

**ASEAN+3 Research Group  
Study Topic 3 of Research Group 2010/2011**

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**FISCAL AND FINANCIAL IMPACTS OF  
THE CLIMATE CHANGE AND POLICY CHALLENGES IN EAST ASIA  
(*Final Report*)**

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**National Institute for Finance  
MINISTRY OF FINANCE, VIETNAM**

## PREFACE

This report is prepared as part of the ASEAN+3 Research Group's policy – oriented studies of 2010/2011. It is a synthesis report conducted by National Institute for Finance, Ministry of Finance of Vietnam.

The report is based on background researches, which have been done by National Institute for Finance (NIF), Korea Institute for International Economic Policy (KIEP) and JICA Research Institute (JICA-RI).

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The final version, entitled "*Fiscal and Financial Impacts of the Climate Change and Policy Challenges in East Asia*"<sup>1</sup>, will be summited to the ASEAN+3 Financial Ministers's Meeting in May 2011.

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<sup>1</sup> The views expressed in the report are those of the authors and do not necessarily reflect the views or policies of institutions and organizations they represent. All comments are warmly welcome and please be sent to [lenthuyvan@mof.gov.vn](mailto:lenthuyvan@mof.gov.vn).

## ACRONYMS AND ABBREVIATIONS

ADB	: Asian Development Bank
APCF	: Asia Pacific Carbon Fund
ASEAN	: Association of Southeast Asian Nations
ASEAN+3	: Association of Southeast Asian Nations plus Japan, South Korea, China
CCF	: Climate Change Fund
CDM	: Clean Development Mechanism
CMI	: Carbon Market Initiative
EE&C	: Energy Efficiency and Conservation
GDP	: Gross domestic product
GHG	: Greenhouse gas
GMS	: Greater Mekong Subregion
IMF	: International Monetary Fund
IPCC	: Intergovernmental Panel on Climate Change
JICA-RI	: Japan International Cooperation Agency – Research Institute
KIEP	: Korea Institute for International Economic Policy
MONRE	: Ministry of Natural Resources and the Environment (Vietnam)
NIF	: National Institute for Finance
UNEP	: United Nations Environment Program
UNFCCC	: United Nations Framework Convention on Climate Change
WB	: World Bank

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## **EXECUTIVE SUMMARY**

The study, entitled “*Fiscal and Financial Impacts of the Climate Change and Policy Challenges in East Asia*”, targets at examining observed and potential fiscal impacts of the climate change in East Asia and identifies policy challenges for the region to deal with the climate change. It then proposes policy recommendations for the ASEAN+3 countries to mitigate and reduce negative impact of the climate change.

### **Climate change in East Asia: Observed trends, variability and extreme events**

East Asia is among the most vulnerable areas of the climate change due to its long sea coast, high population concentration at the coast line and its dependency to agriculture and resource. An increase in surface temperature is the most popular characteristic in the East Asian region, which is more pronounced during winter than in summer. The observed increase in temperature in some parts of East Asia during recent decades ranged between less than 1°C to 3°C per century, while the sea level has risen on an average of 3.1mm per year over the last decade compared with 1.7-2.4 mm per year in the last century. East Asia’s precipitation pattern has changed during the second half of the last century with an overall trend toward a decrease in the rainfall and a decline in the number of rainy days. Besides, extreme weather events are more frequent and intense in East Asia in the past several decades. The number of tropical storms, and typhoons reported in the region reached an all-time high, with 21 reported typhoons in Southeast Asia annually, well above the median of 17.5 for the period 1990 - 2003.

### **Fiscal and financial impacts of the climate change in East Asia**

The economic and social impacts of the climate change are significant and long lasting in the region. This study first analyzes regional impacts of climate change such as agriculture and food security, ecosystem, water resources, economic growth, poverty reduction efforts and social security; then focuses on fiscal and financial impacts. Since fiscal and financial impacts of the climate change will likely vary across countries, case

studies of member countries in the ASEAN+3 also be considered to clarify fiscal and financial impacts of climate change in East Asia.

### ***Impacts on State Budget Revenue***

Climate change impacts on budget revenue can be two folds: on one hand the reduction in productivity due to climate change (for example: agricultural productivity, reduction in tourism) may significantly reduces the economy's output and by this way reduce the budget revenue; on the other hand, governments can raise carbon taxes or environmental taxes, etc to mitigate the impacts of the climate change.

Carbon taxes could generate substantial budget revenue for countries in the East Asian region. The study shows that most East Asian economies could generate revenue of about 0.5% of GDP or more by 2020 if a sum of US\$20 per tonne of CO<sub>2</sub> (in 2005 prices) is levied through either a tax or auctioned permits. The revenue implications are especially significant for East Asia's developing economies, since their emissions are higher relative to GDP when measured using market exchange rates. A US\$20 carbon price applied across fossil fuels could fetch China in excess of 2.5% of GDP by 2020.

Carbon taxes could yield large new revenues, which can be used to assist business and poor households, as well as for additional climate change measures. In the case of Indonesia, the revenue from a carbon tax would contribute to the budget and can be used at the government's will. The revenue then may be used to assist the process of reform and help alleviate the impact of higher prices (by the tax) on the poor. Cash transfers directed at poor households and tax reductions can improve income distribution. The revenue can also be used to compensate businesses for losses incurred through the carbon tax or to promote efficiency- enhancing reforms that make it easier for affected firms to do business.

On the revenue reduction effects, NIF (2010) estimates that real indirect tax revenue (discounted by the GDP deflator) will decrease for every region in Vietnam under the medium emission scenario (B2 scenario). Real indirect tax revenue in

Mekong river delta and Central high land regions decreases the most with the magnitude of reduction is about -6% to -7%. The share of budget revenue in GDP is also reduced by approximately 1-6% in every region.

### ***Impacts on State Budget Expenditure***

Impacts of climate change on State Budget Expenditure in the region are mainly assessed through climate change adaptation cost or R&D cost in response to climate change. However, evidences on the aggregate costs are rare. World Bank (2010) has estimated the global costs of adaptation (US\$70-100 billion annually out to 2050, in 2005 prices), and also produced costs for a number of individual economies, including Vietnam. The total undiscounted cost of adaptation measures in agriculture in Vietnam is estimated to be about US\$210 million per annum at 2005 prices over the period 2010-2050. Construction of sea dikes and other flood defenses for urban infrastructure and the most valuable agricultural land is separately estimated at US\$20-50 million per annum.

### **Policy challenges forward**

Despite the multilateral and unilateral efforts, the East Asian countries have to face up the risks of disasters and damages caused by the climate change. Therefore, it is very important for the region to address challenges forward during process of adaptation and mitigation to climate change. Given strong impacts of the climate change and the existing actions, the study identifies key policy challenges that could be exposed by climate change to the region, including: food security; energy security; water resources; carbon emissions reduction targets; natural disasters; social security; and adaptation decision-making in response to climate change.

### **Policy recommendations in response to climate change in the East Asian region**

Since the East Asia region is highly vulnerable to the climate change's impacts, responding quickly and strategically when disaster strikes is vital. While adaptation and mitigation measures are a typically recommendable policies for the East Asia as a



whole as well as individual countries, regional cooperation among the ASEAN+3 economies is especially important to overcome the climate change's challenges.

*Firstly*, climate change adaptation in the East Asian region should focus on measures such as ensuring a strong growth and sustainable development; mainstreaming climate change adaptation in development planning; enhancing fiscal self-insurance; regional insurance facility for immediate needs; ensuring food security as a main task for the East Asian countries; improving management on water resources; raising public awareness of climate change and enhancing human resources; improving research ability on climate change as an important foundation for policy making process.

*Secondly*, effective mitigation strategy should oriented the East Asia region toward a low-carbon economy. To achieve that target, each individual country has to taken actions to become a low-carbon country. In addition, the GHGs emission reduction targets of the region should focus on key sectors such as energy, forestry and agriculture.

*Thirdly*, since most countries in the region experience similar climate hazards, a regional strategy is likely to be more effective than national actions alone. The regional cooperation could effectively address some climate change challenges and identify a response strategy for the ASEAN+3 countries in both adaptation and mitigation to climate change. The study assumes a hypothetical climate change fund for the ASEAN+3 region which would be beneficial for all the member countries, even after considering the burden from making the fund. In addition, it suggests that scientific collaboration should be enhanced between institutions of the ASEAN+3 countries through different forms such as workshops, trainings, scholar exchanges, and joint studies.

# 1. INTRODUCTION

Climate change emerges as one of the most difficult challenges to the sustainable development of the world in the 21st century. The climate change comes from the interaction between the atmosphere, earth, environment, and human. The high concentration of CO<sub>2</sub> created a greenhouse effect, which warm-ups the air and changes the environment. The global warming is the reason of melting ice in the poles, causing the sea level to rise. The climate change can become a disaster for man kind because it directly affects the basic foundation of the human life: water resource, energy, health, agriculture, bio-diversity, food security... As the climate change also affects the economy, climate change mitigation is one of the most important goals in the poverty alleviation and sustainable development agenda of the World Bank.

East Asia (especially Thailand, Indonesia, Philippines and Vietnam) are the most vulnerable area of the climate change due to long sea coast, high population concentration and their dependency to agriculture and resource. The diversity of the region in geography, economy, and demography amplifies the risks of climate change impacts in East Asia. Climate change will significantly affect East Asia's efforts for poverty reduction and sustainable economic growth. The ADB (2009) has warned the GDP loses can be as high as 6,7% GDP in 2100. The climate change also negatively affects the poverty alleviation and sustainable development efforts and by this way creates financial problems, such as revenue loses, expenditures, social security... According to the UNDP Human Development Report (2007), the expenditure should be approximately 1,6% GDP in order to sustain the greenhouse gas emission from now to 2030.

While the current literature on climate change in the region is mostly concentrates on assessment of impact on water resource, forestry, agriculture, health or the impact on the economy, the research on the fiscal and financial impact of the Climate Change in

East Asia is really necessary and important. From that point of view, the 13<sup>th</sup> ASEAN+3 Finance Ministers' Meeting in Uzbekistan in May 2010 has agreed upon the research entitled "*Fiscal and Financial Impacts of the Climate Change and Policy Challenges in East Asia*", which is proposed by the Ministry of Finance of Vietnam.

The study targets at examining observed and potential fiscal impacts of climate change in the East Asian region and policy actions by these countries. It then identifies the policy challenges for the East Asian region to deal with climate change. The study finally proposes policy recommendations for the ASEAN+3 countries to mitigate and reduce negative impact of climate change. In order to reach these objectives, qualitative and quantitative (modeling) analyses is necessary to evaluate fiscal and financial impacts of climate change in East Asia. Besides, seminars, questionnaires and interview questions are also used as important methodologies of the study.

As a result, a comprehensive analysis of the fiscal impacts of climate change in the East Asian and a list of policy recommendations to mitigate and reduce negative impacts of climate change for countries in the region will be expected outcomes of this study.

This report is organized as follows. The next section discusses observed changes of climate in the world as well as the East Asian region and possible scenarios for climate change in the East Asia. Section 3 focuses on fiscal and financial impacts of climate change in the East Asia region, in which observed and potential impacts of climate change are analyzed in different aspects (economic growth; poverty reduction efforts and social security; agriculture, water resources; as well as revenue and expenditure sides, etc.). Section 4 addresses policy challenges forward in the East Asian region despite a lot of efforts have been made in both multilateral and unilateral terms. Section 5 proposes policy recommendations in mitigation and adaptation to climate change in the East Asia, where regional cooperation is required to strengthen in response to climate change. Last but not least, Section 6 concludes with some important remarks and findings of the study, which are expected to be helpful for both the

ASEAN+3 Research Group and the ASEAN+3 finance officials in their efforts to deal with climate change as the most challenges of the member countries.

## **2. CLIMATE CHANGE IN EAST ASIA: OBSERVED TRENDS, VARIABILITY AND EXTREME EVENTS**

### **2.1. Climate change: A global problem**

Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (typically decades or longer), which might result from natural factors and human activities.

