International Conference on Marine Environment and Biodiversity Conservation in the South China Sea

南海海洋環境與生物多樣性保育國際研討會

Conference Proceeding

會議資料

National Sun Yat-sen University, Kaohsiung, Taiwan 台灣•高雄市•國立中山大學 2010.07.16~17

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Welcome Remarks and Acknowledgments

from the Organizing Committee

The organizing committee would like to first extend its cordial welcome to scholars and experts from home and abroad, graduate students and the general public for attending the International Conference on Marine Environment and Biodiversity Conservation in the South China Sea. Thank you for coming to National Sun Yat-sen University (NSYSU), which is located in Sizihwan Bay, a beautiful scenic bay area in Kaohsiung. Assembled here in this conference is an impressive array of experts and scholars from home as well as China, Japan, the Philippines, Malaysia, Vietnam and the United States. The organizing committee would like to express its sincere welcome to every participant.

This conference aims at exploring a wide range of issues regarding marine environment and biodiversity conservation in the South China Sea from a macro perspective. It covers issues such as marine biodiversity, marine environmental changes, marine technology and environmental sustainability, the operation and management of marine protected area (MPA) and so on. This conference mainly addresses issues related to the South China Sea; however, other areas are also covered by conference presenters who explore common issues shared by all. It is hoped that this conference will explore and discuss issues regarding the environment and biodiversity conservation thoroughly.

This conference is organized by the College of Marine Sciences, NSYSU and Marine National Park Headquarters. It receives financial support from National Science Council, Taiwan Ocean Research Institute, National Applied Research Laboratories, Environmental Protection Administration and Ministry of Education. Special thanks will be extended to the sponsors as well as advisors who spent time and made efforts to make this conference possible.

It is hoped that this conference will generate fruitful results for future academic and governmental references for researching and policy-making. Finally, I wish this conference a great success.

> Mo-Lin Yang Director of Marine National Park Headquarters Jin-Yuan Liu Dean of College of Marine Sciences, National Sun Yat-sen University

大會歡迎與致謝詞

首先歡迎來自國內外學者專家、研究生、社會大眾,來到位於高 雄西子灣風景秀麗的國立中山大學,參加「南海海洋環境與生物多樣 性國際研討會」。本研討會參與發表論文的專家學者,除國內諸多先 進外,尚有南海周邊與附近的國家,包括中國、日本、菲律賓、馬來 西亞、越南等,此外,並有美國著名學者,共襄盛舉。主辦單位在此 以最誠摯的心情致上歡迎之意。

本研討會旨在以宏觀的角度,探討南海海洋環境與生物多樣性的 議題,範圍十分廣泛,包括:海洋生物多樣性、海洋環境變遷、海洋 科技與環境永續、海洋保護區經營與管理等。探索的區域雖以南海為 主,惟因問題的共通性,所發表的論文主題,並不以南海為限。希望 藉由本次研討會,深入探索海洋環境與生物多樣性保育的相關問題。

本研討會由國立中山大學海洋科學學院及海洋國家公園管理管 理處主辦,並獲國家科學委員會、國家實驗研究院海洋科技研究中 心、環境保護署、教育部等單位的經費支持,謹此致謝。籌備期間, 承蒙諮詢委員們多方指導,籌備委員們費心費力,在此一併致上最誠 擊的謝意。

最後,期待在這一次研討會能夠順利成功,並獲致豐碩的成果, 所得的結論可以增進學術研究或作為政府施政的參考。

> 國家海洋公園管理處處長 楊模麟 國立中山大學海洋科學學院院長

> > 劉金源

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Welcome Remarks from the President of National Sun Yat-sen University

Distinguished guests from home and abroad, ladies and gentlemen, good morning!

I am delighted to see outstanding scholars and experts from home and abroad as well as friends caring about marine development attending this conference at National Sun Yat-sen University. On behalf of NSYSU, I would like to extend my cordial welcome to you all.

The topic of this conference concerns with marine environment and biodiversity conservation. This is a meaningful topic of our time when the earth is undergoing severe impacts due to people's continuous development. As we all know, because of global warming, the earth is experiencing dramatic environmental changes. Therefore, as we consume the resources of the earth, how to conserve and achieve sustainability is a pressing issue of today.

Oceans cover about 70% of the Earth's surface. The changes of marine environment can impact on the balance of the overall ecological environment. Marine biodiversity is the key to achieving dynamic equilibrium of all creatures on the earth. Taiwan is a typical island country with rather limited land resources. Therefore, the development and conservation of the ocean play crucial roles for Taiwan to achieve sustainable development.

NSYSU is Taiwan's only research university that has a college of marine sciences. Since its inception, NSYSU has been regarding marine development as one of its missions. In the past few years, NSYSU has received key financial support from Ministry of Education. A good amount of this budget was used to conduct marine research which has generated fair results. University of California, San Diego (UCSD) is the benchmark for NSYSU in that NSYSU strives to enhance its cooperation with Scripps Institution of Oceanography (SIO) so as to promote its academic performance in the filed of marine studies. I hereby call for participating leading experts from Taiwan and abroad to support NSYSU and offer your valuable suggestions to us.

Last but not least, I hope this two-day conference will be of a great success. And I wish you health and happiness.

Hung-Duen Yang President of National Sun Yat-sen University

中山大學校長致詞

各位國內外貴賓、各位女士、各位先生,大家早安!

