



Climate Change and Impact: Module Materials

TEKS Alignment

(4) **Geography.** The student understands the patterns and characteristics of major landforms, climates, and ecosystems of Earth and the interrelated processes that produce them. The student is expected to:

(A) explain how elevation, latitude, wind systems, ocean currents, position on a continent, and mountain barriers influence temperature, precipitation, and distribution of climate regions;

(C) explain the influence of climate on the distribution of biomes in different regions.

(8) **Geography.** The student understands how people, places, and environments are connected and interdependent. The student is expected to:

(A) compare ways that humans depend on, adapt to, and modify the physical environment, including the influences of culture and technology;

(B) describe the interaction between humans and the physical environment and analyze the consequences of extreme weather and other natural disasters such as El Niño, floods, tsunamis, and volcanoes;

(20) **Science, technology, and society.** The student understands how current technology affects human interaction. The student is expected to:

(B) examine the economic, environmental, and social effects of technology such as medical advancements or changing trade patterns on societies at different levels of development.

Key Vocabulary

- Global warming
- Greenhouse Effect
- Greenhouse Gases
- Tsunami
- Monsoon

Module Introduction

Climate change is a very real issue which is becoming increasingly important in the modern world. Record heat waves, storm seasons, droughts, and massive flooding across the globe only hint at what the future holds as the world's temperatures climb steadily. It is becoming clear that certain areas of the world will fare better than others as the temperatures climb. Wealthier countries have the resources to mitigate climate change – wealthier people merely turn down the dial on their A/C and complain about their higher electric bills. But, the poor and the poorer countries of the world will bear the full burden of global warming – even though they have had little to do with its cause.

This project is funded in part by a grant from the National Geographic Society Education Foundation.

Unlike many parts of the world which will become much drier, Southeast Asia will be dealing with a much wetter world. Many of Southeast Asia's major cities lie on land low enough to become inundated with a rise in sea levels of only 2 meters – well below the 4 meter projections if temperatures rise as they are projected to. As a result, even the more well off nations in the region face losing their entire industrial base as their major industrial centers sink under the rising waters. Countries such as Laos and Burma, which rely heavily upon agriculture, will find their crops drowning or prone to molds, mildews and other water induced blights. And all of the countries will face increases in diseases which are affected by water – malaria, dysentery, and others will cause huge losses in life and resources.

Most of the resources below look at climate change from a global perspective. It is important for students to understand that the excess water Southeast Asia will experience is coming from somewhere – other regions will be drying out. The American Association of Geographers presents two case studies focusing on this region and Climate Change. In addition, there are numerous resources available from The World Bank which are worth looking into. The case study draws upon the World Bank's research into climate change and presents a look at the world – 4°C warmer. The lesson plan for this module focuses upon specific changes Southeast Asia will face as temperatures climb and provides students with an opportunity to practice reading strategies using a short article provided by Radio Free Asia.

Video Presentations

- Global Warming Video Clip
 - http://stream.its.txstate.edu/users/tage/Global_Warming_Env.mov
- Climate Change and Stratification of Wealth - Miguel de Oliver
 - http://stream.its.txstate.edu/users/tage/MO_Climate_Change.mov
- World Bank President: Southeast Asian Economy Vulnerable to Climate Change – 1 minute overview of the effects climate change will have on Southeast Asia
 - http://www.youtube.com/watch?v=LlICa_hHfJo

Case Study

4°C of Change Power Point – An examination of the World Bank's "Turn down the heat" program.

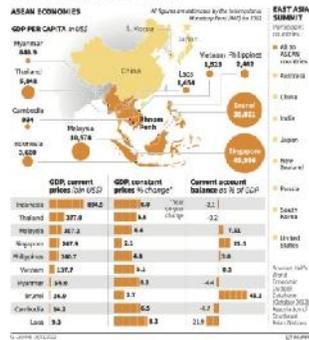
Information compiled from:

http://climatechange.worldbank.org/sites/default/files/Turn_Down_the_heat_Why_a_4_degree_centrigrade_warmer_world_must_be_avoided.pdf

Readings and Visual Resources

2012 East Asia Summit

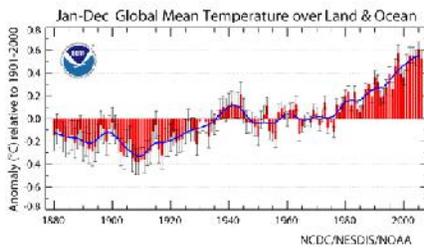
© ASEAN Summit, Singapore. © Cart by Jason S. Saterday and Sunday, 11/11/11. By THE EAST ASIA SUMMIT ON MONDAY AND TUESDAY.



