

INTEGRATED MANAGEMENT OF LAGOON ACTIVITIES  
IMOLA PROJECT

ABSTRACTS

OF

IMOLA THIRD TECHNICAL WORKSHOP

**“THE IMOLA PROJECT, TWO YEARS AFTER:  
TAM GIANG-CAU HAI LAGOON;  
PAST, PRESENT AND FUTURE”**

Hue, November 27, 2007

## CONTENT

1	Welcome speech to delegates and introductory remarks Hoang Ngoc Viet (National Project Director IMOLA)	1
2	Opening speech H.E. Nguyen Ngoc Thien (Vice-chairman of the People's Committee of the Thua Thien Hue Province)	2
3	Two years of IMOLA Project activities: overview and review of critical issues in Tam Giang Mr Massimo Sarti, CTA of the IMOLA Project and Ms Nguyen Thi Phuoc Lai, National Project Manager	3
4	The Venice lagoon, overview and critical issues: Flood and Coastal Protection, Wetland Restoration. Eng. Giovanni Cecconi, Venice Lagoon Management Board (Consorzio Venezia Nuova)	5
5	Collecting, integrating and analyzing information for the Tam Giang lagoon: the IMOLA Geographic Information System Leonardo Disperati and Dr Salvatore Viridis, Centre of Geotechnologies of the University of Siena, Italy	7
6	Aquaculture and inland capture fishery: two critical issues in Tam Giang-Cau Hai Le Cong Tuan (Hue University of Agriculture and Forestry, Michele Marconi (Polytechnic University of Marche) and IMOLA Technical Staff	8
7	Improving capture fishery practices: reorganization of fishery activities and fishing-gear deployment control Mr Massimo Sarti, CTA of the IMOLA Project and Le Xuan Hoang (IMOLA GIS expert and IMOLA Technical Staff	10
8	Environment and Biological resources in the Tam Giang - Cau Hai Lagoon Dr Do Cong Thung (Institute of Marine Environment and Resources)	11
9	Improving the aquaculture techniques I: the IMOLA Project capacity building program and fish disease control. Mr Baku Takahashi (FAO APO), Prof. Nguyen Quang Linh (Hue University of Agriculture and Forestry consultant)	15
10	Preliminary development of aquaculture grass-root extensionist network and aquaculture experimental models Mr Baku Takahashi (FAO APO), Mrs Vo Thi Tuyet Hong (Director FEC), Prof. Nguyen Quang Linh (Hue University of Agriculture and Forestry consultant)	16
11	The fishing gear selectivity experiment Mr Nguyen Phong Hai (Nha Trang Fishery University)	17
12	Establishment and strengthening of fisherfolk organizations Mr Arie Pieter Van Duijn (FAO APO), Prof. Truong Van Tuyen, consultant HUAF) and Mr Nguyen Luong Hien (Chairman Provincial Fishery Association) and IMOLA Technical Staff	18
13	Exploring alternative livelihoods through village food processing, marketing, and small enterprise development)" Mr Baku Takahashi (FAO APO)	20
14	Improving aquaculture and capture fishery. The perspective of the beneficiaries Mr Nguyen Thanh Ha (Vice-chairman of the Phu Loc District) and Mr Nguyen Xuan Bac, Vice-chairman of the Phu Xuan commune	21 23

15	The Venice lagoon, an integrated management challenges between conservation and development Eng. Giovanni Cecconi, Venice Lagoon Management Board (Consorzio Venezia Nuova)	25
16	Technologies Applied to Lagoon Studies in the Venice Lagoon: Tools for Planning Design and Operation Dr Gianfranco Castelli, Te.Ma. Faenza and Eng. Giovanni Cecconi, Venice Lagoon Management Board (Consorzio Venezia Nuova)	28
17	Tam Giang - Cau Hai lagoons- values should be sustained and promoted Dr Do Nam (Department of Science and Technology of the Provincial People's Committee of Thua Thien Hue)	29
18	Economic valuation of the Tam Giang-Cau Hai lagoon Prof. Mai Van Xuan, Hue University of Economics	30
19	The IMOLA GIS as a tool for territorial planning Dr Salvatore Viridis and Leonardo Disperati (Center of Geotechnologies of the University of Siena) and Dr Do Nam (Department of Science and Technology of the Provincial People's Committee of Thua Thien Hue)	31
20	Shaping the Integrated Lagoon Management Plan: sizing and time-constraining the Tam Giang lagoon problems Massimo Sarti (CTA IMOLA Project) and Nguyen Thi Phuoc Lai (National Project Manager IMOLA Project)	32
21	Closing remarks H.E. Nguyen Ngoc Thien (Vice chairman of the Provincial People's Committee)	34

**“The IMOLA Project, two years after:  
The Tam Giang-Cau Hai lagoon;  
past, present and future”**

***Third one-day Technical Workshop of the IMOLA Project  
(Integrated Management of Lagoon Activities)***

***Hue, Vietnam, 27 November 2007***

**Date:** Tuesday, November 27<sup>th</sup> 2007

**Venue:** Conference Hall, Heritage Hotel, 5 Ly Thuong Kiet Street, Hue, Vietnam

**Services provided:** Simultaneous translation, travel arrangements and hotel reservation, residence permits and visa issuing for foreign guests.

**Workshop Secretariat:** Ms Pham Thi Lien Hoa, Project Assistant and Miss Ho Bich Huong Giang, IMOLA Interpreter, IMOLA Office at the Department of Fisheries (Thua Thien Hue Province), 53 Nguyen Hue Street, Hue. Telephone: +84 54 831387 (ext. 112 or 0), Fax: +84 54 831587, E-mail: [imola.project@gmail.com](mailto:imola.project@gmail.com)

**Project rationale and workshop objectives:** The IMOLA Project activities officially begun on August 6<sup>th</sup>, 2005 and continued until to date for over two consecutive years. This third workshop, at the expiration of the second year is aimed i) to offer state-of-the-art overview of the project, ii) to highlight critical issues raised from assessment, monitoring and surveying activities and iii) to present to the beneficiaries in draft form the Integrated Lagoon Management Plan, foreseen by the project document at this stage.

This 3<sup>rd</sup> Technical Workshop will offer a background for evaluation of the project achievements by a wide range stakeholders, beneficiaries, the IMOLA Project Steering Committee members and a will provide a forum for discussion of the Integrated Lagoon Management Plan before consultation sessions take place. Moreover, an opportunity for monitoring project achievements will be provided to the delegates of the second Tri-Partite Review mission, schedule to happen thereafter.

By bringing at one comprehensive discussion table all parties, donor-country representatives, governmental and non-governmental institutions involved in research and management of the Tam Giang-Cau Hai lagoon system, the workshop aims at further stimulating ideas and criticism, for the sake of better tailoring and redirecting project strategies in the final year, according to those perceived as most urgent and imperative needs. Foreign guests from management boards of lagoons and costal wetlands of Northern Italy are invited to attend the workshop to offer their own perspective on the matter.

Unlike many other projects operating in the Thua Thien Hue Province, the IMOLA Project is specifically designed to tackle urgent and un-deferrable problems affecting the extensive wetlands developed seaward of the city of Hue; problems that impact to a large extent the activities of the lagoon inhabitants, the quality of their life, their livelihoods and income. The IMOLA project, funded through FAO of the United Nations by the Government of Italy has a declared objective of providing food security to the province population relying on lagoon natural resources, improving their livelihoods by optimizing the management of the biological stock and alleviate

their poverty. Besides these immediate objectives, there are several other issues that, despite appearing less pressing, bear an equally profound influence on the social and economic fabric that is one of the major concerns for the local government. These include strategies for mitigation of natural recurrent disaster, environment conservation and rehabilitation, prevention from long-term physiographic modifications of the shoreline, development of management tools and modern decision-support technologies, river regimes and flood prevention, territory infrastructure, marine protected areas and nursery rehabilitation.

The IMOLA strategy to prepare an Integrated Lagoon Management Plan consists of an integration of the following four components: i) understanding and scaling of the problems, ii) stabilizing the current situation; iii) improve planning tools (technical, legislative, social); iv) identify environmental and social critical operands, v) develop a GIS-based dynamic Integrated Lagoon Management Plan. The project focus shifted from mere community development and training to that of an environment and resource state understanding, technological enhancement of Government agencies, regulatory streamlining and alignment to international requirements, assuming a steady tendency to more decentralized power devolution in the coming future and, from the environmental standpoint, natural resilience, to bring the locale to a sort of pristine state.

The objectives of this workshop are to illustrate the logical thread that links all diversified project activities into a coherent framework and the principles on which the draft Integrated Lagoon Management Plan is built. The project aims to bring all valuable experiences together in a public confrontation on lagoon management strategies in sight of project termination in 2008 and prospects for future years. Criticism and feedbacks to drive project operation into the crucial final years are welcome.

The workshop will be open by the IMOLA National Project Director and conducted by the National Project Manager, with the assistance of the Chief Technical Adviser. There will be a half-a-day session of formal presentations by IMOLA staff and consultants on project achievement, followed by a presentation of the draft Integrated Lagoon Management Plan principles and content. A summary and conclusion discussion will close the meeting.

**Institutional attendance:** A number of national and international agencies are invited to attend; among which:

- The FAO Headquarter Representative, Rome, Italy
- The FAO Regional Office Representative, Bangkok, Thailand
- The People's Committee of Thua Thien Hue Province, Hue
- The PPC Office
- The Italian Development Cooperation Office, Hanoi
- The Consorzio Venezia Nuova Representative of the Venice Lagoon Management Board, Venice, Italy
- The Chairman of the Consortium Delta Po Adige, of the Po Delta Water Management Board
- Center of Geotechnology, University of Siena
- Director, Te.Ma. environmental monitoring and survey Joint Stock Company
- The Department of Fisheries of Thua Thien Hue Province, Hue (DOFI), the Sub-department of Aquatic Resources Protection and Aquaculture Extension Center

- The Department of Science and Technology of Thua Thien Hue Province, Hue (DOST)
- The Department of Natural Resources and Environment of Thua Thien Hue Province, Hue (DONRE)
- The Department of Agriculture and Rural Development of Thua Thien Hue Province, Hue (DARD)
- The Department of Foreign Affairs of Thua Thien Hue Province, Hue
- The Department of Planning and Investment of Thua Thien Hue Province, Hue
- The Department of Finance of Thua Thien Hue Province, Hue
- The Department of Social Labour and Invalid Affairs of Thua Thien Hue Province, Hue
- The Tourism Department
- The Perfume River Project management Board
- The Natural Disaster Mitigation and Flood Control Board
- Chan May – Lang Co Management Board
- The Hue Meteorology and Hydrology Center
- The Women’s Union of Thua Thien Hue Province
- The Farmer’s Union of Thua Thien Hue Province
- The Provincial Fishery Association
- The Phong Dien DPC Representatives and its DARD
- The Quang Dien DPC Representatives and its DARD
- The Phu Vang DPC Representatives and its DARD
- The Phu Loc DPC Representatives and its DARD
- The Huong Tra DPC Representatives and its DARD
- Representatives of interested communes: Quang Cong, Hai Duong, Quang Phuoc, Quang Thai, Huong Phong, Thuan An, Phu Xuan, Phu An, Phu Dien, Vinh Phu, Vinh Hung, Vinh Giang, Vinh Hien, Loc Binh, Loc Tri, Loc Dien, Phu Loc town.
- The Hue University
- The Hue College of Sciences and its Departments
- The Hue College of Agriculture and Forestry and its Departments
- The Hue College of Economics and its Departments
- The Institute of Marine Resources and Environment, Hai Phong
- The Hanoi Research Institute for Aquaculture N° 1
- The Nha Trang Research Institute for Aquaculture N° 3
- The Nha Trang Fisheries University
- The International Union for the Conservation of Nature, Hanoi Office
- The DANIDA FSPS II Project
- The Thua Thien Hue rural development programme
- The Quang Dien Rural development project
- The GVC Rural Development Project Phu Vang
- IMOLA steering committee members
- IMOLA management board
- CTA, NPM, APOs, IMOLA staff
- HVTN, TRT televisions, National and local newspapers

