack of supporting budget and materials.

3) Satisfaction People were satisfied with the process of coastal erosion solutions at the moderate level, starting from the preparation on problem analysis, decision-making, problem-solving, bamboo revetment design, places for bamboo revetment, coordination with supporting agencies, knowledge, and activity information acquisition, training, field study, collaborative maintenance of bamboo revetment line. Satisfaction evaluation also covered evaluation, public relations, measures, and conditions determined for allocating benefits gained from bamboo revetment. In general, people were satisfied with bamboo revetment for coastal erosion solutions at a moderate level. They perceived that generally the eroded areas were managed rather successfully as there were more deposited sediments in the areas. However, some areas

could not be solved by bamboo revetment as there had been no sufficient maintenance of the bamboo line. Therefore, people's satisfaction with the overall operation was at a moderate level, including input factors of the project, outcome of the operation, economic, and social impact.

4) Proper form of coastal erosion solution management by bamboo revetment. The bamboo canes used for planting should be solid and thick, aged over 3 years. Types of appropriate bamboo species were Pai Tong, Pai Pa, and Pai See Suk. Planting lines should consider the depth of the coast and the appropriate distance should not be farther than 50 meters from the coastline and there should be channels at regular intervals for passing boats. The right way of planting is to have no less than 5 rows and bamboo canes should be planted no less than 2 meters deep. Besides, for considering which part of bamboo canes should be planted, it was recommended that at the beginning the end of the cane should be used because of its advantage for protecting wave severity and slowing it down. Besides, rotten or damaged canes should be replaced or replanted immediately. Moreover, appropriate mangrove forests for the area behind the bamboo should be planted. Also, bamboo planting should be extended to cover all eroded areas of the community, including adjacent communities. For the old bamboo line, additional bamboo should be planted at the outer line. Some communities might have measures to regulate and monitor bamboo revetment. It was recommended that awareness should be stimulated to people who make use of a coastal area in their occupations at the bamboo line or nearby. Moreover, the concerned agencies should consider supporting budgets for surveillance of bamboo lines, which is out of the potentials of communities and local administrative organizations.

5) Knowledge and needs of communities in coastal erosion solutions by bamboo revetment People of communities had knowledge and understanding of coastal erosion protection, problems, and causes of coastal erosion, mangrove forests, water and wind currents, the use of land, coast erosion impact, and preventive approaches for coastal erosion by bamboo revetment, at a moderate level. For knowledge on the evaluation of group performance in solving coastal erosion problems, people knew at a rather low level, including knowledge on coastal erosion solutions by sand sausages and seawalls. Besides, people had knowledge and understanding of teamwork for coastal erosion solutions at a rather high level. Moreover, people reflected their needs

for extending the bamboo revetment line in two aspects: (1) For the area of bamboo revetment, people needed a process and mechanisms for monitoring and evaluating the operation, including repairing damaged or rotten bamboos continually. Besides, they needed to have bamboo revetment cover all coastal areas with erosion problems for preventing coastal erosion of adjacent coastal areas, including multiple and higher rows due to high waves and strong wind in some areas. (2) For the unplanted areas, many communities needed the government sector to plant bamboos at the coastal eroded areas in parallel to other protection methods, especially growing mangrove forests. Moreover, some areas needed revetment and permanent dams; however, it depended on the compatibility of the area and the impact on adjacent areas.

6) Measures and approaches for coastal erosion management by bamboo revetment are composed of four measures: preparation of the area and communities, bamboo revetment operations, maintenance, and effective management.

7) The enhancement of communities' learning in coastal erosion protection by bamboo revetment. In a learning process, knowledge on policies and approaches for coastal erosion solutions of the Department of Marine and Coastal Resources was provided for communities. Moreover, situations and approaches for coastal erosion solutions in Thailand were explained, including case studies of coastal erosion solutions of several communities. In general, the patterns of enhancing communities' learning were lecture, group discussion, panel discussion, brain-storming, public hearing, and recommendations from communities and involved parties, which increased communities' knowledge, understanding, and acknowledgment of information from experts. People were encouraged to share experiences and opinions, and jointly determine approaches for coastal erosion management. Moreover, research findings and knowledge gained from coastal erosion solutions by bamboo revetment were publicized through the websites of Sukhothai Thammathirat Open University and the study radio station of the university via the Department of Public Relations to students and general people for their application for coastal erosion solutions and mangrove forests resources.

Chamchuri Yumalai (2014) studied the value of willingness to pay for supporting bamboo revetment for coastal erosion protection project of Bang Khun Thian, Bangkok, and analyzed factors affecting the value of willingness to pay by

assuming technical events or the Contingent Valuation Method (CVM) with close-ended questions. The study found that the mean of the value of willingness to pay for supporting the project equals 1,174 baht/person/year, and the value of the benefits of the project for the Na Dan Tha Lae, Bang Khun Thian, equals 1,652,992 baht/year. Factors found to affect the value of willingness to pay were household income, the perceived coastal erosion problems, experiences of land loss, and the membership of environmental organizations. The samples were willing to pay because they perceived it was citizens' duty to help protect coastal erosion protection for the Bang Khun Thian community. Notably, the benefits the samples perceived from the project excluded benefits other adjacent areas would gain. For the samples' opinions on coastal erosion problems, it was found that most samples perceived coastal erosion was caused by waves, water currents, tide level, and physical characteristics of coastal erosion (97.20%). For the perception of the problems and coastal erosion protection, most samples perceived the coastal erosion problems the most, followed by self-experience of coastal erosion, and self-protection of coastal erosion respectively. For self-protection of coastal erosion, the samples used throwing-stone the most, followed by bamboo revetment for slow-wave, concrete-pile planting, and others respectively.

Jaruwan Ketsomboon (2014) studied the adaptation of Ban Krasa Khao community for coastal erosion, and found that the coastal eroded area of the community yielded economic impact, namely cost of occupation, income, and expenses for repairing houses and constructing coastal erosion protection. The found impact on ecosystems was decreased area of mangrove forests and aquatic animals. The social impact was the retreat and migration of residence, while the impact on the quality of life was decreased commerce on aquatic-animal products. Some families changed occupations as well. For mental impact, anxiety on the security of life and property and fear of the loss of land was found. Regarding the adaptation of people, caused by coastal erosion, three ways of adaption were found: adaptation of their residence by raising the house and belongings from floods, an adaptation of occupations by occupational changes and supplementary occupations for additional income, i.e. the establishment of community enterprises of seafood processing of Ban Krasa Khao, and the adaptation to coastal erosion protection and solutions by collaborating with the government sector,

including the construction of coastal erosion protection and solutions by themselves, i.e., bamboo revetment, seawalls, and others.

Taweesak Theppitak (2014) studied the project on studying the appropriateness of the eastern coastal erosion protection of Chonburi Province to know about technical needs and readiness of geographic, engineering, economic, and environmental information processing, including people's participation in the construction of structure and others for protecting sea waves and the eastern coastal erosion. The study found that from selecting the severe or crisis areas for constructing structures, both hard and soft, for coastal erosion protection through the analysis of gravity weighting of the factors with various kinds of criteria, including scoring other secondary factors based on proper and correct academic principles of diverse fields: coastal engineering, economics, civil engineering, architecture, and landscape architecture, and environment, two areas found to be the riskiest or crisis areas from the analysis were selected from seven areas: Bang Saen Beach, Na Jom Thian Beach. However, each area had different strengths and weaknesses, which were considered for designing the structure for coastal erosion protection and resolutions.

Siriwan Siriboon et al. (2014) studied the empowerment of communities' potentials in monitoring and evaluating the success of coastal erosion solutions in the area of Ban Khun Samut Chin, Samut Prakan. Three main issues were found:

1) From evaluating the effectiveness of coastal erosion solutions by ecological indicators, it was found that breakwaters played a part in helping coastal areas more stable, making the environment appropriate for planktons of high economic-value animals. Besides, it was found that the types and complexities of food webs reflected the stability of ecosystems and increased fertility of fishery resources.

2) From studying the communities' satisfaction with coastal erosion solutions and management, it was found that members of Ban Khun Samut Chin Community gave 8.6 scores from 10 full scores for their satisfaction with the breakwaters. The findings indicated that after the establishment of the breakwaters, the quantity of captured aquatic animals increased, while the income of fishermen tended to go in a better direction. Because of the bettered condition of fishery resources and economics, it decreased the number of members moving out of the community.

3) From the study on communities' potential towards coastal erosion protection, it was found that although community members had strong determination for solving coastal erosion, the management process had not been systematized yet. It still lacked a concrete plan and continuity. The activities were still separately conducted or were only specific activities, case by case.

Kanlayanee Pornpinetphong et al. (2015) analyzed economic costs and returns for comparing policy alternatives for beach erosion management. Two main alternatives were found: 1) coastal erosion by hard structures in different forms, and 2) coastal erosion protection and rehabilitation by the methods accordant with the balanced cycle of the beach and the use of the beach as a natural barrier or bumper in combination with the demolition of structure disturbing sand equilibrium system that is unused. The analysis was conducted from 2014-2034, for 20 years. The decrease was 4.16%. The study showed that the second alternative method yielded higher economic effectiveness, while stakeholders gained net benefits more than the first alternative. (The Net Present Value or NPV of the first alternative equals -2,646 million baht, while the second alternative equals 37 million baht.) Additionally, it was found that if any foreign or adulterated matter that was the cause of erosion was demolished and rehabilitated by methods per natural mechanisms, such as coastal structure demolition (i.e., seawalls, geo-bags, etc.) and jetty at the mouth of Khlong Na Thub in combination with the rehabilitation that imitated nature would yield higher NPV than the demolition of an only coastal structure that used to be a beach. (The increased NPV equaled 214.7 million baht). Moreover, from the investigation of the distribution of burden cost and benefits for stakeholders of three groups: 1) taxpayers, 2) local communities, and 3) tourists, it was found that taxpayers had to bear the burden cost 43% of the projects in the second alternative (the use of coastal structure). On the other hand, the fourth alternative (the demolition of foreign matter in combination with natural-imitation rehabilitation) yielded lower burden costs for every group of stakeholders than the alternative of using hard-structure coastal erosion protection. Besides, the gained benefits of every group of stakeholders were higher. Therefore, in terms of righteousness for stakeholders, the alternative of demolishing foreign matter in

combination with nature-imitation rehabilitation would be the most appropriate method.

Nittanun Thapsook and Utai Parinyasutinun (2015) studied Seawalls: the government's development project and ways of living of Ban Bo It Community and found that governmental development projects like breakwaters decreased beach area continuously from the eroded shoreline; thus, people living along the coast had to retreat their houses endlessly. Besides, breakwaters destroyed the scenery of the beach, caused trashes or a black oil slick on the shores, and decreased the number of sea animals. Thus, it affected the ways of the community's life enormously. Accordingly, people in the community had to adapt themselves to be congruent with current situations, especially some emerging occupations from the adoption of breakwater applications, i.e., fishery by making fish cages, recycled trashes blown by waves, etc. The study also indicated that for sustainable coastal erosion solutions, a community and affiliated parties have to collaborate in determining their local development direction, including the approval or allowance of any coastal construction, and management of coastal resources granted to the community.

Warunee Hanwanna (2015) studied the social impact and approaches for coastal erosion solutions: a case study of Song Khlong Sub-district, Bang Pakong District, Chachoengsao Province, and found that the impact on people, caused by coastal erosion problems, were divided into several domains. For social impact, it was found that people had to demolish and move their houses. Consequently, it caused occupational barriers along the original shoreline and made people derived their main income from the fishery. In terms of assistance needs, people needed budgets from the central government or local agencies for their expenditure in demolition, migration, and construction of new residences. Moreover, they required the government sector to introduce or promote new occupations because of their decreased income from the fishery. Regarding approaches for coastal erosion solutions, four approaches were given: (1) The construction and heightening of rock walls or seawalls from 2.5 meters to more than 3 meters, 2) the plantation of mangrove forests, 3) the release of aquatic-animal species, and 4) campaigns or movements against deforestation along the coastline.

Sukhothai Thammathirat Open University (2015) studied the enhancement of knowledge for developing the target's potentials in coastal erosion solutions of 23 provinces. The study showed that 1) the empowerment of community networks in coastal erosion protection and solutions in Samutsakhon Province was operated by reviewing the structure and board of the community network management, issuing regulations of the community networks, issuing regulations and supporting the budget of 200,000 baht for establishing community networks funds, field trips in Phetchaburi and Chumphon, and other relevant activities, 2) the support of the establishment of community networks for coastal erosion protection and solutions in Samut Songkhram, Samut Prakan, and Chachoengsao Province by determining the structure of the board of community networks of all three provinces at the sub-district level, namely Bang Kaew, Laam Fa Pha, and Song Khlong Sub-District respectively. Besides, regulations of each community network of each sub-district were issued and supported by 50,000 baht for establishing the network funds of each sub-district for their field trips in Chonburi, Rayong, and Chanthaburi, including other relevant activities, 3) the connection of community networks for coastal erosion protection and solutions of four provinces, especially for the network meetings of all four provinces on August 25, 2015, in Samutsakhon Province. Moreover, online social groups were formed for learning exchanges among community networks, and 4) the promotion of activities of the community networks for coastal erosion protection and solutions of four provinces, a totally 10 projects and the support of the budget of 950,000 baht for project implementation, i.e., the repair of damaged bamboo revetment line, mangrove afforestation, coastal garbage collection, the establishment of the living museum, local fishery ways, and the center of coastal conservation.

The Department of Marine and Coastal Resources (2016) studied littoral cells and approaches for coastal erosion protection and solutions. From integrating the information on the suitability of the area and engineering information for specifying approaches, types, strategies, and measures for coastal erosion protection and solutions, beach characteristics and condition were classified into four types: coast with natural stability or with a balanced gulf, coast with coastal-process disturbance or coast disturbed by human activities, coast with natural changes or coast changing towards equilibrium in the future, and coast with protective structures or with coastal protection.

Moreover, each type of the coasts can be sub-divided based on the characteristics of the area: a deteriorated coast or an eroded coast, a steep beach or no beach, a coast in good condition or a beach with a lot of sand, or a wide, and beautiful beach, coast with natural characteristics or a beach without disturbance from external factors, and adapted coast or beach with coastal-protection structure, etc. The classification of beaches by their characteristics and condition led to four types of coastal management: the equilibrium adjustment of natural coasts, coastal erosion protection, coastal erosion solutions, and coastal rehabilitation, following the measures proposed by the Department of Marine and Coastal Resources.

Jamikorn Hiranrat et al. (2016) studied coastal erosion monitoring systems through the development of mobile applications on Android 4.4 Kitkat and web application by CodeIgniter Framework 3.0, installed on Apache Web Server 2.2 and database management system (MySql 5.5). They found that 1) field staff could select the application menu and set basic information. Information from the measurement device was recorded so it could be verified before applying it to a server. Besides, they can access information and service on a server via prepared web service. Information could be analyzed by the web application for managing survey information of the surveillance stations, which monitored crisis areas, and then the survey summary could be reported. The recorded measurement figures were calculated and formulated into the graphic presentation of the steepness of the surveyed areas before being verified and recorded into the database. 2) From evaluating the satisfaction on the system quality in responding to users' needs, the functional capacity of the system, the easiness of the use, and information security, it was found that users had a high level of satisfaction. Thus, it could be summarized that the developed system was accepted by the users as it could facilitate their work in verifying the correctness of the information, reducing errors, and increasing their operational effectiveness.

Chatkhanok Boonyapinyo. (2016) studied the adaptation of the Sub-District Administrative Organization of Lam Fa Pha and the community of Phra Samut Jedi District, Samut Prakan Province, caused by the coastal erosion impact. The findings showed that the area of Lam Fa Pha Sub-District was open to being easily exposed to and threatened by natural threats with the Level-5 risk, or at a very severely risky level. Thus, it required a lot of resources and had been solved for more than a year. The area

was highly sensitive to coastal erosion. On the other hand, some factors affected the potential and capacity of the Sub-District Administrative Organization, which were insufficiency of budget and inaccessibility to new knowledge. Besides, it was found that the potential and ability for coping with coastal erosion of the community was at a moderate level. The factors affecting its potential and capacity were insufficient budget, no explicit plans, and the difficulty in accessing new knowledge. Therefore, the community had to adapt itself very well to live and cope with the occurring erosion in the area.

Haphifi Sama-ae (2016) studied the evaluation on the fragility of a coastal community from coastal flooding: a case study of the coast of Samut Prakan Province. The study analyzed coastal changes by a program called, “Digital Shoreline Analysis System” (DSAS), to indicate the rate of coastal changes. The findings showed that 1) In 2026 and 2046, the sub-districts that were forecasted to be the most fragile area for coastal changes will be Pak Nam, Khlong Dan, and Bang Poo Mai. Also, under the situation in which wave storm occurred, the most fragile sub-districts in 2016 would be Khlong Dan, Bang Phriang, and Pak Nam respectively, while in 2026, the most fragile sub-districts would be Khlong Dan, Pak Nam, and Bang Poo Mai respectively. By 2046, the most fragile sub-districts would be Pak Nam, Khlong Dan, and Bang Poo respectively. Moreover, it was found that Pak Nam Sub-District had hugely increased fragility since it was a very sensitive area, while the ability for coping with disasters was lower than in other areas. 2) It was found that in 2026, there would be coastal erosion of a total of 4.37 kilometers and would increase to 12.44 kilometers in 2046. The highest ratio of coastal erosion would be 10.01-20 meters per year, covering 20.09 kilometers of the coastline. Thus, the study areas would face high coastal erosion as they were exposed to disasters the most due to their fragility on coastal flooding the most.

Jantira Rattanarat and Patcharin Saetang (2017) studied communities' opinion on coastal erosion problems in Thailand and found that 1) in terms of environment, they perceived that coastal erosion affected coastal ecosystems directly; thus, it affected beach forest, mangrove forest, corals, seagrass, etc. On the other hand, the amount and diversity of aquatic resources decreased with more severity of wind-wave, sea level rise, and loss of coastal area for aquatic-animal nurture and house construction. 2)

Concerning economics, they perceived that coastal erosion affected the business sector directly since it affected tourism, deteriorated tourist attractions, and destroyed beautiful scenery. Moreover, it caused damages to the whole economic system at all levels: household, community, and national, including affecting people's quality of life and mental state because of their anxiety and stress on the lost property. 3) Regarding the social domain, they perceived that coastal erosion forced them to move to other areas that were less risky and safer. Accordingly, communities lost their traditional ways of living and culture, kinship and neighbor relationships, and the shift from old to new occupations, which lowered their quality of life. Besides, in some areas, historic and religious places, as a spiritual center of people in the communities, were damaged. Therefore, to solve coastal erosion, the physical characteristics of each area needed to be studied first: geographic and geological nature, steepness of beach, wave amplitude and wind currents, etc. Importantly, communities had to participate to help to solve the problems more accurately and properly for the area condition.

Preecha Piyachan et al. (2018) studied the good practices of communities on the environmental impact from coastal erosion in the upper Gulf of Thailand. They found that 1) the upper Gulf of Thailand was a deteriorated mangrove forest caused by the human invasion, i.e., shrimp or salt farming, etc. It was found that coastal erosion affected physical resources at a high level, but biological resources at a low level. It also affected the types, quantity, and growth of aquatic animals at a moderate level. Besides, while it affected human utilization value at a low level, it affected human residence, agricultural, aquatic-animal farming, and public forests at a moderate level. Despite its low-level impact on the quality of life, it affected community economics or income, fishery, tourism, and migration at a moderate level. 2) In terms of measures for protection and solutions for coastal erosion in the upper Gulf of Thailand, several measures were applied, both hard and soft measures or structure. For hard measures or structure, the following were used: revetment, sand-sausages, concrete-pile planting for slowing waves, rock-filled concrete pavements, semi-road dams, and artificial coral reefs. For soft structure, they used bamboo - planting for slowing waves, mangrove afforestation, etc. All of the preventive and corrective measures were supported by the governmental budgets. Still, the most used method was bamboo revetment and stone-throwing. However, the former was easy to be rotten, while the latter subsided. 3) For

the management process in coastal erosion protection and solutions by good-practice communities, it was found that the community of Moo 10, Bang Kaew Sub-District, Muang District, Samut Songkhram Province was the community that managed coastal erosion by itself. It was the community in which a community leader collaboratively consulted with people who had a common ideology and working style for planning and providing materials or equipment for bamboo revetment and mangrove afforestation with people's participation to protect and solve coastal erosion.

Aumthip Srithong and Konit Srithong (2019) took off lessons learned from coastal erosion affecting Chai Tha Lae Community, Tha Kham Sub-District, Bang Khun Thian District, Bangkok, and found that people in the community had two ways of adaptation. 1) Occupational adaptation. Due to the decreased amount of natural aquatic animals, people adapted their occupation towards nurturing them instead of capture. Some people changed to do some hireling. 2) Adaptation by protecting their coastal land and property from coastal erosion. People focused on protecting the coastal area and preventing coastal erosion increasingly. For their protection and prevention, it was found that the community managed by finding ways to reduce the severity of wind and wave currents, which could move soil sediment offshore and was the main cause for losing coastal area. Several methods were applied: bamboo revetment, concrete-pile planting, 3) mangrove afforestation, and 4) geo-bags. The government and private sectors supported all four methods well; thus, the severity of wind and wave was reduced at a certain level. The result of the community's management helped to enhance its participation, bring about harmony and engagement among people in collaborating in coastal erosion protection. Besides, the community is collaboratively responsible for maintaining and repairing planted bamboos. As a result, a learning center of mangrove forest was established in Bang Khun Thian District.

2.5.2 Studies Related to People's Participation Factors

From studying factors of people's participation, it was found that Green (2010) studied people's participation in coastal and shoreline management through the application of a Public Participation Geographic Information System (PPGIS) on the study area in Scotland. It was found that PPGIS helped to increase the accuracy of the information for people's decision-making in their coastal management in parallel to

environmental policies, i.e., referendum. Besides, it enhanced public participation in the study area. The study indicated that PPGIS had the potential in promoting people's participation in coastal planning and management. Furthermore, PPGIS could be developed to apply with Decision-Support Systems (DSS).

Yutthapol Pongpleesal et al. (2011) studied community networks for coastal erosion solutions by local wisdom: a case study of bamboo revetment of the Upper Gulf Conservation Network. They found that eight factors can strengthen the network. 1) A network leader. The network leader must have an ideology, sacrifice, and possess both formal and informal positions in a community, including having creativity and being trained as a leader of the new generation. 2) A community's awareness and participation. The community must have an awareness and participation by its perception of coastal erosion problems and changes in the community's ways of living. 3) Good relationships. The network must have a goal towards good relationship establishment so the network can brainstorm ideas for determining common goals, suggesting approaches for problem-solving, and assigning people responsible for each area. 4) Similar ways of life and culture. 5) Effective communication. 6) Knowledge and understanding. People in a community must collaboratively share their goals, benefits, and success gained from an operation. 7) Continual budget supports from the government sector. 8) NGO's technical support and consultation.

Anek Sophon and Sompop Rungsupa (2011) studied people’s satisfaction with coastal erosion protection and rehabilitation: a case study of Ban Khok Kham, Muang District, Samutsakhon Province. They found that people were satisfied with coastal erosion protection and rehabilitation in terms of the process, steps, methods, concerned personnel, facilities, and the overall performance at a high level. Besides, they expressed their needs to see the fertility of natural resources in the area of Khok Kham Sub-District, especially the fertility of mangrove forests the most, followed by the fertility of aquatic-animal resources, the development of the coastal area as natural tourist attractions, and the beautiful environment without any toxic condition respectively. However, the most obstacle for coastal erosion protection was a lack of budgets for an operation, followed by insufficient public relations to let people be informed widely, and no serious attention by the government officials to solve and rehabilitate coastal erosion respectively.

Rujaporn Chaiyapong (2012) studied people's participation in coastal erosion protection in Koh Perd Sub-District, Lamsing District, Chanthaburi Province. The findings showed that 1) The overall public participation in coastal erosion protection is at a low level, while people accepted their community leader and acknowledged the benefits gained from the protection at a high level. When classifying participation into different functions, it was found that both of their participation in investigating problems and causes of coastal erosion, and in monitoring and evaluating the project area at a moderate level, while in investment and operation at a low level. 2) people of different sex, age, education, and residential areas had different levels of participation at the .05 statistical significance level. However, people of different levels of income, acceptance of community leaders, and acknowledgment of gained benefits had a no different level of participation.

Phurita Kerdprang and Theerawat Chanthuek (2016) studied the perception of news of local community toward coastal erosion and found that people knew that “coastal erosion made them lose coastal land” at a moderate level (61.65%), followed by “coastal erosion solutions by mangrove afforestation” at a high level (23.28%), and “too much underground-water pumping was another cause made coastal areas submerge and easily be eroded,” at a low level (15.07%). Besides, it was found that people were exposed to news via television the most (91.78%).

Siriporn Phannaphatkun (2013) studied people’s participation in coastal erosion protection and solutions in the western Gulf of Thailand in the area of Lam Yai Sub-District, Muang District, Samut Songkhram Province. It was found that 1) people participated in operations, benefits, monitoring, and evaluation, while the problem investigation and planning towards operational alternatives were the mission of the government agencies. 2) Predominant conditions of people's participation comprised 2.1) people's perception of the significance of coastal erosion protection reported from the community's research. 2.2) People's needs in protecting their land and occupation. 2.3) good relationships within the community. 2.4) budget support and knowledge from external organizations. 2.5) legal requirements and governmental policies for encouraging people's participation. 2.6) a leader who keeps stimulating and supporting people's participation. 2.7) people's increased income from planting woods beyond their main earnings from the fishery. Moreover, regarding problems and obstacles in

operating the project, the following was found: 1) A part of people did not see the importance of coastal erosion protection. 2) People participated in wood- or bamboo revetment because of their needs towards increased income rather than in coastal protection and solutions. 3) A political movement occurred in the community. 4) The community lacked experience in managing the project. Besides, it was found that despite the success of the project, it could not have proceeded sustainably.