2012 East Asia Summit – ASEAN Economies

- <http://blog.thomsonreuters.com/index.php/2012-east-asia-summit-graphic-of-the-day/>

This graphic illustrates the varying levels of development in Southeast Asia. Since climate change is affected by industrialization, it is helpful to see which countries in Southeast Asia might be contributing more to climate change than the others. In addition, since countries at lower levels of development have the most difficulty mitigating the effects of climate change, this graphic also helps illustrate which countries might be most at risk.



Jan-Dec Global Mean Temperature over Land & Ocean

- http://www.wunderground.com/resources/climate/fifth_war_mest_year.asp

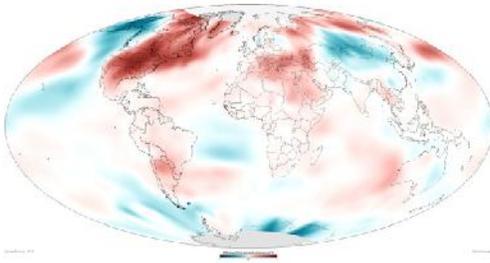
This graphic illustrates how global mean temperatures have changed over the last century.



Ten Signs of a Warming World

- <http://cpo.noaa.gov/warmingworld/>

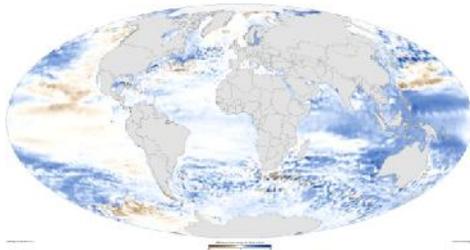
This website produced by NOAA explains the 10 signs that Global Warming is affecting our planet. The site explains each sign in detail and provides a variety of graphs, charts, graphics and videos to support their instruction. In addition, there is a downloadable poster, a downloadable interactive presentation and links to lesson plans appropriate for multiple grade levels over each topic.



Global Surface Temperatures, 2012

- <http://www.climate.gov/news-features/understanding-climate/2012-state-climate-earths-surface-temperature>

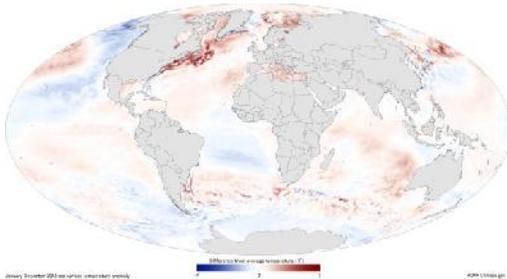
This map shows the difference from average temperatures in 2012. While many areas are much warmer than normal, others are cooler than normal; illustrating that global warming isn't affecting every place in the same way. Southeast Asia shows slightly higher temperatures than normal.



Global Sea Levels

- <http://www.climate.gov/news-features/understanding-climate/2012-state-climate-global-sea-level>

This map shows the difference from average sea levels in 2012. Sea levels near Southeast Asia are clearly rising, while others are falling.



Sea Surface Temperatures

- <http://www.climate.gov/news-features/understanding-climate/2012-state-climate-sea-surface-temperature>

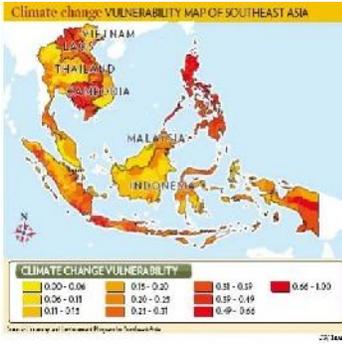
This map illustrates the difference from average sea temperatures in 2012.



