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Dealing with Climate Change Disaster in Thailand

Abstract

In some parts of the world, '*Climate Change*' is contributing to socio-political tensions but only as one factor amongst other. The study will elaborate the situation and lesson learned from Thailand especially from the eyes of a landscape architect.

This paper aims to explore the innovations on disaster risk reduction and climate change adaptation practices in the tropical cities in Thailand. They are included : King of Thailand's projects including the UN's award philosophy: '*Sufficiency Economy'*, *Royal*, Forest rehabilitation using temporary weir, *Chaipattana*, Constructed wetland and other biological techniques of waste water treatment, Floodwater management using detention area called '*Monkey cheek*' and diversion technique called '*Klong Lad Pho*', '*The living barrier*' Vetiver Grass (Vetiveria zizanioides, Crysopogon zizanioides), and many more mitigations by scholars and all levels of agencies to deal with emerging trends and vulnerabilities.

Landscape architects are now playing an important roles working together with others to deal with the problems. The questions are whether the mitigations and adaptations are theoretically applicable to other landscape architecture concepts, and whether they relevant and helpful to be generalized for other tropical countries.

Keywords: climate change; landscape architecture; hotspots; disaster; cyclones; flooding; drought; adaptations; environment; tropical

1. Introduction : Locate Thailand in 'Climate Change' hot-spots

The NASA's Moderate Resolution Imaging Spectroradiometer, or MODIS (land surface, shallow water, clouds) during June through September 2001. MODIS shows polar sea ice combined with those of Antarctica and the green and desert areas. This helps us imagine the situation of the earth landscape. From this image Thailand and south-east countries are seen in the green area as well as the other tropical climate countries like Brazil and south America. The further question has risen whether or not we are in the climate change '*hot-spots*'.



Figure 1 : The NASA's Moderate Resolution Imaging Spectroradiometer (MODIS)

If we explore further, the country's environmental profiles show its emerging trends and possible vulnerabilities affected from *'Climate Change'*. As a country located in tropical climate zone in South East Asia, World Resources Institute reports¹ Thailand's environmental profile that Thailand has 7066 km length of coastline, therefore if it is compared to the size of country which is only 513,115.02 square kilometer, Thailand has quite long coastline especially at the Southern part where the long narrow continent is penetrated into the Andaman sea and Gulf of Thailand surrounded with islands and coral reefs.

Considering the area of Mangrove Forests: 5092 km2, total forest area: 14,762,000 ha (more 9,842,000 ha natural forest area than 4,920,000 ha plantations area). Forest area in 2000, compared with other country as a percent of total land area Thailand is better than the average of Asian countries 29 % (Asia 20 %, World 29 %). Also percent of total land area covered by: Forests in Thailand is higher than average of the Asian countries and the world 31 % (Asia 17 %, World 24 %). But the shrub lands, savanna, and grasslands is lower 9 %(Asia 37%, World 37%), and higher mosaic 59 % (Asia 34 %, World 20 %). Urban and built-up areas, Thailand is similar to others 0.2 % (Asia 0.2 %, World 0.2 %). Wetlands and water bodies 2 % (Asia 2 %, World 3 %).

Even though, the emission data of those Thailand's contribution regarding 'green house effects' are not as high as industrialized countries, but it seems in these following data that Thailand has increased the numbers of emissions significantly, perhaps in order to serve for economic

¹ World Resources Institute <u>http://earthtrends.wri.org</u>

development proposes. The information of the per capita CO_2 emissions in 1998 was three thousand metric tons of CO_2 . But in percent change since 1990 in Thailand is recently high 85 %, while the world -2%, and Asia (excl mid east) 19%.

Thailand's main domestic products have been shifted from agriculture to service and industrial sectors, especially tourism related industries. Percent of GDP earned by Agriculture 10 % Industry 40 %, and Services 49 %. One problem which may cause to the forest areas, where are the resources of tourism. This is shown in data of the change in forest area, the total during 1990-2000 is in higher minus digit than Asia and the world: Thailand -7 %, Asia (excl mid east) -1 %, World -2 %). This cause from the natural forest, and we have planted more forest during 1990-2000. Natural forest in Thailand decreased -26 % (Asia -1 %, World -4 %), but the forest plantations increased 6 % (Asia 5 %, World 3 %). Briefly, there is a significant relationship between increasing GPD in tourism sector and the total area of the natural forest.

