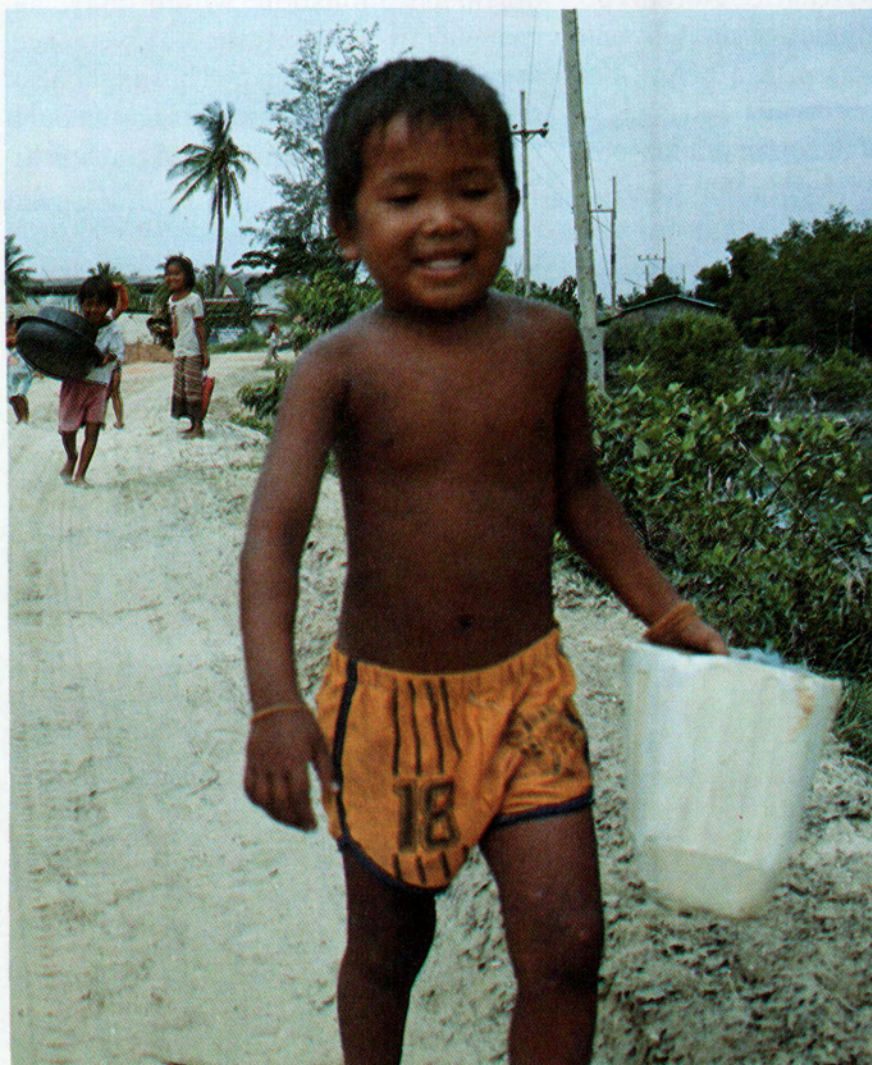


CHAPTER THREE

FRESHWATER: A PRIME CONCERN



"There is a lack of freshwater in Pak Phanang"

King Rama V in a letter to the Crown Prince

July 9, 1905

Boromthanasart, S., Cobb, S., Lee, V. (1991). Chapter 3. Freshwater: A Prime Concern. Coastal Management in Pak Phanang: A Historical Perspective of the Resources and Issues. Hat Yai, Thailand: Coastal Resources Institute, Prince of Songkla University

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PakPhanang_Chapter2.pdf	Local Climate: Is It Changing?
PakPhanang_Chapter3.pdf	Fresh Water: A Prime Concern
PakPhanang_Chapter4.pdf	Sedimentation: The Bay Is Filling In
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Deforestation on the hillside.

