Climate of Coastal Cooperation

"Sharing 20 years of experiences in integrated coastal cooperation is sharing our trust in long term, sustainable development of coastal resources and in finding resilient, adaptive responses to climate change for valuable and vulnerable coastal areas"

Robbert Misdorp – Editor

2011

List of contents

- The country conclusions of Part I and II are written by Gerrit Baarse and Robbert Misdorp

Message from

Joop Atsma
State Secretary of Infrastructure and the Environment, the Netherlands

More than sixty percent of the world's population lives within 60 kilometers of the coast. The world's coastal zones represent a precious resource. They are vital to international trade, habitation, wildlife, travel, recreation and energy capture. Economic development, social development and protection of the environment are equally important.

The management of coastal resources is quite a challenge. Many coastal zones are placed under intense pressures. Nations and communities must balance the benefits of short-term resource exploitation with long-term resilience. Adaptation to climate change has become a priority policy issue around the world.

As State Secretary of Infrastructure and the Environment, I am responsible for water policy in the Netherlands. A fascinating job! The Netherlands is a dynamic and densely-populated delta. It has a long tradition of water management; our ancestors have been 'water managers' for almost one thousand years. Given its vulnerable position in a low-lying delta, coastal zone management and flood protection are of the utmost importance to the Netherlands. We have chosen an adaptation strategy in which we look one hundred years into the future. Our Delta Programme identifies appropriate policies to protect the country from high water and secure its freshwater supply for today and the future.

We have learned how to keep our feet dry with infrastructure and engineering. And we have learned to find solutions in which Mother Nature lends a helping hand. An eye-catching example is the so-called Sand-Engine (see photo). We are depositing millions of cubic meters of sand in the shape of a large hook, extending from our coast. Wind and waves will spread this sand along the coast, making it stronger. With this approach, the Netherlands is a front runner.

Together delta countries can find better answers to the great challenges they are facing. We recognise the need to share information, experiences and knowledge. Therefore, we are a driving force behind intensifying international cooperation. Important in this respect are:

- The Netherlands Water Partnership. An umbrella organization for the public sector, companies, knowledge institutions and non-governmental organizations that aims to increase international exchange of knowledge and technology.
- The Delta Alliance. An international knowledge-driven network aiming to improve the resilience of the world's deltas.

This 'Climate of Coastal Cooperation'-publication is meant for anyone interested in coastal zone management. It contains a wealth of experience on coastal processes obtained through programmes and projects in Asia and Europe. Many of these projects were planned and executed with the support of the Dutch government and Dutch companies and universities.
I hope this production will strengthen the exchange of experience and will encourage the planning of adaptive measures to address the strongly changing conditions in the world's coastal zones.

Preface

Wim Kuijken

- *Government Commissioner for the Delta Programme,*
- *Former Secretary-General of the Ministries of the Interior, General Affairs, and Transport, Public Works and Water Management, the Netherlands*

The Netherlands is a fertile, highly productive, densely populated, low lying coastal country, which serves as a gateway to Europe and the world. Located at the confluence of four major rivers and the sea, the Netherlands is an important hub for the worldwide transport of goods as well as a key centre of international commerce. Our rivers are vital axes of transport and providers of water for agriculture, industry, nature and drinking. The western part of the Netherlands is extremely low lying, with some areas more than six metres below present sea level. These conditions pose major challenges for survival. To survive, during the last millennium, our nation developed an almost inborn alertness to combat the forces of the rivers and the sea. The Delta Works (1953 – 1998), a series of hydraulic constructions in the south-western part of the Netherlands was created after the great flood in 1953. This post-disaster reaction was based on the advice of the first Delta State Committee.

The Netherlands is safe for now, but can become more vulnerable to the impact of future global changes such as climate change. We measure and predict that both temperature and sea water levels are rising and that our soil is subsiding. We expect that wet –and dry – extremes will increase further. We are already observing increasing extremes in precipitation. Consequently, we must improve our coastal and river defences against flooding in order to prevent future disaster.

Effective responses in advance of future developments are now being formulated on a global level. The Netherlands' government, following the advice of the second Delta State Committee (2008), has started the Delta Programme not as a reaction to a disaster but to avoid one and to be prepared for the future. A Government Delta Commissioner was mandated to direct the implementation of this long term Delta Programme with all relevant Ministries, regional authorities, non-governmental organisations and local stakeholders. The Delta Commissioner is assigned for the national coordination of the Delta Programme, securing the cooperation and integration of all relevant parties involved.
This programme, our Delta Works of the future, aims to protect the Netherlands and its future generations against flooding and to safeguard a sufficient fresh water supply.

Based on our long tradition of enabling life in a delta where four rivers continuously interact with the North Sea, we have learned how to adapt to ever changing circumstances. Building with nature has become an important lesson, and we apply this concept wherever possible to make the Netherlands safe and attractive, now and in the future. We seek flexible solutions, for instance, by adding sand to our coast to maintain and expand natural sand budgets. Moreover, we prepare for greater financial investments that may be needed in the future if critical stages regarding the impacts of climate change are reached.

In its continuous fight with the forces of nature, the Netherlands has developed a vast amount of knowledge and experience in the field of coastal zone management and flood protection and water management. In the last decades, the Netherlands has been actively supporting the cooperation with other countries and will continue to do so, particularly in the field of adaptive measures, preparing for the near future.

I wish the "Climate of Coastal Cooperation" all the success in the world on its path to promoting international exchange of knowledge and experiences, in order to deal effectively with the coastal challenges…. empowering our children to cope with their future challenges.

Foreword

Ursula Schaefer - Preuss

Vice-President for Knowledge Management and Sustainable Development, Asian Development Bank

The inherent high productivity of coastal zones means that they have become home to the majority of the Earth's population – centers for trade, commerce and food production from the sea. Much of the world's economy, therefore, is at least partly dependent upon the health and integrity of coastal resources.

Highly dynamic coastal systems, however, face growing pressures from urbanization and resource mismanagement, including wetlands loss, coral reef destruction, urban and industrial pollution, and over-fishing. These stresses are now being exacerbated by the adverse impacts of climate change, with coastal zones among the most vulnerable due to the combined effects of increased ocean levels, temperature and acidity and more intense storm events. These development and climate strains are putting coastal populations, infrastructure and environments at risk around the world.

Nowhere are these trends more apparent than in Asia and the Pacific, where more people live and work in proximity to the sea than in any other region. Moreover, the hundreds of millions who live in low-lying coastal areas of this region often face a range of other vulnerabilities due to their poverty, vulnerability to natural disasters, and lack of access to clean water and other services. The rapid pace of development along Asia's coasts – often with inadequate attention to environmental sustainability – further strains both coastal systems and their inhabitants. In the Pacific, the survival of entire nations is being put at stake by these forces.

The Asian Development Bank (ADB) is well aware of these trends, and is working closely with countries around the Asia and Pacific region and partners including the Government of the Netherlands to establish policies, institutions, management systems and the infrastructure needed to ensure that the region's coastal resources will meet both current and future environmental and economic demands.

In the People's Republic of China, for example, ADB has worked with the City of Shanghai to restore its main waterway – Suzhou Creek – from a murky and essentially dead river that polluted not only the City but the shore at its delta. It is now the cornerstone of a coastal ecosystem rehabilitation program. ADB is also a founding partner of the Coral Triangle Initiative, supporting Indonesia, Malaysia, Philippines, Papua New Guinea, Solomon Islands and Timor Leste in improving coastal and marine resources management across the most highly productive and biologically diverse marine region in the world.

Integrated approaches like those applied in Suzhou Creek and the Coral Triangle are the wave of the future, and ADB will continue to work with its many partners to support such by providing policy advice, building institutional capacity and investing in well planned coastal infrastructure.

The main message of this *Climate of Coastal Cooperation* publication is that a holistic perspective is needed to devise effective and sustainable coastal management systems, and the report provides an important knowledge resource for those seeking to understand and employ such integrated approaches to coastal management.
I am certain that it will contribute to improving the quality of life for coastal inhabitants and the integrity of coastal resources upon which we all depend.

CCC Statement

Cees Veerman

- Chairman of the Netherlands' NGO: "Nature Monuments", 2007-present
- Chairman of the Second Delta State Committee, the Netherlands 2008
- Netherlands Minister of Agriculture, Nature and Food Quality, 2002 – 2007

The Dutch take the impact of climate change seriously. We cannot do otherwise; we are living in a vulnerable low-lying deltaic country:

- Our deepest polder with human settlements lies 6.5 m below mean sea level,
- Our national airport (fourth largest of Europe) is located 4.5 m below mean sea level,
- Several trillion Euros of capital investments in flood prone areas are at risk.

Our reference points are two large flooding disasters in the last century: 1916 and 1953. The recovery from these two events took several decades. Nowadays, we assess the impacts of climate change and we realise that responding needs extra vigilance, additional overarching, integrating institutional arrangements and the creation of reserve funds.
Is this acute, no, is it urgent, yes.
This need of urgency must be shared with the inhabitants of one of the most densely populated coastal countries.

As Chairman of the 'Second Delta State Committee – Outlook for the Netherlands in 2100: safe and sustainable', I choose to include a worst-case climate change scenario of 1.3 m sea level rise in the 21st century - why? Because we, in the Netherlands, know that preparing long-term measures takes many years, whilst their execution takes many decades. Dutch society needs to know, whether there is a need to change fundamentally our present strategy for dealing with the risks associated with living in a flood prone delta. The good news is that even the worst-case scenario can be handled, both technically and economically.

We propose mostly no-regret, win-win adaptive responses. Implementation should begin immediately and intensified as soon as the signals for an accelerated, irrevocable change are clear.
One of the examples of a no-regret, resilient measure, is to defend our coast from sea level rise and increased storminess, by using the flexible approach of sand nourishment on our sandy coasts. We have been gaining experience with this economically viable and effective coastal engineering method since the 1990s.
An example of a win-win solution is to increase significantly the storage-capacity of our largest fresh water Lake IJsselmeer, by raising the water level and the surrounding dikes with 1.5 m. This will improve the supply of fresh water, and help counteract the much drier summer seasons anticipated in the future. Raising these dikes, including the 1932 Afsluit Dijk (Enclosure Dam) also provides a higher level of security against the increased risk of flooding.
Some of the proposed solutions are required anyway, for other reasons. Strong economic growth, increase in capital investment and population necessitates a thorough review of risks and new safety standards for our dune and dike systems.

We have gained experience over many centuries how to cope with the sea and the rivers, which are often a friend but sometimes, a foe. We are preparing for the impacts of climate change and are learning how to plan and implement timely adaptive measures. Our experiences have been shared with other low-lying countries. We have seen that international cooperation is mutually beneficial. We look forward to exchanging our practical experiences with you, through this "Climate of Coastal Cooperation"- publication.

CCC Statement

Getting the most out of coastal cooperation : sharing knowledge

Jeroen van der Sommen

Director Netherlands Water Partnership

The world's coastal population is at risk. Expanding economies, urbanisation and climate change force us to act. This CCC publication on coastal cooperation stresses the complexity of coastal zones. At the same time, it underlines the opportunities change may offer.

In the Netherlands, we know all about living by the sea, which has always been a source of life and prosperity. Our two thousand years of habitation in a delta area close to mean sea level have produced an ambivalent relationship: we both love the sea and fear it. Living in a delta comes at a price. Such heavily populated areas are often favoured places for building industrial infrastructure and housing putting a great deal of pressure on the environment. More recently, climate change has created new challenges. Our permanent battle to control the sea and rivers has made us experts in water management. The experience has taught us two fundamental truths: that water management is a process of continuous innovation and that water management has to be a team effort.

That is why the Netherlands possesses both technological expertise and a deep-rooted willingness to cooperate. We have well-known research institutes in the field of water innovation, earth surveying, and dredging firms that operate world-wide, front-ranking hydraulic engineering companies and market leaders in the field of water purification technology. However, that is not all. We also have government bodies that deal specifically with water management, a relevant knowledge infrastructure and, last but not least, a strong public awareness of the issue. By combining expertise and experience at all levels, we are equipped to devise appropriate solutions to complex problems. Challenges in the field of water policy development include hydraulic engineering and design; construction, implementation and maintenance; water supply and sanitation; flood control; environmental protection, and integrated water and coastal management.

Illustrative of our willingness to cooperate is the number of Dutch that have contributed to "Climate of Coastal Cooperation" together with their colleagues from all over Asia and Europe. Together, these 100 contributors to this book – and those who did not made it to the list of authors – form a network of experts. Added to them are the future readers of the CCC book and its internet production. This results in a large number of experts cooperating and learning from each other, helping to change our approach to the management of vulnerable coastal areas. The key lies in networking.

The Netherlands Water Partnership (NWP) is itself a comprehensive network that unites Dutch water expertise. The partnership consists of private companies, government, knowledge institutes and NGOs, acts as a centre of information and cooperation on water expertise, policy developments and opportunities. The knowledge available in the Netherlands is broad as well as deep and covers a great many areas, including drinking water, floating construction techniques, wastewater purification, mobile dams, storm surge barriers and water-related spatial planning and development. In the Netherlands as well as abroad, the NWP is the gateway to what you need to know about the Dutch Water Sector and its solutions to global water related challenges.

Now more than ever, sharing and exchanging knowledge has become vital for us all. Join the network! Only by working closely together, can we ensure a safe and sustainable future for the deltas of the world. The Netherlands Water Partnership therefore warmly endorses and supports this CCC publication.

We are happy to exchange and make accessible our knowledge and experiences with others elsewhere in the world. Do not hesitate to contact us: www.nwp.nl, www.dutchwatersector.com and info@nwp.nl.

CCC Statement

Coastal cooperation and the role of an NGO

Albert Salman

Director General,
Coastal & Marine Union - EUCC

Early coastal concerns in Europe

In Europe, the Council of Europe raised the coastal environment as an issue of concern by as early as 1974. The Council issued a number of studies, documenting the decline of coastal environments, as well as recommendations and ministerial resolutions.
Since the end of the 1980s an increasing number of integrated planning and management initiatives began in NW Europe at local and regional level. Many of the bottom-up and fruitful coastal partnerships originated around estuarine water bodies. Some of these early concerns can be considered as the start of integrated coastal management in Europe. However, the Mediterranean Action Plan and UNEP launched the only 'official' international ICZM programme in the Mediterranean region, during the 1990s.

Emergence of a European coastal network

International contacts between coastal experts, practitioners and planners increased as a result of the European integration process. An awareness developed that multidisciplinary networking would be important to solve planning problems, involving both governmental and non-governmental practitioners. At a European coastal conference in Leiden in 1987, delegates from 12 countries agreed to establish a coastal network, resulting in the establishment of the EUCC in 1989.
The emergence of EUCC has led to a considerable boost for ICZM throughout Europe. In 1991 the EUCC organised the European Coastal Conference, in close cooperation with the Dutch government that was President of the European Union at the time. A month later, the European Council of Ministers unanimously adopted a Resolution inviting "the Commission to propose for consideration a Community strategy for ICZM". The result of this initiative was twofold: the 'official' and the 'informal' ICZM programme.

Official and informal ICZM programme

The informal programme developed as a patchwork of local initiatives, running as a process in a climate of cooperation ("the more partners the better"). Most could not meet the rules and criteria of EC-funding. Because of their dependence upon local funding, they developed very slowly but often steadily.
The official programme developed later in the form of the EC Demonstration Programme for ICZM (1997-'99), in a climate of competition for funds ("only the best project is a winner"). This programme consisted of 35 projects with EU co-funding. However, because of EC-regulations for open competition and tendering, this programme could not be connected to the EUCC's practitioners network nor to the informal ICZM programme.
The Commission realised, after some time, the value of networks of coastal practitioners and invited EUCC to act as a representative of the European ICZM community.

Interface

Over the last couple of years EUCC has been involved in an increasing number of coastal projects including very large ones: the EU's EUROSION study, the Coastal Practice Network and the ENCORA, SPICOSA and OURCOAST providing interfaces between the European Union and the coastal experts, practitioners and stakeholders community. EUCC's first role is to ensure the input from the stakeholders in the fields of planning, management, conservation, and industry. This task

is implemented through its international staff and office network and its ability to communicate in 15 languages. The second role is to provide external communication mechanisms and media to Europe and the large English speaking countries in the world. This relies on the presence of a range of electronic newsletters, magazines, and websites in 7 languages, reaching more than a million people a year.
In this way the Coastal & Marine Union (EUCC) became the largest European organisation of coastal and marine professionals: experts, practitioners and policy makers.

Concluding

After more than a decade at the forefront of European coastal management, many achievements of the informal international networking by the EUCC can be mentioned. It has been particularly successful in delivering studies, promoting integrated approaches in planning, implementing ICZM-focused projects, and developing information and communication tools.
Some examples of the important role of international and national NGOs at the threshold between formal and informal ICZM activities in Europe as well as in Asian countries such as Bangladesh, India and Vietnam, are described in the CCC publication.

Executive Summary

Robbert Misdorp

1. Coastal zones: valuable and vulnerable

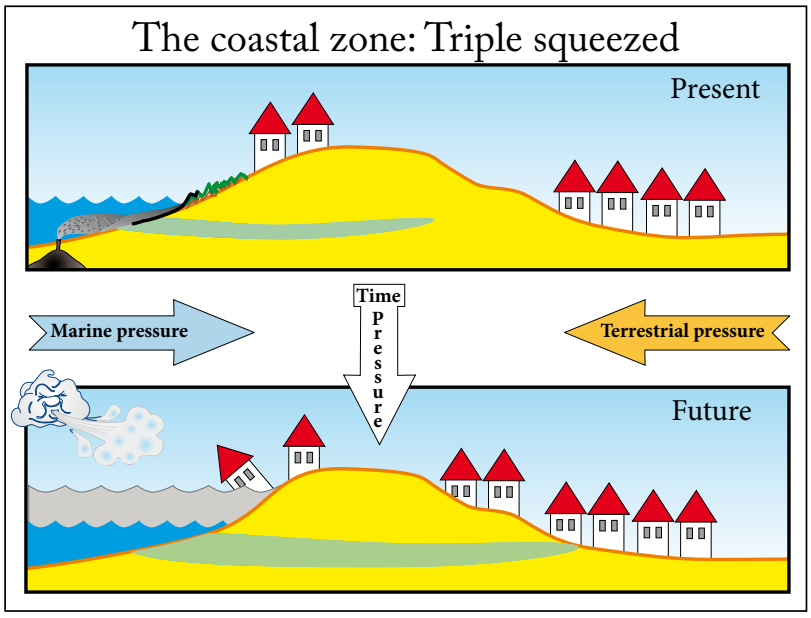
The coastal zone incorporates one of the world's most diverse and productive ecosystems. It provides a significant proportion of global food production and supports many major economic activities. Half of the world population lives here even though it encompasses only about 15% of the land surface. Economic activity provides more than half of the world Gross Domestic Product. At the same time, it is under increasing pressure from rapid population growth and major coastal urbanisation. The natural resources and habitats suffer from eutrophication, pollution by waste and litter, from sediment depletion and over-fishing.

The anticipated impacts of climate change will exacerbate these terrestrial pressures and may adversely influence fresh water availability, affecting the livelihood of coastal inhabitants.
Anticipated impacts of climate change on the marine side of the coastal zone will include sea level rise, increased sea surface temperature, storm surges and typhoons, increasing flood risks, coastal erosion and saltwater intrusion. As these pressures intensify, deterioration of marine habitats, water quality and resource depletion will increase in case no adaptive, sustainable measures are taken.

Finding the balance between exploitation for short-term profit and developing long term, environmentally sustainable approaches to resource use is difficult. This book seeks to help find that balance.

2. Audience and action

This book is for coastal stakeholders and professionals who are or will be responsible for physical planning, applied research and management of their countries' coastal resources. In particular, the target group includes:



***The coastal zone is triple squeezed**: from the land and sea, and the development in time. The coastal zone is in urgent need of adaptive, 'no-regret' measures, planned and implemented within an integrated framework (source: R. Misdorp and H. van Reeken).*

- Applied scientists;
- Policymakers;
- Non Governmental Organisations;
- Decision makers.