Climate Change Vulnerability Index 2011

- <http://thescientistgardener.blogspot.com/2010/11/climate-change-and-importance-of.html>

The blue areas in the poster indicate regions that are most environmentally, socially and politically vulnerable to the predicted changes.



Climate Change: Vulnerability Map of Southeast Asia

- <http://ki-media.blogspot.com/2009/05/map-pinpoints-se-asian-vulnerability-to.html>

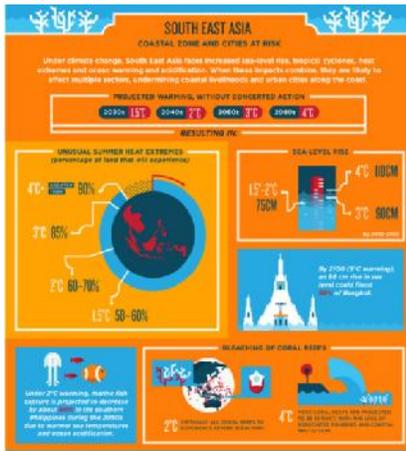
Environment Program for Southeast Asia (EEPSEA), which is administered by the International Development Research Centre of Canada, produced this map showing vulnerability to climate change in Southeast Asia.



Coastal Regions in Southeast Asia Vulnerable to Climate Change

- http://www.nature.com/nclimate/journal/v2/n7/fig_tab/nclimate1463_F1.html

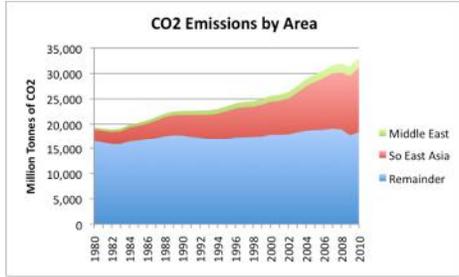
Map depicting coastal regions in Southeast Asia that are particularly vulnerable to climate change produced by Jones, H. et al. 2012.



World Bank Infographic

- <http://www.worldbank.org/en/news/feature/2013/06/19/Infographic-Climate-Change-in-Sub-Saharan-Africa-South-East-Asia>

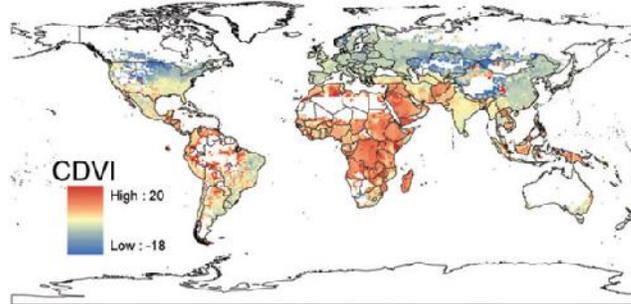
Depicts the effects rising temperatures will have on Southeast Asia.



CO2 Emissions by Area – Focusing upon Southeast Asia and the Middle East

- <http://www.financialsense.com/contributors/gail-tverberg/world-energy-consumption-since-1820-in-charts>

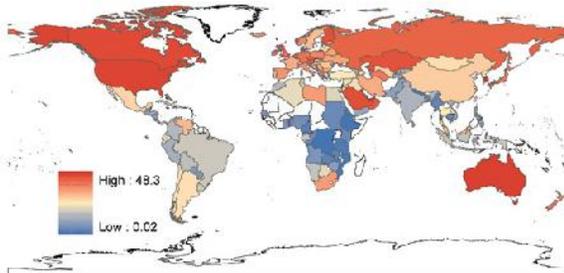
Climate Demography Vulnerability



Index

- <http://www.skepticalscience.com/Those-who-contribute-the-least-greenhouse-gases-will-be-most-impacted-by-climate-change.html>

This map illustrates a new way of looking at climate change. The index takes into consideration which world regions will be most impacted by climate change as well as the population growth for those regions in order to illustrate which regions will suffer the most as a result of climate change. Blue areas will be affected the least, while red areas will be affected the most.