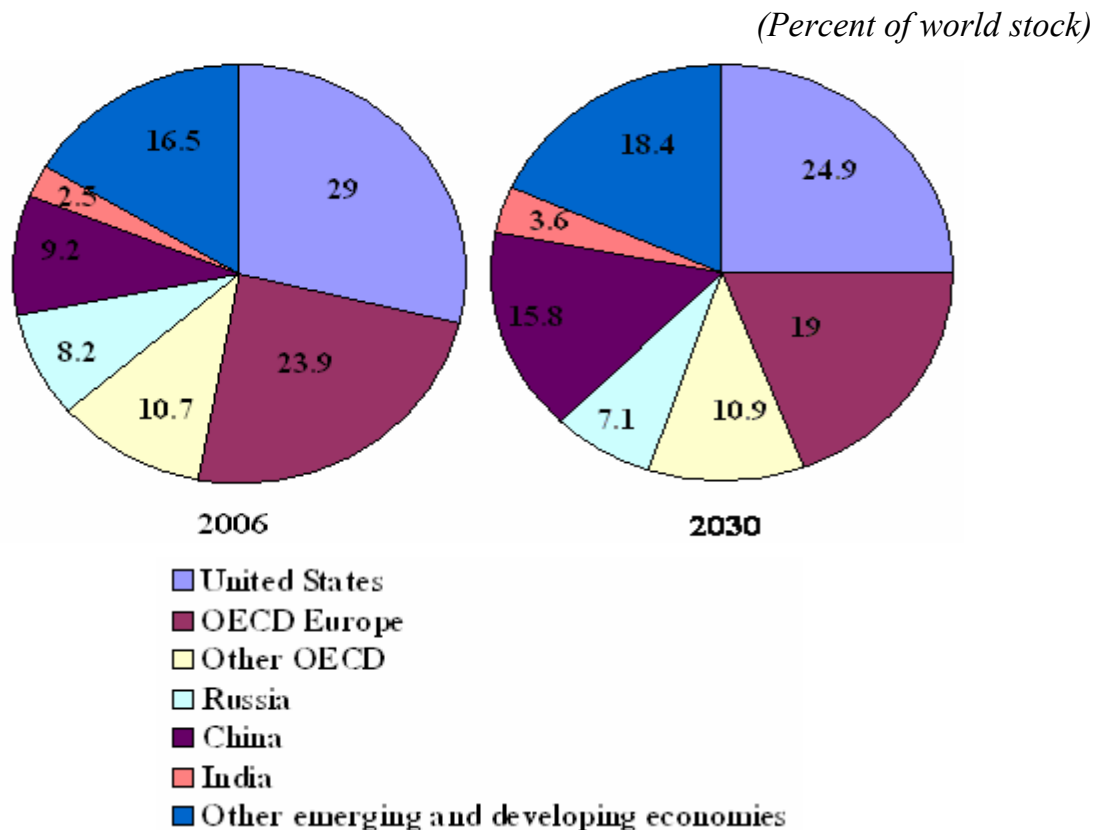
Climate change comes from the interaction between the atmosphere, earth, environment, and human. Over the last several decades, evidence of human influences on climate change has become increasingly clear and compelling. Human activities such as electricity production and transportation are adding to the concentrations of greenhouse gases (GHG). As GHG trap more energy in the Earth's atmosphere, average temperatures at the Earth's surface are expected to rise. Most of the observed increase in global average temperatures since the mid-20<sup>th</sup> century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. However, some areas might experience more warming than others, and some might experience cooling. Changes in air temperature can, in turn, cause changes in sea surface temperature, precipitation patterns, and other aspects of climate. The following analysis is expected to clarify these issues mentioned above.

#### **Greenhouse gas (GHG) emissions are now at record-high levels.**

Human has increasingly used energy, mainly from fossil sources (coal, oil, gas), which released more and more green house (mostly CO<sub>2</sub> and CH<sub>4</sub>) to the environment, causing global temperature increase. These heat-trapping gases are now at record-high levels in the atmosphere compared with the recent and distant past. The UNDP (2008) in its human development report shows that the concentration of greenhouse gas is now

up to 380 ppm, exceeded the sustainable level in the past 650.000 years. UNDP's data (2008) shows that emission CO<sub>2</sub> made by advanced countries (especially the US, Germany, Canada and the UK)<sup>3</sup> reaches 45% of the total number of the world in 2004 (even 70% of the total CO<sub>2</sub> in the period of 1840-2004) despite they only present for 15% of the world population.

**Figure 2.1. Stock of Carbon Dioxide Emissions Beginning in 1900**



Sources: Energy Information Administration, International Energy Annual (2005) and International Energy Outlook (2006); International Energy Agency, World Energy Outlook (2007); and World Resources Institute's Earth Trends database, IMF Outlook (2008).

As shown in Figure 2.1, advanced economies account for most past energy-related emissions and thus for most of the current stock of these emissions. However, when changes in land use and deforestation are considered, a different conclusion (den

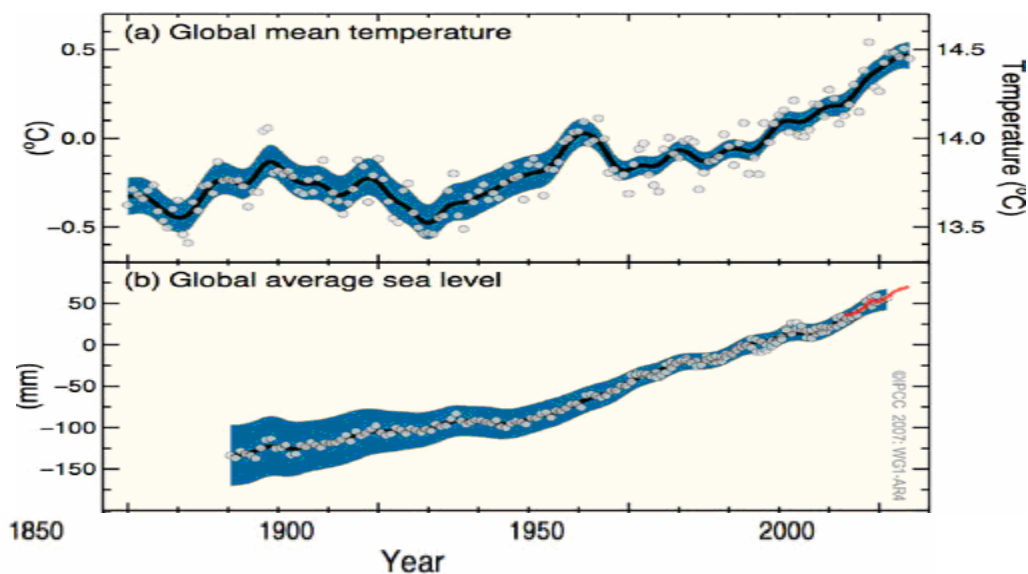
<sup>3</sup> In 2004, CO<sub>2</sub> level of the US was 6 billion ton, accounting for 20% of the total number of the world, Germany (800 million ton), Canada (600 million ton), UK (580 million ton).

Elzen and others, 2005; Baumert, Herzog, and Pershing, 2005) emerges: advanced economies account for less than half of the current stock of total emissions. Emissions from developing countries would peak around 2030. Large and fast-growing countries such as China and India, contribute most to the growth in emissions. (Figure 2.1)

**Global temperatures are expected to rise between 1.4 and 5.8° C by 2100 at current trends in greenhouse gas emissions growth**

The global climate is projected to continue to warm in coming decades, as new GHG emissions augment the already large stock of past emissions. According to the IPCC (2007), at the current trend in greenhouse gas emissions growth, global temperatures are expected to rise between 1.4 and 5.8° C (2.5 to 10.4° F) by 2100. United Nations Environment Program ’s data (UNEP, 2007) shows that the average temperature increased by 0.74 ° C in the 20<sup>th</sup> century and is estimated to increase by 1.8 to 4 ° C or higher in 2100.

**Figure 2.2. Changes in Global Temperature and Sea level**



Notes: Observed changes in (a) global average surface temperature and (b) global average sealevel rise from tide gauge (blue) and satellite (red) data. All changes are relative to corresponding averages for the period 1961-1990. Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties.

Sources: IPCC (2007)

As shown in the IPCC's data, the period of 1995 - 2006 is the warmest years of global surface temperature since 1850 (Figure 2.2). In the past 100 years, average Arctic temperatures have increased at nearly twice the global average rate. Land regions have warmed faster than the oceans.

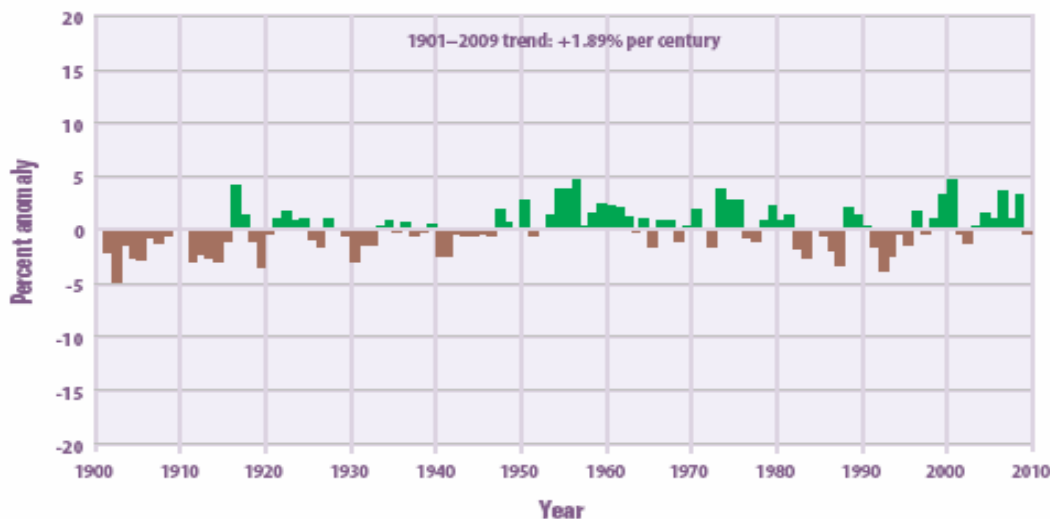
### **Sea levels could rise rapidly with accelerated ice sheet disintegration**

Increases in sea level are consistent with warming (**Figure 2.2**). Global average sea level rose at an average rate of 3.1 [2.4 to 3.8] mm per year from 1993 to 2003, almost twice rate of the period of 1961-2003 (IPCC, 2007). Sea levels could rise rapidly with accelerated ice sheet disintegration.

### **Precipitation globally has changed since 1901, which causes wide-ranging effects on human life and ecosystems.**

Climate change is likely to change precipitation patterns. The frequency of heavy precipitation and long drought may increase. Heavy precipitation will cause soil erosion. Longer and persistent droughts may cause decrease water availability, lower yields, increase livestock deaths, and lose biodiversity. Changes in precipitation causes wide-ranging effects on human life and ecosystems. It can break natural processes, particularly when these changes occur suddenly and plant, animal species do not have time to adapt.

**Figure 2.3. Precipitation Worldwide, 1901–2009**





*(Notes: It uses the 1901 to 2000 average as a baseline for depicting change. The indicator shows annual anomalies, or differences, compared with the average precipitation from 1901 to 2000. These anomalies are presented in terms of % change compared with the baseline)*

Source: Environmental Protection Agency (2010)

Figure 2.3 shows how the amount of precipitation globally has changed since 1901, based on rainfall and snow-fall measurements from land-based stations worldwide. Global precipitation has increased at an average rate of 1.89% per century since 1901.

## **2.2. Climate change in East Asia: Observed trends, variability and extreme events**

East Asia is a region with the east-west direction of 5000 km and the north-south direction of 3.000 km including parts of China, Japan and Korea. The region is almost rural while most of its mega cities, especially in China, are located on the coast. This feature make the region become a first candidate to be impacted by sea level rise and weather related disasters.

East Asia is among the most vulnerable areas of the climate change due to long sea coast, high population concentration and their dependency to agriculture and resource. The diversity of the region in geographic, economic, and demographic amplifies the risks of climate change impacts in East Asia. Herminia Francisco's research of 2008 (Economy and Environment Program For Southeast Asia - EEPSEA) shows that Asia suffers from 85% of the total disasters and 75% of the total damage in the world during the period of 1980-2005 as Asia is among areas of high vulnerability to and low adaptive capacity for climate change in the world. Observed climate trends and variability in East Asia are generally characterised by such as the followings:

### 2.2.1. Surface air temperature

Surface air temperature in East Asia is on increasing trend. Increases in surface temperature is the most popular characteristic in the East Asian region, which is more clearly during winter than in summer. The observed increases in some parts of East Asia during recent decades ranged between less than 1°C to 3°C per century.