今天非常高興看到諸多國內外傑出學者專家以及關心海洋發展的朋友來到本校參加研討會,個人謹代表學校,致上誠摯歡迎之意。

本次研討會所探討的主題是有關海洋環境及生物多樣性保育的 問題。這個議題在當今地球環境因為人類不斷的開發而受到嚴峻衝擊 的關鍵時刻,相當具有時代的意義。眾所周知,此時此刻,我們的地 球正因全球暖化而造成環境的巨變,因此,人類在使用地球資源的同 時,如何保育以期永續,乃是當今相當迫切的問題。

海洋占地球表面積百分之七十以上,海洋環境的變遷關係著整 個地球的生態環境的平衡,而海洋生物的多樣性更是地球生物動態平 衡的關鍵。台灣是一個典型的海島國家,陸地資源十分有限,因此, 發展與保育海洋,乃是台灣永續發展的命脈。

本校乃是台灣主要研究型大學中唯一設置有海洋科學學院的大 學,自創校以來,海洋領域一直是本校發展的重點之一。尤其是過去 幾年,本校藉由教育部重點經費的支援,投入了不少的經費於海洋研 究,也獲致不錯的成果。現今,本校以UCSD(加州大學聖地牙哥校 校區)作為標竿學習的學校,其中因素之一,也是希望加強本校與SIO (Scripps Institution of Oceanography)在海洋方面的合作,提升本校 在海洋領域的學術水準。懇請在座國內外先進,能給予本校指導。

最後,預祝這兩天研討會順利成功,各位朋友身體健康、心想 事成。

> 國立中山大學校長 楊弘敦

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Welcome Remarks from the Director-General of the Construction and Planning Agency, Minstry of the Interior

Good morning, President of National Sun Yat-sen University, Dean of College of Marine Sciences, distinguished guests from abroad, Deputy Minister of Environmental Protection Administration, Deputy Minister of Research, Development and Evaluation Commission, ladies and gentlemen.

I'm honored to be here, on behalf of Construction and Planning Agency, Ministry of the Interior and Marine National Park Headquarters, to welcome every one of you to the conference.

South China Sea is a marginal sea connecting Indian Ocean and Pacific Ocean. Known for abundance in natural marine resources, South China Sea is an important hotspot of biodiversity and has long been a fishing ground. The world-renowned Coral Triangle encompasses an area from Indonesia, Malaysia, Philippines, Papua New Guinea, Solomon Islands, and Timor-Leste and nurtures more than 600 coral species, which is 1.5 times more than the number of coral species found in Great Barrier Reef, and about 2 times more than that in Kenting, Taiwan. And why is Dongsha atoll, which is in the area of South China Sea near Coral Triangle, not considered as part of the triangle? Last year, on a visit to Marine National Park Headquarters, coral reef scholars from Australia and the US indicated that Coral Triangle was defined by marine areas containing 500 or more species of reef-building corals and there was no sufficient evidence to show whether South China Sea had so many coral species. To explore the biodiversity in South China Sea and to make sure whether it is as biodiversified as Coral Triangle, more full-scale investigations are needed and it is also necessary to integrate the research projects in different countries.

The agency's subordinate Marine National Park Headquarters is the competent authority of Dongsha Atoll National Park, which is located in the north of South China Sea. As the managing body of the area, we've tried to figure out answers to the question by enhancing exchanges between the academic research and the real practice of management, and joining in the world's efforts in preservation.

The two-day "International Conference on Marine Environment and Biodiversity Conservation in the South China Sea" is co-organized by Marine National Park Headquarters and College of Marine Sciences, National Sun Yat-sen University, with the presence of local and international experts and scholars to share relevant research results on the environment of South China Sea. Under the premise of eco sustainable development, we hope to achieve a feasible framework for international cooperation to delve into the resources in South China Sea. At the same time, the event is a chance for us to convey the results of scientific research and idea of preservation to the public, call to people's attention the valuable resources in South China Sea, and form a preservation consensus among the general public so as to encourage everyone to lead a greener life and bring the idea of marine preservation into practice.

Also part of our concern is the issue of the forming of trans-boundary marine protected area, which has become a focal point in global conservation efforts. Currently, up to 227 trans-boundary protected areas has been established worldwide. If the governments can put aside the political controversy of Nansha waters and establish a preservation-oriented trans-boundary marine protected area or a peace park, that will be beneficial to the neighboring countries and the marine lives in South China Sea.

Thank you for attending the conference despite your tight schedule and playing a role in the research of the marine environment of South China Sea and resources protection. We hope this event to be a starting point of international cooperation on the resource preservation of South China Sea. Thank you very much. And I hope this is going to be a successful event.

Shih-Wen Yeh Director-General of Construction and Planning Agency, Minstry of the Interior

署長致詞稿

中山大學楊校長(弘敦)、海洋科學院劉院長(金源)、與會 的各國嘉賓、環保署邱副署長、研考會魏副主委,以及在座各位女士、 先生,大家早安。

本人謹代表內政部營建署及海洋國家公園管理處誠摯歡迎各位 嘉賓、先進蒞臨本研討會。

南海位於印度洋與太平洋的銜接帶,向來以豐富的海洋自然資源知名,被公認為生物多樣性熱點,自古即為重要的漁場。而世界知 名的「珊瑚大三角(Coral Triangle)」涵蓋印尼、馬來西亞、菲律賓、 巴布亞新幾內亞、所羅門群島、東帝汶之間的海域,珊瑚種類高達600 種以上,是大堡礁的1.5倍,幾乎是台灣墾丁的2倍,而東沙環礁所處 的南海就緊鄰此區域,「但為何南海沒能被劃入Coral Triangle的範 圍?」,去(2009)年澳洲及美國珊瑚礁生態學者前來海洋國家公園 管理處訪問時指出,納入Coral Triangle的一項要件是要有500種以上 的造礁珊瑚,然而目前沒有充分數據證明南海有如此豐富的珊瑚物 種。所以唯有更全面的研究調查,將各國獨立進行的研究計畫整合, 才有機會了解南海生物多樣性是否如「珊瑚大三角」一樣豐富。

本署轄下之海洋國家公園管理處經營管理位於南海北端的東沙 環礁國家公園,我們從這個區域經營管理者的角色試著去找出問題的 答案,從加強學術研究與經營管理實務的交流,並參與國際合作共同 保育的方向著手,應該是不錯的方法。

海洋國家公園管理處與中山大學海洋科學院共同舉辦為期兩天 的『南海海洋環境與生物多樣性保育國際研討會』,集結台灣與南海 周邊地區相關領域的專家學者,分享各項對於南海環境的研究成果, 希望在生態與環境資源永續的前提下,型塑具體可行的國際合作架構