National Average CO2 Emissions

- <http://www.skepticalscience.com/Those-who-contribute-the-least-greenhouse-gases-will-be-most-impacted-by-climate-change.html>

This map is used to compare with the map. The countries which will be affected the least by climate change are the countries which contribute to it the most.

Global Climate Change Case Study: How are Countries Adapting to Climate Change? - Singapore

- <http://cgge.aag.org/GlobalClimateChange1e/cs-2/index.html>

This case study investigates the causes and impacts of climate change, as well as the effectiveness of policies designed to mitigate climate changes caused by human activities. As the reading level might be challenging for high students, the case study is listed here as a background source for teachers. However, it might prove to be a good resource for an AP Human Geography course. The module is part of a collection of online modules designed for college courses by the AAG Center for Global Geographic Education.

Global Climate Change Case Study: Where are Rising Sea Levels Threatening Human and Natural Environments? – Southeast Asia

- <http://cgge.aag.org/GlobalClimateChange1e/cs-4/index.html>

This case study investigates the threats to Vietnam’s social and economic progress, as well as threats to its natural environment. As the reading level might be challenging for high students, the case study is listed here as a background source for teachers. However, it might prove to be a good resource for an AP Human Geography course. The module is part of a collection of online modules designed for college courses by the AAG Center for Global Geographic Education.

Lesson Plan

Climate Change in Southeast Asia Lesson Plan – Students will learn how people in Southeast Asia are or will be affected by rising sea levels caused by climate change and how climate change impacts will vary among countries at different levels of development.



Climate Change in Southeast Asia Lesson Plan

Grade Level: 9-12

Created By TAGE Teacher Consultant: Michelle Crane

Time Frame: One 55 minute class period (can complete at home, if necessary)

Curriculum Connection: This lesson is intended to be part of a 9th grade World Regional Geography course in a unit on Southeast Asia. It is assumed that students have already had prior instruction in the physical geography of the region and some introduction to natural disasters such as flooding and tsunamis. Some understanding of the processes responsible for climate change would also be desirable before students complete this lesson.

Learning Outcomes:

Upon completing this lesson, students should be able to:

1. Describe how people in Southeast Asia are or will be affected by rising sea levels caused by climate change,
2. Understand how the impacts of climate change will vary among countries at different levels of development.

TEKS Strand(s) Objective(s):

(8) **Geography.** The student understands how people, places, and environments are connected and interdependent. The student is expected to:

(B) describe the interaction between humans and the physical environment and analyze the consequences of extreme weather and other natural disasters such as El Niño, floods, tsunamis, and volcanoes;

(20) **Science, technology, and society.** The student understands how current technology affects human interaction. The student is expected to:

(B) examine the economic, environmental, and social effects of technology such as medical advancements or changing trade patterns on societies at different levels of development.

Materials :

For Student Use:	
Computer lab with internet connection	Optional – if computer lab is not available, see notes below
“Climate Change Conjures Up 'Alarming' Scenarios in Southeast Asia” Article from	One per student - Students may access this using the information provided under References. However, if computer lab is not available, the teacher can access the article and print it as a student handout.

Radio Free Asia	
Blank map of Southeast Asia	One per student, If a suitable blank map is not available, see References for an online source.
Colored pencils	
For Teacher Use:	
2012 East Asia Summit – ASEAN Economies Graphic	Included in the Climate Change and Impacts Module
Computer with projection device and internet connection	

References:

Climate Change Data. (2013). Retrieved September 12, 2013, from The World Bank:

<http://data.worldbank.org/topic/climate-change>

Landsberger, J. (n.d.). *The SQ3R Reading Method*. Retrieved September 12, 2013, from Study Guides and Strategies: <http://www.studygs.net/texred2.htm>

Maps of Continents and Large Regions. (n.d.). Retrieved September 12, 2013, from Arizona Geographic Alliance: http://geoalliance.asu.edu/azga_site/maps/regions

Ponnudurai, P. (2013, July 02). *Climate Change Conjures Up "Alarming" Scenarios in Southeast Asia*.