In addition, Bangkok is a mega-city and ranked as the world's 15th largest metropolitan capital. Furthermore, Bangkok is considered the largest center for international airlines in the Southeast Asian region with its rich natural resources for tourism industry. Bangkok as the capital of Thailand, the Metropolis and its vicinity towns have constituted the national base economic, political and cultural activities serving the international community as the country's main focal point throughout the years. Once Bangkok is exposed to all kinds of disasters, it assumes to affect to countries and probably at least to the South-East Asian region.

According to 2009 'The Climate Games Change' meeting by UN in Bangkok, Thailand considers itself another '*climate change hot spot*' of several risks such as particular from cyclones, flooding, and drought. '*The convenient truths*' are not only in the movie but it is coming closer to us in the near future. Those are the followings:

- South and Southeast Asia are climate change "hotspots" at particular risk from cyclones, flooding, and drought.
- Climate change will likely kill around 30% of Asia's coral reefs in the next 30 years, making coastlines more vulnerable to storm surges.
- Insect populations will thrive in warmer weather, making crops more vulnerable and carrying diseases like dengue to new locations.
- With a 1 meter rise in sea level, 2 500 km2 of mangroves in Asia are likely to be lost, increasing storm damages.
- The United Nations predict that the global cost of adaptation will be \$86 billion per year by 2015.
- Insurance companies worldwide are already raising premiums and changing policies to reflect new risks from climate change.

[Source : THE CLIMATE GAME CHANGE, Bangkok 22 Jan 2009]



Figure 2 : Climate hotspots in south and south-east Asia

Figure 2 shows climate change hotspots on the land which are cyclone, flood, and drought. But we can also observe the hotspots in the sea (see Figure 3), this shows coral bleaching events from increasing of the sea surface temperature (1997 – 1998). The sea surface temperatures in different areas are increasing significantly from $1-4^{\circ}$ C.





Figure 3 : Coral Bleaching Events and Sea Surface Temperature Anomaly Hot Spots, 1997 - 1998

In some parts of the world, 'Climate Change' is contributing to socio-political tensions but only as one factor amongst other, more immediate environmental triggers like water shortages, food insecurity and land degradation. A combination of conditions – including poverty, inequality and poor governance – is typically required for tensions to erupt in outright conflict². Thus, it is an important movement in all disciplines in order to deal with the climate change. The crisis requires not only in the national level, but also all levels of participations; public, private, community, and also individually.

The study will elaborate the lesson learned from Thailand especially from the eyes of a landscape architect. Landscape architects are now playing an important roles working together with other environmental disciplines to deal with the problems. The questions are whether the mitigations and adaptations are theoretically applicable to other landscape architecture concepts, and whether they relevant and helpful to be generalized for other tropical countries.

2. Situation in Thailand : Climate change crazy fear?

The author explored the innovations on disaster risk reduction and climate change adaptation practices in the tropical cities in Thailand. The climate change disasters are concluded as followings:

- cyclones, flooding, and drought,
- coastlines more vulnerable to storm surges,
- coral bleaching events and sea surface temperature anomaly Hot Spots
- mangroves in Asia are likely to be lost, increasing storm damages, crops more vulnerable,
- and carrying diseases like dengue to new locations

There have been many scholars and experts discussed on the climate change issue, some of them argued that whether Thai society is currently *climate change crazy*. Sathon Vijarnwannaluk, a lecturer at the physics department, Chulalongkorn University, voiced concern over a misapprehension about climate change among the public forum on 5th Feb, 2009. And at least, the following outstanding scholars talked about sinking Bangkok in a magazine;

Dr. Smith Thammasaroch, Chairman of National Disaster Warning Committee

Dr. Seree Suprathit, Director of Natural research centre at Rangsit University

Dr. Rawee Pavilai, Astronomer

Dr. Anond Snidwongse Na Ayudthaya, expert on Global Warming from Chulalongkorn University

Dr. Thanawat Jaruphongsakul, Research Unit for Disaster and Land information studies-Chulalongkorn University

The question is it is actually the fear or the information is scientific proved. The situations such as extreme weather, increasing in strength/frequency of typhoons, heavy rainfall (La Niño), storm surge, sea level from glacial retreat and Arctic shrinkage, salt water evades to the Chao Phraya river, sea temperature (El Niño / ENSO -El Niño - Southern Oscillation), drought (5-10% less than average) from El Niño / ENSO, health and diseases, bio diversity, coastal area, coastline erosion : Wat Khun Samut Chine, Samut Prakarn 20-25 m/yr and impact on settlements in the

² Humanitarian Implications of Climate Change. <u>http://www.careclimatechange.org</u>

Bangkuentian, or 130,000 rai all over Thailand, or even stronger affects from national disasters : Gay Typhoon in 1989, Indian Tsunami in 2004, etc are some evidences of the real approaching of the 'Climate Change Disasters'.