Lack of freshwater and salt water intrusion were mentioned again and again as increasing problems for Pak Phanang. Many local people are concerned that salt is intruding up the river and into the khlongs. They observe that salt is poisoning the rice fields, killing the indigenous freshwater fish or birds that used to be common in the river and khlongs and draining the drinking water supply for villagers and for people living in the municipality of Pak Phanang. Long time residents believe that the salt intrusion is related to a gradually diminishing quantity of freshwater. There is no longer a sufficient supply of freshwater for drinking, cooking, washing and irrigation where the supply, at one time, was adequate most of the year.

Is there a trend of widespread salt water intrusion in the coastal zone of Pak Phanang? Is it related to a reduction in freshwater or to other causes such as shrimp farming? It is difficult to tell because so many changes have recently taken place in the watershed that could affect the water budget. Changes in land use could have diminished the amount of freshwater flowing from the drainage basin to the coastal area of Pak Phanang and caused salt water intrusion. Such changes include:

- Deforestation of the hillsides of the upper watershed for rubber plantations. The steady rise in rubber prices since 1985 led to massive clearing for rubber plantations on steep slopes and marginal land. Loss of vegetation resulted in faster run off of rainwater, more extreme flooding, and perhaps less freshwater during the dry season for the coastal lowlands.
- Changes in rice farming to modern technology and new rice strains. Twice the volume of irrigation water is needed for double crop rice as for traditional single crop rice farming in order to extend production into the dry season. Expansion of rice paddies into the uplands also may be using more freshwater.
- Construction of irrigation system and reservoirs in the upper watershed to support expansion of rice paddies into the uplands. Government policy to expand rice production and change water distribution may be diverting water from the coastal region by holding it in the upper watershed or transporting it to irrigation canals in other watersheds.
- Shrimp farming is causing salt intrusion along the coastal zone. Tide gates are being opened to let sea water in to irrigation canals. Salt water is pumped into ponds where there were once mangroves or rice paddies and it may be seeping into the groundwater or surrounding rice fields.

Shrimp farming is replacing rice paddy field.



Water gate: a means to prevent salt water intrusion.



Another change that may contribute to salt water intrusion is an increased demand for freshwater. With increasing population growth, and more prosperity, the use of water may have increased so much that it appears that supplies have diminished.

It may also be that there has been a change in the local climate since typhoon Harriet in 1962, as the residents who have lived in the area many years suggest. They say rainfall patterns have become unpredictable (timing is critical for rice planting and harvest, especially for the traditional single crop system that relies on natural rainfall rather than irrigation). Extremes of weather (typhoons and droughts), are perceived to be more common now. Certainly in times of drought as occurred in 1989 and 1990, freshwater supply is drastically diminished. Salt water intrudes far up into the Pak Phanang River and seeps into the irrigation khlongs.

All of these things are probably happening to some degree. The consequences are felt in many ways.



Table 3.1. Timeline of Events Associated With Water

- 1897 Khlong Sukhum dug from Khlong Bangchak to Pak Phanang River to protect rice fields from salt water and to provide transportation from Nakorn Si Thammarat to Pak Phanang.
- 1905 Requests to Rama V to close Khlong Bangchak to keep salt water intrusion out of Klong Sukhum so that it can be used as drinking water supply for port city of Pak Phanang.
- 1907 When the first big mechanized rice mill in Pak Phanang, rice export increases 5x in 2 years.
- 1929 Mangrove lumbering starts.
- 1940 Port booming, big mechanized rice mills along river.
- 1941 Japanese invade Pak Phanang.
- 1944 Road constructed parallel to Khlong Sukhum. Central government takes control of rice export.
- 1947 Period of modernization, Pak Phanang established as municipal authority, irrigation canals constructed, rice farming shifts from dependence on rainfall and integration with animal farming to irrigation.
- 1955 Big rice mills along Pak Phanang River stop production, cannot compete with small rice mills under new export prices set by central government.
- 1961 Mangroves proclaimed conservation areas by Forestry Department.
- 1962 Typhoon "Harriet" devastates region. Rice farming impossible for 3 years. Chinese merchants leave Pak Phanang for Nakorn Si Thammarat and Phuket.
- 1967 New variety of double crop rice planted according to government policy. Needs twice the volumes of freshwater as single crop rice.
- 1970 Water gate constructed at Khlong Sukhum at Pak Phanang River.
- 1977 Start of green revolution in new type of rice production. Water gates constructed in khlongs.
- 1987 Start of conversion of coastal zone to intensive shrimp farming.
- 1988 Flood devastates the region.
- 1989- Drought years, drinking water has to be trucked to supply Pak Phanang.
- 1990