**Workshop Programme,  
Tuesday, November 27<sup>th</sup>, 2007**

07.30-08.00	Delegate registration	Workshop Secretariat
08.00-08.10	Welcome speech to delegates and introductory remarks	Mr <b>Hoang Ngoc Viet</b> (National Project Director IMOLA)
08.10-08.20	Opening speech	H.E. <b>Nguyen Ngoc Thien</b> (Vice-chairman of the People's Committee of the Thua Thien Hue Province)

<b>Session 1</b>	<b>The IMOLA Project: overview and review of critical issues activities and achievements (Chairman: Nguyen thi Phuoc Lai, National Project manager)</b>	
08.20-08.35	Two years of IMOLA Project activities: overview and review of critical issues in Tam Giang	Mr <b>Massimo Sarti</b> , CTA of the IMOLA Project and Ms Nguyen Thi Phuoc Lai, National Project Manager
08.35-08.50	The Venice lagoon, overview and critical issues.	Eng. <b>Giovanni Cecconi</b> , Venice Lagoon Management Board (Consorzio Venezia Nuova)
08.50-09.05	Collecting, integrating and analyzing information for the Tam Giang lagoon: the IMOLA Geographic Information System	<b>Leonardo Disperati</b> and Dr Salvatore Viridis, Centre of Geotechnologies of the University of Siena, Italy
09.05-09.20	Aquaculture and inland capture fishery: two critical issues in Tam Giang-Cau Hai	<b>Le Cong Tuan</b> (Hue University of Agriculture and Forestry, Michele Marconi (Polytechnic University of Marche) and IMOLA Technical Staff
09.20-09.35	Improving capture fishery practices: reorganization of fishery activities and fishing-gear deployment control	Mr Massimo Sarti, CTA of the IMOLA Project and <b>Le Xuan Hoang</b> (IMOLA GIS expert and IMOLA Technical Staff
09.35-09.50	Environment and Biological resources in the Tam Giang - Cau Hai Lagoon	Dr <b>Do Cong Thung</b> (Institute of Marine Environment and Resources)
09.50-10.05	Improving the aquaculture techniques I: the IMOLA Project capacity building program and fish disease control. (Presentation 1)	Mr <b>Baku Takahashi</b> (FAO APO), Prof. Nguyen Quang Linh (Hue University of Agriculture and Forestry consultant)

10.05-10.25	Preliminary development of aquaculture grass-root extensionist network and aquaculture experimental models	Mr Baku Takahashi (FAO APO), Mrs <b>Vo Thi Tuyet Hong</b> (Director FEC), Prof. <b>Nguyen Quang Linh</b> (Hue University of Agriculture and Forestry consultant)
10.25-10.40	Tea break	
10.40-10.55	The fishing gear selectivity experiment	Mr <b>Nguyen Phong Hai</b> (Nha Trang Fishery University)
10.55-11.15	Establishment and strengthening of fisherfolk organizations	Mr <b>Arie Pieter Van Duijn</b> (FAO APO), Prof. Truong Van Tuyen, consultant HUAF) and Mr Nguyen Luong Hien (Chairman Provincial Fishery Association) and IMOLA Technical Staff
11.15-11.30	Exploring alternative livelihoods (environmentally compatible culture techniques, food processing and marketing, enterprise developments) (presentation 2)	Mr <b>Baku Takahashi</b> (FAO APO)
11.30-11.45	Improving aquaculture and capture fishery. The perspective of the beneficiaries	Mr <b>Nguyen Thanh Ha</b> (Vice-chairman of the Phu Loc District) and <b>Mr Nguyen Xuan Bac</b> , Vice-chairman of the Phu Xuan commune
11.45-12.10	Discussion	
12.10-13.30	Lunch break	
<b>Session 2</b>	<b>Integrated lagoon and wetland management: national experiences and international perspectives</b>	
13.30-13.45	The Venice lagoon, an integrated management challenge between conservation and development	Eng. <b>Giovanni Cecconi</b> , Venice Lagoon Management Board (Consorzio Venezia Nuova)
13.45-14.00	Technologies applied to lagoon studies in the Venice lagoon: tools for planning design and operation	Dr <b>Gianfranco Castelli</b> , Te.Ma. Faenza and Eng. <b>Giovanni Cecconi</b> , Venice Lagoon Management Board (Consorzio

		Venezia Nuova)
14.00-14.15	Tam Giang - Cau Hai lagoons-values should be sustained and promoted	Dr <b>Do Nam</b> (Department of Science and Technology of the Provincial People's Committee of Thua Thien Hue)
14.15-14.30	Economic valuation of the Tam Giang-Cau Hai lagoon	Prof. <b>Mai Van Xuan</b> , Hue University of Economics

14.30 - 15.00	Discussion	
---------------	------------	--

15.00-15.20	Tea break	
-------------	-----------	--

<b>Session 3</b>	<b>Shaping the IMOLA Integrated Lagoon Management Plan</b>	
15.20-15.40	The IMOLA GIS as a tool for territorial planning	Dr Salvatore Viridis and <b>Leonardo Disperati</b> (Center of Geotechnologies of the University of Siena) and Dr Do Nam (Department of Science and Technology of the Provincial People's Committee of Thua Thien Hue)
15.40-16.00	Shaping the Integrated Lagoon Management Plan: scaling and time-constraining the Tam Giang lagoon problems	Massimo Sarti (CTA IMOLA Project) and <b>Nguyen Thi Phuoc Lai</b> (National Project Manager IMOLA Project)

16.00-16.30	Discussion	
-------------	------------	--

16.30-16.45	Closing remarks	H.E. <b>Nguyen Ngoc Thien</b> (Vice chairman of the Provincial People's Committee)
-------------	-----------------	--

## **WELCOME SPEECH TO DELEGATES AND INTRODUCTORY REMARKS**

Mr **Hoang Ngoc Viet**, Director of Department of Fisheries cum National Project Director IMOLA

H.E Mr. Nguyen Ngoc Thien, the Vice chairman of People's Committee, Thua Thien Hue province,

H.E the Representative of FAO Rome,

H.E the Representative of FAO Vietnam in Hanoi,

Distinguished scientists and guests,

Ladies and Gentlemen,

On behalf of Hue-IMOLA project, I would like to extend to you my best regards and most sincere appreciation for your participation in the 3<sup>rd</sup> technical workshop of IMOLA project, entitled "Tam Giang-Cau Hai lagoon: Past, present and future". It is our great honor to welcome your presence today, an indication of your responsibility and concern for people living in the lagoon and the sustainable development of its precious resource. Your contribution and information expressed at this workshop will be of great value to Thua Thien Hue's lagoon and received with much appreciation by the project.

IMOLA-Hue project came into operation in August 2005 under the Italian Government financial support and through the execution of FAO.

During the Project implementation stage, apart from the most profound endeavors from the whole Project management board, project office, and all national and international experts, IMOLA has also received the attention and guidance from Provincial People's Committee. H.E Nguyen Ngoc Thien, the Vice-chairman of the Provincial People's Committee, the Head of Project Steering board and also stakeholders from various departments, agencies, district and commune people's committees, Hue University of Science, Hue University of Agriculture and Forestry, and Research Institutes of Fisheries, etc. We would like to express our deepest thanks to your precious cooperation.

Besides these advantages, there are a variety of difficulties that were encountered since this is an integrated project concerning with different fields and activities.

The objective of this workshop is to illustrate the logical thread that links all diversified project activities into a coherent framework and principles serving as the basis for developing the draft Integrated Lagoon Management Plan. The project aims to bring all valuable experiences together in a public forum on lagoon management strategies in sight of the project termination in 2008 and prospects for the impending years. Comments and feedbacks with the view to orient the project to formulate essential recommendations or decisions in 2nd Tripartite meeting on 29th November 2007 are welcomed.

Ladies and gentlemen, during the last 2 years IMOLA-Hue project has overcome a great deal of difficulties in implementing activities cited in the Project document to improve the lagoon people's livelihoods and build a sustainable management planning strategy for Thua Thien Hue's lagoon system. All these efforts have gained certain achievements.

Obviously, some issues to be raised by the CTA and project experts need be more discussion. I look forward to your critical contributions so that project's activities can bring out more practical outcomes.

Once again, I would like to express my wishes of good health to you and the utmost success to the workshop. Thank you for your kind attention.

## **OPENING SPEECH FOR IMOLA THIRD TECHNICAL WORKSHOP**

H.E. **Nguyen Ngoc Thien**, Vice-chairman of the People's Committee of the Thua Thien Hue Province

Distinguished guests and international attendants from Italy,  
Honorary representative of the Italian Ministry of Foreign Affairs,  
H.E the Italian Ambassador to Vietnam,

Officials from the FAO Headquarter in Rome and FAO Office in Vietnam and outstanding scientists,

The integrated management of lagoon activities IMOLA project has completed most of its activities during the last two years. At this third technical workshop of the IMOLA project, on behalf of the Provincial authority, let me extend my warmest and most honorable greetings to all distinguished guests, representatives and scientists coming from many part of the nation, from Italy and elsewhere.

Ladies and gentlemen,

The IMOLA third technical workshop aims to provide an understanding of IMOLA activities, their outputs, achievements as well as obstacles after two years of operation; with a view to receive precious contribution and evaluation of all stakeholders, particularly the beneficiary people. The workshop is designed to be an experience-exchange session, where all participants, including some Italian scientists, will bring up their technology and experience in coastal and lagoon management. The outcome of this session will provide the background to formulate the recommendations at the TPR conference to be held on 29 November 2007 among the Donor Government, the Implementing Organization and the Beneficiary Government.

IMOLA is a multi-disciplinary project. With effort by national and international consultants and staff, and thanks to technical support from FAO experts, many activities have been implemented to achieve an understanding of the lagoon ecosystem and life of lagoon-dependant people. Upon completion of these activities, and based on their results a sustainable management strategy shall be developed for the lagoon of Thua Thien Hue.

At this workshop we hope that knowledge, experience and opinions shall be openly exchanged for the sake of better management of the lagoon, to be potentially realized through the identification of modern management tools, and not excluding the application of latest technology and regard of traditional knowledge. We hope to come up today with solutions to basic issues in the lagoon in order to balance the use of lagoon resources economic development and social stability.

With contribution of you who are expert in your field, we are positive that the most appropriate and realistic approach to the existing issues in the lagoon of Thua Thien Hue would come out from this workshop, so that an integrated management plan can be built with high feasibility.

On behalf of the provincial authority, I declare the opening of the workshop, and please find here my best regards to all attendants and utmost success to the workshop.

Thank you for your kind attention.

## **TWO YEARS OF IMOLA PROJECT ACTIVITIES: OVERVIEW AND REVIEW OF CRITICAL ISSUES IN TAM GIANG-CAU HAI**

**Massimo Sarti**, FAO Chief technical Adviser,  
and **Nguyen Thi Phuoc Lai**, FAO National Project Manager.

The scope of the IMOLA Third Technical Workshop is to i) illustrate the project activities so far undertaken, in the prospect of building an Integrated Lagoon Management Plan, iii) discuss critical issues affecting the Tam Giang-Cau Hai lagoon and priorities, both from a national and international perspective, iii) illustrate tools and strategies deployed to build an participated and dynamic Integrated Lagoon Management Plan.