Somjai Juanan (2015) studied people's participation in coastal erosion protection in Song Khlong Sub-District, Bang Pakong District, Chachoengsao Province. The results were as follows:

1) Factors leading to participation. It was found that people perceived the roles of the Sub-District Administrative Organization in persuading people to participate at a high level. The persuasive appeal used by the Sub-District Administrative Organization that induced them to participate in the project the most, at a high level, was “the benefits from coastal erosion protection.” The factor enabling them to influence their participation the least was the acknowledgment or invitation from other people.

2) Factors of opportunities and channels for participation. It was found that the clear timing, specified by the Sub-District Administrative Organization, enabled participants to determine conditions for participation that are compatible with their actual situation. Thus, it led them to participate at a high level. On the contrary, the least influential factor was the unclear timing by the Sub-District Administrative Organization to allow people to participate in the project whenever they had an opportunity to do so.

3) Factors of power in promoting participation activities. People's power in specifying benefits they would gain from coastal erosion protection with the Sub-District Administrative Organization influenced their needs for participation at a high level, while the least was people's power in determining or designing activities with the Sub-District Administrative Organization for coastal erosion protection.

4) People's participation in different steps. The overall participation of people in every step was at a high level, by participating in the step of investigating problems and causes of coastal erosion the most. The overall people's participation in the operation step and the evaluation step was at a high level, and the participation of

people in compiling information from operating activities with the Sub-District Administrative Organization regularly was found to be the most influential factor.

5) From the hypothesis test, it was found that predicting variables, i.e., motivation, structure or channels for participation, power in promoting activities affected people's participation in all steps, especially due to the perceived benefits gained from coastal erosion protection.

Sasipa Punyawattanasakul (2016) studied participation in the community's knowledge management: a case study of bamboo revetment in the coastal areas of Samutsakhon Province. From the study, it was found that 1) the community had participated in establishing collaborations, criticism, decision-making, operations, monitoring, and evaluation, at a moderate level. 2) In terms of the community's knowledge management, people participated in exchanging knowledge, having common knowledge inventory, sharing visions, and inducing changes at a moderate level. 3) The community's participation in the coastal areas had a positive relationship with the community's knowledge management at a very high level. 4) The model of the community's knowledge management through the community's participation must give importance to shared decision-making and collaboration building, leading to knowledge management, focusing on inducing changes and shared visions. Besides, it must enhance the mobilization of self-administered management towards a strong community organization.

Kampon Lertkiatdamrong (2017) studied people's participation in coastal erosion protection in the area of Bang Pakong District, Chachoengsao Province, and found that 1) the overall people's participation in coastal erosion protection in the area was at a moderate level. When analyzing each domain, it was found that participation in every domain was at a moderate level as well. The highest to the lowest mean of the top three were "the listening to people's ideas", "consultation," and "information provision" respectively. 2) The overall coastal erosion solutions in the area of Bang Pakong District, Chachoengsao Province, was at a moderate level. When classifying into different domains, participation in every domain was at a moderate level as well. The highest to the lowest mean of the top three were "problem-identification," "actual problem analysis," and "problem-solving alternatives" respectively. 3) People's participation had a positive relationship with coastal erosion solutions at a high level.

The domain that had the highest level of relationship was “collaborative planning,” followed by “consultation,” and “listening to people's ideas” at the .01 statistical significance level. 4) Concerning suggestions for people's participation in coastal erosion solution in the area of Bang Pakong District, Chachoengsao Province, the following was suggested: “the government and private sector, including other concerned agencies should give importance to people's participation in coastal erosion solutions in every dimension,” “approaches and ways for solving coastal erosion should be considered seriously to ensure effective and efficient a problem-solving process that can yield the utmost benefits for people in the coastal areas sustainably. 5) From the study of the relationship between people's participation in coastal erosion solutions and coastal erosion problem solving, it was found that people's participation in all dimensions had a positive relationship at a high level with the overall coastal erosion solution at the .01 statistical significance level with correlation coefficients value of .934.

Chanan Saengnapa (2017) studied the level of the community’s perception of coastal erosion problems through the application of Public Participation Geographic Information Systems: a case study of Song Khlong District, Bang Pakong District, Chachoengsao Province. It was found that Song Khlong Sub-District was the area resolved by applying four kinds of coastal erosion protection: stone-throwing dams, offshore breakwaters, bamboo revetment for slowing waves, and concrete-pile planting, in combination with mangrove afforestation. Regarding approaches for adaptation to the situation of coastal erosion situation in Song Khlong Sub-District, it was found that people perceived stone-throwing dams were the best adaptation way. Besides, it was found that people in some areas still needed the Sub-District Administrative Organization to solve coastal erosion problems urgently, which was a major part of a participatory process that promotes an exchange of ideas between people with legal or authorized power in making decisions and the community. Thus, the Sub-District Administrative Organization listened to the problems and contained them in the three-year (2017-2019) development plans and four-year (2017-2020) local development plans.

2.5.3 Studies Related to Coastal Erosion Management Factors

Rattikarn Sittiphan (2009) studied Communication and Improving Community Participation and Management on Erosion: A Case Study of Baan Khun Samutchine, Samutprakarn," and found that communication occurred in Ban Samut Chin was an informal two-way communication process for informing information to the community and making appointments in doing activities together, including solving the community's problems, namely the coastal erosion of the community. Communication was in the form of confiding one's troubles or the effects of the erosion, which was the regular problems they had been facing for more than 20 years. Each household had to move to a new place no less than 3-7 times. The communication that occurred was thus intra-community communication. On the other hand, for external communication, it was communication between the community's leader or mainstays and neighboring communities affected by coastal erosion, including the government and private agencies. During the communication, community mainstays or leaders played a role as a mediator in transmitting information, both internal and external communication. It thus led to people's participation in identifying problems, planning, implementation, and evaluation.

Wantanee Sawangarom (2010) studied eco-tourism management of the coastal community in Bang Khun Thian District, Bangkok. The study showed that the community used local-wisdom technology for tourism well. Specifically, the bamboo revetment structure was used to reduce coastal erosion to manage the coastal area of Bang Khun Thian as an eco-tourist attraction through participatory management at a high level. Congruently, factors of the community's participation also influenced the community's tourism management at a high level. As for structures or technologies using local wisdom for reducing coastal erosion perceived by the community, i.e., bamboo revetment, mangrove afforestation, stone walls, tire-concrete piles planting, and concrete piles along the canal or shoreline. The samples perceived the existence of such structures in the community at a high level. Thus, it indicated that the community possessed local structures or technologies, which were the specific identity of the community, and were managed to be a learning center and tourism resources for the community. Besides, the eco-tourism route of the community (or on-land tourism route at the end of the walking path of a bridge from which mangrove forests could be eroded.

Especially, Samae of Na Dan species or Pioneer species were planted at the outermost as they could tolerate soil conditions with salinity. At the end of the bridge, the bamboo-piles were planted by local people to study the possibility of coastal erosion protection. For the water route, there was a boat trip for seeing ways of life, the natural environment of mangrove forests of Bang Khun Thian, and the sea of Bangkok.

Sasinee Sorin (2010) studied the community-based management of coastal erosion of Ban Bang Bo Lang, Bang Kaew Sub-District, Muang District, Samut Songkhram Province, and found that local people knew about the eroded areas from their observation and personal experiences of the community's surroundings, i.e., soil, sea, wind currents, mangrove forests, etc. All of these helped them to calculate which period would be the most severe erosion period and used their experience to cope with such problems with the assistance of village chiefs, mainstays, and members in the community, including other supporting agencies. Firstly, they started by studying coastal erosion protection and management, choosing coping methods, and then proposing a protection or solution project to the Sub-District Administrative Organization, and implemented coastal erosion management plans (i.e., choosing to use the bamboo revetment structure, ways of planting bamboos, sludge sediments, forestation). After that, benefits people would gain from rehabilitating eroded areas: getting their land back, feeling relieved, the fertility of the land for mangrove forests and aquatic animal nursery, and increased potential of the community, were highlighted.

Saowalak Matusornskoon (2010) studied approaches for coastal erosion management of Chao Lao Beach and Lam Sadet Beach, Khlong Khut Sub-District, Tha Mai District, Chanthaburi Province and found that the problems and obstacles of coastal erosion management were the lack of information about fundamental resources of the community. Concerned people had no knowledge, understanding, and awareness of coastal erosion problems. Besides, there were few participation activities in the conservation projects. Leaders were not determined, while the operation of concerned agencies was not seriously and continually committed. Therefore, coastal erosion management requires well-arranged information or data resources systems, the stimulation of awareness, and the enhancement of knowledge and understanding about

coastal erosion problems. Besides, participation should be promoted increasingly, while using laws and policies clearly with sufficient and proper budget allocation.

Department of Marine and Coastal Resources (2011) studied coastal erosion management in Thailand and found that the found methods and structures of coastal erosion protection and solution management as follows:

1) No action since the property and land that need to be protected have too low or limited economic, social, environmental, historical, and cultural value, compared with investment costs in protection and problem-solving.

2) Migration to other areas or retreat, which will be the best and worthiest method for the area worth an investment for avoiding any damage that might occur to life, property, buildings, and construction because of coastal erosion

3) The establishment of coastal stability without using any structure. One of the methods is bamboo revetment for slowing waves. From the observation of the area where woods and mussel stalls were planted, muddy soil or clay sediments were accumulated; thus, they were applied to struggle against nature. Thus, proper areas should be muddy beach and have no severe or violent wind and waves. When the sediments are sufficiently deposited and stable, mangrove afforestation then could be done to seize the sediments and gain mangrove forest ecosystem back. Therefore, it is the method with little impact on the adjacent areas so a community can operate this method by itself as it is local wisdom and uses natural materials available in the area.

4) The establishment of coastal stability using structure, which is appropriate for protecting erosion in the beach area. Typically, to choose any method or structure for coastal erosion protection and solutions depends on what needs to be conserved, i.e., a community's area, construction, or natural resources. Once the coastal erosion is protected or managed, it is essential to plan and operate for the next stage since the construction of engineering structures will not be demolished again as it might affect the community. Therefore, it is important to publicize information, knowledge, and exchange experiences and learning between government officials, scholars, Local Administrative Organization, and concerned coastal communities so that alternatives for coastal erosion protection and management can be considered towards effectiveness and response to coastal communities' needs.

Suthilak Rawiwan (2011) studied coastal erosion management (a case study of the empowerment of the Department of Marine and Coastal Resources) and proposed the empowerment and readiness of the Department of Marine and Coastal Resources as the main agency in coordinating and integrating coastal erosion protection and solutions of three parts:

1) Management structure of the Department by revising the authority as specified in the ministerial regulations to cover all missions and establishing the Office of Coastal Erosion Protection Management by allocating manpower covering all needed fields for supporting the operation.

2) Mechanisms and the process of driving an integrated operation by connecting the policy to an operational level, i.e., reviewing and improving the roles of mechanisms at the policy level, academic mechanisms, development of tools, criteria, and approaches, etc.

3) International collaboration and coastal and marine management obligations by empowering personnel's potentials and skills of both management and operational level. Subsidiaries in Thailand still lack the readiness of developing mechanisms and the process of exchanging information and knowledge. It includes the survey and study at the organizational and academic level and collaboration and alliances in mobilizing conventions and obligations.

Umpinun Keesakul (2011) studied "Legal Measures for the Prevention and Control of Coastal Erosion from Erosion Control Structures." The study found that coastal changes were a continual occurrence, but yielded increasing impact because of both natural and human action. Especially, coastal erosion was the change that yielded the largest effect so the state should focus on it urgently. In the past, the solutions were the construction of engineering structures for coastal erosion, i.e., revetment, seawall, groin, etc., which could protect coastal erosion. However, it is essential to study details of each engineering structure and nature's characteristics of the area where an engineering structure was constructed to ensure the utmost effective coastal erosion design and planning, including studying laws related to the coastal private sector, such as the approval of seawalls of more than 200 meters long, the groin of each size, or offshore breakwaters, etc. A project owner has to prepare the environmental impact assessment (EIA) and propose it to the concerned agencies for consideration by steps.

If any report of EIA does not pass the consideration, no construction cannot be proceeded, etc. Thus, continual monitoring of the impact must be conducted continually.

Wimontaya Yeatapud (2013) studied the roles of Local Administrative Organization in coastal erosion management: a case study of Khok Kham Sub-District, Muang District, Samutsakhon Province. It was found that the community faced severe coastal erosion by the erosion rate of more than 2.48 meters yearly. Causes of coastal erosion were climate changes, the collapse of the land because of too much underground-water pumping for industrial use, very severe and violent wind during monsoon season, decreased mangrove-forest area because of invasion, etc. Such causes yielded impact as following: 1) On residence, so local people had to retreat and some parts of them had to move to other areas. Besides, they had to pay for the repair and renovation of their houses. 2) On ecosystems of mangrove forests, so plants were blown out by the severe wind. 3) On fishery, so the number of aquatic animals and fishermen's income decreased. In the first period, coastal erosion was solved by filling stones, but it was ineffective. Later, a bamboo revetment structure was used, which most people agreed with it because it could help to rehabilitate natural resources. Regarding the roles of the Local Administrative Organization, due to its roles in many domains, it could not perform its roles fully, including limited budgets for operation. For approaches for coastal erosion protection, it started with the assembly of the community leader and people of Khok Kham Sub-District and their collaboration in finding ways for coastal erosion protection. Bamboo revetment for slowing waves was chosen. Thus, it was an outcome of the action research in combination with local wisdom to solve coastal erosion of the area by mangrove afforestation and bamboo revetment.

Thanate Prapaipong (2016) studied the adaptation of a fishery community to coastal resources management and measures on coastal erosion management: a case study of in the coastal area of the upper Gulf of Thailand. The findings showed that the samples perceived the measures on fishery resources and mangrove forests 64.3%. and perceived negative impact of coastal erosion on decreasing or worsening natural resources and the environment. On the contrary, they perceived its positive impact on economics and society for better changes. Still, coastal erosion affected both fishermen and the community's traditional or artisanal fishery in every aspect, which were

contradictory impacts. Regarding the benefits gained from the government's measures in coastal resources management, it was found that the coastal erosion protection measure found to be the most beneficial was revetment (at a rather high to high level) as the samples perceived that it could reduce coastal erosion the most, followed by bamboo revetment, sand-sausages, and mangrove afforestation respectively. Besides, it was found that most of them (90.0%) agreed more with activities and measures occurring in the areas, 95.6% with the control of usage of coastal resources and environment, 99.0% with the coastal resources management planning and supporting measures, and 98.9% with a group formation and knowledge provision. Furthermore, the adaptation of the traditional fishery communities could be divided into three domains. They adapted themselves in the cognitive domain the most (96.3%) and factors that were found to affect their adaptation were “the perception of information”, followed by “the level of severity of the occurring problem”, and “knowledge on coastal resources management and measures,” respectively.

Apirak Somrak et al. (2017) studied the construction of a process model and tools for marine and coastal management in Trang Province towards sustainability. They found that the strategic plans of marine and coastal resources management of Trang Province in 2017-2021 should have approaches for implementing plans into action, such as the enhancement and development of understanding on the main content of marine and coastal resources management plans, including participation of every sector in driving the implementation at all levels: central, regional, and local, i.e., a conference for creating understanding, public relations through a variety of media, integrated coordination of action plans for marine and coastal resources management and the provincial development plans under the strategic issues that were interconnected, a drive of integrated budgets for managing marine and coastal resources management, the designation of the roles of the agencies and alliance networks at all levels by their responsibility, i.e., the central and provincial governmental agencies, Local Administrative Organization, the private sectors, NGOs, education institutes, research units, and media. Besides, the establishment of the Provincial Sub-Committee of Marine and Coastal Resources was supported for regulating and monitoring strategic plans, including searching collaboration from the agencies responsible for and having activities related to the use and conservation of marine and coastal resources. Therefore,

it is essential to monitor and evaluate the participation of all agencies, both central and local. A report on the performance was determined to be submitted regularly every year, including the evaluation of the implementation at all levels during and at the end of the plans as information for reviewing and considering plans for further improvement. Research and knowledge development in marine and coastal resources management in various issues: promotion, problem-solving, protection, etc. should be conducted for improving laws and regulations related to and congruent with the situation effectively.

Navamin Rattanapongtara et al. (2018) studied the problems and management of six communities in the coastal area of Bang Khun Thian, namely Bang Khun Thian, San Toh, Wat Luang Phoh Tao, Sao Thong, Si Kuman, and Khlong Phittaya Longkon. The study found that 1) Coastal erosion and electricity problems were found in Bang Khun Thian and Sao Thong as they are communities located in front of the sea so they receive the impact of wind and waves. Moreover, due to the wave amplitudes, soil surface and coast edge were eroded gradually in combination with people's invasion to the areas for their fishery. Accordingly, natural resources important for protecting wind and wave currents were lost. Most distinctively, all through the past ten years, local people had lost their residence and occupation area, so they had to retreat or move their residence to other unaffected areas. Consequently, their traditional lifestyle was changed, and they lost their income and occupation inestimably. Besides, the occurred erosion damaged coastal ecosystems. 2) Community management occurred from the participation of people in the community, which is the main principle, leading to concrete community development directed to the needs and the community's problem-solving precisely through the following components in community management:

1) Planning and policies must come from the collaboration of each community's members, while the assigned committee of the community should have collaborative consultation on the problems and causes of problems. Then, representatives of each community collaboratively determine the goal and direction for solving the problem.

2) In decision-making, people of each community should collaboratively make decisions on advantages and disadvantages that might occur cautiously, based on the existing or available information before solving any problem for the community’s utmost benefits.

3) After the operation as planned, people or representatives of each community should have been informed of their responsibility and operate as planned. For those who are not representatives, they are also important in surveillance and monitoring the operation in parallel to those representatives.

4) From the problems that had been solved by people's representatives, people from every community, including those who are not should participate in monitoring and evaluating the operation, including collaboratively solving problems to avoid accumulated problems and enable to change for better operations in the future.

2.6 A Summary of the Studied Issues from the Related Studies

1 = Cause
2 = Management
3 = Protection and Solution
4 = Techniques
5 = Problems and Obstacles
6 = Participation
7 = Perception
8 = Adaptation
9 = Impact
10 = Construction Structure
11 = Model
12 = Economics
13 = Prediction
14 = Technology

Table 2.1 Summary of the Studied Issues from the Related Studies

Issue / Research/Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Rattikarn Sittiphan (2009)		/				/	/							
Payom Rattanmanee et al. (2008)			/	/						/	/			/
Rawadee Jarungrattanapong (2008)			/	/				/	/			/		
Kannigah Asavadorndeja (2009)	/		/	/	/									
Theerawut Onda (2009)	/		/	/					/	/		/		

Table 2.1 (Continued)

Issue / Research/Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Wutthichai Sriprasertkul (2010)									/					
Wantanee Sawangarom (2010)		/	/	/		/								
Sasinee Sorin (2010)		/	/	/			/							
David R. Green (2010)		/				/					/			/
Saowalak Matusornskoon (2010)		/			/		/							
Department of Marine and Coastal Resources (2011)		/	/						/	/				
Department of Marine and Coastal Resources (2011)			/			/				/				
Nittharat Paphawasit (2011)	/		/	/		/								
Boonchuay Attawattana (2011)	/		/	/								/		
Pichsinee Muadhama. (2011)	/		/						/					
Suthilak Rawiwan (2011)		/	/											
Orawan Thitnun. (2011)									/	/				
Yutthapol Pongpleesal et al. (2011)			/			/								
Surachai Claythong. (2011).			/	/					/					
Suvimol Saelim and Sawanya Suelueam (2011)	/								/					
Anek Sophon and Sompop Rungsupa (2011)			/				/							

Table 2.1 (Continued)

Issue / Research/Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Umpinun Keesakul (2011)		/	/							/				
Pipat Leeladee (2012)			/						/					
Sawanya Thamma-apipon (2012)			/						/					
Rujaporn Chaiyapong (2012)			/			/								

2.7 A Summary of the Research Tool on Coastal Erosion Problems Management

The tool used in the study of Suthilak Rawiwan (2011) is a questionnaire containing opinions on coastal erosion management, which consists of four principal factors or variables: 1) the situation and coastal erosion management in Thailand 2) the level of opinions towards each sector about their knowledge, understanding, and orientation to the coastal erosion situation, 3) roles of concerned agencies and 4) the manpower structure and limitations/obstacles in coastal erosion management missions of the concerned agencies.

The tool used in the study of Surachai Claythong (2011) is a semi-structured interview guide on the impact of coastal erosion on Ban Chai Tha Lae Community, Phan Thai Norasing Sub-District, Muang District, Samutsakhon, which consists of two main factors and sub-factors as follows:

1) Environmental changes, the condition of the area in the past, and general characteristics consisting of the following sub-factors: (1) physical condition: coastal condition, sea level, weather condition, (2) biological aspects, i.e., the quantity and types of natural aquatic animals, amount and fertility of mangrove forest, and (3) the use of land in the past and at present.

2) Changes in ways of living, consisting of the following sub-factors: (1) a comparison between occupations in the past and (2) a comparison between

occupational earnings in the past and at present, and reasons, (3) the relationships of people in the community, (4) a comparison between household characteristics and settlement in the past and at present, (5) a comparison between community traditions and culture in the past and at present, and (6) a comparison between other aspects of culture in the past and at present.

The tool used in the study of Pipat Leeladee (2012) is a semi-structured interview guide on the impact of coastal erosion on a coastal community: a case study of Chai Tha Lae Community, Bang Khun Thian, in two sets, consisting of the principal factor and sub-factors as follows:

Set 1: Interview guide for local people, consisting of the following principal factors: (1) the situation of coastal erosion in the study area, (2) ecological impact, (3) economic impact, (4) social impact, and (5) impact on the quality of life and mental state.

Set 2: Interview guide for a community leader and concerned government agencies, consisting of the following principal factors: (1) the situation of coastal erosion, (2) impact of coastal erosion problems on the community (economics, society, environment, quality of life, and mental state, (3) coastal erosion solutions by the community, and (4) coastal erosion solutions by the government sector.

The tool used in the study of Sawanya Thamma-apipon (2012) is an in-depth interview guide on the coastal erosion impact on a coastal community in four sets, consisting of the following principal factors and sub-factors:

Set 1: An interview guide for community wisdom and the elderly in the community, consisting of (1) physical condition changes of the coastal area from the past to present, (2) impact of coastal erosion on the community: economics, society, ecosystems, and environment, and (3) people's adaptation in living and occupations.

Set 2: An interview guide for local people living in the coastal area, consisting of (1) impact of coastal erosion on the community: economics, society, ecosystems, and environment, and (2) people’s adaptation in living and occupations.

Set 3: An interview guide for formal and informal leaders in the area, consisting of the following factors: policies and action plans in coastal erosion protection and solutions of the organizations.

Set 4: An interview guide for concerned agencies and organizations in the area, consisting of the following factors: missions and responsibilities for coastal erosion protection and solutions in the study area.

The tool used in the study of Prathana Ngarmbanharn (2013) is an interview guide on the roles of the community in coastal erosion management, consisting of two principal factors and other variables as follows:

1) The roles of the community in coastal erosion management, consisting of the following sub-factors: (1) coastal protection, (2) coastal rehabilitation, (3) the issuance of regulations and obligations, and (4) local wisdom.

2) The roles of external agencies in supporting coastal erosion management, consisting of the following sub-factors: (1) The existence of any external assistance, (2) name of external agencies or organizations, (3) types and details of assistance, support, and operations, (4) the efficiency of the operations and reasons, and (5) recommendations.

The tool used in the study of Phurita Kerdprang and Theerawat Chanthuek (2016) is a questionnaire on the perception of the community on coastal erosion problems, consisting of two principal factors: knowledge on coastal erosion and perception of information on coastal erosion.

The tool used in the study of Wimontaya Yeatapud (2013) is a semi-structured interview guide on the roles of the Local Administrative Organization on coastal erosion management, consisting of two principal factors and sub-factors as follows:

1) The situation of coast erosion problems in the area of Khok Kham Sub-District, Muang District, Samutsakhon Province.

2) Roles of the Local Administrative Organization in coastal erosion management, consisting of the following sub-factors: (1) opinions on the situation of coastal erosion, and (2) opinions on the roles of the Local Administrative Organization on coastal erosion problems management.

The tool used in the study of Siriporn Phannaphatkun (2013) is an interview guide on people's participation in the project of coastal erosion protection and solutions for the western Gulf of Thailand in the area of Lam Yai Sub-District, Muang District, Samut Songkhram Province, in two sets, consisting of principal factors and sub-factors as follows:

Set 1: An interview guide for concerned officials responsible for the project of coastal erosion protection and solutions for the western Gulf of Thailand, consisting of the following principal factors: (1) general information (governmental position, the relevance to the project), (2) Operational plans of the Office of Public Works and Town & Country Planning, Samut Songkhram Province on the coastal erosion protection and solutions for the western Gulf of Thailand, (3) details of the project in the area of Lam Yai Sub-District, Muang District, Samut Songkhram Province, (4) types of operations providing an opportunity for people's participation, (5) outcome of the project, (6) problems and obstacles of the project operations, and (7) opinions on the project operation and suggestions for the next phase.