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來了解南海資源。另一方面也希望藉由本研討會的舉辦將這些科學調 查與保育概念傳遞給社會大眾,激起民眾對南海資源的重視,建立保 育共識,更具體內化改變個人平日的生活習慣,以實際行動實踐對海 洋環境與生物資源的保護。

另外,劃設跨界海洋保護區(transboundary marine protected area) 也是我們所關心的議題。跨界保護已成為國際保育的重點,目前全球 共有227座跨界保護區,未來若能促成各國擱置南沙海域爭議,轉而 成立一座以保育研究為主的海洋跨界保護區或是和平公園,對於周邊 國家及南海的海洋生物都將是一件美事。

各位於百忙中前來參加研討會,貢獻對南海海洋環境與資源保 護的熱忱與關心,希望這個研討會能成為國際合作來保育南海海洋資 源的第一步。最後,再次感謝大家熱心的參與本研討會,謹祝各位身 體健康,萬事如意,也祝研討會順利成功。謝謝各位!

> 內政部營建署署長 葉世文

AGENDA 議程

July 16th 2010 (Friday)

2010年7月16日(週五)

| Time | Activity 活動 | Chairman 主持人 |
|-------------|--|---------------------------------------|
| 8:30~9:00 | Registration 報到 | |
| 9:00~9:30 | Plenary, VIP Keynote Address President Hung-Duen Yang (楊弘敦), NSYSU; Director-General Shih-Wen Yeh (葉世文), Construction and Planning Agency, Ministry of the Interior 開幕、貴賓致詞 | Jin-Yuan Liu(劉金源) Mo-Lin Yang(楊模麟) |
| 9:30~10:00 | John W. McManus and Kwang-Tsao Shao (邵廣昭), The Spratly Islands (Nansha): Networking Marine Protected Areas for Region-wide Benefits1 | Kwang-Tsao Shao (邵廣昭) |
| 10:00~10:30 | Coffee Break 茶敘時間 | |
| 10:30~11:00 | Ting-Hsuan Huang and Chen-Tung Arthur Chen (黃婷萱、陳鎮東), The Influence of Anthropogenic CO2 in the South China Sea | Kon-Kee Liu (劉康克) |
| 11:00~11:30 | Henrik Schmidt, Nested Autonomy with MOOS-IvP for Interactive Ocean Observatories | Jin-Yuan Liu (劉金源) |
| 11:30~12:00 | Wen-Yan Chiau (邱文彦), Taiwan's Marine Environmental Policy in the South China Sea19 | Kun-Hsiung Chang (張崑雄) |
| 12:00~13:45 | Lunch 午餐 | |
| 13:45~14:05 | Shao, K.T., T.Y. Fan, L.S. Liu, H.J. Lin, I.J. Chen, D.J. Kuo (邵廣昭、樊同雲、劉小如、 程一駿、林幸助、郭道仁), Current Status and Perspective of Marine Biodiversity of Taiping Island in the Spratlys, South China Sea | Hwung-Hweng Hwung (黄煌煇) |
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| 14:25~14:45 | Kuo-Yen Wei, Tien-Nan Yang and Li-Ling Chen (魏國彥、楊天南、陳俐陵), How many specimens should one count to obtain a reliable measurement of species diversity? Case studies of coccoliths using rarefaction analyses | Forng-Chen Chiu (邱逢琛) |
| 14:45~15:10 | Coffee Break 茶敘時間 | |

| | Group Sessions 分組發表 | | |
|-------------|---|------------------------|--|
| | Session A1 (Room 1106) | Session B1 (Room 1107) | |
| 15:10~16:10 | Marine Environmental Change/ Science & Technology/Management | Marine Biodiversity | |
| 16:10~16:30 | Coffee Break 茶敘時間 | | |
| | Session A2 (Room 1106) | Session B2 (Room 1107) | |
| 16:30~17:30 | Marine Environmental Change/ Science & Technology/Management | Marine Biodiversity | |
| 18:00~21:00 | Banquet 晚宴 | | |

July 17th 2010 (Saturday)

2010年7月17日(週六)

| Time | Activity 活動 | Chairman 主持人 | |
|-------------|---|----------------------------------|--|
| 8:30~9:00 | Registration 報到 | | |
| 9:00~9:30 | Minhan Dai (戴民漢), Carbon Biogeochemistry of the South China Sea – current understanding and potential changes in the context of global change | Tswen-Yung Tang (| |
| 9:30~10:00 | Chong Ving Ching, Marine Biodiversity and Conservation in the South China Sea, with Emphasis on Ichthyofauna (Malaysia)31 | | |
| 10:00~10:30 | Coffee Break 茶敘時間 | | |
| 10:30~11:00 | Edgardo D. Gomez, Enhancing Biodiversity in the South China Sea through Restoration and Restocking | Chang Feng Dai (盐旦圆) | |
| 11:00~11:30 | Makoto Tsuchiya (土星誠), Landscape Diversity and Connectivity of Tropical Coastal Ecosystems | (戴台 <i>鳳)</i> | |
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| 13:30~13:50 | Hideo Yamasaki (山崎秀雄), Biological Impacts of Global Warming on Coral Reefs: Lessons from Coral Bleaching Studies | Kervea Soong | |
| 13:50~14:10 | Rudolf Wu (胡紹燊), Eutrophication and Hypoxia: Problems and Scientific Challenges | (宋克義) Chia-Hung Hung (洪嘉宏) | |
| 14:10~14:30 | Nguyen Van Quan, Coastal and Marine Ecosystem Services and Poverty Alleviation: A Case Study of Vietnam | | |
| 14:30~14:40 | Break 休息 | | |

| | Group Sessions 分組發表 | | |
|--------------|--|------------------------|--|
| | Session A3 (Room 1106) | Session B3 (Room 1107) | |
| 14:40~15:40 | Marine Environmental Change/Science & Technology/ Management | Marine Biodiversity | |
| 15:40~16:00 | Coffee Break 茶敘時間 | | |
| 16:00-16:45 | Session B4 (Room 1106) | Session B5 (Room 1107) | |
| 10.00/~10.45 | Marine Biodiversity | Marine Biodiversity | |
| 16:50~17:20 | Final Conclusions and Declaration of the Conference, Closing Ceremony 大會宣言、閉幕 | | |