The coastal tract of the Thua Thien Hue province is characterized by a vast lagoon (Tam Giang-Cau Hai) consisting of a number of hydrologically independent basin and located in a region of four-season tropical climate subject to the influence of autumnal typhoons. The characteristic hinterland and fluvial regime make the coastal region vulnerable to autumnal flash floods potentially hazardous for the population, human settlements and activities. The South China Sea tract of Central Vietnam is dominated by a micro-tidal regime, with strong wave-action and storm-surge dominance that make coastal erosion and long-shore sediment drift locally intense. Long-shore drift coupled with weak tidal currents cause inlet instability and tendency to closure, inhibiting water masses exchange and transforming the lagoon into a sort of semi-enclosed coastal lake.

Fair-weather river-water discharge mainly happen through the centrally located internal mouth of the Perfume river and Thuan An inlet, with moderate dispersal of fresh-waters in the southern basins of Thuy Tu and Cau Hai. Ventilation of the northern basin of Tam Giang is ensured by the more-or-less continuous discharge of riverine waters from the O Lau and Bo permanent rivers. The southern basins (Sam Chuon, Thuy Tu and Cau Hai) are rather prevented from riverine water influx by infrastructures (sea-dykes, river barrages) thus suffering poor ventilation and seasonal anoxia.

Autumnal typhoon season reactivates the whole distributary system, causing widespread bottom erosion, removal of superficial sediments, widespread freshwater conditions, pollutant wash-out and oxygen replenishment.

From the standpoint of the anthropogenic impact, the main problems are caused by excessive development of aquaculture in the past two decades, far beyond the capacity of the natural environment to flush out the excess of biological wastes and nutrients, especially after progressive restriction of river-water driven circulation and in the lack of technological plants (open-water culture ponds, sedimentation ponds, sewage system, etc.) helping to reduce the organic load. The discharge of excessive organic-matter through aquaculture wastewaters caused oxygen depletion in poorly ventilated basins and unfavorable conditions for most aquatic species of economic importance. To worsen the situation, excessive unregulated capture, capture of juvenile species, destructive practices and reduction of nursery grounds caused by encroaching aquaculture ponds progressively depauperated an already overexploited biological stock, thus reducing the catch. This persisting situation undermined the subsistence economy of local fishermen, with no prospect of improvement, lead to a steady deterioration of the social fabric, to poverty or at best, to critical living conditions for most of the lagoon-dwelling communities.

Socially, the lagoon-dwelling community show a different approach towards the improvement of their living conditions, trapped in between two conflicting necessities: subsistence and improvement of environmental conditions. Under these circumstances, the response of the communities to overcome individual needs and collectively promote virtuous actions may be very different depending

upon the trust of the communities in their leaders, the hardship of the locale, contingent situations.

The high incidence of aquatic animal diseases in aquaculture, the inability of coping with climatic adverse conditions, the lack of skill in most aquaculture elementary practices and poor knowledge of how to plan a profit-generating economic activity lead to income instability for vast strata of the lagoon-dwelling population, not to speak of the nomadic boat-dweller that still lacking of any allocated land are left with no alternatives.

Marketing capacity of households is primitive and the common destination of their products is the local market. The ability to organize themselves in small enterprises to realize scale economies, the power of negotiation with middlemen, technology and skill on how to process rural commodities as a way to increase their value are left with no guidance and no financial resources. Credit access for the poorest is virtually non-existent, as excluded from the official banking circuit and even for the better-off chances are limited; loans from neighbors and villagers is widely practiced but with no concrete possibilities of success, as in most cases aimed to cope with contingent situations.

The Provincial authorities are in the process of designing the future setup of the lagoon, prospecting the development of alternatives in the long-range plan but facing objective immediate difficulties in the present that are legacy of past policies: legislative instruments for the fishery sector are being designed but social preparedness to enforce co-management is low and there is often a detachment between the actions promoted by the center and the degree of consensus manifested by the communities, with a few of remarkable exceptions.

On the lines of these critical issues, the IMOLA Project designed its strategy with the purpose of i) stabilizing the existing situation by removing those elements representing of immediate hazard (e.g. the "improving aquaculture" activities and the reorganization of capture fishery), possibly linking with ongoing activities undertaken by local authorities. At the same time ii) improving the capacity of communities at selected communes to manage themselves or practice co-management in collaboration with their authorities was attempted by developing the appropriate social instruments or promoting aggregation in Fishery Associations. Experimentation of radically different culture techniques (e.g. integrated fish polyculture, mollusc culture) with prospect of commercial development in the mid-term was initiated with success. Mollusc culture, commonly and successfully practiced in enclosed coastal sea tract of the world, may represent in Tam Giang-Cau Hai a viable alternative to remove environmental stress and pressure on the impoverished biological stock. Shift from subsistence economy to market economy (local but with prospect for national trade and export) by promoting village enterprises for processing rural commodities is a realistic opportunity if coupled with a sound policy for environmental control and achievement of quality standards for products.

Territorial planning requires appropriate technical tools; a prototype of GIS-based lagoon database has been prepared for the purpose of i) managing information, ii) generating automated thematic maps, iii) setup zoning plans and iv) predispose informative tools for a participated process of consultation.

## **THE VENICE LAGOON OVERVIEW AND CRITICAL ISSUES: FLOOD AND COASTAL PROTECTION , WETLAND RESTORATION.**

**Giovanni Cecconi**, Consorzio Venezia Nuova, S. Croce, 505 – 30135 Venezia  
Italy.

E – mail: [giovanni.cecconi@consorziovenezianuova.com](mailto:giovanni.cecconi@consorziovenezianuova.com).

[www.salve.it](http://www.salve.it)

The MOSE system has been designed to protect the lagoon area, its inhabitants and its inestimable historical heritage from flooding, including extreme events. It consists of mobile barriers to isolate the lagoon from the Adriatic Sea during storm surges and a series of structures for increasing flow resistance in the inlet channels.

The mobile barriers, the complementary structures together with raising of quaysides and paving in the lowest lying urban areas represent an integrated defence system with a minimum number of closure (3-5 times per year with the current mean sea level). The MOSE system is thus able to guarantee water quality, safeguard the morphology and maintain port activity.

The MOSE system, as an environmental protection and restoration tool, is the result of a complex design process which always considered the sensitivity of the various components of the ecosystem, including the constraints imposed by socio-economic conditions and land use.

The mobile barriers consist of rows of buoyant flap gates installed in the inlet channels. When not in operation, the gates are full of water and rest in caissons on the bed. When a storm surge higher than 110 cm is forecast, compressed air is introduced into the gates, expelling the water (the level of 110 cm has been agreed with the relevant institutions as optimum with respect to current sea level and the level to which the lowest lying areas of Venice are being raised). As the water is expelled from the gates, they rotate around the axis of the hinges until they emerge and block the storm surge flow entering the lagoon. The mobile barriers remain in position for the duration of the high water only. When the water level drops and the lagoon and sea are at the same level, the gates are again filled with water and return to rest in the seabed.

The complementary structures are made of a breakwater outside each lagoon inlet and the raising of the seabed at Malamocco from –16m to –14m. In the Malamocco inlet, the MOSE system also includes construction of a navigation lock to allow the transit of large ships for port operations during storm surges.

The Venice storm surge barriers offer a number of advantages in terms of: the limited time of operation; the reduced size of the foundations; the low impact on navigation and tidal exchange of water and sediments; the low landscape impact.

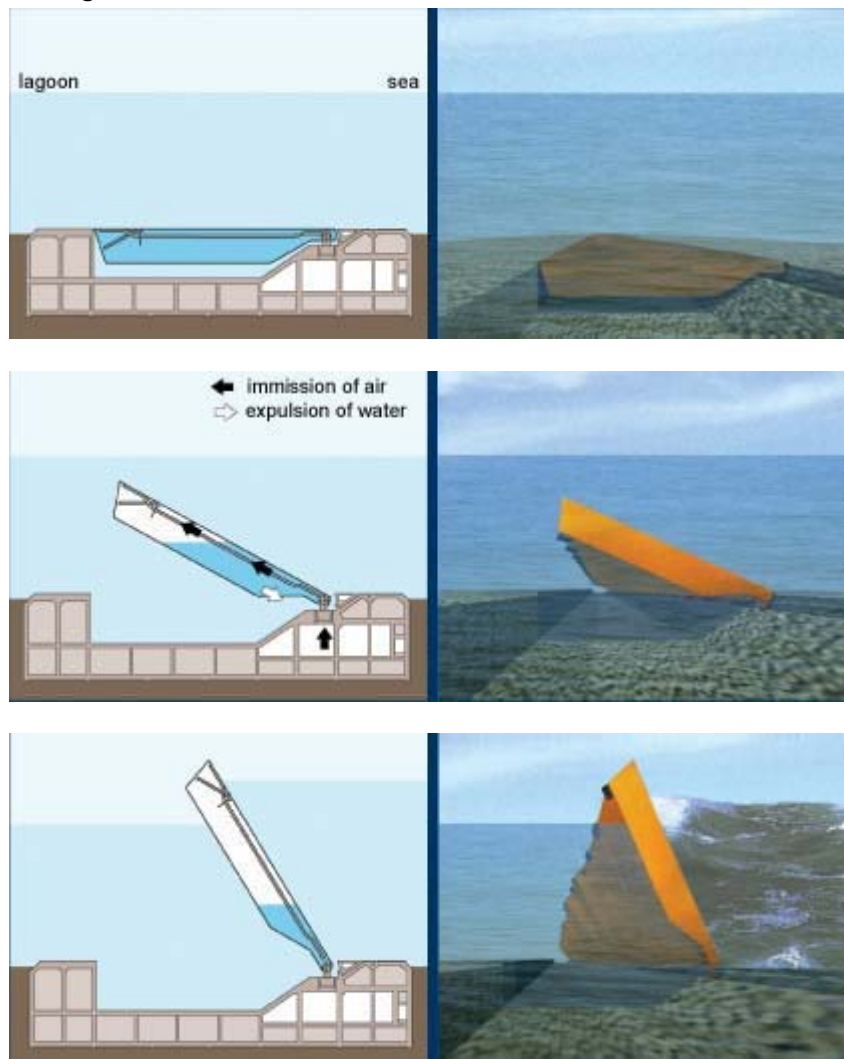
Year 2003: Works on the MOSE system begins. The final design of the system was approved on 28 November 2002 by the Water Authority Technical Committee, a branch of the Higher Council of the Ministry of Transport and Infrastructure. On 3 April 2003, a unanimous resolution of the Inter-Ministerial Committee gave the go-ahead to execute the design and construction of the project and the start of work were officially celebrated on 14 May 2003.

The work have started with the construction of the breakwaters at the Malamocco and Chioggia inlets, the refuge port of Lido-Treporti and of Chioggia, and the navigation lock of Malamocco.

Works at the lagoon inlets: work in progress: Construction of the high water defence system involves three phases of work lasting a total of eight years. At present the second phase of work is almost finished. It involves construction of the abutments for the gates and associated structures: the small craft harbours and locks for fishing, pleasure and emergency crafts at Lido and Chioggia inlets,

the lock for large ships at the Malamocco inlet and protection of the seabed on either side of the gates.

The third and last phase of work involves construction of the barriers themselves (caissons and gates) and their installation.



▪ *The buoyant flap gates and foundations.*

The presentation will be completed with the coastal works (protected beach nourishments) and the works for the morphological restoration of the lagoon (constructed marshes and tidal flats re-using sediments from maintenance dredging).

