

The possibility of making water retention basins (“monkey cheeks”) in the Gulf of Thailand as a long-term solution for flooding

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Abstract:

After the devastating floods of 2011, the floodwaters in areas of upper Thailand flowed down the course of the natural flood plains of the Chao Phraya river basin. Their entrance into the Gulf of Thailand was slow. This occurred because of many factors that arose as the government and other stakeholders were attempting to ameliorate the problems. At least three major factors related to the drainage of water into the Gulf should have been considered by the government in order to address the issues and to achieve full protection from flooding. As it is, the cost of damages reached 1.44 million baht. Taking into account the experiences from 2011, we must keep in mind the following three issues: the amount of surface that bears the floodwater (the retention basins, or “monkey cheeks,”), the drainage of the extra water into the ocean proceeds at a slow pace, and the water level in the ocean is rising due to global climate change and storms in the Gulf of Thailand. In-depth research has not yet been carried out about the phenomenon of rising sea levels in Thailand.

This paper presents trends of thought on the possibility of making water retention basins in the Gulf of Thailand at the river basin of the Chao Phraya River in order to target the problem of the drainage of water into the ocean with a fully systematized solution. The concept of the water retention basins, or “monkey cheeks,” comes from the research and ideas of King Bhumibol Adulyadej combined with local knowledge about living with water in ancient cities of the past. This approach will be enhanced with technologies related to dams, water locks, and modern, floating architecture, in addition to techniques related to material use and modern construction. Furthermore, the propose methods will address flooding challenges without or less damaging the coastal ecosystem and could also help with the problem of coastal erosion in Bang Khun Thian. Also the multidisciplinary assessment including the biosphere environment condition and socio-cultural aspect along the coastline shall be taken into account to support the concept.

Keywords: *in-the-gulf flood water retention basin, living with water, coastal ecosystem*

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1. Introduction

After the devastating floods of 2011, the floodwaters in areas of upper Thailand flowed down the course of the natural flood plains of the Chao Phraya river basin. Their entrance into the Gulf of Thailand was slow. This occurred because of many factors that arose as the government and other stakeholders were attempting to ameliorate the problems. At least three major factors related to the drainage of water into the Gulf should have been considered by the government in order to address the issues and to achieve full protection from flooding. As it is, the cost of damages reached 1.44 million baht. Taking into account the experiences from 2011, we must keep in mind the following three issues: the amount of surface that bears the floodwater (the retention basins, or “monkey cheeks,”), the drainage of the extra water into the ocean proceeds at a slow pace, and the water level in the ocean is rising due to global climate change and storms in the Gulf of Thailand. In-depth research has not yet been carried out about the phenomenon of rising sea levels in Thailand. This article will present trends of thought on the possibility of making water retention basins in the Gulf of Thailand at the river basin of the Chao Phraya River in order to target the problem of the drainage of water into the ocean with a fully systematized solution. The concept of the water retention basins, or “monkey cheeks,” comes from the research and ideas of King Bhumibol Adulyadej combined with local knowledge about living with water in ancient cities of the past. This approach will be enhanced with technologies related to dams, water locks, and modern, floating architecture, in addition to techniques related to material use and modern construction. Furthermore, this method will address flooding challenges without damaging the coastal ecosystem and could also help with the problem of coastal erosion in Bang Khun Thian.