Retrieved September 12, 2013, from Radio Free Asia:

<http://www.rfa.org/english/commentaries/east-asia-beat/climate-change-07022013165938.html>

Strategies: Students will utilize the reading strategy SQ3R while reading the article. (If a thorough explanation of this method is needed, refer to the Reference section for an online source.) After they have completed reading, they will create a map based upon their reading.

Procedures to conduct the lesson:

Starting the Lesson: 5 minutes

Display the 2012 East Asia Summit – ASEAN Economies Graphic for the students to see. Have them complete the following questions:

1. According to the graphic, which 3 countries have the highest GDP?
2. According to the graphic, which 3 countries have the highest GDP per capita?
3. Explain why the answers to the questions above are different.
4. Using your knowledge of geography and the graphic, list the countries in Southeast Asia which would be most prone to flooding – either from the monsoons, rising sea levels, or tsunamis.
5. Which information, GDP or GDP per capita, gives the most accurate sense of which countries in Southeast Asia would be most able to recover from such a natural disaster? Explain why this would be so.

Asking Geographic Questions: 5 minutes

Introduce students to the Guiding Question:

How will Southeast Asia be impacted by climate change?

The Lesson:

Acquiring Geographic Information: 15 minutes

Hand out copies of the article to each student or direct them to the link online. If necessary, review the SQ3R method with students. Tell them that they are to take notes following SQ3R while they read.

Organizing Geographic Information: 15 minutes

Once the students have completed their reading, hand out the blank outline maps. They should create an annotated map illustrating the issues Southeast Asia will face as the climate changes. They will need to create symbols for each issue and include a key.

Analyzing Geographic Information: 10 minutes

Have students review their notes from the reading and their map. They will use the information to answer the guiding question. Make sure they know to include as many details as possible.

End the Lesson:

Closing product: 5 minutes

Answering Geographic Questions:

Write a short essay or paragraph answering the Guiding Question. Be sure to explain in detail how Southeast Asia will be affected by climate change. Use examples from the reading and your map. Think back to the warm-up activity. Explain which countries in Southeast Asia will be most able to mitigate the effects of climate change and which will have the most

Questions:

Explain how Southeast Asia will be affected by climate change.

- Rising sea levels will threaten settlement, industry, agriculture, and aquaculture through saltwater intrusion. Tropical areas will experience extreme temperatures; cool months will be warmer than the warmest months previously experienced. Increasing temperatures will increase heat-related deaths, forest fires and loss of crops. Ocean acidification will lead to extinction of coral reefs. Monsoon regions may be wetter and rivers may swell affecting water quality which will then lead to the spread of disease. Food production will be impacted by both saltwater intrusion and increasing temperatures leading to famine.

Explain why GDP per capita would be a more accurate prediction of a country's ability to recover from a natural disaster.

- Countries with higher GDP's tend to have more resources which can help them prepare for and deal with a natural disaster. For example, countries with higher GDP's tend to have access to more advanced technology which can alert people to an impending disaster. Also, building codes and other safety measures are more likely to be present and enforceable due to more stable and better funded government agencies which oversee such things. In addition, homes and buildings are typically built of more advanced materials, which can also better withstand some disasters. During and after the disaster, better equipped emergency management agencies such as fire, EMS, and police can better help rescue and aid victims. Access to better medical facilities can reduce deaths. More advanced infrastructure can make it easier for relief to reach victims. And more stable governments with access to more resources will be better prepared to rebuild. Most importantly, before and after, countries with higher GDP's tend to have more advanced communications systems which are crucial for alerting people to dangers and assisting with recovery. While higher GDP does not guarantee that a government is stable or prepared enough to deal with disasters in all of the ways listed, they are more likely to be able to than countries with lower GDP's.

Explain which countries will be most able to mitigate the effects of climate change.

- Based upon the per capita GDP, Brunei and Singapore would be most likely to mitigate the effects of climate change. The higher per capita GDP, the more resources each would have as listed above.

Evaluation/Assessment :

Use the following rubric to grade the map and the short answer question.