# **COLLECTING, INTEGRATING AND ANALYZING INFORMATION FOR THE TAM GIANG LAGOON: THE IMOLA GEOGRAPHIC INFORMATION SYSTEM**

**Leonardo Disperati** and **Salvatore Virdis**

Centre of Geotechnologies of the University of Siena, Italy

In this presentation we describe the structure and contents of the IMOLA Geographic Information System (IMOLA GIS) two years after the beginning of the project.

The IMOLA GIS was designed and developed in order to fulfill the following main objectives: to store existing data about the Tam Giang lagoon useful for the project, to organize data collected by the project's partners and to analyze the whole dataset in order to provide constraints and tools for the lagoon management.

For the above reasons the IMOLA GIS integrates today the following information for the lagoon area: topographic data, digital elevation model, GPS network data, multitemporal panchromatic and multispectral satellite images (Landsat ETM+, Aster and SPOT), multitemporal land cover/use database, water and sediments environmental database, aquaculture database and fishing gears database.

Hence the IMOLA GIS represents a comprehensive, homogeneous tool include up-to-date info about the Tam Giang lagoon.

Most of the data were collected by the project's partners and allowed us to development of management tools and modern decision-support technologies gathered information.

## **AQUACULTURE AND INLAND CAPTURE FISHERY: TWO CRITICAL ISSUES IN TAM GIANG-CAU HAI**

**Le Cong Tuan** (Hue University of Agriculture and Forestry),  
**Michele Marconi** (Polytechnic University of Marche)  
and the HUAF team and IMOLA Technical Staff.

Abnormally developed aquaculture, with predominance of shrimps among the cultured species and excessive and unregulated capture at the expenses of an impoverished biological stock are two of the main and primary drawbacks of the Tam Giang-Cau Hai lagoon. Progressive encroaching of low-tide aquaculture ponds at the expenses of the free-water lagoon surface, excessive waste-water discharge and feed dispersal, the spread of diseases and lack of management caused inefficient production and unstable income for most producers, with repercussions in the local economy and environment. On the other hand, a degraded aquatic environment, the reduced nursery area (intertidal flats, sub-tidal seaweed and sea-grass fields) and increased fishing effort caused a depauperation of the biological wild fish stock beyond the capability of spontaneous recovery.

In the attempt of predisposing better management practices of aquaculture activities, ensuring a more efficient environmental control, preventing negative impacts of aquaculture on other aquatic activities (capture) and setting up a system of efficient information, the IMOLA Project implemented the following: i) assessment of the lagoon environment carrying capacity, ii) assessment of the impact of the aquaculture on particulate and dissolved organic matter, both in the sediment and in the water (with identification of areas more heavily impacted), iii) prepare a census of aquaculture pond systems in selected communes, with GIS rendering.

### **ASSESSMENT ON THE ENVIRONMENT CARRYING CAPACITY OF CONCENTRATED AQUACULTURE AREA IN SAM CHUON LAGOON, VIETNAM**

The Environmental Carrying Capacity (hectare) is the maximum number of hectare of a given farming system the environment can accommodate without exceeding the Environment capacity. The objective of the research is to estimate the Environment Carrying Capacity (ECC) for CAA at Sam Chuon lagoon and assist the project in formulating policies for the sustainable development.

The method used for analyzing waste and nutrient concentration in water was Standard Methods for Examination of Water and Wastewater (APHA, USA, 1995). For measure the water exchange Standard methods of marine hydrometeorological centre-Vietnam (1981) was used. To estimate Environmental carrying capacity, methods of Christensen M.S., 2005 were applied.

Environmental carrying capacity of concentrated aquaculture area of Sam Chuon lagoon for BOD<sub>5</sub>, COD, TN, TP are 433.06ha; 389.98ha; 1828.08ha; and 5969.26ha respectively. The limiting factor of environmental carrying capacity is BOD and COD. The unplanned development of net-enclosed system in the concentrated aquaculture area is the main reason for low environmental carrying capacity of BOD and COD. However, the area still has high potential of environmental carrying capacity for TN and TP. Our recommendations include 1) expanding the research in the lagoon to a larger spatial and temporal scale to update the data on environmental carrying capacity, and 2) applying the result of environmental carrying capacity study in re-planning aquaculture area in Sam Chuon.

### **BENTHIC-TROPHIC DYNAMICS AND HUMAN ACTIVITY IN TAM GIANG-CAU HAI LAGOON**

Our objective is to study the variability of biochemical composition of organic matter in lagoon sediment and to find out its relation with different activities and natural phenomena taking place inside the lagoon. We measure total concentration of organic matter in sediment (TOM) with gravimetric method, and the main biochemical component (protein, lipid, carbohydrates) with common colorimetric method adapted to sediment analysis, using spectrophotometer. The same instrument was used for detecting the concentration of chlorophyll-a and phaeopigments. For autotrophic classification of carbon, De Jonge 1980 was followed. To measure Bio-Polymeric Carbon (BPC) we followed the formula of Fabiano et al. 1995. To calculate the trophic benthic index we followed the method by Sensu Pusceddu et al. 2007).

The result showed a significant importance of two benthic variables: ratio PRT/CHO and chlorophyll-a concentration, which are useful to show the main human activity. This variable could be included in a future environmental monitoring routine for monitoring and evaluating the impact of new best management practice that might be introduced in aquaculture and other human activities.

### **CURRENT SITUATION OF AQUACULTURE IN PILOT SURVEY COMMUNES IN TAM GIANG – CAU HAI LAGOON, IN VIETNAM**

To meet the special requirement of updating information from IMOLA project, 12 communes were selected for the pilot survey: Quang Thai, Quang Phuoc, Huong Phong, Quang Cong, Hai Duong, Phu An, Phu My, Thuan An, Phu Xuan, Phu Dien, Vinh Giang and Loc Binh communes.

The objectives of the survey are 1) to update the information of aquaculture situation in selected communes; 2) to build a GIS database of current situation for aquaculture, for purpose of better management and research.

We combined GIS and Participatory Rural Appraisal techniques for both top-down and bottom-up survey. The final products of the survey provided a superb database on real situation of the commune, as stated by commune authorities and survey staffs from 12 communes in 2006. The GIS database is easy to update and one advantage of the database is that thematic maps on aquaculture can be exported and used for many purposes in management and research. For future activity, there is the need to expand the survey to other communes along the lagoon to complete the aquaculture database.

## **IMPROVING CAPTURE FISHERY PRACTICES: REORGANIZATION OF FISHERY ACTIVITIES AND FISHING-GEAR DEPLOYMENT CONTROL IN CAU HAI**

**Massimo Sarti**, CTA of the IMOLA Project and **Le Xuan Hoang** (FAO IMOLA GIS expert) and IMOLA Technical Staff

The development of capture fishery in Tam Giang-Cau Hai lagoon has a twofold aspect: technical and social/legislative. Technically, the overall improvement of the aquatic biological stock and the recovery of the resource have to pass through the decrease of the fishing effort: no inland water of the world carry such an intensive exploitation without severe detriment and the Tam Ginag-Cau Hai lagoon makes no exception.

This reduction under the present circumstances does not seem viable without paying a toll in social tension and mistrust towards the local Authorities. Hence, the rectification of the capture system has to be actuated in steps, with the participation of communities in the process and within the frame of legislative perimeters set up by the Governments.

The activities of the IMOLA Project in supporting the Phu Loc District to reorganize the fishing-gear array in Cau Hai aimed to: i) help the communal authorities in performing a complex task of translating and reduce the size of stake traps ("fish corrals") in a vast area encompassing five major communes and a total number of instruments of over 800 units; ii) stimulate the communities to undertake a joint effort with their authorities to improve their locale, iii) remove the false concept that under the present circumstances a reduction of the size of the gear implies a proportional reduction of the catch; iv) endorse and technically assist in putting into practice a series of concerted action that concurrently will contribute to ameliorate the environment (e.g. widening the coastal respect zone, design permanent seaways, reduce the size of the gears to a more manageable scale and increase the distance among them, thus favoring water circulation. At last, the IMOLA Project wished to drag into the process the nascent Fishery Associations from communes around Cau Hai in order to concretely involve them in management. It is obvious that the undertaken measures are not resolving on their own, but the exercise had some interesting implications.

In general, the surveying of the existing array using GPS, the proposal of a possible scenarios, the negotiation with the populations and authorities, the acceptance of the new plan and repositioning with the GPS, performed by the fishermen themselves was an interesting and illuminating test on how self-management and co-management is perceived and how it could be performed, with very different reactions and approach from the grass-root.

Technically, the operation of redesigning the no sao arrays was performed in successive stages implying i) surveying of the existing array, survey of official communal boundaries and official waterways, ii) presenting plan and make a census of owner fisherman, iii) receiving feedback from the communities and drafting a plan, iv) holding multiple consultations with communities and reaching a consensus, v) presenting the final plan, vi) relocating the vertexes using GPS, vi) preparing the final map and related database. All steps were accompanied by tutorial sessions of the use of the GPS and communal technicians and villagers, under supervision of IMOLA technical staff, performed most tasks.

The output of the work are: i) a more orderly, organized, less dense and manageable array, ii) a computerized GIS-based fishery database including a census of all fishermen from Cau Hai (including information on existing or nascent Fishery Associations), iii) a cartographic planning tool and monitoring system for communal authorities, iv) a verifiable and updatable tool for issuance of fishing license and right whenever applicable.

# ENVIRONMENT AND BIOLOGICAL RESOURCES IN THE TAM GIANG - CAU HAI LAGOON

**Đỗ Công Thung, Nguyễn Văn Tiến, Đàm Đức Tiến, Chu Văn Thuộc, Nguyễn Đăng Ngải, Nguyễn Văn Quân, Nguyễn Thị Thu, Nguyễn Thị Minh Huyền, Lê Thị Thuý, Vũ Thị Lựu, Trần Mạnh Hà, Institute of Marine Environment and Resources, Academia of Science, Vietnam.**

**Massimo Sarti, Marconi Michele, Stephano Carboni, Polytechnic University of Marche, Italy.**

**Nguyễn Văn Hợp, Trương Quy Tùng, Hoàng Thái Long, Nguyễn Hải Phong, Thuý Châu Tờ, Trần Hải Bằng, Department of Chemistry, the University of Sciences of Hue.**

**Lê Công Tuấn, Nguyễn Văn Huệ, Hue University of Agriculture Forestry. Lê Văn Miên, University of Hue**

## 1. Materials and methods

The report presented the results of four lagoon surveys organized by IMOLA in April, May, August, and November 2006, including results of three surveys by BIOD, a project between Vietnam and Italy in 2003, 2004 and 2005, and data of others scientific projects since 1995 up to date.

Methodology for these surveys was taken from the Manual of Marine Method by the Committee of Science and Technology of Vietnam (1981) and the Method for Marine Monitoring by the Environmental Department of MOSTE (1997), Canada - ASEAN (1997), Wilkinson and Baker (1998)

By providing data on fundamental characteristics of the environment and biological resources in Tam Giang – Cau Hai lagoon, these results might set up good measures for management of the lagoon.

## 2. Results

*Meteorology.* Rainy season in this region often comes late in the year, typically from September to December, with total of rainfall at 2000mm (or 72.8%). High rainfall concentrates in October and November and peaks in October (at 740mm, or 26.96%). Rainfall in the other months of year is not noticeable. High concentration of rainfall in a short period of the year brings about flood concurrence in winter, while summer is subject to dry weather due to low rainfall.

*Hydrographic.* The lagoon hydrography reflects the influence by river hydrography and oceanography. Water level in the lagoon changes from site to site, and is not identical to sea level. Water exchange happens at the inlet of Thuan An and Tu Hien, and was calculated using 3-Delf model of Dynamic Institute of Harland.