Session A1: Marine Environmental Change/ Science & Technology/ Management

Room 1106

July 16th 2010 (Friday)

Chairs: Cho-Teng Liu (劉倬騰), Bang-Fuh Chen (陳邦富)

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| 15:25~15:40 | T.C. Yang, J. Schindall, CF. Huang, JY. Liu, Underwater-Intruder Detection in Harbor Environments Using Doppler-Sensitive Waveforms | 77 |
| 15:40~15:55 | Wen-Miin Tian, Techniques for Automatic Mapping Coral Reef Habitats off Southern Taiwan using Side-Scan Sonar | 79 |
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Session A2: Marine Environmental Change/ Science & Technology/ Management

Room 1106

July 16th 2010 (Friday)

Chairs: Ruo-Shan Tseng(曾若玄), Fuh Kwo Shiah (夏復國)

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Session A3: Marine Environmental Change/ Science & Technology/ Management

Room 1106

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| 15:25~15:40 | I.H. Lee, J.J. Hung, K.L. Lin and Y.H. Wang, Observations of Vertical Mixing due to Shoaling of Internal Waves at Dongsha Atoll South China Sea | 101 |

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Room 1107

July 16th 2010 (Friday)

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Session B2: Marine Biodiversity

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July 16th 2010 (Friday)

Chairs: Hin-Kiu Mok (莫顯蕎), Meng-Hsien Chen (陳孟仙)

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Coastal and Marine Ecosystem Services and Poverty Alleviation: A Case Study of Vietnam

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ABSTRACT

I. BACKGROUND

The linkages between ecosystems and human well-being have been the focus of a global scale study - the Millennium Ecosystem Assessment (MEA). The MEA deals with the full range of ecosystems-from those relatively undisturbed, such as primary forests, to landscapes with mixed patterns of human use, to ecosystems intensively managed and modified by humans such as agricultural land and urban areas. Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling. The human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services (MEA, 2005).

Coastal ecosystems-coastal lands, areas where fresh water and salt water mix, and nearshore marine areas-are among the most productive yet highly threatened systems in the world. These ecosystems produce disproportionately more services relating to human well-being than most other systems, even those covering larger total areas (MEA, 2005). At the same time, these ecosystems experience the heaviest impacts from human uses and environmental changes These pose critical challenges for the maintenance of ecosystem services and poverty alleviation.

As part of the South East Asia regional efforts, this national analysis for Vietnam aims to assess the state and trends in ecosystem services associated with marine and coastal systems; driven factors; how they support the livelihoods and well-being of human societies and particularly poor communities in Vietnam; and the threats, opportunities and constraints to these. It will also identify the key challenges for research, as well as current gaps in knowledge and capacity in order to inform the development of a research strategy to support the maintenance of ecosystem services explicitly for poverty alleviation (ODG, 2007). The research was carried out by the Centre for Marinelife Conservation and Community Development (MCD) in collaboration with external research agencies in Vietnam. The research team consists of multidisciplinary experts including marine biologist, human ecologists, coastal resources managers and climate change professionals.

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II. CURRENT SITUATION OF THE COASTAL AND MARINE ECOSYSTEM SERVICES AND MANAGEMENT APPROACHES

Coastal and marine ecosystems in Vietnam (including coral reefs, seagrass bed, lagoons, mangroves and tidal flats) provide a wide range of economic benefits (food, income, employment) and many social values (such as sight-seeing, entertainment, culture) to human well being and the poor through its important functions and services of regulating, provisioning, cultural and supporting.

There is an increasing demand for ecosystem services due to a high population growth and economic development in the coastal areas (such as aquaculture, tourism, industry). However, there is trend of decrease in ecosystem services, especially provisioning and regulating, due to the reduced ecosystem area, decreased productivity and less resilience, caused by anthropogenic and natural factors. This has directly negatively affected the lives of humans, especially the poor who have fewer opportunities to get access and benefits from ecosystem services.

The key issues identified by the national assessment about the linkages between ecosystems services and poverty are i) climate change effects on coastal communities; ii) nearshorenear shore over-exploitation and destructive exploitation iii) reduction and degradation of habitat, iv) low livelihood resilience and poor coastal zone management.

As part of the research assessment results, it is identified that a number of critical challenges exist in relation to knowledge and capacity to address ecosystem services and poverty alleviation issues. While data and information about the ecosystems are largely available, the understanding about services and values they provide for human being is very limited. In addition, there is an inadequacy of public knowledge about the poverty in the coastal zone. Therefore, the knowledge about the linkages between ecosystem services and poverty alleviation is also limited. This has led to uncertainty and is a dilemma for the government's decision making and policy development for possible interventions at the national level. Studies of the root cause and problems of poverty in the coastal areas and linkages of ecosystems and poverty alleviation are rare and are usually limited in scope. Research tends to be focused on ecosystem services or poverty alleviation separately and more often conducted at the local level (coastal province/district) rather than national level.

Coastal and marine ecosystem services are important for millions of people in Vietnam, especially for the small scale fishers and the poor who are highly dependant on the coastal resources for their livelihood. Their economic and social benefits and costs should be valuated properly, for awareness raising, actions and policy development to sustain the ecosystem services for the purpose of poverty alleviation and sustainable development.

Several trade-offs are considered in linking ecosystem services and poverty alleviation. It seems that the key practical trade-off is found in long-term economic development and ecosystem conservation versus the short-term goals. In addition, there are conflicts between different resources users (such as aquaculture vs. capture fisheries, tourism vs. conservation), between the poor and the rich, women and men. How to address this problem would be a question for the government in terms of political, socio-economic development and conservation of ecosystems should be in the way that can be supported to the poor.