	Not There Yet	Satisfactory	Clearly Outstanding
Content	<p style="text-align: center;">1 Point</p> <ul style="list-style-type: none"> ▪ Answer merely lists disasters. ▪ Answer makes little to no attempt to analyze the impact of climate change. ▪ Answer and annotations do not utilize appropriate vocabulary. ▪ Answer and annotations are difficult to read due to spelling and/or grammar errors. ▪ Map features are missing or incorrectly labeled. 	<p style="text-align: center;">2 Points</p> <ul style="list-style-type: none"> ▪ Answer correctly describes most issues faced by climate change. ▪ Answer adequately analyzes the impact of climate change. ▪ Answer and annotations correctly utilize appropriate vocabulary. ▪ Answer and annotations are generally free from spelling or grammar errors. ▪ Most map features are correctly labeled. 	<p style="text-align: center;">3 Points</p> <ul style="list-style-type: none"> ▪ Answer completely and correctly describes each issue. ▪ Answer completely analyzes the impact of climate change. ▪ Answer and annotations demonstrate mastery of appropriate vocabulary. ▪ Answer and annotations are largely free from spelling or grammar errors. ▪ All map features are correctly labeled.
Appearance	<p style="text-align: center;">0.75 Points</p> <ul style="list-style-type: none"> ▪ Map features are not clear and are difficult to read. ▪ Annotations obscure map features. ▪ Map shows minimal effort. 	<p style="text-align: center;">1.25 Points</p> <ul style="list-style-type: none"> ▪ Map features are clear and legible. ▪ Annotations are neat and do not obscure map features. ▪ Map shows effort and attention to detail. 	<p style="text-align: center;">2 Points</p> <ul style="list-style-type: none"> ▪ Map features are clear, legible and attractively drawn. ▪ Annotations are neat and enhance the map presentation. ▪ Map shows great effort and attention to detail.



Climate Change Conjures Up 'Alarming' Scenarios in Southeast Asia

By Parameswaran Ponnudurai
2013-07-02



A Vietnamese woman steers a boat as the sun rises along the Mekong Delta, where rice production could take a tumble due to climate change.
Photononstop

Imagine these scenarios: The rice bowl of Vietnam cracking. Popular diving spots in the Philippines, Malaysia, and Indonesia lying idle with no tourists. Nearly half of Bangkok inundated with water.

Well, they could become a reality in 20 to 30 years—no thanks to the adverse effects of climate change in Southeast Asia exacerbated by forest fires particularly in Indonesia which recently blanketed the region with deadly smoky haze.

Scientists warn in a new World Bank report of major impacts on the region if the temperature rises by up to 2 degrees Celsius—warming which they say may be reached in two to three decades—fueled by the burning of fossil fuels and deforestation.

The warming climate will push up the sea level in the region and cause an increase in heat extremes, a higher intensity of tropical cyclones, and ocean acidification stemming from excess carbon dioxide in the air, according to the latest edition of the bank's "Turn Down the Heat" report.

The scientific report predicts a drop in agricultural production and widespread food shortages, rapidly diminishing fish catch, increasing water- and vector-borne diseases, and diarrheal illnesses, impacting mostly the urban poor, who constitute large proportions of city populations in the region.

The climate change effects will also dampen the region's tourism industry, a top money-spinner, as coral reefs in pristine waters that lure divers and help fish breed are rapidly destroyed.

'Alarming scenario'

The World Bank issued its first "Turn Down the Heat" report last year, likening it to a wake-up call to climate change. It concluded that the world would warm by 4 degrees Celsius by the end of this century if no concerted action is taken.

In the new report, scientists say that if the temperature rises by just 2 degrees Celsius, warming may be reached in 20 to 30 years.

It gives a more detailed look at how the ongoing negative impacts of climate change could create devastating conditions especially for those vulnerable, predicting what the bank's chief Jim Yong Kim calls an "alarming scenario for the days and years ahead."

"The displacement of impacted rural and coastal communities resulting from the loss of livelihood into urban areas could lead to ever higher numbers of people in informal settlements being exposed to multiple climate impacts, including heat waves, flooding, and disease," the report said.

"Basically, you'll have a range of impacts on countries but the incidence on that will fall disproportionately on poor people, because fisheries and agriculture [are the key areas to be affected]," John Roome, the bank's director for sustainable development in the East Asia Pacific Region, told RFA.

