Behavior of Adoption of a Low Carbon Society: A Case Study of Bangkok, Thailand

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***Abstract*—**This study aims to explore people's behavior to develop a low carbon society in Bangkok Metropolitan Administration (BMA), Thailand. The study was done in three districts of the BMA, i.e., Phra Nakorn, Patumwan and Dusit. The sample size was 400 households from these districts. The study used a questionnaire for primary data. Data analysis applied both quantitative and qualitative methods. This study aims to explore people's behavior influencing perception of a low carbon society in Bangkok, Thailand. The BMA implemented a low carbon society program with four specific strategies: 1) to increase green space, 2) to develop efficiency in waste management, 3) to encourage energy efficiency, and 4) to promote sustainable consumption. The results showed that 1) household were interested in information about green space in Bangkok 2) people's behavior tended to develop effective waste management 3) people's behavior were energy inefficiency and 4) people's behavior did not perform the sustainable consumption.

The study found that people knew about the news and/or information of LCS and participated in activity of LCS were still low but they were interested in information about green space in Bangkok. The government should set national government priorities for policies of LCS. LCS should be a governmental concern and a policy road map.

***Keywords*—** Low Carbon Society, Bangkok, Behavior.

I. Introduction

One of the main challenges of a global society in this century is to mitigate the phenomenon of global climate change (Martens et al., 2009). It induces several kinds of natural hazards such as rising sea levels, floods, and droughts (Rowlands, 1998). It can also cause epidemics, such as malaria, which has killed millions of people over the years (Burroughs, 2007). There are scientists who argue climate change is a result of unwise anthropogenic activities and is the main factor that induces Greenhouse Gases (GHG) effects (Smith, 2006). GHG are produced from both natural phenomenon and from human activities. Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons (CFCs) are the major GHGs responsible for global warming (Houghton, 1997). Among these, CO_2 has the most impact because it is approximately 70 percent of the total amount of GHGs released into the atmosphere

(Houghton, 1997). The most common consequences of climate change are disruption of normal weather patterns and ecosystems. Moreover, climate change is a natural phenomenon that induces several other natural hazards.

Climate change mitigation is an approach to help reduce the amount of GHG emissions. It is a long term solution to protect both the global climate and human beings from the effects of climatic change (UNFCCC, 2009). GHG emission reduction strategies typically focus on the development sectors such as transportation, industry and energy since they are responsible for the majority of GHG emissions. However, sector-based reduction of GHG emissions is not a sufficient climate change mitigation strategy. Human societies as a whole are responsible for GHG emissions and are therefore responsible for emission reductions as well. This means every human activity is part of both the problem and solution. Among the holistic approaches that encompass the whole human race, the "Low Carbon Society" (LCS) approach has come into prominence in recent times. This approach is centered on the idea of reducing carbon (C), which is the main element of most of GHGs. Therefore, one can say that reducing the amount of carbon emitted from anthropogenic activities is a crucial approach to mitigation of climate change.

Bangkok emits a total CO_2 equivalent of 42 million tons /year. The city is one of the top five cities in the world for carbon emissions. The Bangkok governor aims to have a LCS by the year 2050. Therefore, the policy and practice of the LCS concept in BMA is a fundamental approach that requires cooperation from all sectors. The BMA implements a LCS program with four specific priorities: 1) increasing green space, 2) waste management, 3) energy efficiency, and 4) sustainable consumption (TGO, 2015). This study aims to explore people's behavior to develop a low carbon society in Bangkok Metropolitan Administration (BMA), Thailand.

II. Literature Review

A. Climate Change and Its Negative Effects

Some critiques and participants of the climate change debate argue that developing countries are not GHG emitters. They postulate that the developed countries such as the United State of America (USA) and the countries of the European Union (EU) are responsible for most GHG emissions. For example, North America and the EU are, respectively, the second and the third largest GHG emitting regions of the world (IPCC, 2007). However, some developing countries are also major sources of GHG emissions. For example, India, China, and Brazil are highlighted as three large emitters of GHG among the developing countries. Without any stringent measures to

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control GHG emissions, it is anticipated that these countries will responsible for 61% of all global GHG emissions by 2030 (Koh et al., 2011). Thailand is the second largest carbon emitter in Southeast Asia. It is also ranked 24th in the world for total GHG emissions (UN, 2010). The above example highlights the reality that GHG emission reductions are not the sole responsibility of the developed and industrialized countries of the west. Accordingly, there are several international efforts to bring an agreement among countries irrespective of their degree of development and responsibility to abate GHG emissions. Among these agreements, the Kyoto Protocol and the United Nations Framework Convention on Climate Change (UNFCCC), are the most prominent. As a responsible global citizen, Thailand has been a member of the UNFCCC since 1994. Thailand also ratified the Kyoto Protocol as a 'Non-Annex 1' country in 2002. The 'Non-Annex 1' countries agreed to reduce GHG emissions by 15-40% by the year 2020 (TRF, 2010).

