

tropical coasts

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Coastal Resources: Productivity and Impacts on Food Security



**Biodiversity and food security:
Understanding the threat**

Mangroves in a changing climate

**Tropical coastal ecosystems in a high
carbon dioxide world**

Aquaculture and the poor

Facing the Consequences

“Buy a man a fish and you will feed him for a day...teach a man to fish and you will feed him for a lifetime” (Chinese Proverb).

Whoever first coined this old adage would have second thoughts about the wisdom of such a message today. The philosophy probably made perfect sense in a world where men were few and the oceans were abundant with fish; where you were free to hunt and plant your crops. But times are changing and this philosophy of self dependence and freedom to fish and harvest may not work anymore. It has always been wise for men to exploit the land and seas and be independent, but something has happened to change all that.

The security of access to food of communities, nations and the world is jeopardized by the unmitigated and unprecedented degradation of the environment. And the culprits are us — our numbers are increasing beyond the capacity of our planet’s ability to match our consumption patterns, we overexploit our vast resources, foul our air, and contaminate our water and sources of food. Adding to these problems is the impact of climate change, oil prices and growing demands for alternative sources of energy, and the global economic crisis, which are being felt today. Complex, interconnected and cumulative, these issues have resulted in soaring prices in basic commodities, which further worsen the already existing problem of insufficient food access to poor populations in the world. There are more than 840 million people in the world who are suffering from chronic hunger. In the East Asian Seas (EAS) region alone, the share of hungry population is at 28 percent — people who do not have access to sufficient, safe, and nutritious food for an active and healthy life. Most of these poor and hungry people are located in the coastal areas of the region.

Rodrigo U. Fuentes, Executive Director of the ASEAN Center for Biodiversity (ACB) expresses the concern emphatically (page 30, this Issue) when he states, “Ultimately, the loss of biodiversity is one of the greatest threats that we face. It is in the area of food security, perhaps more than any other, that biodiversity’s value is most clear. When we destroy biodiversity, we destroy our source of food.”

Public attention on the pressing problem of global food security has, in the past, mostly focused on the role of agricultural food production. It is often forgotten that the world’s oceans are one of the largest food reserves on the planet. The EAS region is home to 30 percent of the world’s coral reefs and mangroves and considered as the world’s center for tropical marine biodiversity. These serve as the major resource for more than 1.5 billion people in the region of whom live within 100 km from the coastline. The region accounts for about 40 percent of the world fish catch and 84 percent of the world aquaculture production.

But these natural coastal and marine resources are under threat. In the ASEAN region, for example, 80 percent of the coral reefs are at risk and if losses and destruction are not abated, the remaining could disappear in the next 20 to 40 years. Similarly, 40 percent of the mangroves in the world can be found in Asia, but there are high losses, about 60 percent, in diversity (D.J. Macintosh and M.M. Epps, page 6). Losses in these habitats not only affect ecological diversity and food security (R. A. Inciong, page 4), but greatly endangers the livelihood of fishers in the region. About 520 million people are

directly or indirectly dependent on the fisheries and aquaculture sector for employment, that’s nearly eight percent of the world population (see Back Cover, this Issue). Approximately 86 percent of these people live in Asia.

This issue of *Tropical Coasts* is a joint effort of PEMSEA and the ASEAN Centre for Biodiversity. In this issue, we take a look at the linkages between biodiversity and food security, and some of the issues and activities that are being pursued in the region and elsewhere.

Michael Kendall (Plymouth Marine Laboratory) explores areas of research that require greater international cooperation to overcome the threats posed to the ocean and its resources in a high carbon dioxide world. While Jin Hwan Hwang (Dongguk University) calls attention to the changing perspectives regarding climate change adaptation measures for food security, and the need to improve the balance between food productivity (direct impact) and food supply (virtual impact).

G. Robin South (International Ocean Institute - OceanLearn Programme) shares the experience in the Pacific Islands Region where IOI has been conducting modular training courses on the management of fisheries, using the FAO Code of Conduct for Responsible Fisheries as a vehicle to review existing arrangements and options for the management of oceanic and coastal fisheries.

Donald J. Macintosh (Mangroves for the Future (MFF) Secretariat) and Minna M. Epps (IUCN Asia Regional Office) relate the efforts of MFF to build knowledge, strengthen empowerment and enhance governance to address the current and future threats of natural disasters, and to conserve and restore ecosystems. Natasja Sheriff (WorldFish Center), David C. Little (University of Stirling), and Kwanta Tantikamton (Rajamangala Institute of Technology) outline policy considerations regarding aquaculture and viable livelihood alternatives for the poor, based on a research project conducted in Southern Thailand.

Three on-the-ground examples of improved governance of coastal and marine resources are also included in this issue. Darren Raeburn and Katie Chalk (World Vision) relate the changes that have occurred in Tabogan, Philippines, as a consequence of the development a Coastal Resources Management Plan (CRMP), and the implementation of a marine sanctuary. In Cavite, Philippines, Anabelle L. Cayabyab and Evelyn M. Reyes (Provincial Government of Cavite) demonstrate how ICM has strengthened the governance of marine and coastal resources and resulted in benefits to low-income, less privileged fisherfolks and fish farmers. Vitaya Khunplome (Provincial Administrative Organization of Chonburi, Thailand) and Nisakorn Wiwekwin (Sriracha Municipality, Chonburi Province) similarly explain scaling up of ICM as a sustainable development strategy in Chonburi, which is beginning to show results in terms of increased harvest of crabs and other marine species, enhanced mangrove coverage and restoration of seagrass beds.

In sum, this issue of *Tropical Coasts* emphasizes that the “teaching a man to fish” proverb is still relevant. What has changed over time is the context of the philosophy, where the emphasis has shifted from fishing to teaching, learning and living with the indisputable connection between biodiversity and food security.



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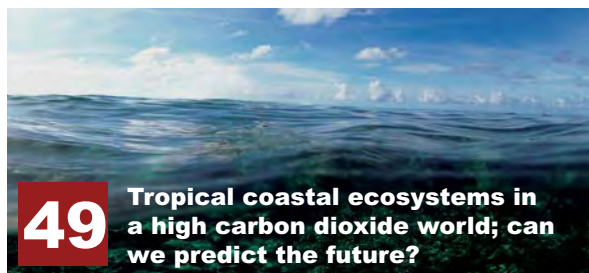
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By Rolando A. Inciong, Head Public Affairs, ASEAN Centre for Biodiversity

Biodiversity and food security: understanding the threat

There is a growing evidence of the narrowing biological diversity base for food production from land and marine sources in Southeast Asia and in other parts of the world.

The Food and Agriculture Organization (FAO) reported that the pressure to produce food to meet the world's increasing demand has intensified over the past 100 years. As a result, the natural functions of ecosystems and the variability of genes, species, and populations is now severely affected. Over the millennium, humans have relied on over 10,000 various plants species for food. Now, there are barely 150 species under cultivation. Even livestock diversity, according to FAO, is likewise significantly under threat. The first global assessment of livestock biodiversity indicated that 643 breeds

are at risk of extinction, 45 of which are in Asia.

Deforestation, habitat destruction, overfishing and destructive fishing practices, coral reefs degradation, large-scale mining, poverty traps, inappropriate agricultural policies, industrialization, and pollution are the culprits that cause massive biodiversity loss. Biodiversity loss is also caused by emerging influences, including liberalization and globalization of production, urbanization, invasive alien species, climate change, and shifting consumption patterns. All these contribute to the reduction of food sources.

The Association of Southeast Asian Nations (ASEAN) region has one-third or 284,000 km² of all coral reefs, which are

among the most diverse in the world. But 80 percent of the region's coral reefs are at risk. Sedimentation and pollution from upland and coastal developments threaten coral reefs. Destructive fishing methods destroy marine ecosystems resulting in diminishing breeding grounds for fish and other aquatic life.

The proliferation of marine protected areas (MPAs) in the region shows a growing consciousness on the need to deal with the increasing threats leading to the degradation of the coastal and marine resources of Southeast Asia and to food security. A marine protected area is any area of inter-tidal or sub-tidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by legislation to protect part or all enclosed environments (IUCN, 1988).



Photo by Leslie Jose

In 2002, UP-MSI, et al., conducted a review of the marine protected areas of Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Singapore, the Philippines, Thailand, and Vietnam focusing on the sub-tidal areas and inter-tidal areas essential for marine species, such as coral reefs and turtle nesting beaches. Results indicated that environmental degradation is causing the most impacts on the marine environment and MPAs in almost all countries. The array and intensity of threats vary from site to site. For example, sites in Peninsular Malaysia suffer much more from development than those in Sabah where coral mining is a bigger problem. The amount, completeness and accuracy of the data on MPAs vary among countries, depending on the amount of research and government interest in the subject. Protected area data held by different Southeast Asian government agencies are not always consistent. Some of the MPAs lack information on their exact location and most do not have a defined boundary or size, making quantitative coverage comparisons impossible.

During the 2nd ASEAN Heritage Parks Conference in Sabah, Malaysia, Dr. Chou Loke Ming of the National University of Singapore reported that out of the total number of MPAs in the region, only 10 percent are effectively managed; 88 percent of the coral reefs are under threat, the region's MPAs cover only eight percent of its reefs; and only one percent within MPAs are effectively managed. The identified gaps include management effectiveness including transboundary management; effective management network; prioritization and identification of sites of global/regional significance to preserve biodiversity; and coordination, including information resources sharing, and capacity building.

The ASEAN Centre for Biodiversity (ACB) is working to address these gaps, and in particular to increase the number of

marine protected areas and to ensure that they are designed and located in the best places to conserve biodiversity and ensure food security.

ACB is an intergovernmental regional centre of excellence that facilitates cooperation among the members of ASEAN, and with relevant national governments, regional and international organizations on the conservation and sustainable use of biological diversity, and the fair and equitable sharing of benefits arising from the use of such biodiversity.

On 4-7 November 2008, ACB convened in Bali, Indonesia, an experts meeting on marine gap analysis for the Philippines, Malaysia, Indonesia, and Vietnam. The meeting served as initial step for ASEAN Member States to enhance understanding and agree on the process of marine protected area gap analysis. Experts identified representation, ecological and management gaps of marine protected areas, and established regional and national action points for marine protected area gap analyses. These are very important in conserving coastal and marine biodiversity which could contribute to food security (Fuentes, 2008).

Today's challenge is how to increase agricultural and fisheries yield while conserving biodiversity ecosystems. We have a menu of available options for sustainable food production which involves mixed farming systems, integrated pest management, crop rotation, organic agriculture, recycling of crop and animal wastes, regulated fishing, and other mechanisms.

However, it should be pointed out that there is a very limited adoption rate of these options. The international regime is unable to touch the heart of the issues. The heart of the issues is within us. We have to examine our way of consuming resources, and know that in

our little ways, we can do a lot to curb biodiversity and food insecurity. There is a need to develop and expand the knowledge base from the scientific arena, and all practical means of using biodiversity resources. We also have to recognize the importance of building alliances to address the issue of food security.

Understanding the threat is good, but not good enough. If we acknowledge that biodiversity loss in both land and marine resources has implications on food security, and recognize that everyone is entitled to access to food, as philosopher Onora O'Neill has said, let us start to define who will do what, for whom and when.

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By Donald J. Macintosh, Coordinator, Mangroves for the Future (MFF) Secretariat
Minna M. Epps, Regional Communications Officer, IUCN Asia Regional Office

Mangroves in a changing climate



Mangroves at Ranong, Thailand. Mangroves protect against erosion, storms and sea level rise.

INTRODUCTION

Coastal areas have been centers of human settlement and economic activities for thousands of years due to their easy accessibility from the sea, their remarkable biological productivity, and the wide array of goods and services that they provide. Today, many of the world's largest cities occupy coastal locations; ports, shipping and other major industries are also concentrated here; while beaches, coral reefs and islands have become a magnet for tourism. Coastal ecosystems are also our best allies in the face of climate change. Coastal ecosystems, especially mangrove forests, act as buffers against extreme weather conditions and

natural disasters, thereby reducing the vulnerability of coastal communities and investments. The important role of healthy mangrove forests gained recognition after the December 2004 Tsunami where areas with extensive mangrove coverage suffered less damage compared to areas which had been cleared for other forms of land use. Despite the global awakening to the importance of mangroves and their interdependence with other coastal ecosystems such as coral reefs and seagrasses, many coastal areas and resources remain under severe pressure. High population growth, compounded by migration into coastal areas, overfishing, habitat conversion and poor development planning, have led to increasing pressure on the remaining

resources and the vital ecosystem processes that sustain them.

Mangroves are one of the most productive ecosystems worldwide, which millions of people in the Indian Ocean still depend upon. In addition to timber, mangroves provide a wide range of goods and services, and even cultural attributes. These include valuable fishery and aquaculture resources, wildlife, medicines, gums, tannins, honey and fruits (Saenger, 2002). Mangroves also protect shorelines from erosion and flooding, and provide storm protection; they are also efficient in carbon sequestration and nutrient retention. Thus, mangroves are often seen as the backbone of tropical ocean coastlines, yet many

mangrove ecosystems are under severe threat because of climate and human-induced changes, the latter being mainly attributable to increasing population, coastal infrastructure development and rising demand for fishery products.

There are more than 70 mangrove and associate species in the world. Approximately 40 percent of all mangroves occur in Asia (and Australia) (Spalding, et. al, 1997). Thousands of hectares of mangrove forests have been cleared for shrimp farming and other forms of coastal development across the region. In several Asian countries mangrove loss has exceeded 60 percent, on average, in recent decades (Macintosh and Ashton, 2002), while the total area has decreased to less than 15 million ha worldwide from an estimated 32 million ha originally. Globally, mangroves provide more than 10 percent of the essential dissolved organic carbon that is supplied to the ocean from land (Dittmar, et. al., 2006), yet less than one percent of the world's mangroves are adequately protected. Seagrasses, which provide indispensable nursery grounds for many fish species and feeding habitats for turtles and dugongs, have also declined at an alarming rate and even disappeared in some parts of the Indian Ocean. A Reefs at Risk study in 2002 found that 88 percent of coral reefs in Southeast Asia faced medium to high threats from human impacts (Wilkinson, 2002). Climate change is a factor that further threatens these fragile ecosystems and is exacerbating the existing environmental problems caused by human impacts. Rising sea temperature is considered to be the largest threat to coral reefs today. According to the CORDIO 2008 Status Report released by the Global Coral Reef



Top to Bottom: Mudskipper caught in the mangroves of the Mekong Delta; white shrimp harvested by cast net from mangrove channels in Java; mud crab seed are caught in mangroves throughout Asia for rearing in aquaculture ponds.

Monitoring Network, 19 percent of the world's coral reefs have already been lost and the remaining may disappear within 20-40 years if current trends in carbon dioxide emissions continue (Obura, et al., 2008). However, coastal ecosystems would have a better chance of survival if other stress factors related to human activity were minimized.

Climate Change Effects on Coastal Communities

The effects of climate change, as manifested by sea level and sea temperature rise, greater climatic variability, increased frequency and

magnitude of tropical storms and other extreme events will have negative impacts on both ecosystems (coral bleaching, saltwater intrusion, flooding, erosion) and human well-being (loss and/or reduced productivity of goods and services provided by ecosystems). Reduced protective and regulatory services of coastal ecosystems will leave coastal communities more vulnerable to climate-related disasters. Further loss, or degradation, of mangroves will further jeopardize the livelihoods and food security of marginalized coastal communities with already limited resilience or adaptive capacity. Low-lying coastal areas, such as the Mekong Delta region of Vietnam, have already suffered from more frequent and severe climatic extremes between flood and drought conditions, with serious consequences for agriculture, aquaculture and even salt production. Climate change impacts are already being witnessed across the region.

The Role of Mangroves in Climate Change Adaptation and Mitigation

Mangroves are nature's first line of defence against climate change along the land-sea margin of many of the world's most populated countries, where people now exist at very high densities within low-lying and vulnerable coastal zones (e.g., Bangladesh, India, Indonesia and Vietnam). Mangroves produce a vast array of goods and services, which millions of already marginalized communities depend. These goods and services provide not only economic benefits, but also food security and other environmental support. More specifically in relation to climate change, mangroves: (a) eliminate or reduce coastal soil erosion by trapping

sediments, thereby promoting land conservation as a vital contribution against sea level rise; and (b) hold back the sea and reduce wave forces with their extensive and dense above ground roots by an estimated 70-90 percent on average, or by 20 percent per 100 m in the case of mangrove green belts in Vietnam, which were planted for coastal protection purposes (Mazda et al., 1997). Mangrove forests moderate climate extremes by providing shade and increased air-humidity, while also reducing wind velocity and soil water evaporation. Mangrove ecosystems nurture coastal fish and shellfish stocks by providing rich feeding and nursery grounds, thereby contributing to the livelihood and food security of millions of coastal dwellers around the region. An early fishery-coastal habitat study in Indonesia, for example, revealed a direct correlation between the area of

mangroves adjacent to coastal fishing grounds and the yield of shrimp caught by fishers (Martosubroto and Naamin, 1977).

Even today, shrimp and other mangrove-dependent species, such as mudskippers (*Pseudapocryptes*) and mud crabs (*Scylla*) support the subsistence needs of millions of poor aquatic collectors, who include some of the most vulnerable people in Asia. Moreover, many of these mangrove products are sold to pond owners, who rear them commercially as part of the very important coastal aquaculture industry flourishing throughout the region. Thus, mangroves are not only a vital first line of defence against sea level rise and storms, they are also fundamental to food security and to sustaining livelihoods.

Mangroves and the global carbon cycle

Mangroves are proving to play a vital role in the global carbon cycle. Despite covering less than 0.1 percent of the global land surface, they nonetheless account for 10 percent of the dissolved organic carbon (DOC) that flows from land to the ocean (Dittmar, et al., 2006). Researchers at the Florida State University have noted that the organic matter that is dissolved in the world oceans contains a similar amount of carbon as that stored in the skies as atmospheric carbon dioxide (Dittmar, et al., 2006). Dissolved organic matter is an important player in the global carbon cycle that regulates atmospheric carbon dioxide and climate.

There is also growing awareness, backed by scientific studies, showing the value of mangroves for carbon sequestration. Their aboveground biomass can contribute 100-200 tonnes C per

hectare, with annual productivity in the range 9-12 t C/ha (Ong, 1993). The belowground accumulation of carbon by the root systems of mangroves is harder to estimate, but could approach 700 t C/m depth of soil/peat per hectare, with an estimated rate of carbon sequestration of 1.5 t C/ha/year (Ong, 1993).

Mangrove foliage production results in an annual rate of leaf litter fall in the order of one to several tonnes per hectare, much of which leaches into coastal seas, or becomes converted into particulate detritus as a key food source for fish, shrimp and other aquatic consumers that make up mangrove-dependent coastal food webs. However, leaf-burying (by crabs), other forms of litter build up, and soil surface carbon accumulation can be significant under certain local conditions, especially where tidal water flows are impeded. Moreover, as mangrove forests have declined in extent, or become increasingly isolated from the sea by dyke and canal-building, ever smaller quantities of mangrove-derived detritus have become available for the formation and export of organic matter offshore. Researchers speculate that the rapid decline in mangrove cover threatens the delicate ecological balance in coastal waters and may eventually shut off the important link between land and ocean along previously mangrove-dominated coastlines, with potentially adverse consequences on atmospheric composition and climate stability.

One area of particular concern is that climate change may lead to more frequent and severe storm events, especially in cyclone (= typhoon/hurricane) prone areas of the tropics. Severe storms have the potential to cause significant mangrove damage and even mass tree mortality which, coupled with sediment removal and related hydrological changes, could threaten the ability of mangroves to recover (Gilman, et al., 2008). In Honduras,



A subsistence fisher in the Mekong Delta.

for example, mass mortality of mangroves caused by Hurricane Mitch also led to the collapse of the peat soil layer, which in turn reduced the mangroves' rate of recovery (Cahoon, et al., 2003).

Coping with Climate Change

Mangrove Clearance and Sea level rise — The case of Demak, Central Java, Indonesia

The Demak District of Central Java illustrates the damaging consequences of mangrove clearance in relation to sea level rise. The north coast of central Java used to feature extensive mangrove forests until rapid land use changes resulted in the mangroves being cleared for shrimp farming (*tambak*) in the 1970s. With little or no mangroves to sustain the topography and productivity of this coastline, a combination of land subsidence and sea level rise has resulted in an average increase of 50 cm in mean sea level over the past 12 years. Villages that used to be several kilometers from the sea are now flooded at high tide and many of the *tambak* can no longer be operated because the pond dykes are too low to prevent tidal inundation (see *aerial photograph*).

The local government has responded to this rapid environmental change by relocating more than 200 households. However, most families in the area did not want to relocate since their main livelihoods are based on *tambak* fish and shrimp farming, or fishing. A relocation programme would have to be coupled with training and other support to help generate alternative income-generating opportunities. Stilt houses have also been built as part of a government initiative in the worst-affected areas as a means of adapting to a changing environment. This appears



Tambak (shrimp farms) submerged in seawater in Demak District, Central Java.

to be an adaptation response welcomed by the local communities, as they are able to continue their traditional *tambak* and fishery livelihoods.

