eas Congress 2009

Theme 2

Natural and Manmade Hazard Prevention and Management

WORKSHOP 3:
IMPACTS OF CLIMATE CHANGE AT THE COASTAL AND OCEAN AREAS OF THE EAST ASIAN SEAS REGION

25 November 2009

World Maritime University

Ministry of Land, Transportation and Maritime Affairs, RO Korea (MLTM)

Swedish Environmental Secretariat for Asia (SENSA)

Chair: **Dr. Björn Kjerfve**
President, World Maritime University
Sweden

Co-Chair: **Prof. Chui-Hwan Koh**
Seoul National University
RO Korea

The East Asian Seas Congress 2009

"Partnerships at Work: Local Implementation and Good Practices"

Manila, Philippines
23–27 November 2009

The East Asian Seas Congress 2009
"Partnerships at Work: Local Implementation and Good Practices"
Manila, Philippines, 23-27 November 2009

Theme 2: Natural and Manmade Hazard Prevention and Management
Workshop 3: Impacts of Climate Change at the Coastal and Ocean Areas of the East Asian Seas Region

25 November 2009

Co-Convening Agencies:
World Maritime University; Ministry of Land, Transportation and Maritime Affairs, RO Korea (MLTM); and Swedish Environmental Secretariat for Asia (SENSA)

Chair:
Dr. Bjőrn Kjerfve, President, World Maritime University, Sweden

Co-Chair:
Prof. Chul-Hwan Koh, Seoul National University, RO Korea

SECURING THE OCEAN, SAVING THE CLIMATE, SAVING LIVES

Climate changes are not new — cycles of tremendous climate changes have happened throughout Earth's history; but in those times, the contributions from humans were nil or very insignificant. A grave concern is very apparent today; IPCC, in its 2007 report declared, beyond doubt, a warming of the global climate system and linking it to human activities. Humankind's excesses have thus become manifold: pollution, over-extractions, introductions, habitat destruction, and now climate change have tremendously altered ecosystems and the climate and are contributing to Earth's destruction.

It is against this backdrop that the Workshop on Impacts of Climate Change at the Coastal and Ocean Areas of the East Asian Seas Region was convened during the EAS Congress in Manila, Philippines in November 2009. This workshop was aimed at articulating climate change adaptation and resilience strategies within the context of sustainable development in coastal and marine environment. In particular, the workshop objectives are:

- To understand the types, level and severity of the adverse social and economic impacts of climate change; and
- To outline actions, initiatives or response measures within and outside the East Asian Seas region related to climate change adaptation and resilience strategies.

The workshop was co-convened by the World Maritime University (WMU), the Ministry of Land, Transportation and Maritime Affairs of RO Korea (MLTM) and the Swedish Environmental Secretariat for Asia (SENSA). The impacts to the East Asian Seas region were discussed as they relate to sustainable development in Monsoon Asia, fisheries production, and shipping (with the opening of Northeast Passage and Arctic meltdown). The active discussion and sharing of experiences between natural and social scientists and policymakers made reaching a common understanding of global change issues as they affect vulnerability and adaptation in coastal regional settings. The workshop also became a venue which bridged the practitioners of global change with those of a local rural development focus. Also amply articulated were different perspectives coming from disaster risk, conservation and coastal management practitioners.

IMPACTS OF CLIMATE CHANGE AND GLOBAL CHANGE

The impacts of climate change on the oceans have severe and immediate implications for the well-being of billions of people globally. East Asia is particularly affected. The seas of East Asia sustain 30% of the world's coral reefs and mangroves; produce about 40% of the world's fish catch and 84% of world aquaculture; and represent one of the world's centers for tropical marine biodiversity. East Asia has the biggest yield, consumption and international trade of fishery products. Currently it has the strongest influence on market, employment and economy of the world's fisheries (Kim and Low). Unfortunately, these benefits are threatened.

The coasts, oceans and islands (and their inhabitants) are particularly affected by phenomena linked to climate change, which include: the warming of ocean surface water, a rising sea level, and oceans becoming acidic. In turn, ecosystems (and their capacity to deliver goods and services) are threatened. Coral reefs are destroyed by bleaching whereas the slowly decreasing pH in the oceans affects the basic structure of calcium-dependent organisms; the implications of which are detrimental to coral reefs and associated coral reef productivity. Are we going to lose our coral reefs in the next 40 years? Probably, yes. The dire consequences are unimaginable given other functions which will be lost once these ecosystems cease to exist.

It is a well-known fact that coastal habitats play an important role in coastal protection during hurricanes and tropical storms (Gilman, et al., 2006). Studies have shown that coral reefs, seagrasses and mangroves provide protection to coastal communities as they naturally buffer against high-energy waves, even under scenario of sea-level rise (David, et al.; see Figure 1). Samonte-Tan cited the article by Brander, et al., (2007) which estimated the value of coral reefs in coastal protection globally which is in excess of $9.0 billion. This value represents what will be lost in economic terms if reefs and mangroves are not protected. And the cost to human lives? Ethically, that cannot be estimated because it is true that: "One life lost is just too many" (Tay, et al., 2006).

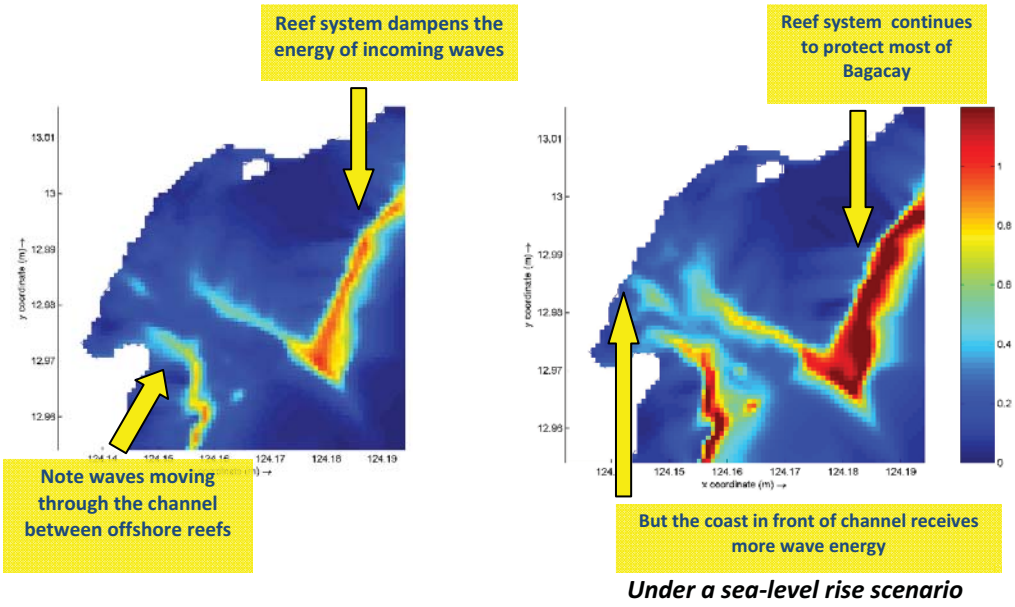
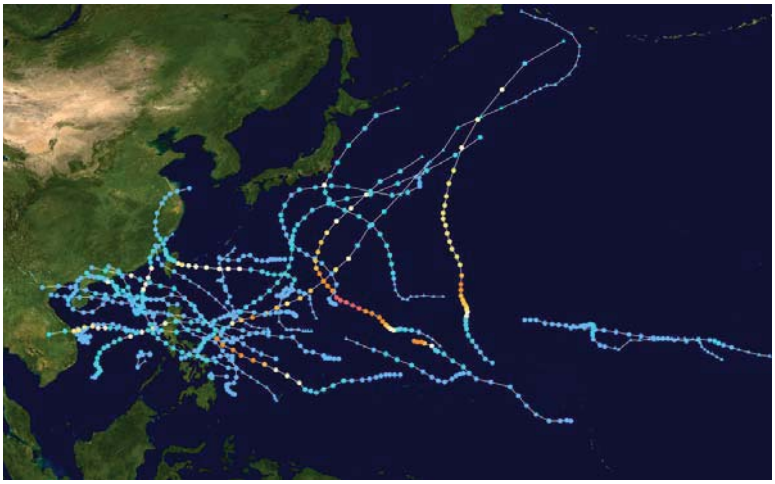


Figure 1. Coral reefs, seagrasses and mangroves, provide protection to coastal communities as they naturally buffer against high-energy waves, even under scenario of sea-level rise.

