

MINIREVIEW ARTICLE

**The Uthokawiphatprasit Watergate: A Man-Made Change
in Pak Phanang River Basin**

Pipop PRABNARONG and Janjira KAEWRAT

*School of Engineering and Resources, Walailak University,
Nakhon Si Thammarat 80161, Thailand*

ABSTRACT

This minireview article investigates the environmental changes since the operation of the *Uthokawiphatprasit* watergate over the Pak Phanang River in the southern east coast of Thailand. It was revealed that the watergate caused the slow down of water circulation in the bay which accelerated the rate of sediment deposition. The watergate also resulted in poor water quality in the Pak Phanang River which caused the declination of fish species and fish production. Moreover, it resulted in a lower production of *Nipa Palm* which is an important economic tree in the basin. Finally, there was evidence that the watergate might cause the spread of *Malaria* in this area.

Keywords: Uthokawiphatprasit Watergate, Pak Phanang River Basin, environmental changes

INTRODUCTION

Pak Phanang River Basin, in the southern east coast of Thailand covers a total area of 760,000 acres with a total population of approximately 600,000 (**Figure 1**) [1,2]. The Pak Phanang River Basin was once a fertile plain and with its huge area, coupled with a suitable climate for this type of geophysical landscape, its potential for agriculture was limitless. It was one of the most important rice farming and watershed areas in the south of Thailand, with the ability to produce rice for export. Now the only remnants of the glory of its past are the abandoned rice-mills along the riverbanks, waiting to deteriorate and rot through the passage of time [1].

In the view point of the Thai Government, Pak Phanang River Basin's demise can be attributed to several factors. One was the encroachment and destruction of the watershed of the River Basin, causing floods during the monsoon and water shortage during the dry season, thereby decreasing the amount of farming areas. Furthermore, seawater that has intruded into the Pak Phanang River and its tributaries giving rise to shrimp farming activity. As a result, sewage from shrimp ponds is released into the river, damaging agricultural land, especially paddy fields, and forcing some rice farmers to leave their land in search of a better profession for a better living [1].

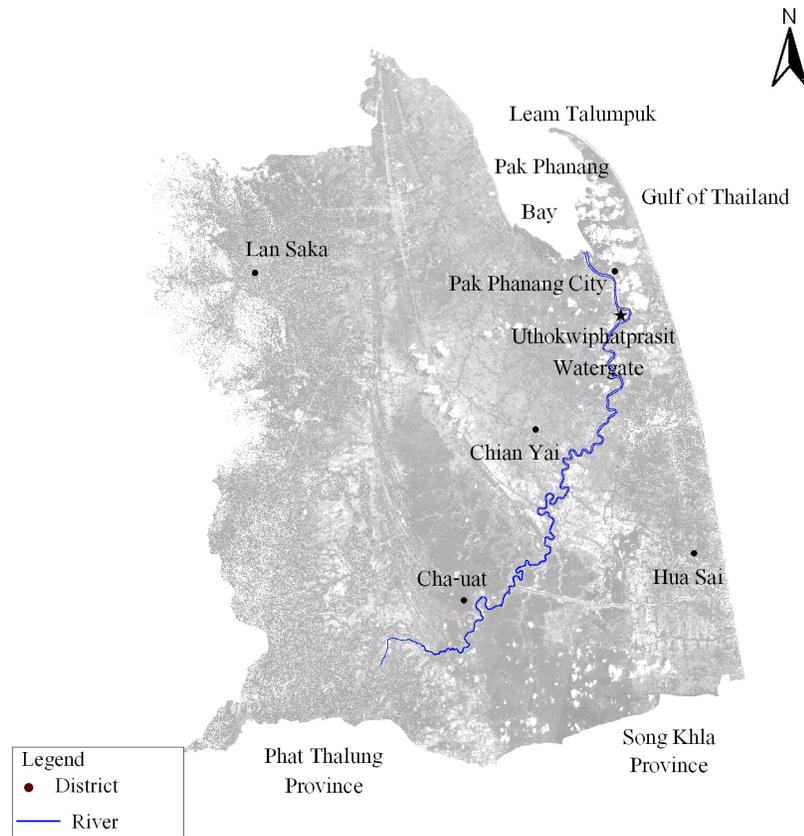


Figure 1 A satellite image showing the boundary of the Pak Phanang River Basin.