To address ecosystem services and poverty alleviation in coastal areas in the long term, it is suggested relevant national policies and strategies are formulated and enacted. Several possible policy options could be:

i) Co-management is applied in fisheries management, with enforcement and support from both the government and community;

- ii) Ecosystem based management approach is introduced and applied widely to improve the rehabilitation and productivity of the ecosystems to sustain their services for the benefits of the human-being;
- iii) Integrated coastal zone management (ICZM) to enhance the planning of coastal zone and coastal resources uses, the cooperation of responsibilities between different stakeholders and the coordination of actions related to coastal areas;
- iv) Private-public partnership would be studied and examined as to better manage and sustain the resources to allocate the user rights and ownership of the resources.

The following sections further summarie and analyse specific aspects and issues of ecosystem services and poverty alleviation linkages (see also table 1, below).

2.1 General national trends in supporting, regulating, provisioning and cultural Ecosystem Services

Vietnam currently has a diverse marine and coastal ecosystems - including more than 155,000 ha of mangrove forests, about 1300 km² of coral reef, nearly 500 km² of lagoons, about 16,000 ha of seagrass and many tidal flats and estuaries. These ecosystems have long provided important services to Vietnamese people, including supporting, regulating, provisioning and cultural services.

Among a total population of approximately 85 million people, it is estimated that 20 million people are indirectly affected by marine and coastal services while 8 million poor people are directly dependent on such services.

Provisioning services:

The value for the annual production of goods and services of the coral reefs in Vietnam is estimated about USD 100 million. One square km of coral reef can provide a total of fish an equivalent to USD 10,000. One ha of mangrove reforest supports a marine catch of about 450 kg in the Mekong Delta. Vietnam seagrass support both commercial fisheries and services value at over USD 20 million per year. The total economic value of lagoon in Vietnam is estimated at more than USD 2000 per ha.

Regulating services:

The value of shoreline protection of the coral reefs can easily be seen in some marine area in the central provinces of Vietnam like Bai Tien and Hon Khoi, Khanh Hoa province. Mangrove forests significantly reduce coastal erosion and may provide protection from tropical cyclones and tidal waves. Mangrove roots, especially where vegetative communities grow densely, help sediment to accumulate more rapidly. Natural hazards, such as typhoons and storm surges, are not uncommon in coastal communities, particularly in the North-Central and Central Coastal macroregions. Thus, the protection role of mangrove should be increased to ensure the security for local people. Each square meter of sea-grass can generate ten liters of dissolved oxygen that contributes to balancing O_2 and CO_2 in the water environment, and assists to mitigate the greenhouse effects due to efficient absorption of the CO_2 in the water.

Supporting services:

A single square meter of seagrass can product over 25 tons of leaves per year. This vast biomass provides food, habitat, and nursery areas for myriad of adult and juvenile vertebrates and invertebrates. Seagrass epiphytes also contribute to food webs - either directly via organisms grazing on seagrass, or indirectly following the deaths of epiphytes which then enter the food web as a detritus carbon source. Seagrass beds serve as a favourable breeding and hatching ground for numerous marine species, and are important nearshore fishing grounds. Several offshore islands such as Hoang Sa and Truong Sa archipelago were created by the build up of dead coral skeleton. Many beautiful swimming beaches found in Ha Long and Cat Ba are related to the marine depositional regimes associated with the coral reef

production.

Cultural services:

Coral reefs play a central role in Vietnam's marine tourism industry. The major recreation activities on reefs are snorkeling and scuba diving. Nha Trang City, for example, is one of the first marine tourism centers in Viet Nam, showcasing its very diverse and abundant coral reefs surrounding the nearby islands. The number of visitors to Nha Trang is increasing (30,000 people in 1995 and 400,000 people in 2003). About ten percent of these visitors participated in diving and snorkeling on the reefs of Hon Mun MPA. These services brought a benefit about US\$400,000 and accounted for approximately 2% of the total revenue from the tourist sector in Khanh Hoa province. Mangrove areas has the potential to eco-tourism, which contribute to local livelihoods, especially in cases where the natural environment is the main attraction. Protected areas are a major existing and potential tourist attraction. There are a number of ongoing community-based tourism initiatives in Vietnam like Can Gio and Giao Thuy.

General trends

The ecosystems are degrading in term of both quantity and quality over the last decades.

Among 1300km² of coral reefs distributed along the coast of Vietnam only 1% are in good condition. Coral coverage has declined down to 30% in some areas since 1993-2004. General trend is towards wide scale coral reef degradation.

Mangrove ecosystems have shown a trend of increasing degradation during the period from the early 20th century to the 1990s – however, they appear to have stabilized in the last ten years.

Fish caught per ha per year from lagoon reduced by nearly half over the last decade.

Significant reduction of seagrass beds in recent years with the averages rate of 80ha loss per year from 1997-2002 (Khanh Hoa province).

The demands for ecosystem services are increasing, driven largely by population growth.

Policy makers and coastal managers have paid more attention to provisioning and cultural services while the importance of regulating and supporting services remains at a basic level of awareness and academic knowledge. For example, a total area for shrimp aquaculture has increased from 250,000 ha in 2000 to 478,000ha in 2001 and 530,000 ha in 2003. Today, Vietnam probably has the largest total area for shrimp aquaculture in the world.

However, the capacity of ecosystem services to respond to such high demand remains low due to general trends toward reduced ecosystem area and productivity caused by anthropogenic and natural factors.

There are a number of key factors driving the above mentioned trends.

Direct factors include: nearshore overfishing and destructive fishing, unsustainable aquaculture, industrial and land based activities, and the effects of climate change.

Indirect factors include: poor coastal resources management and enforcement, increasing market demand for marine products and low livelihood resilience.

These direct and indirect driven factors are described below.