It aims to aid cooperation and show decision makers that integrated coastal management provides a means of achieving development that is economic profitable and environmentally sustainable.

Sustainable development of the coastal zone is an important topic in Europe. This is especially true for the Netherlands, where more than half of the densely populated and highly developed country lies below sea level. In order to protect this area from flooding, coastal erosion and salt water intrusion, coastal protection is an important component of management. In recent decades this approach has broadened to include integrated spatial planning, which together help define an Integrated approach to Coastal Zone Management (ICZM). The European Commission (EC) actively supports coastal member states in improving the Governance component of ICZM by providing integrated frameworks, institutional arrangements and legal provisions. Romania has similar problems and, as a new member of the European Union (EU), is developing within an EU framework ambitious ICZM programmes.

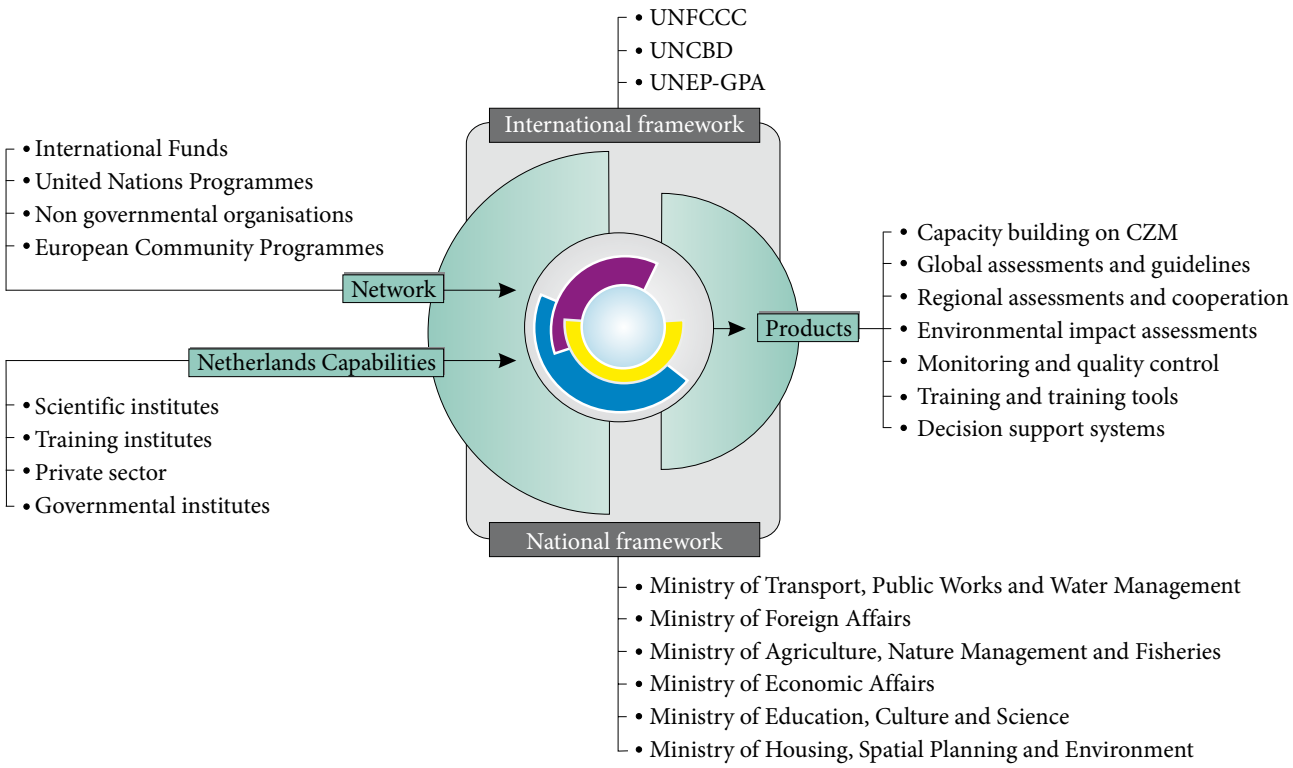
The low lying and deltaic coastal zones of many Asian countries and island states are also critically vulnerable to the impacts of rapid socio-economic growth and climate change, including accelerated sea level rise when compared to other areas of the world. The number of people at risk to flooding and the potential loss of rice production, for example, are amongst the highest in the world. In order to address these vulnerabilities, a number of Asian coastal countries have embarked on a holistic approach, started ICZM programmes and intensified (inter)national coastal cooperation.

3. Structure

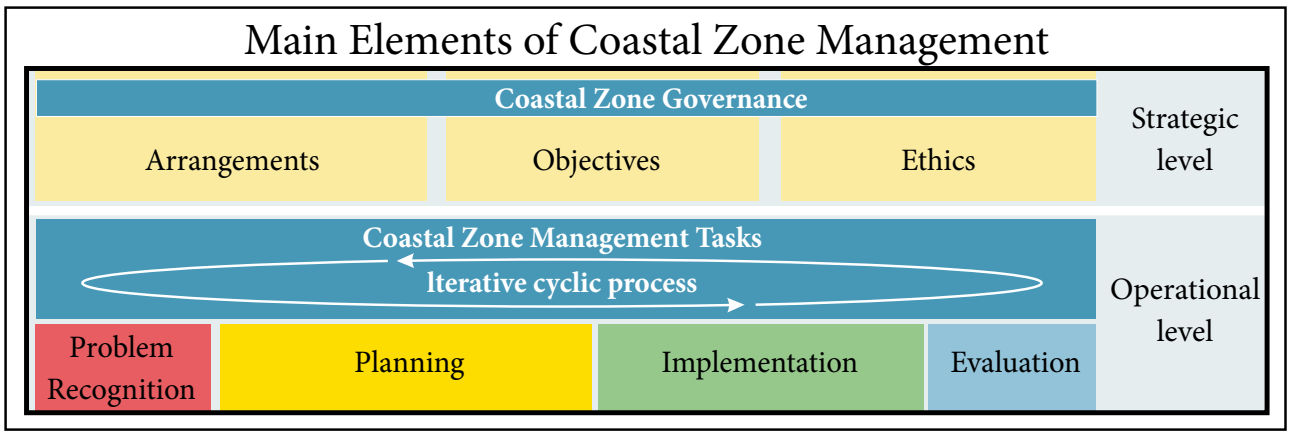
The book is structured in the following way:

- Introductory words and statements;
- Case summaries of coastal cooperation in EU, the Netherlands and Romania (Part I);
- Case summaries of coastal cooperation programmes and projects in eight Asian coastal countries and island states (Part II);
- Concepts, ICZM planning tools, adaptive coastal measures and training manuals - the 'What, Why and How' to plan and implement ICZM programmes (Part III);
- Summary of the book, include learning experiences and recommendations for future cooperation (Part IV);
- Lists of free-of-charge downloadable demos of ICZM planning tools, training manuals, and an alphabetic list of the 101 CCC authors and acknowledgements (Part V).

The full chapters of each of the case studies, the tools and training manuals can be found on the Climate of Coastal Cooperation (CCC) website:
www.coastalcooperation.net



The international Coastal Zone Management – Centre (1993-2006), The Hague: its setting and activities



This book is based on actual project experiences and shows the benefit of ICZM in practice over the last decades.

4. Integrated Coastal Zone Management (ICZM), as a tool for addressing both short and long term coastal management issues is not new. It was adopted by the:

- Rio de Janeiro Declaration (UNCED – Agenda 21, Chapter17, 1992);
- United Nations Framework Conventions on Climate Change and Biodiversity (1992) ratified by the governments of almost all countries of the world. The assistance from so-called developed countries to developing countries is called for in these ratified UN Conventions;
- UN-Intergovernmental Panel on Climate Change (IPCC - First Assessment, 1990) and confirmed during
- the 1993 World Coast Conference in the Netherlands organised under auspices of the IPCC;
- The EU - ICZM Recommendations (2002).

The European Commission (EC) promotes coastal cooperation among other things between European regions by enlarging and exchanging scientific research on coastal processes relating to ICZM tasks. These tasks range from problem analysis to planning and implementation of coastal actions and an evaluation of their effectiveness. Monitoring the natural and socio-economic coastal system is an essential element in all phases of an ICZM programme.

Old, new and green Shanghai. *(photo: Siemens AG Pictures of the Future)*

5. The international Coastal Zone Management Centre (CZM-C, 1993 – 2006) was created as a response to the call for action during the 1993 World Coast Conference (WCC). Its aim was to help developing sustainable policies for coastal resources in the face of the potential adverse impacts of climate change. It did this by facilitating international cooperation through coastal networks, promoting integrated planning and the adoption of adaptive management. The Centre was situated in the Netherlands, generously supported by the Ministry of Transport, Public Works and Water Management (V&W), and five other Ministries including the Ministry of Foreign Affairs, which also provided funding and guidance through its Embassies.

Reorganisation of the tasks within the ministry (V&W), led to phasing out the CZM-C's activities. Parts of these activities now lie within the newly created Centre for Water Management and the Directorate General Waters of new Ministry Infrastructure and the Environment (former V&W). Some of the other tasks have been taken on by the Coastal & Marine Union - EUCC practising ICZM since 1991 also beyond the borders of Europe. It is therefore appropriate that the EUCC is publishing this CCC publication.
Quite a number of chapters are based on CZM-C's activities, thereby reflecting some of their valuable work.

6. Coastal Vulnerability Assessment a first step to ICZM
ICZM encompasses a wide range of disciplines, any of which may identify the need for an ICZM programme. Climate and climate change can have a profound impact on densely populated coastal zones and is one such trigger. A first stage of an ICZM programme may include a Vulnerability Assessment (VA). Following a request from the UN-Intergovernmental Panel on Climate Change the Netherlands assisted the production of a Common Methodology for such an assessment in 1991. It was adopted and provides guidance for coastal nations in estimating their coastal vulnerabilities to a 1m sea level rise and socio-economic development in relation to the present situation. Two illustrative examples of this approach:

"From VA to ICZM", are found in the CCC chapters on Bangladesh and Vietnam.

More than 90 nations reported on and discussed their Vulnerability Assessments during the WCC'93. A Global Vulnerability Assessment (GVA) was also carried out, taking into account 179 coastal countries and using a selected number of Vulnerability indicators. This revealed that many Asian countries and island states are critically vulnerable to a 1m sea level rise, not least because of the rapid socio-economic development in their coastal zones. Because of this Asia has a prominent place in this publication.

7. Coastal cooperation and ICZM

Not all examples of successful integrated coastal cooperation follow the ICZM approach. Good examples of such cooperation are the integrated planning of the innovative Chinese coastal Eco-cities, involving many national and international partners. The Rotterdam harbour development is another, which includes many elements of an ICZM programme, but without the label.
The main thrust of this CCC-Publication is to demonstrate that coastal cooperation pays off, with or without a formal ICZM framework.

8. Concepts and Cases

The coastal zone is subject to a multitude of complex functions with ICZM acting as a cyclical process involving the following concepts derived from the CCC cases:

- Increasing coastal resilience, which decreases vulnerability;
- Using soft solutions for coastal protection where possible and hard ones only where needed (Working with Nature concept);
- Increasing the area of valuable wetlands such as mangrove systems;
- Using innovative sustainable applied technology e.g. decentralised solar energy and sanitation techniques;
- Addressing both short and long term problems: Simultaneously the creation of short term adaptive solutions and drafting long term strategies in one project;
- Integrating the input of international and national authorities and experts in the analyses of coastal problems and the identification of sustainable solutions by the local authorities, NGOs and applied scientists. An example of successful application of vertical integration is found in Vietnam.

The setting of each coastal area is different requiring different ICZM approaches. This is clearly illustrated by the European and Asian cases included in this publication. The opportunities to exchange information on common problems and pressures, and the different ICZM approaches to solving these problems are considerable.

9. Tools and measures

GIS tools can support the planning phase of an ICZM programme. The tools described here by the developers simulate the effects of alternative spatial planning options and functional uses in the face of climate change. These include principles of 'Environmental Impact Assessment' and 'Decision Support Systems' such as those applied in India.

The tools to support policy preparation were developed whilst undertaking ICZM tasks, with emphasis on training and capacity building. The reader can explore these interactive tools.

The Netherlands - Oosterschelde: *nature building - man made dunes and the Storm Surge Barrier in the background. (photo: //beeldbank.rws.nl, Rijkswaterstaat)*

This publication provides examples of adaptive, innovative, 'no-regret' measures based on the precautionary principle. Capacity building, awareness raising and education have also been adopted as essential elements in ICZM development programmes. There are four training manuals including subjects ranging from improving the management of Marine Protected Areas, experiences with Thai Aquaculture, a Coastal Defence Guide and Teaching Material on water and coastal management for primary and secondary school teachers. These manuals can also be downloaded.

10. Benefits of ICZM, coastal cooperation and adaptive, no-regret measures

Although pressures on the coastal zone may trigger an ICZM programme, probably the most convincing argument is that it can be both economically and environmentally beneficial. The secret lies in creating multiple-use, win-win, resilient and 'no-regret' solutions. Examples with a high benefit – cost ratio are shown in this publication and include several of the evaluated European Commission – ICZM projects, the Rotterdam sustainable harbour development, the large-scale mangrove planting in Vietnam and the conservation of habitats from mountain to the sea in the Seychelles.

The combined, active and supportive participation of donor Ministries, consultancies and knowledge institutes is also important, safeguarding the quality of work and providing the deliverables as specified in contracts with the recipient countries.

11. What makes this CCC-Publication unique?

There are many books written on ICZM. The 2002 worldwide review by Jens Sorensen identified more than 700 ICZM projects. He concluded that lack of communication between coastal stakeholders was one of the key issues, which hampered progress in achieving sustainable development of the coastal zone!

This CCC-Publication aims to exchange and transfer coastal management experiences. It promotes the exchange of information between you the reader and the CCC-authors and developers engaged in planning and implementing coastal activities. It provides information on the experiences gained from the many different coastal projects and programmes described. It is different in three ways from many of other ICZM publications:

Firstly, it provides conclusive evidence of the feasibility and the effectiveness of coastal cooperation.

Secondly, it presents practical background information on coastal cooperation and the 'What', 'Why' and 'How' of ICZM. It is based on actual project experiences and shows the benefit of learning from ICZM in practice over the last few decades.

Thirdly, it is not just a book for reading quietly in a library. The CCC Book offers a summary of the cases of Part I and II, while the "Climate of Coastal Cooperation" website provides background information and more detailed project results of theses CCC cases in the full Chapters. Furthermore, this website also gives the user access to the ICZM planning tools described by the developers. The demos of these tools and the training manuals can be downloaded free-of-charge. They provide a common platform for discussion, stimulating participation by the coastal stakeholders, NGOs and local authorities. Examples of coastal measures described range from 'low' to 'high tech' solutions and come from a wide variety of coastal situations making this CCC publication particularly valuable.

The List of Contents provides an overview of each contribution. The alphabetic List of Authors then facilitates the required communication, strengthening international cooperation. You are invited to explore the CCC website with is extended, full chapters, tools, training manuals and to forward your questions and views to the authors.

12. The CCC authors – a coastal community in the making

This Executive Summary presents an overview of the relevant steps of ICZM as well as results of coastal cooperation in practice. The authors come from many different fields of experience and expertise. These range from (former) Ministers and permanent secretaries, executive directors of international organisations and funding institutions, to representatives of many different NGOs, educators, coastal experts and stakeholders, governmental officials and university professors. They offered quite some time making this CCC publication possible. Their contributions are much appreciated and can be regarded as a demonstration of coastal cooperation in practice. It also shows that cooperation can make a difference.

The authors hope that the lessons from the case studies, the tools, manuals and measures prove to be valuable in their applicability to the reader.

CCC - Part I

Coastal Cooperation in Europe

CCC Part I - Chapter 1: Europe

EU- Integrated Coastal Zone Management Initiatives

Introductory Statement - Europe

Jacqueline McGlade

Executive Director of the
European Environment Agency, Copenhagen, Denmark

Coastal zones are valuable and highly productive areas in economic and environmental sense.
The coastal zones are however also vulnerable to non sustainable uses and impacts of climate change.
Integrated coastal zone management is directed towards sustainable development and is addressing these challenges in a comprehensive way. Managing the coastal zones requires knowledge of the socio-economic and natural, coastal processes.
Good management is the base for well balanced and informed decision making.

It is the mandate of the EEA to assist European Commission and the NGO community, in: "Making informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability".
Increasing the knowledge base of coastal systems is especially important in addressing the serious challenges dealing with the functioning of ecosystems and their resources.
We strive to build up profound insight on the coastal dynamics, to decrease its vulnerability, to increase its flexibility and its resilience.

The EEA facilitates this building up of knowledge through assisting in monitoring capabilities of member states, to assist in data base management, to disseminate information in Europe and in EU related countries. Our support to the **Asia-Europe Environment Forum** shows that we also reach out to Asian countries, many of which have strongly developing coastal zones. We facilitate countries in their efforts to manage the narrow and densely populated and economic vibrant coastal zones in a sustainable manner.

The present day challenges are complex. The future challenges will be more pressing. Increased knowledge on impacts of global climate change for planning and designing measures to mitigate and to adapt is highly needed, as illustrated by our participation in: "One degree matters" (www.eea.europa.eu/cop15/bend-the-trend/one-degree-matters-movie).
Collecting data and transferring into information are essential activities. It is important to ensure proper data management and dissemination of knowledge to international, national, provincial and local authorities and coastal stakeholders and managers. The EEA facilitates monitoring of coastal processes and assists in creating information systems: example EUROSION data base can be consulted even after this valuable EU project finished. The EEA's hosting of such important data base provides continuation in data gathering, and data storage and information dissemination for EU coastal countries and beyond. Thus, it brings together key aspects of national and international research outputs including those from the Global Monitoring for Environment and Security (GMES) initiative in order to strengthen the link between science and policy.
EEA is an open structured organisation and will also in the future facilitate such important services directed at analysing the functioning of ecosystem and natural resources.
The European Commission and EEA strongly support integrated coastal management approaches as can be read in the following chapters of this "Climate on Coastal Cooperation" publication.