2. Releasing floodwater & the capability of the river and ancient yet changing canal systems to support the water

In the past, the area of Bangkok, including both sides of the Chao Phraya River, especially the Thonburi side, was crisscrossed with a network of canals. If a person were a farmer or a gardener in those times, they would know the phrase: “Bangchang is outside [in the countryside]; Bangkok is inside [the cosmopolitan space].” The area called Bangkok, which used to be known as Bangkor, is on the Thonburi side, cut through by the Thonburi Canal. In the past, the canals in Thonburi Canal were the main paths for floodwaters, helping to drain water from the upper Chao Phraya to flow into the sea, from Samut Sakhon to the Chao Phraya estuary. At the present time, the canal network has been encroached upon; the canals have been separated by embankments and filled in for purposes of land development, and the system is nearly destroyed. As a consequence, during the floods of 2011, the canals in Thonburi were unable to bear the amount of water, and the flooding was severe. This kind of flooding could happen again. Due to the expansion of communities onto dry land and the use of roads as routes of transportation and communication instead of canals, which were used by fisher people in Thonburi, the number of canals has been reduced from the many thousands that used to exist. Now they have become streets, and the places that used to be filled with water are now prefabricated housing developments, the canals having been filled in and covered with concrete. These changes have caused the area’s ability to sustain floodwaters to disappear.

We can see that the natural topographical conditions of this place have changed; they have been violated by the rapid growth of communities and cities, and streets now block the paths of water. The city plan for Bangkok did not take into consideration the natural characteristics to which the ancestors were able to adapt and to establish ways of life that fit with the aforementioned natural surroundings. Because of this lapse, the huge amounts of water in 2011 could not be drained into the sea quickly enough, and the water was confined to land for months, resulting in devastating flooding.

Meanwhile, King Bhumibol Adulyadej had an idea to provide a place where water retention basins, or “monkey cheeks,” could be created in order to sustain the amounts of floodwater in areas at the mouth of the river before the water flows to the sea. This method should be systematized in order to alleviate flooding. Since 1995, this method has not been able to be applied successfully and completely. Only some aspects have been implemented and the state of affairs is regretful.

3. The purposes of the Monkey Cheeks Project according to the concepts of the King

The Monkey Cheeks Project is one part of the plan to address flooding problems in Bangkok. The approach has been set according to the King’s concepts, including a project to dig new canals, get rid of weeds, build and improve pump stations, and build water release gates. In 1995, heavy flooding occurred in the lowlands around the Chao Phraya River due to heavy rains in the upper river basin. Large quantities of water were rushing down the river with much flooding, especially around the Yom and Nan Rivers. There was excessive water in the reservoir of the Sirikit Dam, and the reservoir overflowed, flooding a large area. This event impacted flooding in the lower parts of the Chao Phraya River, including in Bangkok and the surrounding areas. The floods persisted for more than two months.

On the 14th of November 1995, King Bhumibol Adulyadej called a royal audience for those individuals working on flood prevention and alleviation in order to speak with them about his ideas on protecting Bangkok and surrounding areas from flooding. He drew a comparison involving the eating habits of a monkey; after a monkey has chewed a banana, the monkey does not swallow it but saves the food in both cheeks. The monkey then proceeds to eat the banana slowly. This behavior is similar to the case of the diversion of water from the Chao Phraya River, including the

water that flowed into the sois (side streets off of main roads). When high tide comes and water flows into the large swamps that are close to coastal areas and settlements, large water gates can block the water in the retention basin areas on the western side at the Chai Thale Canal, and on the eastern side the water retention basin area will be near Sapasamit Canal. When low tide comes and the water recedes, the gates will open and the water will be released. The swamps can then receive continual cycles of water.

The concepts and ideas proposed by the King to prevent flooding in Bangkok are as follows:

- 1.) Build levees by adjusting the paths of existing roads;
- 2.) Create green spaces, or a “green belt,” in order to expand the scope of the city and to increase drains and drainage areas during times of flooding;
- 3.) Build new canals and levees and expand the sizes of existing canals;
- 4.) Build reservoirs at various sites; and
- 5.) Expand water channels that receive and carry water beside railway tracks and highways. The Highway Department can undertake this project according to the Royal Monkey Cheeks Project guidelines which propose using the path of Sukhumvit Road as a levee that can support the rising water from the sea that floods into the coast, and the interior of Sukhumvit Road can be used as a canal to store water that flows down from the upper region. The Highway Department can coordinate with the Irrigation Department and the Public Works Department to build pump stations at various canals that are near Sukhumvit Road and the Chai Thale Canal. Canals that are efficient in pumping water and should be included in the project are as follows: Tamru Canal, Bang Plaaraa Canal, Bang Plaa Canal, Charoen Rat Canal, Dan Canal, and Chon Han Pichit Canal. The amount of water that these canals can pump into the ocean is 267 cubic meters of water per second, which would enable all of the water from the upper region gathered in canals to flow down and out to the ocean in a convenient way at a faster pace.