Table 2.1 shows change in temperature in the East Asian countries (China, Japan, Korea, Indonesia, Philippines, Thailand, Singapore and Vietnam). In China, climate is warming during last 50 years while the rate of increase is more pronounced in minimum than in maximum temperature. Temperature in Japan has risen about 1.0°C in the 20<sup>th</sup> century, and even 2 to 3°C in large cities. Korea experiences a smaller change in temperature with 0.23°C rise in annual mean temperature per decade. Meanwhile, in the Southeast Asian countries, the average temperature has increased 0.1–0.3°C per decade between 1951 to 2000 (ADB, 2009). (Table 2.1)

**Table 2.1. Observed temperature changes in East Asian countries**

Country	Change in temperature
China	Warming during last 50 years, more pronounced in winter than summer, rate of increase more pronounced in minimum than in maximum temperature
Japan	About 1.0°C rise in 20th century, 2 to 3°C rise in large cities
Korea	0.23°C rise in annual mean temperature per decade, increase in diurnal range
Indonesia	Homogeneous temperature data were not available
Philippines	Increase in mean annual, maximum and minimum temperatures by 0.14°C between 1971 to 2000
Singapore	Increase by about 0.3 °C per decade as observed between 1987-2007 (Ho, 2008)
Thailand	Increase of 1.04-1.80 °C per century (Ho, 2008)
Vietnam	Increase of 1.0 °C per century (Cuong, 2008)

Source: IPCC (2007); Ho (2008); Jesdapipat (2008); Cuong (2008)

There is also an evidence that temperature increases became more clearly in recent years compared to the first half of the 20th century. In the Philippines, warming

has occurred since 1971 while mean, maximum, and minimum temperatures have increased  $0.14^{\circ}\text{C}$  per decade according to IPCC (2007). In Vietnam, the annual average temperature increased faster in the latter half of the century and rise at  $0.7^{\circ}\text{C}$  per decade, during the period of 1951 - 2000. Summers have become hotter in recent years, with average monthly temperatures increasing  $0.1\text{--}0.3^{\circ}\text{C}$  per decade.

Warming is projected to be stronger in East Asia. Min et al (2004) showed that East Asia may experience warmer and wetter climate over the 21<sup>st</sup> century with bigger impacts than the world. Hulme and Sheard (1999) projected a temperature increase of  $1.2\text{--}3.9^{\circ}\text{C}$  in the Philippines by 2080, using all the IPCC emission scenarios. Temperature rise in Singapore by the end of this century, according to IPCC (2007), is likely to be similar to the projected global mean temperature rise of  $2.5^{\circ}\text{C}$  with a range of  $1.7\text{--}4.4^{\circ}\text{C}$ . Most regions in Vietnam are projected to experience an increase in temperature of  $2\text{--}4^{\circ}\text{C}$  by 2100 (Cuong 2008).

### **2.2.2. Sea levels**

Sea levels in East Asia has risen with the rate of increase accelerating in more recent years relative to the long-term average. Given its long sea coast, East Asia is the most vulnerable area to sea-level rise, together with other regions (Africa, South Asia, etc).

In Southeast Asia, sea levels have risen in the last few decades, at the average rate of 1-3 mm annually, higher than the global average. IPCC (2007) cites several studies reporting rises in sea level, with the rate of increase accelerating in more recent years relative to the long-term average. Arendt et al. (2002) and Rignot et al. (2003) show a rise of 3.1 mm per year in the past decade, compared to  $1.7\text{--}2.4$  mm per year in the entire 20<sup>th</sup> century. While mean sea level increased by  $1\text{--}8$  mm per year in Indonesia with the highest increase registered in the area of Belawan, Vietnam experienced a higher sea level rise of 2-3 mm per year (ADB, 2009). A phenomenon called “rob”, which refers to the inundation of coastal areas during the spring tide, has been observed in a number of coastal areas in the East Asian countries (such as Demak,

Bantem, Jakarta in Indonesia or Tanjong Pagar in Singapore). In the Philippines, studies on rising sea levels in major coastal cities show a slight upward trend (Yanagi and Akaki 1994). The Manila area has showed a particularly strong increase in mean sea levels, probably due to a global rise in sea levels. **(Table 2.2)**

**Table 2.2. Observed Change in Sea Level in East Asian countries**

<b>Countries</b>	<b>Change in Sea Level</b>
Indonesia	Increased by 1–8 mm/yr depending on location
Philippines	Increasing in major coastal cities with Manila exhibiting the highest increase
Singapore	No observable trends toward higher mean sea level so far
Thailand	Trending higher in recent years
Viet Nam	Increasing by 2–3 mm/yr

Source: ADB ( 2009)

Sea level in East Asia is likely to continue to rise based on an average of 3.1mm/year in the last decade, compared to 1.7-2.4 mm/year in the last century. Sea levels are projected to rise 40 cm in Southeast Asia by 2100, which will likely increase the loss of small islands (IPCC 2007). Terra Daily (2007) reported that Indonesia could lose 2,000 small islands by 2030 due to an increase of sea level as a result of climate change. Hulme and Sheard (1999) projected an increase in sea level in the Philippines of 0.19–1.04 meters by 2080 relative to mean sea level during 1961 - 1990. An increase of 40-90 cm in sea level is predicted in different parts of China by 2050,

### **2.2.3. Precipitation**

East Asia’s precipitation patterns have changed during the second half of the last century, with an overall trend toward decreasing rainfall until 2000. Inter-seasonal and inter-annual in rainfall trend has been almost observed during the past few decades in the East Asian region. Decreasing trends in annual mean rainfall are observed in Indonesia, Singapore, Thailand, Vietnam, China and some areas in Japan. **(Table 2.3)**

Annual rain declined in the past decade in North-East and North of China while there is an increase in Western, Changjiang River and along south-east coast of China (IPCC, 2007). Aldrian (2007) reported that Indonesia's rainfall decreased in recent decades, except in the Lesser Sunda Islands, the eastern coast of Java, and the northern part of Indonesia. Rainfall in Thailand and Singapore also decreased in the past few decades, compared to the first half of the last century. In most areas of Vietnam, average monthly rainfall has decreased, particularly between the months of July and August. Rainfall intensity has also increased significantly (Cuong, 2008). In contrast, mean annual rainfall and the number of rainy days in the Philippines has increased since 1960.

**Table 2.3. Observed Change in Precipitation in East Asian countries**

<b>Country</b>	<b>Change in Precipitation</b>
China	Annual rain declined in past decade in North-East and North China, increase in Western China, Changjiang River and along south-east coast
Japan	No significant trend in the 20th century although fluctuations increased. However, decreasing trends in annual mean rainfall are observed in some areas of Japan.
Korea	More frequent heavy rain in recent years
Indonesia	Decrease in annual rainfall during recent decades in some areas (Decline in rainfall in southern and increase in northern region)
Philippines	Increase in annual mean rainfall since 1980s and in number of rainy days since 1990s, increase in inter-annual variability of onset of rainfall
Singapore	Decrease in annual rainfall in the past 3 decades
Thailand	Decreasing annual rainfall for the last 5 decades
Vietnam	Decrease in monthly rainfall in July-August and increase in September to November

Source: IPCC (2007); ADB (2009)

Annual precipitation will likely increase in East Asia both in terms of winter and summer.. In Southeast Asia, precipitation is projected to decrease in the first half of the 21<sup>st</sup> century, but to increase by the end of the century, with strong variation expected between March and May. Southeast Asia's precipitation will increase by 1 - 2.25% by

2050 under different scenarios, with the strongest rise starting in December and ending in May (ADB, 2009). Moreover, the projected precipitation pattern is that the wet season will become wetter and the dry season drier.

#### 2.2.4. Extreme weather events

Extreme weather events are more frequent and intense in East Asia in the past several decades. The number of tropical depressions, tropical storms, and typhoons reported in the region reached an all-time high, with 21 reported typhoons in the Southeast Asian area, higher than the median number of 17.5 in the period of 1990 - 2003. These extreme events led to massive flooding and landslides in many parts of the region, causing extensive damage in property, assets, and human life. In recent years, El Niño events have become more frequent together with an increase of global temperatures. Boer and Perdinan (2008) shows that climate-related hazards have increased over the past 5 decades. The most frequent hazard is flooding, followed by landslides and water or diseases. As shown in the **Table 2.4**, East Asian countries are among the most vulnerable to climate change with risk of drought, floods, storms and sea level.

**Table 2.4. Economies Most at Risk from Drought, Floods, Storms and Sea Level**

<b>Drought</b>	<b>Floods</b>	<b>Storms</b>	<b>Sea Level Rise</b>
Malawi	Bangladesh	<b>Philippines</b>	All Low-Lying Island States
Ethiopia	<b>China</b>	Bangladesh	<b>Vietnam</b>
Zimbabwe	India	Madagascar	Egypt
India	<b>Cambodia</b>	<b>Vietnam</b>	Tunisia
Mozambique	Mozambique	Moldova	<b>Indonesia</b>
Niger	<b>Laos</b>	Mongolia	Mauritania
Mauritania	Pakistan	Haiti	<b>China</b>
Eritrea	SriLanka	Samoa	Mexico
Sudan	<b>Thailand</b>	Tonga	<b>Mynamar</b>
Chad	<b>Vietnam</b>	<b>China</b>	Bangladesh

Source: World Bank, Sustainable Development Network, Environment Department (2008)

In the Philippines, the frequency of typhoons entering its area of responsibility increased more than four-fold during 1990–2003. During the past 15 years, the Philippines was hit by the strongest typhoons. Thailand suffers from extreme events include flood and drought, landslides, and strong storm surges while extreme events in Vietnam take the form of typhoons, droughts and flooding, as well as heat waves (Jesdapipat, 2008). Over the last 50 years, the peak month for typhoon landfalls has shifted from August to November, and most of the storms now occur later in the year. Droughts and floods now occur with greater frequency than before and affect mostly the central coastal provinces of Vietnam. Results of regional climate model experiments for East Asia (Sato, 2000; Emori et al., 2000; Kato et al., 2000; Ichikawa; 2004; Japan Meteorological Agency, 2005; Kurihara et al., 2005) show that heatwave conditions over Japan are likely to be enhanced in the future..

### **3. FISCAL AND FINANCIAL IMPACTS OF THE CLIMATE CHANGE IN EAST ASIA**

#### **3.1. General Regional Impacts**

Given its variability and extreme events in climate, East Asia is one of the most vulnerable regions to climate change impacts. The economic and social impacts of climate change are significant and long lasting in the region. This study focuses on regional impacts of climate change which are considered as characteristics in the East Asian region, such as the followings: (i) impacts on agriculture and food security; (ii) impacts on ecosystem; (iii) impacts on water resources; and finally (iv) impacts on poverty reduction efforts and social security.

##### **3.1.1. Impacts on agriculture and food security**

From the result of the economic analysis presented in Jung et al. (2010), it is also worth noting that the economic costs of the climate change will be higher in low income countries than those in high income countries, since the former tend to have a larger dependence on climate-sensitive sectors, particularly agriculture. Agriculture is the main source of livelihood for most rural people in the region and it is also the human activity most affected by climate change with serious losses of high-value agricultural lands.

Table 3.1 shows the ratio of agricultural sector to GDP of ASEAN+3 member countries. While Korea and Japan have relatively very low weight on agriculture, ASEAN member countries have overall high ratios, and those of Lao Republic and Cambodia are over 30%. The average ratio of ASEAN is about 14.9%, which is higher weight than that of Korea, China, and Japan. In addition, the great importance of tourism in ASEAN economy makes ASEAN be more vulnerable to the climate change.