He said that while there is greater awareness by governments to combat climate change, efforts needed to be accelerated by putting in place early warning, monitoring and evaluation systems, and allocating special budgets to mitigate the crisis.

"The alarming part is that a 4-degree world [where the temperatures are 4 degrees warmer] is not going to be a very pleasant place to live in for all the reasons that are set out in the report but there are things that can be done if countries act soon to stem the temperature rise so that [the rise] doesn't reach 4 degrees," Roome said.

Mekong Delta crop production drop

The new report, based on analysis using advanced computer simulations to paint the clearest picture of vulnerabilities, says that as early as 2040, Southeast Asia's major rice-growing region—the Mekong River Delta in Vietnam—will see crop production drop by about 12 percent due to an estimated sea-level rise of 30 cm (nearly 1 foot).

The Mekong Delta, popularly known as the "rice bowl" of Vietnam and home to some 17 million people, makes up half of Vietnam's total agricultural production and contributes significantly to the country's rice exports.

"Any shortfall in rice production in this area because of climate change would not only affect the economy and food security of Vietnam but would also have repercussions for the international rice market," the report said.

The Mekong Delta is also Vietnam's most important fishing region. It is home to almost half of Vietnam's marine fishing vessels and produces two thirds of Vietnam's fish from aquaculture.

But saltwater intrusion associated with sea-level rise is already affecting freshwater and brackish aquaculture farms.

By 2050, the sea-level rise is expected to increase by over 30 percent of the total current area—1.3 million hectares— affected by saltwater intrusion in the delta, the report said.

Sea levels rising

It also warns that floods due to sea-level rise will engulf 43 percent of Thailand's capital Bangkok around 2025, and about 70 percent in 2100.

Bangkok together with Jakarta, Yangon, Manila, and Ho Chi Minh City are projected to be among cities in Southeast Asia to be most affected by sea-level rise and increased storm surges.

Coral reefs, fish catches vulnerable

The report said that rising ocean acidity caused by excessive carbon dioxide will lead to a significant loss of coral reefs and the benefits they provide as fish habitats, protection against storms, and revenue-generators in the form of tourism.

Thailand, Indonesia, the Philippines, Myanmar, and Cambodia were cited as "among the most vulnerable tourism destinations."

Based on the projections, all coral reefs in the Southeast Asia region are very likely to experience severe thermal stress by the year 2050, as well as chemical stress due to ocean acidification.

"Coral bleaching and reef degradation and losses are very likely to accelerate in the next 10–20 years; hence, revenue generated from diving and sport fishing also appears likely to be affected in the near term," the report said.

It also said that ocean fish catch in the southern Philippines is expected to be slashed by half due to warmer water temperatures and habitat destruction.

Fish in the Java Sea in Indonesia and the Gulf of Thailand are also projected to be severely affected, with "very large reductions" in average maximum body size by 2050.

Weather extremes and forest fires

Scientists are also forecasting a significant increase in Southeast Asia in the intensity and maximum wind

speed of tropical cyclones making landfall. Heat extremes are expected to surge in the region.

More important, Southeast Asia is one of two regions—the other being the Amazon—which is projected to see, in the "near-term," a strong increase in monthly heat extremes with the number of warm days projected to increase to 45–90 days per year under a 2-degree temperature rise scenario or to 300 days in a 4-degree scenario.

The heat scare has also fueled concerns over a rise in brush, forest, and peat fires across Indonesia's Sumatra Island and in nearby Borneo Island.

Such fires recently caused a smoky haze in Indonesia, Malaysia, and Singapore and raised air pollution to hazardous levels.

The burning "causes a short-term problem with the smoky haze but in the medium- and longer-term would exacerbate climate change and warming," Roome said, calling for a concerted regional action to stem the crisis.

"If countries could put in place actions that could better manage the forest resource and the peat land to preserve the green cover and to preserve peat land, you will get two benefits—in the short term you wouldn't get the smoky haze and in the medium and longer term, it would reduce the impact on climate change," he said.

In all of East Asia, the biggest contribution to global warming come from China, particularly its energy sector, but the second biggest culprit is forest cutting in Indonesia, the biggest Southeast Asian nation.