The *tambak* owners also need financial and technical assistance to enable them to raise the height of the pond dykes and to introduce new technologies to farm alternative and higher value species. The communities are well aware of the need to replant mangroves, but feel that they lack the technical skills to select the most suitable species and locations for mangrove rehabilitation. The *tambak* operators have noticed that different species of fish and shrimp now enter the canals and the *tambak*, such as white shrimp (*Penaeus indicus*), which they attribute to the rising sea level. There is an overall consensus that their livelihoods from fishing and aquaculture are much poorer and less secure than before. The drastic decline in *tambak* production has resulted in a shift from farming to capture fisheries due to the lack of other employment opportunities, which is

further increasing pressure on coastal resources.

Climate change mitigation – The case of Vietnam

Vietnam is a low-lying country and one of the countries most at risk from climate change, especially sea level rise. Following a massive typhoon in November 1997 (Typhoon Linda), families living in the mangrove areas in the lower Mekong Delta were evacuated and with Government and international support, a 500-km long protection belt of mangroves was re-established. People were resettled in better houses behind the safety of a sea dyke along the back of the new mangrove protection zone. They were given small plots of land and helped to learn how to develop their livelihoods based on farming and aquaculture. The mangroves also helped to enrich the coastal fisheries where shrimp, crab and fish culture are thriving today. Still there are many risks from climate change due to the extremely low

land level in the delta and the huge population it supports. The climate is becoming more extreme with several severe droughts in recent years, creating water shortages and extreme salinities that threaten agricultural and aquacultural production. In response, the Government of Vietnam is carrying out large-scale mangrove rehabilitation, sea-dyke upgrading and other investments for climate change mitigation. Mangroves for the Future (MFF) is helping to promote positive examples like Vietnam — to show the world why investing in mangroves and other coastal ecosystems is so important and cost-effective, and how community groups and governments can take action to prevent further losses.

Mangroves for the Future (MFF)

MFF is a regional multi-partner initiative to promote investment in coastal ecosystems. MFF is partnership-based, people-focused and policy-relevant, and climate change is of direct relevance. The MFF programmes of work reflect this through its adoption of climate change considerations as a cross-cutting programme of work. MFF is also adopting a new approach by moving from a reactive response to a more proactive one. The aim is to address long-term sustainable coastal management needs and develop community resilience, including building awareness and capacity for improved food and livelihood security, and to ensure that environmental considerations are included in disaster preparedness and climate change adaptation responses.

Methods for integrating climate change considerations into all MFF activities have been developed based on existing climate proofing tools. MFF also conducts regional and in-country training courses on the use of practical climate proofing tools and methods applicable to the field/

project level. Incorporating climate change adaptation considerations and enhancing adaptive capacity of coastal communities is crucial to ensure the long-term sustainability of coastal development projects.

In recognition of the importance of mangroves and other coastal ecosystems, MFF is encouraging the countries around the Indian Ocean region to increase their investment in these vital coastal ecosystems and to share knowledge and experiences about the best ways to cope with climate change along their vast coastlines. A recent Scientific and Technical Symposium on Sustainable

Mangrove Ecosystem Management was held in Ranong, Thailand, which brought together close to 200 mangrove experts/scientists and local community representatives engaged in mangrove management. The aim was not only to illustrate the value of local and traditional knowledge and how it can help shape sustainable mangrove forests, but also to share experiences and lessons learned in post-tsunami mangrove reconstruction efforts across the region, as well as approaches for understanding and embedding stakeholder interests more effectively in future mangrove rehabilitation initiatives.

Mangroves for the Future Initiative (MFF)

MFF builds on a history of coastal management interventions before and after the 2004 tsunami, especially the call to continue the momentum and partnerships generated by the immediate post-tsunami response. It focuses on the countries worst-affected by the tsunami with projects in India, Indonesia, Maldives, Seychelles, Sri Lanka, and Thailand. MFF also includes other countries of the region that face similar issues, with an overall aim to promote an integrated ocean wide approach to coastal zone management.

Its long-term management strategy is based on identified needs and priorities that emerged from extensive consultations with over 200 individuals and 160 institutions involved in coastal management in the region.

The initiative uses mangroves as a flagship ecosystem in recognition of the important role mangroves played in reducing the damage caused by the tsunami, and the implications on livelihoods because of mangrove forest destruction. But MFF is inclusive of all coastal ecosystems, including coral reefs, estuaries, lagoons, sandy beaches, seagrasses and wetlands.

MFF is based on a vision of a healthier, more prosperous and secure future for all sections of coastal populations in Indian Ocean countries. It is a unique partnership-led initiative working in four key areas of influence: regional cooperation, national programme support, private sector engagement and community action.

MFF undertakes collective actions to build knowledge, strengthen empowerment, and enhance governance through 15 broad programmes of work to address the current and future threats, and to conserve and restore coastal ecosystems. These are implemented through a series of on-the-ground projects, through small and large grant modalities.

MFF seeks more effective and inclusive institutions, policies and mechanisms for cooperation at national and regional levels by prioritizing coastal ecosystem management across national development agendas, policies and budgets.

Mangroves in the future

MFF and its partners are seeking to develop and test climate proofing tools at project sites in the region. It will further identify mechanisms for REDD (Reducing Emissions from Deforestation and Ecosystem Degradation), based on an ecosystem approach that enhances natural sequestration and storage of carbon in existing mangrove forests and restored degraded mangroves areas. The effectiveness of REDD activities will ultimately depend on the success of its contribution to the development needs of communities that rely on mangrove products. Considering the large number of people in coastal areas that climate change impacts could displace, MFF would seek to conduct activities to: mobilize local communities and governments to undertake joint actions for sustainable coastal management; ensure food security through sound ecosystem management; build knowledge to better understand the links between livelihoods and climate systems; and increase adaptive capacity

to meet the long-term development needs of coastal communities, while securing their livelihoods against climate change impacts and helping coastal communities prepare for potential climate-related disasters.

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A mangrove protection zone, or "green belt" now extends around the Lower Mekong Delta, Vietnam.

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Aquaculture and the poor: Culturing high-value fish can be a viable livelihood option

Introduction

When the role of aquaculture in food production is considered in combination with the importance of fish in the diets of many of the world's poorest nations, it is clearly central to meeting the Millennium Development Goal of halving poverty and hunger by 2015. In addition to providing food, the benefits of aquaculture in terms of employment and income are widely cited. However, the ability of the poorest to engage in aquaculture or derive benefits from it may be questioned. The poor are often excluded from aquaculture by the lack of land or access to financing, water or seed fish.

Extensive fish culture systems are generally credited with poverty mitigation. As extensive systems require few inputs and produce cheap fish for the household to consume or sell in local markets, they are considered suitable for poor households. In contrast, rearing high-value marine fish in cages is an intensive form of aquaculture that produces fish for export and is seen as an unlikely option for the poor. However, data from a case study of grouper aquaculture in southern Thailand show that, under certain

conditions, culturing high-value fish has the potential to generate substantial benefits for poor households.

Background

Thailand's maritime provinces have cultured grouper and other high-value marine finfish for three decades, driven by the live reef fish trade (LRFT). Keeping fish alive until minutes before cooking them has been popular for centuries in Chinese communities, with live fish locally supplied until recently. A preferred species was red grouper (*Epinephalus akaara*) until overfishing of adults and later fingerlings for culture in Hong Kong waters severely depleted local stocks. The international LRFT began in the 1960s to supply fish markets in Hong Kong, and it has expanded rapidly since the early 1990s. Thailand has become an important contributor to the LRFT, with most green grouper (*E. coioides*) sourced from Thai mariculture. In 1997, over half of Hong Kong's imports of *E. bleekeri* and *E. aerolatus* were also from Thai mariculture (Lau and Parry-Jones, 1999).

The development and expansion of the LRFT has raised concerns

regarding impacts on reef fisheries and the broader coastal environment. Of particular concern are destructive fishing practices, including the use of cyanide and explosives. In response to these concerns, culturing grouper has been promoted as an alternative livelihood option for coastal fishers (Haylor, et al., 2003; and Pomeroy, et al., 2006). However, little is known about the socioeconomic context of aquaculture in coastal communities or the potential of grouper culture as an alternative livelihood option. This



paper presents the findings of a study that addressed these questions.

Grouper aquaculture

Cultured grouper are fish of the family Serranidae, subfamily Epinephelinae, variously called grouper, coral trout, rock cod and gag. Widely distributed as 159 species in the tropics and subtropics (Heemstra and Randall, 1993), grouper is economically valuable in sport and artisanal fisheries throughout their distribution (Seng, 1998). Grouper culture is largely confined to Asia. In Thailand, production is dominated by small-scale producers, but there is interest in developing larger, offshore systems (Kongkeo and Phillips, 2002). Culture is predominantly in cages and, to a lesser extent, in ponds and net pens. As hatchery production of grouper fry is sporadic, with survival of grouper juveniles to 2.2 cm at less than five percent (Marte, 2003), most grouper farmers depend on seed fish from the wild, either caught by the farmer or purchased from a fisher or fish trader.

Study methodology

A study carried out in three phases



Little grouper (E. coioides).



Fish cages

in southern Thailand over 15 months between March 2000 and October 2001 had as its principal objective: understanding grouper culture in the livelihood strategies of coastal fishers and its potential as an alternative option for coastal fishers engaged in destructive practices. An initial survey was carried out in six provinces of southern Thailand, from which two provinces, Trang and Satun, were selected for more detailed analysis, followed by case studies in three communities.

The findings presented here focus on the extent to which poor households are able to benefit from culturing high-value fish like grouper and the necessary conditions for success. Wealth ranking within communities generated an understanding of how members defined wealth and allowed individual households to be assigned to a wealth category. Key informants in each of the three case study villages defined household wealth similarly, with a key criterion being types of income-generating activities, as these determined households' ability to save money or build up assets. Households engaged in fish trade or who owned a rubber plantation, for example, were considered wealthy, as these activities required large investments. Fishing

did not necessarily define the poorest households, but the types of fishing in which a household was engaged and the gear used were indicative of household wealth. Small-scale fishing was generally an activity undertaken by middle-to-lower wealth groups.

Results

Grouper culture — An activity for a wealthy minority?

Initial surveys indicated that grouper culture was primarily in the hands of wealthier members of rural communities. The high initial investment cost, estimated at 20,000 Thai baht (US\$460) for two cages, was reported as a principal constraint to uptake. Once grouper farms are established, maintaining production depended on the availability of seed fish. Although purchasing seed was beyond the means of most households, the second phase of the study found that poor households need not be excluded from grouper culture (Sheriff, 2004 and Sheriff, et al., 2008). Research carried out in Trang and Satun provinces revealed that the uptake of grouper culture varied greatly among communities. The number of households practicing cage culture of grouper or other high-value

species such as seabass or red snapper averaged 12.5 percent in the 27 villages surveyed. The adoption of fish culture — and specifically of grouper culture — was not confined to any wealth category but occurred in the livelihood portfolios of all wealth groups and was equally prevalent among the wealthiest and poorest households (Figure 1). How was it possible for poorer households to establish and maintain grouper culture?

Institutional dimensions and access to finance

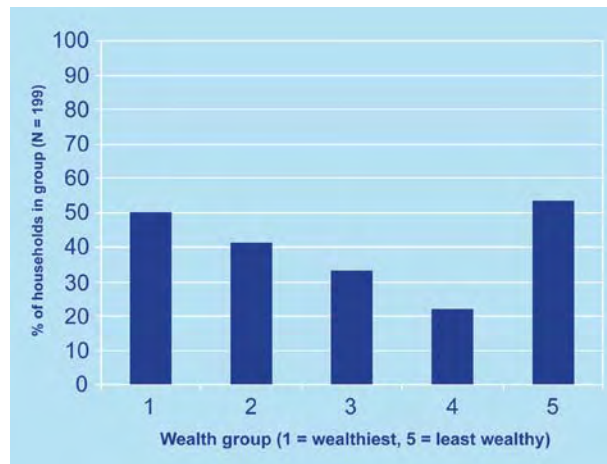
Lack of financing was among the most frequently reported constraints to the uptake of grouper aquaculture throughout southern Thailand. Yet the residents of one village in Satun Province, where a remarkable 69 percent of households cultured grouper, were able to overcome this constraint regardless of wealth group. This can be largely attributed to the involvement of external organizations, particularly the Department of Fisheries (DOF), which helped fishers in coastal villages to adopt fish culture or other alternative activities, principally to curtail the use of destructive fishing gears. Selected villages were given materials sufficient to allow 20 to 30 families to construct two cages. Extension officers from DOF then showed the new farmers how to build cages, nurse seed fish, grade fish and recognize disease.

By providing all the materials necessary for cage construction, the project allowed poor households to overcome this biggest hurdle to entry. DOF provided seabass fingerlings, but many farmers subsequently stocked grouper fingerlings from their own fish catch.

It is significant that DOF did not provide money or burden households

with a debt they might be unable to repay. Successful farmers repaid into a village fund 50 percent of the value of the materials and seed they received, with payments spread over two years. If a farmer experienced problems, repayment was rescheduled without penalty. The funds were used to finance other villagers' entry into aquaculture. The scheme has clearly been successful, as the number of households in the village involved in grouper culture rose from an initial 40 households in 1996 to 60 in 2000.

Figure 1. Relationship between wealth status and fish culture. ^a



^a Shown as the percentage of households in each wealth group whose livelihood portfolios include fish culture (no significant association $P = 0.065$).

Livelihood synergy and capital substitution

Important links were found to exist between activities in the livelihood portfolios of fishers that enabled poor households to maintain and develop their culture systems. This synergy was particularly pronounced between fishing and aquaculture. Ranking and preference matrices completed by focus groups in the case study communities revealed that different livelihood activities contributed in a variety of ways. Villagers ranked activities by importance according to participant-defined criteria, which

included the activities': (1) importance as a source of income; (2) contribution to household ability to save money; (3) degree of financial or personal risk; (4) level of investment required; (5) importance in relation to other activities; (6) required physical capital and its lifespan; and (7) length of time before the investment was recouped.

The matrices constructed in showed that fish culture and fishing were closely related. Villagers reported being willing to undertake a relatively risky method of fishing because it provided

trash fish with which to feed cultured fish, reducing or eliminating the need to buy feed. The extent to which households were prepared to take risks to supply feed for grouper culture clearly indicated the importance they attached to it. Similarly, fishers' ability to source seed fish from their own catch was important to maintaining grouper culture. In 2000–2001, the cost of a seed fish measuring 10–14 cm was 20 baht (\$0.50). Stocking 500 fish per cage was thus a considerable investment in a region where the average annual household income

in 2000 was \$3,062. However, fishers were able to offset this investment by replacing financial capital with natural capital.

Strategies to cope with risk and uncertainty

Fish disease was found to be the biggest risk to grouper culture throughout southern Thailand. Many risk-averse grouper farmers offset risk by stocking an additional species, most commonly seabass. Seabass enabled producers to minimize risk, as they are less vulnerable than grouper to salinity fluctuations and disease, and

can be sold on the relatively stable local market, which is indifferent to the more expensive grouper. Seabass seed is easily obtained from government or private hatcheries and grows more quickly than grouper. The downside is that seabass requires more feed than grouper and, whereas grouper can be fed every 2–3 days without any detriment to fish health or growth (an important advantage to fishers who may be away from home for some time), seabass must be fed daily.

Grouper farmers also managed risk by varying the culture cycle. They did not generally adhere to a strict regime of stocking and harvesting, primarily because of the variable availability of grouper seed. Instead, they stocked and harvested continuously as long as juvenile fish were available. As one farmer reported, the culture cycle cannot be planned, as fingerlings of different sizes reach a market size of 1.2 kg at different times. This prevents their managing the culture cycle so that harvesting coincides with Chinese New Year, when grouper prices spike. Many wealthier farmers expressed the wish for hatchery-produced fingerlings of standard size that would allow precise scheduling of stocking and harvesting, but the cost would be more than what most grouper farmers could afford. Instead, farmers with limited finances distributed the costs and benefits of grouper culture over time.

The strategies of farmers rearing grouper in floating cages in the case study communities can be divided into two broad categories: (1) a short grow-out period of 3–6 months to minimize risk; and (2) a long grow-out period of 6–13 months to obtain the maximum price for fish of market size.

The preferred total length of juvenile grouper for stocking was 20–23 cm for short grow-out and 10–14 cm for long or partial grow-out.

Grouper culture is vulnerable to the international market. However, predominantly small-scale production holds down supply and supports prices. At the time of the study, grouper had a farm-gate value of 300 baht per fish weighing 1.2 kg, enabling farmers to generate income, or at least

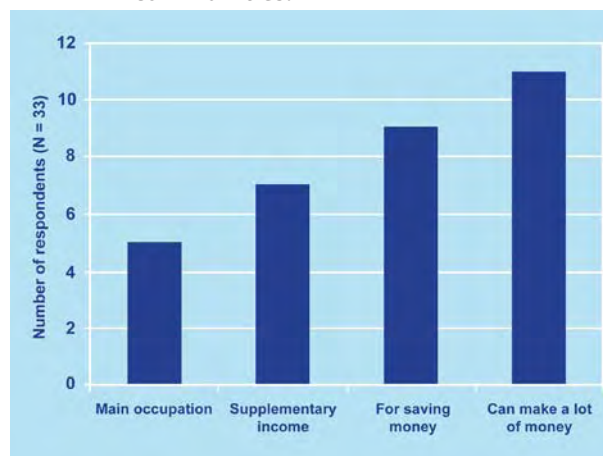
and building up assets. Other activities, such as fishing, trading and wage labor, are generally accorded more time and provide income to meet daily needs. This suggests that efforts to encourage fishers to leave fishing for fish culture are likely to fail or make fishing households more vulnerable unless alternative options for daily income are provided (Sheriff, 2004).

Conclusions and policy implications

The study found that culturing grouper can generate substantial financial benefits for poor households. However, this depends on a number of conditions:

1. Support from external agencies allows poor households to overcome investment constraints. Providing materials for cage construction and establishing a village fund allows poor households to take up grouper culture.
2. Natural capital substitutes for financial capital. The availability of wild-caught seed and feed allows poor fishing households to stock and feed grouper.
3. Grouper culture is compatible with other livelihood activities. Fishers are able to integrate grouper aquaculture into their livelihood strategy without narrowing livelihood diversity. Modest time demands and the ability of grouper to withstand infrequent feeding leaves farmers free to pursue additional occupations.
4. Farmers can manipulate the culture cycle to suit their risk profile. This was facilitated by the existence of a market for juvenile fish for further growing out.
5. Grouper is highly valued on the international market. The high price farmers get for their fish ensures

Figure 2. Significance of grouper culture in household livelihood strategies aggregated for all three case study communities.



breakeven, despite high mortality of up to 80 percent (Sheriff, 2004 and Sheriff, et al., 2008). Sensitivity analysis indicated that grouper culture could remain viable in the face of significant increases in feed and seed fish prices and a fall in market price to 100 baht. Grouper culture would therefore appear to pose little risk to households and is unlikely to increase vulnerability when carried out as part of a diverse set of livelihood activities.

The role of grouper aquaculture in household livelihood strategies

Grouper culture is considered a main occupation by few villagers in any of the communities studied (Figure 2). Rather, it is primarily for saving money

that grouper culture is economically viable even if market prices decline. The current lack of hatchery-produced seed keeps production low and prices high.

The following policy considerations affect the success of grouper aquaculture:

1. **Affordable and accessible credit.** DOF support in the form of training and extension, together with the provision of funds for getting started, were crucial to making the benefits of grouper culture accessible to all wealth groups in the community. Without external support or credit, grouper culture is dominated by wealthier households.
2. **Livelihood synergy.** Synergy in livelihood activities is essential to the ability of poor households to maintain grouper culture despite lack of capital. Yet synergy is a livelihoods aspect of the poor that is often overlooked, as recent studies suggest that aquaculture may provide an alternative livelihood for fishers, replacing rather than supplementing fishing. The study made clear that livelihood activities perform a variety of roles. Failure to understand the functions of each

activity will cause interventions to fail and may worsen household vulnerability.

3. **Hatchery-produced seed.** The development of grouper broodstock and hatchery production technology is currently a major area of research in the Asia-Pacific region, reflecting the hope that grouper cultured from hatchery-produced seed will lift pressure on wild fish stocks. However, requiring a closed culture cycle may be inappropriate in the case of grouper. Commercial hatchery seed production is likely to stimulate grouper production and encourage its emergence on an industrial scale, boosting supply, undermining market prices and making grouper culture less attractive as a livelihood option for poor fishers. The future of the sector, and its role in reducing pressure on reef fisheries, is more likely to be sustained by keeping production in the hands of small-scale farmers.

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Fry fisher in Koh Khiam

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ICM at Work: Harnessing Local Initiative to Achieve Food Security

Historic Cavite, home of modern revolutionary Caviteños braving the challenges of protecting the coastal areas and securing the needs of the people. At the end of implementing and adopting management strategies and approaches to attain sustainable coastal development, integration, coordination and sectoral participation remain key to the success or failure of management programs.