Set 2: An interview guide for community leaders and project participants, consisting of the following principal factors: (1) general information (sex, age, education, religion, old residence or hometown, primary and secondary occupation), (2) factors related to participation (problems of coastal erosion occurring in Lam Yai community, and members' understanding on the objectives of the project), (3) participation in the project (reasons for participation, types of and roles in participation, i.e., decision-making, operation, benefits, evaluation), (4) outcome of the project (the impact on the coastal area and the community), (5) problems and obstacles in the project operation (personnel, internal and external coordination, budgets, etc.), and (6) suggestions for the project and plans in the future.

The tool used in the study of Chamchuri Yumalai. (2014) is a questionnaire on the value of willingness to pay for supporting the bamboo revetment project to protect coastal erosion in Bang Khun Thian, consisting of three principal factors and sub-factors as follows:

1) Coastal erosion in Bang Khun Thian, consisting of the following sub-factors: (1) opinions on coastal erosion causes, (2) self-administered coastal erosion protection, (3) information exposure on coastal erosion problems and (4) the utilization of mangrove forest.

2) Opinions on the utility of the bamboo revetment project for coastal erosion protection in Bang Khun Thian, consisting of the following sub-factors: (1) the maintenance of coastal stability, (2) the maintenance of natural equilibrium of ecosystems, and (3) no impact on the community's ways of living nor the adjacent areas.

3) Willingness to pay for supporting the bamboo revetment project for coastal erosion protection in Bang Khun Thian, consisting of the following sub-factors: (1) willingness to pay, (2) the amount of willingness to pay, (3) convenient channels for payment, and 3.4) reasons for payment or no payment.

The tool used in the study of Jaruwan Ketsomboon (2014) is an interview guide on the adaptation of Ban Kra-Sao Khao Community to coastal erosion problems, consisting of two principal factors and sub-factors as follows:

1) Causes and impact of coastal erosion on Ban Kra-Sao Khao Community, consisting of the following sub-factors: (1) the impact on economics, (2) on ecosystems, (3) on society, (4) on quality of life, and (5) on mental state.

2) The adaptation of the community, consisting of the following sub-factors: (1) occupational changes, (2) residence changes, and (3) methods or ways of coastal erosion protection and solutions.

The tool used in Taweesak Theppitak (2014) is a questionnaire on people's opinions towards the project of the study on the appropriateness of the coastal erosion protection in the eastern coast of Chonburi Province, consisting of three principal factors and sub-factors as follows:

1) Opinion on the area project

2) Opinions on the construction of coastal erosion structures.

3) Opinions on the study project on the appropriateness of coastal erosion protection in the eastern coast of Chonburi Province, consisting of the following sub-factors:

(1) Coastal engineering factors, consisting of sub-factors as follows: (1.1) wind and wave energy towards the target coastal area, (1.2) direction of wave and wind towards the target coastal area, (1.3) types of coastal erosion severity, and (1.4) tendencies of coastal erosion of the target areas in the future.

(2) Economic factors, consisting of the following sub-factors: (2.1) estimated prices of the eroded land, (2.2) the loss of resources, (2.3) the impact on economic systems in the target area, and (2.4) compensation for damaged property.

(3) Structure and structure design for coastal erosion protection factors, consisting of the following sub-factors: (3.1) visible location and landscape,

(3.2) the relations between landscape condition and related projects, and (3.3.) the landscape condition and surrounding.

(4) Environmental factors, consisting of the following sub-factors: (4.1) physical resources, (4.2) biological resources, (4.3) human utilization value, and (4.4) quality of life value.

(5) Civil engineering factors, consisting of the following sub-factors: (5.1) geographic aspects, (5.2) geological condition, (5.3) geometric patterns of the area, and 3.5.4) the original constructions surrounding the area.

(6) Participation factors, consisting of the following sub-factors: (6.1) the community's trouble and petition, (6.2) concrete coastal erosion solution, (6.3) the study on the impact and protection approaches, and (6.4) self-administered construction of coastal structure for protection and solutions.

The tool used in the study of Somjai Juanan (2015) is a questionnaire on people's participation in coastal erosion protection of Song Khlong Sub-District, Bang Pakong District, Chachoengsao Province, consisting of two principal factors and sub-factors as follows:

1) Opinions on factors leading to people's participation, consisting of the following sub-factors: (1) motivational factors, (2) structural factors of opportunities and channels for participation, and (3) power factors in promoting participation activities.

2) The level of participation following the steps of participation, consisting of the following sub-factors: (1) participation in initiating the project, (2) participation in planning, (3) participation in implementation, and 2.4) participation in evaluating the project.

The tool used in the study of Warunee Hanwanna (2015) is a semi-structured interview guide on the social impact of coastal erosion, consisting of three principal factors and sub-factors as follows:

1) Social impact caused by coastal erosion problems, consisting of the following sub-factors: (1) migration, (2) family and kinship relationships, (3) local culture and tradition, (4) the community's ways of living, (5) quality of life, and (6) people's occupational shift.

2) Needs for the government sector's assistance.

3) Approaches to coastal erosion solutions.

The tool used in the study of Sasipa Punyawattanasakul (2016) is a questionnaire on people's participation in knowledge management of the community: a case study of the use of bamboo revetment in the coastal areas of Samutsakhon Province, in two sets, comprising principal factors and sub-factors as follows:

1) Participation in knowledge management of the community: a case study of bamboo revetment in the coastal areas of Samutsakhon Province, consisting of five principal factors and sub-factors as follows:

(1) Participation in establishing collaboration, consisting of the following sub-factors: (1.1) spiritual collaboration, (1.2) strategic collaboration, and (1.3) Public relations collaboration.

(2) Participation in criticism, consisting of the following sub-factors: (2.1) information provision, (2.2) public hearing, and (2.3) consultation

(3) Participation in decision-making, consisting of the following sub-factors: (3.1) situation analysis, (3.2) operational approaches positioning, and (3.3) benefit coordination.

(4) Participation in operation, consisting of the following sub-factors: (4.1) labor force, (4.2) investment, and coordination.

(5) Participation in monitoring and evaluation, consisting of the following sub-factors: (5.1) monitoring the operation, and (5.2) evaluating the operation.

2) Knowledge management in the community, consisting of four principal factors and sub-factors as follows:

(1) Sharing knowledge-exchange, consisting of the following sub-factors: (1.1) the creation of new knowledge, (1.2) the spatial arrangement for knowledge exchange, and (1.3) shared learning.

(2) Having a common knowledge base or repository, consisting of the following sub-factors: (2.1) Knowledge system arrangement, (2.2) knowledge examination and (2.3) knowledge utilization.

(3) Having common visions, consisting of the following sub-factors: (3.1) vision determination, (3.2) vision transmission, and (3.3) vision implementation.

(4) The adoption of shared changes, consisting of the following sub-factors: (4.1) leadership, (4.2) persuasion and (4.3 empowerment.

The tool used in the study of Thanate Prapaipong (2016) is a structured interview guide on the adaptation of a local fishery community to coastal erosion management and measures, consisting of three principal factors and sub-factors as follows:

1) Coastal erosion impact, consisting of the following sub-factors: (1) coastal erosion changes situation in three domains: resources and environment, economics, and society, (2) Governmental approaches and measures for coastal resources management, and (3) activities and measures for coastal erosion protection and management.

2) The adaptation of the fishery community, consisting of the following sub-factors: (1) behavioral adaptation in occupation, (2) opinions on the situation and problems, and (3) the interdependence towards the occurring changes.

3) Adaptation factors, consisting of the following sub-factors: (1) information exposure and frequency of information exposure, (2) knowledge about coastal resources management and measures, (3) the severity level of the problems and accomplishment in coastal resources management and measures.

The tool used in the study of Chatkhanok Boonyapinyo (2016) is an interview guide on the impact of coastal erosion on the Sub-District Administrative Organization and the community in Phra Samut Chedi, consisting of four principal factors and sub-factors as follows:

1) The exposure/ threat risks of coastal erosion, consisting of the following sub-factors: (1) the exposure/threats of coastal erosion, (2) risk levels of coastal erosion, and (3) vulnerability of the area.

2) The assessment of the adaptability following policies, strategies, plans, and activities, consisting of the following sub-factors: (1) Systems of policies, plans, and projects, (2) quality and coverage of plans, (3) outcome of plans and activities, (4) appropriateness and sufficiency of administrative resources, (5) awareness of coastal erosion impact, (6) the community's participation, (7) accessibility to information and technology, and (8) knowledge base.

3) Factors affecting patterns and approaches for managing risks, consisting of the following sub-factors: internal and external factors of the Sub-District Administrative Organizations of Lam Fa Pha and the community.

4) Vulnerability, consisting of a sub-factor, namely the vulnerability of Lam Fa Pha Sub-District, Phra Samut Chedi District, Samut Prakan Province.

The tool used in the study of Kampon Lertkiatdarong (2017) is a questionnaire on people's participation in coastal erosion solutions in the area of Bang Pakong District, Chachoengsao Province, consisting of two principal factors and sub-factors as follows:

1) People's participation in coastal erosion solutions, consisting of the following sub-factors: (1) information provision, (2) public hearing, (3) consultation, (4) collaborative planning, (5) collaborative operation, (6) collaborative monitoring, inspection, and evaluation, and (7) people's control.

2) Coastal erosion solutions, consisting of the following sub-factors: (1) identifying problems, (2) investigating for genuine causes of problems, 2.3) analyzing for all possible alternatives to solve problems, (4) selecting the best problem-solving approach, (5) planning to apply the selected alternative for implementation, (6) regulating and controlling the implementation as planned by focusing on the success indicator, and (7) following up and investigating if problems are solved effectively.

The tool used in the study of Chanan Saengnapa (2017) is a semi-structured interview guide on the level of perception of the community's coastal erosion problems through the application of Public Participation Geographic Information Systems (PPGIS), consisting of two principal factors and sub-factors as follows:

1) Perception on the coastal erosion situation, consisting of the following sub-factors: (1) level of coastal erosion situation in the community, (2) the severity of the situation, (3) level of coastal erosion situation in the community in the future, (4) main causes of coastal erosion by nature and the level of severity, and (5) main causes of coastal erosion by human activities and the level of severity.

2) Preventive approaches and adaptation to coastal erosion in the community, consisting of the following sub-factors: (1) preventive approaches for coastal erosion in the community, and (2) the compatible adaptation for coastal erosion management in the community.

The tool used in the study of Apirak Songrak (2017) is a questionnaire for constructing a process model and tools for marine and coastal resources management in Trang Province, consisting of two principal factors and sub-factors as follows:

1) Opinions of local fishermen on plans of marine and coastal resources management for Trang Province, consisting of the following sub-factors: (1) local fishermen's opinions on marine and coastal resources management plans, and (2) local fishermen's needs in participating in the plans of marine and coastal resources management in Trang Province.

2) Utilization of aquatic-animal resources and economy of local fishermen

The tool used in the study of Preecha Piyachan et al. (2018) is a questionnaire on the best community-based practice towards the environmental impact caused by coastal erosion in the upper Gulf of Thailand, consisting of eight principal factors and sub-factors as follows:

1) Opinions on the coastal area and the situation of coastal erosion problems.

2) Impact caused by coastal erosion on physical resources, biological resources, human utilization, and quality of life value, consisting of the following sub-factors: (1) impact on physical resources, (2) impact on biological resources, (3) impact on human utilization value, and (4) impact on the quality of life value.

3) Measures of coastal erosion protection and solutions, responsible people, and budgets for implementing measures, consisting of the following sub-factors: (1) hard-structure measures, and (2) soft-structure measures.

4) The perception of information about the adoption of researchers' findings for coastal erosion protection and solutions.

5) Changes of occupational places and residence, consisting of two sub-factors: the loss of occupational land, and changes of residence.

6) Economic changes, consisting of two sub-factors: occupational changes and income, and incurred debts.

7) Social changes, consisting of the following sub-factors: (1) Migration of the family and relatives, and (2) the relationship and interaction of people in the community.

8) Breakwaters, consisting of the following sub-factors: (1) the quantity of coastal aquatic animals, (2) the amount of mangrove forest, and (3) convenience of being out to sea.

9) The existence of the community and future expectation, consisting of the following sub-factors: (1) the community's major problems, (2) satisfaction with living conditions, and (3) moving from the community to other places in the future.

The tool used in the study of Aumthip Srithong and Konit Srithong (2019) is an in-depth interview guide on the impact of coastal erosion problems on the coastal community, consisting of five principal factors: 1) the current situation of coastal erosion problems, 2) causes and impact of coastal erosion, 3) people's adaptation to coastal erosion problems, 4) organizations playing roles in assisting or operating coastal erosion protection and solutions, and 5) the promotion of the community's quality of life.

2.8 Research Conceptual Framework

From documentary analysis and in-depth interviews for developing the structural equation model of factors affecting the success of the coastal erosion management in the upper Gulf of Thailand, including from literature review of concepts, theories, and related studies, a research conceptual framework based on all analyses was developed.

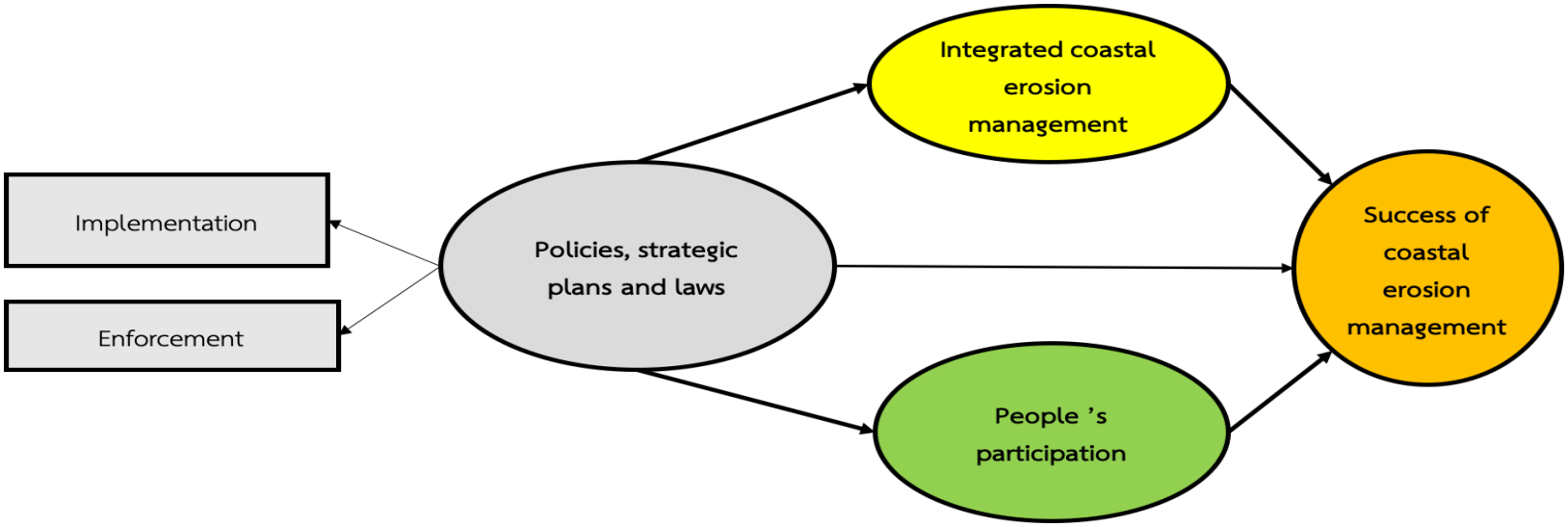

Figure 2.3 Research Conceptual Framework

CHAPTER 3

RESEARCH METHODOLOGY

The study entitled, "The Development of the Structural Relationship Model of Factors Affecting Success for Coastal Erosion Management at the Upper Gulf of Thailand," is mixed-method research. The conduction of research was divided into two stages. The first stage is qualitative research through 1) document analysis and 2) in-depth interview by a semi-structured interview sheet as a tool in data collection. The second stage is quantitative research by survey questionnaires with close-ended questions as a tool for data collection. The questions in the questionnaire were synthesized and compiled from the qualitative research in the first step, combined with data gained from a literature review of theoretical concepts and related previous studies to acquire questions under the actual context of the area. Besides, the researcher also consulted with experts of various sectors: government, private, community, and academic. and had them confirm the research findings. From the consultation, the recommendations were given to improve the study to be more complete and be able to be applied for managing coastal erosion in the upper Gulf of Thailand further. The details are as follows:

3.1 Stage 1: Qualitative Research

3.1.1 Research Methods

Two methods were used:

1) Document analysis. The research started with this method for gaining preliminary information from research contexts, concepts and theories, literature review, and related previous studies of both Thai and foreign.

2) In-depth Interview. An in-depth interview was conducted with those involved in managing coastal erosion in the upper Gulf of Thailand. A Semi-structured

interview guide or sheet was used as a tool for data collection. The questions are open-ended.

3.1.2 Information Sources

There were two types of information sources collected for this study:

1) Document or information sources, i.e. books, academic articles, research reports, and theses, policies, plans, strategies, and related laws related to the management of coastal erosion, including integrated coastal zone management and people's participation in the management of the coastal erosion in the upper Gulf of Thailand, and all involved agencies and organizations, etc.

2) Personal sources are key informants who were representatives of all sectors related to the coastal erosion in the upper Gulf of Thailand: 1) People within the affected communities who were involved in coastal erosion management, and 2) people involved in coastal erosion management from outside the coastal communities. The samples of an in-depth interview were selected by purposive and snowball sampling, recommended by other samples, to get diverse and saturated data.

3.1.3 Samples

As mentioned above, the samples of this study were divided into two groups, samples within coastal communities who were people within the affected communities or people outside the coastal communities involved in coastal erosion management. The group division was based on research questions. The details of the samples are as follows:

1) 15 samples within coastal communities who were people within the affected communities or people outside the coastal communities who were involved in coastal erosion management to answer research question no. 1: What are the factors affecting the success of coastal erosion management in the Upper Gulf of Thailand?

1. Assistant Professor Kuaanan Techato, Ph.D.	Prince of Songkla University
2. Narawadee Buakwan, Ph.D.	Songkhla Rajabhat University
3. Danuwat Suwanwong, Ph.D.	Prince of Songkla University

4. Assistant Professor Payom Rattanamanee	Prince of Songkla University
5. Banlung Miangbua	Civil Engineering Specialist, Marine Department
6. Suthee Rangcharoen	President of Bang Khun Thian Sea Dwellers
7. Aree Dujkla	The Upper Gulf of Thailand Conservation Network
8. CP02 Udorn Boonchuylaew	Agriculturist of Samut Prakan Province
9. Sophon Jindachom	Committee of Sao-Thong Community
10. Amphorn Seekulab	KhokKham Sub-District Administrative Division
11. Amornsak Chattin	President of Laem Yai Sub-District Administrative Organization
12. Siriwat Khantharot	Coordinator of Prachakom Konlux Maeklong
13. Wissanu Khengsamut	Village Head of Moo 9, Ban Khunsamutcheen
14. Bongkot Samosorn	Director of Oceanography Division, Hydrographic Department
15. Pran Dilokekunakul	Director of the Coastal Resource Conservation Division, Department of Marine and Coastal Resources.

3.1.4 Research Procedure

The researcher researched five provinces as follows:

1) Studying from documents related to the factors concerning policies, plans, strategies, and laws related to coastal erosion management, including integrated coastal zone management of the coastal erosion and people's participation in the upper

Gulf of Thailand, that affect the success of the coastal erosion management in the upper Gulf of Thailand.

2) Coordination and asking for collaboration from the top management of concerned agencies and network leaders of the coastal erosion communities in five provinces: Bangkok, Samut Prakan, Samutsakhon, Samut Songkhram, and Chachoengsao by making an appointment for explaining research objectives. Besides, permission to get an interview from the samples in the communities was also requested.

3) Meeting coastal erosion network leaders, concerned agencies' leaders, and community representatives in five provinces, who were personal sources of the study to explain the research objectives and for a further appointment for an interview.

4) Conducting an in-depth interview with all concerned within communities, i.e., leaders of the coastal erosion community network, and network members, community leaders (sub-district heads/village heads), directors and staffs of the sub-district administrative organizations in five provinces, those responsible for and concerned with the communities' coastal erosion management from outside the communities, i.e., the directors of the government sectors, such as Marine Department, Department of Marine and Coastal Resources, and Department of Public Works, Town & Country Planning.

5) Analyzing data from documentary analysis and in-depth interviews for developing the structural equation model of the factors affecting the success of the coastal erosion in the upper Gulf of Thailand. The findings from such analysis and a literature review of concepts, theories, and related studies were modified to construct questions and a questionnaire as a tool for quantitative research to ensure the most precise and congruent with the actual context of the study.

3.1.5 Data Collection Period

Data collection of the study took three months during April - June, 2020.

3.1.6 Data Collection Instruments

For collecting data for this study, two tape recorders, a notebook, a camera, and the researcher's smartphone were used.

3.1.7 Interviewing Questions

The researcher classified the questions based on the research questions as follows: 1) For the research question no. 1: “What are the success factors of the coastal erosion management in the upper Gulf of Thailand?” the researcher raised the questions based on

1) policies, plans, strategies, and laws related to coastal erosion management

2) theoretical concepts on the integrated coastal zone management of coastal erosion.

3) concepts of people’s participation in coastal erosion management.

The details are as follows:

3.1.7.1 Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management

1) Are the budget and personnel for regulating and investigating the implementation of policies, plans, and strategies sufficient for coastal erosion management? And why?

2) Do you think if the policies, plans, and strategies related to coastal erosion management are updated, sufficient, and inclusive for coping with coastal changes or meeting the needs of coastal development? And why?

3) Do people and stakeholders understand and participate in implementing policies, plans, and strategies related to coastal erosion management equally? And why?

4) Do the laws specify penalties severe enough to protect any misconduct that might yield a negative effect on coastal erosion? And why?

3.1.7.2 Theoretical Concepts on the Integrated Coastal Zone Management of Coastal Erosion

1) Do you think if the solutions to solve coastal erosion are compatible with the area, both terrestrial and maritime? And why?

2) Is the resource allocation and utilization, i.e., habitats of living creatures, fishery, tourism, the pier, and industrial development, etc. inclusive and equal? And why?

3) Is there any collaboration for a joint operation between government agencies, private sectors, general people, and stakeholders related to coastal erosion management? And why?

4) What are coordination mechanisms among agencies responsible for coastal erosion management?

5) How can the knowledge in science and technology, economics, and society be integrated for collaboration?

6) Do you think about what kinds of instruments concerned agencies use to cope with coastal erosion?

7) Do you think about what kinds of local wisdom a community uses in solving coastal erosion?

3.1.7.3 Concepts of People's Participation in Coastal Erosion Management

1) Do you think people have participated in any project or activity related to the coastal erosion in their area at the initiation stage? And how?

2) Do you think people have participated in any project or activity related to the coastal erosion in their area at the planning stage? And how?

3) Do you think people have participated in any project or activity related to the coastal erosion in their area at the implementation stage? And how?

4) Do you think people have participated in any project or activity related to the coastal erosion in their area at the evaluation stage? And how?

3.1.7.4 The success of Coastal Erosion Management

1) How do the coastal erosion solutions by engineering structures or hard solutions, i.e., revetment, seawall, Groin, offshore breakwater, etc. affect the fertility of environmental structure and functions in the area?

2) How do the coastal erosion solutions by soft solutions, i.e., beach nourishment, dune nourishment, mangrove afforestation, determination of setback zone, etc., affect the fertility of environmental structure and functions in the area?

3) Do you think if and how coastal erosion management in the upper Gulf of Thailand brings about economic benefits?

4) Do you think if everybody in the coastal areas can access and make use of coastal erosion management in the upper Gulf of Thailand inclusively? And how?

5) Do government agencies support their personnel to deal with the coastal erosion in the upper Gulf of Thailand appropriately and sufficiently? And why?

6) Do government agencies enhance the capabilities of their officials following the plans of coastal erosion management? And how?

7) Do government agencies support proper and enough budgets to deal with the coastal erosion in the upper Gulf of Thailand appropriately and sufficiently? And why?

8) Do you think if stakeholders in the area participated in the policy implementation as planned? And why?

9) Do you think if the outcome of coastal erosion management accords with the determined objective? And why?

3.1.8 The Validation of the Qualitative Research

In conducting the research, the researcher examined the completeness of the obtained information and considered what kind of information should be added or needed for further conduction. The data analysis was done in parallel to the data collection of the qualitative research. The information obtained each time was categorized into topics or issues to cover the conceptual framework and scope of the study. Then, information was investigated again through the principle of data triangulation from various personal sources, such as those involved with coastal erosion management in and outside the communities, until the information is saturated and complete to answer the research questions and to match with the actual current situation as much as it could. (Siriporn Jirawatkul, 2009).

3.1.9 Data Presentation

The researcher summarized all findings from documentary research and interview by the issues based on determined groups of questions in the form of descriptive analysis with some direct quotation of the key informants. Data were

classified, compared, and interpreted from the analysis framework, or namely studied concepts and related studies. Besides, the analysis focused on a holistic view of each contextual phenomenon through both Emic and Etic Perspectives.

Then, the researcher combined the findings from the qualitative research, including from the literature review of concerned concepts and studies, to develop a structural equation model of the factors affecting the success of the coastal erosion management in the upper Gulf of Thailand, and to modify them to be questioned in a questionnaire in the part of quantitative research. The questions thus were ensured to be explicit and compatible with the actual context of the studied areas as much as possible.

3.2 The Second Stage: Quantitative Research

Quantitative research is the approach that scholars use with figures or with countable or measurable data. Thus, every concept or variable is numerable that can confirm the findings. Quantitative research with well-planned study and proper use of research methodology can cover all population groups. (Suchart Prasitratthasin, 2007). Especially, for data collection with a large-sized population with huge-resources investments, quantitative research opens an opportunity for a researcher to do sampling from a group of representatives, who later can be implied towards a larger population. The details of the quantitative research for this study are as follows:

3.2.1 Population

The population of the study is stakeholders of the coastal erosion management in the upper Gulf of Thailand, who were classified as the government officials, community leaders, officials of the local administrative organizations, regional government staffs, state-enterprise workers, academic personnel (i.e., of schools or universities), and other government sectors, including private employees, entrepreneurs, students, and general people in the areas.