Addressing the problems of flooding in Bangkok and surrounding areas according to the Royal Monkey Cheeks Project involve the following methods and characteristics:

- 1.) Water that drains from the upper regions should be managed by directing it down through large canals in the coastal areas;
- 2.) When the water level of the ocean is lower than the water level in the canals, then the water should be drained from the aforementioned canals to flow out, according to the natural theory of Gravity Flow;
- 3.) Pump water out of the canals that serve as “monkey cheeks” so that water from the upper regions can gradually flow down on its own over time. This will result in a reduction of the amount of floodwater; and
- 4.) When the water level of the ocean is higher than the water level in the canals, the water gates should be closed so that water can only flow in one direction (“one way flow”).

Three principles that will cause the structure and layout of the Monkey Cheeks Project to succeed with efficiency according to the ideas of the King are as follows:

- 1.) The main performing areas will be the water storage ponds and the main method will be to direct the water so that it flows into the water storage ponds;
- 2.) The routes for water flow must be convenient so that the water can enter the water storage ponds; and
- 3.) Water must be drained continually from the water storage ponds.

The Royal Monkey Cheeks Project for the Western Coast of the Chao Phraya River will use the Chai Thale Canal that runs along the ocean in Samut Prakan Province as a water storage pond or as a space to receive and store water.

The Royal Monkey Cheeks Project for the Western Coast of the Chao Phraya River has the goal of receiving the water from areas on the western coast of the Chao Phraya River in order to drain the water into the ocean through Samut Sakhon Province. King Bhumibol Adulyadej has developed this project so that floodwaters can be drained into the ocean at a faster pace by using a variety of methods.

The Monkey Cheeks Project for the Tha Chin River uses the principle of controlling water in the Tha Chin River by releasing large amounts of water into the Gulf of Thailand when the sea level is low.

The Monkey Cheeks Project for the Lower Tha Chin River is successful and efficient due to the combination of three different project components, as follows:

- 1.) The Monkey Cheeks Project for the Lower Tha Chin River
- 2.) The Monkey Cheeks Project for the Maha Chai and Sanam Chai Canals
- 3.) The Monkey Cheeks Project for the Sunak Hon Canal

The Monkey Cheeks Projects can be regarded as an omen that will help the Thai people to escape from suffering and hardship so that they may live safely and contentedly. The King's concepts are theories about flood administration and management, and the King elaborated, "Now we can proceed on a path that is correct. I ask that you hurry to find methods to improve and increase efficiency related to these ideas, because in the future the Monkey Cheeks Project will be able to help many areas in Thailand."

In fact, if we ask, "Has the Royal Monkey Cheeks Project been implemented thoroughly and successfully or not?" the answer will be, "Not yet." At the present, the areas of land that were referred to in the Royal Project in 1995 are being used in many different ways, and some areas have very high prices; these areas have become economic zones and stakeholders are not open to the idea of turning them into "monkey cheeks" or water storage areas. Furthermore, these areas lack effective administration and dedicated project leaders. Looking at statistics from recent years, the numbers indicate that amounts of rainwater are increasing, and storms are growing stronger. These changes are results of global climate change. What can we do to address these problems?

4. Global climate change and impacts for the Gulf of Thailand

We all know that one phenomenon that has impacted the massive floods of recent years, including the floods of 2011 is the phenomenon of global climate change. Data clearly indicates that ice at both poles is melting, and sea levels will rise across the world by at least 1.0 to 1.5 meters by the year 2100, but no experts have predicted the speed at which the water will increase. Furthermore, predictions have not been made about the extent to which flooding and storms, especially local storms in Southeast Asia, will increase as a result of global climate change. These weather changes will have negative impacts in lowland areas. The question now is: When and to what extent will these changes impact Thailand?