- Population increase: The population in Vietnam has doubled over the past 60 years (approximately 85 million in 2008). The population density of Vietnam is more than 200 people per 1 km2. Vietnam has become one of the countries that have the highest population density in the world. This has drastically reduced the rate of available agricultural land per person. Population increase has placed a large burden on the natural

resources in a few ways. The need to find extra cash income for the food demand and it led to the over-exploited natural resources

- Over and destructive exploitation: After the war, the demands for building timber, firewood and charcoal, and the increasing exploitation by forestry agencies lead to resources becoming exhausted. Overfishing caused break down of the coral community structures (fishing down marine food web phenomenon). Destructive fishing practices bad habits and short-term thinking are reducing diversity in habitats and species of mangrove, destroying the coral structure and causing mass mortality of the coral colonies.
- Unplanned Aquaculture: Due to the big benefits from shrimp exports and because the fish catch yield has decreased, shrimp farming has been encouraged by the government and many local authorities. Therefore, both local people and state bodies have felled lush mangrove forests to make natural extensive shrimp ponds over all coastal mangrove areas of Vietnam. Since 1980s, this happened on a large scale in Ca Mau, Minh Hai, and a large number of mangrove areas were destroyed. In the end of 1980s, shrimp practice has developed strongly in the central and northern region of Vietnam and also cause the reduction of mangrove forests.
- Impact of the urbanization and industrial production: The construction of towns, ports and factories has many other bad effects on the environment as a result of discarding solid domestic and industrial waste into water; by gathering ships, motor boats which discharge oil and other substances, thus polluting the mangrove environment as well as adjacent areas and killing many animals or forcing them to move away
- Ineffective coastal management: The management of the coastal areas shows the weakness of law enforcement and the conflicts in exploitation of the natural resources. The coordination and co-management among the economic sectors/stakeholder areas are not close enough (Hue, 2004; Dao et al., 2007).
- Increasing demand from the domestic and international market: Ever since shrimps, crabs, and other marine animal products became valuable, the consumption markets have also extended. As of today, marine-products are consumed throughout cities of Vietnam and other countries. The main export product is shrimp and clam. As the markets become more and more extensive, the fishery production has been also become more extensive. As a consequence of such actions, the pressure on natural marine resources as well as ecosystem has been increasing
- Climate change effect: There are many environmental factors that affect these ecosystems as a whole, but climate change plays an important role as it not only influences the biodiversity directly but also has indirect impacts through factors such as the environmental hydrology and edaphon. Frost caused by low temperature damages the mangroves in the north of Vietnam. Inundation is one of the effects generated by sea level rise
- Poverty is also one of the causes of overexploitation by poor people. Poverty has been studied at the district level of most coastal areas where the main ecosystems services are provided. In general, the poverty rate in coastal regions is lower than that in Vietnam's mountainous interior. However, in terms of density, the two deltas (Red river and Mekong river) and the Central Coast are the regions with highest absolute numbers of poor

Poor people in our analysis are typified as artisanal fishermen, often have small landholdings or are landless, and with very limited financial capital. Their livelihoods are strongly dependent on access to "common resources". Over the last two decades, the 'enclosure of the commons' and the privatization open-access resources have excluded many poor artisanal fishermen from their own livelihoods. Low resilience of livelihoods has exacerbated the situation of the poor people.

The Vietnamese government is now trying to apply the co-management concept in terms of the sustainable utilization of ecosystem services. In addition to the traditional agricultural sector, aquaculture development is being promoted. For example, marine and brackish water aquaculture is developing rapidly in Khanh Hoa and coastal region. Total area for shrimp aquaculture has increased from 250,000 ha in 2000 to 478,000ha in 2001 and 530,000 ha in 2003. Today Viet Nam probably has the largest total area for shrimp aquaculture in the world.

Poor people can apply to get funding through the credit schemes at the women's association that are active in every village. Farmers can also get a land registration card for their own aquaculture area in the long term. However, the long-term positive and negative impacts of current aquaculture practices are not fully assessed yet and further promotion of aquaculture should be carefully thought out. Environmentally, expansion of aquaculture ponds and sea water channels creates groundwater salinization. Waste water from those ponds which is not treated is a source of pollution for the surrounding sea water. In truth, aquaculture can bring in high turnover, but maintaining such profit requires a certain level of skills, capital, technology, infrastructure and land which are often less accessible to the poor.

2.2 Key national trade-offs

The most critical national trade-off appears to be short term interests driving policies towards the exploitation of provisioning services rather than long term interests that might best be protected by conserving or enhancing regulating and supporting services. Cutting of mangrove forest for shrimp aquaculture or using coral reef for decoration or construction materials are typical examples of this conflict.

Conflicts also occur in the competing use of coastal resources by various user groups, such as small scale fisheries vs. aquaculture. Untreated waste from aquaculture ponds creates pollution in surrounding waters. Industrial vs. artisanal fisheries contributed by case of oil spills and environmental pollutions is severe in many areas. Examples of such conflicts can be taken from Halong bay in the north or Van Phong Bay in the central of Vietnam.

Other conflicts regarding the provisioning of benefits from ecosystem services are fuelled by the increasing gap between the rich and the poor. Aquaculture development makes the rich become richer and the poor become relatively poorer. When people with available funds participate in such marine-product rearing, the area utilized by low-income individuals to catch such products becomes limited. Therefore, their low-income becomes even lower. As a result, the boundary line between rich and poor becomes even wider.

There is also a gender issue in some cases in the coastal areas between women and men in access to the ecosystem services benefits (such as mangroves, coral reefs and lagoons). In the traditional fishing communities, women have more working hours than men, and they have less opportunities to training, education activities because of spending more time on reproductive work such as taking care of the children and thus this has limited their opportunities for income generation and their participation and roles in the social and community development.

The reduction of ecosystems (such as mangroves) has significantly socially impacts to the poor people and especially women, who collect the fish and resources in the nearshore coastal areas. The privatization of the land resources for aquaculture industry activities in the coastal areas has led to the fact that more power to the rich and poor people (including women) seem to have more challenges in finding other livelihoods due to their limited access to capital, technology and other resources (land) in the coastal areas.