Figure 1. Map of Cavite Province

Aside from its rich historical legacy and culture, the Province of Cavite, which is one of the provinces bordering the Manila Bay in the Philippines, is blessed with natural resources that have provided food and sources of livelihood for the people. It has 71,202.76 ha of agricultural land favorable for growing major crops such as rice, corn, coffee and others. Its forest area of 8,624 ha supports diverse flora and fauna. Cavite has eight coastal municipalities and one city with a total coastline of about 85 km stretching from the municipalities of Maragondon to Bacoor. It has an estimated coastal water of about 93,679 ha that supports coastal habitats and diverse marine resources (**Figure 1**).

Moving towards industrialization

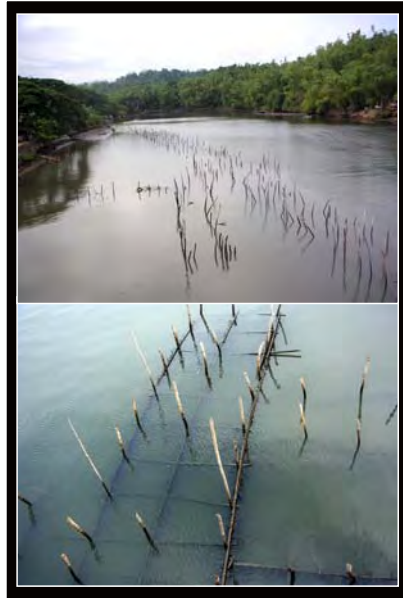
In the 1990s, Cavite transformed itself from an agricultural province into a highly commercialized province that serves as haven for a number of world-class industrial estates situated both in the coastal and non-coastal municipalities. These estates house companies mostly engaged in manufacturing of electronics, clothing, food and beverage, plastics and pharmaceuticals. Cavite's industrialization and its proximity to Manila enabled a large segment of the population to be employed in the industries.

In recent years, the province is facing various challenges, including

pollution from land- and sea-based sources, habitat degradation and overexploitation of resources, illegal fishing and intensive land development for industrial and human settlements. As migration from neighboring provinces and the metropolis sets in, more and more people are settling in the coastal area. Coupled with rapid industrialization, this has caused environmental problems particularly the deterioration of water quality and destruction of coastal habitats. Operators of illegal structures for fish production and other marine products likewise sprouted up in the coastal waters of Cavite. Such illegal structures hampered navigation of small boats,

obstructed the circulation of water and affected the mussel and oyster farms in the area. Legitimate fish cage and mussel culture operators were affected due to competition for space with these illegal structures.

The total population of the province was estimated to be almost 2.9 million in the recent 2008 census, representing an average growth rate of 4.59%. There are about 17,400 fishers whose livelihoods mainly depend on fishing in three major bays, namely: Manila Bay, Bacoor Bay and Cañacao Bay. Cavite is also known for the production of mussels, oysters, milkfish, prawns and tilapia.



Mussel and oyster culture methods in Cavite.

coastal towns. Each Council consists of representatives from government agencies, private sector and the civil society (Figure 2 and 3). The two levels of Council serve as policy making bodies of the program at the provincial and municipal levels, respectively. The Project Management Office (PMO), which coordinates the day-to-day activities of the ICM program was created and likewise institutionalized under the Provincial Environment and Natural Resources Office (PG-ENRO) on November 2004 through Executive Order No. 48. The Governor, who serves as Chair of PICMC, mandated the nine coastal Mayors to designate one permanent coordinator either from the Municipal Planning and Development Office, Municipal Environmental and Natural Resources Office, or Municipal Agriculture Office. The coordinators automatically served as Vice-Chairs of the Municipal/City Council.

The ICM program is financed by the provincial and municipal governments. Replicating the Province of Bataan's experience, which serves as a shining example on how the private sector support can be tapped, Cavite also managed to entice the participation of a number of private sector enterprises, which recently evolved into a council, the Cavite Corporate Social Responsibility Council (CCSRC). Among the activities supported by the private

Provincial Government Taking the Lead

In 2001, the Provincial Government took concrete steps to address the environmental issues and threats in the coastal areas of Cavite. While the national government defines the policy framework for development and proper management of Manila Bay, the provincial government of Cavite took the lead role in establishing and operating a province-wide management system to address the multiple and conflicting uses of the coastal waters and to ensure that the livelihoods of the people were sustained.

Cavite embraced the integrated management approach when it became an integrated coastal management (ICM) parallel site in March 2004, when it signed a Memorandum of Agreement with PEMSEA and the Philippines Department of Natural Resources and Environment (DENR).

Establishing mechanisms to sustain the ICM program

The ICM Program was institutionalized from provincial to barangay or community levels through the creation of the Provincial ICM Council (PICMC) and Municipal/City ICM Councils in 9

Figure 2. Cavite Provincial ICM Council.

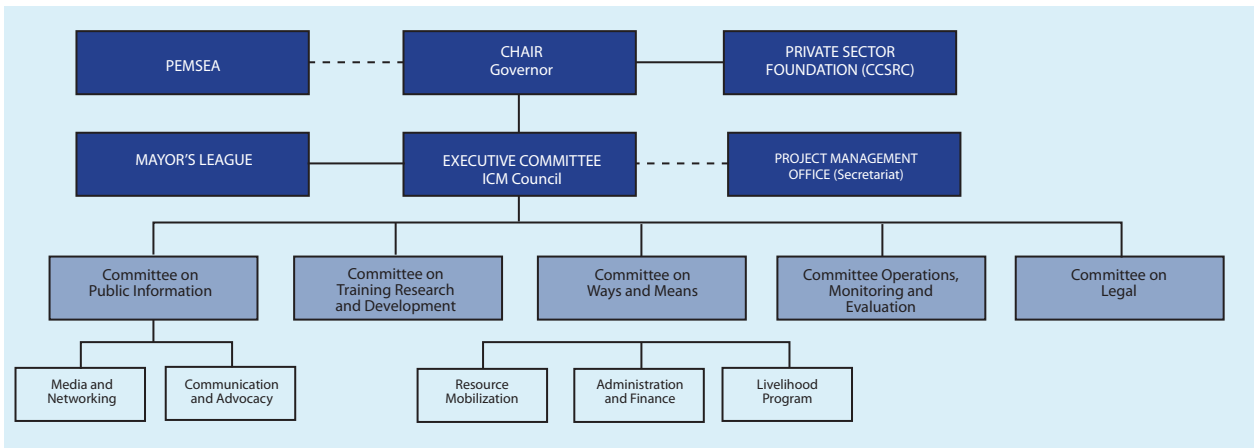
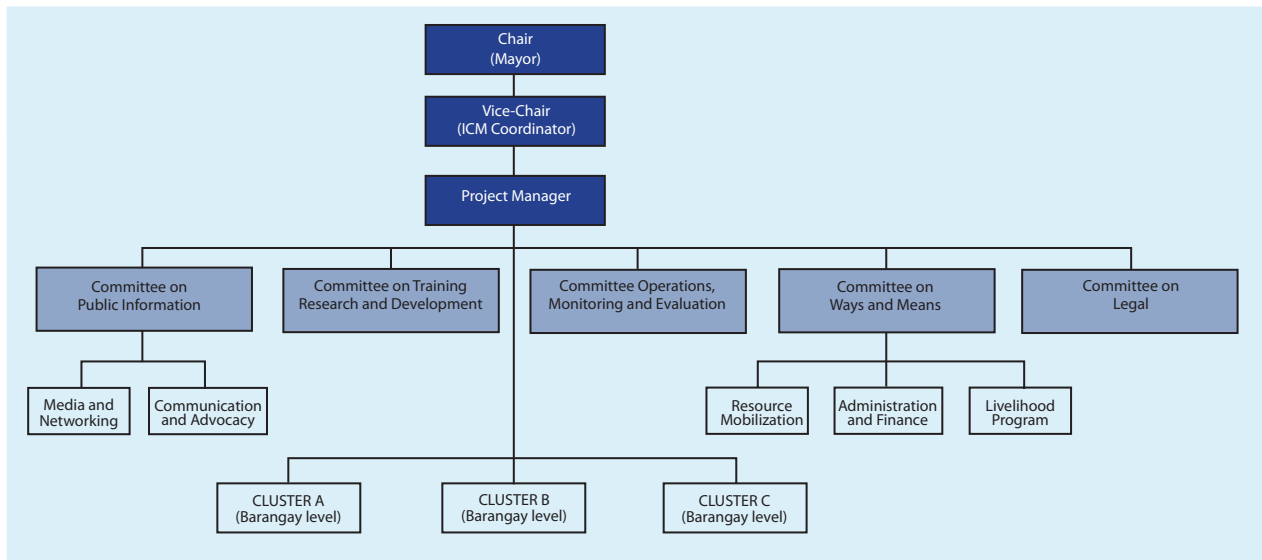


Figure 3. Cavite Municipal/City ICM Council.

sector included providing assistance for alternative livelihood projects for coastal communities, especially the fisher folks, adopting a highway program, participating in conservation programs, and participating in regular coastal clean-ups and other relevant projects coordinated by the Province.

Staff from the local governments, private sector, academe, non-government organizations and people's organizations of the 9 coastal towns of Cavite have attended trainings on ICM and specialized training courses including resource valuation, integrated information management system, advocacy and communication. The Province is also a member of the PEMSEA Network of Local Governments for Sustainable Coastal Development, which serves as a platform for the local governments to share knowledge and good practices in ICM implementation.

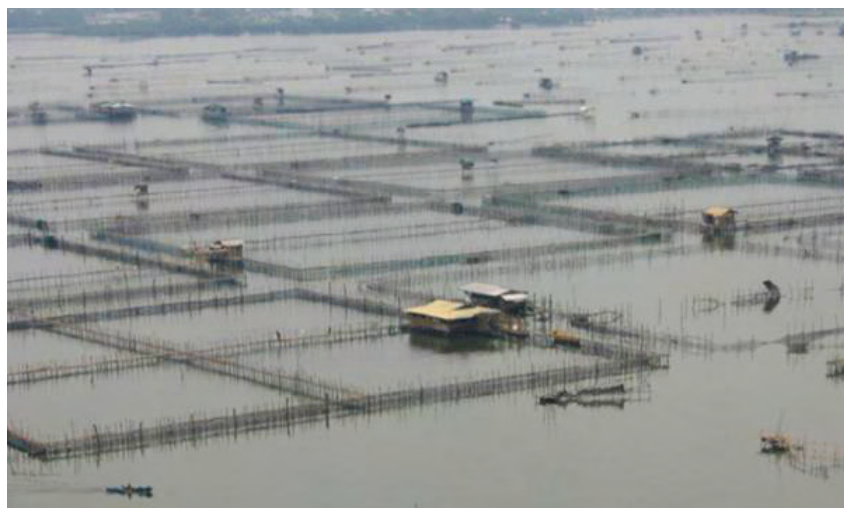
Recognizing the importance of broad-based stakeholders support

ICM requires the involvement and mobilization of stakeholders to develop their sense of ownership of the program. Stakeholders who derived benefits from the coastal resources were encouraged to participate in the program through various means. A series of consultation seminars were

conducted for various groups such as barangay (community) leaders, religious groups, nongovernmental organizations, local government units, the academe, fisherfolks, the youth sector and the private sector to explain the ICM program, discuss issues and solicit their respective views and commitments to attaining sustainable development of the coastal areas of Cavite. For the creation of the councils at the various municipalities, extensive stakeholders' consultations were undertaken to ensure transparency and awareness of the ICM program. This process has resulted in high public acceptability and participation in ICM implementation.

Contributing to bay-wide management of Manila Bay

Being part of Manila Bay, where a bay-wide environmental management program is in place, Cavite participated in the development of the Manila Bay Coastal Strategy. The Manila Bay Coastal Strategy was developed through consultations with various stakeholders from the three regions surrounding the bay, the National Capital Region and Regions 3 and 4, which included Cavite. The strategy provided a comprehensive environmental framework, targeted outcomes and a series of action programs involving the participation of relevant stakeholders of Manila Bay



Aerial photo of illegal fish pens and fish cages along coastal water of Cavite



Fish pens and fish cages in Bacoor Bay

including local governments. With the passing of a landmark decision by the Supreme Court of the Philippines in December 2008, requiring 12 government agencies and LGUs surrounding Manila Bay to clean and rehabilitate the bay, the Cavite ICM Program is playing a key role towards facilitating the implementation of the Operational Plan for the Manila Bay Coastal Strategy at the provincial and municipal levels.

Achieving a Sustainable Fishery Industry

Fisheries is one of the major components of the agriculture sector in Cavite. It is also one of the main sources of livelihood and food production. In Rosario, Tanza, Noveleta and Cavite City, fish drying, smoking, fermentation and salting of various fish species known locally as *tinapa*, *tuyo*, *daing* and *binanlian* are recognized alternative livelihoods of fisher families, as is production of *patis* (fish sauce) and *bagoong* (fish paste). Among the fish products produced in the province, the *tinapa* is gaining markets both locally and internationally.

Mussel industry in Cavite

Mussel culturing is widespread in the province. It is reported that the mussel industry in the Philippines began in 1962 at the Binakayan Demonstration Oyster Farm, in Binakayan, Kawit,

Cavite, with the Philippine Fisheries Commission, now Bureau of Fisheries and Aquatic Resources (BFAR). Earlier, mussels had been considered by oyster growers as a

fouling organism and were neglected most by shellfishers. The movement and spreading of mussel culture in Manila Bay came when oyster growers, who attempted to collect oyster spats in less silty offshore waters, accidentally obtained heavy and pure mussel seedlings. Mussel culture gained further recognition due to the fact that it does not require sophisticated techniques or methods compared to other aquaculture technologies.

In 2007, the province registered the highest annual oyster production of 1,578 mT and mussel production of 4,580 mT proving its viability as a source of livelihood and its marketability within and outside the province. In a survey conducted by the Office of the Provincial Agriculturalist from 2005 to 2007, oyster production for three consecutive years increased, while the mussel industry production fluctuated. The production level was affected by

several factors, including the number of operators, extent of the area and the situation and quality of the water (see **Table 1**).

Likewise, with regards to milkfish, prawn and tilapia production, there is evidence increased production from 2006 to 2007 of about 872 percent for tilapia, 18 percent for prawn and 26 percent for milkfish. The drastic increase in the production of the species was mainly because of the increasing number of illegal fish pens and fish cages in the coastal area as shown in **Tables 2 and 3**.

Dismantling of illegal fish pens and fish cages

One of the threats to sustainable aquaculture identified by the ICM Division of PG-ENRO was the mushrooming of illegal fish pens and other structures along the coastal waters which are owned by local Caviteños and commercial trespassers. Based on the survey conducted, there were 98 units of *baklad* (fish corral) mostly situated in Cavite City, 44 total fish pens and fish cages with the biggest fish pen area of about 130,000 m², and 679 *saprahan* (stationary lift net) in Bacoor Bay.

Under the stewardship of Governor Ayong S. Maliksi, in partnership with DENR, the first phase of dismantling was enforced in July 2008 in Bacoor Bay, comprising of three municipalities and



Governor Maliksi (3rd from left) and DENR Secretary Jose Atienza (2nd from left) during the actual dismantling of fish pens and fish cages.



one city (Noveleta, Kawit, Bacoor and Cavite City). To support this initiative, the Provincial Government issued Executive Order 69 that prohibits the proliferation of the illegal structures. EO 69 also required the adoption of a holistic and integrated management approach for managing the coastal areas of Cavite and more importantly the development of the Coastal Use Zoning Plan for Cavite. This action is expected to address the multiple use conflicts and result to better water quality in the area.

Table 4 summarizes the dismantled structures in Cañacao Bay and Bacoor Bay. It is expected that the potential long-term socioeconomic benefits of the activity conducted will ultimately translate to fisheries productivity capable of providing sufficient marine harvest for Caviteño families, increased tourism revenues, sustained coastal resources, and reduced water pollution.

Maliksing Isda, Masaganang Pangisdaan (Agile Fish, Healthy Fishery)

Geared towards sustainable production in support of the Department of Agriculture's Productivity Enhancement Program, the Provincial Government through its implementing arm, the Local Development and Livelihood Office and the Office of the Provincial Agriculturalist is vigorously pursuing a pro-poor program called *Maliksing Isda, Masaganang*

Table 1. Production of Oysters and Mussels based on the number of operators and area.

Year	No. of Operators		Area (ha)		Production (mT)	
	Oyster	Mussel	Oyster	Mussel	Oyster	Mussel
2005	395	306	15.18	120	674.50	3,630.08
2006	395	191	15.28	145.87	708.76	4,707.84
2007	426	117	31.93	155.52	1,578.48	4,580.40

Table 2. Annual Production of Milkfish, Tilapia and Prawn in 2006.

Municipality	No. of Operators		Area (ha)		Annual Production (mT)		
	Brackish	Freshwater	Brackish	Freshwater	Milkfish	Tilapia	Prawn
Bacoor	28		40		14.1		11.1
Cavite City					0.09		
Kawit	107		257		105		69.2
Noveleta	21	1	71.50	1		2.5	13
Tanza		50		11.55		21.27	
Imus		7		0.21		0.19	
Maragondon	2	30	2	1.2		0.94	
Naic	17	47	3.6	4.16		11.18	
Ternate	45	8	47	1			9.8

Table 3. Annual Production of Milkfish, Tilapia and Prawn in 2007.

Municipality	No. of Operators		Area (ha)		Annual Production (mT)		
	Brackish	Freshwater	Brackish	Freshwater	Milkfish	Tilapia	Prawn
Bacoor	67		93.75		56.75	56.25	18.75
Cavite City	4		0.15		0.09	0.03	0.03
Kawit	107		257		105		60
Noveleta	21	1	71.50			257.40	42.90
Tanza		64		10.80		23.76	
Imus		7		0.21		0.25	
Maragondon	2	30	2	1.2	0.92	0.87	
Naic	17	47	3.6	4.16	6.20	11.40	
Ternate	45	8	72	1	23.50	0.95	



Aerial view of coastal water after the dismantling of illegal fish cages.

Table 4. Summary of dismantled structures in Cañacao and Bacoar Bay

Illegal Structures	Illegal Fish Pens/ Cages	Fish Corral (Baklad)	Stationary Lift Net (Sapra)	Guardhouse/ Shanties
No. of Units	85	98	46	--
No. of Dismantled units	81	93	42	25
Remaining units	4	5	4	--

Pangisdaan (Agile Fish, Healthy Fishery). The program, which is being spearheaded by the Governor focuses on enhancing fish production through utilization of fish hatchery technologies and providing aquaculture technical extension services. Furthermore, the program is in support of the President of the Philippines' *Ginintuang Masaganang Ani* (Golden Harvest) Program and the Department of Agriculture's thrust of developing rural areas through aquaculture.

Major activities have been implemented that are expected to benefit the low-income, less privileged fisherfolks and fish farmers. The following are some of the major projects:

1. Establishment of Tropical Fish Ponds. Six fishponds were established in 2007-2008 to propagate tropical fishes that are known for their ornamental value.

2. Fish/Fingerlings Dispersal. This is an ongoing activity of the province since 2008 that involves the purchase of 300,000 fingerlings for distribution to fish farmers and other groups.
3. Promotion of Get Excel Tilapia. Tilapia fingerlings will be purchased for distribution to interested fish farmers and other groups. A total of 18 fishpond operators are expected to benefit from this project.
4. Establishment of Fish Hatcheries. This is a proposed project where propagation of fingerlings will be undertaken in the upland areas of Cavite. Six hatcheries are being planned to serve as sources of fingerlings that can be purchased at very reasonable costs. The income that will be generated will be used for production inputs and maintenance of the hatcheries.
5. Establishment of Marine-based Enterprises. This includes fish processing, seaweed farming, purchase of gillnets and boats, and backyard fish farming. It is expected that 20 agri-enterprises will be established, contributing to the job generation efforts of the provincial government.

Establishment and maintenance of fish sanctuaries

Cavite is also promoting the establishment of marine protected areas as another approach towards achieving sustainable fisheries in the province. There are three existing fish sanctuaries in Cavite, namely, the 56-hectare Carabao Island Fish Sanctuary in Maragondon, the 15-hectare Bulaklakin Reef Marine Sanctuary in Ternate, and the 5-hectare Fish Sanctuary in Tanza. The sanctuaries are expected to promote the conservation of the marine resources in the area. The respective local governments have passed the necessary ordinances that

Box 1. Objectives towards achieving sustainable fishery industry.

Six major objectives towards achieving sustainable fishery industry: (1) Conserve, protect and rehabilitate the earth's finite resources for sustainable environment; (2) Integrate, coordinate and strengthen the work of environmental group by catalyzing the active sharing of information, knowledge, expertise and other resources; (3) Promote ecological consciousness and action on issues relevant to the protection of people's health and environment; (4) Promote corporate social responsibility through the implementation of environmental programs and activities; (5) Build partnership and promote sense of ownership; and (6) Strengthen the mass based multi-stakeholder participation, the dismantling of illegal structures along the coastal waters was successfully enforced and now on its stage of harmonizing the mussel and oyster farmers to form a cooperative.

Box 2. Coastal use zoning in Cavite Province.