In 1995 Thailand's cabinet endorsed the plan for construction of an irrigation system, which consisted of a regulating watergate and drainage canals. In 1999, the *Uthokawiphatprasit* Watergate began its operation over the Pak Phanang River (**Figures 2 and 3**) in order to prevent salt-water intrusion into the inner area along the river and to keep fresh water for mainly agricultural purposes. Since the implementation of the watergate, debates over the environmental change in the area have raised many issues. The objective of this mini-review article is to examine some of the environmental changes in the Pak Phanang River Basin after the operation of the *Uthokawiphatprasit* Watergate.

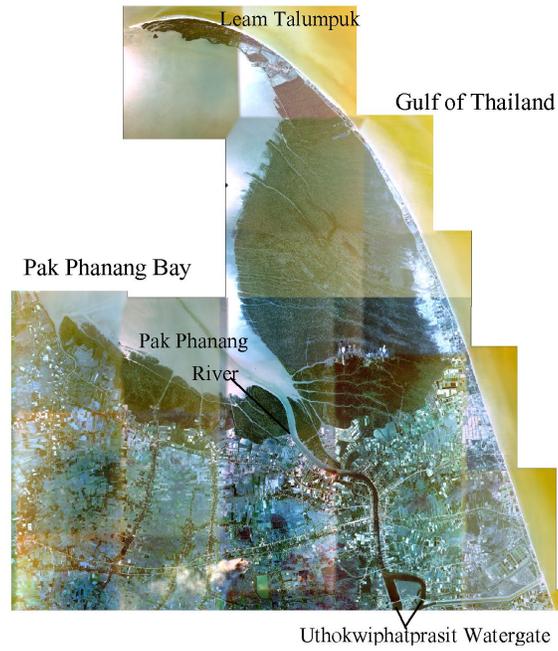


Figure 2 An aerial photograph of Pak Phanang Bay.



Figure 3 The *Uthokawiphatprasit* Watergate over Pak Phanang River.

ENVIRONMENTAL CHANGES

There have been many changes in the Pak Phanang River Basin since the operation of the *Uthokawiphatprasit* Watergate. However, only 5 environmental changes (morphology of the bay, water quality, fishery resources, field crops and human health) will be mentioned in this minireview article. This is because the authors only want to broadly explain the situation in the study area after the implementation of the watergate. Some environmental dimensions, then, may be missing from this article.

1. Morphology of the Bay

Pak Phanang Bay is a shallow basin that has an average depth varying from 1.5 meters to 5 meters in the middle of the bay's navigation channel [3]. There are three rivers emptying into the bay: Pak Phanang River, Bang Chak Canal and Pak Nakhon Canal but only the Pak Phanang River is a major source of fresh water supplying the inner bay [3]. Naturally, the circulation of the water in the bay depends on the tidal influence and the water from the river [3,4]. It was found that since the operation of the watergate water circulation in the bay has decreased [4]. This was because the watergate blocked the main waterway and caused stagnation of water in the bay. This might accelerate filling of the bay and make the navigation channel more shallow [3]. A recent study shows that the average depth around the boundary of Pak Phanang Bay is now only 0.5 meters [5] compared to 1.5 meters in 1991 [3]. With the watergate still in operation, the process of accumulation of sediments would guarantee that the progressive shoaling would continue, and that mangroves would colonize the inter-tidal areas, and encroach on the bay. Eventually, the entire bay would fill in except for the present channel, which would become the river [3]. Moreover, the stagnation of water in the bay might induce more deposition of sand along the east coast of Laem Thalumpuk. As a result, the Laem Thalumpuk shoreline would increase in length and extend its curving shape due to the influence of strong winds and currents from the Gulf of Thailand [6]. The more curved its shape becomes, the narrower the entrance to the bay. This assumption has thus called for further investigation over a longer monitoring time period.