There is a conflict between national and local interest as well. Overlapping in function of various agencies involving in marine and coastal resources management, poor coordination among them and weak enforcement of law and regulations have all contributed to this conflict. The case of Xuan Thuy national park, a RAMSAR site in Nam Dinh province best illustrates this conflict.

2.3 National state of knowledge

There is a well developed body of knowledge about ecosystems and their services in Vietnam, compiled primarily by research institutions and individuals. The information about these services is usually broken down to the regional and local levels. Updated information is available in hard copy and Vietnamese languages. Only limited number of information are ready in English language and in a soft version.

More than 200 coral sites have been surveyed along Vietnam's coast over the last 10 years. Some research organisations are devoted to wetlands and mangrove research, such as MERC.

Both the scientific and local communities are aware of the changes to mangrove ecosystems. However, the studies on the processes underlying these changes are limited and tend to focus on the reduction of fishery production and the change of soil.

There have been reports of large-scale seagrass decline at 17 locations in Vietnam, almost all of which were attributable to human-induced disturbance. Trends for recovery remain unknown

Most of the research was done within a scope of a project or a certain area, thus, it is not possible at the moment to know about all services at national level. Most of the information about these services remain at researchers level, not yet available to policy makers and general managers.

Poverty has also been studied in coastal areas - mainly at the district level; however, the data and information has been no longer updated. There is limited analysis regarding the linkage between ecosystems services and poverty in coastal areas. General information about the access by the poor to various ecosystem services is available at the case specific level, creating an incomplete national picture.

2.4 Key knowledge gaps

Information available on the ecosystems services have been remained at research and academic level, not yet updated or interpreted for other important stakeholders such as managers, policy makers and community members.

Policy makers at various levels, from national to provincial and local levels all need to first understand the ecosystems services, how they work, how they link with poverty and factors that influence their functioning. Many decisions relating to natural resources managements are made based on administrative or political aspects without a sound scientific justifications. Partly it was due to lack of up to date information.

Coastal managers also need to see the linkage between the ecosystems services and poverty so that their work can be well harmonised. Sometime their management is based on the research results. But researchers have different focuses when studying coastal ecosystems. They do not often integrated natural and social sciences perspectives nor expound on the relationship between the two. While other indirect factors come from ecosystem services such as mitigation of climate change through absorption of CO_2 in the seawater or shoreline protection values are overlooked.

The poor coastal people themselves also need to see the linkage between their livelihoods and the services that ecosystem services provided. This awareness will help them to see other longer benefit of ecosystems such as regulating and supporting rather than just a short term and visible services like provisioning. Local people will only committed to protect the ecosystems once they well understand that they link to their own livelihoods and that all the community is also committing to management.

Any intermediate agents such as NGO or community based organisations who work in the coastal areas also need to fully understand such linkages.

Knowledge of the poverty in the coastal zone is limiting and outdated

The poverty in coastal areas in broader context of social development and justice needs to be studied thoroughly. Specifically, what factors facilitate or prevent the poor to accessing ecosystem services, how to promote/limit these factors? From the sectoral and intersectoral points of view?

Furthermore, the adaptive capacity of key stakeholders to address the issue mentioned above needs to be elucidated.

Knowledge of the linkages between ecosystems services and poverty in the coastal areas of Vietnam is limiting

The quantitative data to demonstrate the linkages between ecosystems services and poverty is still limited and a major study on increasing the access of poor people to benefits from ecosystem services should be conducted.

Future research needs to analyse in depth other aspects of ES and poverty alleviation within the context of specific provinces and in particular address the question of how people employ ecosystem services aside from the capture fishery? (For example: fishers may use coral reefs for supporting eco-tourism; aquaculture as an alternative to capture fishery...).

Furthermore, other factors should be incorporated into the assessment of poverty alleviation such as distance from main land (offshore islands), distance between the fishing communities and the city/town, infrastructure influencing the transportation of goods, etc.

Very few previous studies deal with the linkages between the reduction of ecosystem services (eg. typhoons,– floods) and the poverty conditions of fisher communities in the coastal lagoons of Vietnam. Since 80% of the population depends on wetlands where lagoon system provides most services, it is need to conduct such studies.

All these needs of understanding of the ecosystem services and their linkage with poverty in coastal areas of Vietnam are not met at the moment.

2.5 Key policy options

Ecosystem based management approach to the use and management of natural resources need to be promoted in Vietnam. Most of management decisions are made based on administrative or political aspects which are not good for natural resources management. Any province or district when making decision on developing certain economies need to base on the services that the ecosystems existing in their location could provide and respect the rule of nature.

Co-management in the fisheries sector should be strengthened by institutionalizing the models from pilot activities at the national level. Since most of the poor identified in the coastal areas of Vietnam are engaged with fisheries, the way fisheries are managed need to be improved. The top down and central management does not work well and only community participation also is not enough. Thus, co-management of fisheries resources need to be promoted and leveraged to policy level.

Non fisheries options should be sought when confronted with low livelihood resilience. Near shore resources are recorded to be depleted and fishing efforts are encouraged to be reduced in Vietnam. Thus, options to alternative livelihoods are encouraged to seek, However, other options outside fisheries need to be found. The adoption of other sectors like IT, tourism or services should be studied to help the future generation of fishers to convert their way of making living.

Integrated coastal zone management (ICZM) should be promoted at both policy and practical levels. Sectoral management sometimes creates severe conflicts in the coastal areas as interests differ. A mechanism supported by a sound scientific justifications and a balance of economic and conservation purposes should be in place to ensure a sustainable development of the vulnerable coasts. ICZM was piloted in some provinces of Vietnam and need to further promoted at national level and concretized at local levels.