Therefore, in one of baseline scenarios done by Jung et al. (2010), they considers only the economic costs of ASEAN. There can be a long list of the costs including negative productivity in agricultural sector, negative labor productivity caused by health problem, negative effects on tourism, and so on. In a report (*IMF World Economic Outlook, 2008*), IMF assumes that there will be large negative productivity shocks, higher death rate, and negative country risk premium shocks in South Asia caused by the climate change. In its background research, Jung et al. (2010) simply assumes that there will be 0.1% negative productivity shocks each year for ten years in a row.

**Table 3.1. Ratio of Agricultural Sector to GDP in East Asian countries**

(Unit:%)

Country	Agriculture
Korea, Rep.	2.88
China	10.77
Japan	1.44
Vietnam	20.36
Singapore	0.07
Malaysia	10.27
Indonesia	13.71
Lao	35.52
Cambodia	31.88
Thailand	10.68
Philippines	11.68
Brunei	0.69

Source: World Bank WDI; Jung et al. (2010)

The expected impacts on agricultural productivity in tropical Asia due to climate change are all key sources of production losses. In the Philippines, the weather disasters mentioned were responsible for over 80% of the total rice losses in the period of 1970 - 1990, costing up to US\$39.2 million in 1990 (WB, 2006).

Some studies indicate that production of rice and wheat in the past few decades has declined in many parts of the East Asian region due to climate change (such as

increasing water stress arising, increasing frequency of El Nino and reduction of rainy days). Additionally, frequent and extreme events, such as droughts and floods, are likely to make local crop production more difficult. It is projected that climate change will put around 49 million more people at risk of hunger by 2020 in Asia (IFAD, 2009).

**Table 3.2. Observed Impacts of Climate Change on Agriculture in East Asia**

<b>Climate change</b>	<b>Observed impacts on Agriculture</b>
Increasing temperature	<ul style="list-style-type: none"> <li>– Decreased crop yields due to heat stress</li> <li>– Increased livestock deaths due to heat stress</li> <li>– Increased outbreak of insect pests and diseases</li> </ul>
Variability in precipitation	<ul style="list-style-type: none"> <li>– Increased frequency of drought, floods, and tropical cyclones (associated with strong winds), causing damage to crops</li> <li>– Change in precipitation pattern affected current cropping pattern; crop growing season and sowing period changed</li> <li>– Increased runoff and soil erosion caused decline in soil fertility and consequently crop yields</li> </ul>
Sea level rise	<ul style="list-style-type: none"> <li>– Loss of arable lands due to advancing sea level</li> <li>– Salinization of irrigation water affected crop growth and yield</li> </ul>

Sources: Boer and Dewi (2008); Cuong (2008); Ho (2008); Jesdapipat (2008); Perez (2008); ADB (2009)

Crop yields in the four East Asian countries (Thailand, Vietnam, Indonesia, Philippines) are projected to decline averagely by 50% between 1990 and 2100 in case no adaptation activitive is done. Additionally, areas in water crisis such as northeast China and flood-prone river deltas of Vietnam, may experience significant land degradation and loss due to climate change. The risk of hunger is expected to remain extremely high in several developing countries under the pressure of fast population growth and urbanization. Moreover, such agriculture impacts may threaten not only

food security, but also economic productivity for the least developed nations. (**Table 3.2**)

### **3.1.2. Impacts on water resources**

East Asia's water resources have come under increasing strain cause by climate change (decreasing precipitation and increasing temperatures), along with rapid population and industrial growth. The Mekong River, Red River, and Chaophraya River cradle much of the region's productive rice growing areas. With an increase in temperature, the rate of evaporation and transpiration increases. This in turn affects the quantity and quality of water available for agricultural production and human consumption. While El Niño makes stream flows reduce, La Niña makes rainfall become heavy and intense, which results in excessive runoff and water flows. This can cause severe erosion of river banks and sedimentation of transported soils in water reservoirs.

In the Philippines, the worst drought in the El Niño years of 1997-1998 resulted in severe water shortages at the Angat dam - the main source of water for Metro Manila and surrounding areas. Droughts make the dam's storage reduce by 10%, resulting in water rationing in some areas (ADB, 2009). The falling water levels affected the operation of hydroelectric plants that provide power to major cities and surrounding areas. Meanwhile, in Indonesia, floods caused by La Niña in the period of 2003–2005 damaged houses, roads, bridges, dams, dikes, water resources, buildings, with a total damage to infrastructure of S\$205 million (Sutardi, 2004).

### **3.1.3. Impacts on ecosystems**

The ecosystems in the East Asian region is considered as a key asset of local, regional and international level. They contribute substantially to the regional economies by providing food and water to sustain poor rural people as well as natural resources. The ecosystems of the region will be under increasing pressure from human activities and land use change. These factors will reduce the resilience of ecosystems to the effects of climate change and increase their vulnerability..

The overall impact on the forest ecosystems of the region is likely to be negative, as for forest cover. Intensity and spread of forest fires in the region increased in the past 20 years, largely due to an increase of temperature and decrease of precipitation with rising intensity of land uses. Wetlands are also being threatened by temperature increase. Furthermore, more frequent and prolonged droughts will result in the increasing trends of desertification in the East Asia region, affecting its natural ecosystems and the poor rural people dependent on them. In Korea, the areal coverage of pine forests is projected to decrease by 20 - 35% with a significant northward shift. In Japan, about 90% of the suitable habitat for a dominant forest species, beech tree could disappear by the end of the 21<sup>st</sup> century (IPCC, 2007).

#### **3.1.4. Impacts on poverty reduction efforts and social security.**

Climate change is a serious risk to poverty reduction and threatens to undo decades of development efforts. Climate change will create barriers to future poverty reduction efforts and reverse many of the important socioeconomic gains made by developing countries in East Asia. While climate change is a global phenomenon, its negative impacts are more severely felt by poor countries. They are more vulnerable because of their high dependence on natural resources, and their limited capacity to cope with climate variability and extremes.

The Stern Review (2007) and IPCC (2007) both state that climate change will have adverse impact on people's health, safety and livelihoods, with the "poorest people in the poorest countries expected to suffer first and foremost". Many poor people in the region live in coastal areas and in the low-lying deltas, who are most vulnerable to risk of climate change, as their income provides little to health services or other safety nets to protect against the threats by climate change. In the East Asian region, the poor living in mega-cities are particularly at risk. Vietnam country report (2010) shows that the consumer's price level in both urban and rural area will increase with the climate change. Even though the increase is similar in both rural and urban

area, the rural people are far more vulnerable. However, the increase in price level is not the only pressure on social security system. The lost of inhabitable land and the increase in the natural disasters will soon put their pressure on the system as the global temperature rises.

## **3.2. Fiscal and Financial Impacts**

### **3.2.1. Impacts on regional economic growth**

This study focuses on impacts of climate change on economic growth because climate change may cause general economic disruption that reduces consumption. Besides, climate change require more costly adaptation measures to protect against extreme weather events that reduce investment.

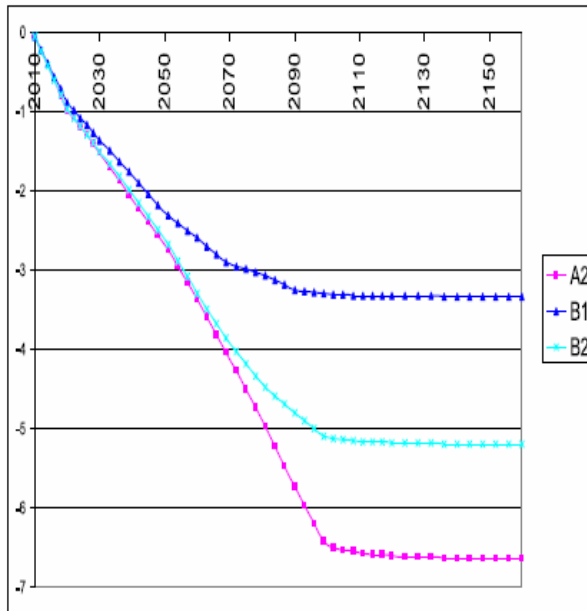
In East Asia, climate change is projected to have negative effects on the sustainable development of most developing counties, as it increases the pressures on natural resources and the environment together with rapid urbanization, industrialization and economic development. The net effect of climate change on regional and national economies is projected to be largely negative. A loss in agricultural revenue and additional costs for managing water resources, and disease will put negative impacts on economic activity. The regional economic damage caused by climate change make the insurance industry suffer a loss of billions of USD each year.

ADB (2009) shows that Indonesia, Philippines, Thailand, and Vietnam could suffer a loss of 6.7% of GDP annually by 2100, twice as the global average loss if there is no action taken. Other recent estimates indicate that a 1-5 meter sea level rise would impact the region's GDP between 1.7 and 8.3%, respectively. Countries most affected would be Vietnam (10.2-36.2%); China (2.4-10.8%), Indonesia (1.9-8.1%), Thailand (1.4-22.6%), and Cambodia (1.1-11.2%) (WB, 2006). In Thailand, Boonpragob (2005)

noted that the country suffered an economic loss of over 70 billion baht (or US\$1.75 billion) due to floods, storms, and droughts in the period of 1989 - 2002.

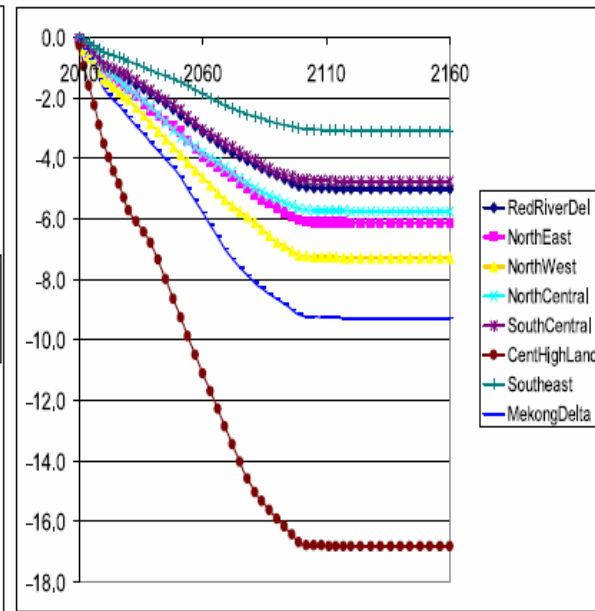
In case study of Vietnam (NIF, 2010), the country could lost about 5-6% its GDP under medium (B2)<sup>2</sup> climate change scenario with only crop productivity and lost of land (due to inundation) taken onto account. The damage range will be between 3-7% if we take other two high and low CO2 emission scenarios (A2 and B1). As shown in **Figure 3.3**, the damage will stop going up after 2100. This is because we assume that the temperature will not rise further after 2100. If this is not the case we could easily imagine that the damage will continue its trend in the years before 2100.

**Figure 3.3: Impact on the country's GDP.**



Source: NIF, 2010

**Figure 3.4: Regional GDP under climate change - B2 scenario**



Source: NIF, 2010

<sup>2</sup> Ministry of Natural Resources and Environment (MONRE) of Vietnam has made a prediction on future directions of climate change in Vietnam according to a scheme of three scenarios: Low emission scenario (B1), medium emission scenario (B2), and high emission scenario (A2 of equivalently A1FI). The scenario classification based on IPCC's 40 scenarios

The regional GDP picture in Vietnam is quite different from region to region (**Figure 3.4**). This is not a surprise since the climate change affects regions differently. The Mekong river delta is not surprisingly among the hard hit region. However, Mekong river delta is not the hardest region – Central high land region is the biggest victim of climate change in Vietnam. This is because of the fact that the region's GDP is agriculture dependent. Focusing on the agricultural sector, we could observe that the output of rice production decrease the most in Mekong river delta. The lost of paddy output in Mekong river delta is about 11% in 2100. Meanwhile, the output damage to other crop is more severe in all regions. The output lost will be around 23-33% a year in 2100.

### **3.2.2. Fiscal and Financial Impacts**

Since fiscal and financial impacts of climate change will likely vary across countries, it is very difficult to identify perfect characteristics for these impacts in a region, especially a diversified one as East Asia. This study, therefore, will try to clarify some possible aspects which will provide a general consistent analysis of fiscal and financial impacts of climate change in the East Asian region. Case studies of member countries in the ASEAN+3 region may also be helpful to clarify fiscal and financial impacts of climate change in East Asia.