2. Water Quality

The implementation of the watergate tends to cause a dramatic change in the water quality of the Pak Phanang River since the water stored over the watergate which was once brackish water for 3 months in summer would become permanent freshwater. In contrast, water below the watergate would become more saline. Without circulation of water stored over the watergate, the stagnant water might further decrease in quality due to contamination by insecticides, herbicides and fertilizers from the surrounding agricultural areas including shrimp farms and municipal wastewater [7]. The study of water quality along the Pak Phanang River by the Pollution Control Department of Thailand during 2002 to 2004 revealed that the values of the biological oxygen demand (BOD), total coliform bacteria (TCB) and fecal coliform bacteria (FCB) all were higher than the standard limit for surface water quality especially, during the operation of the watergate [4]. Surprisingly, the TCB and FCB values in many sampling stations were both high up to 160,000 MPN/100 milliliters (the standard limit of FCB and TCB are not higher than 4,000 and 20,000 MPN/100 milliliters respectively) [4]. It was also found that the dissolved oxygen (DO) values, which is an important parameter for the survival of aquatic animals, were lower than the standard limit in many sampling stations due to the reduction of flow velocity (the standard limit of DO is not lower than 4 milligram per liter). The DO values in some stations were even lower than 0.4 milligram per liter (the DO value for fishes survival is not lower than 2 milligram per liter) [4].

A remark by the Pollution Control Department was that the longer the time period of watergate closing, the poorer the water quality of the river [4]. However, the water quality of the Pak Phanang River is classified into class number 3 (the moderate class) according to the Surface Water Quality Standards by the Pollution Control Department which is suitable for consumption but needs to be purified and treated before domestic use, and for agricultural purposes [8].

3. Fishery Resources

It was found that before the operation of the watergate, the total number of aquatic animals found in the Pak Phanang River were 135 species classified as 116 species of fish, 10 species of crab, and 9 species of shrimp [9]. However, the number of animals has dropped to 82 species, classified as 72 species of fish, 2 species of crab, and 8 species of shrimp, since the watergate was installed 2 years

ago. The species most affected were the saline fishes (fishes living in salt water) of which 16 species were lost [9]. Moreover, it was reported that 96 species of aquatic animals all over the basin have become extinct in the wake of the operation of the watergate [10]. This significant decrease in fishery resources might be due to the blocking of fish migration by the watergate resulting in a lower abundance of fish diversity [11].

Since the fishery resources have declined, the degree of fishery production in the Pak Phanang River has also consistently decreased. A recent survey has shown that the fishery production in 4 districts along the river in 2001 was approximately 37 tones per month but declining to 27 tones per month in 2002 and to 22 tones per month in 2003 respectively [11]. This has caused many local fishermen to leave their career in search of a better profession for a better living. The survey also found that the number of fishermen along the Pak Phanang River has been dropped by 58 % since the operation of the watergate. It also revealed that only 20 % of fishermen still earn their living by fishing (**Figure 4**) but 80 % of those do fishing as their part time job [11].



Figure 4 A fisherman earning his living along the Pak Phanang River.

4. Field Crops

One reason for construction of the watergate is to store fresh water for agricultural purposes especially for rice production in the hope that rice production would increase and rice farming would expand. However, the tendency has been a decline year by year. The data in 1993, 6 years before the operation of the watergate, showed that the production of rice in 4 districts, which were the most important production areas along Pak Phanang River, were 136,000 tonnes but decreased to 95,000 tonnes in 1999, the year that the watergate started operation, and down to 78,000 tonnes in 2003 [12,13]. Meanwhile, the areas of rice farming successively decreased from 181,000 acres in 1993 to 147,000 acres in 1999 and further down to 90,000 acres in 2003 respectively [12,13]. This was because these areas have been subject to natural disasters such as flooding and drought nearly every year and also have been impacted by the effluent from shrimp farms. Therefore, saline water from shrimp farms will penetrate into the adjacent paddy fields and then damage the physical and chemical properties of soil in the paddy field, leading to inhibited rice growth and low production [14,15].

Besides rice farming, *Nipa Palm* (**Figure 5**) is another important economic field crop in this area. Villagers cultivate the *Nipa Palm* as their primary source of income in producing various products including sugar, vinegar, whisky, roofing, and cigarette wrap paper [16]. The data from surveys in 1995 showed that villagers could receive an average of 2,500 US. dollars per year per household for selling the sugar meanwhile the average income in this area was only 530 US. dollars per year per household [17]. *Nipa Palm* groves also play an important part in the natural ecosystem as a place of abundant marine life that also provided additional income for local fishermen [16]. It was found that in 1995, 4 years before the watergate installation, there were 10,200 acres of *Nipa Palm* in Pak Phanang River Basin especially, in the sub-district of Khanap Nak in Pak Panang district which was the most abundant with 2,000 acres [16].