The impacts of climate change on fisheries could be seriously detrimental, because the warming rate is very steep over East Asia (Kim and Low). Changes in storm events create destructive typhoons, which disrupt fishing patterns and seasons, damage fishing vessels and aquaculture facilities, and disrupt formation of fish schools and primary and secondary productions.

The tremendous value of fisheries is a given. Worldwide, approximately one billion people are dependent on fish as the principal source of animal protein and half a billion people depend on fisheries and aquaculture for their livelihoods, the vast majority of them live in developing countries (Allison, et al., 2009). More than half of the protein consumed by over 400 million people in the poorest countries comes from subsistence and artisanal fisheries (Dulvy and Allison, 2009). This essential food source is immediately threatened by changes to the oceans. But how do governments ensure food security? How do governments manage sustainable fisheries for changing fish populations and distributions? How do governments provide an equitable supply distribution chain for all? Save for greater emphasis on the role of aquaculture to future changes, the answers remain elusive. Unless we come up with viable options very fast, one Congress participant derisively commented that we can expect a generation of morons given that it is increasingly being proven that fish nutrition provide for brain development.

A drastic change in the occurrence of natural hazards is observed, rendering coastal areas and islands prone to destructive storm surges, erosion, riverine flooding and inundation; and among communities, particularly in developing states, economic losses and poverty resulting in disasters have eroded the years spent in alleviating these same conditions.



The 2009 storm tracks in East Asia.

The storm events in the 2009 typhoon season in the region recorded 20 storms entering the Philippine area of responsibility; 10 of which were typhoons and three were considered super typhoons. Kim and Low reported that more than 2,000 people died and losses of about USD 5.6 billion were estimated; some experts considered these numbers as severe underestimates

In Taiwan, although the average amount of precipitation showed no real change in trends over time, the number of raining hours is decreasing but the events with significantly heavy rains are increasing, e.g., in three days, 3 m of rain was estimated in Xiaolin Village, causing extreme flooding (Chen). In the Philippines, in September 2009, Typhoon *Ondoy* (*Ketsana*) dumped 341 mm of rains in only six hours which almost equaled the average monthly rainfall in Metropolitan Manila of 392 mm (Perez). The rainfall broke the record for the highest 24-hour rainfall of 334 mm in Metro Manila recorded in June 1967. Some countries have technological solutions in dealing with these events, e.g., barrages, but most, in particular poorer nations, do not have these capacities (Chen).

And although international, national and local efforts to mitigate the effects of natural hazards such as typhoons and flooding were vigorously instituted before, these seemed inadequate given the increasing frequency and severity of these disaster agents in recent years. How do governments manage for continuous shifts in weather patterns and hence changing exposure to coastal flooding? The answer may lie in more knowledge about Monsoon Asia. The monsoons in Asia are the dominant climate conditions that have influenced, among other factors, the way of life in the region through the years (Yu, *see also below*). The amount and timing of rainfall govern human activities, like agriculture and fisheries, and their other livelihoods. Monsoon Asia is very important because, along with other climate “choke points” in the world, it influences global biogeochemical processes (Lebel, et al., 2009). It can affect economies and social well-being of people in the region and the world.

A study showed that Monsoon Asia developed when the balance between landmass-sea-radiation (that was unique to the region) was delicately reached thousands of years ago (Wu, et al., 2008). But this delicate balance is rapidly being eroded with changes in other “choke points” as well as the tremendous transformation in topography, land use and land

cover in the region. This could be two of the reasons why we are experiencing shifts in weather patterns.

The link between ecological degradation, caused by man's activities, and the increasing vulnerability to and impacts of natural hazards is thus increasingly being validated. Coastal habitats are being lost and converted to accommodate settlements and other land uses. Not only are we losing our natural protection from natural hazards, human impacts on ocean ecosystems such as mangroves and seagrass beds have significantly reduced the capacity of global ecosystems to sequester carbon from the atmosphere (Laffoley, 2009, as cited by Samonte-Tan).

Degradation and loss of marine habitats contribute directly to increasing carbon dioxide levels in the atmosphere and ocean. The carbon stocks in coastal marine habitats, such as mangroves, seagrass meadows, kelp forests and tidal salt marshes, are similar to many of the terrestrial systems. The carbon sequestration in sediments by coastal habitats has not been accounted for, especially in assessments of the cost of degradation and loss of coastal marine habitats.

Another land use policy, the construction of dams, built to supply electricity, mitigate flooding and provide for the increasing need for water for domestic and agriculture uses, unfortunately, has tremendously altered ecological functions and affected climate-related risks as well. Dams affect the environment further downstream causing reduced outflow and sediment discharge. With a reduction in freshwater discharge, salinity intrusion in estuaries increases. In Yangzhou River, PR China, the Three Gorges Dam has significantly affected the migration of various species and decreased downstream land/sediment accretion with a reduction in sediment discharge; shoreline has thus retreated by 500–600 m/yr (Chen). It is also known that river discharges create productivity in the estuaries and coastlines through the buoyancy effect when river plume triggers nutrient-rich upwelling from the sub-surface. But this function is usually hampered when dams are built.

Mimura and Yokoki (2008) concluded that "reduction in sediment outflow not only results in less food for the marine biota but it adds to the sea level rise problem. Local sea level rise depends not only on mean sea level rise, but also on sediment transport, land subsidence, waves and current flow patterns."

Do we see more dams being built? Possibly, yes. How do governments strike the balance between conservation and development? When do we say "enough" to unregulated development? The answer may probably lie with governments' policy on population. Approximately 2 billion people live in East Asia, with its numbers expected to increase to 3 billion by 2015. Unless we institute very drastic lifestyle changes, we see consumption patterns increasing dangerously. Thus we can expect further aggravation in climate patterns and adding yet another constraint in our ecosystems' ability to provide us with goods and services.

Over-pumping of groundwater causes land subsidence. The combined effects of rising sea level, sinking land and reduced riverine discharges enhance climate-related risks.

East Asia's coastal cities host an estimated 77% of the total population. Clustered around these coastal cities are traditional resource-based activities, such as coastal fisheries, aquaculture, forestry and agriculture, side-by-side with industry, shipping and tourism. Half of the world's merchant fleet sails through the Malacca and Lombok Straits, while 14 of the 20 largest maritime ports in the world are located in the shipping corridor that stretches from Singapore to Japan.

In East Asia, a lot of coastal urban areas are very densely populated and where poverty is high. These coastal areas will most likely be inundated with ocean water (David, et al.).

How do we see shipping in the region being affected by climate change? Some are clearly regional impacts. But the other answer lies outside of the region — in the Arctic. Arctic Ocean is the smallest "ocean" but its significance is global. Only 4% of the world's ocean area, it is bounded by six coastal states: United States, Canada, Greenland and the Faroe Islands (Denmark), Iceland, Norway and Russia (Kennedy, et al., 2008).

Records showed that the summer sea ice extent in the Arctic has reached its minimum in September 2007 but there is still plenty of sea ice during winter (Kitagawa). A "blue" Arctic Ocean is predicted in the summertime (for four months) to occur from middle of this century to as late as the 22nd century (Ho and Ng). With this, trans-Arctic shipping is very possible and it means a reduction in travelling distances (Figure 2). The high oil prices also drive up speculation that the Arctic route will be very busy in the coming years (Kitagawa) because this translates to significantly lower transportation costs.