A Public Private Partnership model should be promoted to invest in further studies of the linkages between ecosystems services and poverty. Burden to government need to be reduced by promoting the investment from private sector. Business taken services from ecosystems need to pay back to those who are dependent on these resources. This philosophy works in many places and need to be promoted in coastal areas of Vietnam. The government encourages the development of marine and coastal economies. It needs to create policy to engage others stakeholders to invest and benefit from their investment in a sustainable way.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|--|---|--|---|---|--|--|
| Ecosystems status and geographical coverage | ES | Issues Relevant to poverty alleviation | General national trends and driven factors linked to poverty | Key national trade off | National state of knowledge/gap | Key policy options |
| Mangrove Distributed in the north and south of Vietnam Total area of 155,290ha, 21% of which is natural forest and 79% is planted. Coral reef Distributed widely in central Vietnam Total area is about 1300 km2 | (A). REGULATING Protection: beaches/coastlines from storm surges, floods, and waves Reduction of beach and soil erosion Formation of beaches and islands Land stabilization: trapping sediments Water quality maintenance Climate regulation | Climate Change • Coastal flooding • Coastal erosion • Changes in ecosystem productivity • Sea level rise | Reduced ecosystem area leading to reduced protection function, affecting the poor strongly. Demand for regulating services increased Direct: Human activities-convert mangrove and lagoon area into aquaculture Human activities destroy, reduce and weeken coral reefs Climate change Indirect: Lack/Low awareness poor planning weak enforcement | Economic development vs ecosystem protection Use conflicts between aquaculture and other uses (mangrove removal), destruction of coral reef) | Limited information available on regulating services of ecosystems Total Economic Value is available at regional and local levels. | Increased awareness of protection function Valuation in monetary terms Integrated Planning |
| More than 300 coral species 1 ha of coral reef can harverst fish = 10,000 USD | (B). PROVISIONING Fisheries for food Fisheries for aquarium trade Aquaculture for food and aquarium | Near shore overfishing and destructive fishing Low resilience of livelihoods Poor management of | Nearshore fishstock reduced significantly and low resilience in short term Increasing demand, mainly for capture – small scale fishery and | Capture fishery vs aquaculture Offshore exploitation vs nearshore Rich vs poor | Availability of information about provisioning services but only at regional and local levels. Available info on poverty conditions in areas where | Integrated coastal planning Co-management of fisheries Ecosystem based approach - Restoration of |

III. MATRIX OF ECOSYTEM SERVICES, TRENDS AND INTERACTIONS

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|--|---|---|--|---|--|
| Ecosystems status and geographical coverage | ES | Issues Relevant to poverty alleviation | General national trends and driven factors linked to poverty | Key national trade off | National state of knowledge/gap | Key policy options |
| Lagoon • Concentrated in central part of VN • Total area of 447.7 km2 • Sea Grass • 8,940 ha of seagrass | Pharmaceutical products Building materials Jewelry and other decorations Fuel-wood Traditional medicines | resources | aquaculture Used extensively by the poor: 28 coastal provinces, 20 million people directly and indirectly dependant Food security Directly affecting the jobs and income of 8 million people | Long term vs short term goals Industrial vs artisanal fisheries | provisioning services are provided, but the linkage between the two is not analysed Poverty status data is not updated (dated back nearly a decade) Mainly on fisheries aspects | habitat Fair and Sustainable trading Non-fisheries options. |
| supports both commercial fisheries and services valued at over 20 million USD per year | (C). CULTURAL Tourism and recreation Spiritual, aesthetic appreciation | Marine and coastal ecotourism Marine tourism 2% of total income from tourism (Khanh Hoa province) Low access by the poor | Direct: Demand increasing Limited capacity and skills Poor support services Indirect: Poor planning Improper investment | Economic interests vs, conservationio n Social status of the poor | Limited information and understanding of status, trend and dynamics | Community based ecotourism Public - Private Partnerships Education |
| Including estuaries and coastal tidal flat areas. | (D). SUPPORTING Cycling of nutrients Nursery habitats | Climate change Change in types of species Change in capacity of nursery habitats Destructive human activities Reduction of nursery habitat coverage | Maintenance and restoration Direct: • Climate conditions Indirect: • Lack of awareness • Week enforcement | Short term vs long term goals Rich vs Poor | Basic biophysical info available at regional levels. Limited link to whole ecosystems and their services | Awareness raising on interactions between ES and poverty alleviation Public Private Partnership |

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海岸及海洋生態系統服務及減貧:越南個案研究

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摘要

一、背景介紹

千禧年生態系統評估(MEA)之研究遍及全球,一直以來皆著眼於生態系統與人類福祉 之關聯性。千禧年生態系統評估對生態系統之研究鉅細靡遺,內容包含較不受影響的原 生林等,到被人類以不同方式使用的山區,再到農地及城市這些受到人類密集使用及改 變的生態系統。生態系統服務意指生態系統為人類社會帶來的利益,其中包括供應服務 如食物、水、林木及纖維,調節服務則影響氣候、洪水、疾病、荒地及水資源品質,文 化服務提供娛樂、美學及精神調劑,支援服務則為成土作用、光合作用及養分循環。人 類與環境改變間雖有文化及科技作緩衝,但人類生存基本上仍仰賴生態系統服務之流動 (千禧年生態系統評估,2005)。

海岸生態系統意指沿海土地,是淡鹹水交會處和近海區,也是世界上最具生產力又最受 威脅的系統之一。與其它甚至總面積更大的系統相比,海岸生態系統為人類生活提供了 更高比例的服務(千禧年生態系統評估,2005)。然而,人類使用及環境變化卻帶給海 岸生態系統最嚴重的衝擊。這些衝擊為生態系統服務保育及減貧帶來嚴苛的考驗。

此份越南全國性分析報告是東南亞區域計劃的一部分,主要評估海洋及海岸系統相關生 態系統服務之狀態及趨勢、驅動因素,以及系統服務如何支持人類社會,特別是越南貧 窮地區之生計及福祉。本報告亦評估上述各點之相關威脅、機會及限制。此報告更指出 研究時之關鍵難處,以及當前知識和能力之差距,以期研究策略發展在生態系統服務保 育上專注於減貧(ODG,2007)。此研究由海洋生物保育及社區發展中心(MCD)進行, 接受越南外部研究機構協助。研究小組成員包括海洋生物學、人類生態學、海岸資源管 理及氣候變遷等專家學者。

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