Inaccessibility of freshwater supply.



Khlung supplies freshwater for daily consumption.

DIMINISHING DRINKING WATER SUPPLY

In the Pak Phanang area, drinking water is taken from irrigation khlongs, from the river and from large jars that households use to store rainwater runoff from the roof. Three khlongs, Sukhum, Cha Mao and Bang Sai, provide drinking water for the municipal water system of Pak Phanang, which delivered 6,000 cubic meters per day in 1991. Dug wells are rare but are used in a few places like the village at the end of Laem Talumpuk.

Although safeguarding adequate supplies of freshwater and dealing with salt water intrusion always has been a challenge for the people of Pak Phanang, it seems to be getting worse. Salt water has always intruded up the river and into the nearby khlongs during the dry season when river flow is least and when the southeast monsoon winds blow sea water into the bay, raise sea level and push salt water up into the river. One hundred years ago, the people of Pak Phanang could get freshwater from the river mouth only during the three months of the rainy season. The rest of the year they had to go up to Pak Praek, the first branch of the Pak Phanang River. In 1905, Chinese merchants asked King Rama V to close off Khlung Bang Chak from Khlung Sukhum, so that freshwater would flow down along Khlung Sukhum to provide Pak Phanang with a constant, convenient source of drinking water.

To this day, Khlung Sukhum is the principal source of freshwater for the municipal water supply of Pak Phanang and nearby villages. New deep water gates were constructed to keep more freshwater in Khlung Sukhum, in 1962 at Khlung Bang Chak and in 1970 at the Pak Phanang River as part of Irrigation Department policies. This also helped increase the amount of fresh drinking water available for villagers and for the town of Pak Phanang. Even so, during the dry years of 1989 and 1990, there was not enough freshwater in the khlung, and salinity inside the gate exceeded national standards for acceptable drinking water for six months. Town officials had to truck in drinking water from Nakhon Si Thammarat. They also requested that the Irrigation Department divert freshwater from the irrigation system northwest of Nakhon Si Thammarat to fill Khlung Sukhum. Now, sea water from shrimp farming is intruding into the khlongs and rice paddies near the coast, according to water officials at the town. A 300 rai reservoir is under construction to provide an adequate supply of freshwater to the municipality of Pak Phanang.

Laem Talumpuk community's reservoir.





Pak Phanang River.

The Pak Phanang river is also a traditional source of freshwater for drinking, cooking and washing. Most of the year, salt probably intrudes (at 1 ppt) to Chian Yai about 35 km from the river mouth. However, during the three months of the rainy season, the river flows fresh all the way to Pak Phanang at the mouth. In the opinion of the local people, less freshwater is flowing down the river each year and salt is intruding up farther. They point out that in drought years, they have to go much farther up river than before to find freshwater. For instance, in the drought of 1937, they had to go 20 km to find

freshwater, since the early 1960s they had to go twice that far and most recently, in 1989-1990 drought they had to go 60 km up river to find freshwater. There is a shared perception that problems of diminishing freshwater and increasing salt water intrusion have gotten worse since Typhoon Harriet. Salt intrusion is now to the point where shrimp farms are locating far up the river, and they use salt water from the river and discharging it to the river farther upstream than salt water normally extended in the past. Salt water appears to be intruding into the ground water too.

Water is pumped from Pak Phanang River for shrimp farming.