Source : ค คน Magazine Oct 2008





Source : IKONOS images

Figure 5 :Khao Lak before and after Dec 2004 Tsunami





Figure 6 :Wat Khun Samut Chine

3. How do we deal with Climate Change Disasters?

Even though the climate change issue is concerned by several actors, but the adaptations and reductions have been fragmented. Some of them are ad-hoc reactions, most of them are not yet in a holistically way of resolving. Campaigns and programs in the international and national level seem to be under 'the game of negotiations'.

3.1 Think global : The hand-in-hand in the international level

Eventually, in order to deal with this global problem, in addition to submitted the '*Agenda21*', and ratified the '*Kyoto Protocol'* - Kyoto Protocol to the United Nations Framework Convention on Climate Change (see in Figure 4, 5³). The Agenda 21 provides a program of action designed to promote sustainable development through the two main focus areas of environmental issues and social and economic issues.





Source : World Resources Institute

Figure 4 : Signatories to the Kyoto Protocol (June 2005)

[Full text]

³ World Resources Institute [<u>http://www.wri.org</u>]



Source : World Resources Institute

Figure 5 : Agenda 21 National Reporting Status (2002)

The World Resource Institute⁴ also gave a clue that most developing countries like Thailand are not the main contribution to climate change compared to industrialized countries (see Figure 6, 7), with lower than 1 ton per capita per year (1999) and ratio of area to emission 12.2% when USA 30.3%, EU 27.7%, Australia 1.1%, and Mid East 2.6% (1990-1999). But Thailand is among many countries around the world that ratified Kyoto Protocol and submitted the Agenda21 national report (again in Figure 4, 5).

In the international level, many strategies and campaigns have been applied to resolve the problems included '*Carbon credit'*, '*Earth Hour*', '*Cool Cities*' from US Mayor's Climate Protection Agreement and Center, '*The Partners for Climate Protection*' (PCP) program of ICLEI's Cities for Climate Protection (CCP) network, which involves more than 900 communities worldwide, etc.

⁴ World Resources Institute [<u>http://www.wri.org</u>]



Source : World Resources Institute





Source : World Resources Institute

Figure 7 : Industrialized and developing countries and the contribution to global warming

3.2 The mitigations and adaptations in the national level

Through the eyes of a landscape architect, the author found several efforts in the national level recently reflect in these mitigations and innovations; the initiation of the National Disaster Warning center (NDWC)⁵ for disaster preparedness, King's Philosophy : Sufficiency economy, Royal

⁵ National Disaster Warning center (NDWC) [<u>http://ndwc.opencare.org</u>]

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project initiatives / Royal rain (cloud seeding technique), Flood protection : Monkey Cheeks, 3 waters projects (Fresh water, flooding water, waste water), Reforestation project : Village that learn : Check dam and wet fire barrier, Bio diesel, E-ternol, Ecological approaches in design and planning, Green architecture / Green roof, permeable surface, rain garden, etc, Alternative Energy, Agriculture and food security, Public awareness, Private sector and their CSR programs, and many more mitigations by scholars and all levels of agencies to deal with emerging trends and vulnerabilities.



Figure 8 : Coast line protections

Thailand applies '*The Thailand Strategic Plan on Climate Change*', approved by the Cabinet in January 2008, incorporates six strategies on capacity building, research and development, awareness and public participation, and international cooperation, addressing both climate change mitigation and adaptation. In addition, there have been a number of regulations; New Building code and ministerial regulations, Energy saving Label (Site location, Landscape, Bldg skin, A/C, Lighting system, Alternative Energy management, Sanitation, Bldg Materials, Other energy conservation and environmental concerns), Green building design competitions, etc.

Especially, 'Sufficiency Economy': the United Nations first Human Development Lifetime Achievement award philosophy developed by the recent King of Thailand; Bhumibhol Adulyadej. It focuses on development integration with people as the centre and balance with economic, social, politics and environment aspects. It help promote the production sector and the awareness of the necessity of changing attitude and some consumption habits have aimed to more self-reliance, morality, efficiency, quality, modernization, and better income.



Source : Excerpted by A. Aruninta (2006)

Figure 9 : Sufficiency economy diagram

Base on the concept of 'Sufficiency Economy', many of agencies have been introduced various programs in order to create better and well being environment and sustainable development. In the local government level, BMA (Bangkok Metropolitan Administration) joins the World Car Free Day (every 22 September), March 29, 2008. Bangkok joined other major cities of the world in a campaign to raise awareness about global warming by turning off lights, BMA also issued Green Bangkok to reduce heat island, etc.