"So one of the most important ways of mitigating climate change in Southeast Asia is to mitigate the reduction of forest cover—stop the rate at which forests are being burned or being chopped and stop the conversion of peat land," Roome said.

2012 East Asia Summit

The ASEAN summit takes place in Cambodia on Saturday and Sunday, followed by the East Asia Summit on Monday and Tuesday.

ASEAN ECONOMIES

All figures are estimates by the International Monetary Fund (IMF) for 2012

GDP PER CAPITA in US\$



EAST ASIA SUMMIT

Participant countries:

- All 10 ASEAN countries
- Australia
- China
- India
- Japan
- New Zealand
- Russia
- South Korea
- United States

	GDP, current prices (bln US\$)	GDP, constant prices % change*	Current account balance as % of GDP
Indonesia	894.9	4.0	-2.1
Thailand	377.0	5.6	-0.2
Malaysia	307.2	4.4	7.51
Singapore	267.9	2.1	21.0
Philippines	248.7	-4.8	3.0
Vietnam	137.7	5.1	0.3
Myanmar	54.0	6.2	-4.4
Brunei	16.9	2.7	49.1
Cambodia	14.2	6.5	-0.7
Laos	9.3	8.3	-21.9

Sources: IMF's World Economic Outlook Database (October 2012), Association of Southeast Asian Nations

4°C of Change

The World Bank's "Turn down the heat" program

By Michelle Crane

Teacher Consultant for the Texas Alliance for Geographic Education





Current Climate Changes

- Global Mean Warming is $.8^{\circ}\text{C}$ above pre-industrial levels
- Ocean temperatures are $.09^{\circ}\text{C}$ warmer than in the 1950's
- Sea levels are 20cm higher than pre-industrial levels
- Sea levels are rising 3.2cm per decade



2°

- For years, scientists have been warning us of the effects of a 2° increase.
- Attempts have been made to ensure that we did not reach a 2° increase in temperatures.
- Current research suggests that 2° is no longer avoidable.
- Even if the current United Nations Framework Convention on Climate Changes pledges and commitments are met – a 4° increase seems likely.



Effects of a 4° increase – Global Temperatures

- Warming would not be evenly distributed.
 - most would be over land
 - it would range from 4° to 10°
 - increases of 6°C could be expected across Mediterranean, North Africa, the Middle East and the US
- Increase in extreme temperatures ac
 - tropical areas would experience extreme temperatures
 - cool months would be warmer than the warmest months previously experienced
 - Increasing temperatures would increase heat-related deaths,
 - forest fires and loss of crops.



Increase in CO₂ would also acidify the Ocean

- 150% increase in ocean acidity with 4° increase
- Could cause wide spread extinction of coral reefs



Rising Sea Levels

- A 2° change would result in sea level changes of about 2 meters.
- A 4° change could cause up to a 4 meter change by 2300
 - A .5 to 1 meter change would be expected by 2100
 - Sea levels will be higher in tropics, lower in polar regions.



Distribution of Water will be affected

- Europe, Africa, North and South America and southern Australia will be drier.
- Northern North America, northern Europe, Siberia and monsoon regions will be wetter.
- Rivers in monsoon areas will be particularly affected – will affect availability of water
- Danube, Mississippi, Amazon, and Murray Darling river basin runoff will decrease by 20 to 40%
- Nile and Ganges will increase by 20%



Food security, Health and population growth

- Water availability, flooding, and drought will affect food production
- Population growth will increase food demand
- Flooding, drought, food scarcity, and increasing temperatures will increase spread of diseases
 - Diseases which are affected by precipitation and humidity will be particularly affected, such as vector borne diseases – malaria, dengue fever, Lyme disease



Notes & Credits

- Slide 1
 - All information from “Turn Down the Heat” a publication of The World Bank, 2012
[http://climatechange.worldbank.org/sites/default/files/Turn Down the heat Why a 4 degree centigrade warmer world must be avoided.pdf](http://climatechange.worldbank.org/sites/default/files/Turn%20Down%20the%20heat%20Why%20a%204%20degree%20centigrade%20warmer%20world%20must%20be%20avoided.pdf)