3.2.2 Sample Size

Due to a large number of population, sampling was conducted to obtain samples or representatives of the study. According to Leslie Kish (year, cited in Suchart Prasitratthasin, 2007), a sampling expert, the proper size of samples depends on several factors. One of them is the technique used for analysis. Since this research uses the analysis of the Structural Equation Model, the size of samples or units should not be less than 20 times of the observed or manifest variables. (Grace, 2008; Lindeman, Merenda, & Gold, 1980; Zhu, Walter, Rosenbaum, Russell, & Raina, 2006). As there are 12 manifest or observed variables in this study, the total number of samples that will be proper must not be less than 400 samples.

3.2.3 Sampling

After determining the sample size, stratified random sampling was used to obtain the representative units (Suchart Prasitratthasin, 2007) through the following steps:

1) The researcher classified the samples into government, local administrative organizations, and regional officials, including community leaders, state enterprises, schools, universities, and other government staff, private employees, entrepreneurs, and students, and general people.

2) Then, the quota sampling of each group was conducted; thus, each group in each province: Bangkok, Samut Prakan, Samutsakhon, Samut Songkhram, and Chachoengsao, consisted of 80 samples.

3.2.4 Instrument Development

A questionnaire, as a research instrument, was developed by the following steps:

1) Concepts and theories from documents, textbooks, articles, and research reports related to coastal erosion management, coastal erosion, policies and planning at the strategic, legal, rules, and regulations levels, including techniques and knowledge in investment on and protection of the coast and collaborations between government agencies and people, in combination with the findings from the qualitative research, were applied as a conceptual framework and hypotheses for the study,

including the construction of a questionnaire for collecting information for this research.

2) The research instrument was further modified and developed with more complete and explicit details as follows:

(1) Content validity. The developed instrument was submitted to the advisor and the other three experts: in environmental management, community and coast management, and coastal erosion management, for consultation.

(1.1) Narawadee Buakwan, Ph.D., an expert in community and coast management

(1.2) Danuwat Suwanwong, Ph.D., an expert in government and private management

(1.3) Assistant Professor Kuaanan Techato, Ph.D., an expert in environmental management

The opinions of the experts were compiled and analyzed towards Index of Item-Objective Congruence (IOC) by the following formula: Laddawan Petchroj and Achara Chamniprasas, 2004).

$$IOC = (\sum R)/N$$

when IOC = Index of Item-Objective Congruence

$\sum R$ = The total sum of experts' opinions

R = Scores of experts' opinions for each question

N = The number of experts

Scoring criteria are as follows:

+1 means the question is congruent with the research objective

-1 means the question is incongruent with the research objective

0 means unsure if the question is congruent with the research objective or not.

Criteria for interpretation are as follows:

$IOC \geq .50$ means the question is congruent with the research objective

$IOC < .50$ means the question is incongruent with the research objective

From the analysis of the content validity of the questionnaire, IOC equals 0.975, so the instrument was improved by the experts' recommendations. Thus, the instrument was proposed again and all questions passed the required criteria.

(2) After the questionnaire was developed and improved by the advisor and the experts, the reliability of the questionnaire was tested by a pilot study with 30 non-actual samples. After the pilot study, the researcher examined if the respondents had any problems with the questionnaire or in answering the questions or not. Thus, it was the step of analyzing the reliability of the questions and questionnaire to assure that the items measured the attributes. (Suchart Prasitratthasin, 2007). During the process, Cronbach's Alpha Coefficient was used to measure internal consistency or to find how the variables are associated and related. If the reliability level is high, it means those indicators are highly associated. Therefore, internal consistency is typically a measure based on the correlations between different items on the same test. The measurement of the internal consistency of each part yields indicator variables that aim to measure the same variable. (Kanlaya Vanichbuncha, 1999).

(3) Confirmatory Factor Analysis or CFA was used to test the construct validity by the application of the LISREL program.

3.2.5 Research Instrument or Tool

Two kinds of instruments or tools were constructed. A close-ended questionnaire comprising 45 questions in five parts was developed:

Part 1: Questions on the general information about demographic attributes, i.e., sex, age, education level, types of work/occupation, and the average monthly income. (5 questions)

Part 2: Questions on the policy, plan, strategy, and law factors related to coastal erosion management (8 questions).

Part 3: Questions on the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand (7 questions)

Part 4: Questions on people's participation in managing the coastal erosion in the upper Gulf of Thailand (14 questions)

Part 5: Questions on the success of coastal erosion management in the upper Gulf of Thailand (11 questions).

3.2.6 Definitions of Variables and the Construction of Indicators

This study consisted of 4 latent variables, which were divided into exogenous and endogenous variables.

3.2.6.1 Part 1: Exogenous Variable

Exogenous variables mean the variables whose value is not determined by the model or variables that are not affected by other variables, such as policies, plans, strategies, and laws related to coastal erosion management. The researcher synthesized variables from the qualitative research in the initial stage, including concepts, theories, and related studies, and found that there were two observed variables, namely 1) the implementation of policies, plans, and strategies, related to coastal erosion management into practice, and 2) the enforcement of laws related to coastal erosion management. The researcher modified them to be eight questions in the questionnaire.

3.2.6.2 Part 2: Endogenous Variable

Endogenous variables mean the variables whose value is determined by the model or are affected by other variables. For this research, there were three principal variables:

1) The coastal erosion management in the upper Gulf of Thailand. From synthesizing its components from qualitative research at the first stage and from a literature review, three observed variables were found: 1) integration of space and resources, 2) integration of concerned agencies and 3) integration of techniques and knowledge. The researcher modified them to be seven questions in the questionnaire.

2) People's participation in managing coastal erosion in the area. From synthesizing its components from qualitative research at the first stage and from a literature review, four observed variables were found: 1) Participation in the initial stage of projects or activities related to coastal erosion management in the area. 2) Participation in the planning stage of projects or activities related to coastal erosion management in the area. 3) Participation in the implementation stage of projects or activities related to coastal erosion management in the area. 4) Participation in the evaluation stage of projects or activities related to coastal erosion management in the area. The researcher modified them to be fourteen questions in the questionnaire.

3) Success of the management of the coastal erosion in the upper Gulf of Thailand. From synthesizing its components from qualitative research at the first stage and from a literature review, three observed variables were found: 1) sustainable development, 2) implementation and 3) evaluation. The researcher modified them to be 11 questions in the questionnaire.

3.2.7 Variables and Scoring Criteria

The variables used in this research were demographic attributes, factors of policies, plans, strategies, and laws related to coastal erosion management, the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand, people's participation in managing coastal erosion in the area, and success in managing the coastal erosion in the upper Gulf of Thailand. Details and criteria of scoring are as follows:

3.2.7.1 Part 1: Demographic Attributes

Demographic attributes were demographic attributes of the population in the upper Gulf of Thailand, namely Bangkok, Samut Prakan, Samutsakhon, Samut Songkhram, and Chachoengsao, i.e., sex, age, education level, occupation, and average monthly income.

3.2.7.2 Part 2: Factors of policies, plans, strategies, and laws related to coastal erosion management. These factors were 1) the implementation of policies, plans, and strategies, related to coastal erosion management, and 2) the enforcement of laws related to coastal erosion management.

Ranges of scores were 1-5 scores, from the highest to the lowest degree or level, based on the Likert Scale, as follows:

The most/highest	5	scores
Much/high	4	scores
Moderate/fair	3	scores
Little/low	2	scores
Least/lowest	1	score

Criteria for interpreting the meanings

The mean score of a respondent's opinion towards a statement was interpreted by the following criteria:

4.21 – 5.00 means the respondent’s opinion towards policies, plans, and strategies related to coastal erosion management is at the highest level.

3.41 – 4.20 means the respondent's opinion towards policies, plans, and strategies related to coastal erosion management is at a high level.

2.61 – 3.40 means the respondent's opinion towards policies, plans, and strategies related to coastal erosion management is at a moderate level.

1.81 – 2.60 means the respondent's opinion towards policies, plans, and strategies related to coastal erosion management is at a low level.

1.00 – 1.80 means the respondent’s opinion towards policies, plans, and strategies related to coastal erosion management is at the lowest level.

3.2.7.3 Part 3: Information of the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand

1) The integration of space and resources, 2) the integration of concerned agencies, and 3) the integration of techniques and knowledge. Ranges of scores were 1-5 scores, from the highest to the lowest degree or level, based on Likert Scale, as follows:

The most/highest	5	scores
Much/high	4	scores
Moderate/fair	3	scores
Little/low	2	scores
Least/lowest	1	score

Criteria for interpreting the meanings

The mean score of a respondent’s opinion towards a statement was interpreted by the following criteria:

4.21 – 5.00 means the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand was conducted at the highest level.

3.41 – 4.20 means the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand was conducted at a high level.

2.61 – 3.40 means the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand was conducted at a moderate level.

1.81 – 2.60 means the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand was conducted at a low level.

1.00 – 1.80 means the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand was conducted at the lowest level.

3.2.7.4 Part 4: Information on people's participation in managing coastal erosion in the area.

1) Participation in projects or activities related to coastal erosion in the area in the initiation stage. 2) Participation in projects or activities related to coastal erosion in the area in the planning stage. 3) Participation in projects or activities related to coastal erosion in the area in the implementation stage. 4) Participation in projects or activities related to coastal erosion in the area in the evaluation stage. Ranges of scores were 1-5 scores, from the highest to the lowest degree or level, based on the Likert Scale, as follows:

The most/highest	5	scores
Much/high	4	scores
Moderate/fair	3	scores
Little/low	2	scores
Least/lowest	1	score

Criteria for interpreting the meanings

The mean score of a respondent’s opinion towards a statement was interpreted by the following criteria:

4.21 – 5.00 means people participated in managing coastal erosion in the area at the highest level.

3.41 – 4.20 means people participated in managing coastal erosion in the area at a high level.

2.61 – 3.40 means people participated in managing coastal erosion in the area at a moderate level.

1.81 – 2.60 means people participated in managing coastal erosion in the area at a low level.

1.00 – 1.80 means people participated in managing coastal erosion in the area at the lowest level.

3.2.7.5 Part 5: Information on the success of coastal erosion management in the upper Gulf of Thailand

1) Sustainable development, 2) Implementation, and 3) evaluation. Ranges of scores were 1-5 scores, from the highest to the lowest degree or level, based on Likert Scale, as follows:

The most/highest	5	scores
Much/high	4	scores
Moderate/fair	3	scores
Little/low	2	scores
Least/lowest	1	score

Criteria for interpreting the meanings

The mean score of a respondent's opinion towards a statement was interpreted by the following criteria:

4.21 – 5.00 means the success of coastal erosion management in the upper Gulf of Thailand was at the highest level.

3.41 – 4.20 means the success of coastal erosion management in the upper Gulf of Thailand was at a high level.

2.61 – 3.40 means the success of coastal erosion management in the upper Gulf of Thailand was at a moderate level.

1.81 – 2.60 means the success of coastal erosion management in the upper Gulf of Thailand was at a low level.

1.00 – 1.80 means the success of coastal erosion management in the upper Gulf of Thailand was at the lowest level.

3.2.8 Data Collection Period

The researcher collected data by a closed-ended questionnaire during April - June, 2020.

3.2.9 Validity and Reliability Test of the Instrument

The developed and refined questionnaire was examined by the advisor and the experts in environmental management, community and coast management, and coastal erosion management to test the content validity and the proper use of wordings,

including the preciseness and completeness of the questionnaire for further improvement to assure that every question could answer research objectives.

Regarding the reliability test, the researcher tested the modified questionnaire by a pilot study with 30 non-actual samples to see if questions in each part were precise and could communicate correctly as desired, including considering if the questionnaire's level of complexity is suitable for target respondents and if it was reliable.

The questionnaire's reliability was calculated by Cronbach's alpha reliability coefficient for a rating scale or Likert-type scales as follows: (Wichian Ketsing, 1998)

$$\alpha = \frac{k}{1-k}\left\{1 - \frac{\sum V_i}{V_t}\right\}$$

where α = reliability of the instrument

K = the number of items

V_i = the average variance of each item

V_t = the average of all covariance between items.

From the calculation, Cronbach's Alpha reliability coefficient of the factors affecting the success of the coastal erosion in the upper Gulf of Thailand (40 items) = .928, with detailed reliability of each factor as follows:

1) Factors of policies, plans, strategies, and laws related to coastal erosion management (8 items), α = .723, which was divided into 2 sub-items as follows:

(1) The implementation of policies, plans, and strategies, related to coastal erosion management (3 items), α = .501

(2) The enforcement of laws related to coastal erosion management (5 items), α = .691

2) The integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand (7 items), α = .826.

3) People's participation in managing coastal erosion in the area (14 items), α = .921

4) The success of the management of the coastal erosion in the upper Gulf of Thailand in the area (11 items), $\alpha = .819$.

After collecting data from the samples, the researcher tested the quality of the instrument or construct validity by confirmatory factor analysis and measurement model of all latent variables in the model. The results of the test were displayed in Chapter 4.

3.2.10 Data Processing

After data collection, the following was administered:

1) Examining if the received information from the questionnaires was complete. In case any questionnaire was incomplete, such a questionnaire would be sorted out as unusable.

2) Determining codes and coding received information on a coding sheet until reaching the needed number of the samples.

3) Recording and processing information by the software package for calculating statistical values used in this study for further data analysis.

3.2.11 Data Analysis

1) Descriptive statistics

Frequency, percentage, mean, and standard deviation were applied for explaining data of each part of the questionnaire as follows:

(1) Demographic attributes of the respondents, i.e., sex, age, education level, occupation, and average monthly income.

(2) Factors of policies, plans, strategies, and laws related to coastal erosion management

(3) The integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand

(4) People’s participation in managing coastal erosion in the area

(5) The success of the management of the coastal erosion in the upper Gulf of Thailand

2) Inferential statistics

The researcher combined the findings from qualitative research with the information reviewed from literature and previous studies, modified, and developed them as questions in the questionnaire, and to construct the structural equation model (SEM) of the factors of policies, plans, strategies, and laws related to coastal erosion management, the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand, and people's participation in managing coastal erosion in the area, which affected the success of the coastal erosion in the upper Gulf of Thailand to test the congruence of the model and empirical data gained from the study area by the quantitative research.

Table 3.1 Illustrates Full Names and Abbreviations of Latent and Observed Variables, Including Questions in the Questionnaire Used for the LISREL Program Processing

Full names Structural Equation Model	**Abbreviation Structural Equation Model**	**Questions in the Questionnaire Used for Measuring Observed Variables**
1. Latent variables Factors of policies, plans, strategies, and laws related to coastal erosion management	**1. Latent variables** policy	
2. Observed variables 2.1) The implementation of policies, plans, and strategies related to coastal erosion management	**2. Observed variables** 2.1) B21	2.1) Part 2.1, item 1 - 3

Table 3.1 (Continued)

Full names Structural Equation Model	Abbreviation Structural Equation Model	Questions in the Questionnaire Used for Measuring Observed Variables
2.2) The enforcement of laws related to coastal erosion management	2.2) B22	2.2) Part 2.2, item 1 - 5
1. Latent variable Integrated management of coastal erosion	**1. Latent variable** manage	
2. Observed variable	**2. Observed variable**	
2.1 Integration of space and resources	2.1) C31	2.1) Part 3, item 1-2
2.2 Integration of concerned agencies	2.2) C32	2.2) Part 3, item 4 - 5
2.3) Integration of techniques and knowledge	2.3) Technique	2.3) Part 3, item 6 - 7
1. Latent variable People's participation	**1. Latent variable** Partici	
2. Observed variable	**2. Observed variable**	
2.1) Participation in the initiation stage	2.1) D41	2.1) Part 4, item 1 - 4
2.2) Participation in the planning stage	2.2) D42	2.2) Part 4, item 5 - 7
2.3) Participation in the implementation stage	2.3) D43	2.3) Part 4, item 8 - 12
2.4) Participation in the evaluation stage	2.4) D44	2.4) Part 4, item 13 -14

Table 3.1 (Continued)

Full names Structural Equation Model	Abbreviation Structural Equation Model	Questions in the Questionnaire Used for Measuring Observed Variables
1. Latent variable	**1. Latent variable**	
The success of coastal erosion management	SUCCESS	
2. Observed variable	**2. Observed variable**	
2.1) sustainable development	2.1) E51	2.1) Part 5, item 1 - 4
2.2) implementation	2.2) E52	2.2) Part 5, item 5 - 8
2.3) evaluation	2.3) E53	2.3) Part 5, item 9 - 11

3) Inferential statistics

Regarding the data analysis for testing the congruence of the structural equation model and empirical data, the researcher analyzed the data by estimating parameter values of the model through Maximum Likelihood Estimates and using indexes to test the congruence between the model and empirical data. The index criteria for seven indexes, based on the concept of Diamantopoulos & Siguaw (2000) (as illustrated in Table 3.2), were applied.

The criteria used for testing the congruence are that more than three indexes from the total of seven indexes must pass the determined criteria (as illustrated in Table 3.2) as follows:

Table 3.2 Illustrates the Criteria for Analyzing the Congruence Between SEM and Empirical Data

Statistics for Measuring the Congruence	Criteria Accepted as Congruent
1. χ^2	At the statistical significance level
2. χ^2/df	< or = 5.00
3. Comparative Fit Index (CFI)	> or = 0.90
4. The goodness of Fit Index (GFI)	> or = 0.90
5. Adjusted Good of Fitness (AGFI)	> or = 0.90
6. Root Mean Square Error of Approximation (RMSEA)	< or = 0.08
Interpretation of SMSEA	0.000 - 0.050 = a close fit
	0.051 - 0.080 = a reasonable fit
7. Standardized Root Mean Square Residual (SRMR)	< or = 0.05

Source: Diamantopoulos and Siguaw, 2000.

3.2.12 Data Presentation

For presenting the findings of the quantitative research, they were presented by the research questions, objectives, and hypotheses, supplemented by the researcher's statements and the confirmed findings from a literature review of theories, concepts, and related studies, including the results of the qualitative research, to explain if they were congruent or incongruent.

Finally, the researcher presented if the developed measurement model and structural equation model of the factors of policies, plans, strategies, and laws related to coastal erosion management, the integrated coastal zone management of the coastal erosion in the upper Gulf of Thailand, and people’s participation in managing coastal erosion in the area, affect the success in managing the coastal erosion in the upper Gulf of Thailand, or are congruent with the empirical data.

CHAPTER 4

RESEARCH FINDINGS

The research entitled, “The Development of the Structural Equation Model of Factors Affecting Success for Coastal Erosion Management at the Upper Gulf of Thailand,” conducted by both qualitative and quantitative methodologies, was aimed 1) to study policies, strategic plans, and laws related to coastal erosion, including the integrated coastal zone management of coastal erosion and people's participation in managing coastal erosion that affects success in coastal erosion in the upper Gulf of Thailand, 2) to study the direct and indirect effects of the variables in the structural equation model that affect the success of coastal erosion management in the upper Gulf of Thailand, and 3) to develop and test the congruence of the measurement model and the structural equation model of the factors affecting the success of coastal erosion management in the upper Gulf of Thailand with empirical data. The research was conducted in two steps. The first step was qualitative research, collecting and analyzing data from the related document, and in-depth interviews with a semi-structured interview guide. The second step was one-shot quantitative research by survey questionnaires with close-ended questions. Questions were designed from the qualitative-research findings, including related concepts, theories, and literature review, to obtain more accuracy and congruence with the actual situation of the studied areas. Moreover, a preliminary structural equation model was analyzed and modified by the consultation with experts from different sectors, comprising scholars in the relevant fields of study, and representatives of the government and private sectors, including community leaders in the coastal area of the upper Gulf of Thailand. The model was confirmed and expected to be useful information for coastal erosion management in the upper Gulf of Thailand. The research findings were as follows:

4.1 Findings of the Qualitative Research

4.1.1 Policies, Plans, Strategies, and Laws

Table 4.1 Illustrates Policies, Plans, Strategies, and Laws

Budget and Personnel	Policies, Plans, Strategies	Knowledge and Understanding of Stakeholders	Related Laws
- Insufficient budget for complex problems - Insufficient personnel - A lack of activities for supporting policies and plans - Requiring a collaborative operation.	- Not updated due to different area conditions and problems. - No agency with direct responsibilities - No proper implementation - Not covering all areas. - Not initiated by people in the community. - Not responding to the problems and improper for some areas. - Causing a disharmony between the government sector and people - A collaborative design with people in the affected area should be promoted.	- unequal as people tended to perceive the outcome but did not understand strategic plans. - No continuity in operation. - A lack of the communities' knowledge and understanding in policies and plans - Difference in opinions - The diversity of stakeholders and affected people, both directly and indirectly.	- Not enough severe punishment – Facilitating for capitalists more than communities - Those who enforce laws ignored the violation. - No serious and righteous enforcement - More laws enforcement with local people than with entrepreneurs.

From the above Table, it indicates that

1) For the dimension of budgets and personnel and dimension of policies, plans, strategies, and laws, the study found that budgets and personnel of the related agencies were not sufficient. Consequently, they lacked activities for supporting policies and plans. On the other hand, the existing ones were not updated, especially due to the different physical conditions of the areas, while they did not cover all affected areas either. Besides, the concerned agencies did not implement plans and policies earnestly. Notably, such plans and policies were not initiated by people in the affected areas. Thus, it led to the disunion between the government sectors and people, which could be considered as a major weak point of the management. Therefore, there should be a collaboration of all concerned in designing the protection and solutions.

2) In the dimension of knowledge and understanding of stakeholders, it was found that stakeholders included a diversity of sectors and groups. Still, most people had no knowledge and understanding of the plans and policies. In addition, opinion differences and non-continual operation were found.

3) In terms of the legal dimension, it was found that the related punishment was not severe. Especially, those who enforced the laws ignored the violation against the laws, while the laws were found to facilitate capitalists and enacted more with local people.

4.1.2 The Integrated Coastal Zone Management

Table 4.2 Illustrates the Integrated Coastal Zone Management

Solutions to the Negative Impact	Resources Allocation and Utilization	Collaboration Among all Concerned	Coordination Mechanism among Concerned Agencies	A collaboration of Knowledge in Science, Technology, Economics, and Society	Utilization of Tools in the Management of Concerned Agencies	The Use of Local Wisdom in Problem-Solving
- A few policies, plans, and projects - No progress - No integration among concerned agencies - Determination of the same measures and structures despite the difference in area condition.	-Very few and each issue needed to be considered separately - Violation by planting mussels, or mussel farming - Local people tended to obtain resources allocation more than the private sector	- Little attention from the government sector to the civic sector. - A lack of collaboration - - Different opinions - Increased public hearing and implementation towards actual use.	- A lack of coordination mechanisms at the spatial operation level - A lack of integrated collaboration between government agencies and people. - Government agencies lacked coordination. - Talks between the government sector and local communities were witnessed. – Coordination was done	- The appearance of local wisdom use in the area - Collaboration with academic institutions was found. - Occasional conferences - Difficult to understand.	- A top-down command of policies - laws and budgets - There were some meetings for providing the overall information, including various laws. - Research procedures and public hearings	- Coastal wood-planting for slowing waves - forestation to strengthen the coast. - Knowledge of water management. Of soil water - coastal erosion protection knowledge

Table 4.2 (Continued)

Solutions to the Negative Impact	Resources Allocation and Utilization	Collaboration Among all Concerned	Coordination Mechanism among Concerned Agencies	A collaboration of Knowledge in Science, Technology, Economics, and Society	Utilization of Tools in the Management of Concerned Agencies	The Use of Local Wisdom in Problem-Solving
- impractical enforcement of laws or incongruence between the laws and actual condition - Separated operations by individuals - Activities on coastal areas yielded a direct impact on the coastal areas	- Improper allocation - inequality and righteousness -- the proportion of water allocation for ecosystem maintenance, especially in the coastal areas, was small. - No actual stipulated proportion and condition in using coastal areas.		through community leaders, conferences, and seminars occasionally. - Emergence of conservation networks, but without collaboration from concerned agencies. - The appearance of collaboration at the policy level, but without mechanisms for interconnectivity at the spatial level.		from people in the community were conducted - Bamboo revetment - Concrete structure - Stone-wall	- A lack of support - Mangrove afforestation - Bamboo revetment - Bund or spoil bank - Stone-throwing

From the above Table, it indicates about the integrated coastal zone management with details as follows:

1) In solving problems caused by the no-progress impact due to the lack of integration among concerned agencies, and different physical conditions of the areas, the management was still determined to have the same design for all areas. Besides, law enforcement was incongruent with the actual condition of the areas.

2) Regarding resource allocation and utilization, it appeared to have an improper and unequal allocation with clearly specified proportion.

3) Concerning the collaboration among involved agencies, the government sector still lacked collaboration, had different ideas from people's, and gave little importance to it. Besides, the agencies lacked mechanisms for coordination at the operational level, including integration among government agencies; although, it was found that the government officials talked to a community through its leader. Still, despite the enacted policies, they had no connections at the area level. Accordingly, they should listen to people's ideas and apply them increasingly.

4) For the collaborative exchange of knowledge in science, technology, economics, and society, it was found that the government agencies had some cooperation with some academic institutions with some occasional meetings. However, for local people, it seemed to be difficult for them to understand. Furthermore, for the utilization of the tools, the concerned agencies divided the tools into two types. Firstly, the tools were plans, policies, budgets, and related laws, including a public hearing. The second tool was local wisdom, which was used towards coastal erosion protection. The local wisdom used to solve coastal erosion was mangrove afforestation, bamboo revetment, soil structure, stone fence, and soil-water management.