LACK OF FRESH WATER FOR IRRIGATION

Local rice farmers who were interviewed by CORIN members and who attended the workshop in August 1991 all agreed that water supply does not meet the demand. It is of course a problem to supply irrigation water in a region where most of the annual rainfall occurs in three months and most of that within one week. The problem is

much worse in drought years. Figure 3.1 shows the annual pattern of salinity inside the irrigation gate at Khlong Bang Sai, which is 18 km up river from the river mouth. A dry year (700 mm below mean rainfall, see Figure 2.5 is compared to a wet year (300 mm above mean rainfall). Salinity for most of both years is quite similar. However during March and April, in the dry year, salinity inside the khlong rises to 1-2 ppt, more than a 10 fold increase over concentrations normally.

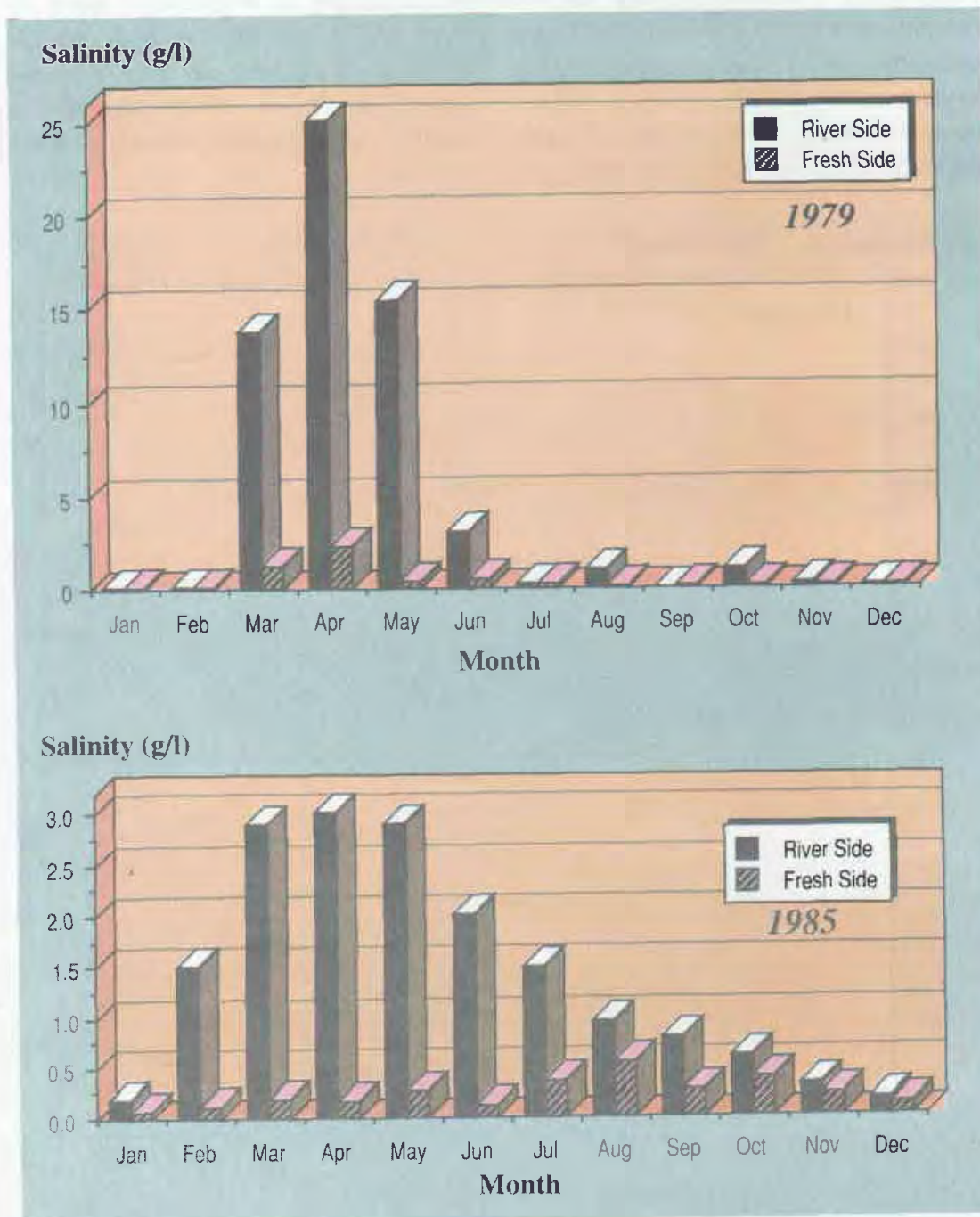


Figure 3.1. Salt concentration in Khlong Bang Sai measured at water gate in 1979 and 1985.

The Thailand Natural Resources Profile, (1989) states that "In the Northwestern and Southern regions, water shortages usually result from inadequate water regulation rather than from insufficient rainfall input."

Unfortunately, there is no river gage of flow or salinity with which to demonstrate whether there is a long term reduction of freshwater flow in the river that is causing salt water intrusion. The Irrigation Department does have records of salt content and water height measured inside and outside of the water gates that separate irrigation khlongs from the river. But the records available to us as we write this Ecological History only cover the years

1978 to present, not a sufficient time period to assess whether or not there is a long-term trend in diminishing river flow and accelerating salt intrusion. It is worth considering however that the last thirty years, the time in which local people observed diminishing freshwater, is a time that also coincides with at least two other events that may be causing freshwater shortages. One of these is the growth in population of both the town of Pak Phanang and the wider region (see Figure 3.2). Consumption of freshwater must be increasing at least this rate and probably higher as water use per capita is also increasing. As the demand exceeds the supply, it will, of course, cause freshwater shortages.