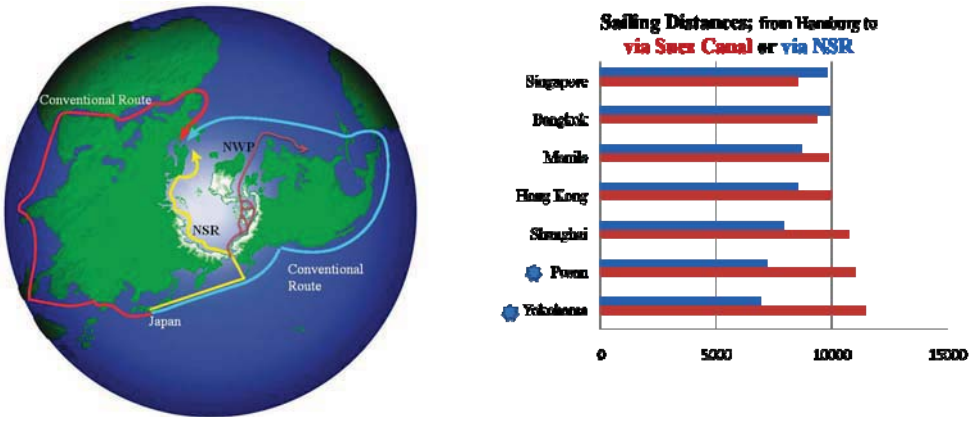


Figure 2. Northern Sea Route, Northwest passage and conventional shipping routes.

But taking account of yearly and regional fluctuations of the ice conditions in the Arctic, the real opening of the Arctic may still be years away (Kitagawa). Kitagawa opined that the growing environmental and ecological awareness may put off commercial shipping even if the melting of the polar ice cap is advancing (Table 1).

Table 1. Arctic shipping tradeoffs.

Positive factors	Negative factors
• Sailing distance savings • Travelling days saving (probably) • Reduction of total amount of fuel oil • Reduction of total amount of emission • Demand for Arctic natural resources • Polar tourism • Fisheries in the future	• Expensive ship • High maintenance cost • Highly-skilled crew • Poor infrastructure • High damage risk • Uncertainty • High insurance cost • Environmental concerns

Ho and Ng, however, speculate that the plans to develop more hub-ports may indicate opening up of the Northern Sea Route for passage as early as 2013. Its opening is expected to bring changes in the Asian market — changing regional shipping features and heating up competition of hub-ports. It was speculated that the prime movers would be trading for oil and natural gas, while bulkers would follow closely (Kitagawa). Will the Malacca Straits hub lose out from its would-be competitor? It may be too early to tell but the stakes are definitely high once this becomes a reality. But is East Asia ready for this?

Challenges and opportunities will accompany the Arctic when it opens up. But it is expected that the gains and losses will be very differentiated. Developing countries could lose out from Arctic shipping. And when the climate worsens (and the oceans falter), tropical fisheries will deteriorate whereas fisheries could boom in the Arctic. And when rich fisheries become a reality in the Arctic, only rich fishing nations will have the advantage. Are the Arctic nations and other rich states willing to share these benefits? Will a new international solution be needed to ensure equity in benefits? Clear answers are yet to be posed. But we can be sure that the events that will be taking place in the Arctic will have big impacts on East Asia — impacts that have economic and social repercussions for the region whereas the causes are external and very far.

East Asia's growing populations (a lot of them, poor) and their migration to coastal areas, dynamic economic growth and rising global demands for fishery and aquaculture products (met largely by export products from the East Asian Seas), and rapidly increasing shipping traffic collectively exert tremendous pressure on East Asia's marine environment and coastal resources. There is no denying the magnitude and rate of development in this region are unprecedentedly high (Seto, et al., 2008). The state of dynamism, however, is constrained by global climate change. Climate variability affects land use and population policies. A country's vulnerabilities to natural hazards is closely linked to poverty. While environmental degradation is the strongest argument for instituting comprehensive climate policies in the coming years, the cost to human society has to be an important criterion to have sustainable development in East Asia.

STRATEGIES AND RESPONSES

The imperative is clear: knowledge about the interactions (and the tight linkage) between regional development and the Earth's climate system no longer allows for "science-as-usual" and "business-as-usual" scenarios as the cost to ecosystems and human societies is too high. This drives further reforms that consider: (1) science-to-action strategies; (2) developing an alternative, comprehensive climate policy within the sustainable development framework; and (3) a major rethink in governance for local government development.

First: Science-to-Action Strategies.

A science-to-action strategy allows science to reframe its hypotheses and analyze its results that can be fed to management and policy decisionmaking processes. It asks that scientific results be turned into information that communities and governments can use in their planning and other activities. It thus asks science to develop decision tools. For example, climate-related models should anticipate changes in both time and space that can help in developing realistic future scenarios and action plans. Among available mechanisms and options, several were articulated during the Congress.

1. **Accurate predictions and monitoring** — This is a fundamental tenet because to put a handle on trajectories and trends about environmental conditions and phenomena, very early on, is crucial in saving lives. They "serve as basis for forecasting impacts and developing appropriate response strategies" (APN).

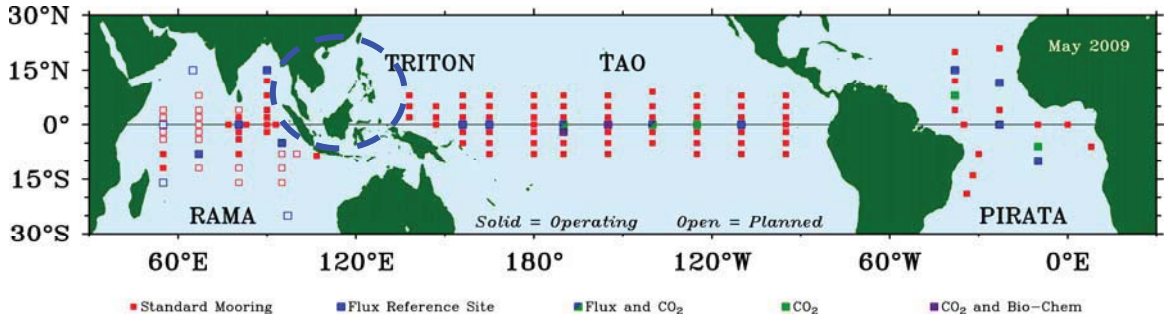
For instance, several studies about the Asian Monsoon have helped in understanding the role of the ocean-atmosphere interaction that generates the phenomenon (Box 1). They help principally in determining regional rainfall patterns or even patterns of rainfall for an entire season.

Box 1. Studies on ocean-atmosphere interaction about the Asian Monsoon (*Yu*).

- The ability to simulate an intra-seasonal oscillation (ISO) — referred to by Yu as the elementary bricks of monsoon which is based on surface heat fluxes — can help in determining regional rainfall patterns or even patterns of rainfall for an entire season.
- The variations in the Asian Monsoon are highly correlated with two very important ocean-atmosphere coupled modes: the Indian Ocean Dipole (IOD) and the El Niño Southern Oscillation (ENSO).
- The recent concern about big deviations from the normal patterns of the Asian Monsoon as induced by climate changes (as well as human activities, e.g., land-use changes) is valid. These abnormal events are usually accompanied by devastating flooding and droughts.
- Recently, incidents of coral bleaching tended to occur during the pre-monsoon onset when sea surface temperature (SST) reaches its annual maximum.

Because the Asian Monsoon exhibits a strong seasonal, intra-seasonal and inter-annual variability, the monitoring of its onset is thus very important (Yu). This information influences a number of action plans and decisions that are hinged on its accurate forecasting. But the information remains incomplete because other ocean data are not available. In particular, an information gap exists in the SEAGOOS region compared to observation capability in the Pacific (TRITON/TAO) and the Indian Ocean (RAMA) (Figure 3).

Figure 3.