Integrated Coastal Zone Management in the European Union

Birgit Snoeren* *(European Commission - DG Environment, Brussels)*
Niels Roode and Hugo Niesing *(Rijkswaterstaat/Ministry I&E, the Netherlands)*

***Severe cliff erosion** threatening the coastal settlement of Happisburgh, UK. (photo: EUROSION)*

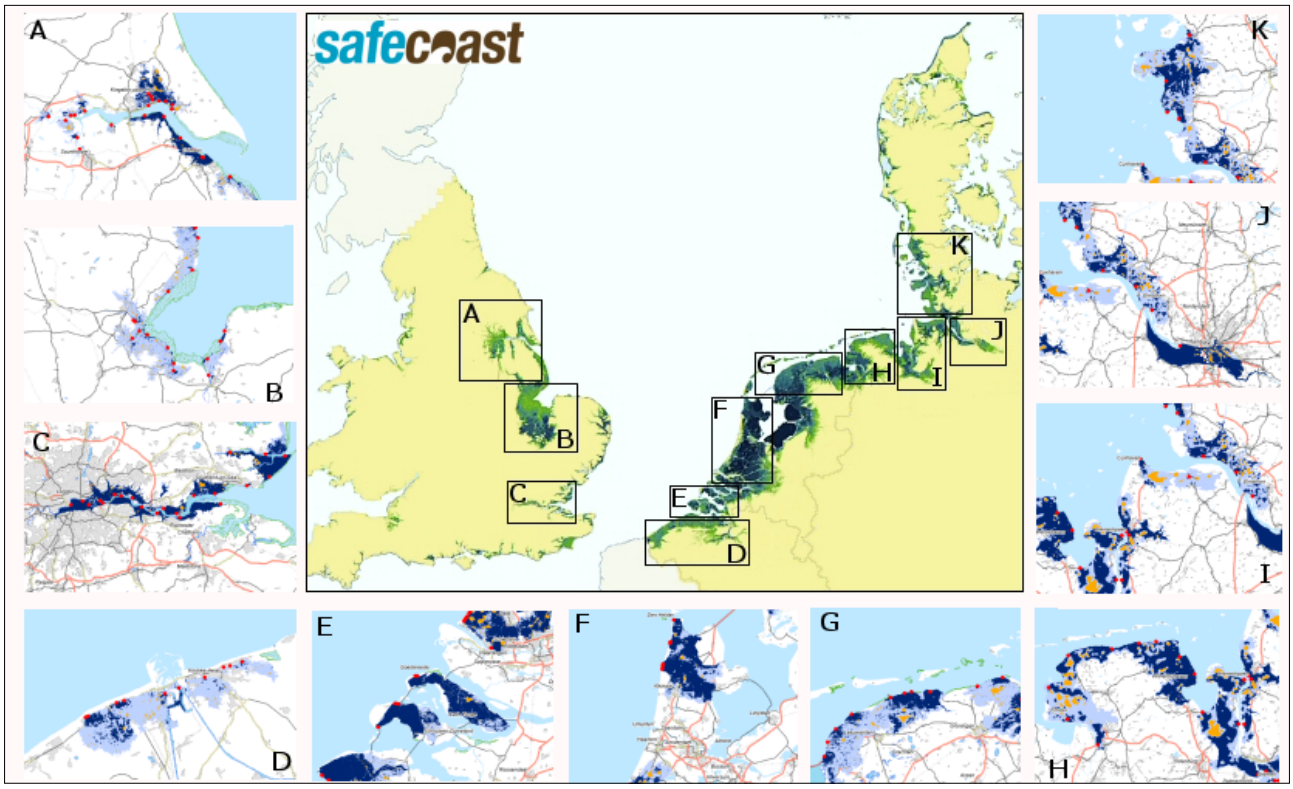
Summary

Since the early 1990s, both the UN and EU have specifically addressed problems related to the state of the coast and seas. The EU institutions supported the development of ICZM programmes, in both an economic and environmental sense, adopting eight ICZM principles. In 2000, an assessment of the socio-economic costs and benefits of demonstration projects revealed significant monetary and non-monetary benefits of ICZM.
Since 2002, most EU countries have adopted the principles of ICZM in their national coastal strategies or spatial planning processes. Many initiatives and projects related to exchanging information and sharing best practice have emerged. In 2007, the European Commission evaluated the national reports on the implementation of ICZM. Future activities have a greater emphasis on adaptation to climate change, cooperation at a level of regional seas and coherence between plans, programmes and management of the maritime and terrestrial parts of the coastal zone. The EU will continue to support ICZM efforts also in non-member states when requested.

Contents

* Publication written in a personal capacity. The opinions expressed do not commit the European Commission and do not necessarily represent the official position of the European Commission.``

Touristic facilities *so close to the sea provide short term economic benefits, but make the low lying coast vulnerable to the impacts of climate change such as accelerated sea level rise. (photo: Villa Joli, Koksijde, Belgium)*



Transnational flood risk assessment *and mapping for the North Sea Region.*

Examples of ICZM practices in Europe

From a NGO point of view

Albert Salman & Alan Pickaver *(Coastal & Marine Union - EUCC, the Netherlands)*

Indicator of good ecosystem health: *White-tailed Eagle fishing in a lagoon of the Oder Delta, indicating a good water quality and habitat. (photo: Reint Jakob Schut)*

Summary

The role of NGOs, such as the Coastal & Marine Union - EUCC, in the process of ICZM is clear: stimulating and initiating ICZM programming at different levels, ensuring stakeholder participation, disseminating experience in sustainable coastal development and day-to-day management of coastal areas. These efforts have helped implementation of successful ICZM programmes in many parts of Europe. EUCC has been instrumental in the development of the 'ICZM Indicator Set' to monitor the progress that is being made in the implementation of ICZM in Member States.

To ensure measurability a linking programme targeting specific ICZM elements for sustainability was set-up: QualityCoast connecting coastal towns and small islands.

Some examples of EUCC's involvement in management and development of deltas are highlighted, specifically in the Baltic. Two examples: the Nemunas delta (Baltic States and Russia) and the Oder Delta Nature Park (Poland) illustrate the effective involvement of a NGO in daily management of coastal areas. This took place in close cooperation with local stakeholders and government officials. Successful cooperation leads to sound economic development and facilitates nature conservation.

The cooperation within and between the EU coastal states, coastal towns and islands helps instil confidence at all levels, which provides a good basis for sustainable resource development.

Contents

QualityCoast programme: *linking a growing number of coastal towns, regions and islands in improving their performance of sustainability and tourism quality. (www.qualitycoast.info)*

Hoisting the QualityCoast flags*: a recognition for sustainable development. (photo: Carlo della Libera)*

NGO participation in Baltic Sea region: *EUCC supports the daily management of specific coastal areas in the Nemunas delta (Lithuania and Russia) and Oder Delta Nature Park (Poland). (photo: Oder Delta Nature Park, Poland).*

Conclusions - ICZM efforts in the European Union

From the nineties onwards, the European Union has taken a *strong leadership role* in the development, application and promotion of ICZM. Starting with the UNCED – Agenda 21 (1992) as a trigger point, the EU has developed mechanisms for long-term support through the funding of ICZM programmes such as Interreg, Cadses and Cohesion, the development of legal and institutional frameworks and anchoring ICZM principles in the EU Water Framework Directive (WFD) and the EU Marine Strategy Framework Directive (MSFD).

The EU efforts cover *a vast array of different ICZM activities,* involving the whole spectrum of ICZM tasks from problem recognition to evaluation. Examples of the EU ICZM initiatives and efforts include:

- The EU Resolution (1992) emphasising the need for ICZM;
- Evaluation of the ICZM Demonstration Programme (1996-1999), which showed a positive benefit - cost ratio;
- The ICZM Recommendation (2002) on the application of ICZM programmes and drafting national reports on ICZM by participating EU countries;
- Development of indicators on the progress of ICZM implementation and their application in the evaluation of national country reports (2002-2007);
- The project OURCOAST (2008-2011): mechanism for sharing lessons from coastal management experience and practice.

From a *top down* perspective, the ICZM activities aimed to strengthen *regional cooperation* among EU member states and also beyond the borders of the EU. A range of supporting projects illustrates this, including:

- EUROSION (2001-2004) investigating the social, economic and ecological impact of coastal erosion on European coasts and the need for action;
- COMCOAST (2004-2007) investigating innovative concepts of flood protection systems allowing for multifunctional land use in coastal zones of five North Sea countries;
- SAFECOAST (2005-2008) providing a stimulating framework for regional cooperation between coastal countries around the North Sea on flood risk assessment, leading towards a common approach for coastal adaptation;
- PlanCoast (2006-2008) focusing on integrated spatial planning of the terrestrial and marine parts of the coastal zone as an important instrument for ICZM implementation and exchanging experiences between EU member states bordering the Baltic, Adriatic and Black Sea;
- ENCORA (2006-2009) on the development of a network for communication and exchange of coastal science, policy and practice in 18 countries within and outside Europe.

From a *bottom up perspective,* the EU has offered an ICZM platform to NGOs, stimulating NGO activity in the field of awareness raising, stakeholder consultation and information dissemination. The NGO efforts have focused on the execution of ICZM measures directed at sustainable development through integrated planning of local and regional Delta areas, such as:

- The EUCC's projects Quality Coast and Coastal Practice Network (2004-2006) establishing the integration of tourism, coastal defence and environmental protection at town level and resulting into the QualityCoast Programme.
- The Nemunas Delta on the Russian-Lithuanian border (nature conservation, agriculture and agro-tourism) beneficial for other coastal areas in Latvia, Estonia, Russia and Poland;
- The Oder Delta Nature Park (2005) was established as a ten-year Dutch - Polish cooperation and its principles are carried forward in various EUCC-projects.

In these examples, the involvement of local and regional stakeholders throughout the process has been vital to their successful implementation.

CCC Part I - Chapter 2: The Netherlands

Coastal planning and implementation

Introductory Statement - the Netherlands

Vision, ingenuity and leadership: water policy and developments in the Netherlands

Seen van der Plas

Permanent Secretary of the
Ministry of Transport,
Public Works and Water Management,
the Netherlands, 1992 - 1998

Introduction

Over the centuries, dynamic coastal processes in and around the mouth of one of our rivers the Maas (Meuse) have formed a large system of sandbanks. The residential and working area of 'Delfland' located in the surrounding area, is a few metres below sea level and protected by natural sand dunes. However, a rising sea level and powerful hydrodynamic forces during storm tides poses a serious threat to the safety of the inhabitants.

Three centuries ago, 'De Beer' - as part of the sandbank in the mouth of the Maas was called - became a "Dangerous sea monster, which could destroy ships and annihilate all of Holland".
Protecting land, property and people from such threats, became a common theme in the physical and geographic history of the low-lying Netherlands. It was the driving force behind the vision and ingenuity, with which much of the low-lying country, now referred to as the Netherlands, was created.

In 1731, a hydraulic engineer by the name of Nicolaas Cruquius launched a plan to dig a channel through the section called the "Hoek van Holland" and the sandbank in order to provide the Meuse River with a wide entrance to the North Sea. In his vision, the strong currents in the mouth of the river would remove the sandbank, strengthen the dikes and reduce the risk of flooding.
Cruquius was far ahead of his time. His plan met a great deal of resistance and was not (yet) accepted. His proposal to "centralise the management of water flows and levels" in Holland met the same fate.
In the 19th century, an engineer by the name of Pieter Caland put this plan on the table again. In 1858, in his role as secretary of the "Raad van Waterstaat" (Public Works Council), he proposed launching a daring project to dig a channel through the dunes to the "Hoek van Holland." The primary aim of his proposal was an economic one: ensuring the free passage of ships from Rotterdam to the sea. In 1863, King Willem III signed a new law: "Den Nieuwen Waterweg" (The New Waterway), and in 1872, the first ship, a steamer of the Harwich line, sailed through the Nieuwe Waterweg to the sea (see the recent map of the Nieuwe Waterweg).

Mouth of the River Meuse and a view on Rotterdam *- Map of the river Maas, Jacob Quack 1665.*
(source: Collectie Gemeentearchief Rotterdam / cat.nr. RI-86; Bertus Wouda, 2008)

Rijkswaterstaat (Dutch Department of Water Management and Public Works)

In the 18th Century, there was an increasing awareness that the safety of the Netherlands was at risk. In 1770, the influential "Bataafsch Genootschap der proefondervindelijke wijsbegeerte" (Dutch Association for experimental philosophy) was established with its most important goal being to prevent the destruction of the Netherlands by catastrophic floods. Influential citizens, including the founder of the Rijkswaterstaat, Christiaan Bruning, were convinced that "unity in the administration and management of water" was needed to ensure the safety and welfare of the entire country - a concept, by the way, which also deserves attention today.

In 1798, the Rijkswaterstaat was established during the 'Bataafsche' Republic (1795 – 1801), a period of national and political change, characterised by a significant move to a central authority.

Rijkswaterstaat became responsible for managing and taking care of the coasts and rivers, all the inland public works, and the supervision of the lower government echelons responsible for public works and water related issues.

The significance of this was far-reaching. The decision and the manner in which the Rijkswaterstaat - worked with research institutes, engineering firms and dredging and construction companies - has transformed the low countries in the course of two centuries into a modern, safe and secure country.

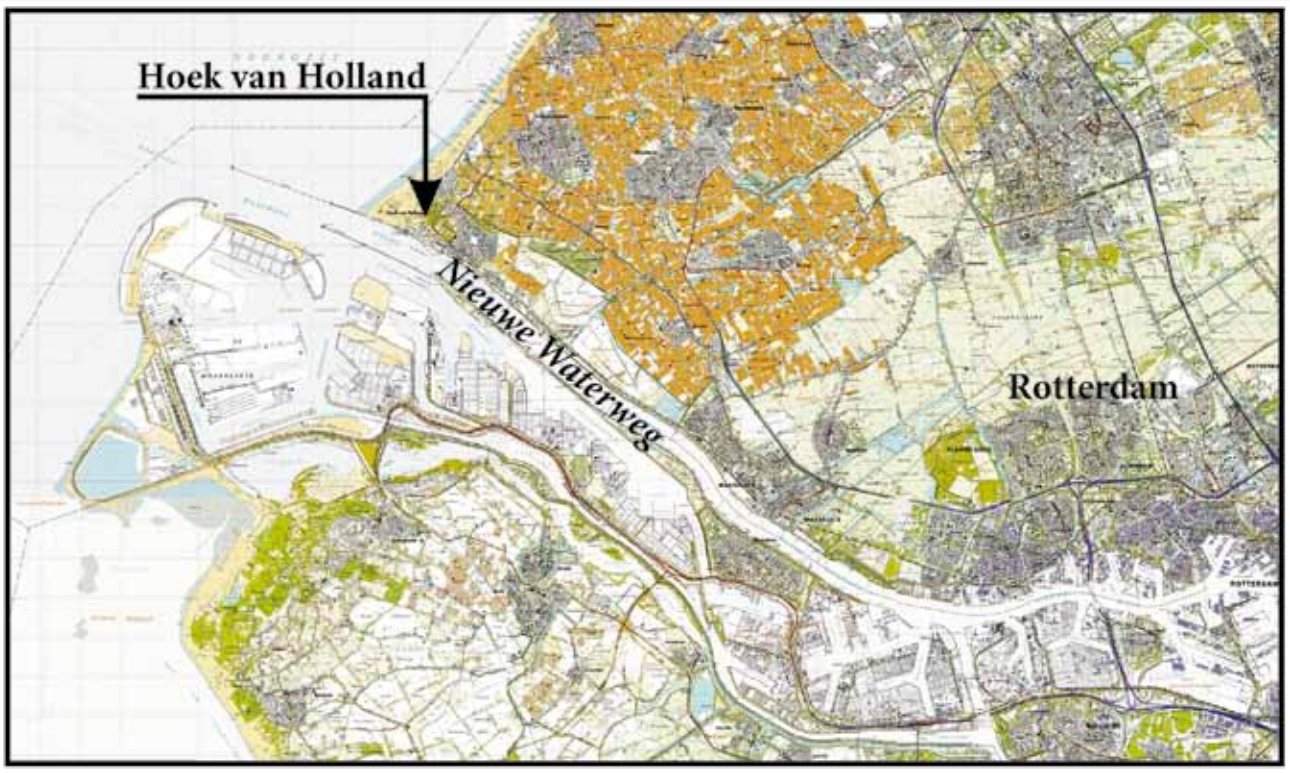
The Dutch policy of integrated coastal management has received worldwide recognition. This was emphasised in 1993 when the first American National Oceanic and Atmospheric Administration: "Excellence Awards for Coastal and Ocean Resource Management" was given to the Netherlands (Van der Plas, 1993).

The Rijkswaterstaat became incorporated in the Ministry of Transport, Public Works and Water Management (Min. V&W) in the course of the 20th century. Since 2010 the Min. V&W changed into the Ministry of Infrastructure and the Environment (Min. I&E).

Vision of the Netherlands future

In the final decades of the 20th century, the focus has been on the economic infrastructure of the Netherlands. The Netherlands was busy preparing itself for the coming century. Its economic strength and potential had to be utilised to the full, but at the same time, there was an increasing focus on issues such as sustainability, quality of the spatial environment, and responsible ecological management. This resulted in an integrated approach to formulating policy, choosing investments, and preparing and implementing projects.

The vision of the economic future of the Netherlands was and still is, in large part, based on the strategic geographical location of the Netherlands as a "Gateway" for Europe, but with an additional focus on broadening the economy to include knowledge-intensive activities. In order to take advantage of the potential in terms of transport,



***The Nieuwe Waterweg**, the navigation channel between Hoek van Holland and Rotterdam, inaugurated in 1872. (source: Topografische Dienst Kadaster, Emmen, 2009)*

distribution, industry and services, it was necessary to invest in the main ports, the links to inland Europe and mobility in our own country. Preparations for major infrastructure projects, included separated railway links for goods and for people connected to the European networks, the Nieuwe Waterweg Storm Surge Barrier, the expansion of Schiphol Airport and the Port of Rotterdam. Most of these projects are complete, whilst others are ongoing.

The CCC-I-2-2 Chapter - "Rotterdam: Long-term sustainable harbour development" - which is presented below, is an excellent example of what can be realised via a modern and integrated project-based approach.

Climate change

The speed with which the world around us is changing, is both fascinating and at the same time frightening. As recently as the last decade of the previous century, the world seemed to be entering a long period of economic growth, but now it is going through a major financial and economic crisis. It is becoming increasingly clear that natural climate change is being accelerated by human intervention, raising the earth's ambient temperature and leading to rising sea levels. One of the greatest challenges facing humanity is to ensure that the areas situated in deltas and along coastlines and rivers, where roughly three quarters of the world's population is located, remain a safe place for their inhabitants to live. Successfully meeting this challenge will demand a high degree of international cooperation. The Netherlands, for its part, has started preparing adaptive measures based on worst-case climate change scenarios.

Concluding

The threat to the low-lying areas of the Netherlands from the sea, now exacerbated by the impacts of global warming, demand leadership from central government.

In view of the enormous scale and complexity of the challenges facing us, we will need vision and ingenuity to find solutions, make plans, and implement the projects to meet these challenges. In so doing, the Dutch treasure trove of knowledge and experience, gained over the centuries in the Dutch delta, will be an invaluable asset. However, to take advantage of this asset, the central government in the Netherlands will need to demonstrate the same type of leadership and vision as it did in the 18th century.

The techniques for protecting life and property acquired during the long period of living in the Dutch Delta can be shared with other coastal areas in the world threatened with inundation from the sea.

References

Bertus Wouda, 2008: Doordachte dieptelijnen op Rotterdamse rivierkaarten, De Nieuwe Maas in 1697 door Pierre Ancelin gekarteerd: Tijdschrift voor Waterstaatsgeschiedenis 2007: www.jvdn.nl/Downloads/WG/TWG 2007_069c-092.pdf

Nieuwe Waterweg Storm Surge Barrier: www.park.org/Netherlands/pavilions/techno/svk/engels/index.html.

Plas, Ir. A.B.M. van der , 1993: " Coastal Zone Management – Challenges for sustainable development", presentation of the "Excellence Award for Coastal and Ocean Resource Management" – New Orleans, 1993; CZM-Centre Publication/Ministry of Transport, Public Works and Water Management, The Hague.