### **Water parameters in Tam Giang – Cau Hai Lagoon.**

*Temperature.* The average atmosphere temperature in the area, which reflects the air temperature in most of the whole country, is 25.2°C, higher than that of north Vietnam, and peak s in July (at 29.6°C) and dips December (at 19.9°C).

*Salinity.* Analysis shows that salinity fluctuation in the region is very complex; and stratification are found in some areas. In April (2006) salinity declines, ranging from 1‰ to 31.5‰, typically at 11.0‰ on the surface and 12.4‰ at the bottom. One month later (May 2006) salinity increased from below 1‰ to 34‰: by average at 18.17‰ on the surface, and 19.18‰ at the bottom.

*pH.* In general, pH ranges from 7.18 to 8.09, some time descending to as low as 5.5.

*Dissolved oxygen.* 6.24mg/L - 6.8mg/L is the average.

### **Some warnings on water quality in Tam Giang - Cau Hai lagoon**

*Acidification.* It was quite clear that in O Lau area, within one month pH was reduced from alkaline to acid.

*Stalinization.* Fresh water body comes from Huong river and saline water from the sea via Thuan An mouth. In April 2006, salinity concentration was low, ranging from 4.5 to 11‰, but high in May, increasing up to 33‰.

*D.O decrease.* The decrease of D.O in the lagoon water obstructs the respiration of organisms, resulting in suffocation. D.O was reduced to as low as 4.7-5.2mg/L, lower than the least threshold of DO demand by organisms.

*Microorganism pollution.* This pollution should be alarming as far as water environment is concerned. Microorganism pollution was 3 - 30 times higher than the allowable standard.

*Increased oil concentration.* Lagoon oil concentration in Tam Giang - Cau Hai was classified as high.

### **Diversity of the lagoon ecosystems**

*Lagoon topography.* There are four basic types of topography: shore topography, bottom topography, topography of lagoon mouth and sand banks.

*Sub-ecosystems in the lagoon.* Located on the Central coast Tam Giang - Cau Hai lagoon system is represented by many types of habitat that provide the background typical wetland sub-ecosystems. Not to mention the coral reef ecosystem, in the area there are all ecosystems typical for the coastal zone of Vietnam. The sub-ecosystem of swamp with seagrass particularly plays an important role in term of attracting waterfowls and aquatic species that form the biological production for the lagoon. Tam Giang - Cau Hai lagoon can be ranked as the typical coastal lagoon system in Vietnam.

### **Biodiversity in Tam Giang – Cau Hai**

*Ecological zoning.* It can be concluded from the above results that the water parameter controlling all aquatic organisms in the lagoon is salinity. The salinity complex changes seasonally, periodically and daily, and spatially (from layer to layer and from zone to zone). Consequently four sub-zones are formed aquatic ecology in the Tam Giang - Cau Hai lagoon, namely *Fresh water*, *Fresh-brackish water*, *Brackish water*, and *Brackish-saline water*. These sub-zones are small at the lagoon mouth.

*Species variety.* 1000 species are estimated to be living in Tam Giang - Cau Hai lagoon, of which 938 had been named. Probably this lagoon was the most fully researched. Phytoplankton has the highest number of species, 250 species, fish 230 species, bird 73 species, zooplankton 66 species, and benthos 205 species.

*Biological resources.* There are over 100 species that provide economic products for local resident in the lagoon. The annual catch by local people in five districts is about 2,500 tones of aquatic product, all consumed in local market, with the exception of some low economic weeds. There are 23 economic species of fish, particular bream (*Siganus sp*), the recognized symbol for the lagoon, and 34 benthic species of high value for local processing activities, like *tôm chua* ("sour shrimp"), *cơm hến* ("clam rice"). Based on frequency of catch species, lagoon biological resources can be categorized into 4 following groups:

i) *High frequency group.* The surveys show that there are 42 economic species captured by push net, 7 of which come under wide distribution at all transects, at the frequency of 78 - 100%.

ii) *Medium frequency group*. The frequency for this group ranged from 46% to 70%.

iii) *Low frequency group*. There were 11 species at the frequency of 25 - 40%.

iii) *Very low frequency group*. There were about 14 species that appeared at 1 or 2 transects.

*Distribution of aquatic species in the lagoon*. Based on the number of aquatic product species caught by push net in the dry season of May 2006, concentration of aquatic species is most high from Quang Cong to Phu Hai (in Tam Giang and Sam Chuon lagoon) with 30 – 32 species. The lowest species concentration was recorded in O Lau (with 20 species), lower than Thuy Tu lagoon with 23 species, and Cau Hai, 26 species.

*Fishery stocks*. Since only one survey trip was conducted, in May 2006, this data provides only initial result. In order to ensure more accuracy, a supplemental survey trip was conducted in the rainy season of November or December 2006. Initial result showed that fishery stock mainly concentrates in Dam Sam lagoon to Thuy Tu lagoon, and lowest in O Lau area. Catch varied from one site to another, ranging from 3,293 kg to 190,200kg/h. Fishery stock for each site and stock distribution map was built based on the catch production. However, it is clear that natural resources have been decreasing in recent years. The total fishery stock in the lagoon is estimated at about 1,408,496kg in May 2006. To maintain fishery stock at stable level, exploitation should not reach over 1,000 ton per year. If this ideal catch is to be divided for 100,000 fishermen, each fisherman will get less than 10kg of fish per year.

*Benthic resources in Tam Giang - Cau Hai*. Analysis of the survey trip showed that benthic resources were highly abundant in April and May 2006. Total macro-benthic stock (including seaweed and sea-grass) were 14,523 tones, of which seaweed made up 3,594 tones, snail 8075 tones, bivalve 2729 tones, crustacean 81 tones, and fish 45 tones. Transects F, G and A were determined to possess the highest benthic biomass. Fishery stock caught in 40m<sup>2</sup> at the transect F was 12,62kg, at the G, 9kg and at A, 6kg. In the structure of natural resources, with the exception of seaweed and marine snail as food for fish, livestock and fertilizer, others are groups of economic value, such as bivalve, crab, and shrimp. Distribution of benthic resources is irregular and depends on their living environment.

### **Orientation of sustainable management of biodiversity**

*Scenario 1*. To maintain present status as it is, assigning management to traditional career groups. In general, all fishing activities in the lagoon pose potential dangers to the environment and threats to sustainable biodiversity.

*Scenario 2*. To impose a supervised primary planning process on the lagoon.

### **3. Conclusion and recommendation**

#### *Conclusion*

1. Salinity and pH fluctuation divides the lagoon into 4 sub-zones different in functions and specific characteristics. These are fresh, fresh-brackish, brackish and brackish saline sub-zones.

2. Preliminarily, four potential harmful factors that are threatening to the lagoon have been determined, including salinization, acidity, low oxygen concentration and environmental pollution.

3. The Tam Giang - Cau Hai lagoon system is high in biodiversity with over 1,000 species, of which 938 species have been named. Probably this area has been well documented as the most abundant coastal lagoon system in Vietnam. The lagoon

sub-ecosystems have specific characteristic and favorable conditions for expansion and development of suitable professions.

4. Over 100 economic species living in the lagoon provide thousands of tones of fishery annually and are the major source of income for local resident. Nevertheless, there is an unbalance between economic and non-economic species. Over-exploitation of natural resources is the main cause of biodiversity reduction in this area.

5. To resume the proper use of biodiversity, and maintain a good variety of activities, particularly with the potential development of lagoon ecotourism, and unblocked water circulation and prevention of environmental pollution are the first priority.

#### *Recommendation*

1. Study on integrated assessment of resources and environment should be conducted to achieve the sustainable utilization of natural resources in Tam Giang - Cau Hai lagoon.

2. Assessment should be implemented on the effectiveness of shrimp culture activities and their environmental impacts, and accordingly to build planning on culture area.

3. A lot of financial and human effort has been put forward regarding the incident of widening and closing of Thuan An and Tu Hien inlets, yet why don't think of the best way to live with this natural event?

## **IMPROVING THE AQUACULTURE TECHNIQUES I: THE IMOLA PROJECT CAPACITY BUILDING PROGRAM AND FISH DISEASE CONTROL**

Mr **Baku Takahashi** (FAO APO), Prof. Nguyen Quang Linh (Hue University of Agriculture and Forestry consultant)

Under the overall objectives of improving the aquaculture for environmental and economic sustainability, the IMOLA project has been providing aquaculture training to the local farmers through Result Demonstration Farmers (RDFs) and undertaking capacity building and survey of aquatic animal health conditions in TT Hue province. The first activity involved the training of around 500 RDFs, who are key aquaculture farmers and who will in turn train about 10 Fellow Farmers (FFs) each in their area. The aquaculture training has six different modules based on the culture models, namely, fresh water fish cage, fresh water fish pond, brackish water fish cage, low-tide shrimp culture, high-tide shrimp culture, and mollusk culture. Each module is composed of three set of training including theoretical, practical, and extension sessions (except mollusk culture, which does not have extension sessions). By the end of October 2007, the training of these 500 RDFs has been completed with promising result despite some recognizable challenges. The IMOLA project is currently assisting the further training of FFs by RDFs in respective communes by providing necessary advice and materials and expects to complete the FF training process by the end of December 2007. The second activities related to aquatic animal health concerns capacity building of communes, districts, and the provincial FEC in conducting sample survey of aquatic animal health conditions in the province, which leads to the establishment of a surveillance system in the future. Towards this goal, the IMOLA project has been conducting a series of training workshops on survey methodologies as well as data input and processing for shrimp and fresh water fish disease surveys. By the end of October 2007, all capacity building activities and actual survey by communes for shrimp disease have been completed while the survey on fresh water fish disease is expected to finish within the Year 2007. The survey data will be analyzed by the international consultants, and a set of recommendations will be proposed by March 2008.

## **PRELIMINARY DEVELOPMENT OF AQUACULTURE GRASS-ROOT EXTENSIONIST NETWORK AND AQUACULTURE EXPERIMENTAL MODELS**

Mr **Baku Takahashi** (FAO APO), Mrs **Vo Thi Tuyet Hong** (Director FEC), Prof. **Nguyen Quang Linh** (Hue University of Agriculture and Forestry consultant)

The aquaculture training by the IMOLA project has produced around 500 capable key resource farmers called Result Demonstration Farmers (RDFs) in the lagoon areas. These RDFs usually working closely with the government extensionists under the Fisheries Extension Center (FEC) to support local aquaculturists for the environmental and economic improvement of their fish farming activities. The RDF network that the IMOLA project has established supports the overall government plan to establish grass-roots extensionists in all the provinces in Vietnam. In the lagoon areas, FEC expects to choose one of the RDFs to be a grass-roots extensionist at the commune level. The establishment of aquaculture grass-root extensionist with support of other RDFs as well as FEC extensionists will promote the mutual learning and mutual help within a commune towards the improvement of aquaculture activities and their overall management in respective communes in the future.

As a part of local-level experience sharing on good aquaculture practices, the IMOLA project, together with FEC and Hue University of Agriculture and Forestry (HUAF), also supports the aquaculture piloting models in select communes. The main objective of the piloting is to explore the environmentally less damaging and economically viable aquaculture models in the Tam Giang-Cau Hai lagoon areas and to share such experiences with local fish farmers. The basic principle of piloting poly-culture is to utilize species that feed at different levels of the food web to attain a balanced ecosystem. The concepts of carrying capacity in a hydrographical system, ecological balance between primary producers, primary and secondary consumers, and nutrient flow within an ecosystem are essential factors for the sustainable development of aquaculture. Out of 12 pilot models planned, 5 piloting models have been in operation in 2007. This presentation will explore two of such piloting models involving clams (*meretrix* sp.) and mullet (*mugil* sp.) in shrimp ponds with the expectation of water quality improvement.

