

CHAPTER 1

INTRODUCTION

1. Background

Pattani Province, covering a land area of approximately 2,000 sq. km. in lower Southern Thailand, is situated on the east coast facing the Gulf of Thailand, between latitudes $6^{\circ} 56' N$ to $6^{\circ} 32' 48'' N$ and longitudes $101^{\circ} 45' 15'' E$ to $101^{\circ} 1' 18'' E$. Pattani is bordered by the Gulf of Thailand on the north, by Narathiwat on the southeast, and by Yala on the south and southwest. Pattani Bay lies between latitudes $6^{\circ} 53' N$ to $6^{\circ} 57' N$ and longitudes $101^{\circ} 14' E$ to $101^{\circ} 21' E$, covering an area of about 74 sq. km. On the north of Pattani Bay lies Laem Pho, a 16-km.-long spit stretching parallel to the east-west coastline of the peninsular mainland. Its mouth faces the Gulf of Thailand to the east. Inside the Bay is the mouth of Yaring River, on which the Yaring District of Pattani lies. Pattani is climatically under the influence of three monsoon winds: northeast (NE), southeast (SE) and southwest (SW), including variation in air pressure which makes its weather and climate changeable and brings about eight months of rain, comprising light to moderate rainfall (up to 10 mm/day) from May to September and heavy rainfall (up to 35 mm/day) from October to December, followed by four months of dryness between January and April (Choonpradub et al, 1997).

For a very long period of time Pattani was considered as having a tropical rain forest climate. However, the climate statistics of Pattani within the last three decades from 1951 to 1980 reported by the Thai Meteorological Department indicate that Pattani is considered to have a tropical monsoon climate. Furthermore, a study of rainfall between 1978 and 1987 conducted by Pongbhai and Heemsuri (1988) at Prince of Songkla University (PSU), Pattani Campus, concluded that the PSU area and its vicinity have a Savanna climate, with wet and dry seasons.

According to Koppen's (1968) system of climate region analysis, Thailand is classified as a tropical climate region. This means that the maximum temperature of its coldest month is higher than 18 degrees Celsius; its average all-year-round rainfall is relatively high, with its minimum level of 889 mm. (35 inches) of annual rainfall. It is worth noting that specific characteristics of tropical climate subregions are as follows. Typically, tropical climates are of three types:

1. Tropical Rain Forest (Af) refers to a particular region having high temperature throughout the year, with a small range of temperature variation of 2-3 degrees Celsius. There is rather constant rainfall and regular rain scattered all year round. On average monthly rainfall exceeds 61 mm. (2.4 inches). Rainfall during the rainy season is usually affected by southwest monsoon winds between May and September, and by northeast winds through the South China Sea and the Gulf of Thailand between October and February. During the hot season, rain and showers are quite plentiful as the air rises during the afternoon and at night.
2. Tropical Monsoon Climate (Am) refers to a particular region having weather with high temperature throughout the year, with a small range of temperature variation similarly to the Af climate. However, rainfall may exceed that of Af climate, but with only 1 or 2 months of rainfall below 2.4 inches.
3. Savanna Climate, Wet and Dry Seasons (Aw) refers to a specific region where the moisture and dryness of the weather vary dramatically. During the moist weather, it is the rainy season which is affected by the air mass from the tropical, oceanic regions from which the southeast winds bring in rain to fall between May and September. During the dry season, the region is affected by the cold air mass from the hemispherical continent, from which northeast winds bring in dry and cold air between November and February. However, there is a similarity between Am and Aw climates, in that their average rainfall during the least-raining months is below 2.4 inches. Thus, in deciding which regions belong to which climate types depends on two types of rainfall: (1) the rainfall throughout

the year, and (2) rainfall of the least-raining months. An equation can help determine the differentiation, as follows:

$$a = 3.94 - (r/25) \quad (1)$$

where a = the dividing-line value between Am and Aw

r = the rainfall throughout the year (in inches)

If the rainfall of the least-raining month is larger than the value of 'a' but smaller than 2.4 inches, the region should belong to be an Am climate; conversely, if the rainfall of the least-raining month is smaller than the value of 'a', it should belong to an Aw climate. Taking into account the influences of the NE, SE and SW monsoon winds, a map of the climate region in southern Thailand can be illustrated in Figure 1.1 below.