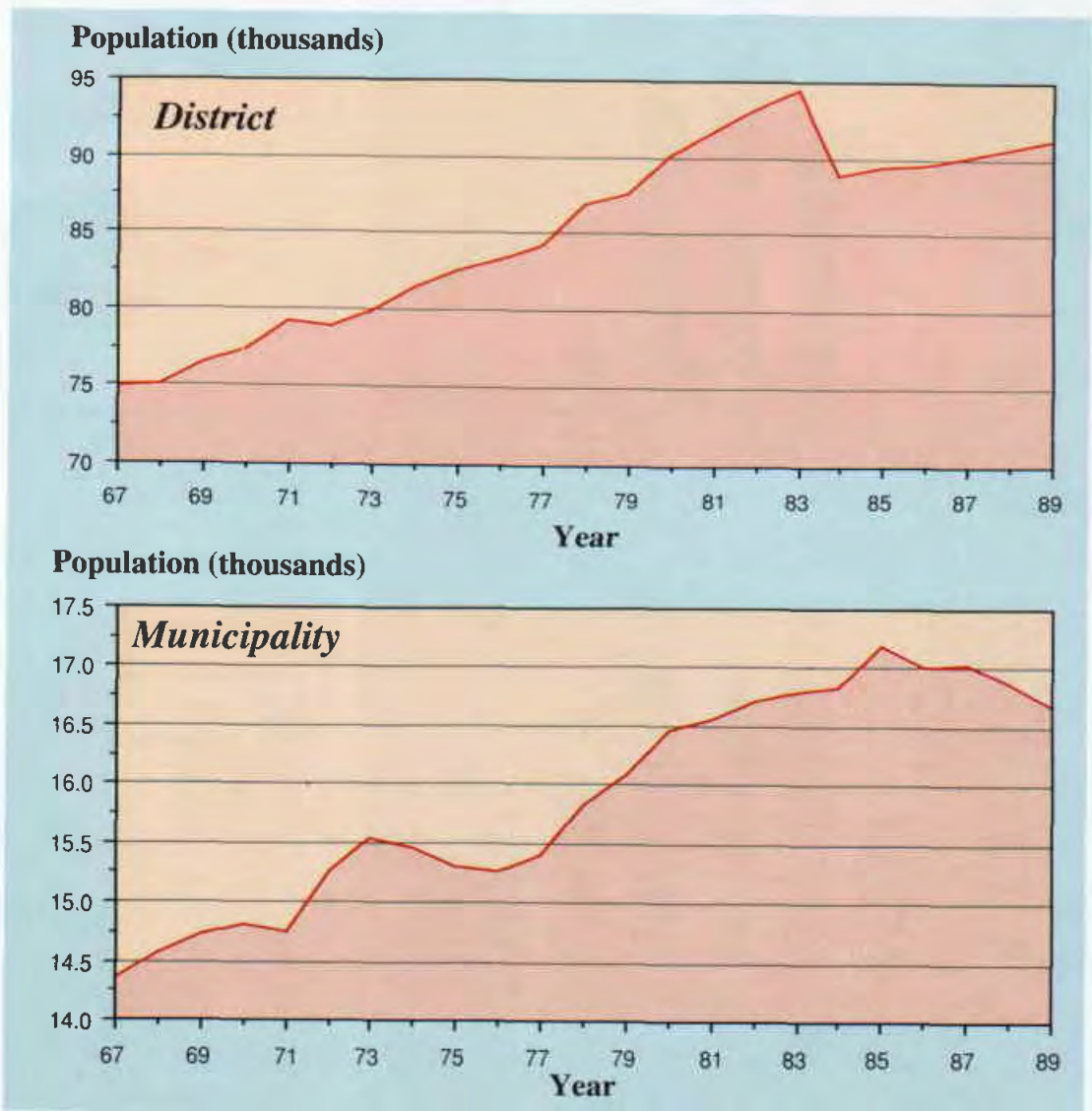


Figure 3.2.
Population growth in
Pak Phanang District
and Municipality.



Khlong Bang Chak water gate.

The other event that coincides with local observation of problems with freshwater supply is a major change in the system of rice production throughout the watershed of the study area. Beginning in 1967, the Thai government began a vigorous campaign to increase rice production using new technologies. The result of these government subsidies and projects was large scale changes to the landscape within the drainage basin of Pak Phanang.

The new rice technology introduced by the government produced two crops per year, but to sustain this, it was necessary to convert to the use of commercial fertilizers, pesticides, and mechanical plows. Most importantly to our considerations, the new method of farming used greater volume of irrigation water. Throughout the drainage basin of the Pak Phanang River the government undertook the construction of a massive irrigation system to supply the necessary water for an extended 2 crop growing season. Khlongs were deepened to 3 meters to store more water. In the early 1960s, water control gates were installed in 11 khlongs to keep

salt water from intruding onto the fields in the dry season, to facilitate drainage in the wet season, and to control the distribution of freshwater throughout the watershed. Main gates were much larger than the others: one at Khlong Bang Chak was 6.5 meters, preventing salt water intrusion into Khlong Sukhum (see map in Figure 3.3). The policy of expanding rice production included projects to