## THE FISHING GEAR SELECTIVITY EXPERIMENT

**Nguyen Phong Hai**, Nha Trang Fishery University,  
**Tran Chuoi** and **Le Quang Nhat Minh** and the IMOLA Project technical staff.

The fish corral (otherwise named stake net, set net or no sao) is a most popular fishing method of Tam Giang–Cau Hai lagoon, with about 1500 units of fishing gear throughout the basin. The gear contains two main parts: the leader net, to restrict and guide the fish towards the trap and the trap itself, to capture the fish. This type of fishing gear is a low selective fishing gear, that is to say it is not able to retain the large-size species and let the juvenile escape. The results are that this kind of net captures all size of species (including juveniles), interrupting their natural life cycle. The major cause leading to the low-selectivity characteristic of this gear is the net mesh size that ranges from 4 to 6 mm. According to a previous study conducted by IMOLA staff, in the lagoon most of the specimens in the catch of fish corral are smaller than the legal size.

The natural role of the Tam Giang-Cau Hai lagoon, as in general lagoons and coastal wetlands, is that of a nursery ground: it means that many species select these peculiar locales as an ideal habitat for their reproduction and the first stage of their life. If we consider that the fish corral is the most common and widespread fishing method in the Tam Giang-Cau Hai lagoon, with an approximate number 1,500 units and its low-selectivity characteristic, it is easy to understand that the impact of this fishing method on the natural environment and the biological stock in the lagoon is enormous.

In order to increase the selectivity of the set net fishery in the lagoon, a pilot study on the application of larger mesh size at the traps of the fishing gear was conducted in Vinh Hien Commune from March 2007 to July 2007. A preliminary investigation implied the IMOLA staff to meet met the fishers of Vinh Hien commune and selected five specific fish-corral owners to cooperate with the project during the research work. Three types of mesh sizes to test for their capability to capture were used for the trap part only of the gear that were selected for the study: these mesh sizes are 12 mm, 15 mm and 18 mm by side. "Cover codend" and "two codend" methods were applied for the selectivity study. An external capture cage (the cover) was constructed using the 4 mm mesh size net, to ensure all specimen escaped through the traps were retained for counting and weighting. A total of 89 valid hauls were performed using the cover trap method and 70 hauls were performed applying the two-trap methods. For "cover codend" method, 159.11 kg were collected in which 112.59 kg remained in the traps and 46.52 kg escaped to the cover. For the two traps methods, 73.61 kg and 37.82 kg remained in experimental traps (accounting for three types of mesh sizes) and in the conventional traps (4 mm mesh size). Selectivity curves of several important commercial species have been produced for 12 mm, 15 mm and 18 mm. Length of 50% captured of the studied species and suitable mesh sizes at the traps of the set nets were adopted. During the research works, the fisher's awareness on the issues of catching juvenile fish has been improved.

# **ESTABLISHMENT AND STRENGTHENING OF FISHERFOLK ORGANIZATIONS**

**Arie Pieter van Duijn**, FAO, APO Socio-Economist fisheries

## **Introduction**

As both the population and the economy of Thua Thien Hue Province are growing, the Hue lagoon ecosystem is coming under increased pressure. Over exploitation of fisheries resources by capture fisheries and encroachment on critical habitats (e.g. shallow spawning, nursery or feeding grounds) by aquaculture ponds are key contributors to the deterioration of fisheries resources. This situation is aggravated by an increasing fishing capacity, use of destructive fishing gears and practices, conflicts between different users and lack of an appropriate fisheries management system. Not surprisingly this situation has a negative impact on the livelihoods of small-scale fishermen who are either full-time or part-time involved in fisheries. Furthermore, aquaculturists are negatively affected as a result of interlinked poor planning and management and frequently reoccurring disease outbreaks. Accordingly it is crucial to develop an appropriate fisheries management system to improve the sustainability of fisheries and aquaculture for the benefit of the immediate resource users.

## **The way forward: empowering co-management**

Nowadays participation of resources users is increasingly seen as a necessary element of a fisheries management system. As the financial burden of monitoring, surveillance and control measures required to implement management measures through top-down control is too high, the only implementation mode which may have impact and be economically effective has to rely on compliance without extensive control. Management measures in which the government shares certain authority, responsibilities and functions of managing the fisheries with resource users as partners are often referred to as co-management. In order to empower resource users it is important to ensure their participation in terms of objectives, knowledge and implementation. However, it will be difficult to effectively implement any management measure, as long as the fishing operation is conducted under an "open access" regime. In view of developing and increasing the efficiency of the management of small-scale fisheries, "group user rights" are considered as appropriate to be promoted under a co-management system.

## **Thue Thien Hue Province: leading the way in co-management**

Within Vietnam, Thua Thien Hue Province is relatively advanced in developing institutions for participatory management. There exists enabling legislation from the provincial government and, with support from the Provincial Fisheries Association (Provincial FA) and the Provincial Department of Fisheries (DOFI), an increasing number of resource users are organizing themselves in local Fisheries Associations (local FAs). These local FAs are voluntary organizations of Vietnamese citizens of the same professions, at the grassroots level under the leadership of the Communist Party and authority of the communes. Local FAs are subject to technical and professional guidance of the Provincial FA. Presently 28 local FAs have been formally established in Thua Thien Hue Province. Many are in an embryonic state of development and require organizational strengthening. A decision by the Provincial People's Committee (4260/2005/QD-UBND) delegates power to District People's Committees to issue fishing rights to these local FAs. It is expected that by adopting fishing rights, ownership and partnership of immediate resource users in fisheries management will be enhanced.

### **Activity 4.3: establishment and strengthening of fisherfolk organizations**

In June 2007 the IMOLA project started to actively support the establishment of local FAs in six communes in Tam Giang and Cau Hai Lagoon, through capacity building and facilitation of a participatory process. During this phase the focus is on the establishment and organisational strengthening of individual fisherfolk organizations. Technical support is provided to local FA members in order to build their capacity to carry out tasks that are vital to the continued operation of a local FA (e.g. bylaws, strategy, management regulations). Up to now IMOLA support has resulted in the establishment of nine local FAs (600 members total) and the organizational strengthening of three already existing local FAs (200 members total). In January 2008 the work plan for activity 4.3 will be drawn up for the remainder of the project. During this phase the focus will shift towards institutional development as the project aims to support the development of co-management as the implementation mode for fisheries and aquaculture management in Thua Thien Hue Province. This requires a definition of roles and responsibilities for a co-management agreement between government and FAs and the development of a network structure of local FAs under the umbrella of the Provincial FA.

#### **Converging activities: resource users at the centre**

During the final year of the project, IMOLA aims to bring about a situation that will enable local FAs to serve as focal points to link together activities carried out by the project. It is expected that this will create a favourable environment in which interlinked activities mutually reinforce each other for the benefit of the immediate resource users. For instance the provision of training on livelihood improvement and alternative income generating activities is expected to increase the incentives for resource users to get actively involved in local FAs while involving local FAs in organizing trainings will contribute to a more rigorous selection of participants and a strong involvement of beneficiaries. Another example is the practical application of research knowledge, which has been generated by the project, to serve the information needs of the local FA members (e.g. GIS maps). The indigenous knowledge of resource users may not only contribute to a better understanding of the scientific research, but may also contribute to the identification of further research needs. However, it is important to be aware of possible incompatibilities between formalized research knowledge and indigenous knowledge of immediate resource users as the first has been institutionalized to address problems on a larger scale than the scale that is relevant to the practice of resource users (Degnbol, 2003). This however is one of the challenges that needs to be faced by IMOLA to ensure empowerment of immediate resource users.

## **EXPLORING ALTERNATIVE LIVELIHOODS THROUGH VILLAGE FOOD PROCESSING, MARKETING, AND SMALL ENTERPRISE DEVELOPME**

Mr **Baku Takahashi** (FAO APO)

The Phase III of the IMOLA capacity building largely focuses on enhancing livelihoods of local fishermen. Under the general objective of promoting sustainable livelihoods of local fishermen, the IMOLA project conducted the Training of Trainers (ToT) on Village Food Processing, Marketing, and Small Enterprises from 8-24 October 2007. This ToT targeted 25 key practitioners (including 24 women) at commune, district, and provincial levels and provided knowledge and hands-on experience in three closely-interlinked subjects of village food processing, marketing, and small enterprise development. Currently, most of the fishery as well as agricultural products from the lagoon areas are marketed as raw material for the local market. Under this condition, the processing of harvested fish as well as available agricultural products is critical for the livelihoods improvement of local fishermen as the food processing provides the local fishermen with methods for longer preservation of their harvests (raw materials) and value addition. Based on the needs and commodity assessments, the ToT transferred the knowledge and skills on how to process the locally available raw materials into the marketable processed food. In addition to hygienic production of processing food from raw materials, the ToT also provided the training on marketing and small enterprise development as they are often overlooked areas in livelihoods improvement through food processing. At the end of the ToT, the training participants presented their action plans for further training and the establishment of a small food processing enterprise in their respective areas. This presentation will explore more detail of the training and its potential impacts on the local livelihoods in the lagoon areas.

## **PERSPECTIVE OF THE BENEFICIARY (1)**

**Nguyen Thanh Ha**, Vice-chairman of Phu Loc Peoples' Committee

Phu Loc is a district lying to the South of Thua Thien Hue province, stretching in an area of 9,800 ha and embracing 65,000 inhabitants of 7 communes and a town.

The District brackish aquaculture and capture fisheries have undergone a remarkable expansion due to its exposure to the available water surface potential.

The yearly aquaculture area is 1,200 ha of which shrimp culture stands for 1,000 ha; shrimp productivity reaches an annual harvest of 1,200 tons of which shrimps accounts for 900 tons.

Natural capture fisheries approaches 1,500 tons annually as a result of the contribution of various fishing tools including, bottom net, lift net, gill net etc. but outstandingly, fish corral (which engages 700 households, according to the statistical result released in June 2007).

That enlargement has encouraged the development of the production force and application of modern techniques to the production; improved fishing tools in terms of the quantity, careers and capacity; generated the economic transition from agricultural and rural sectors to commodity production and brought about more job opportunities for local people.

Thorough planning, however, is bit by bit deployed; there is a lack of the synchronous infrastructure invested in aquaculture. Capture fisheries have exhausted the aquatic resources and resulted in water quality degradation.

Therefore, the district of Phu Loc is constructing and implementing the management plan based on the master management plan for Thua Thien Hue Lagoon regulated by the Provincial People's Committee and rearranging the fish corrals and bottom nets operated to harvest the natural resources in Cau Hai lagoon. Phu Loc Peoples' Committee has received apt assistances from IMOLA project in terms of technical and socio-economic solutions in an effort to stabilize the life of the people after the fish corral rearrangement in Cau Hai lagoon.

For nearly a year, despite technical and socio-economic difficulties of people in making their livelihoods, the implementation of the management plan has reaped some outcomes thanks to the dedicated assistance offered by IMOLA project and cooperative response from people.

Support from IMOLA Project includes survey and establishment of status map and name collection (i.e. household names); draft plan design; organization and selection of rearrangement options. There were 6 communes of interest, including Loc Binh, Loc Tri, Phu Loc town, Loc Dien, Vinh Hien and Vinh Giang with 104, 105, 66, 145, 124 and 112 households, respectively. This can be completed owing to the collaboration reaction of the local people and authority and support from the Project in positioning and planning based on the administrative border lines. Each corral has a length of 300, a width of 350 m; the corral mouth is 150 m wide and the interval between the furrows of corrals is 150 m.