(photo: Aeroview bv)

(photo: Aerophoto-Schiphol)

***The vision of the economic future** of the Netherlands is, in large part, based on the strategic geographical location of the Netherlands as a "Gateway" for Europe; Rotterdam (largest harbour of Europe) and Schiphol International Airport contribute 12% to the GDP.*

The Netherlands: flood, coastal erosion and management

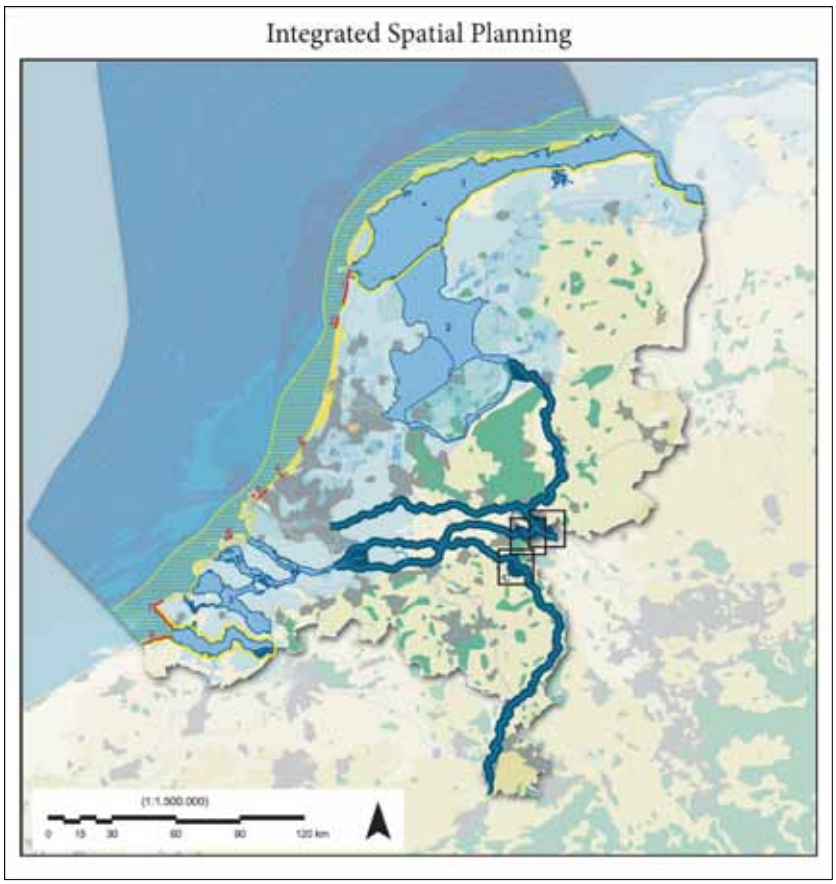
Niels Roode and Tjark van Heuvel *(Rijkswaterstaat/Ministry I&E, the Netherlands)*
Robbert Misdorp

***The low lying western part of the Netherlands**, sensitive to flooding and coastal erosion, is protected by dunes, in places supported by additional coastal measures. Visible behind the single ridge dune are the capital-intensive horticulture in glass houses and urban settlements.*
(photo: //beeldbank.rws.nl, Rijkswaterstaat)

Summary

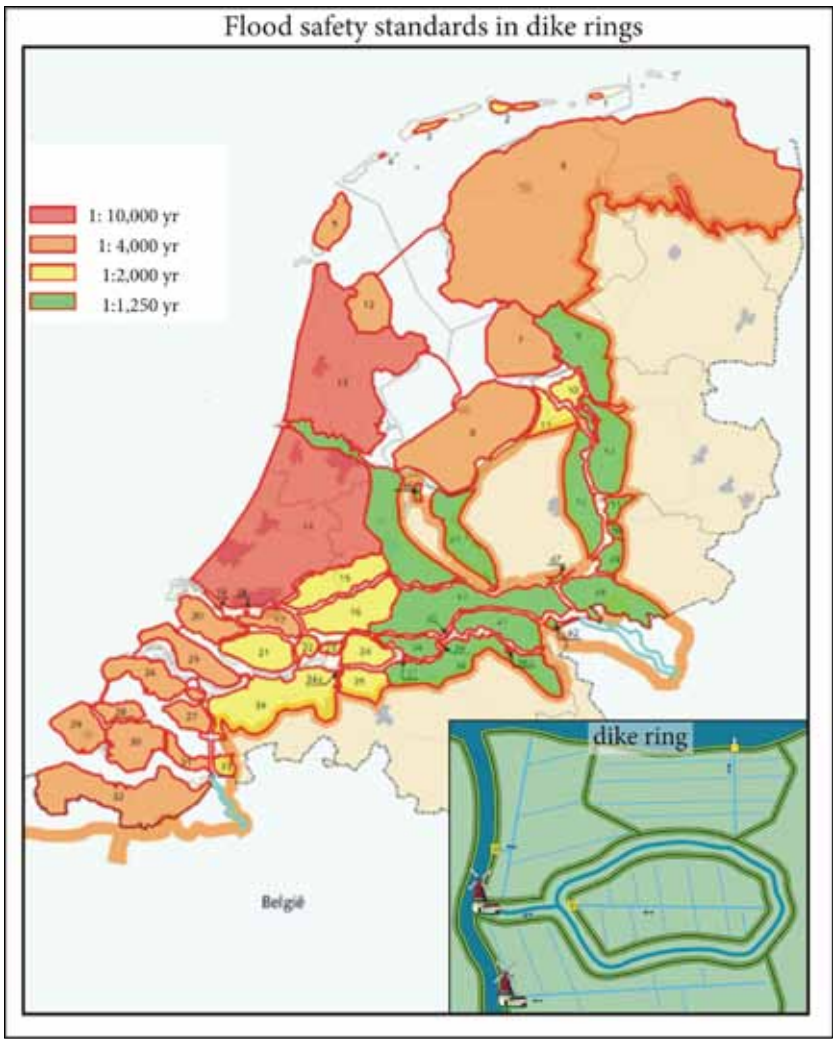
The Netherlands is protected against flooding and coastal erosion by natural dunes, dikes, dams and storm surge barriers. Population growth, coastal urbanisation, economic development and a changing climate increase pressures on the coastal zone.
Managing the sediment budget of the sandy coast is one of the main strategies used to protect coastal land, infrastructure and people in the Netherlands from flooding and erosion. Sand nourishment has been successfully and systematically applied since 1990. Designing and evaluating coastal defences, such as sand nourishment requires long term and annual monitoring of coastal morpho-dynamic processes along the entire coast. Every 6 years, testing the compliance with statutory safety standards requires state-of-art information of the hydraulic conditions and geo-technical state of the primary flood defences.
The total government spending on primary flood defences is from an economic point of view, cost effective with the annual costs representing a tiny fraction of the capital protected. Currently the Ministry of Transport, Public Works and Water Management (Min.I&E) is reviewing the safety standards and looking for alternative approaches. This is because of the strong growth of the socio-economic sectors, which has resulted in a big increase in the value of the assets at risk. Moreover, the increased probability of flooding in the future due to the anticipated impacts of climate change will further exacerbate this. Sand nourishment is a flexible way of adapting to these changes.
Integrated planning addresses the increasing risk of flooding and coastal erosion and is a useful tool to help reduce the risk to the population and capital investments. The integrated approach focuses on 'spatial quality' and 'sustainable safety', and is based on a set of ICZM principles.

Contents:



Water as a guiding principle in integrated spatial planning *of the marine and terrestrial parts of the coastal zone – ('Space for Development' –Governmental Document prepared by four Ministries and adopted by Parliament 2006):*

- *Blue rivers: "Room for Rivers" projects;*
- *Black open squares: non effectuated emergency flooding polders in river dominated areas;*
- *Dark Yellow: protected dune zone: flood safety is first priority;*
- *Light Yellow: coastal foundation zone: area of nourishment: fore shore and deep water (up to 20m below MSL) and reserve for sea ward extensionRed coastal areas: 'weak links' in the coastal zone, reinforcement is being executed;*
- *Light Blue on land: area below sea level, protected against flooding.*

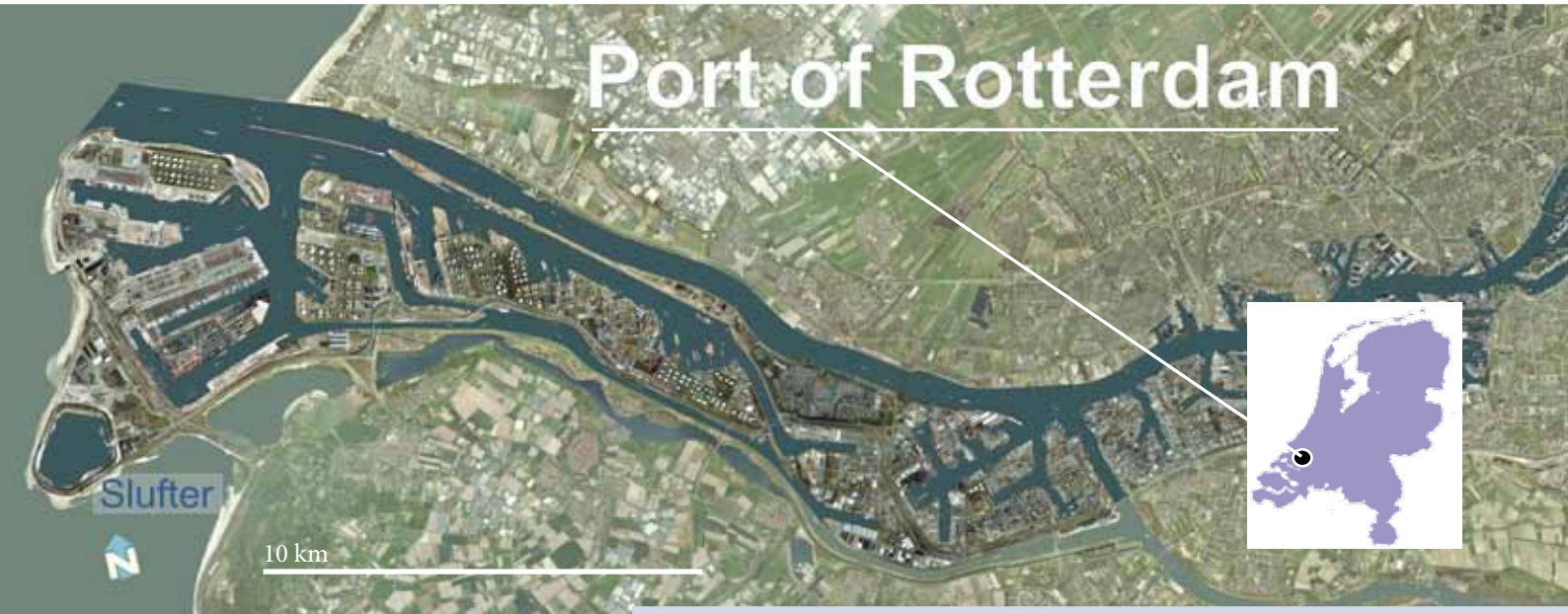


Dike rings and flood safety standards in the Netherlands.
A dike ring is a series of polders surrounded by a primary flood defence dike.
The western part of the Netherlands (red) is most densely populated, with large capital investments, infrastructure, harbours and airport.
This part has the highest safety standard: the coastal defences (dams, dunes and dikes) can withstand a sea level (and waves) which occurs with a chance of 1/10,000 per year.

Rotterdam: sustainable harbour development

Long-term sustainable development is actually good for the economy and environment

Robbert Misdorp



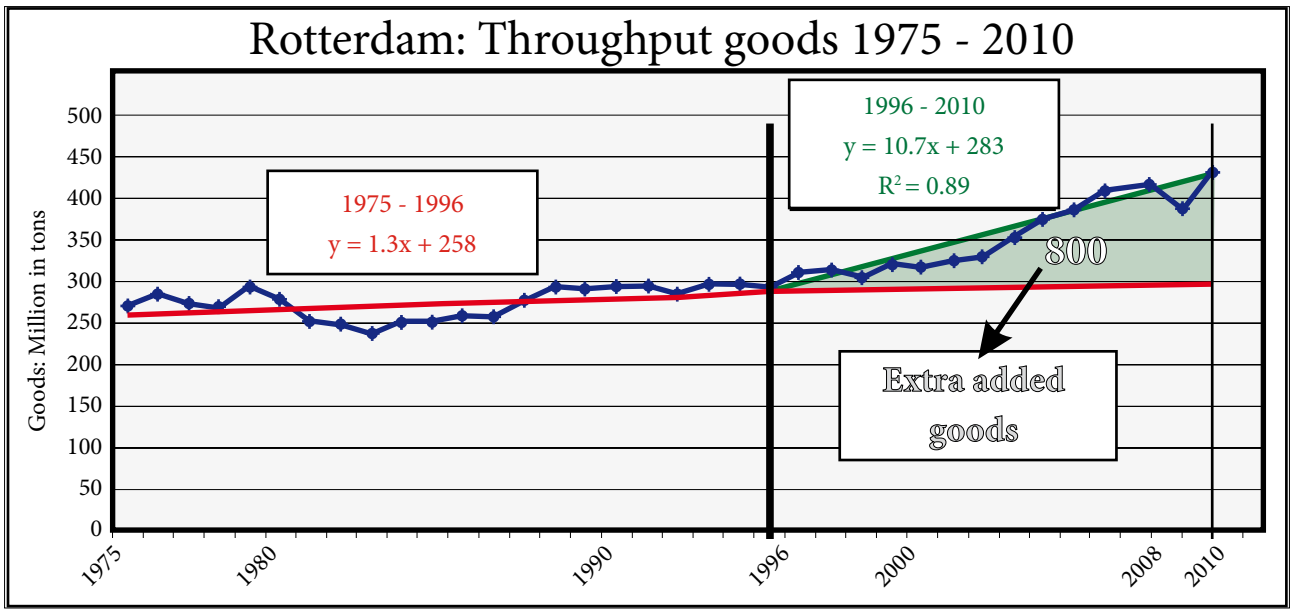
(photo: Port of Rotterdam)

Maasvlakte -2: *2000 ha landreclamation in progress. (photos: NASA)*

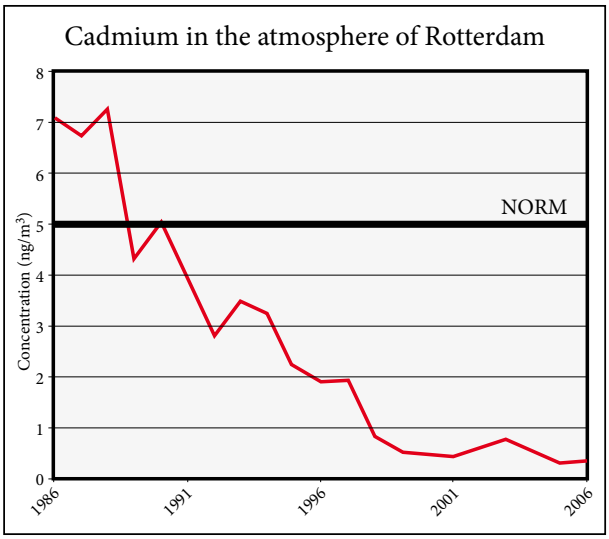
Contents

Summary

It became clear in the 1980s that the growth of Rotterdam Harbour could not continue without creating serious environmental problems. These in turn had an adverse impact on the local population and on economic growth. By bringing all the local stakeholders together in the long term ROM-Rijnmond programme (1993-2010) and with a shared financial risk, it has been possible to realise economic growth and environmental protection. The programme partners were each responsible for the implementation of 28 identified projects. The Port of Rotterdam, one of the major actors, is responsible for building a 2000 ha new harbour extension, Maasvlakte-2. The economic growth of the Rotterdam harbour increased during the programme to such a level that the economic value of the 'Extra added goods' (see Throughput of Goods 1975 - 2008) is of the same order as the investments of the entire programme. The environmental restoration resulted in improved quality of the air, water and soil in the Rotterdam harbour area. A marine Nature Reserve and several win-win situations, involving green solutions, were also created.
Central to this was the development of an integrated and co-operative programme defined by regional spatial planning within a national legal framework. Mitigation of climate change is one of the current challenges. The development of the Rotterdam harbour is a good example of successful sustainable development in practice, involving the planning and implementation of a coastal area programme.
The programme involved long-term cooperation, which was sometimes unwieldy and required careful coordination. However, the time and money invested certainly paid off, both economically and environmentally.
These lessons and the national legal framework for regional development are important components for the next coastal cooperation cycle for the Rotterdam harbour (2010 - 2020). This will address future challenges, such as mitigation of climate change and adaptation to its impacts.

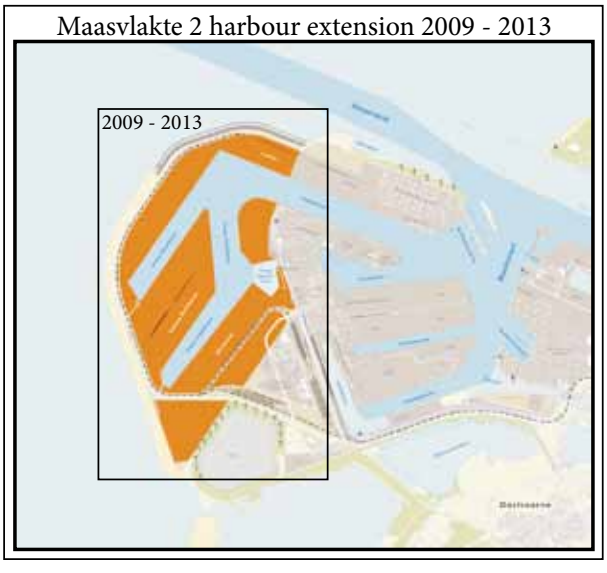


Port of Rotterdam: the strong increase in 'Throughput of Goods' *- the period of 'Extra added goods' - began in 1996, three years after the start of the ROM-Rijnmond programme; the economic value of the 'Extra added goods' is more than the 7 Billion € investments of the entire programme.(source: R.Misdorp based on Port of Rotterdam statistics)*



Strongly reduced cadmium in the atmosphere *of Rotterdam during the period 1986 - 2006, and since 1990 is well below the target level ('norm') of 5 ngr/m³ air, indicating strong environmental improvements during the1990s.*

The man-made 'Slufter' basin (40 m deep) *safely stores contaminated dredged harbour material, surrounded by beaches and shoals being part of a Nature Reserve, providing e.g. habitat for seals. (photo: //beeldbank.rws.nl, Rijkswaterstaat)*



The 2009 – 2013 Maasvlakte-2 harbour extension*, 2000 ha land-reclamation in the sea (orange), executed by the Port of Rotterdam under severe environmental conditions put forward by Netherlands Government and European Commission, in accordance with EU Birds and Habitats Directive. (source: Rotterdam Port Authority; adapted)*

Marine Spatial Planning in the Netherlands Part of the North Sea

Leo de Vrees *(Rijkswaterstaat/Ministry I&E, the Netherlands)*

(photo: //beeldbank.rws.nl, Rijkswaterstaat/ Sander de Jong)

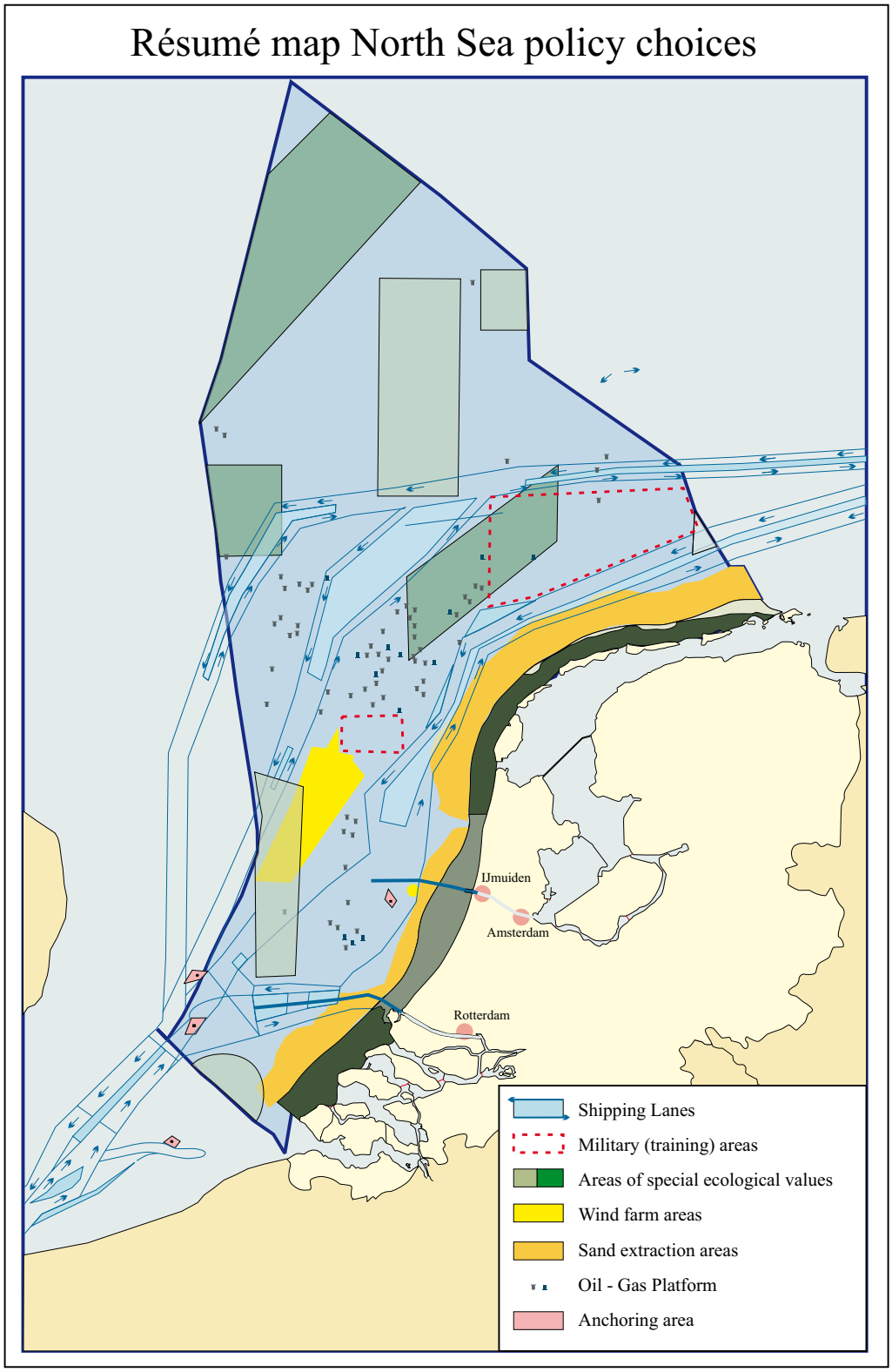
Summary

The coast and territorial waters of the Netherlands form a part of the southern North Sea. The area is intensely used and for several of these uses considerable growth is forecast. This might lead to increasing conflicts with the environment and was the main reason for developing a vision for spatial planning. This has led to an Integrated Management Plan for the Netherlands' North Sea, agreed by Parliament in 2005 and embedded in the National Land Use Planning Act (2008). In national spatial planning, the land and sea are no longer separate entities. The Integrated Management Plan for the North Sea is based on zoning of the functional uses. A number of usage zones are identified with a considerable flexibility in developing initiatives. In the mean time, a system of permits and tools to manage the use of space has been put in place.