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change mitigation as methods to help people decrease the amount of GHG emissions and improve the capacity of GHG sinks (UNFCCC, 2009). Human activities, particularly in urban areas, are the major sources of GHGs. Climate change mitigation and adaptation can be implemented as immediate strategies to protect human beings from the impacts of climate change. They aim for both short and long term solutions for the biggest threats that human beings now face. However, a close scrutiny reveals that the objectives of climate change mitigation and adaptation are different, although both seem to aim at a common goal of finding a sustainable solution for the impacts of global change. As discussed above, mitigation refers to methods that help cut GHG from activities of people, while adaptation means the methods that help enhance the capacity of people to withstand the impacts of climate change. Distribution of information about GHG mitigation methods to the public should be used to help encourage behavioral changes by people to reduce GHG emissions.

A low carbon society is one where people release not more than the amount of GHG that nature can absorb and without negative impact upon the global climate (MOEJ, 2007). To accompany the concept of a LCS and translate it into reality, every society is expected to take into account four basic requirements (Skea and Nishioka, 2008). These include:

(1) Minimizing GHG emissions, especially CO2

(2) Changing people's lifestyles. This method can be implemented by creating awareness among people through education and training to help them realize the dangers of climate change. Such awareness can lead to behavioral changes and lower GHG emissions.

(3) Forest conservation.

(4) Promotion of the cost-benefits of climate change mitigations measures.

Under the concept of a LCS, there are two important methods implemented to reduce GHG emissions. First, apply advanced technologies and alternative energy, and, second, change the lifestyles of people. However, people and organizations have insufficient competencies to implement such methods at present. Therefore, the major purpose of this study is to understand people's behavior or their lifestyle.

B. Greenhouse Gases Emissions in Bangkok

Bangkok is the capital city of Thailand. It has more than 10 million people and 2.2 million households. Most emissions of CO2 come from energy consumption and electricity use of around 21.18 and 14.86 million tonne per year, as shown in Table 1.

TABLE I QUANTITY OF GHG EMISSION IN BANGKOK

Sector use	Quantity (million tonne/year)	% of CO_2 emissions
electricity	14.86	34
energy	21.18	50
waste	1.13	3
other	5.58	13
Total	42.75	100

Source: Bangkok, 2015

III. METHODOLOGY

This study set its target to investigate the existing conditions, perceptions, and factors influencing implementation of a LCS in the BMA. The study was done in three BMA districts, i.e., Patumwan, Dusit and Phra Nakorn. There were 400 households from these three districts in the target sample. The current study used a questionnaire and key informant interviews as a primary data source with supplementary documents, reports, and official records. Data analysis applied both quantitative and qualitative methods. The questionnaire was divided into three parts. The first part probed for general information. The second part inquired about perceptions of a LCS. The final section was used to determine factors that influenced perceptions of LCS practices. The questionnaire was tested for reliability and internal consistency using accuracy indicators. Its internal consistency was estimated using Cronbach's Alpha. A Cronbach's Alpha of 0.831 was obtained, indicating a highly reliable instrument.

Questionnaire responses used a five-point Likert scale to assess respondents' opinions about a LCS. Then, a weighted average index (WAI) was applied to the result. The WAI was computed using following equation:

$$I = \frac{\sum s_i f_i}{N}$$

where, I = WAI, such that , si denotes the scale value at ith priority ranging from very poor, poor, moderate, high to very high and fi denotes frequency of ith priority and N is equal to the total number of observations, i.e., . WAI was used transform the opinions of respondents from a nominal scale (very poor-very high) into numeric scores. The scores were classified into five levels such that 0–0.20 = very poor, 0.21 0.40 = poor, 0.41–0.60 = moderate, 0.61–0.80 = high, and 0.81–1 = very high (Md Abdul, M, Q. 1993).