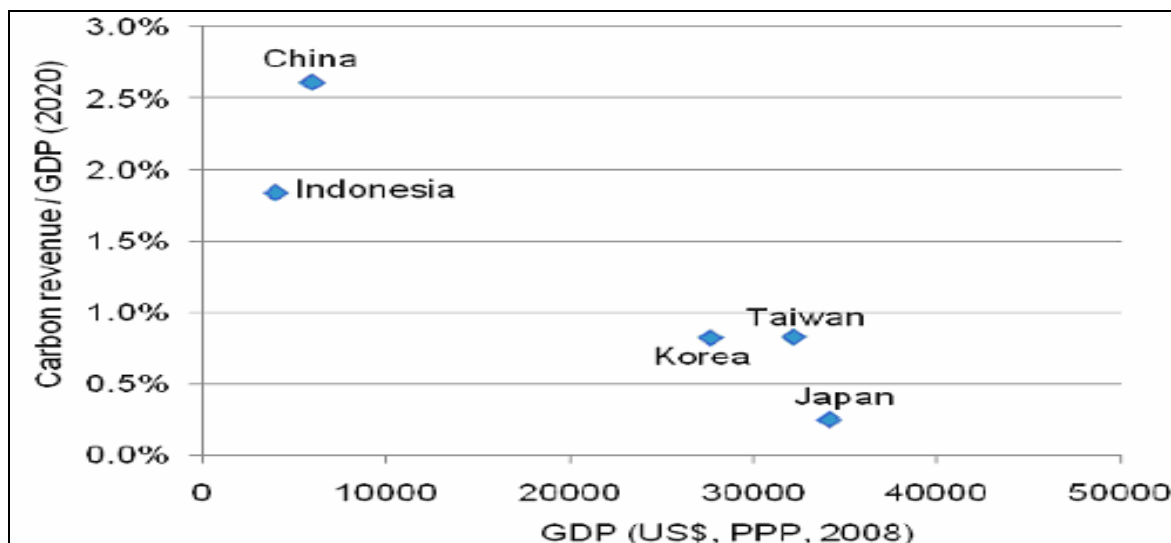
#### **a. Impacts on State Budget Revenue**

Climate change impacts on budget revenue can be two folds: on one hand the reduction in productivity due to climate change (for example: agricultural productivity, reduction in tourism) may significantly reduces the economy's output and by this way reduce the budget revenue; on the other hand, governments can raise carbon taxes or environmental taxes, etc to mitigate the impacts of the climate change.

A carbon tax is simply one levied at the same specific rate on all emissions, whatever their source. Since carbon emissions are proportional to fossil fuel use, this could be charged not directly on emissions but on fossil fuels - petrols, gas, coal -

themselves. Revenue from a carbon tax is commonly presumed to remain in the country that levies the tax, which is taken to be that in which final use occurs. Deepak, M. (2010) finds that global action on climate change by pushing up global energy prices can raise revenues from 0.5% to more than 2% of GDP.

**Figure 3.5: Impacts of Carbon tax on GDP in East Asian countries**



Notes: 2005 prices; USD. Revenue raised is as a%age of GDP measured at market prices; GDP per capita is measured using PPPs. The assumption that 2020 targets are met is used simply to derive an emissions volume by which the US\$20 price can be multiplied to derive revenue. It is not being claimed that a US\$20 price is what is needed to achieve these targets; likely, a higher price would be needed.

Sources: Author's compilation from WB (2010)

Carbon taxes could generate substantial budget revenue for countries in the East Asian region.. Figure 3.5 shows that most East Asian economies could generate revenue of about 0.5% of GDP or more by 2020 if a sum of US\$20 per tonne of CO<sub>2</sub> (in 2005 prices) is levied through either a tax or auctioned permits. The revenue implications are especially significant for East Asia's developing economies, since their emissions are higher relative to GDP when measured using market exchange rates. A US\$20 carbon price applied across fossil fuels could fetch China in excess of 2.5% of GDP by 2020.<sup>3</sup>

<sup>3</sup> <http://www-wds.worldbank.org/external/default/WDSContentServer/WDS>



Carbon taxes could create large new revenues, which can be used to support business and poor households, as well as for additional climate change measures. In the case of Indonesia, the revenue from a carbon tax would contribute to the budget and can be used at the government's will. The revenue then may be used to assist the process of reform and help alleviate the impact of higher prices (by the tax) on the poor. Cash transfers directed at poor households and tax reductions can improve income distribution. The revenue can also be used to compensate businesses for losses incurred through the carbon tax or to promote efficiency- enhancing reforms that make it easier for affected firms to do business. (Table 3.3)

**Table 3.3. Average price impact of Rp 80.000 carbon price, projected revenue, and possible revenue uses**

	<b>Price increase</b>	<b>Tax/levy revenue</b>	<b>Possible use of revenues</b>
Electricity	Rp 60 per kWh	Revenue would rise to around Rp 95 trillion by 2020 per year.	Government free to decide on revenue use.
Diesel/kerosene	Rp 235 per liter		
Gasoline	Rp 190 per liter	Additional permit export revenue of several billion dollars per year may be available	Proposed strategy: Offset the impact of price rises on households and on businesses; reduce other taxes; support additional abatement initiatives.

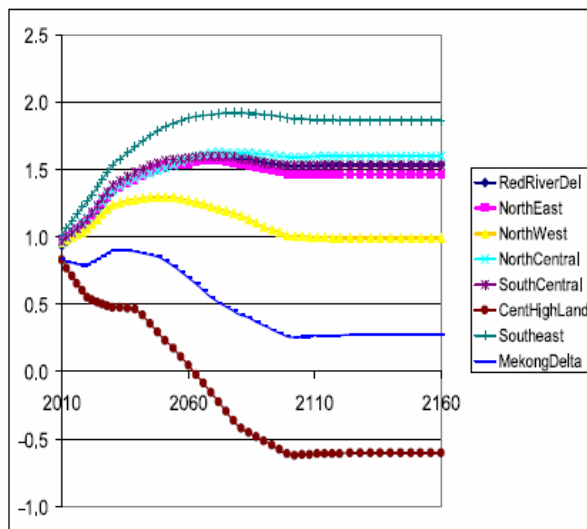
Source: MOF of Indonesia (2009)

Table 3.3 assess average impact of carbon tax/levy on revenue. It assumes that the carbon tax/levy could start at a level of Rp 80,000 per tonne of CO<sub>2</sub>, and rise at a rate of 5% (real) per annum to 2020. This measure is projected to reduce emissions from the energy sector by around 10% from business-as-usual levels by 2020, assuming

full carbon price pass - through<sup>4</sup>. By then it could produce a taxation/levy revenue stream of around Rp 95 trillion per year.

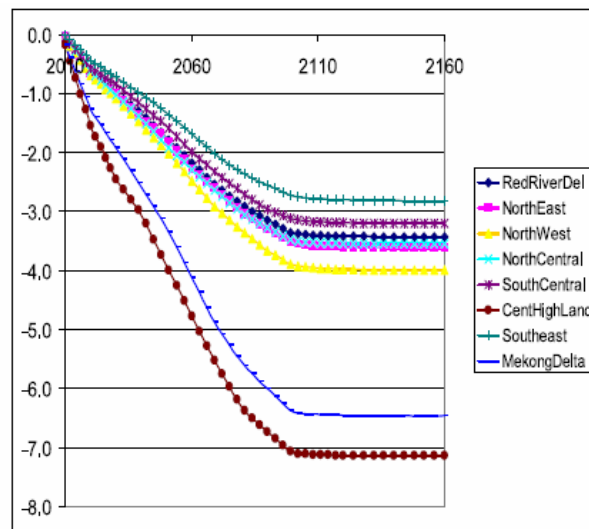
On the revenue reduction effects, NIF (2010) estimates that real indirect tax revenue (discounted by the GDP deflator) will decrease for every region in Vietnam under the medium emission scenario (B2 scenario) (Figure 3.6). Nevertheless, the increase in indirect tax revenue disappears very soon after we take the price effect out. Figure 3.7 shows that if we discount the increase in indirect tax revenue with the GDP deflator, the real indirect tax revenue will decrease for every region. Real indirect tax revenue in Mekong river delta and Central high land regions decreases the most with the rate of reduction is about -6% to -7%. Real indirect tax revenue in Mekong river delta and Central high land regions decreases the most with the magnitude of reduction is about -6% to -7%. The share of budget revenue in GDP is also reduced by approximately 1-6% in every region.

**Figure 3.6. Nominal indirect tax revenue - B2 scenario**



Source: NIF ( 2010)

**Figure 3.7. Real indirect tax revenue - B2 scenario**



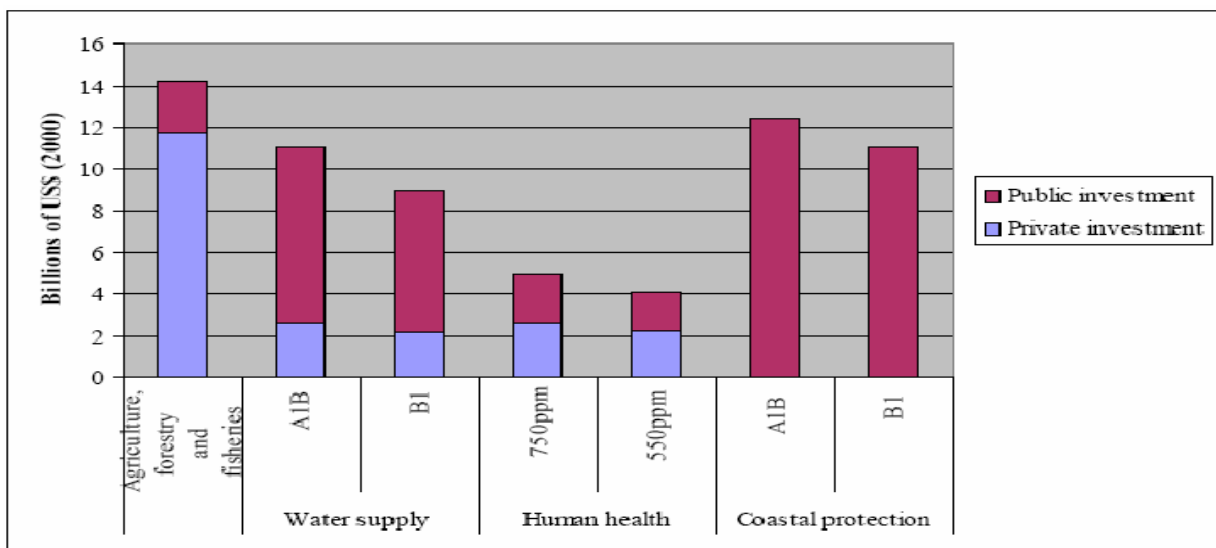
Source: NIF ( 2010)

<sup>4</sup> In the case of Indonesia, energy prices are regulated for many energy users, which means that the carbon price signal does not get passed through to energy and energy intensive goods. However, in order to have an effect on investment and consumption decisions, the carbon price does need to be passed through.

## b. Impacts on State Budget Expenditure:

Impacts of climate change on State Budget Expenditure in the region are mainly assessed through climate change adaptation cost or R&D cost in response to climate change. However, evidences on aggregate costs are rare. The World Bank (2006) puts the cost of climate-proofing existing investments in developing countries at US\$10–US\$40 billion per annum. Even excluding outlying estimates within the study (which are as high as US\$100 billion), this is a wide range: from around 10 to 40% of net ODA. Climate-proofing ODA and the most exposed concessionally financed investments is estimated to cost US\$4–US\$8 billion annually. UNFCCC (2007) estimates suggest an annual investment cost for agriculture, health, water and coastal protection, of around US\$40 billion per annum by 2030 - about half of which might fall on the public sector (**Figure 3.8**). It also reports a very wide range for additional infrastructure needs, of US\$8–US\$130 billion annually.