The introduction of a new spatial planning framework in 2009 was a response to the increasing interest in new activities in the North Sea, which included the development of offshore wind farms, which would not interrupt the busy navigation routes. Furthermore, there was a growing demand for establishing a framework for governmental coordination of these developments.

This integrated policy is needed to safeguard the economic and environmental services of the Netherlands part of the North Sea for future generations.

Contents



Resume map North Sea – National Spatial Strategy, 2009 :
displaying some selected uses.
(source: Policy document on the North Sea 2009 – 2015, December 2009; adapted)

Wind farm in the North Sea, *20 miles west north west of IJmuiden. The sustainable wind energy plans for 6,000 Megawatt of wind turbines require by 2020 at least 1,000 km² space. Integrated marine spatial planning provides clarity for the development and it prevents conflict of uses: the development of the wind farms without disturbing the busiest navigation route of Europe. (photo: //beeldbank.rws.nl, Rijkswaterstaat, Sander de Jong)*

River pollution and coastal sediment quality

Reducing river pollution increases sediment quality

Remi Laane and Jos van Gils *(Deltares, the Netherlands)*
Robbert Misdorp
Kees Kramer *(Mermayde, the Netherlands)*

Summary

Pollutants affecting the Dutch coastal zone mainly come from point and diffuse land-based sources. Transport to the sea is largely by rivers where the chemical compounds adhere to clay and silt particles. In the past there have been damaging effects on the environment. National and international efforts to reduce the contaminant levels of the rivers Rhine, Meuse and Scheldt have been successful, in the last two decades of the last century. This decreased polluting load resulted in a strong reduction of concentrations of chemical compounds in coastal sediments. Reductions have been observed in the load and concentration of metals, PCBs (Poly chlorinated biphenyls) and in PAHs (Polycyclic aromatic hydrocarbon). The total nitrogen and phosphate loads were also reduced.

River basin management has been successful in contributing to the cleanup of rivers. The struggle to reduce contamination involved a successful, dual track policy:

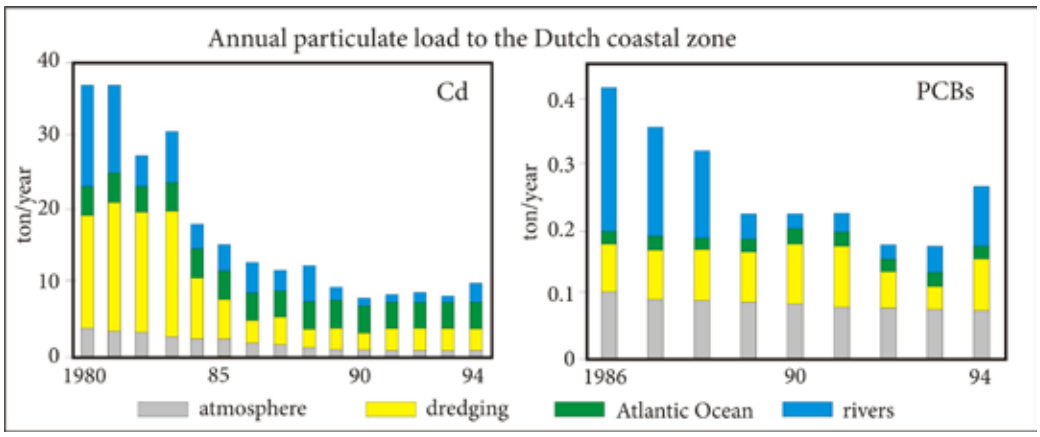
- National efforts: to clean Dutch own sources and
- International efforts: to reduce the upstream emissions through long term, ministerial conferences and negotiations between the riparian countries of the river basins.

The basis for these negotiations was frequent and systematic monitoring and setting of pollution standards by scientists in close cooperation with the policymakers, in the river basins. The benefits, especially for the low-lying areas of the Netherlands were improved water and coastal sediment quality. This contributed, for example, to the improvement of the seal reproduction in the Wadden Sea (the Dutch, German and Danish intertidal area with its tidal channels and creeks).

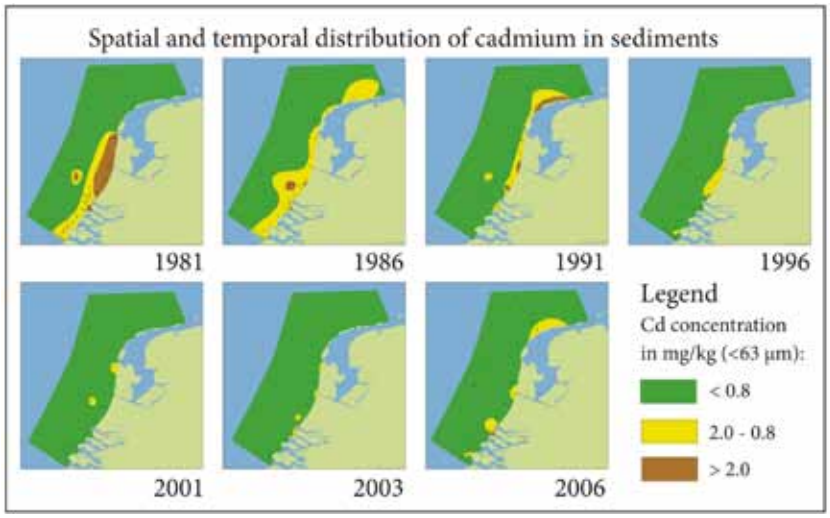
The chemical compounds in the Wadden Sea sediments followed the same trend then those off the Dutch North Sea coast. However, a time lag between the cleaning of the river sediments and the decrease of pollutants in the top layers of Wadden Sea sediments, is observed. Possible mechanism to explain this are that bottom dwelling organisms, such as lugworms, and storms, mixing the deeper and more contaminated layers with the less polluted surface sediments freshly deposited. The released, resuspended polluted particles are transported further east into the Wadden Sea.

The spectacular cleaning of river, North Sea and Wadden Sea sediments, shows that meticulous cleaning of the sources of pollution, monitoring, international negotiations and cooperation benefit all the riparian countries.

Contents



Reduction in pollutant load to the Dutch coastal zone, during 1980 -1994: *Annual particulate load in ton/year of Cd (cadmium) and PCBs (Poly chlorinated biphenyl) from various sources to the Dutch coastal water during the years 1980-1994. (from Sonneveldt and Laane, 2000)*

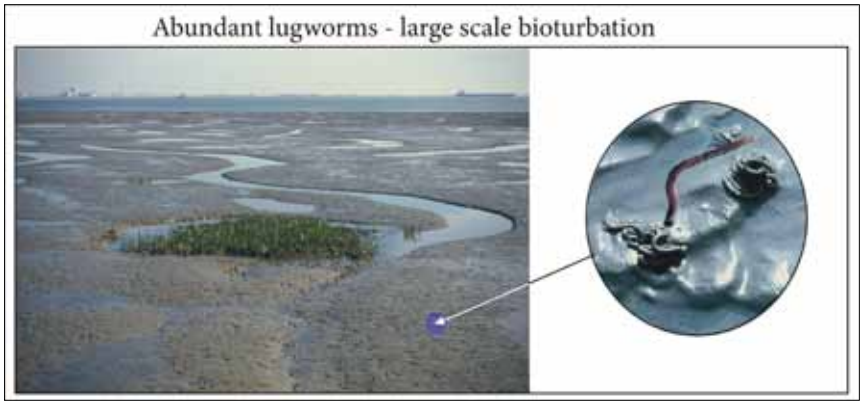


Spatial and temporal distribution of cadmium (Cd) *in the surface sediments (grain size fraction <63µm) in the Dutch coastal zone illustrates a strong reduction of Cd in the North Sea coastal sediments. (from Hegeman and Laane, 2008)*

Serious warning during the 1980s... Cleaning-up is needed:

Foam *of massive dying algae along the Dutch coast, related to high level of nitrogen and phosphate in Dutch coastal waters.*
Liver cancer *in the North Sea flounder. (Platichthys flesux L.)*

(photo: Harry van Reeken) *(photos: Dick Vethaak)*



Abundant pier piles *in the freshly accumulated sediments of the Wadden Sea intertidal flats, indicating large scale bioturbation activities, which also contribute to the retardation of the "cleaning-up" process. (photo: // beeldbank.rws.nl, Rijkswaterstaat)*

The Netherlands: challenges for the 21st century

Marcel J.F. Stive *(Delft University of Technology, Delft the Netherlands)*
Mark van Koningsveld *(Van Oord, the Netherlands)*
Robbert Misdorp

Sand-nourishment along the Netherlands coast: *a flexible answer to coastal erosion, a viable protection measure, now and for the future with uncertainties about the rate of accelerated sea level rise, and in the meantime sand nourishment schemes increase the resilience of the coastal zone. (photo: Van Oord)*

Summary

Dealing with the challenges posed in the 21st century requires a paradigm shift in the approach to water and coastal management. This shift is needed to implement some of the far-reaching recommendations of the Second Delta State Committee (2008). It uses an integrated approach to planning with cross-sectoral strategies based on the two pillars of safety and sustainability. This vision helps strengthen the principle of 'Working with nature' for future flood protection in coastal environments.
Since 1990 annual sand nourishment, using this principle has become standard practice in the Netherlands. It is an economically viable way of protecting the mainly sandy coastline. It increases coastal resilience and provides a flexible response to the uncertainties of future sea level change.
A high rate of sea level rise of 1.3 m by the year 2100 has been taken as a worst case scenario. Sea level rise will increase the frequency of flooding, coastal erosion and salt water intrusion.
The Second Delta State Committee also developed a vision beyond 2100 for water management covering the entire country. Such a long-term vision will help prepare Dutch society for the increasing flooding risks associated with the impacts of climate change. In addition to the increased risks of flooding and coastal erosion, increased salt-water intrusion will threaten future drinking water supplies, and horticulture, agriculture and industry.
Combating these impacts is achievable using integrated solutions, such as significantly increasing the fresh water storage by raising the level of our largest fresh water lake and the surrounding dikes. This also combats salt-water intrusion and provides greater safety against flooding.
Long term, adaptive measures need special institutional arrangements and reserved funding.
The key to future prosperity for the inhabitants is to develop comprehensive management plans for the catchment, rivers, coast and sea - a challenging vision.

Contents

Adaptive measures *under the Delta Programme of the Second Delta Committee: Rivers, lakes, sea and coast, with coherence between the regions and combined in an integrated vision with concrete measures safeguarding livelihood for the future generation.*

A winter storm eroding the beach and dune foot, *in summer time the coastal zone accumulates again, however the yearly net sediment balance along the Netherlands coast over the long term is negative: i.e. there is more erosion than accretion. The rate of erosion and the risk of flooding will increase considerably with the anticipated impacts of climate change. There is a need for timely additional, flexible adaptive coastal and water management measures. (photo: //beeldbank. rws.nl, Rijkswaterstaat/Jan van der Broeke)*

Conclusions - the Netherlands

The Netherlands, being for the greater part a densely populated and highly developed low-lying delta, is extremely vulnerable to flooding, erosion and salt water intrusion. The impacts of climate change will aggravate these problems. In order to survive, coastal zone planning and implementation is embedded in the Netherlands' history and will remain so. Historically the emphasis has been on protecting the land from flooding. With vision, ingenuity and leadership many difficult projects were undertaken. In the last few decades, the concept of coastal protection has broadened to include aspects of integrated spatial planning and sustainable development. Consequently, the Netherlands has become a fertile 'environment' for ICZM development and application, as can be illustrated by the following examples.

1. A number of very large-scale flood protection works (dams and storm surge barriers) were built in the second half of the last century. Today flood and erosion protection is based mainly on managing the sediment budget of the sandy coast. Over many decades, a thorough understanding has been developed of morphological processes and sediment movements along the coast, based on extensive monitoring programs. This facilitates the implementation of a flexible and resilient sand nourishment scheme at acceptable costs. Cooperation was established among public and private bodies, based on vertical and horizontal integration.
2. The sustainable development of the Greater Rotterdam Harbour Area provides a very specific example of the application of integrated coastal planning. This involves a wide variety of aspects related to land use-planning, economic development, environmental protection and sustainable use of resources, all based on integration of regional development plans. These plans were legally founded at national level. The path to achieve the sustainable harbour development through long term cooperation was sometimes quite cumbersome. But the time and money invested certainly pays off, both economically and environmentally
3. From the seventies onwards, the impacts of severe chemical pollution of river and coastal waters and sediments became clear through frequent monitoring and field observations. In the decades that followed, there were extensive national and international efforts to reduce these problems. These efforts resulted in a spectacular improvement of water and sediment quality in the coastal system.
4. More recently there has been a focus on integrated spatial planning of the maritime and terrestrial parts of the wider coastal zone. This has led to an Integrated Management Plan for the Netherlands' North Sea, agreed by Parliament in 2005 and embedded in the National Land Use Planning Act (2008). It is based on zoning functional uses, such as marine wind farms. Although this plan controls and restricts certain uses, it provides more clarity on sustainable development potential and commercial use options, enhancing economic development opportunity and continuity.
5. Considering long-term future developments, the pressures of socio-economic development and the impacts of climate change pose a serious challenge to the Netherlands. The long-term consequences of possible future strategies to deal with these problems have been considered by the Delta State Committee (2008), which has proposed a comprehensive set of actions. These include flood protection, water management and spatial planning with a time horizon of a century. Moreover, the Committee has urged the Cabinet of Ministers to develop a plan for the long-term implementation and financing including the establishment of a legal and political framework. The government has adopted the proposals of the Committee and has taken active steps for their implementation.

To find solutions to meet the future challenges, vision and ingenuity is needed. The central government will demonstrate its leadership in promoting innovative adaptive response strategies, by using the experience gained in protecting life and property, during the long period of developing and living in the Dutch Delta. Finding solutions to the enormous challenges facing us can be applied to other vulnerable coastal areas in the world.

CCC Part I - Chapter 3: Romania

ICZM planning in an initial stage

CCC Part I – Chapter 4:

Introductory Statement - Romania

Ana Lucia Varga

- *State Secretary, Romanian Ministry of Environment and Sustainable Development, (2004-2008)*
- *Chair of the Romanian National ICZM Committee (2005-2008)*
- *Member of the Romanian parliament (2009-)*

Many valuable resources are concentrated in the Romanian Black Sea coastal zone. This makes the area attractive for living, working and recreation, with substantial economic and environmental value. There are two different sectors, the northern Danube Delta Biosphere Reserve and the southern economic zone.

The Romanian coastal area is under pressure from increasing population growth, urbanisation, marine transport, coastal erosion and pollution. As a result, the natural resources are adversely affected resulting is a deteriorating natural landscape, declining water quality and damage to sand dunes and dune vegetation, as well as to marine ecosystems.

Therefore, Romania began implementation of the EU Directives and Recommendations relevant to the coastal zone. The Government created a legal basis for Integrated Coastal Zone Management (ICZM) through the national ICZM Law (2003). Furthermore, the creation of a National Committee for ICZM provides a consultative group having responsibility for coordinating coastal zone management activities. Romania developed a draft ICZM Strategy, in line with the EU ICZM-Recommendations (2002) and EU Water Framework Directive (2000), as a part of a Dutch supported programme.
The National ICZM Strategy will contribute to the sustainable management and development of the Romanian coastal area. At present, this Strategy is under stakeholder consultation. This includes enlarging public support for the implementation of ICZM. The settlements are also in urgent need of a comprehensive infrastructure rehabilitation programme.

In conclusion

Although Romania has only recently joined the EU and still has a long way to go to increase its economy to the EU average level, it recognises the importance of the coastal zone and the need for integrated management for its future development. We also recognise that the increasing effects of socio-economic pressure, exacerbated by the impacts of the anticipated human induced climate change, may increase conflicts between development and the environment. We are therefore looking for ways to manage these pressures, whilst using our valuable resources in a sustainable fashion. The comprehensive nature of an ICZM approach provides a management framework for addressing present and future coastal challenges. We will continue to improve the ICZM process. Integrated physical planning in the Romanian coastal zone is one of the legally binding instruments used. Cooperation between Romanian Ministries, provincial and local authorities, applied scientific institutions and local stakeholders will be improved and focused on achieving a balance between necessary economic development and ecological sustainability. The lessons learned in other countries can be useful to Romania and vice versa. It is therefore with great pleasure that we contribute to this CCC-Production, which seeks to improve coastal cooperation through the exchange of international information and experience.

Integrated coastal zone management in Romania

Claudia Coman *(Black Sea Coastal Centre)*

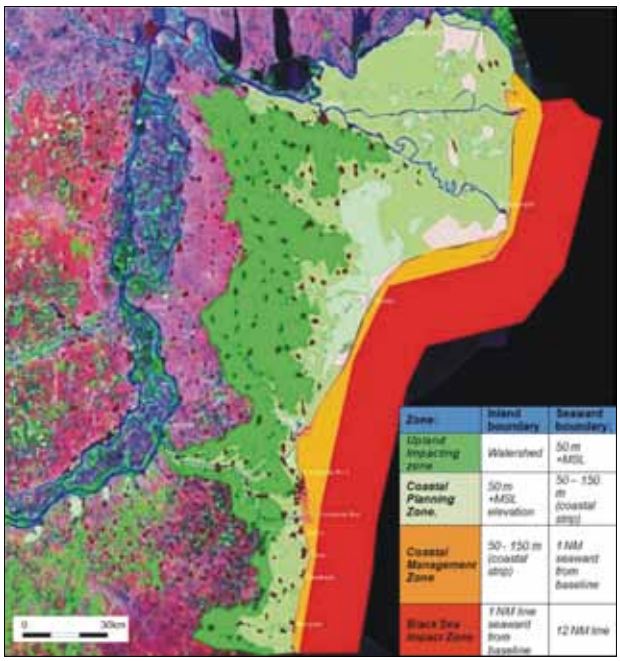
Constanta: *the largest Black Sea harbour city and its coastal zone. (photo: Claudia Coman)*

Summary

The Romanian government has adopted the ICZM Law in 2002 and established institutional arrangements. The Ministry of Environment and Sustainable Development is responsible for water and coastal policy development and chairs the high-level national ICZM Committee.
A preliminary ICZM Strategy is drafted. Stakeholder consultation is a part of the coastal management process. The value of integrated spatial planning in the terrestrial and marine Romanian coastal zone is recognised.
The first steps of the ICZM cycle, dealing with the planning phase have taken place.
To facilitate the next steps relating to the implementation of coastal measures, the ICZM Strategy and accompanying Action Plans need to be incorporated into law. Integrated spatial planning of the coastal zone, including the marine part, may be an important legal instrument. In this respect, the Romanian results within the EU Plancoast project connecting the maritime spatial planning with that of the land, can be considered as a first step of integration within the frame of the traditional Romanian spatial and urban planning.
Furthermore, coastal monitoring capabilities, dissemination of coastal data and information are to be strengthened and a few ICZM pilot projects will be undertaken.
International cooperation within an EU context and in the framework of bilateral aid, sharing knowledge and experience, is of great help in the development of the Romanian ICZM programme and in the preparation of adaptive coastal responses.