4.1.3 People's or Public Participation

Table 4.3 Illustrates People's Participation in Each Step

Initial Step	Planning Step	Implementation Step of Operating Concerned Projects and Activities	Evaluation Step or Evaluating Concerned Projects and Activities
- People seldom participated in this step. - People participated sometimes, but needed some icebreaking and joining in activities first. - People wanted to participate but found some difficulties to access. Especially, people could participate when concerned agencies could not solve problems or operate by themselves	- The communities helped to plan, but given information was not returned to people. - Some areas had no opportunity to participate in the planning step. - Only community representatives or leaders could access the concerned agencies. - Participation was perceived as a major factor for solving problems as they witnessed the occurring problems and effects. - It was recommended to listen to people living in or adjacent to the	- Participation in this step could happen only when the government sector is needed. - Some areas allowed people to express their ideas, but government agencies did not adopt them for application. - People could participate sometimes as they were not coordinated regularly and operations were not continual. - Due to several agencies involved, participation activities varied. - Mostly, people proposed their local wisdom, i.e., forestation, stone-fence, dykes, etc.	- People should be taught how to evaluate a project or activity first. - Previously, people had no chance to inspect a project as much as they should. - People proposed some ideas and solutions against coastal erosion that would not affect the environment and their occupations. - People had a chance to propose their opinions during a meeting. - There was some participation of people, but not sufficient yet. Many agencies did not open an opportunity for people to participate in the

Table 4.3 (Continued)

Initial Step	Planning Step	Implementation Step of Operating Concerned Projects and Activities	Evaluation Step or Evaluating Concerned Projects and Activities
- A lack of a participative process with the community in the area. - Most of the participants were community leaders - Agencies listened to people's trouble after receiving their appeals for assistance and allowed them to participate in solving problems by their local-wisdom approaches	coastal areas for getting coastal erosion solutions	- It was an opportunity for people in collaborative thinking to create their common awareness and surveillance.	evaluation step, while some did not establish a common evaluation pattern.

From the above Table, it indicates that

1) For people's participation in the initial step, it was found that people could not access a participatory process. Mostly, participants were community leaders or mainstays. This step was needed for discussion and listening to people's trouble.

2) The planning step was found as a major step for people's participation; however, it was found that some communities had no roles in this step yet. Besides, when communities participated and shared ideas, such ideas or information were not returned to the communities. In some areas, only leaders or representatives could participate.

3) Regarding participation in the implementation or operational step, it was found that people could participate in this step only when the state needed them. Some communities had an opportunity to participate in this step, but only occasionally, due to no coordination from the government sector nor continual operations. Some communities had a chance to express their ideas in this step.

4) In the evaluation step, it was suggested that the state teach people how to evaluate a project or an activity and allow people to participate. Previously, people did not have an opportunity to inspect a project as much as they should. Some communities evaluated a project through a meeting. Besides, it was found that agencies did not establish or create a common evaluation pattern for a community.

4.1.4 Success of Coastal Erosion Management in the Gulf of Thailand

Table 4.4 Illustrates the Success of Coastal Erosion Management in the Gulf of Thailand by Each Solution and Benefits

Hard Engineering Structure	Natural or Soft Engineering Structure	Economic Benefits	Accessibility and Benefits from Coastal Erosion Management	Support of Governmental Personnel for Coastal Erosion Management	Empowerment of Practitioners of Comply with Management Plans	Appropriate and Sufficient Budgets for Coastal Erosion Management	Participation of Stakeholders in Complying with Management Plans	The Congruence of Management Outcomes with the Objectives.
- Negative may occur because of differences in each area. - Hard structure was not appropriate for some areas - It could prevent	- Each area should be surveyed clearly before any operation since land ownership documents belong to the private sector.	- Coastal erosion management Induced coastal fertility - It helped to maintain and rehabilitate ecosystems. - Common awareness was stimulated.	It helps to remind people of its benefits. - Concerned agencies gave more importance to people. - Innovation from local wisdom was introduced.	Support was still small. Mostly, it was the operation with other government agencies. - In the past, there was very few personnel in the agency.	- Mostly, the state focused on personnel training, but not on the evaluation of their performance. - The outcome was not as planned and did not respond to	- Mostly, the state-operated by itself. - People had not reached the deserved rights yet. - There were some supports, but only a few.	Some areas had no people's participation. - Some communities attended a public hearing for solutions. - People who participated in a process did not gain any	The outcome is accorded with the objectives under the continual operation only. - For some areas, the outcomes were not as planned nor congruent

Hard Engineering Structure	Natural or Soft Engineering Structure	Economic Benefits	Accessibility and Benefits from Coastal Erosion Management	Support of Governmental Personnel for Coastal Erosion Management	Empowerment of Practitioners of Comply with Management Plans	Appropriate and Sufficient Budgets for Coastal Erosion Management	Participation of Stakeholders in Complying with Management Plans	The Congruence of Management Outcomes with the Objectives.
erosion temporarily. - Hard structure obstructing sea tides caused more coastal erosion. - It affected other coastal areas that had not been protected. - Hard structure was	- It depended on the needs of each area. - Some areas could not rely on the natural structure but required some combined structures. - It was for short-term use. - It yielded a positive impact in the long term but	- It required holistic management. - Food sources were created. - it helped to promote tourism. - it helped to rehabilitate ecosystems. - Land for earnings was protected. - Fishery was promoted.	- Only people possessing title deed or land buyers got the benefits. - Sustainable coastal erosion management is a beneficial approach for everybody.	- Some personnel had no enough knowledge of the coast. - There was enough personnel in some areas. - Only some agencies encouraged their personnel to establish people's participation in	the community's needs. - Some agencies should prepare their personnel to have overall knowledge and understanding, including problem-solving skills.	- Granted budgets were insufficient for the area. - The regulations of budget allocation were not compatible with sustainable problem-solving.	benefits. On the contrary, those who did not participate gained the benefits. - Any plans from a community's participation gained compliance from the community.	with the objectives - Evaluating the outcomes of some particular objectives, they seemed to be successful. However, if evaluating the overall management, the accomplishment had not been reached yet. -

Hard Engineering Structure	Natural or Soft Engineering Structure	Economic Benefits	Accessibility and Benefits from Coastal Erosion Management	Support of Governmental Personnel for Coastal Erosion Management	Empowerment of Practitioners of Comply with Management Plans	Appropriate and Sufficient Budgets for Coastal Erosion Management	Participation of Stakeholders in Complying with Management Plans	The Congruence of Management Outcomes with the Objectives.
not compatible with a coastal area in the inner Gulf of Thailand as it is a muddy beach and has complex ecosystems.	required continuity and no effect on the environment. - It has been widely accepted by international countries. - It was a compatible approach for the coastal area of the inner Gulf of Thailand.	- It helped to have clean food all year. - It helped to protect coastal erosion.		the community.				

From the above Table, the perceived success of coastal erosion management in the Gulf of Thailand can be summarized as follows:

1) For erosion solutions by hard engineering structures, it was found that the structures were not compatible with the inner Gulf of Thailand, since it is a muddy beach and a complex area. Nevertheless, it could protect coastal erosion temporarily and increase erosion if hard structures obstructed the waterway.

2) The natural or soft engineering structures were perceived as compatible for coastal areas in the inner Gulf of Thailand. Besides, they were widely accepted internationally. It was perceived to yield a positive impact in the long term without affecting the environment. However, soft structures depended on some communities' needs. Some communities needed to have other structures combined with natural or soft structures. Nevertheless, it was suggested that each area be explored initially since title deeds might belong to the private sector.

3) In terms of economic benefits as a result of coastal erosion management, erosion management was perceived as a way to maintain and rehabilitate ecosystems, create fertility to the coast, bring about food sources, provide clean food, protect the loss of land for earnings, protect coastal collapse, establish accommodations, and promote tourism. However, it requires holistic management.

4) To access and gain benefits from erosion management encouraged innovations from local wisdom. Still, concerned agencies have to give importance to people and let them know about the acquired benefits of sustainable management.

5) Regarding the support of the government personnel for coastal erosion management, it was found that the support was still little since the agencies themselves had a few personnel. Some available personnel lacked knowledge about coastal erosion. Mostly, the collaboration was among the government personnel, and only in some areas, government agencies encouraged their personnel to create participation with a community.

6) The previous empowerment of practitioners was not accordant with management plans, nor respond to a community’s needs. Mostly, government agencies focused on personnel training, but not on the evaluation of their performance. It was recommended that each concerned agency should prepare their personnel to have a good understanding of the area and have problem-solving skills.

7) Concerning the support of a proper and sufficient budget for coastal erosion management, it was found that most agencies had to operate on their own. Despite some support, it was still too little and insufficient for some areas. In some areas, people could not access their rights. Moreover, it was found that regulations of budget allocation did not accord with a sustainable problem-solving approach.

8) For stakeholders' participation in complying with the plans, it was found that an existing participation process was in the form of a meeting for public hearings on coastal erosion solutions. Still, some areas lacked people's participation. Notably, if plans came from a participatory process with a community, people in the community tended to participate and comply with the plans.

4.2 Findings of Quantitative Research

For quantitative research, its findings are presented in three parts, responding to the research question no. 3) or "to develop and test the congruence of the structural equation model of factors affecting success in coastal erosion management in the upper Gulf of Thailand." The findings are presented as follows:

Part 1: The construction of a structural equation model, developed from the qualitative research findings

Part 2: Descriptive analysis

Part 3: Inferential analysis

3.1 Correlation analysis

3.2 Test of construct validity by confirmatory factor analysis of the measurement model.

3.3 Analysis of the structural equation model of factors affecting success in coastal erosion management in the upper Gulf of Thailand

Detailed findings of each part are as follows:

4.2.1 The Construction of a Structural Equation Model, Developed from the Qualitative Research Findings

The construction of a structural equation model of factors affecting success in coastal erosion management in the upper Gulf of Thailand was modified and developed from the findings of qualitative research, in combination with the reviewed concepts, theories, and related studies.

For the findings of the qualitative research, the researcher synthesized them from in-depth interviews with 15 key informants working directly in the area of coastal erosion management in the upper Gulf of Thailand from various sectors: government, private, community, civic mainstays, and scholars. Then, such synthesized data was integrated with information from reviewed concepts, theories, and related studies. All obtained data were modified and developed to be "a structural equation model of success factors for coastal erosion management in the upper Gulf of Thailand," in the part of quantitative research.

From the qualitative research by in-depth interviews, "factors of policies, plans, strategies, and laws related to coastal erosion management" were found, starting from the adoption, implementation, and laws enforcement used in coastal erosion management. These factors were classified as "causal variables," which affected behaviors and a management process of people in communities, government and private agencies, and stakeholders, which resulted in the success of coastal erosion management in the areas through two principal factors:

1) Participation of people, who realized the importance of the coast, in coastal erosion management in the upper Gulf of Thailand, starting from the initiation stage, to the stage of planning, implementation or operation, and evaluation of projects or activities related to coastal erosion management in the area.

2) Integrated coastal zone management in the upper Gulf of Thailand, comprising the congruence of coastal erosion solutions with the areas, both land and maritime; the collaboration between concerned agencies, or stakeholders in coastal erosion, i.e., the government, private, and civic sectors; coordination in scientific, technological, economic, and social knowledge; the utilization of tools for coastal erosion management, i.e., economic tools, etc.; risk assessment; database system

management; environmental impact assessment (EIA); monitoring; and evaluation, which are key factors leading to the success in coastal erosion management.

The variable, “success in coastal erosion management,” comprises the equilibrium in economics, community society, and environment; appropriate and sufficient budgets and personnel for coastal erosion management; stakeholders’ participation in and compliance with coastal erosion management plans; and the revision of action plans by the priority of problems that leads to concrete solutions.

In short, the synthesis of qualitative findings from in-depth interviews of key informants working in coastal erosion management in the upper Gulf of Thailand from government, private, community, civic, and academic sectors, and the findings from reviewing concepts, theories, and related studies was modified and develop a conceptual framework for constructing a structural equation model of the factors affecting the success of coastal erosion management in the upper Gulf of Thailand. For ensuring that the constructed model is congruent with the actual context of the studied areas, questions of the survey questionnaires were obtained from a literature review of relevant concepts, theories, and studies and designed to respond to the current situation of coastal erosion management in the upper Gulf of Thailand more accurately as illustrated in the research conceptual framework in Chapter 2 (Figure 2.3). The constructed model comprises "factors of policies, plans, strategies, and laws," which are assumed to affect the success of coastal erosion management, through two intervening variables: "integrated coastal zone management" and "people's participation."

4.2.2 Descriptive Analysis

Data in the descriptive analysis is information about 1) demographic characteristics, 2) policies, plans, strategies, and laws related to coastal erosion management, 3) integrated coastal zone management in the upper Gulf of Thailand, 4) people’s participation in coastal erosion management in the upper Gulf of Thailand, and 5) success in coastal erosion management of coastal areas in five provinces in the upper Gulf of Thailand: Bangkok, Samut Prakan, Samutsakhon, Samut Songkhram, and Chachoengsao. The details of the analysis are as follows:

Table 4.5 Illustrates the Numbers and Percentage of the Samples in the Studied Areas

Studied Areas	Numbers (n = 420)	Percentage
Bangkok	84	20.0
Samut Prakan	91	21.6
Samutsakhon	81	19.3
Samut Songkhram	83	19.8
Chachoengsao	81	19.3
Total	**420**	**100.0**

From Table 4.5, it shows that the numbers of the samples in the five studied areas are almost equivalent. Information was collected the most from the samples in Samut Prakan, specifically, 91 samples (21.6%), followed by 84 samples from Bangkok (20.0%), 83 samples from Samut Songkhram (19.8%), and 81 samples from Samutsakhon and Chachoengsao equally (19.3%).

4.2.2.1 Demographic Characteristics

Table 4.6 Illustrates Numbers and Percentage of Demographic Characteristics of the Samples

Demographic Characteristics	Numbers (N = 420)	Percentage
Sex		
Male	222	52.9
Female	198	47.1
Age		
Mean = 42.38, Std. Deviation = 12.819, youngest = 15 and oldest = 76 Years old		

Table 4.6 (Continued)

Demographic Characteristics	Numbers (N = 420)	Percentage
Education Level		
Elementary education	103	24
Lower secondary education	65	15.5
Upper secondary education/ Vocational certificate	65	15.5
Diploma/ High vocational certificate	41	9.8
Bachelor's degree	136	32.4
Higher than a Bachelor's degree	10	2.4
Total	**420**	**100.0**
Occupation		
Executives/officials of central governmental agencies	6	1.4
Executives/officials of regional governmental agencies	15	3.6
Executives/staff of public organizations/ academic institutes	30	7.1
Executives/officials of local administrative organizations	23	5.5
Executives/ employees of private companies/ entrepreneurs	77	18.3
Community leaders	32	7.6
Students	33	7.9
Fishermen/ agriculturists	116	27.6
Hirelings	88	21.0
Average Monthly Income		
Less than 10,000 baht	173	41.2
10,001 – 20,000 baht	153	36.4

Table 4.6 (Continued)

Demographic Characteristics	Numbers (N = 420)	Percentage
20,001 – 30,000 baht	62	14.8
30,001 – 40,000 baht	21	5.0
40,001 – 50,000 baht	3	0.7
More than 50,000 baht	8	1.9
Total	**420**	**100.0**

Table 4.6 illustrates the samples' demographic characteristics, classified by sex, age, education level, occupation, and average monthly income, as follows:

Sex: The number of male and female samples is almost equivalent or females have four samples more than males, or 52.9% and 47.1% respectively.

Age: The average age of the samples is 42.38 years old or approximately 42 years old (SD = 12.819). The youngest sample is aged 15, and the oldest 76 years old.

Education level: Most samples earn a bachelor's degree (32.4%), followed by elementary education (32.4%), lower secondary education and upper secondary education and vocational certificate equally (15.5%), diploma or high vocational certificate (9.8 %), and higher than a bachelor's degree (2.4%) respectively.

Occupation: The samples are fishermen and agriculturists the most (27.6%), followed by hirelings (21.0%), executives and employees of private companies and entrepreneurs (18.3%), students (7.9%) community leaders (7.6%), executives and staff of state enterprises, public organizations, and academic institutes (7.1%), executives and officials of local administrative organizations (5.5%), executives and officials of regional governmental agencies (3.6%), and executives and officials of central governmental agencies (1.4%) respectively.

Average monthly income: Most samples earn lower than 10,000 baht (41.2%), followed by 10,001 – 20,000 baht (36.4%), 20,001 – 30,000 baht (14.8%), 30,001 – 40,000 baht (5.0%), 40,001 – 50,000 baht (0.7%), and more than 50,000 baht (1.9%) respectively.

4.2.2.2 Factors Affecting the Success in Coastal Erosion Management in the Upper Gulf of Thailand

The presentation of descriptive analysis of the factors affecting the success in coastal erosion management in the upper Gulf of Thailand (Table 4.7 to 4.9) consists of the lowest and highest value, mean, and standard deviation. The interpretation of each factor (total 4 factors) and indicators (12 indicators) uses the following criteria for interpretation:

Mean 4.20 – 5.00 = highest
3.40 – 4.19 = high
2.60 – 3.39 = moderate
1.80 – 2.59 = low
1.00 -1.79 = lowest

4.2.2.3 Factors of Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management

Factors of Policies, plans, strategies, and laws related to coastal erosion management consist of two indicators:

1) The implementation of policies, plans, and strategies related to coastal erosion management, i.e., policy statement of the Cabinet to the National Assembly (General Prayut Chan-o-cha), National Maritime Security Plan 2015-2021, National Strategy 2018-2037), Strategies for Managing, Preventing and Solving the Problem of Coastal Erosion, the Master Plan of Marine and Coastal Resources Management 2017-2036, and the Twelfth National Economic and Social Development Plan.

2) The enforcement of laws related to coastal erosion management, i.e., National Environmental Promotion and Maintenance Act, B.E. 2535 (1992), and Marine and Coastal Resources Management Promotion Act, B.E. 2558 (2015).

From the analysis, the samples' opinions towards both indicators are at a moderate level; however, the mean of the level of opinions towards the first indicator (X= 3.39, SD = 0.930) is higher than that of the second one (X = 3.27, SD = 1.009).

Table 4.7 Illustrates Mean, Standard Deviation, Frequencies, and Percentage of the Factors of Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management

(n = 420)

Factors of Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management	Lowest	Highest	Mean (X)	S.D.	Meaning
The implementation of policies, plans, and strategies related to coastal erosion management			**3.39**	**0.930**	**Moderate**
1. Budgets and personnel are sufficient for regulating and monitoring an operation as stipulated in policies, plans, and strategies related to coastal erosion management	1	5	3.40	0.917	High
2. Policies, plans, and strategies related to coastal erosion management are updated, sufficient, and inclusive to catch up with coastal changes and respond to the needs of coastal development.	1	5	3.40	0.933	High
3. People and stakeholders have knowledge, understanding, and participate in projects and activities as specified in the policies, plans, and strategies related to coastal erosion management equally and fairly.	1	5	3.36	0.943	Moderate
The enforcement of laws related to coastal erosion management			**3.27**	**1.009**	**Moderate**
1. Budgets and personnel are sufficient for regulating and monitoring an operation following the laws related to coastal erosion management	1	5	3.36	0.983	Moderate

Table 4.7 (Continued)

(n = 420)

Factors of Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management	Lowest	Highest	Mean (X)	S.D.	Meaning
2. Laws related to coastal erosion management are updated, sufficient, and inclusive to catch up with coastal changes and respond to the needs of coastal development.	1	5	3.32	0.951	Moderate
3. People and stakeholders have knowledge and understanding of the laws related to coastal erosion management	1	5	3.12	1.147	Moderate
4. People and stakeholders are protected by laws related to coastal erosion management equally and fairly	1	5	3.18	1.047	Moderate
5. The laws related to coastal erosion management contain punishment severe enough for protecting any wrongdoing that can yield a negative impact on the coastal area.	1	5	3.36	0.917	Moderate

The indicators of the implementation of policies, plans, and strategies related to coastal erosion management, illustrated in Table 4.7, illustrate that the samples agreed with the issue "budgets and personnel are sufficient for regulating and monitoring projects and activities as stipulated in the policies, plans, and strategies related to coastal erosion management" (X= 3.40, SD = 0.917) and "Policies, plans, and strategies related to coastal erosion management are updated, sufficient, and inclusive to catch up with coastal changes and respond to needs of coastal development," (X = 3.40, SD = 0.933) the most. For the statement, "People and stakeholders have knowledge, understanding, and participate in projects and activities as specified in the policies, plans, and strategies related to coastal erosion management equally and fairly,"

the samples expressed their agreement with this issue at a moderate level (X = 3.36, SD = 0.943).

Besides, the samples agreed with the overall indicator of the enforcement of laws related to coastal erosion management, illustrated in Table 4.7), at a moderate level. They agreed equally with the statement, “Budgets and personnel are sufficient for regulating and monitoring an operation following the laws related to coastal erosion management,” and “The laws related to coastal erosion management contain punishment severe enough for protecting any wrongdoing that can yield negative impact to the coastal area” the most. (X = 3.36, SD = .0983 and 0.917 respectively. The next agreed statement is “Laws related to coastal erosion management are updated, sufficient, and inclusive to catch up with coastal changes and respond to needs of coastal development, (X = 3.32, SD = 0.951), “People and stakeholders are protected by laws related to coastal erosion management equally and fairly,” (X = 3.18, SD = 1.047), and “People and stakeholders have knowledge and understanding about the laws related to coastal erosion management.” (X = 3.12, SD = 1.147) respectively.

4.2.2.4 Factors of Integrated Coastal Zone Management in the Upper Gulf of Thailand

Factors of Integrated Coastal Zone Management in the Upper Gulf of Thailand consist of three indicators: (1) Integration of areas and resources, (2) integration of concerned agencies, and (3) integration of techniques and knowledge. The samples perceived all three indicators at a high level. The samples perceived “integration of techniques and knowledge,” the most (X = 3.47, SD = 0.975), followed by “integration of areas and resources,” (X = 3.44, SD = 0.926), and “integration of concerned agencies,” (X = 3.40, SD = 0.966) respectively.

Table 4.8 Illustrates the Mean, Standard Deviation, Frequencies, and Percentage of the Factors of Integrated Coastal Zone Management in the Upper Gulf of Thailand

(n = 420)

Factors of Integrated Coastal Zone Management in the Upper Gulf of Thailand	Lowest	Highest	Mean	S.D.	Meaning
Integration of areas and resources			**3.44**	**0.926**	**High**
1. There have been solutions towards coastal erosion impact that are congruent with the areas, both land and maritime.	1	5	3.47	0.933	High
2. Resources are allocated and utilized inclusively and equally, i.e., habitats of living organisms, fishery, tourism, port, and industrial development, etc.	1	5	3.41	0.919	High
Integration of concerned agencies			**3.40**	**0.966**	**High**
1. There has been a collaboration between the government, private, civic sectors, or stakeholders related to coastal erosion management.	1	5	3.44	0.947	High
2. There have been coordination mechanisms among concerned agencies, both of the same and across a line of authority, for coastal erosion management.	1	5	3.36	0.985	Moderate
Integration of techniques and knowledge			**3.47**	**0.975**	**High**
1. There has been a collaboration in scientific, technological, economic, and social knowledge.	1	5	3.36	1.019	Moderate
2. Tools for coastal erosion management are utilized, i.e., economic tools, risk assessment, database system management, Environmental Impact	1	5	3.28	1.001	Moderate

Table 4.8 (Continued)

(n = 420)

Factors of Integrated Coastal Zone Management in the Upper Gulf of Thailand	Lowest	Highest	Mean	S.D.	Meaning
Assessment (EIA), and monitoring and evaluation system, etc.					
3. Local wisdom is used for coastal erosion management, i.e., bamboo revetment, Taoism rubber- piling (constructing a fence made of wood covered by tires for slowing waves), mangrove afforestation, etc.	1	5	3.76	0.904	High

Table 4.8 illustrates that the samples perceived the indicator of "integration of areas and resources" at a high level. They agreed with the statement, "There have been solutions towards coastal erosion impact that are congruent with the areas, both land and maritime," the most (X = 3.47, SD = 0.933), followed by the statement, "Resources are allocated and utilized inclusively and equally, i.e., habitats of living organisms, fishery, tourism, port, and industrial development, etc." (X = 3.41, SD = 0.919)

For the indicator of the integration of concerned agencies, it was found that the samples agreed with the statement, "There has been a collaboration between the government, private, civic sectors, or stakeholders related to coastal erosion management," at a high level (X = 3.44, SD = 0.947), while they agreed with the statement, " There have been coordination mechanisms among concerned agencies, both of the same and across a line of authority, for coastal erosion management," at a moderate level. X = 3.36, SD = 0.985).

Regarding the indicator of the integration of techniques and knowledge, the samples agreed with the statement, "Local wisdom is used for coastal erosion management, i.e., bamboo revetment, Taoism rubber-piling (constructing a fence made of wood covered by tires for slowing waves), mangrove afforestation, etc." the most, at a high level. (X = 3.79, SD = 0.904). For the other two statements under this indicator, the samples expressed their agreement at a moderate level by agreeing with the statement, "There has

been a collaboration in scientific, technological, economic, and social knowledge," with the mean of 3.39 (X = 3.39, SD = 1.1019), and the statement, "Tools for coastal erosion management are utilized, i.e., economic tools, risk assessment, database system management, Environmental Impact Assessment (EIA), and monitoring and evaluation system, etc." (X = 3.28, SD = 1.001) respectively.