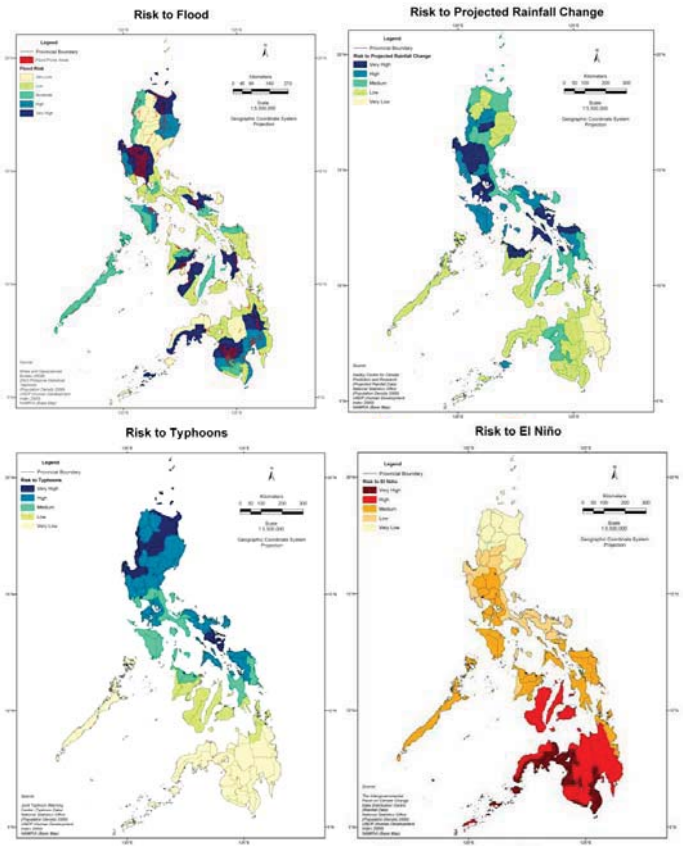


The IOC WESTPAC has recently started the Pilot Project on Monsoon Onset Monitoring and its Social and Ecosystem Impact (MOMSEI) aimed at improving the understanding and forecasting of Asian Monsoon by strengthening the monsoon monitoring capability in the Andaman Sea in support of the existing efforts of the Indian Ocean Observing System (IndGOOS). The project is also aimed at demonstrating the value of ocean observation in ecosystem conservation by analyzing the possible link between the Monsoon onset and coral reef bleaching in the Andaman Sea.

2. **Vulnerability assessments** — The tools discussed in the Congress involve identifying sectors and areas most vulnerable to climate change as well as prioritizing areas where interventions can be started using vulnerability assessments. These tools are instrumental in highlighting the importance of country- or area-specific assessments. These assessments are likewise needed to underpin specific government interventions based on three metrics: a local area's exposure and sensitivity to hazards and the degree of its existing resilience or adaptive capacity (Perez; Lee, et al.).

In the Philippines, Perez presented GIS-based maps which integrated several layers of information (Figure 4). These were helpful in situating where climate-related risks are most pronounced. The maps that were presented include risks to projected rainfall change, typhoons, El Niño, projected temperature increase and floods. The importance of an evidence-based decision-support system was emphasized, particularly towards strategic action planning for climate change.

Figure 4. Climate-related risks in the Philippines. While climate change is taking place globally, impacts can vary from country to country and within country, from place to place.



In RO Korea, to assess vulnerability of coastal cities, data on socioeconomic factors, physical and geological environmental factors, and policies were combined with climate change scenarios (Lee, et al.). The pre-screening of, in particular, Mokpo City, in southern Korea, served as a test case to highlight the city's exposure and its sensitivity to sea level rise (Figure 5). An inundation simulation for Mokpo had likewise been created using scenarios of sea level rises from 1 m to 5 m.

Figure 5. Satellite image of Mokpo City, RO Korea. Mokpo City was considered as a test case for vulnerability assessment with the following metrics (weighted accordingly): population (0.2); coastline (0.3); financial dependency (0.2); and data availability, like coastal maps, etc (0.3).

In another presentation, David, et al., proposed a strategy for prioritizing sites for protection in the Philippines. Their recommendations were based upon various remotely sensed products and numerical model simulations like, presence/absence of reefs and related habitats; entrainment/ connectivity features; variability of environmental exposure; and perceived threats and vulnerability (Figure 6).

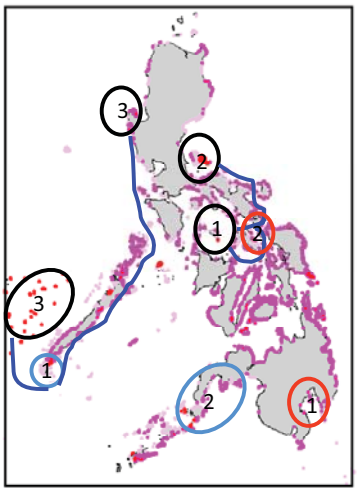


Figure 6. Recommendations for prioritizing sites for protection in the Philippines.

- **offshore reefs that are less vulnerable to thermal stress and storms**
- **reefs that have withstood thermal fluctuations through decades**
- **food security**
- **prioritizing series of reef areas to ensure a sustainable exchange of larval supply through connectivity corridors**

Goh discussed another tool, a modeling tool called the DINAS-COAST DIVA (Dynamic Interactive Vulnerability Assessment) Model that was used to assess the vulnerability of coastal areas in Southeast Asia to sea level rise. DIVA was used to give a preliminary regional perspective, and it was able to show that there is a high cost in doing nothing.

DIVA also showed that adaptation to impacts of sea level rise requires engineering measures to limit damage to human population and coastal resources. Full nourishment (incorporating coastal cover rehabilitation) was the most cost-effective option for minimizing loss of wetland areas, loss of sand and land loss (with consequent reduction in migration of populations). Dike protection was a better option to mitigate the number of people flooded, land loss due to submergence and costs of damage due to flooding from the sea.

Further analyses of the results from the model were done using a geospatial clustering tool, LOICZ-DISCO (Deluxe Integrated System for Clustering) to highlight similarities and disparities between countries. The results indicated that country-specific and target-specific application of cost-benefit relation was apparent between beach nourishment and sea walls/dikes. Beach nourishment effectively mitigated land and wetland losses in Vietnam, Malaysia, Thailand, the Philippines and Cambodia, while dike protection was recommended for Singapore.

On a more refined scale, the project was able to create conceptual diagrams for particular areas in the region. These are useful for identifying specific issues and highlighting sensitive areas for further study. The final phase of this regional project will focus on policy and cost-benefit analysis specifically relevant to the management and governance of coastal areas at risk to global environmental change.

3. **Research culture** — A science-to-action strategy necessitates building a strong research culture and interdisciplinary scientific and technical expertise (APN, Perez). This has been exemplified by the initiatives done by the Asia-Pacific Network for Global Change Research or APN. Established in 1996, APN is an intergovernmental network of scientists and policymakers which fosters research in global change issues.

Some US$ 1.3 million APN funds have so far been appropriated to projects that are governed by regional cooperation and operated within the existing global change programmes, like LOICZ and EMECS. Peñafiel outlined APN's priority actions, including to:

- improve understanding of the pathways of coastal management in the Asia-Pacific (AP) region;
- enhance coastal management in the AP region by the development of more appropriate, more targeted and more effective strategies;
- continue to develop realistic future scenarios of global change for AP coast that can be used as a basis for forward planning;
- continue dialogue between decisionmakers in the AP region;
- generate and share appropriate information intended to solve problems associated with future global change;
- improve understanding of the geographical distribution and current condition of those coastal ecosystems that help sustain coastal populations in the AP region;
- improve understanding of the degree and sources of pollution affecting AP coasts;
- develop a public message about future global change in the AP region coastal zone; and
- pay special attention to the most vulnerable environments on the AP.

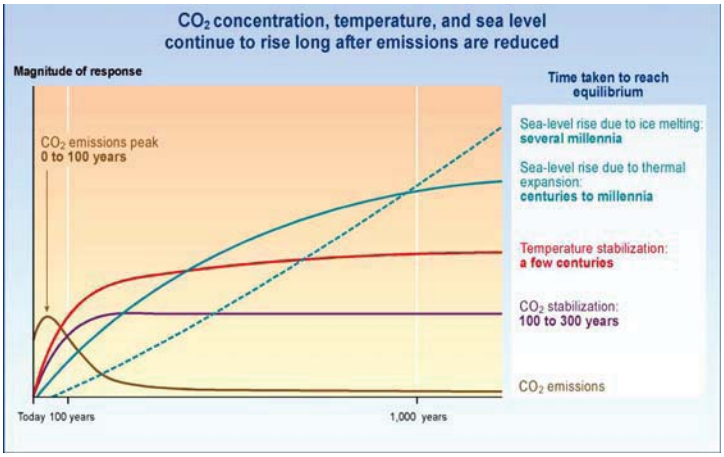
Second: Developing an Alternative, Comprehensive Climate Policy within the Sustainable Development Framework

A climate policy which can be mainstreamed in the sustainable development framework is timely and well-articulated during the Congress. This can be done through comprehensive risk assessment and management and an integrated land- and sea-use planning. Climate- and disaster risk reduction strategies must simultaneously consider all components of the ecosystems rather than specific functions in isolation. In principle, the framework is to combine the strategies of being prepared and able to respond to disasters or emergencies and other disturbances with that of instituting the culture of safety before

hazards wreak havoc. It considers both mitigation and adaptation measures but the focus must now shift for the latter (Box 2). According to Perez, adaptation means "those activities that people, individually or collectively such as households, communities, companies and government, carry out in order to accommodate, cope with or reduce the adverse effect of climate variability and change; they could be anticipatory (proactive) or reactive."