**Figure 3.8. Additional Adaptation Investment, 2030**



(Notes: A1B and B1 are emissions scenarios from the UNFCCC Special Report on Emission Scenarios (SRES), with a faster transition to less carbon-intensive technologies in the latter)

Source: UNFCCC (2007), IMF (2008)

World Bank (2010) has estimated the global costs of adaptation (US\$70-100 billion annually out to 2050, in 2005 prices), and also produced costs for a number of individual economies, including Vietnam. The total undiscounted cost of adaptation measures in agriculture in Vietnam is estimated to be at US\$210 million each year (at 2005 prices) over the period of 2010-2050. Construction of sea dikes and other flood defenses for urban infrastructure and the most valuable agricultural land is separately estimated at US\$20-50 million each year.

## **4. POLICY CHALLENGES FORWARD**

### **4.1. Existing Policy Actions**

#### **4.1.1. Multilateral Efforts**

As most of the East Asian countries suffer from the similar disasters and damages caused by climate change, a regional strategy (multilateral efforts) will be the first priority which followed by national actions (unilateral efforts). Multilateral efforts target at an effective regional strategy in response to the climate change, which is confirmed by the East Asian countries in the regional summits or through regional funds.

#### **From ASEAN and ASEAN +3 Summits:**

In fact, the East Asian countries have raised a lot of ideas and come to agreements in response to the climate change in ASEAN and ASEAN +3 Summits and Meetings.

The ASEAN leaders shared concerns with climate change and expressed their commitment to take appropriate actions through various ways. The “ASEAN Vision 2020” released at the 8<sup>th</sup> Southeast Asia Forum in Kuala Lumpur recognized the climate change as one of the challenges the region was facing and called for “a clean and green ASEAN” with mechanisms to protect the environment and enhance the sustainability of natural resources as well as quality of life. This vision has been reaffirmed at various occasions; during the 13<sup>th</sup> ASEAN Summit in 2007, ASEAN reassured the need to tackle climate change based on the principles set out by the UNFCCC through the Singapore Declaration on Climate Change, Energy and Environment. The declaration aims to deepen the understanding of the region’s vulnerability to climate change and to implement appropriate mitigation and adaptation measures. At the 41<sup>st</sup>

ASEAN Ministerial Meeting in July 2008 delegated the responsibility of mainstreaming climate change actions into ASEAN programs to the ASEAN sectoral bodies on energy efficiency, transportation, and forestry.

In March 2009, the ASEAN countries adopted a five year (2008-2013) Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) with the goal “to ensure long-term food security and to improve the livelihoods of farmers in the ASEAN region”. To implement this action plan, the ASEAN Ministers on Agriculture and Forestry (AMAF) will coordinate with other ASEAN sectoral bodies to monitor the implementation of all member States. The Working Groups under AMAF are in charge of developing implementation measures for all member States. Each member states is also required to produce a monitoring report for compliance reviews by the ASEAN Secretariat annually.

At 16<sup>th</sup> ASEAN Summit (April, 2010), the ASEAN countries agreed to continue to exchange views among ASEAN Member States on international climate negotiations under the UNFCCC as well as other related international conferences. In this regard, the newly established ASEAN Working Group on Climate Change (AWGCC) is suggested to work extensively to develop a common understanding/position of ASEAN international conferences. The ASEAN Climate Change Initiative (ACCI) is also urged by the member countries to actively provide a consultative platform to further strengthen regional coordination and cooperation addressing climate change. The regional countries also agreed to make efforts to engage in cooperation in research and development and knowledge sharing (including on agricultural management and practices so as to enhance food production, agricultural productivity and water resources sustainability) while adapting to the adverse effects of climate change and mitigating greenhouse gas emissions from the sector, which would target at ensuring food security in the region.

Most recently, at 28<sup>th</sup> ASEAN Ministers on Energy Meeting (AMEM, July 2010), the regional countries re-affirmed their commitment to energy cooperation in the

direction of regional integration and building of the ASEAN Community, and stressed the need for coordinated efforts in the implementation of the ASEAN Plan of Action on Energy Cooperation (APAEC) 2010-2015. In this regard, the regional countries welcomed the achievements made so far in the implementation of the key projects/initiatives of the APAEC 2010-2015, notably on Energy Efficiency and Conservation (EE&C), Coal and Clean Coal Technology, Renewable Energy, etc (Aseansec, 2010). The regional countries agreed to strengthen the ASEAN+3 Energy Cooperation in the present five areas of energy security, oil market, oil stockpiling, natural gas, and new and renewable energy (NRE) and energy efficiency and conservation. They also re-affirmed their commitment towards strengthening efforts to address climate change and enhancing ASEAN energy cooperation towards low-carbon and green economy.

### **To Regional Funds in Response to Climate Change:**

The efforts to enhanced a regional cooperation are made through initiatives and funds raised by the Asian Development Bank (ADB) for financing climate change mitigation and adaptation in Asia and the Pacific.

#### ***Carbon market initiative:***

CMI is an ADB's initiative to finance renewable energy and energy-efficiency projects in its Developing Member Countries. The initiative helps its developing member countries to enter the growing global carbon market, which estimated at US\$30 billion in 2007.

#### ***Climate Change Fund (CCF):***

Climate Change Fund (CCF) was established in May 2008 to support projects in terms of finance, technology, research and activities to address causes and impacts of climate change in ADB's developing member countries. ADB provided an initial amount of US\$40 million to CCF, in which US\$25 million for the development of clean technology, US\$5 million for the use of land and forestry sustainably, US\$10 million

for the response to climate change (ADB, 2009). Further contributions from countries, development organizations, foundations and the private sector are encouraged to enlarge to the fund.

***Asia - Pacific Carbon Fund (APCF):***

Asia - Pacific Carbon Fund, established in May 2007, is a credit fund and built by ADB as part of ADB's Carbon Market Initiative. The APCF will provide a new source of finance for ADB's developing member countries to mitigate the impact of climate change. The fund has received funding commitments of US\$151.8 million from seven European countries - Belgium, Finland, Luxembourg, Portugal, Spain, Sweden, and Switzerland. It has committed over US\$50 million in several CDM projects across the region and expects to commit the entire fund in projects by end of 2009 (ADB, 2009).

**4.1.2. Unilateral Efforts**

While multilateral efforts amplify the regional actions' effect on adaptation and mitigation to the climate change, unilateral efforts is required to have timely national actions to deal with the climate change in each country in the East Asia region. The member countries have developed their own national plans or strategies as well as fiscal policies for the climate change. Case studies of China, Thailand and Vietnam are expected to clarify unilateral efforts in response to the climate change in the East Asian region.

**China's national actions and efforts:**

China has established leading bodies and work mechanisms to deal with climate change and relevant laws and regulations. Accordingly, National Climate Change Countermeasure Coordinating Group (1998) and National Leading Group for Coping with Climate Change (2007) have been set up by the Chinese government to responsible for strategical decisions and policies relating to climate change. China has adopted a number of national laws and regulations in its domestic efforts to deal with



climate change such as the followings: *China's Agenda 21* (issued in July of 1994); *Energy Saving Law* (Approved by National People's Congress in Nov,1997; Revised in Oct of 2007; came into force on Apr 1st 2008); *Renewable Energy Law* (Approved by National People's Congress in 2005; Came into force in June 2006; still under discussion and revision) and a series of complementary regulation (MAO, 2009).

The Chinese government has focused its 11th Five-Year Plan (2006-2010) on addressing climate change: cutting per unit GDP energy consumption, developing renewable energy sources and increasing forest area. National Action Plan for Coping with Climate Change has been adopted on June 5, 2007 based on key principles of sustainable development, mitigation and adaptation, policy integration and coordination with other sector policies, technology innovation, active international cooperation. It allows 20% energy intensity reduction during 2006-2010 (same as 11th five year plan) and renewable energy taking up 10% of total energy and nuclear energy 4% of total by 2010. In 2009, China set its 2020 goals for controlling greenhouse gas emissions, and included them in the medium- and long-term national economy and social development plans. Accordingly, Chinese government set the 2020 targets (the unit GDP carbon dioxide emission shall be cut by 40-45%; the proportion of non-fossil energy consumption shall reach 15%; and the forest area shall increase by 40 million hectares and growing stock by 1.3 billion cubic meters).

Regarding China's fiscal and financial policy for climate change, Quyen (2010) focuses on related major taxes such as tax on natural resources; consumption tax; fossil fuel tax; tax on transportation vehicles; and tax on purchasing vehicles. The Chinese government give financial grants for "energy saving products" and subsidies to develop renewable energy by implementing different programs ( Financial Aid Program "Golden Sun"; Solar Energy Plan). Financial fund are also provided for plan using energy saving or renewable energy car. Moreover, in July 2007, the National Council issued "Notice on mandarory regulations to promote government to purchase energy

saving products”, which is consider as a strong solution along with its recommended list of friendly environmental products.

### **Thailand’s national actions and efforts:**

In Thailand, the Ministry of Natural Resources and Environment has responsibility for government policy together with National Climate Change Committee (NCCC). The government has set up technical subcommittees under the national committee to support different aspects of climate change issues, including mitigation and vulnerability and adaptation. Thailand has already developed the country strategic plan on climate change and is currently developing its 10 year climate change plan. The 5 year national plan namely the Economic and Social Plan (2007-2011) and 11<sup>th</sup> National Economic and Social Plan (2012-2016) have pursued the low carbon society and green economy. In other wards, Thailand has pursued sustainable development or equitable and balanced in 3 major interrelated areas: economic, social and environment. On 12 October 2010, Thai Cabinet approved in principle of Fiscal Measures for the Environmental Management bill, which will be introduced as an incentive for environmental conservation and punitive action against businesses that fail to follow environmental regulations (Supradit, 2010). The bill is based on the Polluter-Pay-Principle (PPP). There are some detail that needed to work on it and hopefully it will be approved by the parliament. This is an important move that deserves support from public. There is of course the need to make sure that enactment of this law does not interfere with existing legislation or cause an added, undue burden on business operators and ordinary citizen.<sup>5</sup>

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<sup>5</sup> The details:

- Water pollution tax: A polluter would be liable to pay at a rate of 10,000 baht per one tonne of pollutants annually. (30 baht is about US\$1)
- Air pollution tax: A polluter would be liable to pay at a rate of 2,500 baht a tonne of pollutants annually.
- Tourist tax: 15% of the transportation fare, or 1,000 baht for each tourist
- Product tax: 15% of a product’s price, or 10,000 baht per unit of the product
- Other taxes or fees set at 15% of the price or 10,000 baht per unit of pollutant

The government has also offered the tax incentives which is considered as a big step to promote green investments. Table 4.1 shows the excise tax rates taxing according to the type of fuel. Tax rates of 91 Gasohol and 95 Gasohol are less than 91-octane Petrol and 95-octane Petrol. This is an example to confirm that the government provides incentives for the usage of alternative energy, a clean energy more. Thai government then offered tax incentives in order to encourage not only consumers to buy new green cars to replace the old, mostly highly polluting models, but also carmakers to embrace green technology. From the table, we can see the figures of Excise Taxes based on the engine size and type of low - carbon car (Supradit, 2010). (Table 4.2)

**Table 4.1. Thailand’s Excise tax rates on fuel**

Type of Fuel	Excise Tax Rate (Baht per Litre)
95-octane Petrol	7
91-octane Petrol	7
95 Gasohol	6.3
91 Gasohol	6.3
E20 Gasohol (with 20% Ethanol)	5.6
E85 Gasohol (with 85% Ethanol)	1.05

Note: Ethanol is made from tapioca and sugar

Source: Supradit (2010)

**Table 4.2. Thailand’s Tax on Car**

Regular Excise Tax on Car	
Engine Size	Excise Tax Rate (%)
below 2,000cc	20%
2,001-2,500cc	35%
2,501-3,000cc	40%
larger than 3,000cc	50%
Excise Tax on Low-carbon Car	
Car Type	Excise Tax Rate (%)
Cars consuming E20 fuel with 20% ethanol	25%
Cars using fuel cells, batteries or hybrid systems	10%

Source: Supradit (2010)

### **Vietnam’s national actions and efforts:**

Vietnamese government has actively responded to the climate change over the last years. The government released a Targeted National Program in 2008 to cope with the climate change in the period of 2009-2015. The program deal with every aspects of causes and adaptation to the climate change, especially the sea level rise, development of “green industries” with the guidance of the Ministry of national resources and

environment. The Program is design to improve the current policy measure on climate change adaptation. But not until the release of the program, as heavily affected by the climate change country, Vietnam has implemented a number of financial policies to mitigate and respond to climate change both in revenue and expenditure sides. The policies are aimed at environmental protection; natural disaster mitigation and energy conservation.