4.2.2.5 Factors of People's Participation in Coastal Erosion Management in the Areas

Factors of People's Participation in Coastal Erosion Management in the Areas comprising four indicators: (1) Participation at the initial stage in the projects and activities related to coastal erosion in the area, (2) participation at the planning stage in the projects and activities related to coastal erosion in the area, (3) participation at the operational or implementation stage in the projects and activities related to coastal erosion in the area, and (4) participation at the evaluation stage in the projects and activities related to coastal erosion in the area. It was found that the samples perceived and expressed their agreement with all four indicators of people's participation at a moderate level. The samples perceived people's participation at the evaluation stage the most (X = 3.39, SD = 1.062), followed by at the initial stage (X = 3.36, SD = 0.879), at the operational or implementation stage (X = 3.28, SD = 1.010, and at the planning stage (X = 3.21, SD = 0.914) respectively.

Table 4.9 Illustrates Mean, Standard Deviation, Frequencies, and Percentage of the Factors of People's Participation in Coastal Erosion Management in the Area

(n = 420)

Factors of People's Participation in Coastal Erosion Management in the Areas	Lowest	Highest	Mean	S.D.	Meaning
Participation in the initial stage			**3.36**	**0.879**	**Moderate**
1. Participating in acknowledging information about projects or activities related to coastal erosion management in the area	1	5	3.54	0.907	High
2. Participating in providing information about projects or activities related to coastal erosion management in the area	1	5	3.25	0.841	Moderate
3. Participating in opinion-hearings about projects or activities related to coastal erosion management in the area	1	5	3.25	0.882	Moderate
4. Participating in determining the goals and objectives of projects or activities related to coastal erosion management in the area.	1	5	3.40	0.886	High
Participation in the planning stage			**3.21**	**0.914**	**Moderate**
1 Participating in determining solutions approaches for coastal erosion management projects and activities	1	5	3.27	0.905	Moderate
2. Participating in planning projects or activities related to coastal erosion management in the area.	1	5	3.17	0.922	Moderate
3. Participating in expressing ideas officially for planning projects or activities related to coastal erosion management in the area.	1	5	3.20	0.914	Moderate

Table 4.9 (Continued)

(n = 420)

Factors of People's Participation in Coastal Erosion Management in the Areas	Lowest	Highest	Mean	S.D.	Meaning
Participation in the operational/implementation stage			**3.28**	**1.010**	**Moderate**
1. Attending projects or activities related to coastal erosion management in the area as planned.	1	5	3.23	0.903	Moderate
2. Participating in budget supports related to coastal erosion management in the area as planned.	1	5	3.12	1.057	Moderate
3. Participating in personnel supports related to coastal erosion management in the area as planned.	1	5	3.18	1.026	Moderate
4. People in the area collaborate in coastal erosion management solutions in the area.	1	5	3.48	1.035	High
5. Coordinating for collaboration and joint operations between concerned agencies and people for coastal erosion management in the area.	1	5	3.37	1.027	Moderate
Participation in the evaluation stage			**3.39**	**1.062**	**Moderate**
1. People in the area participate in an evaluation to acknowledge the accomplishment and level of success of the projects or activities related to coastal erosion management in the area.	1	5	3.33	1.038	Moderate
2. People in the area participate in suggesting approaches for improving plans, projects, or activities related to coastal erosion management in the area.	1	5	3.44	1.087	High

The indicators of participation in the initial stage, illustrated in Table 4-9, indicate that the samples participated in “acknowledging information about projects or activities related to coastal erosion management in the area,” the most, at a high level (X = 3.54, SD = 0.907), followed by “participating in determining goals and objectives of projects or activities related to coastal erosion management in the area” at a high level (X = 3.40, SD = 0.886), “participating in providing information about projects or activities” at a moderate level (X = 3.25, SD = 0.841), and “participating in opinion-hearings about projects or activities related to coastal erosion management in the area” at a moderate level (X = 3.25, SD = 0.882) respectively.

The samples had participation in the planning stage in every statement at a moderate level by participating in “determining solutions approaches for projects or activities related to coastal erosion management in the area” the most, (X = 3.27, SD = 0.905), followed by “participating in expressing ideas officially for planning projects or activities related to coastal erosion management in the area” (X = 3.20, SD = 0.914), and “participating in planning projects and activities related to coastal erosion management in the area” (X = 3.17, SD = 0.922) respectively.

For participation in the operational or implementation stage, it was found that “people in the area collaborate in coastal erosion management solutions” the most, at a high level (X = 3.48, SD = 1.035). For the other four statements, the samples participated at a moderate level, ranging from the highest to the lowest mean as follows: "Coordinating for collaboration and joint operations between concerned agencies and people for coastal erosion management in the area“ (X = 3.37, SD = 1.027), “attending projects or activities related to coastal erosion management in the area as planned” (X = 3.23, SD = 0.903), “participating in personnel supports related to coastal erosion management in the area as planned” (X = 3.18, SD = 1.026), and “participating in budget supports related to coastal erosion management in the area as planned” (X = 3.12, SD = 1.057) respectively.

Regarding participation in the evaluation stage, “people in the area participate in suggesting approaches for improving plans, projects, or activities related to coastal erosion management in the area” at a high level (X = 3.44, SD = 1.087) and “people in the area participate in an evaluation for acknowledging accomplishment and

the level of success of projects or activities related to coastal erosion management in the area" at a moderate level (X = 3.33, SD = 1.038).

4.2.2.6 Factors of Success in Coastal Erosion Management in the Upper Gulf of Thailand

Factors of Success in Coastal Erosion Management in the Upper Gulf of Thailand consists of three indicators: (1) Sustainable development, (2) implementation, and (3) evaluation. Two indicators that the samples perceived to enable coastal erosion management in the upper Gulf of Thailand at a high level are "sustainable development" (X = 3.55, SD = 0.989) and "evaluation" (X = 3.41, SD = 1.001). For the indicator "implementation," was perceived at a moderate level (X = 3.34, SD = 1.041).

Table 4.10 Illustrates Mean, Standard Deviation, Frequencies, and Percentage of the Factors of Success in Coastal Erosion Management in the Upper Gulf of Thailand

(n = 420)

Factors of Success in Coastal Erosion Management in the Upper Gulf of Thailand	Lowest	Highest	Mean	S.D.	Meaning
Sustainable development			**3.55**	**0.989**	**High**
1. Structural fertility of the environment in the area, solved by the use of hard engineering structures, i.e., seawall, breakwater, groins, etc.	1	5	3.47	0.990	High
2. Structural fertility of the environment in the area, solved by the use of soft structures or natural solutions, i.e., beach nourishment, sand nourishment, mangrove afforestation, setback zone, etc.	1	5	3.54	1.013	High
3. Coastal erosion management in the upper Gulf of Thailand brings about economic, accommodation, recreational benefits, i.e., to be	1	5	3.63	0.964	High

Table 4.10 (Continued)

(n = 420)

Factors of Success in Coastal Erosion Management in the Upper Gulf of Thailand	Lowest	Highest	Mean	S.D.	Meaning
recreational tourist attractions, transportation, ports, and fishery occupational places.					
4. An awareness of social equality, i.e., everybody in the coastal area can access and gain benefits from coastal erosion management in the upper Gulf of Thailand inclusively.	1	5	3.56	0.988	High
Implementation			**3.34**	**1.041**	**Moderate**
1. The governmental agencies provide proper and sufficient budgets for coastal erosion management in the upper Gulf of Thailand.	1	5	3.33	1.058	Moderate
2. The governmental agencies provide proper and sufficient personnel for coastal erosion management in the upper Gulf of Thailand.	1	5	3.29	1.046	Moderate
3. The governmental agencies empower practitioners to respond to coastal erosion management plans.	1	5	3.32	1.045	Moderate
4. Stakeholders and people in the area participate in complying with coastal erosion management plans.	1	5	3.40	1.016	Moderate
Evaluation			**3.41**	**1.001**	**High**
1. Outcome from coastal erosion plans is congruent with the determined objectives.	1	5	3.44	0.971	High

Table 4.10 (Continued)

(n = 420)

Factors of Success in Coastal Erosion Management in the Upper Gulf of Thailand	Lowest	Highest	Mean	S.D.	Meaning
2. Prioritization of problems and improved operational approaches need to be accordant with social and environmental conditions.	1	5	3.41	0.982	High
3. Improving the operational or action plans in priority by a problem's significance, which leads to concrete solutions	1	5	3.38	1.051	Moderate

The success indicator of sustainable development in Table 4-10 illustrates that all statements under this indicator were perceived to bring about the success of coastal erosion management in the upper Gulf of Thailand at a high level. The success of "coastal erosion management in the upper Gulf of Thailand brings about economic, accommodation, recreational benefits, i.e., to be recreational tourist attractions, transportation, ports, and fishery occupational places" was perceived the most (X = 3.63, SD = 0.964), followed by, "an awareness of social equality, i.e., everybody in the coastal area can access and gain benefits from coastal erosion management in the upper Gulf of Thailand inclusively" (X = 3.56, SD = 0.988), "structural fertility of the environment in the area, solved by the use of soft structures or natural solutions, i.e., beach nourishment, sand nourishment, mangrove afforestation, setback zone, etc." (X = 3.47, SD = 0.990), and "structural fertility of the environment in the area, solved by the use of hard engineering structure, i.e., seawall, breakwater, groins, etc." (X = 3.54, SD = 1.013) respectively.

However, for the success indicator of implementation, there was only one statement under this indicator perceived by the samples as successful at a high level, namely, "stakeholders and people in the area participate in complying with coastal erosion management plans" (X = 3.40, SD = 1.016). For the other three statements, the samples perceived their success at a moderate level as follows: "The governmental

agencies provide proper and sufficient budgets for coastal erosion management in the upper Gulf of Thailand," (X = 3.33, SD = 1.058), "the governmental agencies empower practitioners to respond to coastal erosion management plans," (X = 3.32 SD = 1.045), and "the governmental agencies provide proper and sufficient personnel for coastal erosion management in the upper Gulf of Thailand." (X = 3.29, SD = 1.046) respectively.

For the evaluation indicator, two issues under this indicator were perceived as successful at a high level, namely, "outcome from coastal erosion plans is congruent with the determined objectives" (X = 3.44, SD = 0.971) and "prioritization of problems and improved operational approaches need to be accordant with social and environmental condition." (X = 3.41, SD = 0.982). For the statement, "improving the operational or action plans in priority by a problem's significance, which leads to concrete solutions," the samples perceived it as successful at a moderate level (X = 3.38, SD = 1.051).

4.2.3 Inferential Analysis

This part presents the findings from inferential analysis on the correlations of variables, results of testing construct validity by confirmatory factor analysis of the measurement model, and the findings of the structural equation model, with details as follows:

4.2.3.1 Preliminary statistical agreement of model analysis techniques

This stage is the validation of the variables' characteristics or properties to be used for analyzing the measurement model and structural equation model under two preliminary agreements of statistics proposed by Nongluck Wiratchai (1999, p. 1) Normal distribution of data, and 2) relationships between observed variables.

Normal Distribution of Data

To test the model's statistical estimation effectiveness, the model was constructed to have 4 groups of latent variables and 12 observed variables. Four groups of latent variables comprise

1) The latent variable of policies, plans, strategies, and laws (B) consisting of two observed variables: the implementation of policies, plans, and strategies (B21) and the laws enforcement (B 22)

2) The latent variable of integrated coastal zone management (C), consisting of three observed variables: integration of areas and resources (C31), integration of concerned agencies (C32), and integration of techniques and knowledge (C33).

3) The latent variable of people's participation (D), consisting of four observed variables: participation in the initial stage (D41), participation in the planning stage (D42), participation in the operational or implementation stage (D43), and participation in the evaluation stage (D44).

4) The latent variable of management success factors (E), consisting of three observed variables: sustainable development (E51), implementation (E52), and evaluation (E53).

The details of the normal distribution are as follows:

Table 4.11 Illustrates the Highest-Lowest Value, Mean, Standard Deviation, Skewness-Kurtosis, and Meanings of Observed Variables

	Min	Max	Mean	S.D.	SK	KU	Meaning
B			**3.33**	**0.776**			**Moderate**
B21	1.33	5.00	3.38	0.790	-.012	-.705	Moderate
B22	1.40	5.00	3.27	0.850	-.243	-.823	Moderate
C			**3.44**	**0.782**			**High**
C31	1.00	5.00	3.44	0.842	-.265	-.135	High
C32	1.00	5.00	3.40	0.881	-.226	-.480	High
C33	1.00	5.00	3.47	0.824	-.330	-.268	High
D			**3.31**	**0.764**			**Moderate**
D41	1.00	5.00	3.36	0.702	-.491	.381	Moderate
D42	1.00	5.00	3.21	0.818	-.628	.353	Moderate
D43	1.00	5.00	3.28	0.872	-.640	.000	Moderate
D44	1.00	5.00	3.38	0.998	-.392	-.515	Moderate
E			**3.43**	**0.839**			**High**
E51	1.00	5.00	3.55	0.847	-.445	-.119	High
E52	1.00	5.00	3.34	0.931	-.318	-.752	Moderate
E53	1.00	5.00	3.41	0.905	-.289	-.613	High

From Table 4.11, the analysis shows that both latent and observed variables have a mean at between moderate to a high level, namely the range of means is 3.21-3.55, while the dispersion of the standard deviations of all latent and observed variables is close to the normal distribution, is close to 1 (0.702-0.998). The latent variable of the factors of integrated coastal zone management (C) has the highest mean (X = 3.44, SD = 0.782), followed by management success factors (E) (X = 3.43, SD = 0.839), factors of policies, plans, and strategies (B) (X = 3.33, SD = 0.776), and factors of people's participation (D) (X = 3.31, SD = 0.764) respectively.

The range of means of the factors of integrated coastal zone management (C) is 3.47 - 3.40, and standard deviation 0.824 - 0.881. "integration of techniques and knowledge" (C33) has the highest mean, followed by "integration of areas and resources" (C31), and "integration of concerned agencies" (C32) respectively. The range of means of the factors of management success (E) is 3.34 - 3.55, and the standard deviation of 0.847 - 0.931. "Sustainable development" (E51) has the highest mean, followed by "evaluation" (E53), and "implementation" (E52) respectively.

The range of means of the factors of policies, plans, strategies, and laws (B) is 3.27 - 3.38, and the standard deviation of 0.790 - 0.850. "Implementation of policies, plans, and strategies" (B21) has the highest mean, followed by "laws enforcement" (B22).

The range of means of the factors of people's participation (D) is 3.21 - 3.38, and the standard deviation of 0.702 - 0.998. "participation in the evaluation stage" (D44) has the highest mean, followed by "participation in the initial stage" (D41), "participation in the operational or implementation stage" (D43), and "participation in the planning stage" (D42) respectively.

The skewness and kurtosis of all 12 observed variables display a normal distribution and good enough to be applied for analysis by maximum likelihood (ML), or value from -3.0 to +3.0.

From the test of normal distribution by skewness (SK) of all 12 observed variables, the value is -0.640 - -0.012, which indicates that all variables are enumerated in the Left skew appearance (value < 0), or all 12 observed variables have higher scores than the mean.

The kurtosis (KU) of all 12 observed variables falls from -0.823 to 0.381. There are only three observed variables that have higher KU than the normal curve (value > 0), namely "participation in the initial stage" (D41), "participation in the planning stage" (D42), and "participation in the operational or implementation stage" (D43). Thus, it can be considered that observed variables display low dispersion of data, while the curve of the rest of 9 observed variables is relatively flat from the normal curve (value < 0); thus, such observed variables have high dispersion of data.

Relationships between Variables

To test the relationships between variables by Pearson Product Moment Correlation Coefficient, the following criteria were used to interpret the meanings of the value: (Hinkle,1998)

Value of Relationship Level	Interpretation of Relationship Level
.91 -1.00	Very high
.71 -.90	High
.51 -.70	Moderate
.31 -.50	Low
.00 -0.30	Very low or almost no relationship

Table 4.12 Illustrates Pearson's Correlation Coefficient of the Factors

	Policies, Plans, Strategies, and Laws	**ICZM**	**People's Participation**	**Management Success**
Policies, Plans, Strategies, and Laws	1			
ICZM	.854**	1		
People's Participation	.806**	.800**	1	
Management Success	.829**	.861**	.851**	1

Note: ** p < .01

From the analysis of relationships between latent variables of the factors affecting success in coastal erosion management in the upper Gulf of Thailand by Pearson Product Moment Correlation Coefficient, four latent variables are found to have a positive relationship at a high level in every pair at the .01 statistical significance level. The pair that is found to have the highest correlation coefficient (r) is “integrated coastal zone management (ICZM)” and “management success” (r=.861), while the pair with the lowest correlation coefficient is “ICZM” and “people’s participation” (r=.800).

Table 4.13 Illustrates Pearson's Correlation Coefficient of the Indicators

	B21	B22	C31	C32	C33	D41	D42	D43	D44	E51	E52	E53
B21	1	**B**										
B22	.790**	1										
C31	.733**	.711**	1		**C**							
C32	.745**	.766**	.771**	1								
C33	.742**	.771**	.756**	.795**	1							
D41	.631**	.673**	.625**	.673**	.667**	1			**D**			
D42	.618**	.682**	.577**	.641**	.635**	.700**	1					
D43	.677**	.745**	.650**	.709**	.719**	.711**	.809**	1				
D44	.692**	.747**	.655**	.699**	.711**	.672**	.735**	.841**	1			
E51	.710**	.738**	.740**	.776**	.769**	.697**	.634**	.739**	.767**	1		**E**
E52	.741**	.813**	.717**	.785**	.769**	.661**	.690**	.780**	.782**	.839**	1	
E53	.690**	.715**	.699**	.736**	.705**	.619**	.684**	.743**	.775**	.785**	.834**	1

Note: ** $p < .01$; B = Factors of policies, plans, strategies, and laws C = Factors of integrated coastal zone management (ICZM) D = Factors of people's participation E = Factors of management success B21 = Implementation of policies, plans, and strategies B22 = Laws enforcement C31 = Integration of areas and resources C32 = Integration of concerned agencies C33 = Integration of techniques and knowledge D41 = Participation in the initial stage D42 = Participation in the planning stage D43 = Participation in the operational or implementation stage D44 = Participation in the evaluation stage E51 = Sustainable development E52 = Implementation E53 = Evaluation

From the analysis of 66 relationship pairs of observed variables, it indicates that all 66 pairs go in the same direction or have a positive relationship of the same latent variables and extraneous latent variables at the .01 statistical significance level. As illustrated in Table 4-13, the relationship level of indicator pairs is divided into two groups: 42 pairs of the group with a high relationship level (relationship size = 0.710 - 0.839), and 24 pairs of the group with a moderate relationship level (relationship size = 0.577 - 0.699). The pair with the lowest relationship size is "integration of areas and resources" and "participation in the planning stage," while that of the highest size is "integration of areas and resources" and "evaluation," and "integration of concerned agencies" and "participation in the evaluation stage."

4.2.3.2 Confirmatory Factors of the Measurement Model

The research assumption is "the measurement model is congruent with empirical data." The statistical assumptions are as follows:

H_0: The measurement model is **congruent** with empirical data.

H_1: The measurement model is **incongruent** with empirical data

From the initial validation of the quality of research tools in construct validity by Confirmatory Factor Analysis (CFA) of the measurement model with the empirical data, the parameter value of every line was found to be statistically significant at the .05 level ($p < .05$). However, several harmony indices or indexes did not meet the determined criteria. Thus, the measurement model was modified by adjusting the proportion of variance (the adjustment of a line connecting variables). However, only observed variables of the same latent variables were modified or adjusted. To avoid theoretical errors from a literature review, one parameter/ or variance of the measurement model was adjusted, and the adjustment finished when most harmony indexes met the determined criteria. For this study, the variance of the measurement model was adjusted three times until most harmony indexes passed the criteria, namely $\frac{x^2}{df} = 2.67 < 5.00$, CFI = 0.99 > 0.90, GFI = 0.95 > 0.90, AGFI = 0.92 >0.90, RMSEA = 0.063 < 0.08, and SRMR = 0.018 < 0.05 (illustrated in Table 4.14 and Figure 4.1)

Table 4.14 Illustrates Harmony Indexes of the Measurement Model Classified by Each Criterion, Before and After the Adjustment of the Model

	x^2	df	p-value	x^2/df	CFI	GFI	AGFI	RMSEA	SRMR
Determined criteria			>0.05	<5.00	>0.90	>0.90	>0.90	<0.08	<0.05
Before Adj.	164.4	48	0.000	3.43	0.98	0.94	0.90	0.076	0.024
After Adj.	120.04	45	0.000	2.67	0.99	0.95	0.92	0.063	0.018

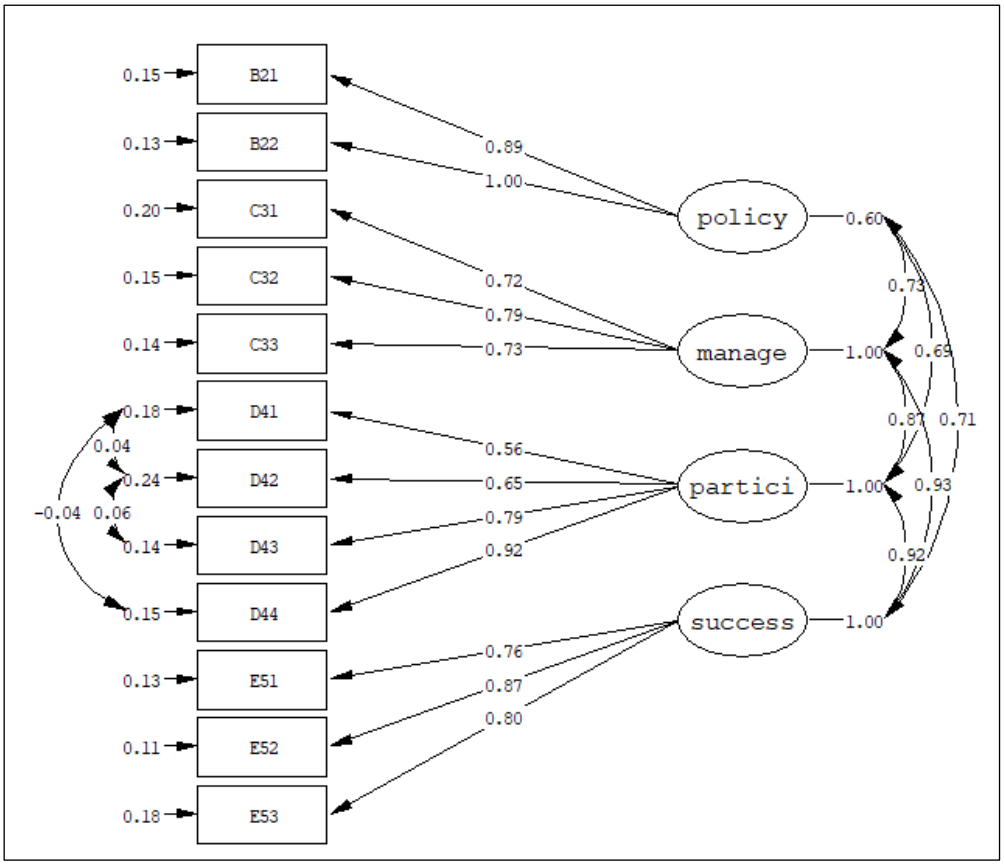

Figure 4.1 Illustrates the Findings of Confirmatory Factor Analysis of the Structural Equation Model of the Factors Affecting Success in Coastal Erosion Management in the Upper Gulf of Thailand by LISREL 9.30 Program

Note: Policy = Factors of policies, plans, strategies, and laws

Manage = Factors of integrated coastal zone management (ICZM)

Partici = Factors of people's participation

Success = Factors of management success

In brief, every harmony index of the measurement model is acceptable after the adjustment at the .01 statistical significance level. After three-time adjustments, the measurement model was tested, and it was found that the model is **congruent** with empirical data. It means that the measurement model after its variances were adjusted, was congruent with empirical data.

4.2.3.3 The Validation of the Quality of Variables in the Measurement Model

From the analysis of the congruence or harmony of confirmatory factors of the measurement model, the following is acquired: 1) Standardized factor loadings, 2) square multiple correlation (R^2) of observed variables for testing their validity and reliability of latent variables (construct reliability and average variance extracted or AVE), with details as follows:

The Validity of Observed Variables

From testing the validity of observed variables with factor loadings with adjusted standards, it was found that all observed variables are good components of latent variables. Specifically, they have the following: 1) Standardized factor loadings $= 0.559 - 0.889$, higher than the determined criterion $(> .50)$, 2) all go in the positive direction, and 3) almost every observed variable has a statistical significance level ($p < .01$), except the laws enforcement, which displays no statistically significant value as the researcher determined fixed value. The details are illustrated in the below Table.

Table 4.15 Illustrates Standardized Factor Loadings, Square Multiple Correlations, and A T-Test of the Observed Variables

Latent/ Observed Variables	Standardized Factor Loading	R^2	t-test
Factors of Policies, Plans, Strategies, and Laws			
- Implementation of related policies, plans, and strategies	0.889	0.76	26.358**
- Laws enforcement	1.000	0.83	N/A
Factors of Integrated Coastal Zone Management			
- Integration of areas and resources	0.715	0.72	21.452**
- Integration of concerned agencies	0.793	0.81	23.540**
- Integration of techniques and knowledge	0.732	0.79	23.090**
Factors of People's Participation			
- Participation in the initiation stage	0.559	0.63	19.104**
- Participation in the planning stage	0.654	0.64	19.348**
- Participation in the implementation stage	0.790	0.82	23.789**
- Participation in the evaluation stage	0.921	0.85	24.435**
Factors of Management Success			
- Sustainable development	0.765	0.82	23.793**
- Implementation	0.869	0.87	25.199**
- Evaluation	0.798	0.78	22.848**

** t-test > 2.58 means p > .01, and R^2 means square multiple correlations value

Note: N/A means fixed parameter of 0.99

From the above Table, it indicates that standardized factor loadings are between 0.889 – 1.000 of the factors of policies, plans, strategies, and laws. The factor loading of the "implementation of policies, plans, and strategies" equals 1.000; thus, it can explain the variance of the factors of policies, plans, strategies, and laws by 76%. The "laws enforcement" has standardized factor loading of 0.889, which can explain the factors of policies, plans, strategies, and laws by 83% respectively.