Contents

Constanta, the largest port at the Black Sea, surrounded by intensively used coastal plain. *Constanta county: the harbour, city, Danube-Black Sea canal, agriculture grounds, coastal lakes and beaches.*
(photo: Digital image taken by STS-112 crew: 17-10-2002, NASA)



Demarcation of the coastal zone in Romania: a first step in the ICZM process
(source: Romanian ICZM Strategy – Outline, 2005)

The pristine coastal zone of the Danube Delta *bordered by beaches with a rich variety of natural resources, lakes such as Lake Razelm and Golovita and with a few coastal settlements such as Sulina and Sf Gheorghe.*
(photo: C. Coman)

The Danube Delta: back to nature through international cooperation

Adrian Stanica *(GeoEcoMar, Bucharest)*

Danube Delta, *Northern river channel to Chilia-Veche. (photo: Robbert Misdorp)*

Summary

Since the second half of the XIXth Century, the Danube Delta has suffered significant changes as a result of human interventions. In order to solve navigation problems at the river mouths – and straighten the waterway, humans expanded and intensified their actions, which altered the natural state of the delta. The most significant changes were made during communist times, when the survival of the delta itself was threatened. The change in the political regime has fortunately reversed this type of human intervention.

After establishing the UNESCO Danube Delta Biosphere Reserve (DDBR), there have been large scale and long term international projects undertaken for the restoration of the natural state and equilibrium in the delta. The Netherlands provided assistance in monitoring the biological, chemical and physical processes supporting the management of the DDBR Administration. Spatial planning in the delta, zoning, including the creation of buffer zones and strict management have been effective tools for restoration.

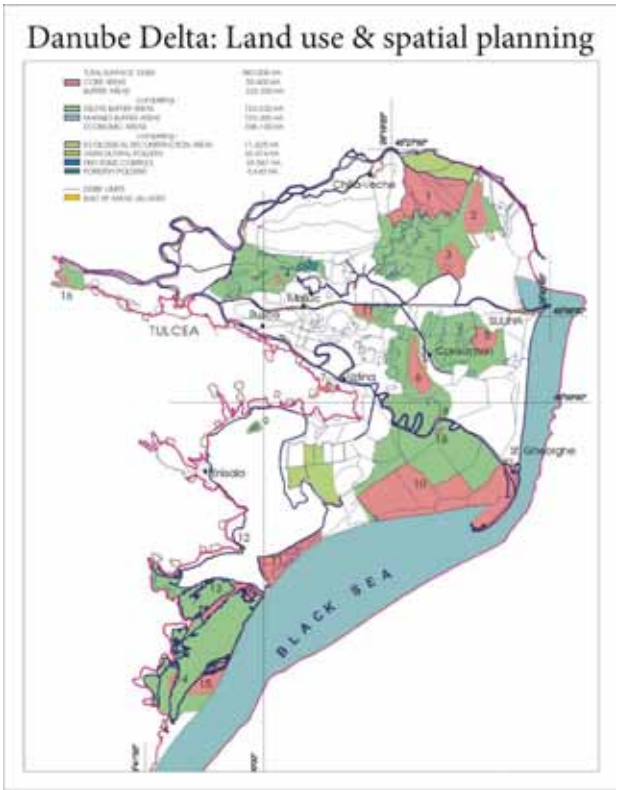
The delta coast suffered from and still endures coastal erosion due to human intervention.

New concepts of coastal dynamics, such as coastal sediment circulations cells, increase insight into coastal erosion processes and contribute to finding adaptive solutions.

Large-scale international cooperative projects have brought best practice knowledge to the assessment of coastal processes, ICZM plans and adaptive responses to global changes.

Contents

The Danube Delta Coast.
Introducing the concept of coastal sedimentary cells (in orange: the southern cell and in yellow: the northern cell) along the Danube Delta coast between Sulina and Cape Midia contributes to finding adaptive responses.
(EU projects: EUROSION and CONSCIENCE).
Better understanding of coastal processes provides more sustainable solutions.
(source: Ministry of the Environment and Forest)



Land use map and spatial planning of the Danube Delta Biosphere Reserve. *The reserve (580,000 ha) is delineated by the red line. Spatial planning is an important tool for integrated management and sustainable development of areas; it provides a coherent view valuable for addressing future global change. The main areas identified are :*

- *Pink/red – strictly protected areas (nature sanctuaries).*
- *Green – buffer zones.*
- *White – traditional economic use areas (for fisheries, reed harvesting, eco-tourism).*
- *Light green – areas in need of ecological reconstruction.*

'The marine part of the Danube Delta coastal zone is also considered as a buffer zone.' (source: Danube Delta Biosphere Reserve Administration, www.ddbra.ro)

The southern Danube Delta coast - highly dynamic: *a tornado approaching the Razim spit between Sf Gheorghe and Cape Media, a phenomenon that may occur more often in the future. (photo – near the former outlet of Lac Razelm: © Laur, Google Earth, 2007)*

Conclusions - Romania

As one of the more recent EU member states Romania is in a process of rapid economic development, increasing the pressures on its valuable resources in the Black Sea coastal zone, including the Danube Delta. Romania has recognised the importance of the coastal zone for its present and future development. It is aware of the threats imposed by uncontrolled socio-economic development and the impacts of climate change. As a result, Romania has undertaken a number of essential first steps in the ICZM process. Examples of recent achievements include:

1. Following the EU recommendation, the Romanian government has adopted the *ICZM Law in 2002;*
2. *Based on this law, a national, high level ICZM Committee* was established in 2004, chaired by the Vice Minister of Environment and Sustainable Development;
3. *A draft ICZM Strategy* (2007) including action plans was developed and is in the process of stakeholder consultation and should become part of the ICZM Law;
4. Within the framework of EU regional cooperation and specific bilateral arrangements, a variety of *coastal projects to support ICZM efforts* are being prepared: strengthening the management capabilities, the development of the data management infrastructure and the identification of coastal protection measures;
5. *Integrated spatial planning* of the wider coastal zone is an important legal instrument, which should be applied to ICZM in Romania. Within the framework of the EU-PlanCoast project (2008) maps for the use of the entire coastal zone (marine and terrestrial) have been produced, which are presently under consultation.

Danube Delta shore. *(photo: Claudia Coman)*

From early 1990 onwards, specific attention was paid to restoring and conserving the sensitive Danube Delta area, which at the end of the communist period had been brought to the verge of destruction through ongoing unsustainable developments. The realisation by Romanian scientists and policy makers, that the Danube Delta was one of the most valuable, surviving deltas of Europe resulted in the establishment of the Danube Delta Biosphere Reserve (DDBR) in the early 1990s, under the auspices of UNESCO. The DDBR-Administration, responsible for the management of the delta, focussed on restoring and maintaining a natural equilibrium and was internationally supported e.g. by the Netherlands. The DDBRA's activities have focused on:

- Monitoring and developing knowledge of the natural and socio-economic deltaic system, including the establishment of the Danube Delta National Institute for Research and Development;
- The spatial planning of the DDBRA territory, with strictly protected areas and areas of economic use separated by buffer zones;
- The sediment management in the coastal zone of the delta area in order to control coastal erosion.

From the above it follows that Romania has taken a number of important steps in the ICZM process. However, quite a number of critical aspects are still to be addressed in the further development and implementation of ICZM. These include the incorporation of the strategies and action plans in the ICZM Law and the strengthening of coastal monitoring programs, mechanisms for data exchange and dissemination of information to stakeholders. Successful international cooperation should be continued to strengthen the relevant Romanian institutions addressing the impacts of climate change and improving the management and quality of the coastal zone e.g. coastal towns and beaches, attracting foreign tourists in a sustainable way.

Synthesis - CCC Part I: EU, the Netherlands and Romania

ICZM progress and achievements

Gerrit Baarse and Robbert Misdorp

Dutch coast: *Wide beach at low tide. (photo: Simon Werner)*

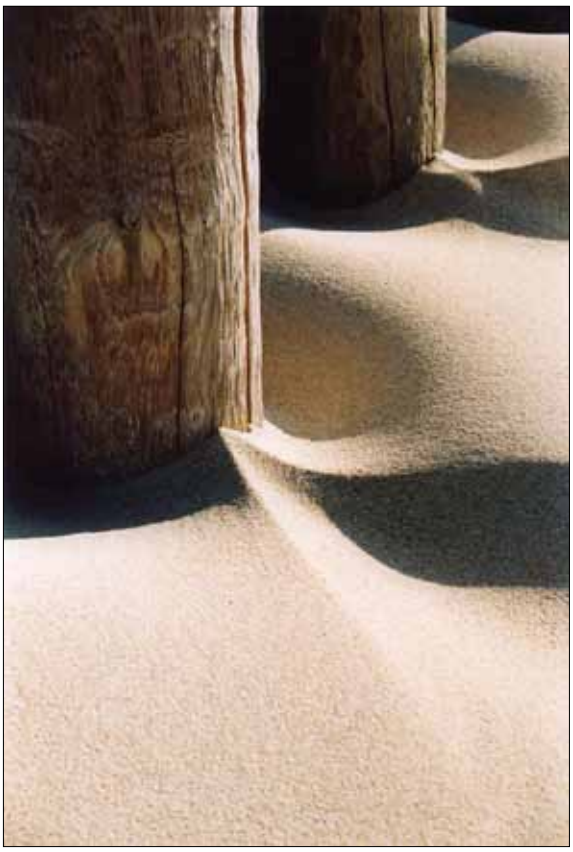
In the last 20 years, **the European Union** has developed a leading role in ICZM, covering the full range of activities from problem recognition to evaluation, including both a top down and bottom up approach. The results of these efforts can be seen in a number of ways:

- By *triggering ICZM* in many EU countries with an increase in the general awareness of the drawbacks of unsustainable coastal development and the impacts of climate change on low lying coastal areas; the general adoption of ICZM principles; and the incorporation of ICZM in national and regional planning procedures;
- By *developing* ICZM knowledge and capabilities, and exchanging experiences between countries at different administrative levels and with local stakeholders.
- By *applying* ICZM principles, through the participation of coastal countries, at all levels (including regions and local communities) in the planning and implementation of coastal management strategies and activities.

ICZM at the EU level, and in most European countries has become very important and includes active participation of NGOs. The latter play valuable roles ranging from dissemination of knowledge on coastal systems to daily management of coastal areas.

From historic perspective, **the Netherlands** has been very active in the field of coastal protection. In the last few decades, the development of the concept of ICZM has led to a large number of tangible results. These relate to a variety of complex problems, common to many coastal areas in the world. The examples in the Netherlands show that it is

possible to overcome serious and complex coastal problems using an ICZM approach, although this may require considerable, long-term efforts. Major innovative achievements improving the development of the delta include the execution of resilient, sand nourishment schemes; the sustainable development of the Greater Rotterdam harbour through integrated planning; the spectacular improvement of water and sediment quality through clean-up measures in the river basins; and the establishment and implementation of a zoned North Sea Management Plan. The recent adoption of a long term strategy and its institutional arrangements is an important step addressing the serious, anticipated impacts of climate change.



(photo: Simon Warner)

In **Romania**, the Danube Delta was the first area to be protected, because of the increasing awareness of its critical state in the early nineties. Although Romania has only recently joined the EU and still has a long way to go to increase its economy to the EU average level, ICZM was recognised as an important mechanism, for managing socio-economic activities and addressing coastal problems such as erosion and impact of climate change in a holistic way. The process of becoming an EU member state resulted in a broadening and intensification of ICZM activities. During this period, a number of steps were taken towards establishing ICZM in Romania. International cooperation was a very important factor in the development and implementation of ICZM activities and projects. However, the ICZM process in Romania has only just begun and many potential obstacles, problems and challenges are still to be faced before it is fully implemented. In this respect, a number of other countries have already taken further steps in providing a wealth of knowledge and learning experiences. The further development of ICZM in Romania will look to the exchange of experience with other countries and cooperation through international projects and programmes.

Danube Delta coast: *coastal retreat and salt water intrusion affecting coastal vegetation. (photo: Stefan Constantinescu)*

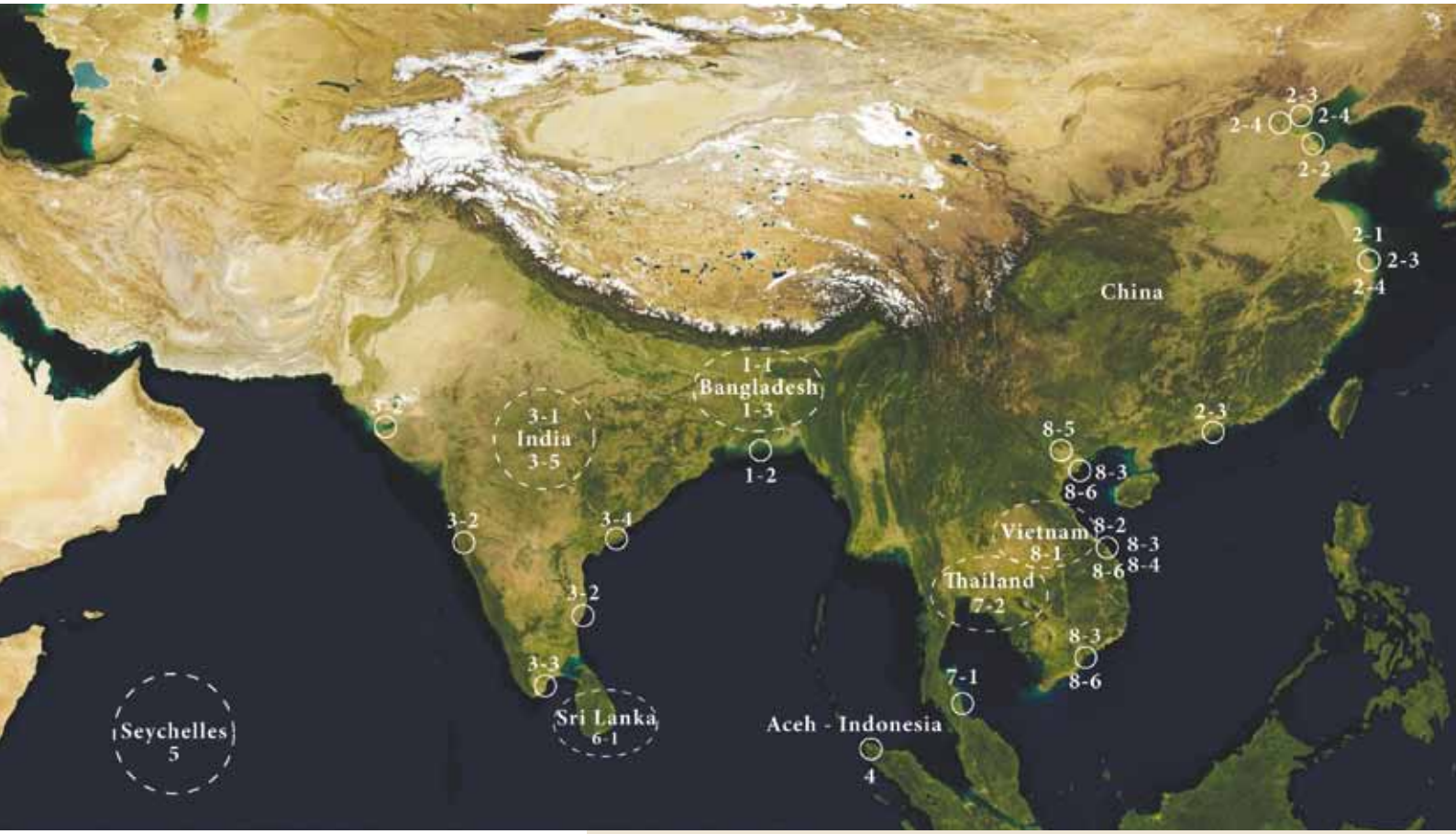
CCC - Part II

Coastal Cooperation in Asia and Island States

Introduction: Coastal Cooperation in Asia

Asia: a highly dynamic continent with a valuable and vulnerable coastal zone

Robbert Misdorp



Asia: *high mountain ranges, long coastline bordered by large oceans, highly dynamic, valuable coastal resources and vulnerable to global change;*

Geographic distribution of the CCC Part II cases:

Legend:

3 - 1 : indication of the CCC Part II Chapter

◯ *: CCC cases*

⬭ *: CCC national/regional ICZM efforts.*

(source- satellite image: NASA)

Asia contains the highest mountain range in the world, the Himalayas. This is the birthplace of several large rivers: the Yellow River, Yangtze, Mekong, Irrawaddy, Ganges, Brahmaputra and the Indus. These rivers provide the lifeline for more than two billion people.
Asia, the most populous continent in the world is highly dynamic.

Rapid socio-economic development, river dynamics and cyclones annually battering the coast, all contribute to a highly dynamic character of the coastal zone.
Moreover, the rate of atmospheric warming in the Himalayas over the last few decades is unprecedented. The glaciers in the Himalayas are highly susceptible to melting and accelerated shrinkage, due to the combination of high altitude and low latitude.

Almost two third of the world population lives in Asia, but the available coastline in Asia is only about a quarter of the total length of the world's coastline!

The migration of many millions of people has made the Asian coastal zone a very densely populated area, probably the most densely populated in the world. With this has come rapid coastal urbanisation. This zone is not only crowded but also economically highly productive.
The Gross Domestic Product of Asia already rivals the GDP of the other two major world economies namely Europe and North America. China recently became the second biggest economy in the world. Out of the five largest harbours by cargo volume in the world, four are located in Asia and one (=Rotterdam) in Europe. Marine Asian fish yields have grown rapidly and have become the largest in the world.
This rapid economic growth - illustrated by the large industrial output, harbour development, coastal urbanisation and fish production - is a sign of increasing wealth, and this helps to combating poverty. However, it comes at a price: increasing pollution, competition for space, and declining fish stocks, to mention but a few examples.

The factors associated with economic growth put considerable pressure on the environment and particularly on the coastal system. These pressures hold especially in Asia, where the anticipated impacts of climate change will exacerbate these pressures. PEMSEA (Partnerships in Environmental Management for the Seas of East Asia, Manila) is one of the Asian based organisations which, for many years, has focused on addressing these pressures. It supports scaling up ICZM programmes - to realise an on-the-ground national framework for achieving sustainable development of coastal lands and waters - as well as twinning arrangements for River Basin and Coastal Area Management in several Asian countries. (www.pemsea.org)
In the beginning of the 1990s, within the framework of United Nations Framework Convention on Climate Change and Intergovernmental Panel on Climate Change, we produced the "Global Vulnerability Assessment" (GVA) encompassing 179 coastal countries. The GVA revealed that many Asian coastal nations and island states are highly vulnerable to an assumed 1 metre Accelerated Sea Level Rise (ASLR).
The main concerns derived from this assessment involve the 'People living in the coastal flood Risk Zone' and the 'Population at Risk' from annual flooding and the loss of food production, e.g. the rice production 'at Loss' (see CCC-III-2).
About two third of the world's 'People living in the Risk Zone' susceptible to flooding from the sea are located in Asia (Figure 1). The estimated, worldwide 'Population at Risk' of annual flooding will increase due to sea level rise, but population growth and coastal migration also play an important role (Table1).
Asia generates about 85% of the world rice production. With a 1 m ASLR, this rice production could decrease by as much as 4% if no adaptive measures are taken. Vietnam is the most vulnerable country in this respect and could lose 20% of its rice production. Overall, this could mean that about 75 million Asian people would face the loss of their main daily food source.