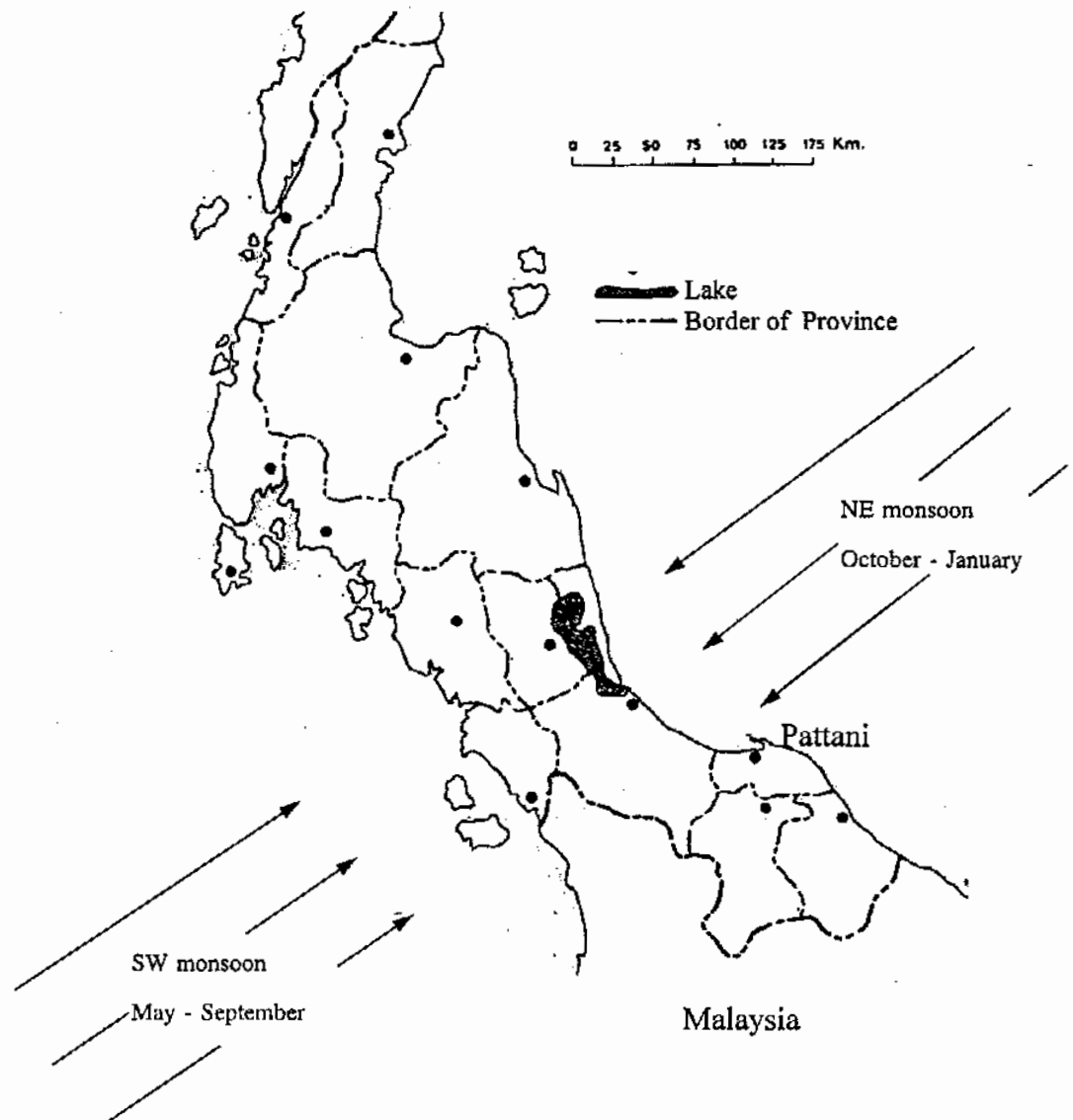


Figure 1: Influences of Monsoon Winds (South of Thailand)

Source: Charoen Charoenrajaphak 1978. "Climate" in *Thai Encyclopedia for Youths*. Under the Royal Initiative Vol. 4, 150-154 (in Thai).

2. Rationale

Pattani Bay is the last receptive source of all effects and impacts from activities on the peninsular mainland, which are intertwined with the activities of the people around

the Bay. It is also the receptive source of freshwater, minerals and deposits from two principal rivers: the Pattani River and the Yaring River.