The activities by NGOs and private sectors' CSR programs are very popular and gain full support from public such as: Coastline protections - a popular CSR activity : Mangrove reforestations, Innovation from Landscape Architects : Earth Plates, Greenpeace South-east Asia published 'The Climate Crisis: a Rescue Handbook', etc.



Figure 10 : Seashore protections



Source : A. Aruninta (2007), Excerpted from original sketch by HM the King Bhumibhol Adulyadej Figure 11 : Monkey Cheeks project : Floodwater management project



Source : Exhibition at TALA Landscape Expo09 - by Shma Company Limited

Figure 12 : Carbon Footprint and Earth-plate

4. Theoretical applicability

The paper analyzes the conceptual idea of these selected climate change related solutions for the environmental impacts: King of Thailand's projects including the UN's award philosophy: *'Sufficiency Economy', Royal Rain* : the artificial rain-making / Cloud seeding project, Forest rehabilitation using temporary weir, *Chaipattana Aerator* : low speed aerator, Constructed wetland and other biological techniques of waste water treatment , Floodwater management using detention area called *'Monkey cheek'* and diversion technique called *'Klong Lad Pho', 'The living barrier'* : Bioengineering soil erosion protection using Vetiver Grass (Vetiveria zizanioides, Crysopogon zizanioides). These initiatives reflect His Majesty's strong desire to mitigate 'Climate Change Disaster' and sustainable by using simple concepts and technology which can be applied quickly and solve problems effectively. The Royal projects also seek to understand nature and the relationship between people and the environment in determining how best to respond to environmental issues⁶.

4.1 'Sufficiency Economy'

'Sufficiency Economy' : the United Nations first Human Development Lifetime Achievement award philosophy developed by the recent King of Thailand; Bhumibhol Adulyadej. 'Sufficiency economy' ultimately aims to a balance, security, and sustainability. But the arguments always rise that 'Is the sufficiency-economy philosophy anti-globalization or anti-profit maximization?'. Pipat Yodprudtikan⁷ explained that the sufficiency-economy philosophy is not against making a profit

⁶ The MRCS Environment Training Program Case Studies [<u>http://www.mrcmekong.org</u>]

⁷ Director of the Thaipat Institute, a non-profit organization working on the sufficiency-economy philosophy

but it is the way to optimize profit-making capability via greater efficiency and effectiveness instead.

The philosophy was initiated by H.M. King Bhumipol since 1974 and H.M. the King stressed it again in his birthday speech in 1997 after the economic crisis. The strategy has been implemented with a common aim to rehabilitate and improve the country's economic situation. Its core focuses on development integration with people as the centre and balance with economic, social, politics and environment aspects. It helps promote the production sector and the awareness of the necessity of changing attitude and some consumption habits have aimed to more self-reliance, morality, efficiency, quality, modernization, and better income. This strategy can be implemented in all levels from individual to informal business sector and encourage them to utilize the resources and facilities provided in the more modest way. The 'Climate Change' crisis, as well, should concern the risk of development and consistent with balanced development strategy, so-called 'sustainable development'. Even at the national level, that would reduce the vulnerability of the nation to shocks and excesses that may arise as a result of fast developments.

4.2 'Royal Rain'

Cloud seeding rain-making technique called 'Royal Rain' was also first initiated by H.M. King Bhumipol in 1972, with his curiosity, observation, and advanced scientific knowledge. Theoretically, there are two types of cloud seeding (hygroscopic seeding); the warm and cold ones. Silverman (2003, and Sukarnjanaset, 1999) concluded that it has strong statistically positive results were reported in warm cloud seeding in different parts of the world including Thailand, especially in the study areas: Bhumibol catchment area in the northwestern Thailand. The Thailand experiment provided evidence that 'Royal rain' with hygroscopic particle seeding can increase the rainfall from warm convective clouds. But Silverman also suggested that we need to understand the timing, location, and other factors as well to have the best result of the rain-making technique

4.3 Vetiver : 'The Living Barrier'

Vetiver : the living barrier – Soil degradation from erosion affects seriously environmental problems in addition to climate change risk from heavier rainfall pattern, cyclone, flooding, and land slides. Thailand as an agricultural based country, soil degradation is an important factor in land reclamation and reforestation. Growing Vetiver grass as part of soil conservation system, were described to reduce run-off and soil loss and increase Nitrogen in relatively fertile soil with good water holding capacity (Pansak et al., 2007). Dalton et al. (1995) also concluded that vetiver hedges are feasible to control flood flow and erosion on cropped flood plains and land slopes between 0.5-2%.