A step-by-step process in developing the coastal use zoning plan include: the analysis of existing institutional framework on spatial planning and zoning scheme to identify gaps and overlaps; analysis of existing uses, plans and activities in the area; evaluation of land and water attribute and use suitability; development of matrices of multiple use conflicts and suggested utilization; collection and completion of project data and maps, determining the classifications of coastal use zones; development of coastal use regulatory, determining the appropriate institutional framework or arrangement; packaging draft coastal use plan and corresponding institutional framework; finalization of the plan; and stakeholder consultation.

The primary use zones identified are: aquaculture, mudflat protection, buildup, municipal fishing, tourism (beach, heritage site, historical and cultural), eco-tourism (mangrove and migratory birds), reclamation/commercial, pollution prevention and control/regulatory, habitat enhancement and management, port development, industrial, shipping and navigational, military reserve, protected area (coral reef and sanctuary), fish port, fish pond, boat landing, agricultural, urban and special zone.

serve as legal basis for the protection and management of the protected areas. Direct assistance is also provided by the LGUs through technical and financial support.

Addressing Multiple Use Conflicts

Cavite has also embarked on developing a coastal use zoning plan as a key measure to address multiple use conflicts and regulate the activities in its coastal areas. This initiative is spearheaded by the Provincial Government and part of the bay-wide project of the DENR to develop a coastal use zoning plan for Manila Bay. The coastal use zoning plan is expected to encourage forging of partnerships among stakeholders and promote enforcement

of policies and ordinances on anti-illegal fishing and encroachment of illegal structures, in support of enhanced fisheries and aquaculture production. The development of the zoning plan also aims to facilitate the delineation of municipal waters and provide designated use zones, including a 10 percent allocation for aquaculture area along Cañacao Bay and Bacoor Bay.

More specifically, the development of the coastal use zoning plan aims to:

1. delineate/validate suitable areas for particular human use, while minimizing the impacts to ecosystems and public health;
3. protect critical or representative habitats ecosystems and ecological processes;
4. protect natural and cultural sites;
5. resolve/minimize conflicting

human activities and uses; 6. protect human welfare; and 7. improve overall management of the coastal areas and the environment.

The Way Forward

ICM has provided Cavite with the management framework and systematic process to address the challenges to sustainable development of the coastal areas in the province. It also serves as a mechanism for the province to contribute to the implementation of the Operational Plan for the Manila Bay Coastal Strategy. The ICM program will continue to promote a broad-based multi-stakeholder involvement and cooperation as the province gains more experience and capacity as well as financial resources to address these challenges including establishing a sustainable fishery industry for its people.

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Tinapa making is a small-scale industry in Cavite.

By Vitaya Khunplome, Chief Executive of the Provincial Administrative Organization of Chonburi (Thailand) and ICM Project Director
Nisakorn Wiwekwin, ICM Secretariat, Sriracha Municipality, Chonburi Province, Thailand

Utilizing ICM to address food security and improve livelihood of communities in Chonburi



Members of the Garbage Banks earn reward points that can be exchanged for cash or goods.

Chonburi is a coastal province situated in eastern Thailand. Its long coastline of 160 kilometers is well-known for its tourism activities both locally and internationally. It also serves as a gateway for import and export, an industrial center and a new energy hub for the country as a result of the Eastern Seaboard Project of Thailand. The project is aimed to develop the region as the new economic zone, based on major manufacturing industries, seafood resource and agricultural business in order to distribute economic and industrial growth at the local levels.

However, as a consequence of Chonburi's simultaneous roles, the natural resources and environment of the province are under increasing pressure and threats.

Growing populations and their migration to coastal areas, dynamic economic growth, and rising global demands for fishery and aquaculture products, and rapidly increasing shipping traffic collectively exert tremendous pressure on the



marine environment and coastal resources. Even with decades of advocacy, political commitments and conservation efforts at the national and regional levels, reversing the decline of coastal and marine environmental quality is still an urgent task that requires a new approach, a new management paradigm. That paradigm is a strategic partnership of governments, international organizations, donors and stakeholders working together



Aerial view of Sriracha City.

to achieve a shared vision of a sustainable resource system at the regional, national and local levels.

The Chonburi ICM Network

Under the concept, “sustainable development of Chonburi”, which puts emphasis on the improvement of the quality of life together with the conservation of natural resources and protection of the environment, the Chonburi Integrated Coastal Management (ICM) Project, a partnership between the Provincial Government of Chonburi and the Regional Programme on Partnerships in Environmental Management for the Seas of East Asia or PEMSEA, (under the Global Environment Facility, United Nations Development Programme and the International Maritime Organization) commenced in 2001. There were initially five participating municipalities, which were joined later on by other municipalities as the benefits of ICM implementation were demonstrated. By late 2008, a total of 26 local government units were part of the Chonburi ICM Network, covering the entire 160-km coastline of Chonburi. It is expected that the ICM network would eventually cover the entire province and other coastal areas in Thailand. Chonburi has initiated the

process of sharing good practices in ICM implementation to adjoining and other coastal provinces in Thailand through the Coastal Resources Management Alliance of Thailand (CORMAT), which was co-founded by the province together with other ICM-related projects, agencies and sectors.

The local governments forming the Chonburi ICM Network make it their responsibility to enhance the quality of life of the public. They are also responsible for natural resources and environment management, including preservation of valuable local traditions in collaboration with various sectors, particularly the general public. A high level multi-sectoral Provincial Coordinating Committee (PCC), headed by the Vice Governor, provides guidance to ICM implementation and facilitates interagency and cross-sectoral collaboration, with a Technical Working Group (TWG) as its scientific arm. A Project Management Office (PMO) consisting of a Local Government Consultative Board made up of local government mayors and chief executives, an ICM Secretariat at Sriracha Municipality, and several committees led by

various municipalities, serve as the operational arm of the ICM project. An ICM Project Director is elected within the Local Government Consultative Board every two years. Supported by local administrative orders, this functional multi-sectoral coordinating arrangement has been able to mobilize necessary support from relevant agencies and institutions, and is recognized to have improved the decision-making process of the local governments in Chonburi.

The Chonburi Coastal Strategy serves as an integrated plan for activities contributing towards sustainable development of the province. Guided by a common vision crafted by stakeholders themselves, it provides a platform for addressing common concerns, including natural- and man-made hazard prevention and management; pollution reduction and waste management; habitat protection, restoration and management; water use and supply management, and food security



Schools and communities are active in mangrove rehabilitation activities in the province.



Resting cage of Crab Condo.

and livelihood management. The action plan for the Chonburi Coastal Strategy identifies marine and coastal management programs and activities that the local government members can jointly as well as individually address, and provides a basis for the development of annual municipal development plans and allocation of local budgets. It also identifies the roles and responsibilities of various stakeholders, including the communities, in the implementation of the planned activities. Local governments are also working closely with universities in the area (Burapha University, Fisheries Research Station of Kasetsart University and the Aquatic Resources Research Institute of Chulalongkorn University) to address various technical information needs to enhance decision-making (e.g., technical study on the impacts of sea-based transfer of cassava flour and other dusty commodities in Sriracha Bay; researches to address sea turtle diseases in the conservation ponds; seagrass transplantation; etc.). Partnerships have also been established with the private sector to support ICM activities, such as the agreement between Sriracha

Municipality and the Underwater World of Pattaya for sea turtle protection and conservation.

By working with the communities, the Chonburi ICM Network provides technical support, facilitates coordination with various concerned government offices and other stakeholders, and makes available some initial or catalytic budget so that communities are able to initiate and carry on various coastal management activities, applying scientific methods together with local knowledge, as appropriate. Activities are geared to address specific aspects or concerns, including food security through local fishery development, as well as provide stakeholders information leading to improved knowledge, behavior and sense of responsibility concerning environmental and resource management.

Within the framework of the ICM project and the Chonburi Coastal Strategy, various activities contributing to local fishery and livelihood development, which apply multi-sectoral engagement, innovative approaches, and technical support, have been undertaken in the Chonburi ICM Site, including the following:

- Crab Condominiums for crab conservation;
- Floating mussel farms;
- Various habitat rehabilitation activities; and
- Promotion of sustainable tourism development

“Crab Condominium” for conservation of blue swimming crabs

The blue swimming crab (*Portunus pelagicus*) is a commercially important species in Thailand. However, the yield from this species has drastically decreased due to over harvesting. In

addition to being severely exploited, the stock has suffered from habitat degradation and non-selectivity of fishing gears, which tend to remove most of the size classes from the population. Ten percent of the hooked crabs are spawning, with 700,000-1.4 million fertilized eggs each.

Chonburi province plays a key role in tourism, and among its attractions are its fresh seafood, including blue swimming crabs and various seafood products. Som-Tam, a papaya salad prepared using young crabs is a popular delicacy. The crabs are also supplied to local and international markets.

Significant decrease in crab population will affect the supply of crabs to local and foreign markets, and increase the price considerably. Currently, one kilogram of crabs at the local fresh market costs approximately 200-300 Baht depending on size. Continuing decline in crab population would also significantly affect local livelihood and lead to losses in income of fishers.

Concerned stakeholders are taking action to ensure sustainable utilization of Chonburi's fishery resources by applying innovative technology together with local knowledge. This project aims to promote sustainable fishery, in particular by protecting spawning crabs from exploitation. Specifically, spawning females caught from fishing grounds are contained in submerged resting cages (crab condominium or “crab condo”) until the offsprings are released, after which they will either be sold to consumers or released to the wild.

Crab condos were successfully established by the Rimtalae and Srirachanakorn communities in

Sriracha Municipality in 2006 as part of the initial implementation of the Chonburi Coastal Strategy, with some support from the Office of the Prime Minister, through the SML Project (a village/community development fund), the Wastewater Management Authority, the Duang Manee private school, and PEMSEA. Building on this initiative, a two-year project to set up new crab condos to be operated by the Wat Luang community in Bangphra Municipality, and to support the maintenance of the existing crab condos in Sriracha Municipality, was initiated in 2007, with funding support from the GEF/UNDP Small Grants Programme (SGP), and with guidance from PEMSEA. This project is currently being implemented through collaboration among communities, government, private sector and academe.

Procedures for this innovative project include:

- The establishment offshore of suitable floating containers with submerged resting cages;
- The collection of spawning crabs from fishers by donation and/or purchase;
- Putting each spawning crab into separate baskets which are vertically stacked like a condominium;
- Assigning responsible teams consisting of fishers, or

community committees, to cage and feed the spawning crabs, and to return them to the owners or market after the crabs release their larvae. The teams are also tasked to educate and provide advice to others supported by technical experts, and a municipal officer;

- Evaluation of project results in terms of increase in blue swimming crab population, through yield stock assessment or abundance in Sriracha Bay;
- Regular environmental monitoring by a relevant research institute in collaboration with the communities and local government.

The Chonburi Fishery Association, local academe and ICM project technical advisers support the crab condos in terms of technology and/or knowledge sharing. Information dissemination and capacity building for project members are being undertaken through training, study tours to existing crab condos, and exchange forums. In collaboration with the Sriracha Fisheries Research Station of Kasetsart University, sea water quality monitoring is being undertaken to assess and to evaluate potential impacts on water quality.

Assessment of sea crab yield stock/abundance are also being

undertaken to evaluate the impact of the project on the blue swimming crab population. There are no scientific surveys in the project area that can serve as baseline for assessment. However, fishers in the two municipalities have observed an increase in crab catch in 2007 compared to 2006 (the crab condo in Sriracha was established in April 2006). In Bangphra for example, in one of the big fishery ports in Chonburi Province that supplies the crab market, crab catch was around 40 kg/boat/day in April 2006. Catch in April 2007 was around 100 kg/boat/day (the same as the catch in the “peak” month of November 2006). Considering the high cost of scientific study/assessment, evaluation of the crab condos are being done through questionnaire surveys of changes in crab catch in the project area. Additional outcomes of the project include:

- Promotion of awareness and recognition of responsible fishing;
- Ecotourism at Koh Loy Public Park by including crab-release activities among its attractions;
- Effective transfer of knowledge to communities and youths by experiential learning and information dissemination; and
- Good practice of generosity, goodwill and cooperation among the community teams.



The crab condo project helps conserve the blue swimming crab, a commercially important species in Thailand.

Crab condos have also been established in Chanthaburi Province, one of the members of CORMAT.

Floating mussel farm

In the past, green mussel was cultured in Sriracha Bay primarily through the use of bamboo poles that were driven into the muddy bottom. This method, however, had many problems, such as inability to culture in hard or rocky surface, bamboos being damaged by waves and winds



Fishers select the appropriate size of mussels to harvest from the floating mussel farm.

leading to decrease in production, and unsightly fragments of bamboo scattered on the beaches, etc. The Sriracha Fisheries Research Station (SFRS) then promoted new culture methods such as green mussel raft culture, involving use of recycled and more durable materials, and allowing easier harvesting. The floating raft consists of an assembly of 1 or 1.5 m long recycled ropes from damaged or old fishing nets, with rocks as weights, which are tied to recycled plastic containers that serve as the float. The young mussels attach and grow on the hanging ropes. The raft culture floats up and down with the tide, enabling the mussels to feed even in the low tide period.

The green mussel raft culture is suitable for areas with some wave action and hard sea bottom which

cannot use the pole culture method. Moreover, the materials used, which include polypropylene or polyethylene for its main parts are durable and last for several years. The plastic containers and mussel lines, as well as the old trawl nets used in making the ropes, are mostly handed down from the fishing industry. These make mussel raft culture more profitable and achievable than its mussel pole culture counterparts.

The green mussel in the floating rafts can be harvested using boats, and the set up makes it easier for fishers to collect the appropriate sizes of mussels for selling. After eight months of operation, marketable size was an average shell length of 6.55 cm, shell width of 3.18 cm, total weight of 20.57 g, and shell weight of 7.06 g.

The density of green mussel was 240 pieces per meter of rope. The average rate of increase in shell length is 0.74 cm/month. The total production using the raft culture method was 57,800 kg (*Sriracha Fisheries Research Station, Faculty of Fisheries, Kasetsart University, 2002*), with raft culture being useful for about six to eight years.

In Sriracha Bay area, there is a total of 235 rafts or 140 Rai (22.4 ha), with at least a production of about 30,000 kg/0.16 ha.

Additional outcomes of the floating mussel farms include:

- Delineation of over 20 km² at the northern part of Sriracha Bay as an area specifically for mussel farming, which cannot be infringed by large fishing boats.

- Development of an alternative habitat for other marine species in the area of the rafts.
- Increase in the number of fish in the areas close to the floating mussel farms.
- Ease of moving the mussel farm for protection in the event of oil spills.

Habitat protection and restoration

In the past two decades of rapid transformation of Chonburi Province from an agriculture-based to an industrial economy, capture fisheries in Chonburi showed significant decline as a result of overexploitation and habitat degradation. The mangrove cover in the province also decreased by more than 97 percent as a result of reclamation and conversion to other uses, with potentially staggering impact on fisheries. Increased waste generation has also become a priority concern, affecting water quality and contributing to degradation of coastal habitats.

On-the-ground solutions related to habitat conservation implemented in partnership with various sectors include local activities such as:

- Mangrove reforestation
- Seagrass transplantation
- Underwater and beach clean up
- Artificial reef establishment
- Shoreline protection
- Community-based oil spill warning system

Crab cultivation, for instance, is being sponsored by a private sector partner, the Vinythai Company, in collaboration with various agencies and areas in the subdistrict of Samaresan, also within the Chonburi ICM site.

Various efforts with regard to waste reduction and management are also contributing to habitat protection and

restoration. A community-based solid waste management project, which encourages students and communities to collect and remit reusable and recyclable wastes to “Garbage Banks” located in schools and communities, also contributes in minimizing degradation of habitats resulting from nonbiodegradable wastes that eventually end up as marine litter. Members of the Garbage Banks earn reward points that are recorded in their bank books, which can be redeemed later in cash or in kind.

Promotion, and legislation in Sriracha and other municipalities, of the use of grease traps in restaurants in order to reduce oil in wastewater, is also contributing to stress reduction in the marine environment from oily wastes. With the active support of the Restaurants Association of Chonburi, 200 restaurants in Sriracha have

already installed grease traps while installation in hotel restaurants has been initiated. In the latest meeting of the ICM Provincial Coordinating Committee in February 2009, the use of grease traps was promoted to all local governments in Chonburi.

The ICM PCC’s habitat protection and restoration successes to date give hope that, through the cooperative efforts of many public and private partners, adequate coastal habitats for fish and wildlife will exist for future generations. The key is to find solutions that ensure self-sustaining natural systems despite conflicting demands on the natural resources.

Sustainable tourism development

Owing to its strategic location along the Gulf of Thailand, its proximity to

Bangkok, its various natural, cultural and historical values, and the availability of supporting facilities and convenient transport services, tourism has been one of the main economic activities in Chonburi. In addition to the appealing seaside, white sand beaches and coastal resources, other tourist attractions of Chonburi include buffalo racing

and other traditional festivals, and ancient royal mansions and vacation homes of previous kings, high-ranked royalties and elites, making tourism one of the main generators of employment and income in the province.

The sustainable and stable development of tourism is recognized as being contingent upon the efforts being taken to protect Chonburi’s natural, cultural and historical attractions. The Chonburi ICM Project has been promoting tourism development that satisfies social, economic and aesthetic needs while respecting cultural and ecological integrity. In addition to coastal protection, restoration and beautification efforts, marine conservation activities have been used to draw local and foreign visitors to Chonburi. In Sriracha Municipality, for example, a sea turtle conservation pond at the Koh Loy (Loy Island) park in Sriracha holds numerous and varying sizes of sea turtles, which visitors can view and feed. At least one hundred of these sea turtles are released annually to the sea with stakeholder participation.

Visitors at Koh Loy are also encouraged to contribute to marine conservation by buying and releasing fishes and crabs. In addition to serving as venues for marine conservation education for young and adult visitors alike, these activities also generate income for local folks who provide the turtle feeds, crabs and fishes, and for local entrepreneurs who operate food stalls and sell various ornaments and souvenir items.

To further promote eco-tourism and at the same time develop a sense of responsibility among the youth for marine conservation and



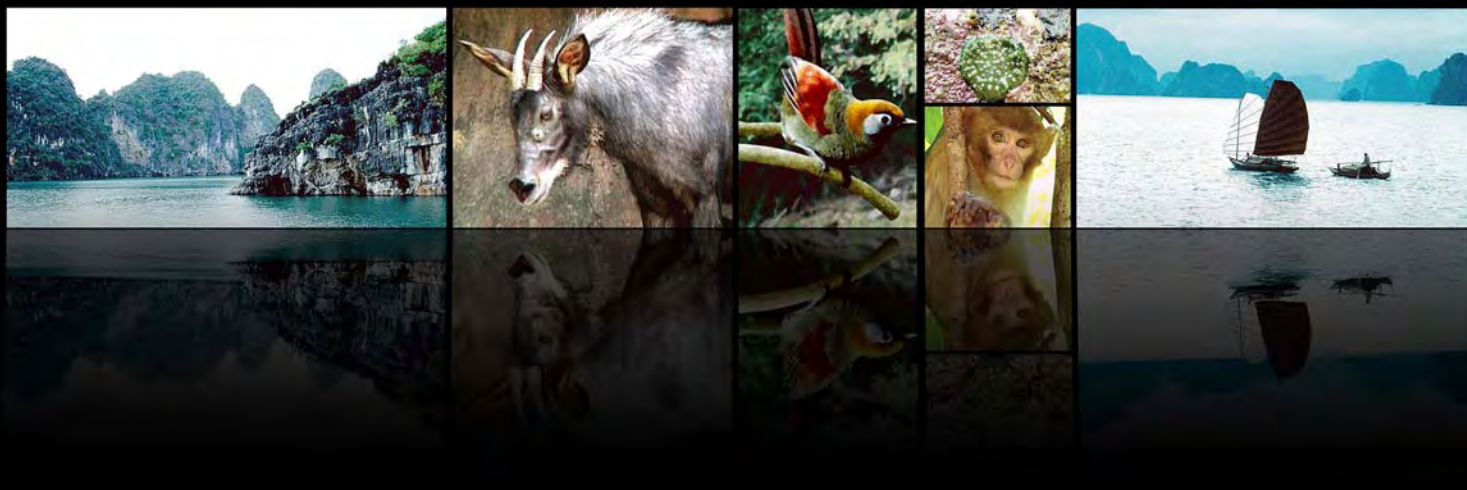
Top: Chonburi is involved in coral rehabilitation activities.
Bottom: Underwater and beach cleanup activities in the province involve various sectors including the youth.

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By Rodrigo U. Fuentes, Executive Director, ASEAN Centre for Biodiversity

Biodiversity loss

The Forgotten Crisis



News about the global financial crisis is always in the front page of newspapers. Bomb attacks in Iraq and Afghanistan are often television news breakers. World attention is focused on the humanitarian implications of conflicts in the Middle East. Effects of climate change are favorite topics of video documentaries. Buried under these global issues and other problems such as terrorism, high crimes, and corruption is a lesser known crisis with far greater implications than anyone can imagine — biodiversity loss.

We are losing our biodiversity at unprecedented rates due to deforestation, large-scale mining, wildlife hunting, illegal wildlife trading, and other irresponsible human activities. Biodiversity loss poses a significant threat to our food security, health, livelihood, and the earth's overall capacity to provide for our and future generations' needs.