Vietnam Country Report (NIF, 2010) analyzes the taxation policy for climate change adaptation with focus on environmental protection and energy conservation such as (i) Corporate income tax – CIT (A low preferential tax rate of 10% or 25% otherwise for project lifetime, applicable for companies operating in the environmental field; a tax exemption for 4 years at most and a 50% tax reduction in the next nine years for newly-established businesses operating in the environmental field); (ii) Special consumption tax (the current legislation provides tax incentives for green products such as electric or solar powered car with the preferential tax rate of only 50% or 70% of the rate applying for cars of the same types, using gasoline); (iii) Agricultural land using tax; (iv) Environmental protection tax (a newly approved by the Parliament tax that will come into effect in 2012); (v) Environmental fees, including Environment fee for industrial and household sewage/waste water, Environmental protection fees for mineral exploitation (2006), Environmental protection fee for solid waste (2007), Gasoline fee (effectively in 2012).

Regarding expenditure policies for climate change in Vietnam, the funds for environmental expenditures are from both central and local budgets. The Ministry of Finance in coordination with the Ministry of Planning and Investment, Ministry of Natural Resources and Environment, and the People’s Committees of provinces and cities allocate funding to environment protection no less than 1% of total expenditure balance the in the annual budget (Article 1, Joint Circular No.45/TTLT-BTC-BTNMT dated 30th March). Besides the state budget expenditures for environment protection, recently, in June, 2010, the Prime Minister has approved a scheme on emission control

for motorcycles, motorbikes with a total estimated budget for implementation in the 2010-2015 period of equivalently US\$12.8 millions (Decision No. 909/QD-TTg on 17th June 2010).

## **4.2. Policy challenges forward**

Despite the multilateral and unilateral efforts mentioned above, the East Asian countries still have to face up to risks of disasters and damages caused by climate change. Therefore, it is very important for the region to address challenges forward during process of adaptation and mitigation to climate change. Given strong impacts of the climate change and the existing actions, the study identifies key policy challenges that could be exposed by climate change to the region such as the followings:

### **4.2.1. Food security**

Food security is a key challenge of the climate change in East Asia. Despite the ASEAN countries has recently adopted a five year (2008-2013) Strategic Plan of Action on Food Security in the region (SPA-FS) in 2009, food security is currently a big challenges faced by the regional countries. The current development of the ASEAN Strategic Plan on food security is inspiring, but the commitments to implementation by its members remain an issue of concern. Agriculture is one of the most vulnerable sectors in terms of risks associated with climate change and distinct programmatic initiatives are necessary.

The United Nations Framework Convention on Climate Change (UNFCCC) has recognized that the climate change will make considerable impacts on agriculture and all countries should prepare adaptation measures to the impacts on food security. In East Asia, the climate change is likely to affect the coastal area and fishery industry, and cause declining crop yields as well as agriculture production. It would also damage food transportation and the storage system, and lead to rising food prices. These adverse

effects are likely to cause widespread hunger and malnutrition, social unrest or even mass population displacement in this region.

Results of recent studies suggest that substantial decreases in cereal production potential in East Asia could be likely by the end of the 21<sup>st</sup> century as a consequence of climate change (IPCC, 2007). Increasing urbanisation and population in the region will likely result in increasing food demand and reducing supply due to limited availability of cropland area and yield declines. NIF (2010) finds that food security will be a challenge of climate change in Vietnam. As a large exporter of agricultural product, the reduction in agricultural production in Vietnam could impose a threat to the world as well as regional food security as well. The loss of land due to sea level rise will severely affect the agricultural sector, especially in the Mekong river delta, the biggest rice producer in the country while the rise in temperature will also negatively affect the crop's productivity. Since loss in productivity in some cases can be more damaging than the loss of land, there is a reasonable threat to the Vietnamese food security should the climate change worsen.

#### **4.1.2. Energy security**

Energy security is a growing concern, as dependency on energy imports and global energy prices rise. Most of the East Asian economies already are energy importers. Vietnam is an exception, but it is likely to follow China, Malaysia and Indonesia and move towards becoming a net importer as its domestic oil production declines and its economy continues to grow (WB, 2010). Besides, the volatility and overall upward trend in world energy prices over the last decade have heightened concerns on energy security. As many East Asian economies increasingly become energy importers, these higher fossil fuel prices will impose an increasing economic cost.

Climate change can cause longer dry seasons. This could pose a threat to the East Asian countries' hydro-power systems. The stricter environmental standards could also affect coal or diesel power stations too. On the other hand, higher temperatures could

change energy consumption behaviours and put more pressure to current power shortage of some countries in the region.

#### **4.1.3. Water resources**

Managing water resources to ensure a secure supply to growing populations is also a major challenge in the East Asian region. Water is also closely tied to food, energy and climate change. In that sense, water is a key component of national security. If the 20<sup>th</sup> century witnessed the rise and fall of nations over oils, the 21<sup>st</sup> century could be one in which the rise and fall of nations is determined by water. Maintaining water security is a key priority for the poor rural people of the region, and climate change impacts to water resources may have a wide array of subsequent negative consequences. In fact, climate change is likely to further modify the availability of water resources, driven by seasonal decreases in rainfall in the region. Glacier melt in the Himalayas is projected to increase flooding, and affect water resources within the next decades.

Freshwater availability in the East Asian region, particularly in large river basin, is projected to decrease due to climate change which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion of people by the 2050s. Expansion of areas under severe water stress will be one of the most pressing and urgent environmental problems in the region, especially in Southeast Asia..

#### **4.1.4. Carbon emissions reduction targets**

A key challenge which may become a barrier to the region's strategy of climate change mitigation is carbon emissions reduction targets. An emission reduction target might worsen energy security, broadly defined as an economy's access to clean energy at reasonable prices. For example, higher fossil fuel prices to reduce emissions may drive poor households to traditional or inefficient sources of energy or switch their source of power generation from coal to imported oil whose price is more volatile. Conversely,

some measures to reduce oil import costs or limit exposure to price volatility can increase emissions

Moreover, the difficulty of achieving emissions reduction targets is underlined by the failure of many developed economies to reduce emissions at their Kyoto Protocol targets and by rapid emissions growth of China. Despite the global financial crisis and the strenuous policy efforts of the Chinese government, emissions growth in China continues to exceed the business as usual projections of analysts.

#### **4.1.5. Natural disasters**

Even though there is considerable uncertainty about the specific risks caused by climate change in the future, the impact of increased climate variability and extremes is already being felt across the East Asia. Natural disasters (flood, landslide, hurricane, earthquake, or volcanic eruption), especially weather related events, are increasing in number and magnitude especially in the East Asian region. The damage is expected to be more collateral should the climate change further. The rise in extreme weather events could mean higher state security reserve and transfer payment, which will further worsen the state budget deficit. NIF (2010) also identifies natural disasters as a key challenge to Vietnam in response to climate change.

#### **4.1.6. Social security**

Since the climate change poses substantial risks to human health and health assurance, social security is likely a major challenge in the region. In fact, an increase of precipitation, frequent floods and sea-level will degrade the surface water quality owing to more pollution, which lead to more infectious diseases. The loss of agricultural production land could also be a potential danger for the social security system should other sector can not absorb the redundant agricultural workers. In addition, rising temperature will negatively affect the human health. All these potential impacts of climate change could pose additional threat to the health and health assurance sector. In Vietnam Country Report, NIF (2010) shows that the burden of



social security payment can be worse as the sea level rise will displace as many as 5.9 million people.

#### **4.1.7. Adaptation decision-making in response to climate change**

Adaptation decision-making in response to climate change is really a key challenge not only to developing economies but also to developed economies in the East Asian region. Costing adaptation to future climate change requires an capability to distinguish clearly between the components of expenditure to adaptation and to development. This is more difficult than it sounds, since most expenditures that can be classified as adaptive can also be classified as developmental.

There appears to be no satisfactory method in general of distinguishing adaptation measures from those intended to foster economic development. It is hard to judge where and when these costs rise to levels of macroeconomic significance relative to the wide variety of other fiscal risks that the regional countries face.

## **5. POLICY RECOMMENDATIONS IN RESPONSE TO CLIMATE CHANGE IN THE EAST ASIAN REGION**

Since the East Asia region is highly vulnerable to the climate change's impacts, responding quickly and strategically when disaster strikes is vital. There should be an effective strategy for the region in response to the climate change. While adaptation and mitigation measures are typically recommendable policies for the East Asia as a whole as well as individual countries, regional cooperation among the ASEAN+3 economies is especially important to overcome the climate change's challenges.

### **5.1. Policy Recommendations on Adaptation**

Adaptation to climate change is an adjustment of a natural system or human behaviours toward the change in the environmental conditions in order to decrease the potential damage of climate change and (even) take advantage of it. The adaptation to climate change depends much on different regions and countries' actions. Since the adaptation measures are based on conditions of meteor, hydrologic, geography and social economy, it is necessary to improve the adaptive ability of the East Asian region. Climate change adaptation in the East Asian region should focus on the following measures:

#### **5.1.1. Ensuring a strong growth and sustainable development**

Keeping growth strong and making development sustainable will be a solution in long term for the East Asian region toward improving its adaptive capacity. Given the fact that adaptive capacity depends on economic, social, and human development of each country, there are wide variations of adaptive capacity across the East Asia and significant gaps between the region as a whole and the developed world. Eliminating

these gaps by keeping growth strong and making development sustainable and inclusive will be a solution in long term for the East Asian region toward improving its adaptive capacity.

East Asia is considered as a key point for the world's economic growth with the strong and rapid growth in the region. However, it is very vulnerable to climate change and polluted environment. Therefore, sustainable environmental growth should be applied in the region. Many countries in the region have begun changing their growth models towards green growth, gas reduction and saving energy (such as Korea and Japan) while others have committed to cut gas exhaustion and transferring green technology. Nevertheless, these efforts are still not effective enough for the whole region to reach a strong growth and sustainable development. Sustainable development and green growth should be addressed as key issues in economic growth models of all countries in the East Asian region.

### **5.1.2. Mainstreaming climate change adaptation in development planning**

Mainstreaming climate change adaptation in development planning is a measure taken which is expected to strengthen adaptive capacity. The climate change adaptation should be considered as an integral part of socio-economic development and poverty reduction strategies of the regional countries. The governments should strengthen policy and planning coordination across ministries and different levels of government for climate change adaptation. It may include linking climate change adaptation with disaster risk management and integrating climate change risk management into development plans. Besides, the regional countries should have a good preparation to cope with extreme weather events since risk can never be eliminated. They should have a warning systems and response plans to save lives and prevent other avoidable losses. The local city governments then can promote risk reduction and risk-based planning.

Moreover, in order to mainstream climate change adaptation in development plan, the regional countries should overcome difficulties in estimating adaptation cost

and project it in the national strategies. It requires a clear distinguish between different components of expenditure that are attributable respectively to adaptation and to development. The cost-benefit analysis should be also used more frequently by the East Asian countries in the cases to assess issues of different adaptation projects and strategies.. Cost-benefit analysis is an analytical tools which permits a comparison of adaptation measures with each other,.

### **5.1.3. Enhancing fiscal self-insurance**

Fiscal self-insurance against climate change is also needed despite it will be difficult to achieve in many low-income countries. Thus, the government budgets must include room for adaptation expenditures, and social safety nets must be strengthened, especially in countries that will be severely affected. External financing may be needed to complement domestic resources in cases where the demands of adaptation overwhelm poor countries' capacity.

### **5.1.4. Regional insurance facility for immediate needs**

It is necessary for the East Asian countries to have a regional insurance facility for immediate or short-term responses to climate-related disasters. The ASEAN+3 countries can pool the resources and use it when needed.

The regional insurance facility is one of new ways of coping with some climate-related fiscal risks which are explored by recent financial innovations. The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a good example which the East Asian countries should look at. Caribbean governments purchase insurance coverage that will provide them with immediate liquidity in case of a major hurricane or earthquake. The participating countries combine emergency reserve funds into a common pool and transfer risks to international financial market (reinsurance market) (Jung et al., 2010).