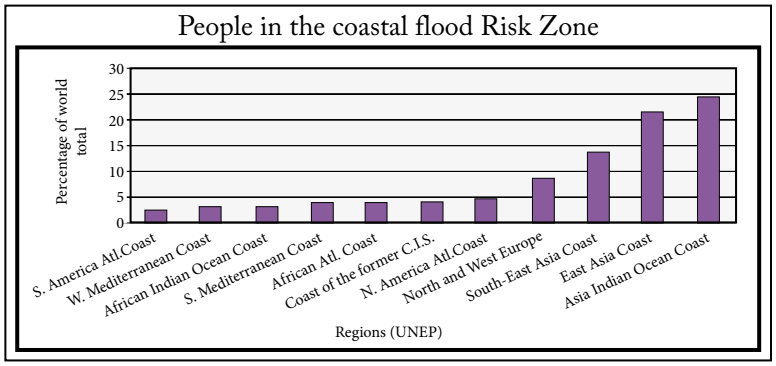


Figure 1: Distribution of People in the coastal flood Risk Zone among the Regions of the world. *(The nine other regions with 'People in the Risk Zone' < 2% are not shown; source: R.Misdorp, based on 1993)*

Table 1:	**People in Risk zone and Population at Risk along the world's coasts, in millions**	
Scenarios:	People living in the flood Risk Zone	Population at Risk of annual flooding
Base line year 1990	205	47
Assuming 1 metre Sea Level Rise (SLR)	260	60
Assuming 1 m SLR + 30 year population growth	395	100

(source GVA - Global Vulnerability Assessment, 1993)

Identifying and being concerned about these problems is one thing, helping to deal with them is another. Accordingly, the following step was to work together with Asian coastal countries, within cooperative frames such as, bilateral and multiple-lateral cooperation, the United Nations Framework Convention on Climate Change and IPCC.
In view of developments described above, it should therefore come as no surprise, that the focus of this CCC-Publication is on Asia.
The following CCC chapters on the Asian cases show how several countries are taking action to deal with the unsustainable overuse of resources. This is particularly important in light of the anticipated impacts of climate change. Addressing these impacts requires coordinated activities such as the planning and implementation of ICZM programmes, cooperative efforts and adaptive, no-regret, resilient actions in the coastal zone.

Reference:

GVA – Global Vulnerability Assessment 1993: Vulnerability Assessment for Population, Coastal Wetlands and Rice Production on a Global Scale. Former Netherlands Ministry V&W, and Delft Hydraulics -Deltares. For basic information see: www.wldelft.nl/proj/pdf/3uk00074.scherm.pdf).

CCC Part II - Chapter 1: Bangladesh

Hazards, Vulnerabilities and ICZM, Institutions and NGOs

Introductory Statement – Bangladesh

Md. Abu Taher Khandakar
Director General, Water Resource Planning Organization,
Ministry of Water Resources,
Government of People's Republic of Bangladesh

It is a great pleasure for us to be associated with the Chapter on Bangladesh in the CCC Publication of Robbert Misdorp.

We all realise that climate change is becoming more and more a reality and Bangladesh will suffer heavily from its adverse impacts. The coastal area of Bangladesh is not only a vulnerable zone but also one of many opportunities. The coastal zone was badly hit by devastating cyclone "Aila" in 2009; some victims are still homeless and jobless. Increasing population, competition for limited resources, natural and man-made hazards, lack of proper economic opportunities, important ecological hot spots (Sundarbans, St. Martin Island) - are all issues that call for a continuation of the structured coastal management approach, particularly to address the negative, near-future impacts of climate change.

Considering this need, it is noted that with the support of the Governments of the Netherlands and the UK, the Ministry of Water Resources of Bangladesh through its macro-planning arm — "Water Resources Planning Organisation" — has already prepared the Coastal Zone Policy (2005), Coastal Development Strategy (2006), Integrated Coastal Resources Database (2006) and Priority Investment Programmes (2006) focusing on the vulnerabilities and opportunities in the coastal zone. We note with great satisfaction that our Government supported these efforts and activities by giving approval to all these documents in a timely way. Bangladesh is willing to carry out the next steps in implementation of the coastal policies, plans and programmes. However, these steps need strong support from the development partners to protect the people and fragile ecosystem of the coastal zone of Bangladesh.

In fact, international cooperation has played an important part in helping us to fulfil our commitment to the coastal community. We look forward to receiving further cooperation and assistance as a follow-up to the identified and initially analysed fields such as: "Vulnerability Assessment", "First Steps ICZM", "Estuary Water Monitoring", "Polderisation" and "Priority Investment Programmes". Renewed cooperation especially in the process of institutionalisation of ICZM, adaptation to climate change, strengthening of embankments, land reclamation and silt management are areas where assistance from others including the Government of the Netherlands is appreciated. Furthermore, development coordination is crucial for aid harmonisation and effectiveness. We whole-heartedly acknowledge the dedicated support of the Netherlands in the water sector in the past and wish that the bond of friendship for improving living standard of our most vulnerable people will always meet on common ground.

This Climate of Coastal Cooperation (CCC) publication will enhance the knowledge and understanding on the vulnerabilities of the coastal zone of Bangladesh to socio-economic developments, hazards and impacts of future climate change. The role played by the government agencies, development partners, NGOs, and communities is inspiring. Our efforts at implementing Integrated Coastal Zone Management (ICZM) to address coastal vulnerabilities will be helpful both for Bangladesh and for other coastal countries.

Bangladesh's Vulnerability to Climate Change

Start of the ICZM Process

Saleemul Huq *(International Institute for Environment and Development , London)*
Mozaharul Alam *(Bangladesh Centre for Advanced Studies (BCAS), Dhaka & UNEP, Bangkok)*

Erosion and flood havoc *About 85% of the total population of Bangladesh (more than 150 million inhabitants) lives in a rural environment, which is often very vulnerable to recurring hazards, particularly floods. (photo: BCAS)*

Summary

Bangladesh, flat and low lying, is one of the most vulnerable countries to present day extreme weather events. More than half of the population suffers annually from typhoons, river flooding and droughts. The changing climate adds a new dimension to the risks that threaten the lives and livelihoods of coastal communities, if no adaptive measures are taken. A Vulnerability Assessment (VA) was meticulously carried out according to the IPCC VA Common Methodology in the beginning of the 1990s. Based on a business-as-usual socio-economic scenario and a 1 metre sea level rise it is predicted that more than three quarters of the total population will be affected annually by flooding. Sharing water resources with India is an important future adaptive option. Without it, almost the entire population will be affected by flooding and drought. Agriculture, in particular rice production, will be adversely affected by increased flooding and salt water intrusion. The salt water front will move inland by several tens of kilometres affecting one million ha of arable land and threaten the supply of drinking water of three major cities. Increased sea surface temperatures will intensify the tropical cyclone activity in the Bay of Bengal. The 2007 extreme Sidr cyclone affected a large part of Bangladesh and could be a foretaste of what is to come with a changing climate.

Bangladesh continues to develop its adaptation techniques sharing their knowledge with other vulnerable countries. The government and Non Governmental Organisations by working together, are setting a good example in how to analyse these vulnerabilities to a changing climate. Integrated planning of the vast river plains and coastal areas is one of the key ways of adapting to the changes brought about by climate change. A comprehensive ICZM programme resulted amongst other things in a Coastal Zone Policy and Development Strategy supporting practical measures such as zoning the use of coastal land and restoring mangrove forests. About 150,000 ha mangrove plantation have already been created. Balanced decision making in the coastal zone is facilitated by increasing knowledge of socio-economic and natural processes in coastal areas. One of the ICZM tools applied in Bangladesh is GIS in combination with remote sensing. CEGIS (Center for Environmental and Geographic Information Services) has been created and developed into an important national knowledge institution and a public trust.

However, much more needs to be done locally, nationally and within a framework of international cooperation to prepare adaptive river and coastal measures. The hesitancy to include findings from assessments of future climate related risks in coastal development strategies and programmes is a major constraint to achieving millennium development goals and preparing adaptive responses. The challenges are multi-sectoral, multi-dimensional and long term.

Contents

***Cyclone Sidr** in the Bay of Bengal : 14 November 2007 - one of the strongest cyclones recorded in the Bay of Bengal; 3,447 deaths were officially declared. The Cyclone Preparedness Programme including the improved warning system, facilitated timely and massive evacuation to many new shelters. (photo: NASA)*

(photo: Tjark van Heuvel)

(source: NASA Jesse Allen, 28-01-08)

***The Sundarbans forest** - a UNESCO World Heritage site, covers 10,000 km² (dark blue green coastal area on the satellite image) is the world's largest single belt of tidal mangroves. It provides livelihood and protection against storms. Large parts of the Sundarbans could be lost under influence of a 1 m sea level rise.*

The stimulating role of NGOs in Bangladesh

Mohiuddin Ahmad *(Community Development Library, Dhaka)*
Atiq Rahman *(Bangladesh Centre for Advanced Studies, Dhaka)*

Water for life *(photo: Mohiuddin Ahmad)*

Summary

Non Governmental Organisations (NGOs) act as windows on applied knowledge and provide links to sources of information. NGOs are active in all nineteen coastal districts in Bangladesh. Among the NGOs that work exclusively in rural areas, the greater numbers are involved in water and sanitation, closely followed by environment and forestry, fisheries and micro-credits, providing small loans.

Many NGOs deal with typical coastal issues, assist in solving local coastal problems and implement programmes among selected coastal communities. In recent years, the government has initiated several development projects addressing issues of coastal zone management and targeting programmes to enhance livelihoods of the coastal population.

A number of NGOs operate both at a national level disseminating coastal knowledge and promoting sustainable development as well as at local level, assisting coastal people to recover from the effects of a typhoon.

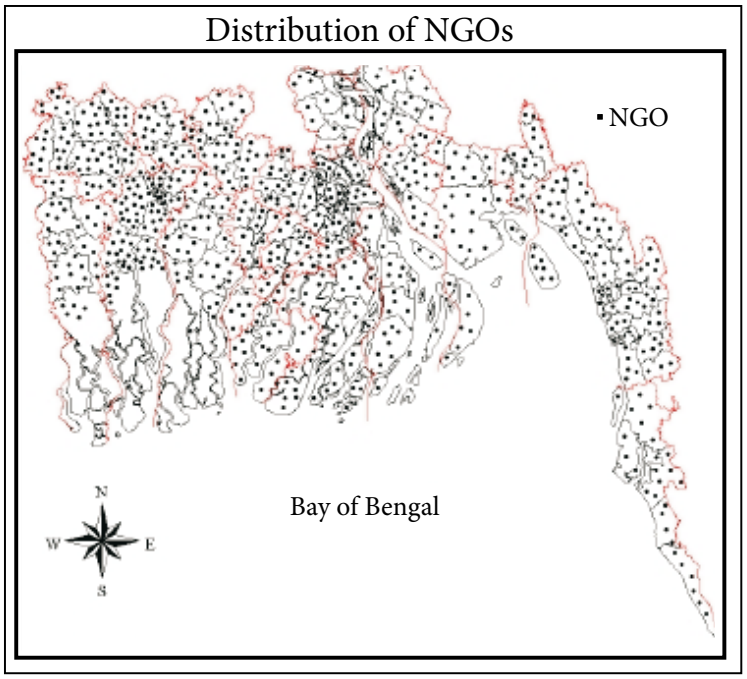
NGOs do have special capabilities that are essential for alleviating poverty and vulnerability that are amongst the objectives of ICZM. An important advantage is their efficiency and effectiveness in reaching out to the poor especially by channelling donor support towards them.

Different NGOs are acting at different levels and a growing number of NGOs play an important role in improving the living conditions of the poor coastal people.

National NGOs with a good overview of pressing coastal issues, can assist both in monitoring coastal processes and helping coastal inhabitants both before and after hazard events. An example is "Bangladesh Centre for Advanced Studies" (BCAS website www.bcas.net), which also acts as bridge between international and national coastal efforts for local people. BCAS is effectively disseminating knowledge on sustainable use of coastal resources (e.g. floating vegetable beds) and co-produced the valuable Bangladesh Vulnerability Assessment (see CCC II-1-1).

NGOs are also very valuable in providing a link between authorities and implementing organisations. The introduction of an overarching project: Coastwatch, can increasingly help civil society to integrate within the national and local development processes, as an important stakeholder. This may lead to greater awareness about coastal issues, better planning through stakeholder participation in media debate and promoting the voice and participation of the civil society.

Contents



***Distribution of NGOs** active in the 19 coastal districts, Bangladesh. (source: PDO-ICZM, 2005)*

Example 1 of the role of NGOs: Water for life

There is no well in this village of Shyamnagar Upazila in Satkhira district, as the groundwater is too saline. The pond is the only source of water and the water is filthy. Diarrhoea, dysentery skin diseases were common in almost every household. An affluent farmer has donated a 0.37-acre pond for community use. The pond was re-excavated and cleaned with support from Caritas Bangladesh and Sushilon, a local NGO. The incidence of water-borne diseases has dropped considerably. The pond is cleaned once in every three months, overseen by a five-member committee: the grammo shebok committee (rural volunteers' committee), which also looks after the maintenance fund. (photo: Mohiuddin Ahmad)

Example 2 of the role of NGOs: Adaptation to climate change – Floating vegetable beds

Flood and water logging is a common problem in Bangladesh. A vast area of Bangladesh is situated two meters below mean sea level, affected by high tides. Climate change will aggravate the problem in the future. Evidences of adverse impacts are now already visual. The main impacts are on the livelihood of people in terms of crop loss and food insecurity. The community has developed baira cultivation as an adaptation strategy to reduce their vulnerability. BCAS with local NGOs are providing training and material to local communities to improve the floating bed cultivation and to reduce seasonal food insecurity in the coastal villages, see CCC III-3-3-8. (photo: Atiq Rahmann)

Bangladesh's ICZM efforts in practice

Rafiqul Islam *(Manly Council, Australia)*

***Bangladesh in perspective**, its coastal zone squeezed between the forces of the mighty rivers and the sea, is low-lying and critically vulnerable to sea level rise.*
ICZM is recognised as an appropriate, adaptive coastal measure. The first phases dealing with coastal policy, strategy and spatial planning, were successfully completed. The transition to ICZM implementation needs to begin.

Contents

Summary

Bangladesh, over the last two decades, has successfully embarked on adopting ICZM approaches and related projects, supported by e.g. the World Bank and the Netherlands. A number of 'coastal success stories' in the beginning of the 1990s formed the basis for integrated and comprehensive coastal management. Between 2002 – 2006 a new stage in the ICZM cycle emphasising stakeholder participation, was reached. Great importance was placed on building cooperation between and among the many national institutions, local NGOs and communities.
These successful ICZM activities included the actually building of coastal cooperation, which is not easy and takes time.
A Program Development Office (PDO) for ICZM was established and a comprehensive knowledge base was built and disseminated in print and via a project website. The WARPO – hosted ICZM Plan site provides an overview of this valuable ICZM resource.
The Coastal Zone Policy and Strategy were adopted and many ICZM planning tasks were accomplished. The translation from planning to implementation started with the identification of series of distinct coastal projects.

However, since 2006, implementation of these projects has not taken place due to reduced funding, complicated project organisation and changes in governmental priorities.

Recently, the cyclones Sidr and Aila have again exposed the vulnerabilities of the Bangladesh coastal zone. With increasing population, declining natural resources and on-going and increasing impacts of climate change, sectoral planning no longer protects the coast as it has in the past. It has also resulted in unintended negative impacts including impeded drainage caused by polderisation and salinisation brought about by shrimp farming.

The ICZM approach not only helps mitigate the effects of disasters, but also provides opportunities for sustainable resource utilisation. ICZM in Bangladesh is not just for environmental or ecological gain but provides a survival strategy for millions living at the mercy of nature. Bangladesh has no other alternative.

The responsibility, still remains with the Ministry of Water Resources and the Water Resources Planning Organisation to lead and to nurture the gains made during the formulation and preparatory years of ICZM.

Conclusions - Bangladesh

Bangladesh is extremely vulnerable to the impacts of climate change due to a combination of factors. It is a low-lying and flat coastal plain, exposed to cyclones and flooding from major rivers. It is densely populated; and has very limited financial resources. International cooperation dealing with water management and coastal development is an important issue for Bangladesh. Particularly the cooperation with the Netherlands, in these fields was mostly successful and appreciated.

Most pressing problems are flooding, intrusion of saline water and seasonal drought. Bangladesh is actively adapting to present problems by building protection works and changing agricultural practices. However, much more needs to be done to cope with future challenges. Key issues in future coastal policy are: afforestation and forest preservation in coastal areas; planting protective mangrove belts; protecting ecosystems by zoning land use; restoring degraded lands; water-sharing arrangements between riparian countries. Most critical for implementation are awareness of climate impacts, understanding the measures required and limitations of available resources. Implementation of integrated coastal policy is limited. Actions are mostly driven by events such as cyclones and storm surges and based on historical knowledge rather than assessments of future risks.

In the last two decades, considerable efforts were made to adopt and implement the ICZM approach initially from the top down. There is a record of accomplishment of historic milestones in ICZM institutional development. Success stories include the polderisation of a substantial part of the coastal area, a massive plantation of forest and mangroves in coastal regions (including Sundarbans), building cyclone shelters (elevated structures of which more than 2500 were realised up to 2004) and the implementation of a low cost cyclone warning system, and producing a comprehensive ICZM knowledge base. In the mean time emphasis was successfully placed on building cooperation between and among the many national and local institutions, stakeholders, and communities to prepare coastal measures.
On the downside, a large number of policy and strategy directives have remained unimplemented, due to organisational and institutional difficulties. National focus and coordination could be strengthened. Further implementation of the identified, priority investment programme for the coastal zone can be considered as an efficient adaptive response option.
The central government, as one of the main partners, has a special duty ensuring the continuation of the ICZM process, raising funds and harmonising the international donor activities related to integrated water and coastal management.

NGOs are widespread in the coastal districts of Bangladesh, operating in a broad field (health, water and sanitation, credits, training and livelihood). The potential for NGOs to involve local communities in developing and implementing solutions at the grass root level is great and a key factor in coastal management. The ICZM concept has been introduced to the NGO community and was well received. Some NGOs combine their hazard relief activities with the creation of adaptive measures. With the support of the coastal villagers they help to create mangrove plantations, to develop floating vegetable beds, to construct clean water ponds or to introduce small solar energy units. Other NGOs are active in dissemination of knowledge to manage coastal resources in a sustainable way.
Although many successes were scored, the organisation and continuity of a number of valuable NGO activities faces challenges.

CCC Part II - Chapter 2: China

Rapid rate of change in the coastal zone

Shanghai: from 'Black and Stink' to clean Suzhou Creek

Peter JM Kerssens *(Deltares, the Netherlands)*
Chen Meifa *(Shanghai Water Authority)*

***The Black and Stink in Suzhou Creek** in the early 1990s. (photo: Simon Groot)*

Summary

Suzhou Creek flows through Shanghai, one of the world's largest mega-cities. During the 20th century, the creek fell victim to rapid urbanisation, swallowing most of the city's waste. In 1996 the 'Economic and Social Development Plan for Shanghai' was adopted, in which the rehabilitation of the creek formed an important component. Due to this 12-year plan to clean up the waterway, Suzhou Creek is no longer an embarrassing, stinky black river.