convert upland fields to rice and provide them with irrigation. Thus the expanded use of water for double crop rice, the irrigation of additional areas of rice high in the watershed, and additional domestic consumption by a growing population may indeed be depleting the amount of freshwater flowing toward the coast. It may be causing salt water intrusion along the coastal portion of the Pak Phanang watershed, making it especially difficult for local people to cope with natural disasters such as the drought of 1989-1990. It is ironic that the government policy to help rice farmers increase rice production in the province may actually be hurting the rice farmers along the coast.



Figure 3.3.
 Map of irrigation canal
 and water gates at
 Nakhon Si Thammarat.



Ice production at Nakhon Si Thammarat Fishing Port.

LACK OF DRINKING WATER FOR FUTURE GROWTH

Adequate freshwater supply is essential for the future of Pak Phanang. It is of great concern if the area is already running out of freshwater in dry years. Industrial growth often requires more freshwater than household consumption. Industrial development has high demands, for instance fish processing factory and the fishing port recently constructed on the Pak Phanang River need water to produce 210 tons of ice per day. Lack of water supply will depress economic growth. It may also force individuals to develop their own supplies. Unless water use development is carefully managed over the entire river system, for both freshwater distribution and waste water disposal, uncontrolled use of ground water may lead

to more severe problems in the future.