### **5.1.5. Ensuring food security as a main task for the East Asian countries**

Climate change's impacts on agriculture will be more adverse in tropical areas than other regions. Thus, adaptations strategies and food security should be addressed as main tasks for the East Asian countries. Developing regional adaptation measures and policies would enlarge the effects and synergize the efforts of East Asian nations. To ensure food security, the member countries should have a good preparation for the following issues: (i) Conduct studies to identify possible impacts of climate change on food security; (ii) Identify measures to mitigate or adapt the climate change's impacts on food security; and (iii) Develop collaboration with other sectoral bodies in the region, which addresses impact mitigation and adaptation of climate change. Moreover, the regional countries should take more specific steps to carry out Strategic Plan of Action on Food Security in the ASEAN Region in the period of 2008-2013.

#### **5.1.6. Improving management on water resources**

This measure is expected to ensure the water resource security in the East Asia, given the fact that water resource security is likely a key challenge of the regional countries in the 21<sup>st</sup> century. Better water management can help protect key resources of the region at a time when climate change and population growth will put agriculture under stress. The regional countries should strengthen water conservation and management. They also need to apply more widely integrated water management such as flood control and prevention schemes; early warning flood systems, etc. Additionally, many solutions should be done to help reduce water consumption while improving farmers' livelihoods such as introducing modern water monitoring techniques.

#### **5.1.7. Raising public awareness of climate change and enhancing human resources**

While poor understanding of climate change among a majority of citizens is a hinder to some East Asian countries, weak human resources is a major challenge to most of the regional countries in response to climate change. Thus, education, training and public

awareness on climate change is considered as a key to overcome threats and challenges of climate change in the region.

Education, training and awareness generation have to be country driven, addressing the specific needs and conditions of developing countries and reflecting their national sustainable development goals, priorities and strategies.

At the national/regional level, the East Asian countries should focus on the following issues such as: (i) The development and implementation of educational and public awareness programmes on climate change and its effects; (ii) Public access to information on climate change and its effects; (iii) Adopting a participatory process for addressing climate change and its effects. Similar approach should also be adopted in developing adequate responses to climate change and its effects; and (iv) Organizing and providing to scientific, technical and managerial personnel for climate change mitigation.

At the international level, the East Asian countries should pay attention to (i) the development and exchange of educational and public awareness material on climate change; and (ii) the development and implementation of education and training programmes, including the strengthening of national institutions and the exchange is secondment of personnel to train experts in the field (in particular for the developing countries in the East Asian region).

#### **5.1.8. Improving research ability on climate change as an important foundation for policy making process.**

Improving research ability on climate change should play an important role in policy making process relating to climate change in the East Asia region. For the regional countries, scientific work should guide policy and strategy for the future sustainable development, especially national infrastructure, cities, public areas, and industrial zones construction strategy. More researches on climate change should be addressed and undertaken to realize its threats, impacts and projected scenarios, which

are necessary for providing inputs and policy recommendations for policy making process in the region.

## **5.2. Policy Recommendations on Mitigation**

Climate change mitigation is a strategy to oriented the response actions to eliminate or reduce the negative impacts of climate change. To be successful, the regional policy framework for mitigating climate change must satisfy three important criteria:

- (i) Firstly, mitigation policy must raise the prices of GHGs to reflect the marginal social damage from emissions. Higher GHG prices could help generate incentives for reducing production of emission-intensive goods and for development of low-emission technologies (IMF, 2008b);
- (ii) Secondly, mitigation policy must be applied across all GHGs, firms, countries, sectors, and periods of time to ensure that policy achieves the desired objectives at the lowest possible cost;
- (iii) Thirdly, mitigation policies must be flexible and robust to changing economic conditions and to new scientific information about climate change.

An effective mitigation strategy should oriented the East Asia region toward a low-carbon economy. To achieve that target, each individual country has to taken actions to become a low-carbon country. In addition, the GHGs emission reduction targets of the region should focus on key sectors such as energy, forestry and agriculture.

### **5.2.1. Mitigation measures in energy sector**

The regional countries can reduce the GHGs emission by improving energy efficiency and promoting energy conservation in the residential and commercial building, industry (steel, cement, pulp and paper, and others), and transport sectors. Encouraging the use

of renewable energy (biomass, solar, wind, hydro and geothermal resources) is also an effective solution toward a low-carbon economy.

Moreover, the regional countries should step up their efforts in developing and switching to clean, renewable and low-carbon energy sources as well as clean transport systems. To do that, the regional countries need support from existing financial transfer and technology cooperation mechanisms. Governments should encourage this switch by further strengthening a policy framework, creating appropriate financial and tax incentives, and supporting research and development. This is an important and strategic solution in the long term.

### **5.2.2. Mitigation measures in forestry sector**

The regional countries should address key drivers of deforestation as one of mitigation measures in forestry sector. They should implement appropriate forest policies and measures to benefit from the future global mechanism of Reduced Emissions from Deforestation and Degradation (REDD).

Besides efforts in reforestation and afforestation, the countries need to enhance national and local governance systems for sustainable forest management. It is also necessary for the regional countries to design policy to fully recognize and respect rights or priorities of indigenous communities. They also need to ensure their participation in the design and implementation of REDD policies.

### **5.2.3. Mitigation measures in agriculture sector**

Reducing GHG emissions from the agriculture sector can be achieved by improving land and farm management such as restoration of organic soils, and restoration of degraded lands, manure and bio-solid management, and bioenergy use (ADB, 2009). These measures can lead to a reduction of fertilizer and methane-related emissions. In addition, the regional countries can use other programs and instruments such as taxes on the use of nitrogen fertilizers, reform of agricultural support policies. Regulatory



measures could also be considered such as limits on the use of nitrogen fertilizers and setting up environmental objectives in the national development strategies.

### **5.3. Regional cooperation among the ASEAN+3 countries in response to climate change**

Since most countries in the region experience similar climate hazards, regional strategies are likely to be more effective than national actions. The regional cooperation could effectively address some climate change challenges and identify a response strategy for the ASEAN+3 countries in both adaptation and mitigation to climate change.

#### **5.3.1. Setting up a climate change fund for the ASEAN+3 region**

The background study of Jung et al. (2010) assumes a hypothetical climate change fund. To show its impact on each country's economy, Jung et al. (2010) set up a model scenario and run it. The study assumes there will be negative productivity shocks to ASEAN caused by the climate change, and considers various policy responses including government investment, government bonds, consumption tax, and a hypothetical cooperative funds for climate change in the context of ASEAN+3. The simulation results give us a implication that if the member countries contribute the ASEAN+3 climate change fund by Chiang Mai Initiative Multilateralization (CMIM) contribution ratio, the results are much better than those of no-action scenario for all member countries.

For burden-sharing of each country, the study uses the CMIM ratio as just a reference point. However, this is only an assumption because the individual countries in the ASEAN+3 region may have a different point of view. In CMIM, China and Japan contribute 32% of the total amount respectively, Korea 16%, and ASEAN 20%. According to this mechanism, China, Japan, Korea, and ASEAN contribute 3.4 billion,

3.4 billion, 1.7 billion, and 2.1 billion respectively each year, considering that the real GDP of ASEAN was 1,065 billion in 2008 and that assumption of 1% of ASEAN GDP is needed. The simulation results imply that the climate change fund would be beneficial for all countries in the ASEAN+3 region, even after considering the burden from making the fund. Korea, China, and Japan have negative impact from the decreasing government transfer to contribute the fund, but it will be smaller than the cost of the ASEAN climate change. Therefore, if the fund successfully offset the negative impact the climate change in the region, it will be beneficial for all ASEAN+3 member countries.

### **5.3.2. Strengthening policy coordination among the ASEAN+3 countries**

Given that climate change is an issue that cuts across all levels of a government and countries of a region or the world, there is a need for strong policy coordination among the ASEAN+3 countries in response to climate change. Policy coordination will promote good policies and practices, sharing information and knowledge on issues such as disaster management, and undertake climate related development in the region.

Policy coordination among the ASEAN+3 countries should address climate change and assess its impacts on socio-economic development, health, environment and water resources, including activities on building adaptive capacities and supporting mitigation and adaptation actions. In addition, energy cooperation with dialogue partners and private sector also provide the region with a support and technical assistance towards a low-carbon economy. The ASEAN+3 Energy Cooperation should be strengthened with focus on areas of energy security, oil market, oil stockpiling, natural gas, and new and renewable energy and energy efficiency and conservation.

### **5.3.3. Enhancing scientific collaboration among the ASEAN+3 countries**

Scientific collaboration should be enhanced between institutions of the ASEAN+3 countries through different forms such as workshops, trainings, scholar exchanges, and joint studies.

Topics and fields of scientific collaboration among the ASEAN+3 should focus on climate change issues such as: (i) detailed climate change impact assessment, vulnerability assessment, adaptation options and needs for the Southeast Asian region and sub-regions such as Greater Mekong Sub-region; (ii) different GHGs emissions scenarios for the region and for local areas according to multiple models; (iii) analytical tools for adaptation, especially cost-benefit analysis; and (iv) formulation of needs and opportunities for GHGs emissions mitigation with both domestic and international support for example water resources management, land management, forestry, agricultural, industrial and domestic energy efficiency measures, renewable energy.

## 6. CONCLUDING REMARKS

This study focuses on examining fiscal impacts of climate change in East Asia and addressing policy challenges to the regional countries. It calls for urgent and even greater adaptation and mitigation efforts of the ASEAN+3 countries than currently under way, in terms of individual member as well as the coordination frameworks for the whole region. The study finds that an immediate policy response in the ASEAN+3 region will be better than a delayed one. The final conclusion results from findings of this study such as the followings:

*Firstly*, the impact of increasing climate variability and extremes is already being felt across the East Asia region. The region is among the most vulnerable areas of the climate change due to its long sea coast, high population concentration and dependency to agriculture. Moreover, the diversity of East Asia in geography, economy, and demography amplifies the risks of climate change impacts in the region.

*Secondly*, evidences and analyses in the study show observed climate trends and variability in East Asia while the economic and social impacts of climate change are significant and long lasting in the region. Climate change is projected to have negative effects on the sustainable development of most developing counties, as it increases the pressures on natural resources and the environment together with rapid urbanization, industrialization and economic development. The net effect of climate change on regional and national economies is projected to be largely negative. A loss in agricultural revenue and additional costs for managing water resources, and disease will put negative impacts on economic activity..

*Thirdly*, since fiscal and financial impacts of climate change will likely vary across countries, it is very difficult to identify perfect characteristics for these impacts in a region, especially a diversified one as East Asia. This study, therefore, has tried to clarify some possible aspects which will provide a general consistent analysis of fiscal

and financial impacts of climate change in the East Asian region. Case studies of member countries in the ASEAN+3 region had been used to clarify fiscal impacts of climate change in the region.

*Forthly*, the study finds that climate change impacts on budget revenue can be two folds: on one hand the reduction in productivity due to climate change (for example: agricultural productivity, reduction in tourism) may significantly reduce the economy's output and by this way reduce the budget revenue; on the other hand, governments can raise carbon taxes or environmental taxes, etc to mitigate the impacts of the climate change. Carbon taxes could create large new revenues, which can be used to support business and poor households, as well as for additional climate change measures. Meanwhile, the study use adaptation cost or R&D cost to evaluate impacts of climate change on state budget expenditure in the East Asian region. However, evidences on aggregate costs are rare.

*Fifthly*, the study finds that managing water resources to ensure a secure supply to growing populations is a key challenge in the East Asian region. Water is a key component of national security as it is closely tied to food, energy and climate change. If the 20<sup>th</sup> century witnessed the rise and fall of nations over oils, the 21<sup>st</sup> century could be one in which the rise and fall of nations is determined by water.

*Sixthly*, food security is likely a key challenge of the climate change in East Asia. Therefore, the study address ensuring food security as a main task for the East Asian countries.

*Seventhly*, the study assumes a hypothetical climate change fund for the ASEAN+3 region which would be beneficial for all the member countries, even after considering the burden from making the fund. Additionally, it suggests that scientific collaboration should be enhanced between institutions of the ASEAN+3 countries through different forms such as workshops, trainings, scholar exchanges, and joint studies./.

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