Up to date, the people have positioned and put into place 358 fish corrals into operation in communes including Loc Binh, Loc Tri, Vinh Giang, Phu Loc town, Vinh Hien, Loc An and Vinh Hung, counting for 53 % of total no sao in Cau Hai lagoon; the rearrangement of the remaining fish corrals will be executed as the weather condition becomes better and expected to be brought to an end in 2007.

The planning and fish corral rearrangement has basically created an open water surface; the buffer zones and beautiful landscape have been recovered.

During the process of fish corral rearrangement, the local staffs have been instructed by IMOLA project experts to use positioning equipment, provided with useful knowledge and practical skills, enabling them to fulfill the management tasks in the future.

Apart from the assistance on the fish corral rearrangement, the authority has received the additional support from the Project, as can be cited following:

*Strengthening and promoting the establishment of 8 grassroots Fisheries Associations in 4 lagoon communes including Vinh Hien, Loc Binh, Loc Tri and Loc Dien.* These associations have preliminarily generated some practical activities contributing to the environmental and aquatic resource protection (fishermen's ceremony, fight against the electrical fishing activities). The fisheries associations will be the community management tool for the future.

*Building the network of the Result Demonstration Farmers (RDF) in the crop of 2007.* They are 215 shrimp farmers from 4 communes, including 35 people from Loc Binh, 40 people from Vinh Hien, 60 people from Vinh Giang, and 80 people from Vinh Hung. Each farmer was supported with a set of equipment for testing the water parameters including salinity, alkalinity, pH and NH<sub>3</sub>.

*2 promotion centres in Phu Loc Town.* These centers have been founded and officially presented to the commune of Vinh Hien and Loc Binh in April 2007 and are currently in operation.

The Project has also paid its attention to the task of conducting shrimp disease survey and organizing workshops on the improvement of the livelihoods for the people.

Present in various activities of IMOLA are awareness raising and capacity building, and the promotion for application of scientific techniques into aquaculture.

### **Suggestions:**

We would like to make the following proposals to the Project:

- Offering more assistances to enable us to soon complete the task of fish corral rearrangement and data transforming, mapping, positioning, etc. for the use of the locality.
- Providing further support to establish fisheries associations in Vinh Giang, Vinh Hung communes and Phu Loc town, especially in aquaculture areas to assist the grassroots authority in long-term water surface management.
- Paying additional attention to the detailed planning for the key aquaculture areas to enhance the efficiency of the farming area.
- Offering support to settle 500 fisherman households living on boats in the Lagoon.

Aforesaid activities belong to those that the District has received form the Project support. We do hope the Project to have more useful activities to support the District in the coming time.

I would like to extend my sincere thanks and the best wishes of success to the Workshop.

## **PERSPECTIVE OF THE BENEFICIARY (2)**

**Nguyen Xuan Bac**, Vice-chairman of Phu Xuan commune

It is my pleasure today to join this 3rd IMOLA technical workshop "The Tam Giang-Cau Hai, present, past and future" as a beneficiary from local communes.

Firstly, on behalf of the local authorities and people in Phu Xuan commune, Phu Vang district, Thua Thien Hue province, I would like to extend my most respectful greetings.

Ladies and gentlemen, Phu Xuan commune, Phu Vang district is a sandy zone alongside the Tam Giang\_Cau Hai lagoon. On a water area of 1100 hectares, there are 645 households doing aquaculture and catching aquatic products. The ecological system used to be rich in aquatic resources of high economic values.

However, with the increase of extensive aquatic exploitation for short-term benefit by various fishing gears (electric trawl net, or fishing net) the lagoon environment is changing rapidly, and is subject to pollution from industrial waste water and chemical waste. These depauperate Sam Chuon lagoon, putting aquatic resources of high economic values in a risk of being extinctive and reducing income of fishermen.

The growth of fishing gears on water surface narrows water way and boosting environment pollution.

Given the situation, with guidance from the government, local authorities have implemented the reorganization of fish corral with an aim to lessen pollution in the lagoon environment. Local authorities also minimized the over-exploitation with the purpose of protecting under control of fishing activities.

In 2005, the IMOLA came into operation, and together with provincial and district authorities, and relevant departments the project started to implement activities for sustainable management and stable livelihoods. If these are carried out as original designed, people's income will be stabilized and environment pollution decreased.

The IMOLA project has been involved not only in environmental and aquatic resource research activities, but also in monitoring the lagoon system, transfer of new techniques in aquaculture and establishment of community associations and awareness raising for people in environment protection.

Furthermore, IMOLA project also invested in promotion centers at commune level for beneficiaries from different communes to share information about issues concerning aquaculture and project's implementation.

Some recommendations are following:

- 1, That for the long-term benefit, relevant department and authorities in coordination with IMOLA project should invest on vocational training for sampan boat people with a view to create their employment and increase their income
- 2, That the fish corral reorganization should be started also in Tam Giang lagoon.
- 3, That awareness raising campaigns should be developed to promote lagoon-friendly fishing practices.
- 4, That pilot projects on aquaculture models should be started for each area.

That is some remarks on IMOLA project activities since its start. We would like to express thanks to provincial and district authorities and related agencies, and IMOLA staff who have kindly supported our people lives in many ways.

I wish you good health, happiness and success in your wok. Finally, I wish the workshop to be successful.

# **THE VENICE LAGOON AN INTEGRATED MANAGEMENT CHALLENGES BETWEEN CONSERVATION AND DEVELOPMENT. PORT AND FISHING DEVELOPMENT AND ENVIRONMENTAL PROTECTION**

**Giovanni Cecconi (\*)**, Consorzio Venezia Nuova, S. Croce, 505 – 30135 Venezia  
Italy.

E – mail: [giovanni.cecconi@consorziovenezianuova.com](mailto:giovanni.cecconi@consorziovenezianuova.com).  
[www.salve.it](http://www.salve.it)

Lagoons represent transitional areas between the land and the sea. Exposed to an intense environmental gradient, lagoons provide a particularly rich and diversified ecosystem maintained by the presence of salt-marshes, mudflats, shallows and channels.

Salt-marshes should be considered as fundamental morphological elements for controlling erosion due to natural (waves and currents) and human (fishing and traffic) origins.

In the last decades, Venice Lagoon ecosystem has been affected by many environmental threats: among them, the erosion of the intertidal areas (salt marshes, mud flats and shallows) lead to loss of habitats and biodiversity.

On the other hand, the navigation in the lagoon and the related economic activities need to be maintained with permanent maintenance dredging of polluted sediments.

Port development is affecting the conservation of tidal flat and lagoon habitats, clam fishing with small dredgers can destroy the macrozoobenthos of the lagoon shallows but regulations and works can be put in place to mitigate erosion

A general target for the safeguarding of the lagoon is to achieve a good status of the lagoon environment balancing conservation need with socio-economical needs: this has to be achieved in a sustainable way: maintaining the idro-morphological and biological **functions** and accepting **some changes** of the landscape (the co-evolution of the natural and human system).

Apart from the historical transformations for salt and fish farming and port preservation with the redirection of the rivers that were siltating the lagoon, a number of interventions have already been made in the last 20 years, driven by a General Plan stated in 1993 and updated in December 2004.

The new Plan should take into account the status-of-the-art of the knowledge about habitat conservation, pollution treatment, erosion control. In addition the sustainability of the present economic activities and their possible evolution.

In order to fulfill the integrated target of the Plan, a wide group of experts in various disciplines has been organized into seven Operative Unit (OU). All OU will participate in the definition of the present lagoon status, identifying the main cause-effect relationships and selecting some indexes, which evolution can be foreseen by means of mathematical models and monitoring.

## **Re-use of Sediments for the Morphological Restoration**

In the last two centuries, as a consequence of lack of sediment inputs, the tendency of the lagoon towards erosion is clearly evident, as it is demonstrated by the progressive disappearance of salt-marsh, the deepening of the mud-flats and the net loss of sediments into the Adriatic Sea.

The protection of marsh and tidal flat habitats is instrumental for the lagoon ecosystem as a whole.

During the last twenty years the Venice Water Authority, through the concessionaire Consorzio Venezia Nuova, has conducted numerous studies regarding the hydro-morphological and biological processes in the lagoon and several works have been carried out with the re-use of dredging sediments of suitable quality (from channel maintenance dredging, the development of the Chioggia harbour and the construction works of the mobile barriers).

Re-using 9 million cubic meters of dredged sediments 90 marsh structures have been put in place along the last 20 years for a total extension of about 800 hectares: this value is comparable to the lost marsh surface in the same period.

The new structures have been located and shaped for improving the local hydro-morphological conditions limiting the flattening of the lagoon (protecting the edge of the channel and increasing sedimentation in the tidal flats).

Care has also been taken to control wave erosion and to enforce the law for stopping illegal clam fishing and reducing the speed of the boats.

The artificial morphological structures have been monitored in order to verify their functionality and habitat value.

In order to improve the development of intertidal habitat process other interventions have been put in place such as the recharge of sediments, the dredging of tidal creek "ghebi" and ponds "chiari" and the transplantation of vegetation.

-----  
**(\*) Dott. Giovanni Cecconi**

Manager of the Engeneering Service  
of Consorzio Venezia Nuova  
Santa Croce, 505  
30135 Venezia, ITALY  
Phone +39-041-2753749 ; cel.+39 335 1379177  
Fax +39-041 5289050  
[giovanni.cecconi@consorziovenezianuova.com](mailto:giovanni.cecconi@consorziovenezianuova.com)  
<http://www.salve.it/>



Giovanni Cecconi, born on January 31, 1954, got his civil engineering degree at the University of Padua in 1978.

From 1979 to 1988, at the Research Centre of Italian Electricity Board, he has conducted hydrological investigations and studies for nuclear and thermal power plant siting .

In 1988 he joined the Consorzio Venezia Nuova for coordinating the plan of studies and investigations for the design of the flood defence system of Venice and the works for the environmental restoration of the lagoon.

From 1991 he has coordinated the design of the mobile barriers, and the associated littoral protection and wetland restoration works for the Venice lagoon.

A peculiar aspect of his 19 year professional experience is the treatment of hydro-morphological and environmental information for decision making in the field of coastal protection and restoration.

The present challenge is the conduction of rinaturalization projects for the Venice lagoon environment and r the barrier islands for the sustainable development of the Lagoon.

Venice 19<sup>th</sup> Dec 2007

## **TECHNOLOGIES APPLIED TO LAGOON STUDIES IN THE VENICE LAGOON: TOOLS FOR PLANNING DESIGN AND OPERATION**

**Dr. Gianfranco Castelli**, Te.Ma. Faenza, **Giovanni Cecconi**, Consorzio Venezia Nuova, S. Croce, 505 – 30135 Venezia Italy.

E – mail: [giovanni.cecconi@consorziovenezianuova.com](mailto:giovanni.cecconi@consorziovenezianuova.com).  
[www.salve.it](http://www.salve.it)

In order to develop and maintain a plan of works and regulations for the environmental management of the lagoon it is essential to **understand the main idro-morphological and biological processes** and the habitat requirements for the different species of interest living in the lagoon and the impact of human activities.

This is a complex process that has to be performed **in an adaptive way** through conceptual models, measurements, experiments, pilot works, and continuous updates of the concepts and the actions.

It is important to know and predict not only the natural processes but also the human activities that can impact the environment.

The best way is to start from the environmental and socio-economical **problems** and produce a preliminary list of **solutions**.

At this point it will be clear that **it is necessary to know more** for reducing the uncertainties about the causes of the environmental degradation and also about the effectiveness of the proposed solutions (works or regulations).

For the active management of the lagoon **the plan of studies** has to start at this point incorporating all the existing knowledge in an integrated way.