In addition, Pattani Bay is also affected by the NE and SW monsoon winds, which in turn bring in a lot of rain throughout the year. Rain and freshwater from the rivers lead the water in the Bay to brackishness and to variations of salinity of 4 - 32 ppt. Thus, salinity varies according to seasonal changes. The effects of the sediment formation at the bottom of the Bay have led to the formation of a long strip of delta as a wide mud beach which gradually developed into a rich resource of mangrove forests in Pattani Bay. Besides, deposits from the riverines piling up along the coastline have led to the formation of eco-mud beach systems along the shoreline around the Bay. This adds up to a land area of about 37 square kilometers. Within the area of mud beaches, mangrove forests, seawater swamps and waterways inhabit a variety of marine life species of some economic significance, such as bass, live fish in cages, sea catfish, blue crabs, giant tiger prawns (*Penaepsis monoceros -Peneidae*), *Peneus merguensis (Peneida)*, cockles and green mussels, including various species of algae, such as glacialaria.

From a marine fishery census of 1995 in Fishery Region 4 (Lower Part of the Gulf of Thailand), jointly conducted by the National Statistical Office under the Office of the Prime Minister and the Fishery Department, a report of the number of fishery establishments and type of coastal aquaculture in Pattani is shown in Table 1.

Table 1: Number of Fishery Establishments by Type of Fishery in Pattani

Type of Fishery	Number	Percentage
Marine Capture Fishery Only	2,864	81.8
Coastal Aquaculture Only	510	14.6
Both of Them	128	3.6
Total	3,502	100.0

Source: 1995 Marine Fishery Census Coastal Zone 4 (Southern Part of the Gulf of Thailand) Nakhon Si Thammarat, Phatthalung, Songkhla, Pattani, Narathiwat.

Moreover, all along the shoreline of Pattani Bay there is a lot of coastal aquaculture. Statistics from a marine fishery census in 1995 in Fishery Region 4 (Lower Part of the Gulf of Thailand) jointly conducted by the National Statistical Office and the Fishery Department, indicated the number of coastal aquaculture establishments and area under culture by aquaculture species in Pattani Province as shown in Table 2.

Table 2: Number of Coastal Aquaculture Establishments and Area under Culture by Aquaculture Species in Pattani Province

Aquaculture Species	Establishment	Area under Culture (rai)
Shrimps	141	4,277
Fish	478	51
Molluscs	22	679
Oyster	2	4
Cockle	4	630
Green Mussel	16	45
Crab	1	2

Source: 1995 Marine Fishery Census Coastal Zone 4 (Southern Part of the Gulf of Thailand):Nakhon Si Thammarat, Phatthalung, Songkhla, Pattani, Narathiwat

The changes of climate directly affect the resources in Pattani Bay, especially during the months of October and December when the NE monsoon winds prevail. It is found that mass migration and deaths of marine life take place particularly in November, a vast number of sea catfish die in addition to the decrease in mass of glacialia and marine fauna. Coastal aquaculture is also affected, probably due to the increase of rainfall and of sea levels in Pattani Bay. This in turn leads to a decrease of salinity in the sea water. It is therefore significant to examine the relationship between rainfall and salinity in Pattani Bay to learn the nature of rainfall, salinity, and the changes of quality of life of

living things, the environments in and around the Pattani Bay. In the long run such a study will be beneficial to fishermen and local people in their coastal aquaculture as well.