The population of the Pak Phanang area will continue to increase. It is also likely that per capita consumption for personal use will increase. If growing industrial and commercial needs for freshwater are to be met, along with an adequate supply of freshwater for personal use, safeguarding a freshwater supply is one of the most critical issues for the future economic, political and social health of the people of Pak Phanang.



PROBLEM OF WATER QUALITY

Besides salt intrusion, there are many other problems of water quality in the Pak Phanang area. Until recently, wastes were discharged untreated to the river from houses, businesses, boats and fish meal plants. In the last few years, many houses and business converted to the use of septic systems. Wastewater discharge from shrimp ponds is causing water quality problems in the khlongs, the river, and perhaps the bay. Contaminants include salt, organic material and associated BOD, high nutrients, and potentially harmful compounds that are used to grow the shrimp. Drainage from the rice paddies also may carry toxins and fertilizers. Wastes are polluting the river and depleting dissolved oxygen to levels where fish cannot survive. According to a survey conducted by a CORIN team member in August, 1991, dissolved oxygen in the river water was depressed near the town of Pak Phanang at the river mouth, higher at Chian Yai, then dropped to about 2 ppm from Khlong Khong to Ban Tha Chit Chan, all the way up to the bridge at Chu Uat, 80 km from the mouth of the river.

As more shrimp ponds are constructed along the river and discharge untreated wastes, water quality is deteriorating. Where the river is tidal, the water discharged one day will be back with the flood tide the next day. The accommodation of many discharges may

be affecting the water supply that is necessary for the continued success of the shrimp farms and at the same time causing environmental degradation that may be felt along the river and into the bay.

It is likely that other activities such as use of herbicides in rice farming, the use of arsenic for fishing and industrial disposal of toxic substances are also contaminating the water. The cumulative impact of waste water disposal must be considered by a coastal community like Pak Phanang that depends on the health of the natural resources in the bay, the mangroves, the khlongs and the river.

The people we interviewed around Pak Phanang feel that water quality is deteriorating. Their impression is based on observations of many factors. The river water is no longer clear in the dry season and the color near the town darkens to green and brown. Recently, scum was seen growing on the water surface in the driest months. Oil sheens often coat the water. Bad odors occur near discharges from shrimp ponds and whenever the fish meal plant discharges waste to the river. The taste of the river water has also changed since 1988. The period that the river can be used as a source of freshwater is now only October to January, whereas it used to be September to February. Salty water now extends up river to Pak Praek and Chian Yai. Even the municipal tap water of Pak Phanang Municipality is occasionally salty. Local people also think that polluted water is harming fish resources.

Water pollution at the harvest of shrimp farm.



WATER QUALITY AND PUBLIC HEALTH

Contaminated water is a major cause of disease throughout Thailand. Acute diarrhea (caused by vibrio) and cholera are endemic. Acute diarrhea is a primary cause of infant mortality. Two deaths from cholera were reported last year in Songkhla. Epidemics of acute diarrhea have occurred twice in the recent past in Pak Phanang.

In Pak Phanang, where people use the irrigation canals and the river for washing, drinking and food preparation, lack of freshwater in the dry season and drought years make waterborne disease an even more difficult problem. Public health records indicate that water borne diseases increase in the dry months and become "epidemic" in dry years. According to records at the public health clinic in Pak Phanang, in 1989, there were an average of 250 cases of intestinal worms, 350 cases of gastroenteritis, 200 cases of water borne skin diseases from people washing or swimming in contaminated water. The Pak Phanang Health Clinic is relatively new, so it is not possible to establish whether diseases caused by polluted water are dramatically increasing over the years but it is an issue of concern to the local people and to the provincial public health officials.



Domestic pollution from Pak Phanang Town.



The degraded environment around shrimp farm.