Box 2. Why adaptation?

Perez and Lee, et al., noted that the focus of interventions must now shift on adaptation measures — to complement mitigations — because of a prediction that global mean temperature, temperature and sea level will continue to rise even if we succeed in stabilizing atmospheric GHG concentrations at present levels. It is however essential that massive, concerted efforts be started as soon as possible.



Source: IPCC, 2001

Comprehensive risk assessment and management. In a comprehensive risk assessment, climate is just one factor in a multiple-stress environment (Perez). Because interconnections between socioeconomic, environmental and climatic stresses exist, it is essential to mainstream climate change adaptation measures in development processes. According to Perez, to mainstream is to:

1. Integrate climate information into the broader sustainable development framework. It requires adoption of an integrated risk framework in formulating strategies for intervention and investments in education, business and development with crosscutting (lateral and vertical) focus on water, energy and food security needs; and
2. Integrate adaptation measures into planning efforts to underpin decisionmaking processes. This is necessary to improve society's ability to cope with changes across timescales.

In the Philippines, there are a number of existing entry points (and emerging opportunities) to mainstream climate change adaptation. For example, the Climate Change Act 2009 was signed into law last October 2009. It mainstreams climate change into a broader government policy through a National Framework Strategy and Programme on Climate Change; sets up a Commission that will coordinate the country's climate change initiatives; and emphasizes the very important role of local government units. The country's experiences in other management initiatives are likewise useful in implementing adaptation

measures; they include environmental programs; integrated coastal zone management; disaster (risk) management; and sector management and plans.

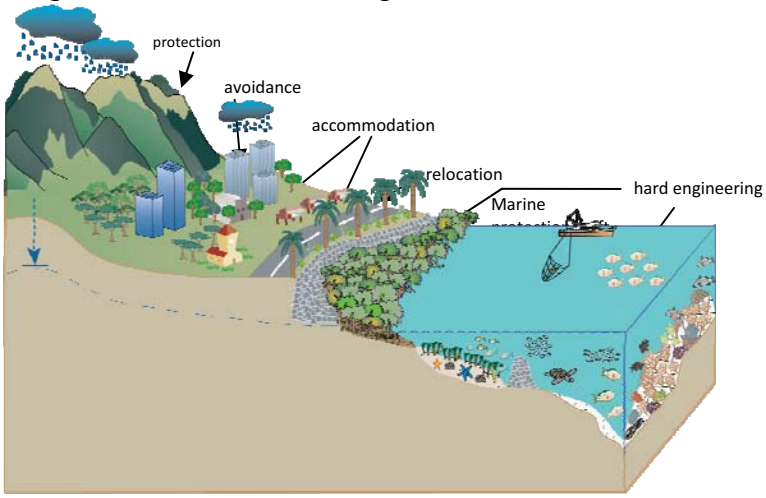
RO Korea has committed to implementing adaptation measures. RO Korea announced a comprehensive plan for adaptation to climate change in 2008 and a five-year green growth plan in 2009. Among other strategies, RO Korea will create adaptation guidelines for local governments as well as nationwide infrastructure/platforms to implement adaptation measures. Recognizing the vulnerability of marine and coastal areas, a list of short- and long-term actions include prediction of and response to the marine impact of climate change and climate-friendly ocean management (Table 2).

Table 2. Actions for marine adaptation in RO Korea (Lee, et al.).

Prediction of and response to the marine impact of climate change	Climate-friendly ocean management
• Establishment of global ocean observation system • Building early warning system through ocean observation • Marine ecosystem monitoring • Disaster vulnerability assessment at the coastal area • Adaptation strategy for coastal area and communities • Adaptive actions to cope with long-term changes	• Protection or restoration of tidal flat • Active management of coastal resources around the Korean peninsula • Strengthening of international cooperation on marine sector

Integrated land- and sea-use planning. Various management interventions in the form of action programs, projects, contingency plans or activities have been developed and undertaken by various national and local governments in response to their priority concerns with respect to natural and manmade hazards. But these are deemed inadequate given predictions of severe events. These can be strengthened in the form of an overall disaster response plan and specific actions in response to the priority needs of the locality concerned. A suite of strategies (Figure 7) was recommended, governed by an integrated land- and sea-use planning (David, et al.).

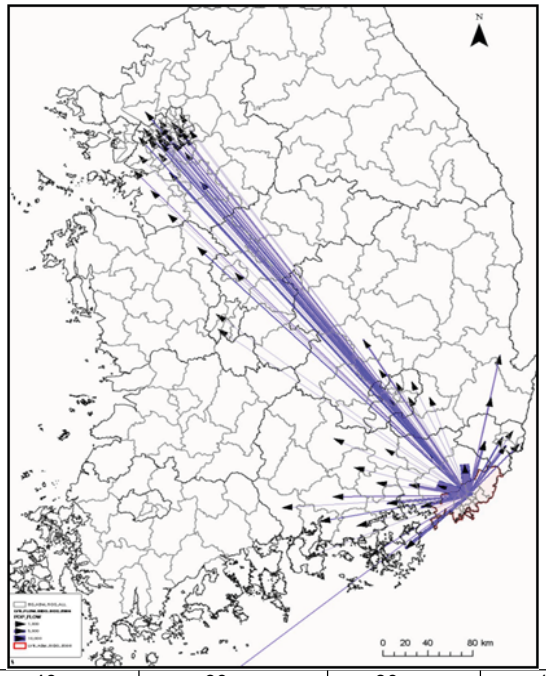
Figure 7. Recommended strategies.



Protection — of the watershed for freshwater source
Avoidance — future structures should not be built where the coast is highly varying (intermittent erosion/accretion)
Relocation — there should be provisions for relocating existing structures in highly hazardous areas
Accommodation — disaster resistant structures are recommended for essential facilities and habitation
Soft and Hard Engineering Approaches — management of coastal integrity necessitates ensuring existence of healthy coastal habitat that attenuate the incoming wave energy. As necessary, hard engineering structures may also be employed

But to pursue these strategies, it is important to develop support mechanisms for implementation, such as needs assessment, technological solutions as well as funding mechanisms (Perez). For example, financing mechanisms must be elaborated in such plans; as such, communities must recognize that the implementation of adaptation measures requires a consideration of the benefits and costs in instituting them. In RO Korea, to support decisionmaking, an inundation damage costing was used (Lee, et al.). Here, the FUND (Framework for Uncertainty, Negotiation and Distribution) model estimated the total cost of moving residents and facilities from submerged areas in Mokpo City to other locations (Table 3).

Table 3. Gross damage cost by sea level rise from FUND (unit: million KRW; $1≒ 1,200 KRW).



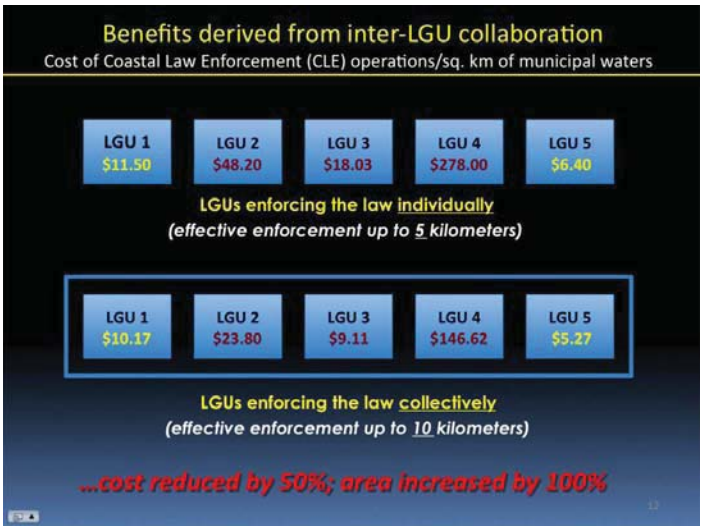
20 cm	40 cm	60 cm	80 cm	100 cm
177,409	678,306	1,117,637	1,743,894	2,498,323

As is the fact in other parts of the world, the development of comprehensive land use plans is more mature than coastal and water use plans. For example in the Philippines, only 250 coastal areas have coastal and water use plans (David, et al.). But this may not be problematic given that there are a lot of marine protected areas (MPAs) established. MPAs can be used as entry points to start more comprehensive integrated land- and water-use plans. As of October 2007, there are 1,161 existing MPAs throughout the country, and 162 are proposed (UP MSI Database). David, et al., are encouraged by possibilities of funds that can be accessed for this endeavor especially when decisionmakers are shown the multiple economic benefits of protecting the coastal resources.