3. Review of Literature

There has been some work related to the study of rainfall in Pattani in the past. For example, Nilarat (1977) overviewed the characteristics of the climate in Pattani during 1969-1976. Pongphai and Heemsuri (1988) examined the rainfall and climate region of Pattani by analyzing data on rainfall collected 20 meters above sea level at the Science Building at Prince of Songkla University, Pattani Campus, and made a claim that Pattani Province belongs to a half-and-half combination of tropical monsoon climate (Am) and Savanna climate (Aw). Yuyeunyong (1990) and others examined and attempted a projection study of hourly rainfall in Pattani from data collected at 11 meteorological stations over Pattani covering the intervals of 15-, 12-, 7- and 6-year-periods from recorded data at Pattani, Sai Buri, Yarang, Khok Pho 1, Panare, Mayo, Nong Chik, Yaring, Khok Pho 2, King Amphoe Mai Kaen and the Khok Pho Help-Settlement. In examining annually combined rainfall at each station since the beginning of record-keeping, it was found that the annual rainfall of each station varied with neither patterned trends of decreased dryness nor increased rains; furthermore, the average precipitation of rainfall at 11 meteorological stations all varied. Another related study was conducted by Wiriyanon and others in the First Phase of the Pattani Bay Research Project (July 1989 - June 1990) on annual rainfall records of 1988-1991 by collecting data at the Science Building of Prince of Songkla University, Pattani Campus (Station 1) and Bo Thong Meteorological Station (Station 2). The results of this study revealed that rainfall comprises a dry period from January to March with a monthly average precipitation of rainfall below 61 mm. (2.4 inches). From then on, the rainfall gradually increases and reaches its peak in November. Every year from December to September, the rainfall at Bo Thong Meteorological Station tends to be somewhat larger than that at Pattani Campus; but the reverse is true during the heavy rain period during October and November. The

annual average precipitation of rainfall in a 4-year period at Station 1 and Station 2 were 1,447.7 mm. and 1,590.5 mm., respectively.

Wiriyanon et al (1989 - 1990) studied salinity in Pattani Bay by collecting data at 12 stations: (1) Bang Tawa, (2) Rusamilae, (3) Pattani River mouth, (4) Laem Nok, (5) Tanyong Lulo, (6) Bang Pu, (7) Dato, (8) Budi, (9) Lighthouse, (10) Laem Tachi, (11) Bay mouth, and (12) Bay center. It was found that the annual salinity ranged from 19.8 ppt. to 29.3 ppt. and the average salinity at each station was 25.2 ppt., whereby the intensity of salinity increased in those stations situated in the lower part and toward the end of the Bay. However, during the dry season the salinity increased at all stations, particularly in March where the peak of the average salinity was 31.2 ppt.; the salinity decreased during the heavy rain period, particularly in November where the average salinity was 21.0 ppt.

4. Research Objective

The research objective is to study the relationship between rainfall and salinity in Pattani Bay. In this study the rainfall data are recorded at three stations: the Science Building of Prince of Songkla University, Pattani Campus (by Haroom Heamsuri in the Department of Science), (2) Yaring River mouth (by postman), and (3) Laem Tachi (by Lighthouse, Laem Tachi, Naval Hydrographic) were between January 1995 and December 1996 were used. The data on salinity were collected by the Pattani Coastal Aquaculture Station at Yaring for 14 stations around the Bay, measured at intervals from two to six weeks during 1995 and 1996. These stations are as follows: (1) Dato, (2) Yaring River mouth, (3) Bay Center, (4) Parae, (5) Cackle bed, (6) Tanyong Lulo, (7) Prince of Songkla University, (8) Talo Samilae, (9) Laem Nok (10) Industry Estate, (11) Barn Num, (12) Budi, (13) Pattani River mouth, and (14) Bana.

Definition of Terms

Rain refers to water falling to earth in drops smaller than 6 mm. that have been condensed from the moisture in the atmosphere. Rainfall may be subdivided into three

quantity types.

1) small rainfall refers to rainwater falling into a measuring container ranging from an unmeasurable quantity to smaller than 2.5 mm/hour.

2) moderate rain refers to rainwater falling into a measuring container ranging from 2.5 mm./hour to 7.6 mm/hour.

3) heavy rain refers to rainwater falling into a measuring container ranging from 7.6 mm/hour and larger.

Salinity refers to the quantity of solid substances containing salts, especially sodium chloride (NaCl) dissolved in water. It is generally measured in weight units in terms of grams per kilogramme of water or parts per thousand (ppt). Salinity results from carbonated salts becoming oxidized, bromide and iodide salts being replaced by chloride and organic matter becoming oxidized.

Salinity in water may be related to chlorinity, which is the quantity of chlorides, bromides and iodides in one kilogramme of weight unit. A similar term to chlorinity is chlorosity which is derived from the chlorinity value multiplied by the water density at 20 degrees Celsius. From this close relationship, salinity can be calculated from chlorinity using the following formula:

$$\text{salinity (ppt)} = 0.03 + 1.805 \text{ chlorinity (ppt)} \quad (2)$$

The salinity of water may vary depending on the location and soil type. Freshwater has an equivalent to zero salinity, whereas seawater has an average salinity of 35 ppt.