In 1990, a geologist from Chulalongkorn University publicized the results of his research on the changing coastline of the Gulf of Thailand due to rising sea levels projected for the year 2100 in the journal *Southeast Asian Studies*, Vol. 28, No. 2, September 1990. The article featured a map of Bangkok showing where the water would reach by the year 2100. This map was created by estimating the amount by which the sea level will rise based on calculations of water ratios using minimum amounts of water as the standard (Hoffman, 1984). When the amount of ground water existing currently in Bangkok is added to the predicted amount of increase, we can envision that in 2100, the coastline in Bangkok, Samut Prakan, and including those areas in Western Bangkok described by the King in his royal concept, extending upwards to northern areas such as parts of Bangken and Lamlukaa, will be underwater.

At the present time, there are measures to stop the use of groundwater in the Bangkok area, and drainage tunnels are being constructed in Ramkhamhaeng, Pra Kanong, and Prawet, which are areas that are regarded as being the lowest points of land in Bangkok (0.0 – 0.15 m average). When the tunnels are finished, water will be able to flow through them to be drained into the Chao Phraya River. If an approach is not developed for protecting Bangkok, floods from rising water levels will increase every year due to global climate change based on the estimations of the aforementioned researchers. Researchers also predict the possibility of storm surge conditions when severe storms gather on the ocean. It is not certain whether Bangkok will survive from drowning, and we must make careful considerations. Apart from this, in the past three to four years, a group of engineers and researchers proposed the idea to build a dam to protect from ocean floods just like the dams constructed in the Netherlands. This kind of dam would separate the upper Gulf of Thailand, or the Gulf in its entirety, causing it to ultimately become a freshwater lake. This method would solve the problem of flooding in Bangkok in the future and would help to protect the coast from waves and storms in cases where large storms blow into the Gulf of Thailand.

However, many researchers and environmental conservation groups have publicly opposed this plan. They assert that the dam will destroy the coastal ecosystems, such as the swampy wetland areas and mud flats that lie at the shores of the ocean. Furthermore, the economic systems of coastal communities will also collapse. At the present, the communities that live at the edge of the sea, numbering around one million people, make their livings as fisher people. If a dam is constructed, how will they survive? (Thanawat Charupongsakul 2009)

Assistant Professor Thanawat Charupongsakul from the Faculty of Science of Chulalongkorn University, at an academic seminar commemorating the occasion of National Environmental and Water Conservation Week and World Water Day in 2009, spoke about his research on the changing sea levels in the future in the upper areas of the Gulf of Thailand. He found that if protection measures aren't implemented in these coastal areas, in twenty years, seawater will flood approximately 67,000 rai of coastal areas and the land will lie below sea level. In 50 years, 197,497 rai will be flooded, and in 100 years, 450,428 rai will be covered with water (Ibid: 35).

5. Conclusion

In conclusion, whether the study in question is of Western or Thai origins, the findings are identical: in the midst of global climate change, the weather conditions will only continue to grow more severe. Seawater will flood the coastal areas of the Gulf of Thailand. When and at what rate will it occur? No one has been able to answer these questions clearly. Therefore, before it is too late, we must educate ourselves and search for protection strategies.

Strategies for releasing water at low tide and protecting the coast at high tide in the Gulf of Thailand “...In the 11th month (late September – late October), the water floods... in the 12th month (November), the water lies still... in the 1st and 2nd months (December and January), then the water flows down...”

The message above illustrates that in the past, local people living in the lowlands surrounding the Chao Phraya River basin in Central Thailand were aware of and acknowledged water patterns. Every person knew that when “water” flowed through Central Thailand, it flowed and drained slowly, especially during the 12th month (November, or the time of the Loi Krathong Festival) when the water stood still and levels remained the same due to the natural cycle of the tides. Knowledge of the system and timing of high and low tides was necessary to enable successful and complete drainage of the flowing water. This knowledge is included in the Royal Monkey Cheeks Project, and is important especially in relation to the plan to create water retention basis on the coast

of the Gulf of Thailand. This plan still has not been achieved; instead, urban development has expanded and intruded across these areas, and the land price has become too expensive to allow for the implementation of the project. Apart from this, the most recent flooding from Upper Thailand resulted in damages costing 1.44 million baht; what will happen if the floods come again, this time from below, or if floods from the upper regions and the Gulf occur at the same time?