The Millennium Ecosystem Assessment published in 2005 reported that humans have increased extinction levels dramatically over the past decades at 100 to 1,000 times the normal background rate.¹ In Southeast Asia alone, 1,312 out of 64,800 species are endangered.

¹ Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, D.C.

Ultimately, the loss of biodiversity is one of the greatest threats that we face. It is in the area of food security, perhaps more than any other, that biodiversity's value is most clear. Nature provides the plant and animal resources for food production and agricultural productivity. When we destroy biodiversity, we destroy our source of food.

The Food and Agriculture Organization reported that out of more than 10,000 different plant species used for food by humans over the millennia, barely 150 species remain under cultivation. Of these, only 12 species provide 80 percent of the world's food needs and only four – rice, wheat, maize and potatoes – provide more than half of human's energy requirements.² What happened to the 9,850 other species? If they have not been lost already, they are vulnerable.

Health is another arena where the natural benefits of biodiversity are most obvious. The natural world holds the key to many medicinal resources and pharmaceutical drugs. If the world continues to lose around 13 million hectares of its forest cover every year³, it would be difficult to develop better kinds of medicine to cure both existing and emerging illnesses. We have to remember that about 80 percent of the world's known biodiversity, many of which have medicinal value, could be found in forests.

Apart from providing people with food and medicine, nature also offers a wide range of ecosystem services such as contribution to climate stability, maintenance of ecosystems, soil formation and protection, and pollution breakdown and absorption. Biodiversity is also a source of livelihood to millions as the economy of many communities is driven by the use of species in industries such as biotechnology, forestry, agriculture and fisheries. Moreover, biodiversity provides social benefits including recreation and tourism, as well as cultural and aesthetic values.

Forgetting the biodiversity crisis is therefore akin to cutting our lifeline to the world's natural treasures. We at ACB wish to remind everyone that extinction is forever.

² Food and Agriculture Organization. Agricultural Biodiversity in FAO. Available at <ftp://ftp.fao.org/docrep/fao/010/i0112e/i0112e.pdf>.

³ Food and Agriculture Organization. Global Forest Resources Assessment 2000. Available at <ftp://ftp.fao.org/unfao/bodies/cofo/cofo15/X9835e.pdf>.

And with every species lost, the natural ecosystems we call home become biologically poorer.

The consensus to save Southeast Asia's thinning biodiversity moved the ASEAN, with funding support from the European Union (EU), to establish the ASEAN Regional Centre for Biodiversity Conservation (ARCBC) Project. From 1999 to 2004, the project facilitated collaboration among



Over 500 million people in Southeast Asia could be affected by massive biodiversity loss.



Southeast Asia occupies 3 percent of the earth's total surface yet serves as home to 20 percent of all the world's known species.

ASEAN Member States for biodiversity-related initiatives. A year later in 2005, the ASEAN and EU agreed to establish ACB to carry on the work of the completed ARCBC project. ACB, an intergovernmental regional center of excellence that facilitates coordination among the members of ASEAN and with relevant national governments, regional and international organizations on the conservation and sustainable use of biological diversity, is at the forefront of conserving biodiversity in Southeast Asia.

It is the first regional initiative to save the ASEAN's rich but highly threatened biodiversity.

With its slogan "Conserving Biodiversity, Saving Humanity," ACB performs its mandate through five components:

programme development and policy coordination, human and institutional capacity development, biodiversity information management, public and leadership awareness of biodiversity values, and sustainable financing mechanism.

To leverage resources, ACB also forms alliances with key stakeholders in the regional and global levels, including the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA). Both ACB and PEMSEA have a common objective of promoting the preservation of marine and coastal species and sustainable use of biodiversity in Southeast Asia.

The two institutions have plans to collaborate in



The author addressing the scientific community in Los Baños, Laguna, Philippines and explaining the impact of biodiversity loss on food security.



Director Mundita Lim of the Protected Areas and Wildlife Bureau of the Department of Environment and Natural Resources, and representatives of Embassies of European Union and ASEAN countries, test ACB's newly designed website.



Experts gather in Bali, Indonesia for a workshop on Marine Gap Analysis organized by ACB to strengthen ASEAN Member States efforts to conserve their marine protected areas.

establishing and maintaining information exchange and public awareness efforts that would promote their respective mandates and activities of PEMSEA and ACB; participate in joint or complementary capacity development initiatives and other events related to the sustainable development and conservation of marine and coastal biodiversity resources and areas; explore opportunities to strengthen regional cooperation in implementing an integrated approach to biodiversity conservation; and support common advocacy efforts within the bounds of PEMSEA's and ACB's mandates.

There is an urgent need to involve all sectors to save the region's endangered biodiversity. The issue may not be as hot as politics or the global financial crisis, but massive biodiversity loss will have a huge impact on the lives of hundreds of millions if left unsolved. Our biodiversity faces a bright future if all sectors would work together to conserve it.

For more information on the ASEAN Centre for Biodiversity, its advocacy, and its programs, please contact (+6349) 5362865 and (+6349) 5361044, e-mail contact.us@aseanbiodiversity.org, or visit www.aseanbiodiversity.org.



ACB Executive Director Rodrigo U. Fuentes and the Governing Board.



Dr. Ahmed Djoghlaif, Executive Secretary of the Convention on Biological Diversity, visits ACB to discuss international cooperation in reducing biodiversity loss.



ASEAN
CENTRE FOR BIODIVERSITY



Agreement on the Establishment of the ASEAN Centre for Biodiversity

The Governments of Brunei Darussalam, the Kingdom of Cambodia, the Republic of Indonesia, the Lao People's Democratic Republic, Malaysia, the Union of Myanmar, the Republic of the Philippines, the Republic of Singapore, the Kingdom of Thailand and the Socialist Republic of Viet Nam;

Being members of the Association of Southeast Asian Nations (hereinafter referred to as "ASEAN"):

AWARE of the immense importance of the rich diversity of biological resources in the ASEAN region and its contribution to social development, economic growth, environmental protection and ecosystem services, at the national, regional and global levels;

REITERATING their commitment to conserve and sustainably use these biological resources, in accordance with national priorities, and regional and international imperatives;

RECOGNISING the valuable achievements of the ASEAN Regional Centre for Biodiversity Conservation Project (1999-2004) in promoting biodiversity conservation and sustainable use, especially in terms of networking, training, research and database management;

RECALLING the support of the ASEAN ministers responsible for the environment for the continued sustainability of the ASEAN Regional Centre for Biodiversity Conservation as embodied in the Yangon Resolution on Sustainable Development signed on 18 December 2003 in Yangon, Myanmar;

THANKING the Government of the Republic of the Philippines for hosting the ASEAN Regional Centre for Biodiversity Conservation;

WELCOMING with appreciation the offer of the Government of the Republic of the Philippines to host the ASEAN Centre

for Biodiversity to further strengthen regional cooperation on biological diversity;

DO HEREBY AGREE AS FOLLOWS:

Article 1

Establishment of the ASEAN Centre for Biodiversity

There shall be established an ASEAN Centre for Biodiversity (ACB), hereinafter referred to as the "Centre". The Centre shall have its seat in the Republic of the Philippines.

Article 2

Purpose of the Centre

The purpose of the Centre shall be to facilitate cooperation and coordination among the members of ASEAN, and with relevant national governments, regional and international organizations, on the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from the use of such biodiversity in the ASEAN region.

Article 3

Structure of the Centre

The Centre shall be composed of:

- (a) a Governing Board;
- (b) an Executive Director and such staff as shall be necessary to perform the functions of the Centre; and
- (c) such committees or subsidiary bodies as may be deemed necessary by the Governing Board.

Article 4

Governing Board

1. There shall be established a Governing Board, hereinafter

referred to as the Board, assuming overall responsibility, and accountable for the operations [of] the Centre.

2. The Board shall comprise of the members of the ASEAN Senior Officials on the Environment or their representatives and the Secretary General of ASEAN or his representative.
3. The Board may invite observers as it deems appropriate to attend the Board Meetings.
4. The Board shall be chaired by the Chairman of the ASEAN Senior Officials on the Environment. The Executive Director shall act as Secretary to the Board.
5. The Board shall meet at least once a year. Extra-ordinary meetings may be called by the Chairman at the request of any member of the Board, provided that such request is supported by at least one other member.
6. The Board shall report to the ASEAN ministers responsible for the environment.

Article 5 Functions of the Board

The functions of the Board shall be to:

- (a) provide policy guidance and directions, and undertake overall supervision of the operations of the Centre;
- (b) approve the organizational structure and staff requirements for the Centre;
- (c) approve the rules and procedures for the conduct of the meetings or proceedings of the Board, its committees or subsidiary bodies;
- (d) approve the rules, procedures and regulations for the operations of the Centre, including the staff and financial rules;
- (e) approve the business plan, including the annual work programmes and budget of the Centre and monitor their implementation;
- (f) appoint an Executive Director for the Centre and determine the terms and conditions for the position, and confirm the appointments of key professional staff;
- (g) administer the funds entrusted to the Centre, and to approve the rules and procedures for the management of such funds;
- (h) perform any other function as and when considered necessary to achieve the purpose under Article 2 of this Agreement.

Article 6 Executive Director

1. The Executive Director shall be responsible and accountable for the day-to-day operations of the Centre and any other function that may be directed by the Board.
2. The Executive Director shall be a citizen of an ASEAN member country, and have a term of office of three (3) years, which may be extended at the discretion of the Board. The Executive Director shall be selected by open recruitment. However, Member Countries that opt for nomination will conduct their own selection process and nominate suitable candidate(s) for the consideration of the Governing Board.
3. The Executive Director shall be assisted by professional and supporting staff to carry out the assigned functions and responsibilities as approved by the Board.
4. The Board shall designate an officer to serve as the Acting Executive Director if the office of the Executive Director should become vacant, or if he/she is deemed by the Board as unable to discharge his/her duties. The Acting Executive Director shall have the capacity to exercise all the powers of the Executive Director pursuant to this present Agreement.
5. The Executive Director shall:
 - (a) administer the Centre and its programmes with a view to ensuring that the Centre fulfils its purpose;
 - (b) prepare annual work programmes, plans, budgets, financial statements or any other documents for the consideration of the Board;
 - (c) report on the implementation of the activities of the Centre to the Board;
 - (d) appoint, subject to the confirmation of the Board, manage and supervise key professional staff of the Centre;
 - (e) appoint, manage and supervise supporting staff, consultants and experts to the Centre;
 - (f) develop and implement strategies to ensure appropriate funding for programmes and institutional

activities relevant to the purpose and functions of the Centre; and

- (g) perform such other duties as may be required by the Board.

Article 7
Host Government Obligations

1. As a commitment to the Centre, the Government of the Republic of the Philippines, hereinafter referred to as the Host Government, shall provide at its own cost, adequate premises, operational facilities and such other facilities needed for the operations of the Centre.
2. The Host Government shall also grant to the Centre and its staff privileges and immunities as may be necessary for the performance of their duties and functions similar to those accorded to the ASEAN Secretariat and its staff and in accordance with the laws and regulations prevailing in the country of the Host Government.

Article 8
Financial Arrangements

1. There shall be established an ASEAN Biodiversity Fund, hereinafter referred to as the Fund.
2. The Fund shall be utilised to meet the expenses necessary to implement the activities required to fulfill the purpose of the Centre, as approved by the Board.
3. The ASEAN member countries may make voluntary contributions to the Fund.
4. The Fund shall be open to contributions from other governments and organizations, as approved by the Board.

Article 9
Juridical Personality

The Centre shall possess juridical personality and have the capacity to:

- (a) contract;
- (b) acquire and dispose of movable and immovable property; and
- (c) institute legal proceedings.

Article 10
Amendments

Any member country may propose amendments to this Agreement. Such amendments, when approved by all Member Countries, shall come into force on such date as may be agreed upon.

Article 11
Review and Termination

1. This Agreement shall be reviewed at least every five years by the Member Countries to this Agreement.
2. This Agreement shall be terminated by agreement of all the ASEAN member countries and shall be conducted in a manner as not to prejudice their respective interests in this matter. Upon termination of this Agreement, the Centre shall stand dissolved.
3. Upon the dissolution of the Centre, the disposal of the assets and liabilities of the Centre shall be determined jointly by all ASEAN Member Countries.

Article 12
Settlement of Disputes

Any dispute concerning the interpretation or implementation of the Agreement shall be settled amicably through consultation or negotiation.

Article 13
Status of Annexes to the Agreement

The Annexes attached to this Agreement shall constitute an integral part of the Agreement.

Article 14
Final Provisions

1. This Agreement shall be subject to ratification by the ASEAN member countries and shall enter into force on the deposit of the sixth instrument of ratification with the Secretary General of ASEAN.
2. The Agreement shall be deposited with the Secretary General of ASEAN who shall promptly furnish a certified copy thereof to each ASEAN member country.

IN WITNESS WHEREOF the undersigned, being duly authorized by their respective Governments have signed this Agreement.

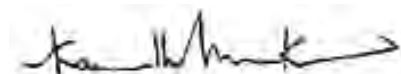
Done at the respective capitals of ASEAN member countries on the dates indicated.

For the Government of Brunei Darussalam,



H.E. PEHIN DATO SERI SETIA DR. AWANG HAJI AHMAD BIN HAJI JUMAT
Minister of Development
Date: 19.04.2005

For the Government of the Kingdom of Cambodia,



H.E. DR. MOK MARETH
Senior Minister, Minister for the Environment
Date: 28-04-2005

For the Government of the Republic of Indonesia,



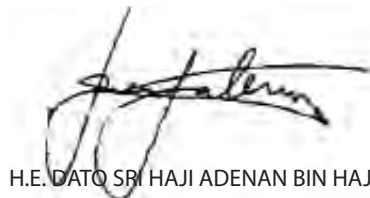
H.E. MR. RACHMAT WITOLAR
Minister for the Environment
Date: 31-08-2005

For the Government of the Lao People's Democratic Republic,



H.E. PROF. DR. BOUNTIEM PHISSAMAY
Minister to Prime Minister's Office
Chairman of Science, Technology and Environment Agency
Date: 4.04.2005

For the Government of Malaysia,



H.E. DATO SRI HAJI ADENAN BIN HAJI SATEM
Minister of Natural Resources and Environment
Date: 26.07.2005

For the Government of the Union of Myanmar,



H.E. U NYAN WIN
Chairman of the National Commission for Environmental Affairs and
Minister for Foreign Affairs
Date: 17.03.2005

For the Government of the Republic of the Philippines,



H.E. MR. MICHAEL T. DEFENSOR
Secretary of Environment and Natural Resources
Date: 2005

For the Government of the Republic of Singapore



H.E. DR. YAACOB IBRAHIM
Minister for the Environment and Water Resources
Date: 08.05.2005

For the Government of the Kingdom of Thailand



H.E. MR. YONGYUT TIYAPAIKAT
Minister of Natural Resources and Environment
Date: 12.08.2005

For the Government of the Socialist Republic of Viet Nam



H.E. MR. MAI AI TRUC
Minister of Natural Resources and Environment
Date: 27.08.2005

By Darren Raeburn, World Vision Australia
Katie Chalk, World Vision Asia-Pacific

Half the water, double the fish; the sanctuary that brought security

As a country of more than 7,000 islands, and 2.2 million km² of sea – including extensive coral reefs – it is hardly surprising that the Philippines relies on its coasts for livelihood, lifestyle and sustenance. The Philippines ranks 11th on the list of fish and seafood producing countries, the vast majority plucked from tropical waters close to shore. More than 2.6 million tonnes of fish, crustaceans, molluscs and aquatic plants are harvested each year.

Some of these “fruits of the sea” are destined for canneries or export, and some for faraway city markets, but still much of it never leaves its province of origin. Fish and seafood have traditionally been plentiful, are usually taken for granted and are central to Filipino diets, culture, livelihoods and the people’s very identity.

Exactly when the balance between dependency and sustainability in marine food security was tipped in the Philippines is arguable. But the effects are not. A fast-growing population together with ever-growing export seafood contracts has meant pressure on this nation’s natural food bank. In the search for quick profit, illegal quotas, dynamite or cyanide fishing, “commercial” or large-scale fishing (also often illegal), and haphazard monitoring of activities or policing of legal provisions have led to widespread damage in fish breeding areas.

In addition, associated coastal degradation caused by extraction of rocks, sand and coral for construction, pollution from rivers, coastal runoff and shipping, and clearing of mangrove forests, has reduced the quality of the marine environment, further destroying the fish and seafood numbers and



Photo by Wong Chi Keung

The devastation caused by over-dependency on the Philippines' unique "fish-basket" can be measured not just in terms of the environment, but also in the deterioration of livelihoods once supported in abundance by fishing.

in many cases, making what food stocks remained harmful for human consumption.

The devastation caused by over-dependency on the Philippines' unique "fish-basket" can be measured not just in terms of the environment, but also in the deterioration of livelihoods once supported in abundance by fishing.

In years not too distant, Filipino fishing workers in areas, such as Cebu and Lamon Bay off the east coast of Luzon traditionally would catch more than 50 kg per day. Twice this was common. But by the mid 1990s, fisherfolk in the same areas reported they were lucky to be able to catch a kilogram a day — not even enough to feed their own families, let alone sell the excess. Many fisherfolk could return to shore for many days in succession without catching a single edible fish.

The pressure for struggling fishers to feed their families and garner an income led to a surge in illegal fishing and ever increasing destructive activities, further exacerbating the situation and the geographical spread of the damage.

World Vision has been working to strengthen coastal communities in the Philippines for over 50 years. In 2002, they began integrated marine resource programmes in two areas that had reported some of the largest drop in fish catches: Lamon Bay in Luzon and Tabogon in Cebu. Both communities depended on their relationship with the sea for survival; without it there would be no chance for community development.

Prior to these programmes, World Vision's expertise had lain in education,

health and emergency relief, rather than environmental or marine programmes. But for World Vision to tackle the core issues facing the communities —

livelihood, food security and nutrition — it was time to learn how to respond to the most pressing cause of these communities' poverty, their depleted ocean.

The Lamon Bay Plan covered an area greater than 200 km² while the Tabogon Plan covered an area less than 15 km². Both have shown measurable and remarkable progress, but for the sake of brevity, this article will detail the less complex of the two: the Tabogon Plan.

Sea runs dry in Tabogon

In the past, the extensive coral reef and marine environments off Tabogon had been noted as areas of high ecological diversity, with local communities assured of food and livelihood from the bounty of the sea.

However, by 2002, rampant illegal fishing and destructive practices had drastically reduced the ability of fishing communities to support themselves or feed their families. Large-scale commercial fishing, although banned by law from nearshore areas, had been common, further depleting fish stocks and damaging the environment. Monitoring of fishing activities by relevant authorities was minimal, and most fisherfolk either did not know or ignored local environmental laws.

For a community in such a crisis, a radical change was called for: the all-important fish breeding grounds were to be protected in a 'marine sanctuary', policed by the local community and legitimized by the local authority. Around 50 percent of traditional fishing territory was to be declared off-limits and marked out by research to identify the richest breeding

grounds. There was no scientific formula to measure success, just a common sense conclusion that the sanctuary would give fish a place to hide, breed and recover, then return to stock the licensed fishing waters. Half the water, but double the fish.

In the face of hunger and economic despair, an environmental protection policy was likely to fall on deliberately deaf ears. The key to success was in leadership, shared jointly between the community and the government. Local community members were asked to become volunteer "fish wardens" who would take responsibility for the safety of the breeding stock by patrolling the waters 24 hours a day. Therefore, while the local government acted to prohibit all fishing, boating, tourism activities and even swimming in the sanctuary, the community actively policed these prohibitions.

This was no soft approach. The local government partnered with World Vision to provide motor boats to increase the fish wardens' response time and effectiveness. Fines for non-compliance were substantial; in addition, fisherfolk found to be flouting the ordinances could have their boats or any other fishing resources impounded and sold.

Less controversial but equally as important, the coastal resource management plan also includes



mangrove rehabilitation, training of local communities in fishing rights and laws, coastal zone management and watershed management.

With the majority of locals dependent on the fishing industry, the project also provided opportunities for people to move into other forms of livelihood, including sustainable farming of oysters and seaweed, technical training such as information technology (IT) training, construction, garment making and even ecotourism.

While World Vision provided technical expertise to draw up the goals and



directions, and support to community groups to implement their decisions, most of the labor came from the community, and the government provided the equipment. As with many of World Vision's most successful community-driven projects, the economic investment was minimal, the driving force coming from local committees and individuals who believed in the benefits that these drastic measures would one day bring.

Community climbs aboard

World Vision had already been working in Tabogon for many years when the 'ambitious' plan for a sanctuary

was proposed. Initially, many in the community were extremely skeptical. Psychologically, the sea had always belonged to them, in addition, the best breeding spots, of course, were also the best fishing spots. Enforced protection met with deep resentment by some in the community.

During the early years after the sanctuary was introduced, community fish wardens, despite the backing of local authorities, reported finding up to 80 fishing boats in the marine sanctuary in a single night. Harsh fines and confiscation of equipment were no match for the backlash from a community that felt their rights were threatened. Sabotage for ideological as well as economic reasons was a real possibility.