The standardized factor loadings of integrated coastal zone management are between 0.715 – 0.793. The standardized factor loading of "integration of areas and resources" equals 0.715; thus, it can explain the variance of the factors of integrated coastal zone management by 72%. The standardized factor loading of "integration of techniques and knowledge" equals 0.732; thus, it can explain the variance of the factors of integrated coastal zone management by 79%. The standardized factor loading of "integration of concerned agencies" equals 0.793; thus, it can explain the variance of the factors of integrated coastal zone management by 81% respectively.

The standardized factor loadings of people's participation are between 0.559 - 0.921. The standardized factor loading of "participation in the initiation stage" equals 0.559; thus, it can explain the variance of the factors of people's participation by 63%. The standardized factor loading of "participation in the planning stage" equals 0.654; thus, it can explain the variance of the factors of people's participation by 64%. The standardized factor loading of "participation in the implementation stage" equals 0.790; thus, it can explain the variance of the factors of people's participation by 82%. The standardized factor loading of "participation in the evaluation stage" equals 0.921; thus, it can explain the variance of the factors of people's participation by 85%.

The standardized factor loadings of management success are between 0.765 - 0.869. The standardized factor loading of "sustainable development" equals 0.765; thus, it can explain the variance of the factors of management success by 82%. The standardized factor loading of "evaluation" equals 0.798; thus, it can explain the variance of the factors of management success by 78%. The standardized factor loading of "implementation" equals 0.869; thus, it can explain the variance of the factors of management success by 87% respectively.

Construct Reliability of Latent Variables

From the test of construct reliability of each latent variable in the measurement model, the construct reliability values of all four latent variables: factors of policies, plans, strategies, and laws; factors of integrated coastal zone management; factors of people's participation; and factors of management success, are between 0.883-0.932, which accord with the determined criterion (CR > 0.70), and the average variance extracted (AVE) is between 0.736-0.821, which also complies with the

determined criterion (AVE > 0.50). Therefore, every latent variable in the measurement model accords with the criteria, as shown in the following table.

Table 4.16 Illustrates the Construct Reliability and Average Variance Extracted of Latent Variables

Latent variables	CR	AVE
Policies, Plans, Strategies, and Laws	0.883	0.791
Integrated Coastal Zone Management	0.911	0.774
People's Participation	0.917	0.736
Management Success	0.932	0.821

Considering the construct reliability (CR) and average variance extracted (AVE) of each latent variable in the above table, it is found that "management success" is the variable that has the highest CR (CR = 0.932), while "policies, plans, strategies, and laws" has the lowest CR (CR = 0.883). Similarly, "management success" has the highest AVE (AVE = 0.821), and "people's participation" has the lowest AVE (AVE = 0.736). The details of each latent variable are as follows:

Factors of policies, plans, strategies, and laws have a common variance at 0.883, and the AVE of observed variables equals 0.791. It means that the factors of policies, plans, strategies, and laws can explain the variance of observed variables in their group by 79%.

Factors of integrated coastal zone management have a common variance at 0.911. It means that the factors of integrated coastal zone management can explain the variance of observed variables in their group by 77%.

Factors of people's participation have a common variance at 0.917. It means that the factors of people's participation can explain the variance of observed variables in their group by 74%.

Factors of management success have a common variance at 0.932. It means that the factors of management success can explain the variance of observed variables in their group by 82%.

4.2.3.4 Structural Model/ Structural Equation Model

Harmony indexes, construct validity of observed variables, and construct reliability of latent variables of the measurement model were tested with empirical data, based on the research preliminary or initial agreement and assumptions, namely "a structural equation model is congruent with empirical data," and with the following statistical assumptions:

H_0: Structural model is **congruent** with empirical data

H_1: Structural model is **incongruent** with empirical data

From testing the developed structural equation model of factors affecting success in coastal erosion management in the upper Gulf of Thailand with empirical data, it is found that the parameter of each line is statistically significant. ($p < .05$) However, several harmony indices or indexes did not meet the determined criteria. Thus, the measurement model was modified by adjusting the proportion of variance (the adjustment of a line connecting variables). However, only observed variables of the same latent variables were modified or adjusted. To avoid theoretical errors from a literature review, one parameter/ or variance of the measurement model was adjusted, and the adjustment finished when most harmony indexes met the determined criteria. For this study, the variance of the measurement model was adjusted three times until most harmony indexes passed the criteria, namely $\frac{x^2}{df}$ = 2.65 < 5.00, CFI = 0.99 > 0.90, GFI = 0.95 > 0.90, AGFI = 0.82 >0.90, RMSEA = 0.063 < 0.08 และ SRMR = 0.019 < 0.05 (as illustrated in Table 4.17 and Figure 4.2)

Table 4.17 Illustrates Harmony Indexes of the Structural Equation Model, Classified by Each Criterion, Before and After the Modification of the Model

	x^2	df	p-value	x^2/df	CFI	GFI	AGFI	RMSEA	SRMR
Determined criteria			>0.05	<5.00	>0.90	>0.90	>0.90	<0.08	<0.05
Before	166.08	49	0.000	3.39	0.98	0.94	0.90	0.075	0.025
After	122.06	46	0.000	2.65	0.99	0.95	0.82	0.063	0.019

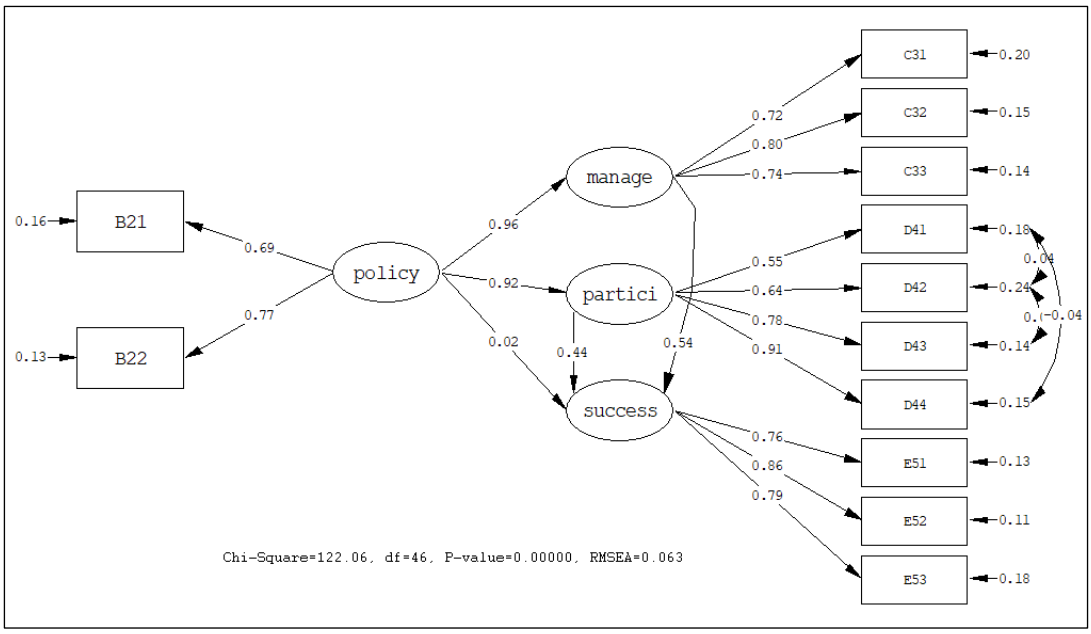

Figure 4.2 Illustrates the Findings of Confirmatory Factor Analysis of the Structural Equation Model of the Factors Affecting Success in Coastal Erosion Management in the Upper Gulf of Thailand by LISREL 9.30 Program

Note: Policy = Factors of policies, plans, strategies, and laws
Manage = Factors of integrated coastal zone management (ICZM)
Partici = Factors of people's participation
Success = Factors of management success

In brief, almost every harmony index of the measurement model is acceptable after the adjustment at the .01 statistical significance level, except the pair of latent variables, "policy" and "success", whose factor loading is almost 0, and is not statistically significant (t-test = 0.095, which is lower than the required t-test significance level, or higher than 1.96). Still, after three-time adjustments, the measurement model was tested, and it was found that the model is **congruent** with empirical data. It means that the measurement model after its variances were adjusted, was congruent with empirical data.

4.2.3.5 The Validation of the Quality of Variables in the Measurement Model

After modifying or adjusting the model until it reached all required indexes, enabling the constructed structural equation model to be congruent with empirical data, the next step was to validate the quality of both observed and latent variables in the structural model by 1) testing the construct reliability between observed and latent variables in its group, and 2) testing standardized factor loadings of observed and latent variables in their groups. The details of the findings from the tests are illustrated in the below Table.

Table 4.18 Illustrates Reliability and Standardized Factor Loadings, Classified by Each Observed Variable

Observed Variables	Reliability	Factor Loading
Factors of Policies, Plans, Strategies, and Laws		
- Implementation of policies, plans, and strategies	0.75	0.69
- Laws enforcement	0.82	0.77
Factors of Integrated Coastal Zone Management		
- Integration of areas and resources	0.72	0.72
- Integration of concerned agencies	0.81	0.80
- Integration of techniques and knowledge	0.79	0.74
Factors of People's Participation		
- Participation in the initiation stage	0.63	0.55
- Participation in the planning stage	0.64	0.64
- Participation in the implementation stage	0.82	0.78
- Participation in the evaluation stage	0.85	0.91
Factors of Management Success		
- Sustainable development	0.82	0.76
- Implementation	0.87	0.86
- Evaluation	0.78	0.79

From the test of the reliability of each observed variable, 12 variables, as shown in the above table, it indicates that the reliability of observed variables is 0.63 - 0.87; thus, observed variables in the model have reliability at a moderate to a high level (Hinkle, 1998). The observed variable with the highest reliability is "implementation," while "participation in the initiation stage" has the lowest reliability. Still, the reliability of all 12 observed variables accords with standardized factor loading in the form of standard scores (> 0.30) as their standardized factor loadings fall between 0.55-0.86. Likewise, the observed variable with the highest standardized factor loading is "implementation," while "participation in the initiation stage" has the lowest standardized factor loading. For other variables, factor loadings are as follows: (classified by latent variables)

1) Latent variable: factors of policies, plans, strategies, and laws

Observed variable: the reliability of "the implementation of policies, plans, and strategies" = 0.75, and factor loading = 0.69

Observed variable: the reliability of "laws enforcement" = 0.82, and factor loading = 0.77.

2) Latent variable: Factors of integrated coastal zone management

Observed variable: The reliability of "integration of areas and resources" = 0.72, and factor loading = 0.72

Observed variable: The reliability of "integration of concerned agencies" = 0.81, and factor loading = 0.80.

Observed variable: The reliability of "integration of techniques and knowledge" = 0.79 and factor loading = 0.74.

3) Latent variable: Factors of people's participation

Observed variable: the reliability of "participation in the initiation stage" = 0.63, and factor loading = 0.55

Observed variable: the reliability of "participation in the planning stage" = 0.64, and factor loading = 0.64.

Observed variable: the reliability of "participation in the implementation stage" = 0.82, and factor loading = 0.78.

Observed variable: the reliability of "participation in the evaluation stage" = 0.85, and factor loading = 0.91

4) Latent variable: factors of management success

Observed variable: the reliability of "sustainable development" = 0.82, and factor loading = 0.76

Observed variable: the reliability of "implementation" = 0.87, and factor loading = 86

Observed variable: the reliability of "evaluation" = 0.78, and factor loading = 0.79

4.2.3.6 Relationships between Latent Variables

From the test of correlation matrix between four latent variables (Table 4-19), it is found that all latent variables have a relationship size of between 0.84-0.96. It means that the relationships of latent variables in the structural model are at a high level (Hinkle, 1998) as every pair has the same direction of relationship or a positive relationship. The pair of latent variables with the highest correlation coefficient is a pair of "factors of policies, plans, strategies, and laws" and "integrated coastal zone management," and "integrated coastal zone management" and "people's participation" is the pair of latent variables with the lowest correlation coefficient.

Table 4.19 Illustrates a Correlation Matrix Between Latent Variables

Latent Variables	Policies, Plans, Strategies, and Laws	Integrated Coastal Zone Management	People's Participation	Management Success
Policies, plans, strategies, and laws	**1.00**			
Integrated coastal zone management	0.96	**1.00**		
People's participation	0.90	0.87	**1.00**	
Management success	0.93	0.93	0.92	**1.00**

4.2.3.7 Path Coefficients of the Structural Equation Model

Path relationships or path coefficients of the modified structural equation model of the factors affecting success in coastal erosion management in the upper Gulf of Thailand are used to analyze a direct effect (DE) and an indirect effect (IE), including the total effect (TE) to verify the effect size of the predicting variables to the success of coastal erosion management in the upper Gulf of Thailand, as illustrated in the below Table.

Table 4.20 Illustrates the Path Coefficients of the Structural Equation Model of the Factors Affecting Success in Coastal Erosion Management in the Upper Gulf of Thailand

Outcome \ Cause		Policies, Plans, Strategies, and Laws			Integrated Coastal Zone Management			People's Participation		
		DE	**IE**	**TE**	**DE**	**IE**	**TE**	**DE**	**IE**	**TE**
Integrated Coastal Zone Management	**b**	0.956		0.956						
R^2 = 0.919	**SE**	(0.042)		(0.042)						
Errorvar.= 0.080	**t-value**	22.983**		22.983**						
People's Participation	**b**	0.919		0.919						
R^2 = 0.814	**SE**	(0.049)		(0.049)						
Errorvar.= 0.192	**t-value**	18.911**		18.911**						
Management Success	**b**	0.017	0.918	0.935	0.539		0.539	0.438		0.438
R^2 = 0.918	**SE**	(0.183)	(0.178)	(0.039)	(0.152)		(0.152)	(0.072)		(0.072)
Errorvar.= 0.083	**t-value**	0.095	5.148	24.137**	3.544**		3.544**	6.066**		6.066**

Note: ** $p < .01$

DE = direct effort IE = indirect effort TE = total effort

From Table 4-20, for path coefficients of latent variables in the structural equation model, the following is presented: 1) direction and sizes of three types of effect of each latent variable, and 2) coefficient of determination and structural equation model, with details as follows:

1) Direction and effect size of each latent variable

(1) Direct Effect

Policies, plans, strategies, and laws have a positive direct effect on the integrated coastal zone management at the .01 statistical significance level, with the effect value = 0.956

Policies, plans, strategies, and laws have a positive direct effect on people's participation in the .01 statistical significance level, with the effect value = 0.919.

Policies, plans, strategies, and laws have a positive direct effect on management success with no statistical significance at the .05 level, with the effect value = 0.017.

Integrated coastal zone management has a positive direct effect on the management success at the .01 statistical significance level, with the effect value = 0.539

People's participation has a positive direct effect on management success at the .01 statistical significance level, with the effect value = 0.438.

(2) Indirect Effect

Policies, plans, strategies, and laws have a positive indirect effect on the management success through integrated coastal zone management and people's participation in the .01 statistical significance level, with the effect value = 0.918.

(3) Total Effect

Policies, plans, strategies, and laws have a positive total effect on the integrated coastal zone management at the .01 statistical significance level, with the effect value = 0.956

Policies, plans, strategies, and laws have a positive total effect on the people's participation in the .01 statistical significance level, with the effect value = 0.919.

Policies, plans, strategies, and laws have a positive total effect on the management success at the .01 statistical significance level, with the effect value = 0.935

Integrated coastal zone management has a positive total effect on the management success at the .01 statistical significance level, with the effect value = 0.539

People's participation has a positive direct effect on the management success at the .01 statistical significance level, with the effect value = 0.438

2) Coefficient of Determination and Structural Equation

For the coefficient of determination (R^2) of the structural equation model of the factors affecting success in coastal erosion management in the upper Gulf of Thailand, it is found that the coefficient of determination = 0.918, which indicates that the latent variables can explain the variance of the success in coastal erosion management in the upper Gulf of Thailand by 91.80%, with details as follows:

(1) Factors of policies, plans, strategies, and laws can explain the variance of the factors of integrated coastal zone management by 91.9% Policies, plans, strategies, and laws have a positive effect on integrated coastal zone management at the .01 statistical significance level. In other words, it can explain that if other independent variables are controlled to be fixed, 1 unit of standard deviation in the factor of policies, plans, strategies, and laws can affect an increase of 0.919 unit of standard deviation on the factor of integrated coastal zone management.

(2) Factors of policies, plans, strategies, and laws can explain the variance of people's participation by 81.40%. Policies, plans, strategies, and laws have a positive effect on people's participation in the .01 statistical significance level. In other words, it can explain that if other independent variables are controlled to be fixed, 1 unit of standard deviation in the factor of policies, plans, strategies, and laws can affect an increase of 0.919 unit of standard deviation on the factor of people's participation.

(3) Factors of policies, plans, strategies, and laws; factors of integrated coastal zone management; and factors of people's participation can explain the variance of the management success by 91.80%. Factors of integrated coastal zone management and people's participation have a positive effect on management success at the .01 statistical significance level. In other words, it can explain that if other independent variables are controlled to be fixed, 1 unit of standard deviation in the factor of policies, plans, strategies, and laws; factors of integrated coastal zone management; and factors of people's participation can affect an increase of 0.918 unit of standard deviation on management success. The structural equation can be written as follows:

Management Success = 0.0823+ 0.539* integrated coastal zone management + 0.438* people's participation + 0.0174* policies, plans, strategies, and laws

4.2.3.8 The Verification of Research Hypothesis

From the analysis, the constructed structural equation model is found to be congruent with empirical data and theoretical concepts developed from chapter 2, in combination with the modification of three relationship lines. As a result, the model can get harmony indexes in accordance with the determined ($\frac{x^2}{df}$ = 2.65 < 5.00, CFI = 0.99 > 0.90, GFI = 0.95 > 0.90, AGFI = 0.82 >0.90, RMSEA = 0.063 < 0.08 และ SRMR = 0.019 < 0.05), with parameter value at the .01 statistical significance level in almost every line, except of the pair of latent variables between "policies, plans, strategies, and laws" and "management success" whose factor loading is almost 0 with no statistical significance (t-Test = 0.095, which is lower than the significance level of t-test, which requires to be higher than 1.96). The value of RMSEA is at a reasonable and consistent level. Therefore, this study accepts the research hypothesis that "the constructed structural equation model is congruent with empirical data."

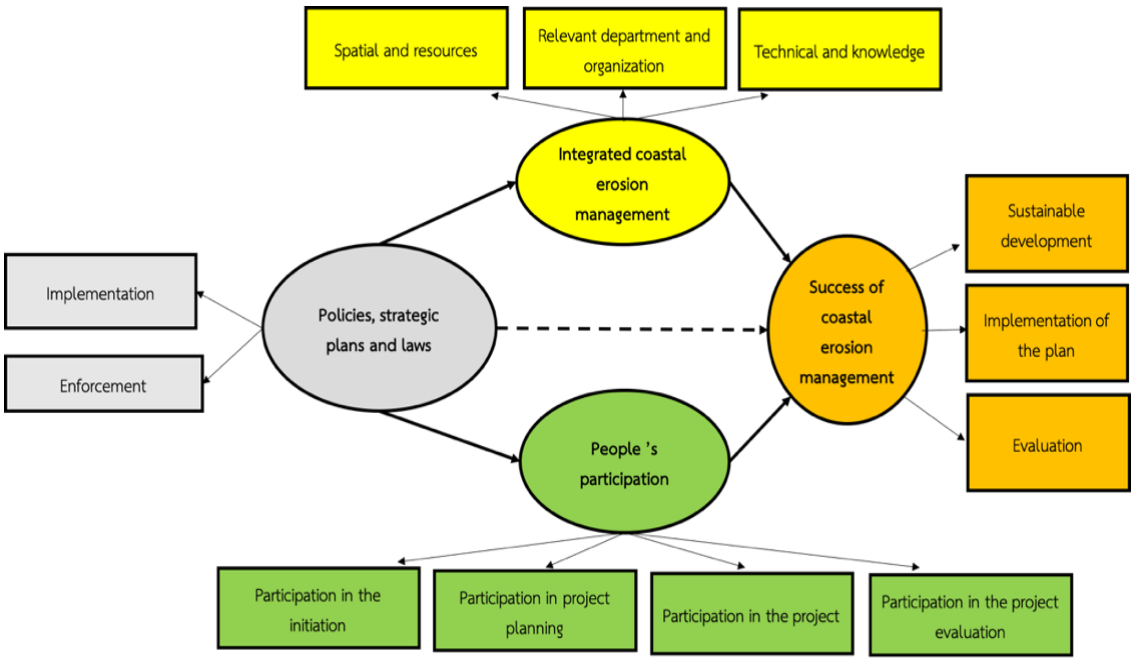

Figure 4.3 The Structural Equation Model of Factors Affecting Success for Coastal Erosion Management in the Upper Gulf of Thailand (Modified from the last step of the Study)

CHAPTER 5

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

The research entitled, “The Development of the Structural Equation Model of Factors Affecting Success for Coastal Erosion Management at the Upper Gulf of Thailand,” is a mixed-method study, aimed to 1) study policies, strategies, plans, and laws related to coastal erosion, including the integrated coastal zone management of coastal erosion and people's participation in managing coastal erosion that affects success in coastal erosion in the upper Gulf of Thailand, 2) study the direct and indirect effects of the variables in the structural equation model that affect the success of coastal erosion management in the upper Gulf of Thailand, and 3) develop and test the congruence of the measurement model and the structural equation model of the factors affecting the success of coastal erosion management in the upper Gulf of Thailand with empirical data.

In chapter 5, the researcher divided the chapter into three parts: Part 1: The summary of qualitative and quantitative research findings, Part 2: discussion, and Part 3: recommendations, with details as follows:

5.1 Summary of Qualitative and Quantitative Research Findings

5.1.1 Summary of Qualitative Research Findings

1) Policies, Plans, Strategies, and Laws

It was found from the study that the insufficiency of budgets and personnel caused discontinuity of activities. Policies, plans, strategies, and laws were found to be obsolete and not inclusive due to area differences and were not initiated by people's needs. Besides, there was no direct agency or office responsible for implementing them. Disunion appeared between the government agencies and civic society, especially owing to the diversity of stakeholders, a lack of knowledge and understanding about coastal erosion management, different opinions, and discontinuing

operations. Moreover, the existing laws and regulations did not exert enough severe punishment. Discrimination in laws enforcement was witnessed. Authorized officials ignored the violation; on the other hand, facilitated only some people or some groups.

2) Integrated Coastal Zone Management

Concerned agencies did not integrate their missions; thus, the management could not proceed. It was found that the same methods were used in different areas. Besides, the allocation and utilization of resources were not equal and proper without a distinctive proportion. The government sector had different ideas from people. Accordingly, people did not collaborate so much. On the other hand, there was no coordination among governmental agencies at the operational level in the affected areas. Despite some collaboration in scientific, technological, economic, and social knowledge, the issues were still too difficult for general people in the areas to understand. The tools used by the concerned agencies for coastal erosion management were divided into two kinds: tools in the form of plans, policies, budgets, related laws, public hearing, etc., and tools from local wisdom for coastal protection, i.e., wood-revetment for slowing waves, coastal afforestation, mangrove afforestation, bamboo-revetment, soil-ridge breakage, stone-throw protection, and inland water management, etc.

3) People’s or Public Participation

Most local people had not yet been able to access a participatory process at the initiation stage like the mainstay of the community. The participation was expected to let people talk and listen to their trouble. People's participation in the planning stage was not so different from that at the initiation stage. Communities still played no role in planning. In some areas, concerned agencies did not return information nor give any feedback to the community after people's participation. At the operational or implementation stage, people could participate only when their assistance was needed. Still, some areas allowed people to participate, not only occasionally. For participation in evaluation, the government agencies had to teach how to evaluate any project or activity first, while some created a pattern for evaluation together, and allowed people to monitor a project or an activity increasingly.

4) Success in Coastal Erosion Management in the Upper Gulf of Thailand

It was found that the use of "hard engineering structure" was not compatible with the inner Gulf of Thailand because of its muddy beach and complex area. Moreover, despite its temporary protection, it caused more erosion if such hard structures obstructed waterways or sea tides. Oppositely, "natural or soft structure" was found to be more suitable for the coastal area of the inner Gulf of Thailand. Besides, soft structures have been accepted widely internationally and were proved to yield positive results in the long-term without damaging the environment. If coastal erosion could be managed properly, it would help to maintain and rehabilitate ecosystems, create coastal fertility, bring about food sources, produce green food, protect the loss of land for occupations, protect future coastal erosion, build up residence, and promote tourism. However, it requires holistic management and innovations from local wisdom as a result of accessibility and benefits from coastal erosion management. Regarding the limitations of the personnel support for communities in the past, it was found that the government agencies had no sufficient personnel. Those available were short of related knowledge; although, they worked collaboratively with local people in some areas. Accordingly, the state should empower needed practitioners to be equipped with capacity and knowledge that responds to management plans by preparing them to have an understanding of the areas and skills in problem-solving, besides personnel training. Furthermore, the previous budget allocation was insufficient; thus, the governmental agencies operated the plans by themselves, which might not be able to solve problems sustainably. Consequently, problems should be solved through a participatory process since the initial stage of collaborative planning by all concerned stakeholders so that they could comply with policies as planned.