However, villagers from most regions point out that recently *Nipa Palm* trees in the region are producing far fewer fruit [16]. This is due to dramatic change in water quality since the implementation of the watergate which changes the brackish water into fresh water (water stored upstream of the gate) and salt water (water stored downstream of the gate). This change apparently has an affect on the health of the *Nipa Palm*, which grows in brackish water. For this reason,

many villagers have changed their *Nipa Palm* forest into shrimp farms to increase their income [16]. Thus, in 2005 there were only 100 acres of *Nipa Palm* trees in the sub-district of Khanap Nak which still produce fruit [18].



Figure 5 *Nipa Palm* Forest.

5. Human Health

The stagnation of water in the Pak Phanang River has resulted in an abundance of vector animals capable of spreading diseases such as *Dengue Fever* and *Malaria* (both transmitted by mosquitoes) and *Leptospirosis* (transmitted by rats) [10]. It was found that the number of mosquitoes has increased since the watergate has been closed [19]. The record from the office of public health in Nakhon Si Thammarat Province revealed that in 2002 the rate of patients suffering from *Malaria* in Pak Phanang district was 0.85 per 100,000 people but as high as to 3.71 per 100,000 people in 2005 [20]. It follows that the watergate might induce a higher incidence of *Malaria* in the area. Meanwhile, the trend in *Dengue Fever* revealed an insignificant difference which in 1996, before the operation of the watergate, was found to be 3.03 per 100,000 people [21] with an increase to 3.07 per 100,000 people in 2005 [22].

For *Leptospirosis*, it was found that the number of rats, which are carriers for the disease, has been growing rapidly. This was because there was an abundance of water and food, good condition for the reproduction of rats [23]. However, it was found that *Leptospirosis* which once spread out in 1988, 1999 and 2000 has since decreased due to control by the local public health office [20]. Therefore, the assumption that the Watergate contributes to the spreading of the disease in the study area requires more investigation.

CONCLUSIONS

The main aims of construction the *Uthokawiphatprasisit* watergate in the Pak Phanang River are to prevent salt-water intrusion upstream into the river and to store fresh water for agricultural purposes. However, since the watergate has been in operation there are many concerns about the impacts of the watergate on the environment of the basin. It was revealed that the watergate caused the water circulation in the bay to slow down which accelerated the rate of sediment deposition and then might result in escalating the sediments filling up the bay. Moreover, the watergate resulted in poor water quality stored upstream and downstream of the gate. It also resulted in less fish diversity as it blocked the migration of fish leading to a decline in fish production in the area which has forced many fishermen to leave their career in search of a better life. Furthermore, the watergate has an affect on the health of the *Nipa Palm*, which was once an important economic field crop in this area. Finally, the watergate might cause the spread of *Malaria* in this area. The suggestions of this study are that the impacts of the watergate need further study and also the local communities should be allowed to have more participation in matters relating to the appropriate management of the watergate. In the next phase of development, a top priority should be given to sustainable development. This is because watergates (or dams) are always at the centre of the debate about sustainable development because of their role in allocating water resources and the impact they have on a wide range of stakeholders and the environment.

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บทคัดย่อ

ทิพย์ ปราบณรงค์ และ เจนจิรา แก้วรัตน์

ประจวบจันทน์ อุตสาหกรรมและพลังงาน: การเปลี่ยนแปลงของกลุ่มน้ำปากพนังอันเนื่องมาจากการกระทำของมนุษย์

บทความนี้กล่าวถึงสิ่งแวดล้อมของกลุ่มน้ำปากพนังที่เปลี่ยนแปลงไปหลังจากการเปิดใช้ประจวบจันทน์ อุตสาหกรรมและพลังงานซึ่งสร้างขึ้นแม่น้ำปากพนัง ในจังหวัดนครศรีธรรมราช เนื้อหาในบทความพบว่า ประจวบจันทน์ทำให้เกิดการหมุนเวียนของน้ำในอ่าวปากพนังลดน้อยลงซึ่งนำไปสู่การเร่งการตกตะกอนในอ่าวปากพนัง ประจวบจันทน์มีผลทำให้คุณภาพน้ำลดลง และส่งผลกระทบต่อชนิดของปลาและปริมาณสัตว์น้ำที่ลดลง นอกจากนี้การสร้างประจวบจันทน์ยังมีผลต่อ “ป่าจาก” ซึ่งเป็นพืชเศรษฐกิจบริเวณนี้ ที่ท้ายที่สุดมีเหตุให้เชื่อว่าประจวบจันทน์ทำให้การขยายตัวของโรคมะเร็งเพิ่มขึ้น