One fisher, Romie Maloloy, can still clearly state the reasons why he was reluctant to join the environmental battle.

"Honestly, I was involved in illegal fishing activities... and I was against the establishment of the sanctuary. My reason was

that I couldn't make a living from the area I was allowed to fish in. In those days fish were very difficult to catch because of overfishing and pollution."

"A year later, I still didn't believe the sanctuary worked – they showed us a video but there was no sign of fish and the coral had deteriorated."

Maloloy continued his illegal activities in the face of increasing penalties and community disapproval. "I was apprehended many times and paid what I had to for my penalty. But I never felt guilty, and I earned more in fishing than I paid in penalties!"

It has taken four years but Maloloy says he is finally a champion of the sanctuary, after members of the sanctuary committee asked him to become a fish warden himself. The sense of responsibility finally hit home.

"Now I understand the whole process of the CRM (coastal resource management) program," he says. "I am a member of the marine sanctuary management committee and I safeguard and sustain the programme."

According to Lota Montejo, the chairwoman of Tabogon's main sanctuary, there were many like Maloloy in the early years of the programme.

"Some fishers intentionally fished in the sanctuary because of the abundance of fish in comparison. Before it had not even been a fishing ground, now suddenly it was the main source of fishing activity. Then suddenly there were 60 to 80 boats sighted there every day."

The occupants of these boats made little effort to disguise their identities and were well known to the government and community. Rather than continuing to criminalize them, there began a slow process of changing their minds, not just through penalties but also through persuasion and proof.

"The impact of our marine sanctuary has changed a lot of perceptions in the community," says Montejo. "Many started with negative impressions, but now they are positive because of the increase in the legal fish catch. The most recent assessment in November this year [2008] shows us clearly that the marine resources have improved."

Tabogon's benefits emerge from the ocean

The ability to provide proof was integral to the success of the sanctuary plan. It came early; within a couple of years,

despite the halving of fishing waters, the yield had indeed doubled from its 2002 low point. By 2006, the catch in the same area had increased to 10 kg per fisher.

This was a turning point for the community. Since then, public support for policing has increased substantially in line with strong community adherence to the principles of local environmental management.

Lately, fisherfolk have been reporting catches of 25 kg/day. With the success of the original marine sanctuary, the community and the local government have entered into an agreement to increase the number of sanctuaries around Tabogon from one to three.

In addition, other neighboring communities, previously unassociated with World Vision, are seeking advice on how to introduce similar coastal management plans. Not only will these initiatives increase protection of the Philippines' most vital resource, but they will further relieve pressure on Tabogon waters where these communities have been fishing.

The changed fortunes of the communities of Tabogon are spilling over into all aspects of World Vision's development work there. Increased fish catches and better availability of food and other essentials to families have restored a sense of optimism and pride, as well as badly-needed self-worth and confidence to many members of the community.

One partnership of particular note is between fishing communities and their local government. Prior to the coastal management resource plan (CRMP), this relationship was ad hoc. But now there is a strong working relationship based on respect and consultation towards common goals. Both view each other as proactive and responsive on issues concerning the area's well-being.

The impact of land-based livelihoods on marine livelihoods, and the importance of coastal zone management and watershed management, has led to an understanding that no community is isolated from the actions of others. Additionally, the training in non-fishing industries has meant that the community is now not as dependent on fishing for either food or income. Nowadays, oyster production, seaweed production, welding, land agriculture and other livelihoods are seeing a significant increase in participation and thus in community value.

A nascent tourism industry has been another promising outcome for the people of Tabogon. The marine sanctuary has allowed extensive coral reefs, now with abundant fish and other sea creatures, to thrive. Previously there was no tourism activity connected to this reef. Now, the fees charged to tourists to view the marine sanctuary areas are helping with the financial sustainability of the CRM activities.

The Lamon Bay project is even more extensive, including a stronger mangrove reforestation component, a large land reforestation programme and significant training and resource provision to relevant fishing authorities to enforce more national-based laws such as effective licensing (of fishing operations). Critically, because the Lamon Bay area had experienced even more widespread destruction caused by dynamite and cyanide fishing, the rehabilitation plan included the laying of substantial artificial reefs to assist in the breeding cycle of many fish species in the area.

The efforts have paid off. An independent European Union-funded assessment of fishing yields in 2006

found that self-reported fish catches in Lamon Bay had already increased to around 10-15 kg/day (again up from 0-1 kg in 2002). Anecdotal evidence from fisherfolk in 2008 suggests that, like in Tabogon, fish catches are approaching 25 kg/day and that illegal fishing practices have decreased considerably.

Taking the model forward

Lightheartedly, the chairman of Tabogon's third marine sanctuary, Mr. Dagino Montemor, recently listed his main concern with the project "that someday fishers' boats will not be able



to pass through the sanctuary even with passage provided, due to the enormous growth of corals..." His attitude is welcome, because so much of the ongoing sustainability of these achievements now lies in the hands of the community. Despite the success of these integrated CRMPs both in human and environmental terms, certain challenges remain to be addressed.

Assessments reveal that neither the Lamon Bay nor the Tabogon communities view environmental protection as a priority outcome of the CRMP. For both communities, the desire

for food security and the restoration of livelihoods and lifestyles are the driving factors behind the success of the activities. Commitment to the value of the environment in its own right, although growing, remains weak in both communities.

Should fish numbers decline again, which could feasibly happen through disease, pollution drift or algal blooms, such as red tide reported in other areas of northern Cebu recently, support for the marine sanctuary could drop significantly.

Even now, a challenge to the sanctuaries lies in the increasingly lucrative nature of the fishing industry. As a result of overfishing globally, rising prices and falling stocks of seafood mean that illegal fishing activities have become even more profitable. Increased pools of cash for illegal and commercial fishing may increase opportunities for corruption where communities and individuals are poor.

Groups involved in illegal and commercial fishing may have the economic power to purchase advanced sonar equipment to better detect schools of fish and faster boats than those used by the community fish wardens. To keep up, the wardens need to upgrade boats, use night vision equipment, obtain sophisticated IT equipment, even build lighthouses and other anti-poaching infrastructure, none of which the coastal communities of the Philippines can afford.

In terms of true sustainability, one other significant challenge merits acknowledgement: the as yet unanswered question of the effect of climate change on coral reefs and marine environments in the Philippines. Although coral reefs are acknowledged to be of great benefit as a “carbon sink” (and therefore protection of coral reefs is of benefit to global efforts to combat

climate change), they are also very vulnerable to slight changes in ocean temperatures, ocean acidity and water height.

Assessment by marine experts on the current environmental effects of this project has not yet occurred, while research to predict the impact of climate change is desperately needed. Even then, it may be impossible to accurately link findings to specific local environments, or to convince local communities of any changes to plan.

Anecdotally, though, the proof is there, reflected not only in stronger food security but also in the life of the sea. More than 60 fish species together with the region’s dolphins, rays and turtles are returning in numbers to the waters off Tabogon — an unusual and rewarding side effect for a project designed to protect and nurture the community’s children!

World Vision plans to continue and expand its marine food security projects in the Philippines. Alongside this, the importance of the Philippine archipelago in marine resource management needs greater research and championing internationally, and messages of protection need to be spread nationwide.

Many communities, not only around Cebu but also in the many islands of the Philippines, still find themselves in very similar situations to that of Lamon Bay and Tabogon before a CRM approach was initiated. The destruction of world-class coral reefs and other marine environments still continue through illegal activities such as dynamite and cyanide fishing, as does overfishing by large illegal commercial vessels.

Addressing this may not seem to be within the realm of a child-focused development agency like World Vision. But Millennium Development Goal Seven calls for environmental

sustainability as a key factor in addressing poverty. One of the biggest challenges to child health and protection occurs when contemporary populations lose their balance with the environment, and take from it without protection and restoration.

For World Vision, the success of coastal resource management in what for us developmentally speaking are “unchartered waters” shows not just what is possible, but also what is necessary — a blurring of the lines of development to acknowledge sustainability as a key responsibility.

The Tabogon Marine Sanctuary Plan was a joint initiative between:

- Local Government Unit of Tabogon
- SOGOD Incorporated (community-based organization in partnership with World Vision)
- Bureau of Fisheries and Aquatic Resources - Province of Cebu
- Japan International Cooperation Agency
- Environmental Legal Assistance Center, Philippines
- Department of Environment and Natural Resources, Philippines

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- World Vision Development Foundation. Annual Reports and Project Evaluations. World Vision Development Foundation. <http://www.worldvision.org>.

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Fisheries Governance and Training in the Pacific Islands Region



Introduction

Great geographic, demographic and developmental diversity exist within the Pacific Islands region. These differences extend to the climate, geological resources, topographical features, soil types, mineral and water availability, extent of coral reefs and diversity of terrestrial, freshwater and marine flora and fauna. The Pacific Islands region

comprises some 23 states covering more than 30 million km² of the Pacific Ocean and includes all of the island nations or territories of the tropical Pacific Ocean, as well as all associated offshore and ocean areas that are considered part of the “cultural areas” of Melanesia, Polynesia and Micronesia. Some “groups” or countries, like Easter Island, Guam, Kosrae, Nauru and Niue, consist of one single small island. Some,

like Fiji, Tonga and French Polynesia, are archipelagic states comprised of numerous large and small highly dispersed islands. Others like Papua New Guinea consist of parts of very large, high continental islands, plus countless offshore large and small islands. The total land areas vary from 12 to 26 km² for groups of low-lying coral-limestone islands like Tokelau and Tuvalu to over 400,000 km² for the

continental island areas like Papua New Guinea.

The Pacific Islands region is the world's most important fishery. The tuna fishery alone is worth US\$1.7 billion annually, although the returns to the Pacific Islands through licensing agreements are small compared with the value. One third of the world's tuna is captured in the region, which includes 40-60 percent of the supply to tuna canneries and 30 percent of Japan's sashimi market (Fisheries Task Force, 2002). The institutional framework for the governance of fisheries within the Pacific Islands region concerns two very different components: the first relates to the enormous oceanic fishery, and the second to coastal fishery.

Oceanic Fisheries — fishes that know no boundaries

The fishery for tropical tuna is carried out mainly by distant-water fishing vessels of non-Pacific Island nations, within the Exclusive Economic Zones (EEZs) of, and high seas adjacent to, Pacific Island nations. Within the Secretariat of the Pacific Community (SPC) Fisheries Statistical Area, excluding Philippines and Indonesian

waters, this fishery currently catches around one million tonnes/year whole weight of skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*) and albacore tuna (*Thunnus alalunga*) (Adams, 1996).

These migratory fish stocks do not recognize territorial boundaries so they are governed and managed through a number of regional and international bodies and agreements overseen by the Forum Fisheries Agency (FFA) based in Honiara, Solomon Islands, the Secretariat of the Pacific Community (SPC) based in Noumea (Oceanic Fisheries Programme), New Caledonia, and the Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean established in 2004 and based in Pohnpei, Federated States of Micronesia.

The FFA advises members on the legal and technical aspects of delimiting their maritime boundaries, and in drafting of appropriate legislation to protect stocks. Important initiatives of the FFA have included the negotiation of the United States — South Pacific

regional Fisheries Treaty, assistance in drawing up the Convention for the Prohibition of Fishing with Long Drift Nets in the South Pacific, and assistance to members in drawing up bilateral agreements with distant water fishing nations (DWFNs). FFA maintains a database on catches and receives, collates and disseminates information on fishing activities in the region (South and Veitayaki, 1999).

The SPC's Oceanic Fisheries Programme plays a critical role in the areas of catch statistics, stock assessment and monitoring of migratory fish stocks, and in research on populations and the environmental conditions that influence them. The SPC also oversees an observer programme for the fishery.

The Tuna Commission manages and monitors the Pacific region's tuna stock and enforces controls in international waters beyond each country's 200 nautical mile maritime boundaries. The Commission is founded on the premise of the United Nations Convention on the Law of the Sea and the subsequent agreement relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. This subsequently led to the



Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean.

Coastal Fisheries — vital to the region's food security

The coastal fisheries of the region include semi-commercial, artisanal and subsistence fishing, stock replenishment (such as Trochus and Giant Clams), and the development of aquaculture.

Coastal fisheries for domestic consumption is a multispecies fishery, mainly reef and lagoon, carried out primarily by Pacific Island nationals in the small-scale commercial and artisanal sectors, using hook and line, net, spear, traditional trap or weir and hand-collection. This interlinked series of fisheries takes around 90,000 tonnes/year, of several hundred species of fish and invertebrates, within the territorial waters of SPC Island member countries and territories (Adams, 1996).

Coastal fisheries for export covers a more limited range of species, generally those which are not consumed locally and/or which obtain a high price overseas, and are exported, mainly to Chinese-speaking areas of the world. These fisheries are carried out mainly by Pacific Islanders and are relatively low in total volume: probably less than 10,000 tonnes/year exported weight, within the territorial waters of SPC Island member countries and territories (Adams, 1996).

The governance of aquaculture is not a major issue in the Pacific Islands region at present. Aquaculture is of minor importance compared to capture fisheries, and has not yet led to major contention. However, it is an issue that will need to be increasingly addressed in the future, and the region will need to be prepared to adapt the best of aquaculture governance systems evolved in other regions (Adams, 1996).

The SPC's Coastal Fisheries Programme has been involved in coastal fisheries matters since 1952. Its assistance to Pacific Islands fisheries development has evolved in an adaptive manner over the past 50 years. Although the changing priorities of external sources of development assistance have inevitably had a large influence on the extent of its work, the activity that has now become the Coastal Fisheries Programme fairly closely reflects the development of Pacific Island fisheries services themselves, from their very inception, through decolonization, to maturity. Although it has always striven to maintain a regional overview and provide a medium for sharing experience and information, its major function has been to fill gaps and support national fishery development needs where more narrowly-focused programmes, either national or regional, fail to reach. Coastal fisheries at the national level are the responsibility of governments (www.spc.int/coastfish/historical.htm).

Training Approaches

Oceanic Fisheries

The Food and Agriculture Organization (FAO) Conference adopted the Code of Conduct for Responsible Fisheries in 1995. Although not legally binding, the Code of Conduct has become the most authoritative reference for fisheries managers. The Code urges all governments and stakeholders to work towards the implementation of responsible practices in the fisheries sector as a means of promoting food and economic security and sustainable livelihoods.

The Code of Conduct resulted from major international efforts in the early 1990s to establish effective management arrangements for the sustainable use of fish stocks in all oceans. Partly in response to concerns about the impact of destructive fishing practices such as



driftnet fishing in the Pacific Islands, the FAO and United Nations placed responsible fisheries prominently on its international fisheries agenda. The Pacific Islands region responded, in collaboration with the United Nations Division for Ocean Affairs (DOALOS), and the UN TRAIN-SEA-COAST Programme to create a course on Responsible Fisheries for the Pacific Islands region. FAO (Rome), the Secretariat for the Pacific Regional Environment Programme (SPREP), FFA and the University of the South Pacific teamed up with the International Ocean Institute (IOI) in the development of the course.

The Course uses the Code of Conduct as a vehicle to review arrangements and options for the management of fisheries in the Pacific Islands region. As such, discussions are not confined to the Code. Other international arrangements, such as the UN Law of the Sea, the UN Fish Stocks Agreement, Harmonised Minimum Terms and Conditions and the Niue Treaty on Cooperation in Fisheries Surveillance and Law Enforcement in the Pacific Islands Region, among others, are discussed to illustrate particular issues presented in this Course.



The broad focus for this Course is the responsible management of oceanic fisheries resources. The focus on oceanic issues reflects the continuing dynamic state of fisheries management arrangements in the Pacific Islands region and the significance of oceanic fisheries resources as the region's primary renewable resource. It also underlines the importance of maintaining an active role for fisheries managers in on-going negotiations to establish effective conservation and management arrangements for regional fish stocks.

While principally targeting oceanic fisheries, this Course also draws the attention of fisheries managers to the potential of the Code, the associated Technical Guidelines and International Plans of Action to support fisheries management initiatives across the broad spectrum of needs encountered in Pacific Islands fisheries — coastal and oceanic. The Course has been offered

three times and consists of six modules:

- Management Advice
- Fisheries Management Policies, Strategies and Plans
- Management of Legal Issues
- Stakeholder Roles
- Regulating and Monitoring Fishing Activity
- Administrative Functions

Coastal Fisheries

Within the Pacific Islands region, the International Ocean Institute (IOI) and its host, the University of the South Pacific's Marine Studies Programme, have played a key role in the development of training programmes supportive of the coastal fisheries sector. The driving force behind the IOI's training programmes is the need to directly impact decisionmakers from government, the private sector and nongovernmental organizations (NGOs) with ocean or coastal mandates, on their nation's obligations under UNCLOS, and under the various conventions and agreements emanating from UNCED. Thus, there are common iterative themes in the training programmes that place the IOI stamp upon them. IOI-Pacific Islands has developed and offered the following courses:

- Management and Development of Coastal Fisheries
- Environmental and Resource Economics
- Sustainable use of Fisheries
- Small Islands
- Integrated Coastal Zone Management
- Quantitative Resource Biology

Effectiveness of Courses

The UN and IOI programmes stress the importance of sharing and networking courses and modules; this is an excellent way of avoiding duplication of effort. Mechanisms exist for the adaptation

of materials for a specific location, and for their translation to other languages. The Coordination Units of all the UN programmes offer assurance of quality control, facilitate networking, and assist in the evaluation of materials. The training programmes are hosted by academic or training institutions, which benefit from the learned methodology and from the opportunity to adapt the training courses to their own specific needs. An example would be the Marine Studies Programme of the University of the South Pacific, where two courses developed by IOI-South Pacific on Integrated Coastal Management, and Environmental and Resource Economics, have subsequently been adapted as undergraduate courses. Furthermore, the TRAIN-X methodology, while radically different from the usual teaching methods at a university, has proved to be a very valuable tool in the improvement of teaching by those staff members who have undertaken the TRAIN-X training.

Fisheries Management and Marine Protected Areas

Coastal fisheries management in the Pacific Islands region is a national responsibility overseen by national governments. With the support of governments, it is now strongly linked to the establishment of Marine Protected Areas (MPAs). Of the more than 400 MPAs in the Pacific Islands region (Pascal, et al., 2008), the vast majority are predicated on the need to protect declining and overfished coastal resources, an important food security issue for the resource owners. The majority of these MPAs is community-driven, and utilizes community-based management strategies, or co-management strategies. Government, NGOs (local, regional and international) and in a few cases, the private sector are among the partners involved in the management of these MPAs. The locally managed marine area programme (LMMA) which originated in Fiji, has

now spread to other Pacific islands, and beyond to Southeast Asia, with a total of 342 sites (2007: www.Immanetwork.org). An LMMA is defined as “An area of nearshore waters and coastal resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside or are based in the immediate area.” (Govan, et al., 2008). This is a novel approach to conservation in which communities play the lead role in project implementation and monitoring instead of scientists or government officials. The project has won several international awards for this innovative approach. The LMMA has developed a training programme designed to provide stakeholders with the necessary MPA management and monitoring skills.

While the jury is still out on how

sustainable these reserves are in the long term, and how effective they are in protecting fish stocks, they represent a strong community response on the importance of coastal fisheries management.

Two courses on MPAs have been promoted by the IO’s OceanLearn Programme, which was established to coordinate the IO’s capacity-building programs (www.oceanlearn.net). One, developed jointly with UN/DOALOS and using the TRAIN-SEA-COAST Methodology, was first offered in the Solomon Islands in 2007: *Development, Implementation and Management of Marine Protected Areas* (Figure 1). Inevitably, substantial parts of the course relate to coastal fisheries management. A second course offered jointly by the United States National Oceanographic and Atmospheric Administration (NOAA) National Marine Sanctuaries Program (Pacific Islands

Region), and OceanLearn also deals with Marine Protected Area Management, and is more geared towards the needs of actual MPA managers. Fisheries management is integral to the course, which is organized as follows:

- Overview of the Pacific Islands
- Introduction to MPAs
- MPAs and coastal management, and
- MPA networks

The course is highly participatory, with input from participants who provide case studies from their respective countries. It was first offered in Fiji in 2008.

Samoa’s Village Fisheries Management Plan

Unique among fisheries management initiatives in the Pacific is the Village Fisheries Management Plan, developed in Samoa (King and Fa’asili, .1999).