IV. RESULTS AND DISCUSSION

In Thailand, the BMA is the center of economic development for the country. The carbon emissions rate of Bangkok is approximately 7.1 tonne/person/year, which is higher than that

of the country as a whole, 5 ton/person/year. The BMA implemented a low carbon society program with four specific strategies: 1) to increase green space, 2) to develop efficiency in waste management, 3) to encourage energy efficiency, and 4) to promote sustainable consumption. Most households have green areas surrounding their dwelling. This is one way of promoting more green areas. Most waste is organic, general, and recyclable materials. More than 50% of it is not separated at its source. The municipality has neither good management of waste nor adequate equipment for waste management. Many people have electrical machinery such as TVs and air conditioners in their homes and use private cars for transportation because they consider mass transit inconvenient. Most households do not receive information about a LCS and there is no program to encourage a LCS in Bangkok. These factors inhibit sustainability.

People's behavior influencing perception of LCS according to four specific strategies can be summarizing as followed:

1. Increasing green space: Go for exercise in the park (WAI 0.65), Buy trees, fertilizer for planting in their garden (WAI 0.66), These two behaviors were still moderate for increasing green space. Interested in information about green space in Bangkok (WAI 0.82), this showed the positive behavior to enhance and preserve green areas.

2. Developing efficiency in waste management: Waste separation (food for other use and separate newspapers)(WAI 0.78), selling used newspaper and/or recycle to garbage collector and waste separation after collection (WAI 0.74) indicated people's behavior to develop effective waste management.

3. Energy efficiency: Forget to turn off the light before leaving home (WAI 0.82), sleep while turn on the television (WAI 0.79), electrical use for many purposes at the same time such as using computer and watch TV at the same time, drive car and/or ride the bike instead of walking when go for the short distance (WAI 0.78), do not plug off after using the electrical (WAI 0.75) showed the energy inefficiency.

4. Sustainable consumption: Know about the news and/or information of LCS (WAI 0.36), participate in activity of LCS (WAI 0.37) indicate that government should encourage and promote the information and activity about LCS to increase the sustainable consumption. Encouraging friends, family and neighbors to change their behaviors can also promote a LCS (MOEJ, 2007). Training about LCS practices (WAI 0.67) should increase knowledge and responsibility regarding a LCS (Skea and Nishioka, 2008).

Table 2 shows people's behavior influencing perception of LCS according to four specific strategies.

TABLE II BEHAVIOR OF HOUSEHOLD INFLUENCING PERCEPTION OF LCS

No.	Household or member in the household's behavior	WAI
Strategy for increasing green space		
1	Go for exercise in the park	0.65
2	Buy trees, fertilizer for planting in their garden	0.66
3	Interested in information about green space in Bangkok	0.82
Strategy to develop efficiency in waste management		
4	Waste separation (food for other use)	0.78
5	Waste separation (newspaper)	0.78
6	Sell used newspaper and/or recycle to garbage collector	0.74
7	Waste separation after collection	0.74
Strategy for efficiency energy		
8	Electrical use i.e., turn on the light while sleep	0.77
9	Electrical use i.e., sleep while turn on the television	0.79
10	Set the temperature of air conditioner at 25 degree C	0.74
11	Electrical use for many purposes at the same time such as using computer and watch TV at the same time	0.78
12	Do not plug off after using the electrical	0.75
13	Forget to turn off the light before leaving home	0.82
14	Drive car instead of walking when go for the short distance	0.78
15	Ride the bike instead of walking when go for the short distance	0.78
Strategy for sustainable consumption		
16	Know about the news and/or information of LCS	0.36
17	Participate in activity of LCS	0.37

Notes: 1. Weighted Average Index (WAI) : 0–0.20 = very low; 0.21–0.40 = low; 0.41–0.60 = moderate; 0.61–0.80 = high; 0.81–1 = very high

V. CONCLUSIONS AND RECOMMENDATIONS

This study aims to explore people's behavior influencing perception of a low carbon society in Bangkok, Thailand. The BMA implemented a low carbon society program with four specific strategies: 1) to increase green space, 2) to develop efficiency in waste management, 3) to encourage energy efficiency, and 4) to promote sustainable consumption.

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The study found that people knew about the news and/or information of LCS and participated in activity of LCS were still low but they were interested in information about green space in Bangkok. The government should set national government priorities for policies of LCS. LCS should be a governmental concern and a policy road map.

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