Is it time yet or not to investigate the possibility of making “monkey cheeks” water storage areas near the sea in order to prepare to live according to the principles and concepts of a holistic approach? We can use the method of creating a new environment in order to enhance and restore our natural environment. Ideas are as follows:

- Drain floodwaters from upper areas into the Gulf of Thailand as quickly as possible using the ideas about gravity flow and water drainage detailed in the Royal Monkey Cheeks Project.
- Store water that has been released from the river and upper inland areas by directing it into the storage areas or “monkey cheeks” along the coast or by draining it into the ocean.
- Protect from flooding during high tide, storm surges, and from rising sea levels due to global climate change in ways that are appropriate.
- Solve the problem of coastal erosion and allow water to go in and out by using water gates to control the water appropriately.
- The impacts on ecosystems and local economies also must be taken into consideration.
- The ability to travel on the ocean with the appropriate routes and paths is necessary.
- The aforementioned areas should be able to be used for various social and economic benefits.

The following four options are proposed for further study and detailed consideration.

1) Option One: Thames Barrier Model

This is a method to protect from high tide and to drain water from the upper river in the area of the mouth of the Chao Phraya River by building a dam at the mouth of the river. The barrier would be a defense against high tide, and water would be pumped and drained from the upper river basin in the rainy season. This method has been developed from the concept for protecting against high tide at the Thames River in England; the project is known as the Thames Barrier. Construction of the barrier took more than three years. The total budget was more than 8,000 million baht.

- The construction time should not exceed four or five years, and the budget should not exceed 10,000 million baht.
- The barrier would protect against high tide during the rainy season.
- This project involves pumping and draining the water from the Chao Phraya River north of the dam into the mouth of the river during the rainy season.
- At regular intervals, the dam must be opened to enable water travel, and the dam can also be a tourist attraction just like the Thames Barrier.
- This option can't help with the problem of coastal erosion and it can't protect against floods that originate in the Gulf of Thailand.

2) Option Two: Build “Monkey Cheeks” or Water Retention Areas at the Mouth of the Chao Phraya

This option involves creating water storage areas at the mouth of the Chao Phraya River by filling in certain areas around the estuary so that they become long islands. Water gates will be created that open and close so that boats can enter and exit at regular intervals. The gates will be closed during the flooding season (September- November) and the water will be pumped out to lower the water level and to drain the water out in the flooding season. The gates will be opened and can serve as water travel routes in normal times.

- Salt water will be blocked from entering the Chao Phraya estuary and water will be stored for possible use during the dry season.

- Small “monkey cheek” areas will be used so that water can be pumped out from the dam in order to lower the water level in the mouth of the river. This will help water to drain through the Chao Phraya waterways at a faster pace.
- This option will help drain water and protect from storm surges from the ocean, like option one and its location at the mouth of the river.
- Construction will take more time and the budget will be higher compared to option one.
- This option would not address the problem of coastal erosion or the problem of flooding coming from the Gulf of Thailand, except for at the mouth of the Chao Phraya and some areas of Eastern Bangkok.

3) Option Three: Build “Monkey Cheeks” on Both Banks of the Chao Phraya River

This option involves building “monkey cheek” water retention areas on both banks of the Chao Phraya. They would be located about seven to eight kilometers away from the coast and they would be about five to seven meters deep. They could be built in combination with monkey cheeks at the mouth of the Chao Phraya (as in Option Two) in order to gradually drain water into the Gulf of Thailand during the flooding season. It is an opportunity to support the use of floodway/diversion according to the policies of the government.