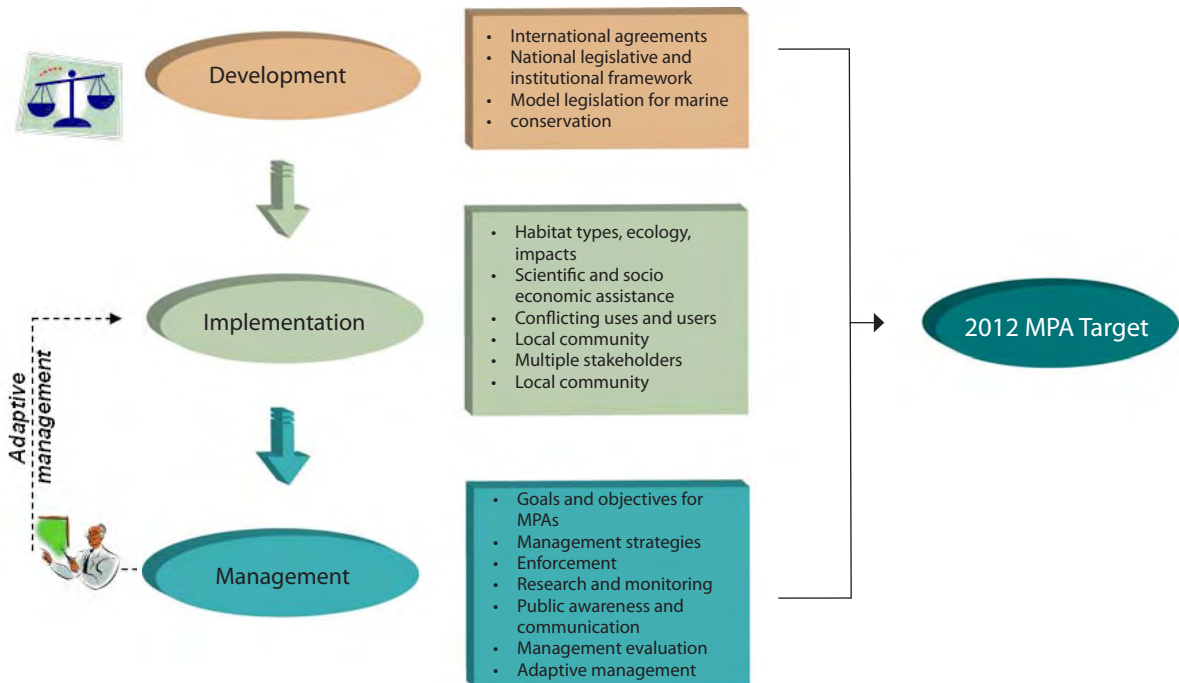


Figure 1. The UN/DOALOS/OceanLearn MPA course consists of three distinct modules that present in a sequential manner the process of developing, implementing and managing sustainable and successful MPAs (source: Training Manual, Development, Implementation and Management of Marine Protected Areas. UN/DOALOS/OceanLearn, 2007).

The coastal and marine ecosystems of Samoa have been a mainstay for the people over many generations. Over the last 50 years, rapid development has led to population explosion, and serious changes to traditional living. Market economies became a dominating force impacting adversely on the traditional social setting and obligations. The Fisheries Act of 1988 and Fisheries Regulations 1995 were enacted to try and manage the fisheries resources.

In recognition of the shift in Samoa's modus operandi, the Government now encourages the participation of the *fono* (council of chiefs) and the role of other users (i.e., the untitled men and the women's group) in decisionmaking. Separate meetings allow for a free flow of discussions, and a representative from each group is selected to form the Fisheries Management and Advisory Committee (FMAC). The overall objective is to develop a Fisheries Management Plan to enable the village to manage its resources.

The process can take between three months to over a year, from the initial introduction phase to the formal adoption of a Fisheries Management Plan. Villagers decide on what are the critical issues to be addressed and what solutions that they would adopt. Fish reserves are declared taboo for a period of time and enforcement is the sole undertaking of the village. The villagers impose penalties for lawbreakers equivalent to the old days, including fines of pigs, chickens or money. This initially worked well for the villagers, but proved to be a toothless tiger when the offenders are outsiders (non-village people). As clause 104 of the Constitution stipulated that all lands lying below the high water mark is public land, this meant that outsiders can fish within the village coastal zone including taboo fish reserves. Villagers found it difficult to impose their fines on members of another village. To overcome this, the Government

recognized the need for village rules to be given legal support to prevent such a loophole, and thus village-level Fisheries Bylaws were introduced. The By-laws are village specific and they often include activities that cannot be carried out within the village coast. To date 83 villages are participating with 62 agreeing to set up fish reserves as part of their Management Plan. This network of 62 reserves provides a good conservation strategy for the marine resources of Samoa.

Conclusion

The management of oceanic fisheries in the Pacific Islands region is a highly structured and regulated process, with extensive input from all stakeholders involved. The development of the UN/DOALOS OceanLearn training course has been designed to address international conventions and agreements supportive of sustainable management of highly migratory fish stocks that have immense global, regional and national significance. Almost 100 fisheries managers have successfully completed the course, but many more need to complete it: what is needed are the necessary funds for this. Regardless of the highly developed management systems in place, it is evident that the stocks of some important species within the fishery are at risk; furthermore, poaching accounts for some 40 percent of the catch.

The management and regulation of coastal fisheries is largely the responsibility of national governments, but includes heavy involvement of NGOs, and the resource owners themselves. Most of the coastal fisheries in the region are unregulated, and information on stocks is scarce. Overfishing and stock depletion have led to the formation of many MPAs in the region, and which are largely focused on fisheries management, and involve both traditional and western strategies. A variety of training courses

is available to assist stakeholders in the management of MPAs; funding limitations are the main hindrance to making them more widely available.

It remains to be seen how effective management of stocks in the high seas and in the coastal waters of Pacific Islands will be, but the signs of decline of stocks throughout the region do not portend well for future security.

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By Michael A. Kendall, Plymouth Marine Laboratory

Tropical coastal ecosystems in a high carbon dioxide world; can we predict the future?

In December 2004, a tsunami struck the coasts of Southeast Asia, causing thousands of deaths in coastal villages and substantial damage to natural resources. The tsunami hit headlines around the world, and states, international nongovernmental organizations and millions of individuals donated money and other resources to provide immediate relief and to sponsor the recovery of livelihoods and public health.

The European Union, through its EcoPro Asia programme provided funds for projects throughout the impacted area that focused on recovery; among these was Tsunami Impacts in Laem Son (TILS), a project coordinated by the Plymouth Marine

Laboratory (PML) with the Natural History Museum (NHM) in the United Kingdom and Kasetsart University of Thailand as principal partners. The principal aims of TILS were to quantify the impact of the tsunami on marine resources in the Laem Son Marine National Park in Thailand, document the subsequent recovery and provide support and information to coastal stakeholders for whom the tsunami had raised fears and doubts about the sustainability of the marine environment.

The tsunami event is in the past and while there is always the possibility that there might be another, research following its passage revealed a real lack of local and regional capacity to

anticipate and understand natural changes in coastal resources. It is now certain that we are already going through the fastest-ever period of change in the marine climate. The oceans of the world are getting warmer and are becoming more acid as carbon dioxide concentrations in both the atmosphere and the ocean increase, but yet TILS participants were very clear that in Thailand, as in other countries of the region, data to document change in the physical and biological environment were largely lacking. Without information on the speed at which the ocean is warming and the rate at which it becomes more acid, states cannot make political and managerial choices concerning adaptation or mitigation



measures which are needed to ensure that the livelihoods of the citizens are maintained. In addition to knowing the speed at which change is occurring, states also need to understand the biological nature of the changes that will occur and the impact that they will have on the goods and services that the ocean provides to mankind.

To deliver predictions on the future nature of coastal ecosystems, there is a need for predictive modeling based on reliable, comprehensive data describing physics, chemistry and biology of marine ecosystems but yet there are comparatively few regional countries that have such a capability. Where there is knowledge, it is often local and may not be well focused.

The biological resources of the Thai coast that were most severely damaged by the tsunami were the shallow water sediment environments that underpinned the productivity of rich coastal fisheries; probably the least damaged were the coral reefs. On the other hand, the knowledge-base for corals in Thailand is vast while that for soft sediments verges on insignificance. Before the tsunami there was no information on the

biology of shallow inshore sediments, with the exception of intertidal data collected by members of the TILS consortium over the previous eight years. This situation would not be unusual elsewhere in East Asia and highlights a fundamental difficulty that must be overcome if a predictive ability is to be developed; this is the absence of systematically collected whole ecosystem information. A number of international agencies have recognized this shortcoming and have funded regional and national capacity-building programs in which PML has been a key player. Nevertheless nationally funded research on sediment ecosystems, except mangroves and seagrass, remains uncommon.

The TILS project has been able to reassure stakeholders that, for the greater part, the marine ecosystem in southwest Thailand has largely recovered from the tsunami but in presenting these results, it has alerted scientists, stakeholders and the government that the ecology of the Andaman coast is liable to undergo substantial change in the coming years.

As mankind continues to burn fossil fuels, the concentration of carbon dioxide in both the atmosphere and the ocean is increasing. Atmospheric carbon dioxide acts as a greenhouse gas leading to its warming while in the ocean it dissolves and in doing so makes it more acidic. A warmer, more acid ocean is liable to lead to substantial changes in the ecology of marine ecosystems and the quality and quantity of the goods and services provided to mankind. The nature of the changes that will be brought about is uncertain and if regional governments are to plan for the coming decades they urgently need to collect knowledge for the whole ecosystem.

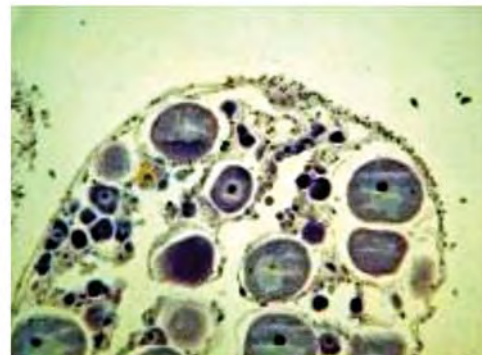
In East Asia, the need for this information is pressing. In the countries of the region there is a high dependence on the ocean for food, yet marine resources are already coming under increasing pressure as



Brittle Star (starfish).
Photo credit: Dr. Hilmar Hinz/MBA (The Marine Life Information Network, www.marlin.ac.uk).

In a recent study PML Scientists found that as the Brittle Star (*Ophiura ophiura*) is subjected to decreasing pH, it causes an acceleration in egg development, a survival response to stress.

Photo credit: David Lowe/Plymouth Marine Laboratory



the population of the coastal zone continues to rise. To make realistic plans to sustain the development of coastal states, politicians and planners need a realistic prediction of the resources that the sea will provide.

Over recent years, there have been major international research efforts to understand to consequences of climate change and ocean acidification for the provision of marine resources in which the Plymouth Marine Laboratory has played its full part. PML has undertaken research on the impacts of increased sea temperatures, on ocean acidification as well as on the interaction between them. The effects on the biology of the ocean are considerable; most species live within well-defined ranges of tolerance and if the environment changes outside these limits then a species must either move or die. If the temperature of the ocean increases, then less tolerant species will move their distribution towards cooler waters and as a consequence patterns of fisheries will change. This can already be seen happening in high latitudes, but in the tropics comparatively little is known about temperature tolerances or the likely result of the biological interactions between displaced species which makes it difficult to make hard and fast predictions. We know there will be changes in marine

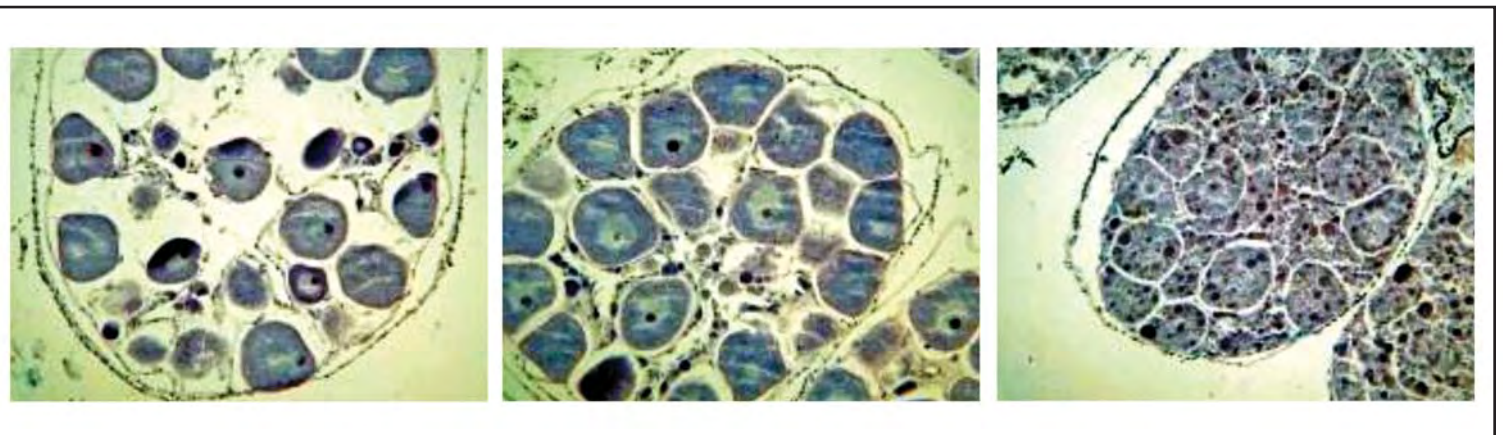
ecosystems but we don't know enough to identify the winners and losers.

As an increasing volume of carbon dioxide dissolves in the ocean, it will become more acidic and, as it does so, its fundamental chemistry and that of the species living in it will change. There will be changes in the availability of the nutrients in seawater that are needed to sustain productivity with knock-on consequences for ecosystem productivity. In animals and plants, there will be changes in basic physiology; acute experiments carried out at PML have indicated impacts on respiration, reproduction and repair following damage, all of which will have an impact on the viability of organisms and the ecosystems in which they live. Evaluating the impacts of ocean acidification is a new field of research in which PML has played a leading role but it remains in its infancy; it is vary difficult to identify the most vulnerable elements of tropical ecosystems. Finally, little attention has been paid to the likely interactions between increasing temperatures and increasing acidity which may well be more severe than the individual impacts combined.

PML scientists are not yet in a position to make firm predictions about the impacts of warmer and more acid

oceans on the goods and services delivered by the marine ecosystems of East Asia. We know there will be an impact but we cannot predict its scale or provide details of the species or ecosystem functions that will be most severely damaged. To do so, we need to develop our existing partnerships within the region and use the methods we have develop in Europe in a new tropical setting. We have already begun collaborations with partners in China and would welcome discussions elsewhere.

PML is highly aware that the threats posed to the ocean in a high carbon dioxide world and has been highly active in disseminating information to policymakers and coastal managers worldwide; as an example, PML recently held a series of workshops in China to increase awareness. In this setting, PML stressed that climate change and ocean acidification are now inevitable and that there is an urgent need to put in place strategies of adaptation and mitigation. For such policies to be formulated, the need for new, well focused, fit for purpose research was emphasized. We believe that this must be carried out on an international scale making use of the widest possible sets of skills. With its long standing background in the East Asian Region, PML looks forward to collaborating in this process.



By Dr. Jin Hwan Hwang
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From Production to Supply: Changing Perspectives in the Adaptation System for Food Security

What is missing in adaptation negotiations?

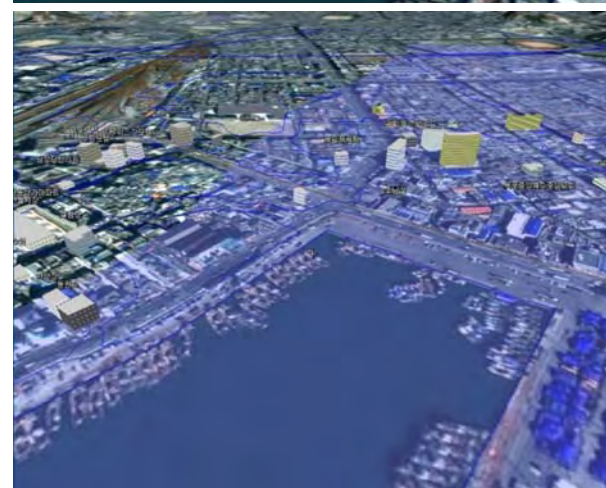
The Nairobi Work Program on Impacts, Vulnerability and Adaptation (2006) is considered the most important global achievement within the climate change convention since the Kyoto Protocol, promoting awareness on early action for climate change adaptation. It may be time to review some aspects of adaptation actions, three years after the Work Program, and think about what more will be needed in the future, even with our limited experience in implementing adaptation measures.

Adaptation, as defined by the Intergovernmental Panel on Climate Change or IPCC (2007), "is the adjustment in natural or human systems in response to actual or expected climate stimuli or their effects which moderates harm or exploits beneficial opportunities."

¹ UNFCCC, "Implementing adaptation." http://unfccc.int/adaptation/implementing_adaptation/items/2535.php

Also, the United Nations Framework Convention on Climate Change (UNFCCC) extends the definition of "adverse impact of climate change" as being "referred to in conjunction with addressing the impact of the implementation of response measures."¹ However, in implementing and describing adaptation as in the IPCC and UNFCCC definitions, there are still some missing points which are critical in preparations for a climate change-stricken world. Two main points are especially important if we are to achieve the global realization of climate change adaptation for food security.

First, we have put too much emphasis on food production rather than food supply in our efforts to address climate change adaptation for food security. Developing countries need to develop their own adaptation strategies, focusing on the food supply chain and distribution systems. Change in production is unavoidable and



Coastal urban flooding simulation. Mok-Po in Korea is very vulnerable to storm surges caused by typhoons.



United Nations Framework Convention on Climate Change, Subsidiary Bodies meeting in Bonn, Germany.

once climate changes, there will be limited increase in food production. Industrialized countries like RO Korea need to consider food self-sufficiency more than protection of food production within their own territories.

Second, there is a need for consideration of the impact of mitigation actions on adaptation.

UNFCCC defined adverse effect as including “the adverse effect of the measure for reducing GHG emissions.” Discussions on the adverse effect of climate change measures has been devoted primarily to diversification of economies of countries that produce oil-related goods. However, the mitigation measures for climate change can affect not only the oil-related economy, but also food production and supply, vis-à-vis the conversion of food crops into renewable energy, such as biofuel generated from corn.

The importance of the issues discussed above is not recognized or discussed in depth in the present adaptation regime. Existing efforts are more focused on localized measures and concepts with the view on future impacts. An adaptation system needs to consider the global

food supply chain, taking into account that climate change will directly impact on food production.

Vulnerability in food security

Impact, vulnerability and adaptation are defined differently depending on what we want to see in a system. Woodroffe (2007) discussed the concepts of vulnerability, resilience, etc., from the perspective of various fields such as ecology, disaster prevention and so forth. The definition of vulnerability in ecosystems is different from the meaning used in the study of human society relating to disasters. Sometimes, this confusion misleads to the construction of an adaptation system designed only for humans. Knowing that it is almost impossible to make migratory birds return to certain areas or to control the blooming seasons of plants with human efforts, the only way for the ecosystem to adapt to a climate-changed world is to mitigate the adverse impacts through reductions on greenhouse gas (GHG) emissions. The only thing that we can do to adapt to climate change is to change and adapt ourselves to the changed environment.

Since an ecosystem cannot be adapted through human intervention, it will not be cost-effective to plant, adapt and make tropical species indigenous in a monsoon region as the global temperature increases. If humans intervene in the ecosystem’s natural adaptation to climate change, there is the risk of causing secondary adverse impacts in addition to climate change impacts.

In the adaptation system relating to food security, controlling production is in the regime of controlling ecosystems. There are several options available such as “double cropping” or enhancing the production of indigenous species, improving irrigation systems and developing water resources, all of which may not create major secondary impact. Nevertheless, such efforts in increasing production may not be enough for a community to adapt to the changed weather. In addition, the amount of food generated as a consequence of enhanced food production via ecosystem control may not be enough for the global community to adapt to a climate-changed world. It can be inferred that the problem of food scarcity may not be solved solely by the

development and implementation of an adaptation system focused on the prevention of declining production in a climate-changed world. It is time to think of other options, except for ecosystem intervention, to keep production steady.

Developed countries are perceived as less vulnerable to climate change. This supposition enables them to focus more on the vulnerability and adaptation of less developed countries. However, this leads to more emphasis being given to food production, whereas adaptation for food security is not only influenced by production but also supply. History shows that supply causes more serious problems than production. For example, in the late 1800s, the El Niño phenomenon caused long-term drought in India, China, Brazil, etc., and resulted in a large number of deaths of over 30 to 60 million around world. This drought was not solely responsible for famine but precipitated the failure in food supply. Also, the major increase in the price of corn in 2007 was not solely caused by decrease in production, but also by the disruption in the supply market.

The view on how food will be supplied explains why industrialized countries need to take into account the adverse impact of climate change in other countries, in particular the developing and less developed countries. The supply chain of industrialized countries begins at production in developing and agricultural countries. Industrialized countries, for example, RO Korea, Japan and some European Union countries, which have a short supply of food internally, build their food supply system outside of their

territories. However, these countries' national adaptation plans are silent on how they will meet their supply needs if their main sources of supply, which are located outside of their territories, fail. For example, RO Korea imports over 60 percent of its grains, except for rice, from countries including China, Chile, the United States, etc. However, what will happen to RO Korea if climate change seriously affects the countries exporting food, or if the global market is shaken by such impacts? In this sense, industrialized countries still need to think about how and from where they can secure their food supply. This is a matter of supply rather than production and in other words, one country's production is also critical to another's own production capacity.