Other strategies can be used based upon the tenets of a comprehensive risk assessment and integrated land- and sea-use planning, they include:

- An **Integrated Environmental Impact Assessment** (IEIA) is also now more relevant, given that knowledge of cumulative impacts of development and proper land and coastal use plannning can be integrated into risk reduction. A *"*natural hazard thinking*"* which incorporates geo-hazard, hydro-meteorological and structural engineering evaluation into IEIA for new coastal development projects and human settlement is needed. According to Perez, this strategy is important because it: (1) improves our understanding of vulnerability (and resilience) of existing infrastructure, settlement and ecosystems; and (2) this risk mapping ensures that new coastal development and infrasturucture are not placed in vulnerable areas.
- A network of marine protected areas (MPAs) under an integrated coastal management governance framework is expected to increase ecological resiliency, protect biodiversity and decrease social vulnerabilities. In addition, David, et al., contend that an MPA network is a strategy for accelerated and synergistic effects. For instance, the existing functional networks that have been established in the Philippines such as the MPAs Support Network (MSN) and inter-local government unit (LGU) alliances can fast track the outcomes of interventions, and in the long run, are cost-effective. A study made on the benefits derived from inter-LGU collaboration showed that it had reduced the cost of enforcement by 50% and increased the area of effective enforcement by 100% (Figure 8).

Figure 8. Benefits derived from inter-LGU collaboration.



- Developing states need **instruments which incorporate social agenda** to increase their resiliency, alleviate disaster impacts and recover immediately after a disaster. These may come from, among others, providing sustainable livelihood opportunities, micro-finance and easy access to insurance schemes (Uy). The need for social science research now is also very crucial to understand the impacts of climate change on human communities and the political implications of changing resource distribution (Samonte-Tan). A greater emphasis in the phenomena of increasing coastal urbanization should be looked at. The coastal area harbors 41% of the global human population and 21 of 33 global megacities (Martinez, et al., 2007). Majority of these megacities are found

in developing countries, where disasters are arguably incidents waiting to happen.

- **Capacity building and knowledge management mechanisms** must be strengthened**.** Access is needed for training and education at all levels, community awareness and public education, as well as access to new technology (e.g., early warning systems, risk mapping, etc.) and information. In the context of a fisheries community focus and habitat protection to contribute to reducing vulnerabilty, David, et al., recomend creating multi-level IEC (information, education, communication) campaigns on change in attitude and greater appreciation of the economic and ecological roles of coastal ecosystems (Box 3).

Box 3. Ecological roles of coastal ecosystems.

Coastal and marine studies highlight that ecosystem health, coastal integrity and other ecosystem goods and services are intertwined and crucial to help build resilience to forthcoming impacts of climate change. For example, coral reefs, seagrasses and mangroves are known to provide protection to coastal communities as they naturally buffer against high-energy waves.

Also, it has been estimated that each km^2 of good reef can provide from 1 to 19 tons of fish/yr, sustainably. It is known that seagrass meadows and mangroves provide nursery grounds for fisheries, and fisheries that target species that need different habitats through the course of their life stages are more vulnerable. Thus, there is a need to protect coastal habitats to ensure food security and contribute to building resilience.

- **Collaboration and partnerships** must be enhanced**.** There is a need to create a common language and platform (i.e., harmonizing policies, institutional structures and financing mechanisms) for disaster reduction, climate change and environmental management and to enhance collaboration among institutions working on climate change adaptation, biodiversity conservation, integrated coastal management, land degradation, wetland management, good governance and poverty alleviation.

Third: Major Rethink in Governance for Local Government Development

It is a sad running commentary that through the years — in response to societal crises — a “bottleneck” has resulted in tremendous increase in the number of policy reforms and directions from the national, regional, and international levels whereas many of these policies remain unimplemented on the ground (Chua, et al., 2008). It is now agreed that the accomplishment of management interventions must rely on local implementation, regardless of the level at which the plans and decisions were made. Thus, in addressing global change issues, including climate change, as they affect coastal environments in East Asia, it is imperative to consider international and national frameworks but local implementation and enforcement. In hindsight, if a lot of international prescriptions to achieve food security, enhance livelihood and improve environmental management have been successfully implemented, the outcomes of these mechanisms may now serve as insurances that can decrease vulnerability and increase resilience to crises in many areas.

But that is the side of the ideal top-down nexus which had evidently prescribed a “straightforward” sustainable development pathway for local governments; the framework of

which is based primarily (and arguably) on normative principles or scientific and economic assumptions. The other side of the commentary is that socio-political realities — now compounded by the dynamics of a changing climate — make it harder and complex to implement international and national prescriptions. Among other issues, three were highlighted during the Congress that could influence a major rethink in local governance approaches amid uncertainties: (1) Local governments and communities still had to contend with unintended impacts of strategies based upon old, existing polices they once implemented to solve previous problems; or (2) with national governments not able to swiftly address emergencies or implement policies, communities relied on autonomous, self-organizing mechanisms (and thus need other support mechanisms); and/or (3) when policies are actively being implemented but stakeholders were forced to self-organize when these same policies had ambiguous directions.

One, a case in point is decentralization as presented by David, et al. They noted that the fishing communities in the Philippines are better equipped to comply with climate change adaptation measures because some adaptation solutions are intricately intertwined with environmental protection and are thus within the control of fisherfolks. Republic Act 7160 and 8550, for instance, provide policy advantages for climate change adaptation with the devolution of stewardship of coastal marine resources from national to the local governments. But through time, decentralization had become problematic because of in-fighting and because local governments need substantial help from the national government in the form of financial and legislative support. But what is more problematic is that the numerous, disparate and diffused local actions that could increase resilience to climate changes — but without directions from a comprehensive national strategy —may, in the end, become counter-productive and very costly. Streamlining the national and local interventions is thus needed. A strategic and comprehensive national policy can strengthen local policies and actions.

Two, another case, as presented by Uy showed autonomous (self-organizing) adaptation strategies in Bagacay, , a poor fishing area in Albay, Philippines (Figure 9), in the face of recurring threats (and extreme infrequent events) from natural hazards.

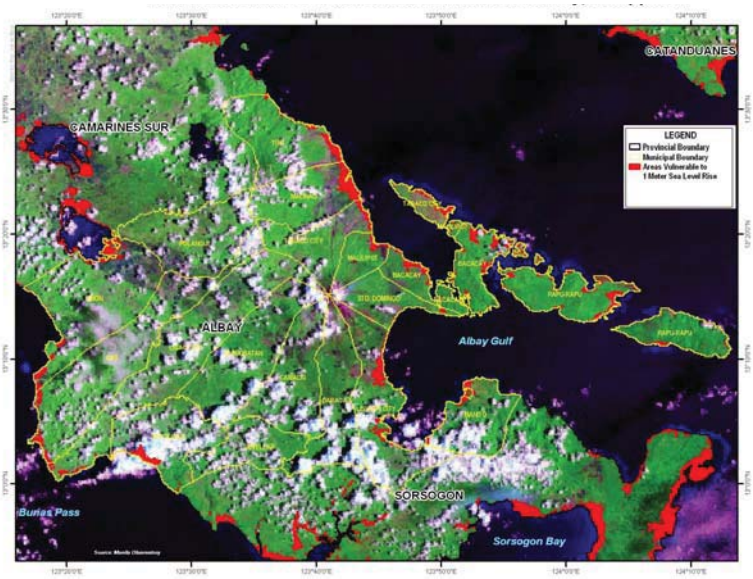


Figure 9. Areas vulnerable to 1-m sea level rise at Albay, Philippines.