5.1.2 Research Findings of the Quantitative Research

Part 1: Summary of descriptive analysis

1) Demographic Characteristics

The number of male and female samples is almost equivalent, namely male samples (52.90%) and female samples (47.10%), their average age is 42.38 years old (SD = 12.819). Mostly, samples earn a bachelor's degree the most (32.40%), work

as fishermen or agriculturists (27.60%), and have an average monthly income of fewer than 10,000 baht (41.20%).

2) Factors affecting success in coastal erosion management in the upper Gulf of Thailand

(1) Factors of policies, plans, strategies, and laws related to coastal erosion management

(1.1) The samples agreed with factors of policies, plans, and strategies related to coastal erosion management (comprising three observed variables) at a moderate level (X = 3.39, SD = 0.930)

(1.2) The samples agreed with factors of the enforcement of related to coastal erosion management (comprising five observed variables) at a moderate level (X = 3.27, SD = 1.009)

(2) Factors of integrated coastal zone management in the upper Gulf of Thailand

(2.1) The samples perceived the integration of areas and resources operated for coastal erosion management in the upper Gulf of Thailand (comprising two observed variables) at a high level (X = 3.44, SD = 0.926).

(2.2) The samples perceived the integration of concerned agencies operating coastal erosion management in the upper Gulf of Thailand (comprising two observed variables) at a high level (X = 3.40, SD = 0.966).

(2.3) The samples perceived the integration of techniques and knowledge operated for coastal erosion management in the upper Gulf of Thailand (comprising three observed variables) at a high level (X = 3.47, SD = 0.975).

(3) Factors of people's participation in the upper Gulf of Thailand in the area

(3.1) The samples perceived people's participation in the initiation stage of coastal erosion management in the area (comprising two observed variables) at a moderate level (X = 3.36, SD = 0.879).

(3.2) The samples perceived people's participation in the planning stage of coastal erosion management in the area (comprising three observed variables) at a moderate level (X = 3.21, SD = 0.914).

(3.3) The samples perceived people's participation in the operational or implementation stage of coastal erosion management in the area (comprising five observed variables) at a moderate level (X = 3.28, SD = 1.010).

(3.4) The samples perceived people's participation in the evaluation stage of coastal erosion management in the area (comprising two observed variables) at a moderate level (X = 3.39, SD = 1.062).

3) Factors of success in coastal erosion management in the upper Gulf of Thailand

(1) The samples perceived "sustainable development" enabled coastal erosion management in the upper Gulf of Thailand to be successful (comprising four observed variables) at a high level (X = 3.55, SD = 0.989).

(2) The samples perceived "implementation" enabled coastal erosion management in the upper Gulf of Thailand to be successful (comprising four observed variables) at a high level (X = 3.34, SD = 1.041).

(3) The samples perceived "evaluation" enabled coastal erosion management in the upper Gulf of Thailand to be successful (comprising four observed variables) at a high level (X = 3.41, SD = 1.001).

Part 2: Summary of Inferential Analysis

1) Preliminary statistical assumptions of model analysis techniques

(1) Distribution characteristics of observed variables

All observed variables must be based on a normal distribution as accepted by the analysis of the measurement model or structural equation model. The skewness (SK) and kurtosis (KU) of all observed variables must not exceed ±3, as specified in the criteria of Diamantopoulos and Siguaw (2000) (SK = 0.640 - -0.012 and KU = -0.823 - 0.381)

(2) Relationships between variables

Pearson's correlation coefficients of all four latent variables, totally six relationship pairs, are found to have a positive relationship (.800 - .854) at the .01 statistical significance level ($p < .01$), at a high level. Pearson's correlation coefficients of all twelve observed variables, a total of 66 relationship pairs, have a high level of relationships. However, from 66 pairs, 42 pairs have a high relationship level, while 24

pairs have a moderate relationship level. Thus, they were used to test the congruence of the constructed model with the empirical data.

2) Confirmatory factors of the measurement model

From the confirmatory factor analysis, it was found that after adjusting the model and relationships between variables three times, a measurement model was found to be congruent with the empirical data, complying with the acceptance criteria. (x^2/df = 0.99, GFI = 0.95, AGFI = 0.92, RMSEA = 0.063, and SRMR = 0.018)

3) Testing of the measurement model

(1) Construct reliability of observed variables

Standardized factor loadings of all 12 observed variables are between 0.559 - 0.889 in a positive direction at the .01 statistical significance level ($p < .01$). Standardized factor loadings of integrated coastal zone management are 0.715 - 0.793, people's participation 0.559 -0.921, and management 0.765 - 0.869 (> 0.50). The average variance extracted (AVE) is between 0.736-0.82.

(2) Construct reliability of latent variables

All four latent variables have higher construct reliability (CR) and average variance extracted (AVE) than the determined criteria and every latent variable is in good criteria. The overall construct reliability falls between 0.883 - 0.932, which complies with the criteria, (CR > 0.70). Factors of management success have the highest CR, followed by factors of people's participation, integrated coastal zone management, and policies, plans, strategies, and laws respectively. The average variance extracted is 0.736 - 0.821 (AVE > 0.50). Factors of management success have the highest AVE, followed by factors of policies, plans, strategies, and laws; integrated coastal zone management; and factors of people's participation respectively.

4) Structural equation model

From the analysis, it is found that after adjusting relationship lines between variables for three times until the model is congruent with empirical as determined by Harmony indexes; thus, the constructed structural equation model, which is congruent with empirical data (x^2/df = 2.65, CFI = 0.99, GFI = 0.95, AGFI = 0.82, RMSEA = 0.063, and SRMR = 0.019) is acquired. RMSEA is at the reasonable and congruent level. Therefore, the study accepts the research assumption that "the constructed structural equation model is congruent with empirical data."

5) Path coefficients of the structural equation model

(1) The validation of the quality of observed and latent variables

From the analysis of construct reliability and standardized factor loading of each observed variable, it is found that all observed variables have construct reliability at a moderate to a high level (0.63 - 0.87) and standardized factor loadings by an acceptable criterion, or between 0.55 - 0.86, which meet the determined criterion (> 0.30). The observed variable with the highest CR is “implementation,” while “participation in the evaluation stage” has the lowest standardized factor loading.

For the relationships between all four latent variables, it is found that the level of the relationship of each pair is very close (r = 0.84- 0.96) and every pair has a linear positive relationship. The pair that has the highest relationship level is a pair of "policies, plans, strategies, and laws" and "integrated coastal zone management." (r = 0.96), while the pair with the lowest relationship level is between "integrated coastal zone management" and "people's participation" (r = 0.87).

(2) Direction and Effect Size

From the analysis, it is found that factors of policies, plans, strategies, and laws have a positive direct effect on factors of integrated coastal zone management and factors of people’s participation (effect size = 0.956 and 0.919) at the .01 statistical significance level ($p < .01$), but have no statistically significant relationship ($p < .01$) with factors of management success. Factors of integrated coastal zone management and factors of people’s participation have a positive direct effect on factors of management success at the .01 statistical significance level ($p < .01$) (effect size = 0.539 and 0.438). Regarding indirect effect, it is found that management success has an indirect effect from policies, plans, strategies, and laws (indirectly via integrated coastal zone management and people’s participation) at the .01 statistical significance level. ($p < .01$) with the effect size of 0.918. For Total effect, it is found that management success gets positive total effect from policies, plans, strategies, and laws at the .01 statistically significance level ($p < 0.01$) (effect size = 0.935), from integrated coastal zone management at the .01 statistically significance level ($p < .01$) with the effect size of 0.539, and from people’s participation in the .01 statistically significance level ($p < .01$), with the effect size of 0.438.

(3) Coefficients of Determination and Structural Equation

From the analysis, it is found that the coefficient of determination of management success can explain by the covariation of three factors: factors of policies, plans, strategies, and laws; factors of integrated coastal zone management; and factors of people's participation by 90% by the use of the following structural equation:

Management Success = 0.0823 + 0.539* integrated coastal zone management + 0.438* people's participation + 0.0174* policies, plans, strategies, and laws

5.2 Discussion

From the research findings, the researcher divided the discussion into two parts to answer all three research objectives as follows: Part 1 is the discussion on the factors of policies, plans, strategies, and laws related to coastal erosion management, integrated coastal zone management, people's participation in coastal erosion management in the upper Gulf of Thailand, and success in coastal erosion management in the upper Gulf of Thailand, which will answer the research objective no. 1. Part 2 is the discussion on the direct and indirect effect, the measurement model, and structural equation model of the factors of policies, plans, strategies, and laws related to coastal erosion management, integrated coastal zone management, people's participation in coastal erosion management in the upper Gulf of Thailand, and success in coastal erosion management in the upper Gulf of Thailand against the empirical data to answer the research objective no. 2 and 3, with details as follows:

5.2.1 Factors and Success in Coastal Erosion Management in the Upper Gulf of Thailand

From the synthesis of the findings of qualitative research in the first stage, it was found that factors of policies, plans, strategies, and laws related to coastal erosion management composed of two factors: 1) The implementation of policies, plans, and strategies related to coastal erosion management, and 2) the enforcement of laws related to coastal erosion management. For the integrated coastal zone management, it

consisted of three domains: 1) integration of areas and resources, 2) integration of concerned agencies, and integration of techniques and knowledge. Concerning people's participation, it comprised 1) participation in the initiation stage, 2) participation in the planning stage, 3) participation in the operational or implementation stage, and 4) participation in the evaluation stage. Lastly, the success in coastal erosion management in the upper Gulf of Thailand consisted of three main principles: sustainable development, implementation, and evaluation.

5.2.2 Direct and Indirect Effect vs. Measurement Model and Structural Equation Model

From analyzing the congruence of the constructed structural equation model after adjustment, it is found that all harmony indexes are at the acceptable level. In other words, "the model is congruent with empirical data at a good level," which complies with general criteria of structural equation model statistical principles. However, it is remarkable that one pair of latent variables, namely "the factors of policies, plans, strategies, and laws" and "management success" have factor loadings of almost 0 without any statistical significance (t-test = 0.095, which is lower than the required level (> 1.96). On the other hand, from the path coefficient analysis, it is found that success in coastal erosion management in the upper Gulf of Thailand gets direct effect from the factors of integrated coastal zone management the most. Such findings were accordant with the study of Thanchanok Thitipongvivat (2009), which found that organizational management had a positive relationship with the success in employees' performance at the .01 statistical significance level.

In short, the success of coastal erosion management in the upper Gulf of Thailand comprised sustainable development, implementation, and evaluation. The finding accords with the study of Taweesak Theppitak (2014) and Kanlayanee Pornpinetphong et al. (2015), which found that the success could be predicted from two latent variables: factors of integrated coastal zone management and people's participation, which did not accord with the determined theoretical framework. However, both factors accord with the study of Distanont et al. (2018) on the triangular cooperation for effective water resources management of the community in Thailand and found that key factors leading to sustainable water management that general

organizations could apply properly, depending on their environment, were stakeholders' participation.

It thus indicates that systematic management that responds to current situations enables those who want to make use of it to consider to adopt the issues for analyzing, planning, and finding solutions to solve a variety of problems more easily and systematically, such as approaches for coastal erosion protection and solutions (i.e. the adjustment of coastal equilibrium by nature, coastal erosion protections, coastal erosion solutions, and coastal rehabilitation), or a process of developing coastal erosion protection and solution activities. Besides, stakeholders' participation can be considered as a part of knowledge and awareness creation for people involved in coastal erosion problems in the areas to acknowledge guidelines for coastal erosion management, both directly and indirectly. Besides, participation is also a part of an opportunity to search for possibility in exerting an organizational power within the scope of authority to promote organizations in value chains to adopt good practical guidelines for coastal erosion management (Distanont et al., 2018)

Nevertheless, although direct relationships between factors of policies, plans, strategies, and laws and success in coastal erosion management in the upper Gulf of Thailand was not found in this study at a statistical significance level, they were found to have an indirect effect on the management success through integrated coastal zone management and people's participation at the .05 statistical significance level (effect size = 0.918). It thus indicates that if policies, plans, strategies, and laws are clear and managed systematically, people can understand them easily. Especially, if policies, plans, strategies, and laws are publicized, while concerned people are trained to acquire knowledge and allowed to participate in activities related to them, these concerned people will understand and realize the importance of coastal erosion management in the upper Gulf of Thailand increasingly. All of these factors then will become a big drive or agent towards increased success in coastal erosion management in the upper Gulf of Thailand.

Factors of policies, plans, strategies, and laws that will lead to success in coastal erosion management in the upper Gulf of Thailand are the implementation of them and enforcement of laws related to coastal erosion management. On the other hand, as integrated coastal zone management and people's participation, which found to have a

direct effect on the success of coastal erosion management in the upper Gulf of Thailand, it is essential to stimulate and mobilize details or sub-factors of these two factors towards success without focusing on either of the two factors, but on both factors. Moreover, the success of integrated coastal zone management requires three kinds of integration: integration of areas and resources, concerned agencies, and techniques and knowledge. Such a notion corresponds to the study of Wantanee Sawangarom (2010), Sasinee Sorin (2010), Saowalak Matusornskoon (2010), Suthilak Rawiwan (2011), Wimontaya Yeatapud (2013), Thanate Prapaipong (2016), Apirak Songrak, et al. (2017), and Navamin Rattanapongtara, et al. (2018). Besides, what enables people's participation to be accomplished is their participation in all stages: initiation, planning, operational or implementation, and evaluation. The finding accords with the study of Rujaporn Chaiyapong. (2012), Sukhothai Thammathirat Open University (2013), Phurita Kerdprang and Theerawat Chanthuek (2016), Siriporn Phannaphatkun (2013), Jaruwan Ketsomboon (2014), Siriwan Siriboon (2014), Somjai Juanan (2015), and Kampon Lertkiatdamrong (2017).

5.3 Recommendations

5.3.1 Recommendations for Policies and Application

1) The government should encourage people to participate in coastal erosion management and shift its role from an operator to be a facilitator via some mechanisms, which may be applied in various forms, such as community-based management, cooperative management with some motivational measures, or having the private sectors to take parts in management. The enhancement of people's participation can help people to be well aware of the importance of the coast and stimulate their conscience for conserving and utilizing it worthily and sustainably.

2) It is very essential to provide some mechanism to equip concerned agents with knowledge, understanding, and awareness of necessities for integrated coastal zone management. Besides, some mechanisms should be used for negotiation towards mutual benefits, which will lead to acceptance and collaboration in management, especially integrated coastal zone management, genuinely.

3) The government sector must empower local personnel to be able to implement management plans, including regulating and monitoring coastal areas effectively.

4) Coastal erosion management needs to be conducted continually and adapted to be suitable for situations in each area and period. Thus, the structural equation model affecting success in coastal erosion management in the upper Gulf of Thailand developed from this study, is not a prototype for all areas. Those who are responsible for coastal erosion management, i.e., policymakers, planners, practitioners, etc. have to adjust patterns that are compatible with problems, political conditions, or management style of each area. Nevertheless, coastal erosion management may take time to see its accomplishment explicitly.

5) To ensure effective coastal erosion management, policy, or strategy planning requires an integration of both top-down and bottom-up patterns. Specifically, all stakeholders: central, regional, community, and other sectors have to collaborate in the planning or policy-making stage.

5.3.2 Recommendations for Future Studies

1) The study should be extended to other coastal areas to see if components of the factors of this study, namely factors of policies, plans, strategies, and laws related to coastal erosion management, integrated coastal zone management, people's participation, and success in coastal erosion management, could be applied similarly or differently.

2) Additional research should be conducted for preparing action plans of coastal erosion management, i.e., studies on the design of plans, projects, or activities for empowering personnel's and people's potential in integrated coastal zone management towards the success in coastal erosion management in Thailand.

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APPENDIX

QUESTIONNAIRE

"The Development of the Structural Equation Model of Factors Affecting Success for Coastal Erosion Management at the Upper Gulf of Thailand."

The area of data collection

☐ **Bangkok** ☐ **Samut Prakan** ☐ **Samutsakhon**

☐ **Samut Songkhram** ☐ **Chachoengsao**

This questionnaire is a research tool for collecting data of the study, aimed to study factors of policies, plans, strategies, and laws related to coastal erosion management, including the impact of the factors; factors of integrated coastal zone management in the upper Gulf of Thailand, and factors of people's participation in coastal erosion management in the upper Gulf of Thailand, affecting the success of coastal erosion management in the upper Gulf of Thailand. The information gained from the research will be used for academic purposes of this study only. Thus, you, as a person involved, are kindly requested to answer the questionnaire. Thank you very much for your kind cooperation herewith.

.....

The questionnaire comprises five parts as follows:

Part 1 Questions on general information about demographic characteristics of a respondent

Part 2 Questions on factors of policies, plans, strategies, and laws related to coastal erosion management

Part 3 Questions on integrated coastal zone management in the upper Gulf of Thailand

Part 4 Questions on people's participation in coastal erosion management in the upper Gulf of Thailand

Part 5 Questions on the success of coastal erosion management in the upper Gulf of Thailand

Instruction: Please kindly collaborate by answering the following questions and mark ✓ in the ❑ that you choose.

<u>Part 1</u> Demographic Characteristics

1.1 Sex

❑ 1) male ❑ 2) female ❑ 3) others (Please specify) .....

1.2 Age .....years old

1.3 Education level

❑ 1) primary ❑ 2) lower secondary

❑ 3) upper secondary/vocational ❑ 4) diploma/high vocational.

❑ 5) a bachelor's degree ❑ 6) higher than a bachelor's degree

1.4 Occupation

❑ 1) Executives/officials of central governmental agencies

❑ 2) Executives/officials of regional governmental agencies

❑ 3) Executives/staff of public organizations and state enterprises / academic institutes

❑ 4) Executives/officials of local administrative organizations

❑ 5) Executives/ employees of private companies/ entrepreneurs

❑ 6) Community leaders

❑ 7) Students

❑ 8) Fishermen/ agriculturists

❑ 9) Hireling

❑ 10) Others (Please specify .....)

1.5 Average monthly income

❑ 1) less than 10,000 baht ❑ 2) 10,001 – 20,000 baht

❑ 3) 20,001 – 30,000 baht ❑ 4) 30,001 – 40,000 baht

❑ 5) 40,001 – 50,000 baht ❑ 6) more than 50,000 baht

<u>Part 2</u> Questions on factors of policies, plans, strategies, and laws related to coastal erosion management.

Factors of Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management	**Level of Agreement**				
	Highest	**High**	**Moderate**	**Low**	**Lowest**
2.1 **The implementation of policies, plans, and strategies related to coastal erosion management** - Policy statement of the Cabinet to the National Assembly (General Prayut Chan-o-cha) - National Maritime Security Plan 2015-2021 - National Strategy 2018-2037) - Strategies for Managing, Preventing, and Solving the Problem of Coastal Erosion - Master Plan of Marine and Coastal Resources Management 2017-2036 - The Twelfth National Economic and Social Development Plan.					
2.1.1 <u>Budgets and personnel</u> are sufficient for regulating and monitoring an operation following the laws related to coastal erosion management					
2.1.2 Laws <u>related to coastal erosion management are updated, sufficient, and inclusive</u> to catch up with coastal changes and respond to the needs of coastal development.					
2.1.3 Laws <u>related to coastal erosion management are updated, sufficient, and inclusive</u> to catch up with coastal changes and respond to the needs of coastal development.					

Factors of Policies, Plans, Strategies, and Laws Related to Coastal Erosion Management	Level of Agreement				
	Highest	**High**	**Moderate**	**Low**	**Lowest**
2.2 The enforcement of laws related to coastal erosion management - The Navigation in the Thai Waters Act, B.E. 2456 (1913) - Building Control Act, B.E. 2522 (1979) - National Environmental Promotion and Maintenance Act, B.E. 2535 (1992) - Marine and Coastal Resources Management Promotion Act, B.E. 2558 (2015)					
2.2.1 Budgets and personnel are sufficient for regulating and monitoring an operation following the laws related to coastal erosion management					
2.2.2 Laws related to coastal erosion management are updated, sufficient, and inclusive to catch up with coastal changes and respond to the needs of coastal development.					
2.2.3 People and stakeholders have knowledge and understanding of the laws related to coastal erosion management					
2.2.4 People and stakeholders are protected by laws related to coastal erosion management equally and fairly					
2.2.5 People and stakeholders are protected by laws related to coastal erosion management equally and fairly					

<u>Part 3</u> Questions on integrated coastal zone management in the upper Gulf of Thailand

Integrated Coastal Zone Management in the upper Gulf of Thailand	**Level of Agreement**				
	Highest	**High**	**Moderate**	**Low**	**Lowest**
3.1 There have been solutions towards coastal erosion impact that are congruent with the areas, both land and maritime.					
3.2 Resources are allocated and utilized inclusively and equally, i.e., habitats of living organisms, fishery, tourism, port, and industrial development, etc.					
3.3 There has been a collaboration between the government, private, civic sectors, or stakeholders related to coastal erosion management.					
3.4 There have been coordination mechanisms among concerned agencies, both of the same and across a line of authority, for coastal erosion management.					
3.5 . There has been a collaboration in scientific, technological, economic, and social knowledge.					
3.6 Tools for coastal erosion management are utilized, i.e., economic tools, risk assessment, database system management, Environmental Impact					

Integrated Coastal Zone Management in the upper Gulf of Thailand	Level of Agreement				
	Highest	High	Moderate	Low	Lowest
Assessment (EIA), and monitoring and evaluation system, etc.					
3.7 Local wisdom is used for coastal erosion management, i.e., bamboo revetment, Taoism rubber- piling (constructing a fence made of wood covered by tires for slowing waves), coastal afforestation, mangrove afforestation, etc.					

<u>Part 4</u>: Questions on people's participation in coastal erosion management in the upper Gulf of Thailand

People's Participation in Coastal Erosion Management in the Upper Gulf of Thailand	Level of Agreement				
	Highest	High	Moderate	Low	Lowest
4.1 Participating in acknowledging information about projects or activities related to coastal erosion management in the area (only in the province you live)					
1) Bangkok					
2) Samut Prakan					
3) Samutsakhon					
4) Samut Songkhram					
5) Chachoengsao					
4.2 Participating in providing information about projects or activities					

People's Participation in Coastal Erosion Management in the Upper Gulf of Thailand	Level of Agreement				
	Highest	High	Moderate	Low	Lowest
related to coastal erosion management in the area					
4.3 Participating in opinion-hearings about projects or activities related to coastal erosion management in the area					
4.4 Participating in determining the goals and objectives of projects or activities related to coastal erosion management in the area.					
4.5 Participating in determining solutions approaches for coastal erosion management projects and activities					
4.6 Participating in planning projects or activities related to coastal erosion management in the area.					
4.7 Participating in expressing ideas officially for planning projects or activities related to coastal erosion management in the area.					
4.8 Attending projects or activities related to coastal erosion management in the area as planned.					
4.9 Participating in budget supports related to coastal erosion management in the area as planned.					
4.10 Participating in personnel supports related to coastal erosion management in the area as planned.					

People's Participation in Coastal Erosion Management in the Upper Gulf of Thailand	Level of Agreement				
	Highest	High	Moderate	Low	Lowest
4.11 People in the area collaborate in coastal erosion management solutions in the area.					
4.12 Coordinating for collaboration and joint operations between concerned agencies and people for coastal erosion management in the area					
4.13. People in the area participate in an evaluation to acknowledge the accomplishment and level of success of the projects or activities related to coastal erosion management in the area.					
4.14. People in the area participate in suggesting approaches for improving plans, projects, or activities related to coastal erosion management in the area.					

<u>Part 5</u> Questions on the success of coastal erosion management in the upper Gulf of Thailand

The Success of Coastal Erosion Management in the Upper Gulf of Thailand	Level of Success				
	Highest	**High**	**Moderate**	**Low**	**Lowest**
5.1 Structural fertility of the environment in the area, solved by the use of hard engineering structure, i.e., seawall, revetment, breakwater, groins, sand-sausage/bag, jetty, etc.					
5.2 Structural fertility of the environment in the area, solved by the use of soft structures or natural solutions, i.e., beach nourishment, sand nourishment, mangrove afforestation, setback zone, etc.					
5.3 Coastal erosion management in the upper Gulf of Thailand brings about economic, accommodation, recreational benefits, i.e., to be recreational tourist attractions, transportation, ports, and fishery occupational places.					
5.4 An awareness of social equality, i.e., everybody in the coastal area can access and gain benefits from coastal erosion management in the upper Gulf of Thailand inclusively					
5.5 The governmental agencies provide proper and sufficient budgets for coastal					

The Success of Coastal Erosion Management in the Upper Gulf of Thailand	Level of Success				
	Highest	**High**	**Moderate**	**Low**	**Lowest**
erosion management in the upper Gulf of Thailand.					
5.6 The governmental agencies provide proper and sufficient personnel for coastal erosion management in the upper Gulf of Thailand.					
5.7 The governmental agencies empower practitioners to respond to coastal erosion management plans.					
5.8 Stakeholders and people in the area participate in complying with coastal erosion management plans.					
5.9 Outcome from coastal erosion plans is congruent with the determined objectives					
5.10 Prioritization of problems and improved operational approaches are accordant with social and environmental conditions.					
5.11 Improving the operational or action plans in priority by a problem's significance, which leads to concrete solutions					

BIOGRAPHY

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ACADEMIC BACKGROUND	Master of Applied Science (Civil Engineering), University of Delaware, U.S.A., 2002
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