4.4 'Three Waters': another BMP

Three Waters Management - The 3 waters problems were categorized to better understanding of the water characteristic that affects to urban area; flooding, drought, and waste water. The Royal Project Initiative focuses on resolve the problems created by the 3-water. With these cost optimization and understand the hydraulic performance made the 3-water as a best management practice (BMP) and integrated Urban Water Management (UWM), which are 2 of the water management theory.

4.4.1 Flooding - The project 'Klong Lad pho' diversion channel and Monkey-cheek detention were both introduced to Bangkok to resolve flooding. Both projects comprise with water gates and pumping stations, which do not require expensive investments and also form an integrated system for efficient flood alleviation in Bangkok and its vicinity.

HM the King observed that most monkeys, when they have obtained bananas, will store them in their mouths. They will do this for a hole bunch of bananas or until their cheeks are filled up. Only then they will start to chew and swallow the bananas.

His Majesty has modeled the technique for water detention on the way monkeys eat. His Majesty has asked the Royal Irrigation Department to construct large water detention reservoirs in a ten square kilometers area near the coast, in order to store water from natural water courses and newly-dug canals. New water gates are also to be constructed to release water into the sea during low-tides, while the gates will be closed during high-tides to prevent seas water from flooding the reservoirs and the area.

The full implementation of the Kaem Ling Project needs careful study and planning which takes time, therefore this cannot be achieved in the preliminary stage. However, certain stages of the project can be carried out to alleviate flood problems in the short run.

[Souce: Chaipattana Foundation⁸]

4.4.2 Drought - Many programs were invented to prevent drought as also discussed earlier on the cloud seeding. Forest rehabilitation using temporary weir was discussed in ECOS Magazine (Mogg, 2005) that deforestation and wholesale destruction of the trees is part of desertification in Thailand. It has be exemplified at Huai Hong Khrai Royal Development Study Center - RDSC, in Chiengmai, in the northern Thailand, demonstrates how best to renew forest by trapping water with numerous small temporary check-dams built out of earth and stone, or even bamboo. Later the area renewed forests are promoted as H.M. The King's initiatives exemplification called 'Village that learn' or RDSC. It also illustrates the creative application of available environmental management theory to provide practical and sustainable development initiatives in rural areas of Thailand.

4.4.3 Waste water - Between 1984 - 1987, H.M. King Bhumipol suggested the use of good quality water to dilute polluted water and also water hyacinth as well as aquatic plants to filter the water. The development of waste water treatment using these following techniques show a good potential with simple operation and low implementation cost among waste water treatment techniques:

- 1) The Lagoon Treatment System,
- 2) The Artificially Constructed Wetland System,
- 3) The Grass Filtration System,
- 4) The Red and White Mangrove System

Ornamental species plants like Canna and Heliconia can be used to enhance the esthetic appearance of the waste water treatment area (Konnerupa, Koottatepb, and Brix, 2008).

Chaipattana Aerator : the award winning inexpensive technology, low speed surface aerator paddle-wheel machine in the form of a floating buoy that helps add oxygen to water. H.M. King Bhumipol modified the aerator from the function of 'Luk', a device made from local wisdom which farmers use for scooping water into the paddy fields. The Chaipattana Aerator is a floating aerator

⁸ Chaipattana Foundation – Monkey Cheeks Water Detention

http://kanchanapisek.or.th/kp2/m_stage/activities_e/ling_e/ling2_e.html

which can be operated in tidal polluted water⁹. The popular Model RX-2, His Majesty's patent in 1993, treats waste water in the water quality improvement project. The aerator can be utilized for sucking waste water from the bottom of the well to mix with outside air, causing movement and circulation below the water surface level which results in greater efficiency in improving the water quality. In addition, it can be modified to be used as a sludge pump by shutting off the air inlet pipe.¹⁰

5. Conclusions

The climate change disasters are not only the issue concerned by only environmental scientists but also everybody. Landscape architecture is recognized by public¹¹ as the most modern of the environment professions and represents a synthesis of arts, science, and technical philosophies and practices that seek to care for the Earth's landscapes in a truly holistic. Therefore, landscape architects are expected to play an important roles working together with others to deal with the problems. The mitigations and adaptations applied in Thailand, especially from the Royal Initiatives are theoretically applicable to other landscape architecture concepts, and relevant and helpful to be generalized for at least other tropical countries.

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⁹ Chaipattana Foundation - Chaipattana Aerator specification http://kanchanapisek.or.th/kp2/m_stage/activities_e/pollution_e/rx2_e.html

¹⁰ R&D of Chaipattana Aerator [http://www.chaipat.or.th/chaipat/journal/apr99/eng/aerator.html]

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