First of all the **self-preserving processes** need the primary attention:

### **THE NATURAL FLUSHING OF THE LAGOON**

It is important to measure not only the input of fresh water, sediments and pollutants but also the capacity of the lagoon to be flushed naturally by the tide and the wind:

*Permanent networks and field campaigns for:*

*i) Meteo marine data: tides, flows at the inlets, temperature, pressure humidity and winds.*

*ii) Discharge stations for measuring sediment loads and pollutants from the watershed*

*ii) Salinity and Turbidity measurements inside the lagoon.*

### **Sediment balance and soil bio-stabilization in dunes, tidal flats and marshes**

It is important to measure and model the natural accretion that are able to produce new soil compensating the loss of habitats due to sea level rise and subsidence:

- *Topographic and bathymetric survey and benchmark leveling.*
- *Periodic survey of submerged and wetland vegetation (also with remote sensing)*
- *GIS visualization of the results*

During the workshop there will be a presentation of the acoustic equipments widely used for flow measurements at the lagoon entrances and for bathymetric survey.

## **TAM GIANG - CAU HAI LAGOONS- VALUES SHOULD BE SUSTAINED AND PROMOTED**

Dr. **Do Nam** (Department of Science and Technology of the Provincial People's Committee of Thua Thien Hue)

The huge and multidisciplinary values of Tam Giang – Cau Hai lagoon system are recognized widely. However, the majority of information and data about the lagoon for long time has been in the primitive stage; and there are differences in results by different research groups. Furthermore, there are values that have not been audited and evaluated yet. A long-term and comprehensive research and conversation programme has not been conducted while pressure of development activities is on the increase, causing new problems. Based on information of various sources, the author provides an overview on the values of Tam Giang – Cau Hai lagoon system, limitations and difficulties in research activities with an aim to better understand, conserve and promote these values.

# **ECONOMIC EVALUATION OF THE TAM GIANG - CAU HAI LAGOON AND PRIORITIZED ACTIVITIES FOR SUSTAINABLE DEVELOPMENT**

**Prof. Mai Van Xuan**, Hue University of Economics

Tam Giang - Cau Hai complex plays an important role in socio-economic development of Thua Thien Hue province, being a livelihood source for 300,000 lagoon population. In recent years, lagoon resources over-exploitation has threaten effective and sustainable development of the complex. The overreaching goal of this research is to provide necessary information, helping policy makers to make advantages comparison in management of lagoon resources for different purposes toward sustainable development. Secondary document sources from organizations, agencies, relevant research program, participatory rural appraisal (PRA), delphy method and random survey of 1189 households in 10 communes in Quang Dien and Phong Dien districts in 2005 have been widely used for this theme. Four key activities have been focused for quantitative and qualitative assessment in Tam Giang lagoon including aquaculture; capture, crop cultivation and animal husbandry in the lagoon shore; hydro-biological grass exploitation and other activities.

Some basic comments can be indicated from the research as follows: management and using Tam Giang - Cau Hai lagoon resouceces is problematic: overaquaculture without planing, uncontrolable capture with high destructive gears; more and more chemicals used in aquaculture and agricultural production, water enviroment polution, degraded biological diversity, depauperated and reduced natural hatchery and submerged ground, and appearance of eutrophication. There exist difficulties of debited local people and their livelihood, the household rate of outstanding loan for aquaculture is over 51 percent, and especially some are bankrupt

The year 2005 is unlucky time for many economic activities in the lagoon area: seriously lost season of aquaculture, water bird raising seriously impacted by bird flu...therefore, economic value of these activities is not high. The Gross Output from studied four activities in Tam Giang is over VND 81.5 trillion, the Mixed Income is vnd 18.9 trillion with average income of 4.4 million/ha/year. If taking account activities individually, aquaculture activity gained highest production value of VND35.4 trillion; natural fishing of VND23.9 trillion; rice cultivation of VND 17.5 trillion, sea weed of VND 3.1 trillion and water bird raising of VND 1.6 trillion. However, if Mixed Income is taken in consideration, the aquaculture have the lowest productivity, (minus) - 7.8 trillion (lost), natural capture with highest value of VND 16.3 trillion, agriculture production of VND 6.9 trillion and sea weed exploitation of VND 2.9 trillion.

Some suggestions needed studying in order to apply for management and using strategy of Tam Giang - Cau Hai lagoon system in an effective and sustainable way is as follows: (i) management enhancement, (ii) overall and detailed plan for sustainable development of Tam Giang - Cau Hai complex; (iii) cultured type diversification, development of conversed aquaculture model in effective, suitable and socialized manner; (v) enhancement of post harvest technology and marketing.

## **THE IMOLA GIS AS A TOOL FOR TERRITORIAL PLANNING**

**Leonardo Disperati** and **Salvatore Virdis**

Centre of Geotechnologies of the University of Siena, Italy

In this presentation we describe examples of outputs and results obtained by analyzing the data stored within the IMOLA GIS; these outputs and results are useful for territorial planning in the Tam Giang lagoon.

Classification and interpretation of satellite images allowed us to obtain multitemporal land cover/use database and to detect changes which affected the lagoon. This data covers aquaculture ponds grown against rice fields from the end '90s of past century.

Moreover, spatial analyses of thematic data like aquaculture and environmental parameters allowed us to obtain indicators which could be used to quantify the effects of actions to be planned for the lagoon area.

Finally we highlight how new source of information, like radar and optical satellite imagery, and new GPS-supported field data and social-economic information will improve the IMOLA GIS potential to support the lagoon planning and management.

## **SHAPING THE INTEGRATED LAGOON MANAGEMENT PLAN: SIZING AND TIME-CONSTRAINING THE TAM GIANG LAGOON PROBLEMS**

**Massimo Sarti**, FAO Chief technical Adviser, and **Nguyen Thi Phuoc Lai**, FAO National Project Manager.

Prerequisites to draft an Integrated Lagoon Management Plan (ILMP) imply i) comprehension of critical issues affecting the locale, ii) identifying, sizing and time-constraining key problems, iii) establishing their hierarchical order and prioritizing, iv) propose viable solutions and prospect scenarios, v) corroborate choices with examples and models, vi) develop tools to support planning, consultation sessions and decisions, vii) adequately prepare communities, stakeholders, government agencies and involved parties in decision making, to adopt and support the plan through appropriate training.

The designing of the IMOLA strategy in the pre-planning phase (August 2005 - September 2007) was inspired by these guidelines. The IMOLA Project start-up and implementation phases, included a) development of a planning outline and budget estimation/revision, b) designing surveys and data acquisition, c) implementing surveys, data collections and thematic reports and d) building-up a GIS-based database and file record for the planning area.

The planning phase (October 2007 - July 2008, possibly extended to November 2008) represents the IMOLA conclusive phase that envisions the following steps (presented for review at the 3rd Technical Workshop herewith concluded): a) identify viewpoint facts, orientations and development objectives, b) propose planning options and planning design, c) generate a planning-area map and preliminary planning report for inception of consultations, d) prepare for preliminary evaluation of proposed planning effectiveness. After consultations started, prepare for e) planning submission for appraisal and approval, and finally f) prospect solutions for planning implementation, for drafting implementation strategies and preparation for official enactment.

At present, after completion of pre-planning operation, the project is undertaking the design of the ILMP by i) preparing the appropriate planning tools (GIS, geodetic network, remote-sensing), ii) listing viewpoint facts, orientations and development objectives, iii) offer planning options and design (based on selected options) and iv) assemble a planning-area zoning map, along with a planning report for preliminary consultations and evaluation.

Orientations in drafting the ILMP include comprehension of the system four main elements of instability, sizing and time-constraining their impact (in the physical environment, in the management and in the bio-resources use), establishing their relationships and priorities. The IMOLA activities were aimed to stabilize critical situations at first (e.g. by improving living conditions through knowledge and training; by improving viability of economic activities, by facilitating processes to reduce the indiscriminate use of the biological stock; by increasing lagoon-dwellers awareness on bio-resources use and management; by adopting measures to prevent further environmental and socio-economic degradation, etc.). Concurrently, GIS-based planning and decision-making tools were prepared for use and preparation of a mid-term Integrated Lagoon Management Plan (which will include nomadic fishermen resettlement, livelihood alternatives out of the fishery sector, infrastructure development, etc.). A long-range plan is a further add-on that may provide prospect for development of the lagoon in a farther distant future.

Viewpoint facts stem from the recognition that capture fishery is abnormally developed in the lagoon and destructive fishing is a common practice: consequences is that eradicating illegal fishing and reorganizing the capture is an

urgent necessity, provided that alternatives are created. From the aquaculture side, the pressure is already beyond the limit of carrying capacity so that alternatives in the integrated fish polyculture or mollusc farming have to be sought. Aquatic species farming has to be practice in condition of disease-outbreak and environmental-quality control, a practice that should be systematized and routinely developed especially in the perspective of developing the production towards the export. High-risk aquaculture ventures (e.g. low-tide shrimp-pond farming) that do not guarantee stable income should be discouraged and replaced but more profitable culture methods, more suitable for enclosed sea tract and inland waters (mollusks). Environment restoration and habitat rehabilitation of low-tide reclaimed land should be included in the zoning plan, to recover unprofitable and degraded area to their pristine conditions in the intertidal zone. The introduction of a coastline respect zone is a positive measure and the identification of ecological islands and corridors is a further step toward conservation.

Unregulated fishery and aquaculture should progressively be banned through the introduction of a system of assignment of fishing rights or property titles, which is under study by IMOLA, for future endorsement by the Province. The assignment of fishing right and property titles is a recognized intervention to be implemented through formally established Fishery Associations and the IMOLA Project undertook a series of concerted activities to promote aggregation of professional fishermen into formalized structures, providing training and educational programs to build community capacity to self-manage.

The promotion of cooperatives or small and medium enterprises to shift income-generating activities from mere production to processing and marketing (for in-country market and export) has been successfully undertaken by the project and should be one of the qualifying targets for any further follow-up.

Elements of vulnerability in the Tam Giang lagoon are of biological and climatic nature. Vulnerability to aquatic animal diseases is an issue primary importance and mitigation measures to limit the impact of outbreaks have been studied by IMOLA to be incorporated in the ILMP. Developing an extensive monitoring system and promote BMPs for sustainable aquaculture are instrumental actions to reduce this drawback. The adoption of quality certification protocol for fish products (experimental HACCP-like protocol to be applied to small-scale enterprises) has been experimented by IMOLA for proposition among the follow up activities. The exposure to risk of flooding as a consequence of extreme climatic events is another cause of economic instability that will be incorporated into the ILMP through the development of vulnerability maps and introduction of respect zone in lowlands prone to flooding.

Tools and methodologies in support of the ILMP include the development of information technology tools (GIS-based searchable databases, remote-sensing thematic mapping, automated techniques for surveying, monitoring, data management). The GIS-based database, allowing complex interrogation routines and visual representation of data and imagery is an indispensable tool for mapping, zoning, and simulating scenarios during the process of consultations.

**Closing remark by the PPC leaders of Thua Thien Hue**

**Nguyễn Ngọc Thiện**, Vice-chairman of the Provincial People's Committee

Distinguished guests, from Italian Ministry of Foreign Affairs, and from FAO Headquarter in Rome and FAO Office in Vietnam

H.E the Italian Ambassador to Vietnam,

Distinguished scientists,

At this moment before closing the workshop, I would express my best thanks for your attendance and contribution.

Ladies and gentlemen,

We all have a chance to understand IMOLA activities, the draft Integrated Lagoon Management Plan and contribution of all stakeholders in the field of lagoon and coastal management. This contribution shall be regarded when the IMOLA is developing the draft lagoon management plan. For certain, this contribution is useful in raising the feasibility of the draft management plan.

I declare the closure of the workshop, and once again, please accept here my best regards to you and thanks for your attention.