Such impact, which can occur in a country through the trade of goods from other places, can be termed "virtual climate change impact" or "indirect climate change impact." Indirect impact mainly occurs through food supply or the distribution system while direct impact occurs during production. While direct impact will be critical in a country that produces agricultural

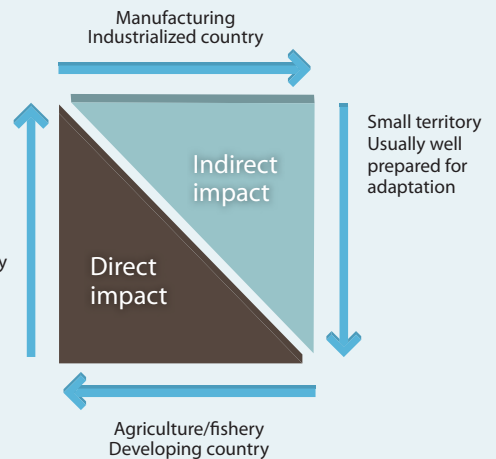


Figure 1. Indirect vs. direct impact of climate change depending on industrialization level and territory size.

or aquatic food products, indirect impact will be important to a country that imports most of its food. Generally, countries with small territories such as RO Korea and Japan may not produce enough food within their own boundaries; but countries with large territories such as the United States and Argentina² would be able to produce almost all their food. To those countries with small territories and high dependency on agriculture or fisheries, direct impact will be more important than virtual impact. Thus, the relationship between direct and indirect impact as well as the size of a country's territory and its status of industrialization would be conceptualized in such a way as shown in **Figure 1**.

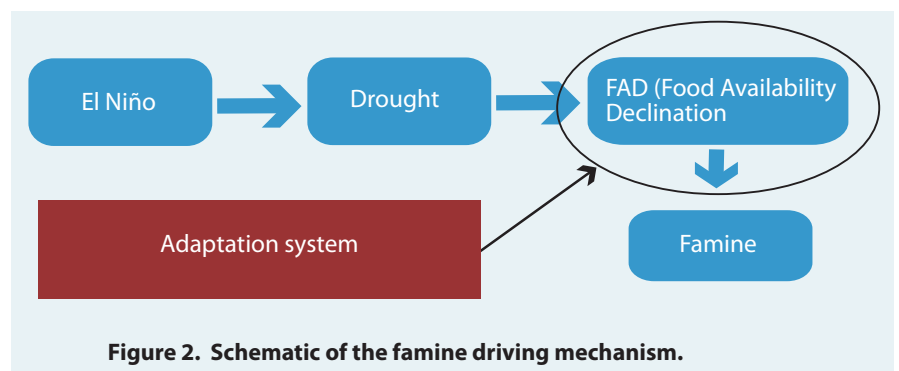


Figure 2. Schematic of the famine driving mechanism.

² These countries are still vulnerable to the competition between food and energy.

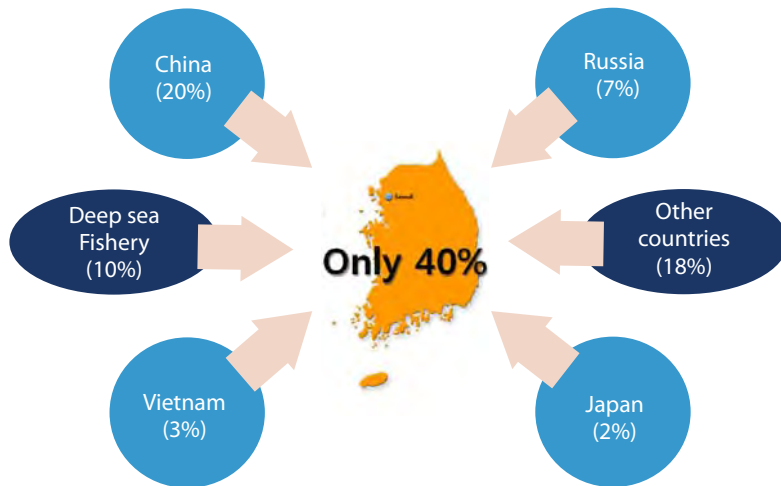


Figure 3. Aquatic food regional supply distribution.

Food Availability

Incidences of food scarcity relating to climate change or variability have been recorded in history. In the late 19th century, the strongest El Niño was observed and its impact was devastating to Asia and southern America. India lost 12 to 29 million people during the periods of 1876-1879 and 1896-1902; and China lost approximately 19.5 to 30 million people during the same periods. Worldwide, the number of the deceased was from 31 million to 63 million during that time (Davis, 2001). The number of deaths did not simply result from drought, but more from the failure in the adaptation system. El Niño caused drought and, consequently, initiated the decrease in food production. However, fatal cause lies in the failure of the food supply system, which increased the death toll. In other words, Food Availability Declination (FAD) could be one of the main reasons which caused the famine in Asia (Figure 2). FAD is not determined solely by food production; consideration on how we can supply if extreme events happen is also a factor.

In summary, history tells us that

survival in a climate-changed world depends not only on production but also on supply. Unfortunately, the 4th Assessment report of the IPCC (AR4, 2007) does not stress this issue much. Global awareness on Africa's problems on food production decline may help Africa through assistance in improving the supply system as well as efforts for increasing food production. DPR Korea's case also provides a perspective on what should be considered in an adaptation strategy. Having a similar weather system as RO Korea, DPR Korea has experienced prolonged famine due to flood and drought. However, RO Korea was able to supply its food without increasing food production within the country. But what will happen to RO Korea if the extreme events caused by climate change occur in China, its major food exporting country? The adaptation system of China may be equally crucial to RO Korea in view of food security, in particular, the food supply system.

Food supply in RO Korea

In RO Korea, food is supplied by production within the Korean territory and by importation. RO Korea's grain self-sufficiency, i.e., the amount of grain produced in RO Korea, has decreased from 80 percent in 1970 to 28 percent in 2006 (see Table 1). This implies that even if RO Korea can avoid serious adverse impacts of climate change on its food production, internal production is accountable for only 30 percent of required grains. More than 70 percent needs to be imported.

In the case of fisheries products, although a large portion of aquatic food is produced within RO Korea, 60 percent of aquatic food is imported. Also, deep sea fisheries, which are located outside of Korean territory, provide over 10 percent of total aquatic food. Only 40 percent of what Korea needs is provided within the territory (Figure 3).

Therefore, it can be concluded that no matter how well a country constructs an adaptation system, the adverse effects of climate change

Table 1. Self sufficiency for grain and rice (Korean Rural Development Administration, 2006)

Year	Grain self-sufficiency (Percentage)	Rice self-sufficiency (Percentage)
1970	80.5	96.3
1975	73.1	94.6
1980	56.0	95.1
1985	48.4	103.3
1990	43.1	108.3
1995	29.1	91.4
2000	30.8	102.9
2001	32.2	102.7
2002	31.0	99.2
2003	27.7	90.3
2004	26.8	96.5
2005	29.3	102.0
2006	28.0	98.9

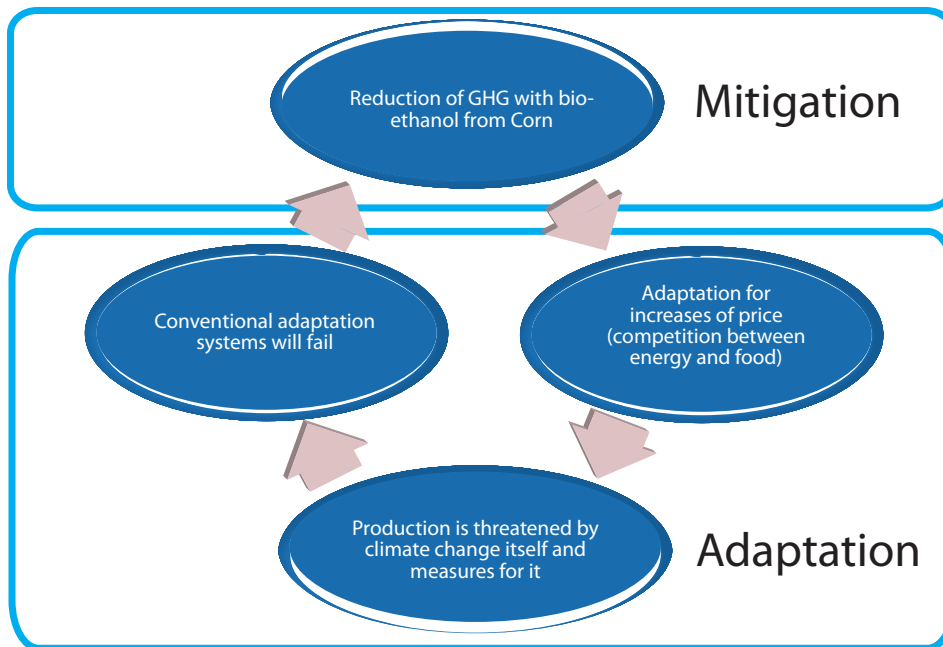


Figure 4. Schematic of competition between mitigation and adaptation to determine the supply for resources.

still pose threats to a country in indirect ways. In the case of RO Korea, there are no measures currently for securing food supply that covers more than 60 percent of what Korea needs. If the Russian coastal water warms up to 2 degrees higher than the present temperature, 7 percent of Korean aquatic food would be in jeopardy.

Competition with mitigation measures for food supply

The importance of a food supply system was raised when the energy issue gained much attention. In 2007, the corn price soared to \$3.50 per bushel from \$2.20 in 2005. This increase in corn price can be explained from two perspectives. One is the rise of oil price, which was caused by different reasons, such as a decrease in oil production in the Gulf of Mexico

and Alaska as well as increases in oil demand in India and China. The other is the alternative use of corn for producing bioethanol as an alternative to fossil fuel. No matter what the main causes of the corn price hike were in 2007³, the supply of corn was a great concern to consumers who use corn as a main food source.

To reduce carbon emissions when the oil price is low, the global society needs to enforce strong mitigation measures including carbon tax and market instruments such as the Clean Development Mechanism (CDM). For example, if a country imposes a carbon tax on shipping (transportation) and food storage (e.g., air conditioning), food prices will increase. CDM can increase the price for storage, by changing cooling or heating from fossil energy to renewable energy. Aquatic food is likely to have a more serious price hike than grains because of the greater demand for cooling. Also, as observed in 2007, the production of biofuel can

reduce the supply of food, e.g., selling corn as an alternative source of energy is more lucrative than selling it as food. If the price of fossil fuel is high, extra costs for shipping will be added to food prices due to higher shipping and storage costs.

Countries like RO Korea, which secure a major portion of their food supply by importation, will be more vulnerable to changes in the supply chain and energy prices. If energy is to be supplied by renewables, the price of food will be affected by the types of measures for reducing

climate change impact and by competition between food and energy use (Figure 4). In Brazil, the distribution of sugarcane to food and energy has been controlled by the international market price for food. In other words, if the utilization of sugarcane for energy is applied globally, it will cost much more to purchase sugarcane as food since the large volume of sugarcane will be sold as an energy source at a higher price.

Conclusion

In the course of developing a strategy for adaptation to climate change, emphasis has been on direct impacts. As already recognized, the direct impact on food production will be serious in some countries. Temperature, rainfall and GHG concentration will alter the rate of grain food production. The production of aquatic food will also be subject to climate change impacts due to ocean warming and increasing

³ In 2008, corn price still kept increasing to over US\$5.00 due to increase in oil price.

concentrations of dissolved CO₂. In response to these concerns, the global society, including Asian countries, has embarked on building adaptation strategies. However, we may need to change our view on adaptation for food security from production to supply. As recorded in history, famine was not solely caused by drought, which is considered as a direct impact. In the late 1800s, famine was exacerbated by the failure in the food supply system, which did not adapt to the food production shortage. Recent experience in the corn price hike warns us that steady production of food sources may not prevent us from food shortages because of complications with energy issues.

The degree of indirect or virtual impact imposed through the supply system varies considerably depending on the characteristics of a country's development and territorial size. Maturity of industrialization and the size of territorial area are deciding factors for the food self-sufficiency of the country. In the case of countries that are industrialized yet small in territorial size, such as RO Korea and Japan, food self-sufficiency is usually low. Therefore, indirect impact of climate change, particularly in a global perspective, will affect their food supply chain more seriously than direct climate change. However, countries with large territorial areas will be more vulnerable to direct impact. In the case of aquatic food, indirect impact will be more significant than direct impact on a county's territory, since the actual fishery occurs outside a country's territory in many cases. For example, over 10 percent of RO Korea's aquatic food comes from deep sea fishing. Also, generally, aquatic food costs more as a consequence of cooling costs

during shipping and in storage.

The indirect impact of climate change on food supply will be more apparent in the future due to competition between food and energy. The competition will always be there regardless of oil prices, even with steady production. When oil prices are low, strict mitigation measures such as carbon tax, carbon labeling, etc., will be applied to prevent the over-use of fossil fuel and reduce GHG emission and leads to the extra cost to purchase food whereas use of food as biofuel arises and this leads to reduction of food supply when the price is high.

Food security will be severely affected by climate change through: 1. direct impact on food production; 2. virtual impact on the food supply system through domestic and global markets; and 3. the impact brought by the

strengthened climate change measures and policies. Therefore, when an adaptation strategy is being developed, a country will need to consider the food security issue with a long-term perspective for a food production as well as food supply system (**Figure 5**).

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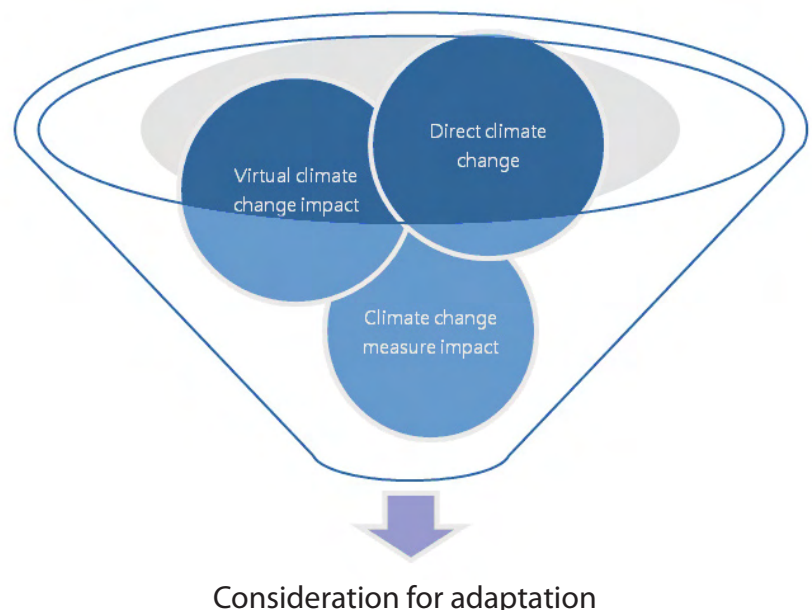


Figure 5. Three main impacts of climate change which are necessary for the adaptation of a long-term plan.

...continued from page 28

environmental protection, selected youths from local schools have been trained to serve as eco-travel guides in Koh Loy and other tourist areas in their spare time. Token incentives are provided to the volunteers by the local government. Hundreds of youths have also been trained in environmental protection and marine conservation and are involved in various activities, including waste segregation and recycling, mangrove reforestation, and water quality monitoring and analysis.

Guided by the vision of a healthy and sustainable coastal city, public parks, promenades and facilities that promote exercise and sports, cultural activities and social interactions for locals and visitors alike have also been built in Sriracha in order to promote not only social and economic vibrance, but also overall wellbeing and improved quality of life.

Outcomes of ICM Implementation

Over the past decades, rapid economic growth, increase in population, and increased resource utilization have exerted a toll on the marine environment and resources of Chonburi. Substantial efforts have been directed by governments and various stakeholders to address the resulting ecological, health and economic threats. But in order to be sustainable, these initiatives needed to be consolidated within an integrated framework that will enhance their effectiveness, reduce duplication of efforts, and promote cooperation and collaboration.

The Chonburi ICM project focused on enhancement of governance mechanisms to support integration and collaboration of various coastal management initiatives, including

corresponding local capacity development. In parallel, the project also spearheaded various on-the-ground actions involving the local governments, communities and various stakeholders in order to demonstrate the benefits of integrated and collaborative actions. Key outcomes of ICM implementation in Chonburi include improvement in the decision-making process through the ICM Provincial Coordinating Committee, improved interaction and cooperation among the local governments, and enhanced stakeholder participation in marine and coastal management activities.

In terms of ecological and socioeconomic outcomes, the lack of systematic comparative studies on these aspects at this point does not yet allow explicit conclusions to be made. Based on stakeholder feedback, however, improvements have been observed with regard to the harvest of crabs and other marine species, mangrove cover has increased and seagrass beds have been restored in Sriracha Bay, among others. Recyclable materials are also being collected every week in various municipalities. Although, there are no systematic studies to determine additional income resulting from these and other activities, they are considered to be directly or indirectly contributing toward local fishery and livelihood development in Chonburi. ICM implementation in general is considered to be contributing significantly to building of local capacity to address various challenges to sustainable coastal development, including enhancing food security and livelihood. Hopefully, the ongoing development of a State of the Coasts (SOC) reporting system will facilitate improved data gathering, documentation consolidation and

analysis for better assessment and reporting of outcomes.

ICM implementation in Chonburi has been facilitated by the following factors:

- A common vision and framework for actions through the coastal strategy and its implementation plan, and consolidation of local initiatives;
- Appropriate legal and institutional arrangements for multisectoral and inter-agency coordination;
- A dedicated coordinating body/secretariat in Sriracha Municipality;
- Political commitment and dedication of ICM “champions”;
- Strategic capacity development of local personnel and awareness building and education of stakeholders;
- Participatory and integrated planning and implementation approach involving various stakeholders;
- Multistakeholder partnerships, including nongovernmental organizations and the private sector;
- Use of scientific information to support management decisions and actions; and
- Integration of ICM activities into the local government development plans and programs.

The Chonburi ICM project is currently focused on further improving the governance mechanisms. As such, ICM scaling up, long-term sustainability, and the continuing commitment of Chonburi’s ICM Network to sharing of experiences, demonstrating good practices will be assured.



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Fish Protein as a percentage of protein supply*



* Protein supply from fish and fishery products as a percent of total protein is defined as the quantity of protein from both freshwater and marine fish, seafood and derived products available for human consumption as a percentage of all protein available (World Resources Institute, 2009).



Photo by Edilberto Magpayo.

Population, Marine Biodiversity and Food Security

The Food and Agriculture Organization defines food security as a "situation [...] when all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life."

Food security is often focused on the role of agricultural food production. However, it should be noted that the world's oceans are one of the largest food reserves on the planet. Protein supply from fish and fishery products as a percentage of total protein in East Asian countries have shown a significant increase from 1980 and 1990 data, with Cambodia having the highest increase (2.4% in 1980 to 16.6% in 2002 (see map)).

In 2006, an estimated 43.5 million people were directly engaged, part time or full time, in the primary production of fish either in capture or in aquaculture. In 2006, the estimated number of fish farmers was nearly 9 million people, with 94 percent operating in Asia. Eighty-six percent of fishers and fish farmers worldwide live in Asia, with China having the greatest numbers (8.1 million fishers and 4.5 million fish farmers).

Estimates also show that for each person employed in the primary sector, there could be four employed in the secondary sector which includes fish processing, marketing and service industries, indicating employment of about 170 million in the whole industry. About 520 million people could be dependent on the sector, or nearly 8 percent of the world population (FAO, 2008c).

Food security, however, does not only depend on climate and socioeconomic impacts on food production, but also on economic growth, changes to trade flows, stocks, and food aid policy (Ludi, E. 2009).

Martin Van Brakel from the WorldFish Centre emphasized that "the anticipated collapse in the world's fisheries as a result of over-harvest, might even happen sooner as a result of the rapid growth of multiple stressors acting in combination." He suggested that at least 20 percent of the world's ocean should be protected from fishing. Currently less than one percent of marine areas are protected (Ganter, 2008).

While the focus is on protection and conservation of coastal and marine resources, the role of small-scale fishers must also be enhanced in order to improve their livelihoods and the state of food security globally.

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People employed in fishing and aquaculture

Country	2000	1990	1980	1970	Population within 100 km of coast (2000) (%)*
Brunei Darussalam	1,355	1,900	722	1,130	99.9
Cambodia	73,425	37,695	13,100	10,000	23.8
China	12,233,128	9,092,926	2,950,344	2,300,000	24
DPR Korea	129,000	129,000	140,000	133,000	92.9
Indonesia	5,118,571	3,617,586	2,231,515	841,627	95.9
Japan	260,200	303,400	376,880	437,900	96.4
Lao PDR	15,000	15,000	11,800	10,000	5.7
Malaysia	100,666	88,494	119,642	81,729	98
Philippines	990,872	898,000	781,500	1,047,441	100
Korea, Rep	176,928	211,753	298,122	367,645	100
Singapore	364	836	2,025	1,919	100
Thailand	354,495	207,019	86,188	74,086	38.7
Timor-Leste	4,057	0	0	116	
Vietnam	1,000,000	800,000	330,000	317,440	82.8

* Globally 2.2 billion people or 39% of the population live within 100 km from the coast. Estimates were based on 1995 population figures.