Albay, which is a high-risk province because of hazards from volcanic eruptions, landslide, earthquake, flood and typhoon, has one of the highest poverty incidence rates in the country. The case study by Ms. Noraleen Uy zeroed in on Bagacay, one of the biggest fishing municipalities in the province. Here the main livelihoods are fishing, farming and handicraft-making which are all climate- and disaster-sensitive sectors.

Uy's assessments, based on a sustainable livelihood analysis (SLA) framework (Box 4), considered the nearly 50-year regional climate trends (temperature, rainfall, tracks and frequency of cyclones) and typhoon disaster events as well as existing livelihood assets. The latter determined how the communities have responded to and coped with the disaster events and climate disturbances through the years. Among the many impacts to livelihood during periods of disturbances, two stood out: income loss and household food insecurity. The communities, in turn, had developed several autonomous adaptation practices during these events, including diversification into supplementary and alternative activities which helped spread the risk across more than one income source (Table 4). But these measures are arguably not enough. To further lessen vulnerabilities and increase the resilience of the communities, Uy recommended a number of adaptation measures: human/technical, financial, infrastructure, and other measures (Table 5). Such additional measures need substantial support from governments and other stakeholders.

Box 4. Sustainable livelihood analysis (SLA) framework.

Ms. Noraleen Uy utilized the sustainable livelihood analysis (SLA) framework with this case study to highlight the link between climate change adaptation, disaster risk reduction and sustainable livelihoods. The SLA (*see figure below*) is a flexible tool which incorporates several metrics, including: (1) external vulnerability (e.g., shocks, trends, seasonality); (2) internal vulnerability (e.g., effect on livelihoods); and (3) analysis of institutional structures and processes. These parameters are basically used to determine security in livelihood. However, these same metrics are commonly used in frameworks dealing with climate change adaptation, disaster risk reduction, resource management and rural development and poverty alleviation. Thus, conceptually, the SLA can then help to better understand the broader institutional, environmental and other key issues that determine vulnerability, adaptation and resilience.

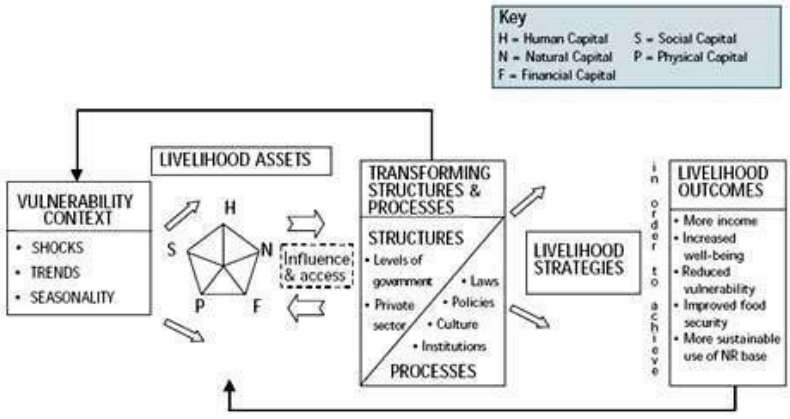


Table 4. Autonomous adaptation practices.	

Fisheries	• Longer time fishing in good weather
	• Additional income sources:
	  ○ Farming
	  ○ Other fisheries-related employment (e.g., fish drying and fish selling)
	  ○ Small business operation
	  ○ Handicraft making
	  ○ Labor during harvest in farms and fishponds
	  ○ Non-agricultural labor (e.g., tricycle driving and construction work such as painting and carpentry)

Agriculture	• Change in planting schedule and cropping patterns • Diversification of crops planted — rice, corn, vegetables and root crops
Disaster Management	• Reinforcement of houses • Reliance on traditional weather forecasting especially by fishers
Food security	• Increasing household food stock • Diversification of food sources (e.g., drying fish and gathering shellfish) • Planting root crops and vegetables
Others	• Loans • Sale of assets (e.g., household appliance, land and livestock) • Outmigration • Reduction in expenditures on food and basic necessities • Change in attitude towards the environment

Table 5. Recommended Adaptation Measures.	
Human/Technical	Seminar/training on climate change, disaster management, alternative livelihoods and fishery laws
Financial	Access to credit and agriculture subsidies
Infrastructure	Construct evacuation center and sea wall and improve roads, street lighting and irrigation system
Others	Increase employment, improve investment climate (especially for handicraft and tourism), reforestation and mangrove rehabilitation

Uy highlighted further that to create transformation in institutions and processes, and to adhere to a goal of a disaster- and climate-proof development, the government of Albay created two separate and distinct bodies: the Centre for Research and Initiatives on Climate Adaptation (CIRCA) and the Albay Provincial Safety and Emergency Management Office (APSEMO). Both have been institutionalized, the first of their kinds in the country. Among their many accomplishments, CIRCA was instrumental in pushing climate change adaptation into the national agenda through the Albay Declaration on Climate Change and the Manila Declaration in 2009. APSEMO was instrumental in a “zero casualty” in major disasters in 1995-2000.

These observations validate what Wong (2009) regards as the “human ingenuity” or the ability to self-organize in the face of uncertainty and disasters; that “individuals, families, and communities will find their own means and ways [to survive and] to strive for better future” and not wait for outside or external decisions. These experiences lend themselves into creating new paradigms in coping with uncertainties. They are very instructive because these strategies start with how communities perceived their risks and their own ways of addressing these.

In this Albay case, it is shown that strengthening adaptive capacity can achieve livelihood security and create resiliency to climate changes and disasters; it thus, can contribute to poverty reduction which can further strengthen adaptive capacity. Thus, poverty reduction decreases vulnerability. This virtuous cycle can, initially, be done in a platform where vulnerability assessments and adaptation strategies consider micro-

variations at local level and the active involvement of the community. But Uy exhorted that it is imperative that these local adaptation actions should be scaled up.

Three, another issue involved the two case studies conducted through the auspices of the Stockholm Environment Institute. They highlighted the socio-political constraints to implement policies on mangrove rehabilitation and restoration. This conservation strategy, which is increasingly being prescribed as an adaptation to coastal storms and other shocks, must contend with operating within environments characterized by ambiguities in policy transmission and of different stakeholder interests including conservation, livelihoods and economic development. The case studies in Tien Hai, Northen Vietnam (Powell, et al.) and Nakhon Si Thammarat, Thailand (Osbeck, et al.) argued that although conservation policies can complement and can have cross-purposes with development policies, implementing them can create discordance between policy actors (i.e., those recipients of policy interventions and those formulating policies and those implementing them). This observation is particularly shown whenever a policy is transmitted from the national level to local levels. Powell, et al., cited several reasons why discordance occurs: (1) poor coherence of a national policy prescription with that of guidelines to effect local implementation; (2) the lack of stakeholder participation in the policy development process; and (3) the absence of feedback mechanisms between the policy actors.

This problem generally results in non-compliance. But worse, some stakeholders could take advantage of the confusion, thus they resort to self-organizing to advance their agendas. This in turn, significantly influences policy outcomes that maybe inequitable or morally questionable in the long run (Osbeck, et al). In Pak Phanang Bay, Nakhon Sri Thammarat, in 1987, a cabinet resolution stopped the operation of shrimp farms in mangrove areas. This action allowed the Department of Coastal and Marine (the *policy formulation actor*) to promote mangrove rehabilitation based upon a conservation agenda that was also aimed at alleviating poverty among communities dependent on mangroves (Figure 10). But the local administration (*policy implementer*) pursued mangrove rehabilitation based on development that initiated eco-tourism and fishery activities instead. Such interpretation resulted in, among others, unclear land classification and very strict regulation prohibiting cutting or other uses of mangroves. This has badly affected the communities (*policy recipient*) and limited their capacity to pursue community-based management in mangrove areas.