- During the flooding season, the gates will be closed to retain water. Small monkey cheek areas will be created on the eastern and western banks. They will contain the water from the floodway/diversion, and the water will be pumped and drained out of the monkey cheeks on both banks in order to reduce flooding in Eastern and Western Bangkok and surrounding areas. When the flooding season is over, the water gates will be opened so that boats can travel back and forth, and the water will flow normally.
- This option would protect against storm surge tides as in Option One, and it would prevent coastal erosion in the areas of Samut Sakon, Bangkok, and some parts of Samut Prakan.
- Coastal areas in Bang Khun Thian and Samut Prakan could be restored.
- Construction would take longer, and costs would be higher compared to the first and second options.

4) Option Four: Build “Monkey Cheeks” in the Gulf of Thailand

This option involves creating enclosed spaces that serve as monkey cheeks in the Gulf of Thailand by building islands in long “I” shapes. The islands would have many water gates in order to balance the flow of water to the coastal ecosystems and to support the drainage of floodwater from Upper Thailand. Furthermore the area could be used for economic gain to balance out necessary investments. In this way, this approach is not unlike the case of Venice, where water gates were constructed in the bay according to natural fortification patterns.

- Large monkey cheeks would be built at the bottom of the Gulf of Thailand at a distance of about 20 kilometers from the coast. They would not be more than twelve meters deep in order to accommodate water from the flood way/diversion and to pump and drain the water out of the monkey cheeks in order to reduce the flood areas in Western Bangkok and the surrounding areas during floods.
- This option would protect against storm surge tides, like Option One, and would prevent coastal erosion.
- Coastal areas of Bang Khun Thian and Samut Prakan that have disappeared could be restored.
- Construction would take longer and costs would be higher compared to Option Three.

Additional benefits expected from the construction of monkey cheeks in the ocean

- The creation of the islands as monkey cheeks can be taken advantage of in that income from the new economy of the green compact cities on the islands will be generated and this will

also support tourism.

- The area can be used as a bridging route (logistics route) to connect the east coast to the west coast and to bypass Bangkok.
- The areas around the monkey cheeks can be used as spaces to breed and raise aquatic animals, and brackish water fisheries can be established within the cheeks during the flood season, for a period of about three to four months.
- An environmental impact assessment must be conducted for the impacted areas.
- The water gates would be opened to allow water travel and to allow the ocean currents to flow. This would be continued in other seasons to keep environmental impacts to a minimum.
- If it is necessary to find an area to store freshwater in the long term to address the problem of drought, Option Three could be used to meet this need with a water holding capacity of approximately 2,450 million meters. Option Four has a water holding capacity of 8,000 million meters. An environmental impact assessment would need to be carried out before a final decision could be made.

Next Steps

The government should study and research in detail the aforementioned ideas by assigning institutes to collaborate with water experts and experts from relevant engineering fields, in addition to coastal environment experts, natural resource specialists, economists, and sociocultural experts. Together they should conduct research with a multidisciplinary, holistic approach and participatory methods that involve local communities in order to achieve fair practice. At the least, the following research objectives should be considered:

- 1.) A study should be carried out on the possibility of creating monkey cheeks in the estuary of the Gulf of Thailand and the Chao Phraya River basin that includes assessment of the technical, economic, and social impacts.
- 2.) Existing research on the coastal ecosystems of the Gulf of Thailand should be reviewed, and the positive and negative aspects of building monkey cheeks in the ocean should be examined. Suggestions of approaches for problem solving should be provided.
- 3.) Existing research on case studies of coastal erosion in the Gulf of Thailand should be reviewed, and relevant positive and negative aspects of building monkey cheeks in the ocean should be studied.
- 4.) The process of comprehensive, participatory collaboration at each stage of the project, from the project's beginning until the research results are presented to the government, must be considered and studied so that the methods can be included in policies and used for future projects.

Thailand should invest in research and development in order to apply beneficial technologies that are integrated with our own wisdom and knowledge. This will help to achieve balance with the natural environment, and these approaches must be put into practice before it is too late.

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