Both case studies articulated complex institutional relationships governing the management of mangrove systems vis-à-vis a need to consider a shift in governance approach in rural development. They propose a multi-purpose approach (Osbeck, et al.) and a mechanism for co-governance, where governments are less dominant and allow stakeholders from market, civil society and state to share power (Powell, et al.). Both cases emphasized that mangroves are ecosystems (not mainly mangrove trees) and are situated in social contexts of diverse stakeholders with different perspectives and priorities. They further recommend that paradigms in mangrove rehabilitation (that can input into changes in rural development) must consider the following preconditions:

- adaptive capacity
- strategic planning process which facilitates multiple stakeholder perspectives; and
- an integrated feedback mechanism

SECURING THE OCEAN, SAVING THE CLIMATE, SAVING LIVES

Tough and uncertain times are ahead of us. We could be nearing a tipping point, as economic, environmental, and social and climate risks are stacked one on top of another, needing to be addressed immediately. Although the November 2009 EAS Congress came a month before the Copenhagen Climate Summit, in-between, several new climate stressors are being heralded: (1) the rate of decline of Arctic summer sea ice extent was 40% greater than what was forecasted, which alerted scientists to revise their estimates upwards (Copenhagen Diagnosis); (2) sea level rise is more likely between 100 cm to 144 cm, way above the forecasts made by IPCC of between 18 cm and 59 cm by 2100 (Hamilton, 2009); and (3) the oceans capacity to absorb CO_2 has started to diminish as much as 10% since 2000 which implies that more emissions will remain in the atmosphere (Khatiwala, et. al., 2009). These are alarming numbers but Miles (2009) is more emphatic when he wrote that:

> *"Additional stressors do not just mean additive impacts. They interact synergistically to produce outcomes that are different, qualitatively and quantitatively, from single factors acting alone. Nor do these outcomes necessarily progress in a linear fashion; instead, a multiplicity of stressors can suddenly create a critical threshold, or "tipping point," at which change can begin to happen much more rapidly or the entire system can shift into a different state."*

There are two calls to action. One, to refocus the lens of coastal and ocean governance within an integrated framework which must now include not only protecting biodiversity and ecological integrity, and sustaining livelihoods, but also of saving human lives — the whole gamut of issues in the concept of "securing the oceans." (Chua, et al., 2008). In the same token, this paradigm can also "save our climate."

Two, the time to act is now! Delay is not a good option as delay would cost more lives and result in more economic disasters.

Presentations

Chen, C.-T. A.. "Global change and human activities in the coastal zone: Implications for sustainable development in Monsoon Asia."

David, L., P. Aliño, M. Atrigenio, C. Villanoy, F. Siringan, W. Licuanan, J. Kho, E. Penaflor; R. Borja; K. Silvano; K. Cordero-Bailey, V. Ticzon; Ma. B. De Venecia; R. Maneja; S. Mamauag; O. Cabrera, M. Magno-Canto, E. Salamante; I. Alabia; E. Magdaong ; Y. Sta. Maria, L. Soria, R. Ramos, M. Samson, V. C. Horigue. "Climate Change adaptation in the Philippines."

Goh, B.. "Vulnerability Assessment of Coastal Areas in South East Asia."

Ho, J. and J. Ng. "The Arctic Meltdown and its Implications on Shipping."

Kim, S. and Loh-Lee Low. **"**Emerging issues of East Asian fisheries production in conjunction with changes in climate and social systems in the 21st century."

Kitagawa, H. “Shipping and Climate Change in East Asia: The impacts of the opening of the North-East Passage.”

Lee, S.-H., J.-H. Hwang, S.-W. Park and K-I. Choi. “National climate change adaptations: Initiative for climate change adaptation at the coastal and ocean areas in Korea.”

Osbeck, M., N. Powell and S. Boromthanarat. **“**Coastal change and stakeholders’ realities: A case study from Nakhon Si Thammarat Thailand.”

Peñafiel, S. “Global change and coastal zone management issues for the Asia-Pacific region: APN’ response in addressing these threats.”

Perez, R. “Mainstreaming resilience building and climate change adaptation to the national policy and planning in the Philippines.”

Powell, N., M. Osbeck and S.B. Tam. **“**The articulation of co-governance: stakeholder agency in coastal development in Vietnam.”

Uy, N. “Local climate change adaptations: (Linking poverty reduction, disaster risk reduction and climate change adaptation in coastal areas: The case of Albay, Philippines.”

Yu, W. “Monsoon Climate over South East Asia Region and Impacts on Ecosystem.”

Panelists

Hwang, J.-h. Dongguk University, RO Korea

Linden, O. World Maritime University

Samonte-Tan, G. Conservation International

Weeratunge, N. WorldFish Center

References

Allison, E.H., Perry, A.L., Badjeck, M.C., Adger, W.N., Brown, K., Conway, D., Hall, A.S., Pilling, G.M., Reynolds, J.D., Andrew, N.L., Dulvy, N.K., 2009. Vulnerability of national economies to the impacts of climate change on fisheries. Fish and Fisheries 10: 173-196.

Brander, L.M., Van Beukering., P., Cesar, H.S.J. 2007. The recreational value of coral reefs: A meta-analysis. *Ecological Economics* 63: 209-218.

Chua, T.-E,, D. Bonga and S.R. Bernad. 2008. “The evolving partnership model in coastal and ocean governance in the seas of East Asian Region — PEMSEA’s role,” pp. 597-628. In *Securing the oceans: Essays on ocean governance-global and regional perspectives.* Edited by Chua, T.-E., G. Kullenberg and D. Bonga. Global Environment Facility/United Nations Development Programme/International Maritime

Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and The Nippon Foundation, Quezon City, Philippines. 770 pp.

Dulvy, N.K, Allison, E.H.. A place at the table? Nature reports vol. 3: JUNE 2009

Gilman, E., and others. 2006. Pacific Island Mangroves in a Changing Climate and Rising Sea. United Nations Environment Programme. Regional Seas Reports and Studies No. 179.

Kennedy, J. A.J. Hanson, and J. Mathias. 2008. "Ocean governance in the Arctic: a Canadian Perspective," pp. 629-667. In *Securing the oceans: Essays on ocean governance-global and regional perspectives.* Edited by Chua, T.-E., G. Kullenberg and D. Bonga. Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and The Nippon Foundation, Quezon City, Philippines. 770 pp.

Laffoley ed. 2009. The Management of Natural Coastal Carbon Sinks, IUCN.

Lebel, L. A. Snidvongs, C-T.A. Chen and R. Daniel (Editors). 2009. Critical states: Environmental challenges to development in Monsoon Southeast Asia. Strategic Information and Research Centre, Kuala Lumpur.

Miles, E.L. 2009. On the increasing vulnerability of the world ocean to multiple stresses. *Annual Review of Environment and Resources* 34:18.1-15.25

Mimura, N. and H. Yokoki. 2008. "Sea-level changes and vulnerability of the coastal zone." In *Changes in the human-monsoon system of East Asia in the context of global change*. Monsoon Asia Integrated Regional Study on Global Change - Vol.1. Edited by Congbin Fu, J.R. Freney and J.W. Stewart. World Scientific Publishing Co. Pte.

Seto, K., D. Ojima, Q. Song and A. Mosier. 2008. "Human drivers of change in the East Asian Monsoon System." In *Changes in the human-monsoon system of East Asia in the context of global change*. Monsoon Asia Integrated Regional Study on Global Change-Vol.1. Edited by Congbin Fu, J.R. Freney and J.W. Stewart. World Scientific Publishing Co. Pte.

Tay, L.H., J.-C. Sainlos, M. Palomares, C. Morris, M. Jacobsson, A. Datta, I. Oliounine, J. Paw and D. Bonga. 2006. "Being safe is being smart." *Tropical Coasts* 13(2):22-37.

Wong, P.P. 2009. "Rethinking post-tsunami integrated coastal management for Asia-Pacific." *Ocean and Coastal Management* 52 (7):405-410.

Wu, G., Q. Zhang. A. Duan and J. Mao. 2008. "Thermal-dynamical effects of the Tibetan Plateau on the East Asian Monsoon." In *Changes in the human-monsoon system of East Asia in the context of global change.* Monsoon Asia Integrated Regional Study on Global Change-Vol.1. Edited by Congbin Fu, J.R. Freney and J.W. Stewart. World Scientific Publishing Co. Pte.