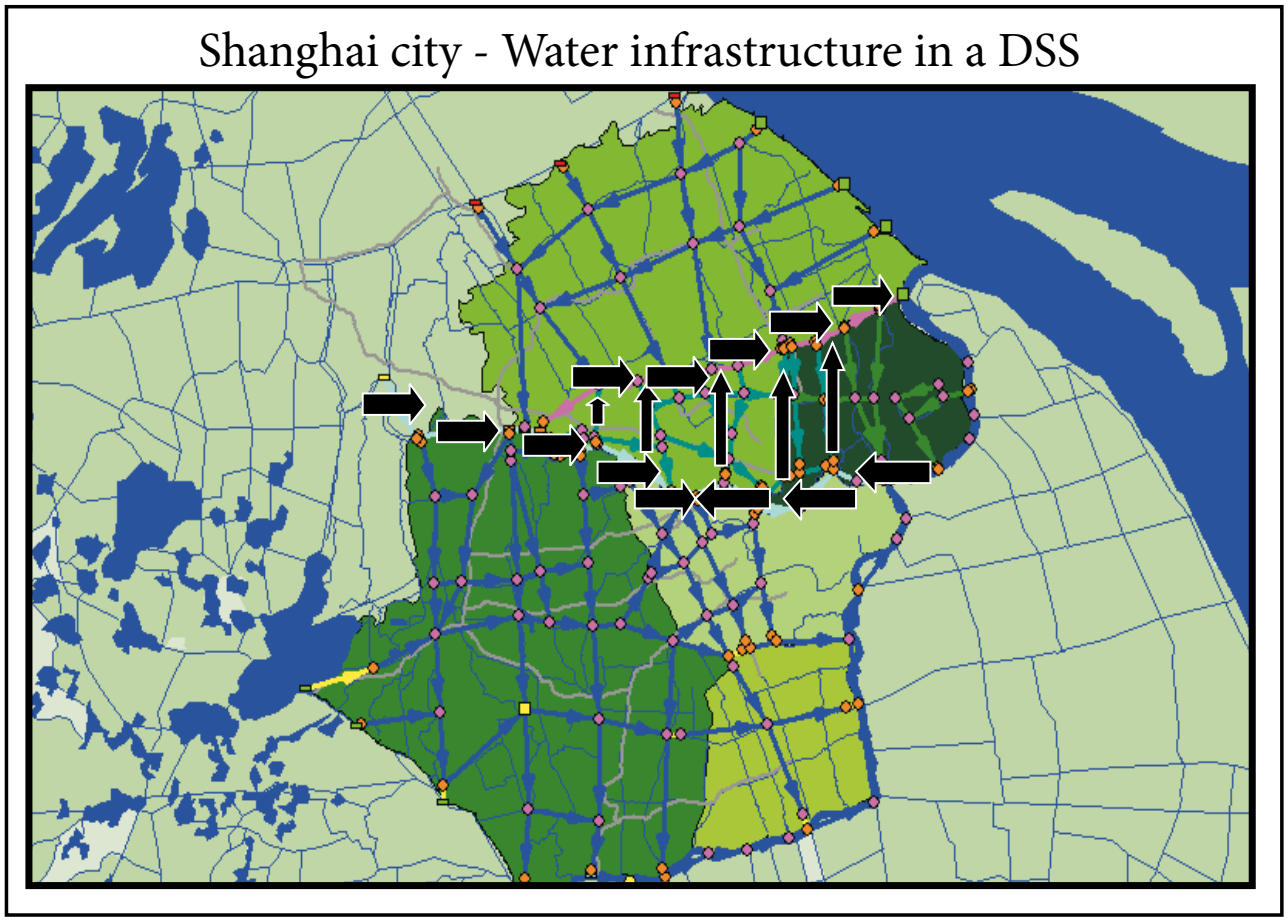
With a number of selected 'no-regret' type of projects, such as flushing, environmental dredging, re-aeration, and interception of wastewater, the Shanghai Municipal Government has been very successful in cleaning up Suzhou Creek .

Furthermore, measures were taken such as elimination of wastewater disposal, wastewater treatment, the relocation of solid waste processing wharves and embankment reconstruction. These different projects, planned in an integrated manner, substantially improved the water quality.

One of the major factors contributing to the success of the Suzhou Creek rehabilitation project has been the institutional arrangements of the project and particularly the willingness of the various relevant parties to cooperate. The formation of the Shanghai Water Authority from the bureaus of Water Resources, and parts of the Environmental Protection Bureau and the bureau of Urban Construction has strengthened the institutional arrangements.

The Shanghai Municipal Government has set a good example of cooperation in the field of water resources and coastal management, and effective decision making in order to enable implementation of such major projects in a relatively short time frame.

Contents



Output of the Decision Support System: *Combined tidal and upland flow flushing scenarios of the Suzhou Creek in relation to the water infrastructure of the entire Shanghai city.*

Renewal of Suzhou Creek *embankment and flood wall. (photo: Peter Kerssens)*

Yellow River Delta: Support for sustainable development

Leo de Vrees *(Rijkswaterstaat/Ministry I&E, the Netherlands)*
Wang Zheng Bing *(Deltares & Delft University of Technology, Delft)*
Marcel Marchand *(Deltares, Delft, the Netherlands)*

Yellow River Delta: fast rate of development *(source: photos: NASA Landsat 1997; Google Earth 2010: ©2011 Mapabc.com, © 2011 Cnes/Spot Image, Image ©2011 GeoEye, Image © 2011TerreMetrics)*

Contents

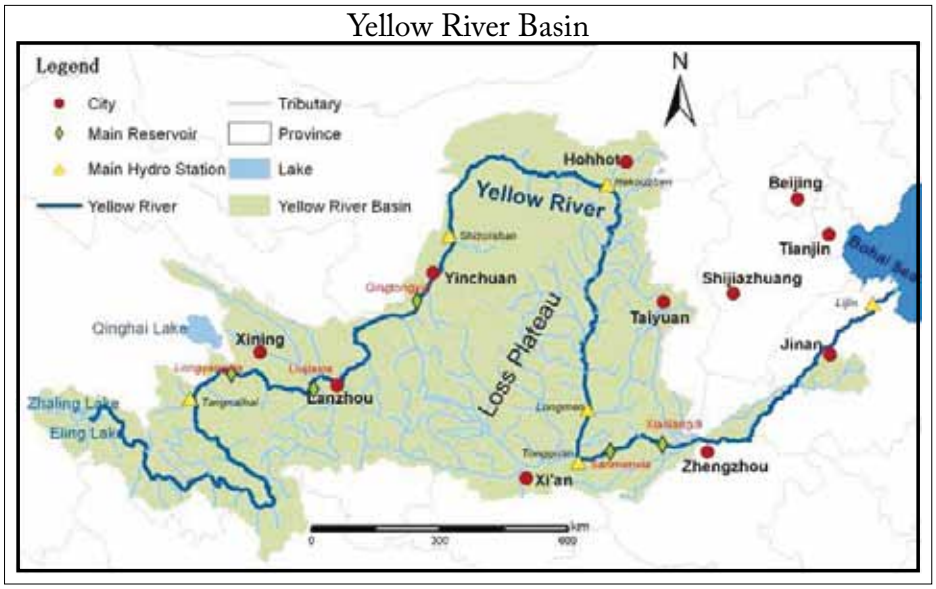
Summary

The environment in the Yellow River Delta (YRD) is under stress from large socio-economic pressures, leading to air, soil and water pollution. A Sino-Dutch project the Sustainable Development YRD project (1995 – 1997) was undertaken with the principle goal of contributing to the sustainable, long-term development of the Yellow River Delta. Objectives and criteria for sustainable development were defined.
One of the main project challenges was to show how to use the limited fresh water resources in a sustainable way. This was undertaken using integrated and analytical tools in which future developments and strategies were systematically analysed. Such an approach provides a strong incentive to begin communication and develop mutual understanding between the different responsible authorities and stakeholders.
Natural and socio-economic developments in a dynamic deltaic area are interrelated. This calls for an integrated approach whereby economic, environmental and social developments are balanced. The management of the river course in the delta should not only include short-term local considerations, but also be geared to a long-term overall vision for the entire river basin.
The Sino-Dutch cooperation resulted in a number of different products: an integrated framework for analyses, hydraulic and economic tools and a GIS allowing temporal and spatial analyses of alternative development scenarios including risk analysis for flooding hazards. Several training courses were organised familiarising the tools and integrated approaches, in China and abroad.

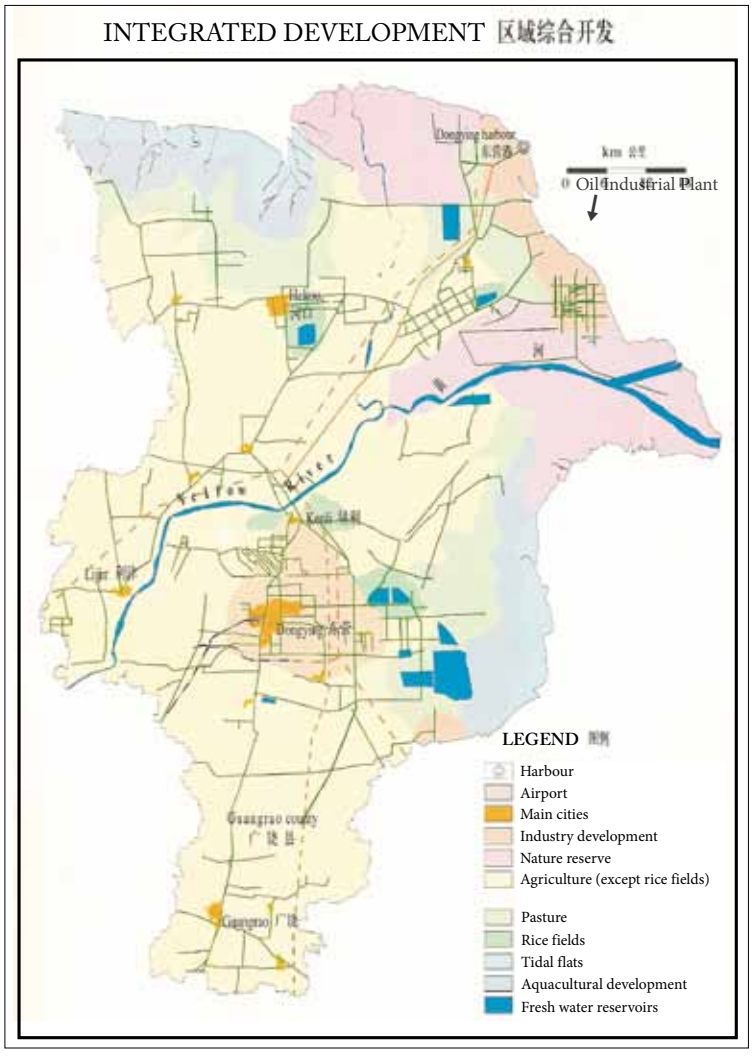
The challenges for the future are manifold. The ongoing rapid economic development in China and Shandong Province increases the demand for energy and fresh water. Complying with the latest environmental standards and the reduced water and sediment flows of the Yellow River due to upstream developments provides a further challenge. In addition, the impacts of climate change will become increasingly important.

Various follow-up studies were proposed upon the finalisation of the YRD project and some of them were executed including a continuing study on the future of one of the main channels of the Yellow River Estuary in relation to long term management. The Yellow River Delta Environmental Flow project, a bilateral cooperative venture between Dutch and Chinese research organisations (2005-2007), provided information on the environmental water demands of the lower (new) delta and its nature reserves.
The results of these international cooperative activities confirm that

an integrated water management policy is the key element in the future development of the Yellow River Delta. Such an approach requires continuation and reinforcement of the teamwork between the many agencies and departments involved in the delta. It will also require a robust system to monitor changes relevant for upgrading design criteria and evaluating the consequences of policy options.



The Yellow River Basin: *second largest river basin of China - 800,000 km², accommodating 9% of the Chinese population and the Three Gorges Dam near Lanzhou. (map: © Shannon, Creative Commons Attribution-Share Alike)*



Integrated, socio-economic development of the Yellow River Delta: *oil and gas exploration plant, agriculture grounds, settlements and nature reserves near the new mouth. (from 'GIS Atlas of the Yellow River Delta' – Sustainable Development YRD project , 1997)*

ICZM and the application of Geosciences in the Chinese coastal zone

Yin Ping, He Qixiang, Jun Li *(Qingdao Institute of Marine Geology, China)*
Cees Laban *(Deltares, the Netherlands)*
Marit B. Brommer *(TOTAL, the Netherlands)*

Chinese Coastal Area.
(source: Geological Survey of China)

Contents

Summary

In recent decades, China's coastal area is being faced with large-scale urbanisation, industrial and harbour development. Subsequent user conflicts and increasing marine pollution led to the introduction of Integrated Coastal Zone Management (ICZM). Geo-scientific research plays an important role in the present planning of large-scale constructions, land reclamation, the creation of coastal eco-cities, and in future adaptation to the impacts of climate change. Information on water quality and coastal and sub-soil stability is very important for the development of the coast zone.
China is addressing the developments in a holistic way and making institutional ICZM arrangements. ICZM, integrated spatial planning and Environmental Impact Assessments are important tools to plan and implement large scale sustainable coastal projects.

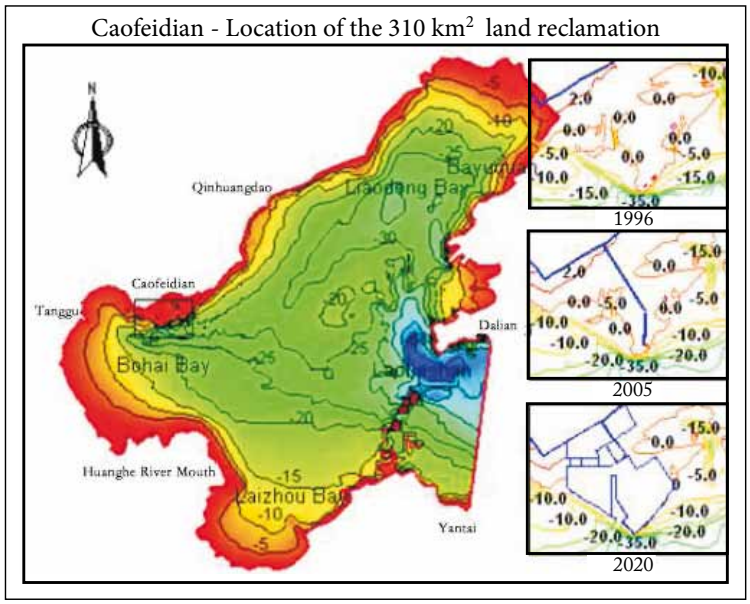
The contribution of Geo-science to ICZM is illustrated by three areas with rapid economic developments (from north to south):

The Caofeidian Island is located along the western coast of the Bohai Bay (Yellow Sea) and suitable for large deepwater ports and industries. The large scale land reclamation (310 km^2) and the Tongdao Sea Bridge Highway, are supported by studies on the tectonic stability and hydraulic coastal processes. Future large-scale drinking and industrial water abstraction will affect the wetland ecosystems. To compensate for the loss of wetlands, artificial wetlands will be constructed storing fresh water. Comprehensive analyses are undertaken to build a safe modern Eco-city of Caofeidian.

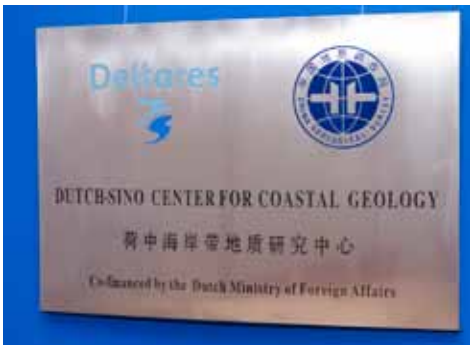
Yangtze River Delta area is one of the most intensely developing coastal regions in China, with the highest population density, a rapid urbanisation, and large-scale coastal infrastructure developments. Its impacts will affect coastal resources, living conditions and the environment. The Yangtze River Delta suffers from serious subsidence. Dam constructions upstream of the Yangtze River increase coastal erosion. Global warming and sea-level rise may increase the frequency of storm surges, floods, and the salt water intrusion.
The rapidly growing city of Shanghai is looking for secure fresh water supplies. The construction of a large fresh water reservoir on a island in the Yangtze River mouth and of a cross-sea Donghai bridge, two harbours and the Pudong Airport required detailed geo-scientific information of the tectonic and coastal stability, river water quality and marine sedimentary processes.

The Pearl River Delta has become one of the leading economic regions and a major manufacturing centre of China. The industrial activities caused the delta to become severely polluted. The sewage and industrial waste treatment facilities are unable to keep pace with the growth in population and industry. At the same time, practically no natural coastal landscape remains. The delta region is also exposed to natural disasters such as typhoons and tectonic movements.

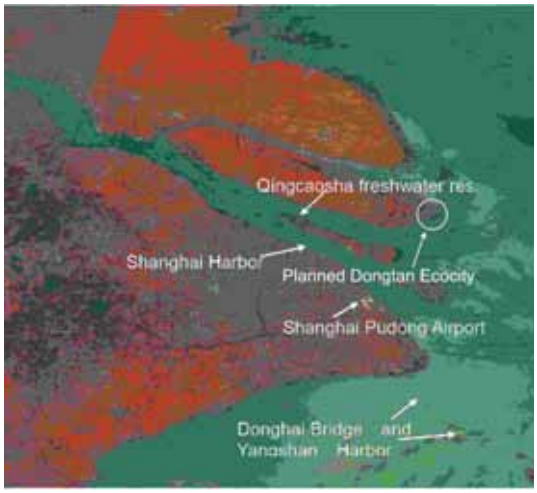
Applied geo-science is delivering knowledge and understanding to the Chinese policy and decision makers and the construction companies. The Netherlands is sharing its coastal hydraulic and engineering experience with China specifically regarding coastal geo-science applications during the planning, design and execution phase of large-scale infrastructure projects.



Location of the stepwise land reclamation *(in blue – inset map) offshore Caofeidian. (After Lu Y.J., et al., 2008)*



A formal cooperation *between China Geological Survey and the Dutch Deltares has been signed on September 11th 2008 establishing the Dutch-Sino Centre for coastal Geology. (photo: Deltares)*



The location of the projects *in the framework of the Shanghai coastal zone development. Modified from satellite images. (After Jun FU & Ping YIN)*

The 32.5 km long Donghai Cross-sea Bridge*, for location see satellite image left. (photo: Zhang 2008)*

Coastal urbanisation and creating Eco-cities

Challenges and innovative, holistic solutions in the Chinese coastal zone

Dick Kevelam *(DHV, the Netherlands)*
Peter Head *(Arup, London)*
Frank de Graaf *(DHV, the Netherlands)*
James Wu *(DHV- Shanghai)*

***Artist's impression of Dongtan**, planned in the Yangtze River mouth. (source: Arup)*

Summary

To address the pressure from a rapid growing population, China is preparing holistic, integrated and sustainable strategies for urban development. These strategies must contribute to better environment for people and improved conditions for nature as well as creating opportunities for local and regional economies. China, with partners, is developing plans for the expansion of old cities and the construction of new ones in harmony with their surrounding landscape. These plans aim at solving user conflicts and contain provisions for delivering sufficient fresh water to sustain large-scale future urban development. The long term components of these plans take into account mitigation measures and adaptive responses to the potential impacts of climate change.
Within this context master plans for three coastal Eco-cities have been formulated in the deltas of the Bohai river and Yangtze river.
These planned coastal Eco-cities are the Tianjin Binhai New Urban Area and the nearby Caofeidian Coastal Port city in the north-eastern part of China and Dongtan Eco-city near Shanghai (see also CCC II-2-3).
The master plan for the expansion of Tianjin, just north of the commercial port, aims to develop a high quality seaside resort as a mixed urban, maritime, green and ecological wetland area with high value waterfronts and coastal leisure facilities.
In the Caofeidian area, a new coastal city will be built. DHV has been commissioned, together with the Chinese Urban Planning Department of the Qinghua University and Arup consultancy, to carry out a masterplan for large scale urban development. The overall development and construction of Caofeidian will be carried out in two phases, the industrial harbour phase to receive up to 300,000 ton vessels (see CCC II-2-3) and the construction of the Caofeidian Eco-city.
The Shanghai Industrial Investment Corporation (SIIC) commissioned Arup to produce a master plan for a 500,000 person Dongtan Eco-city on the eastern part of a large island in the Yangtze River mouth. This island, Chongming, lies near the dynamic metropolis of Shanghai.

The enthusiasm of Chinese society for the concept of Eco-cities is considerable. Planning ambitious urban development in coastal areas based on water management perspectives could well prove to be the template for improved sustainability in city planning.

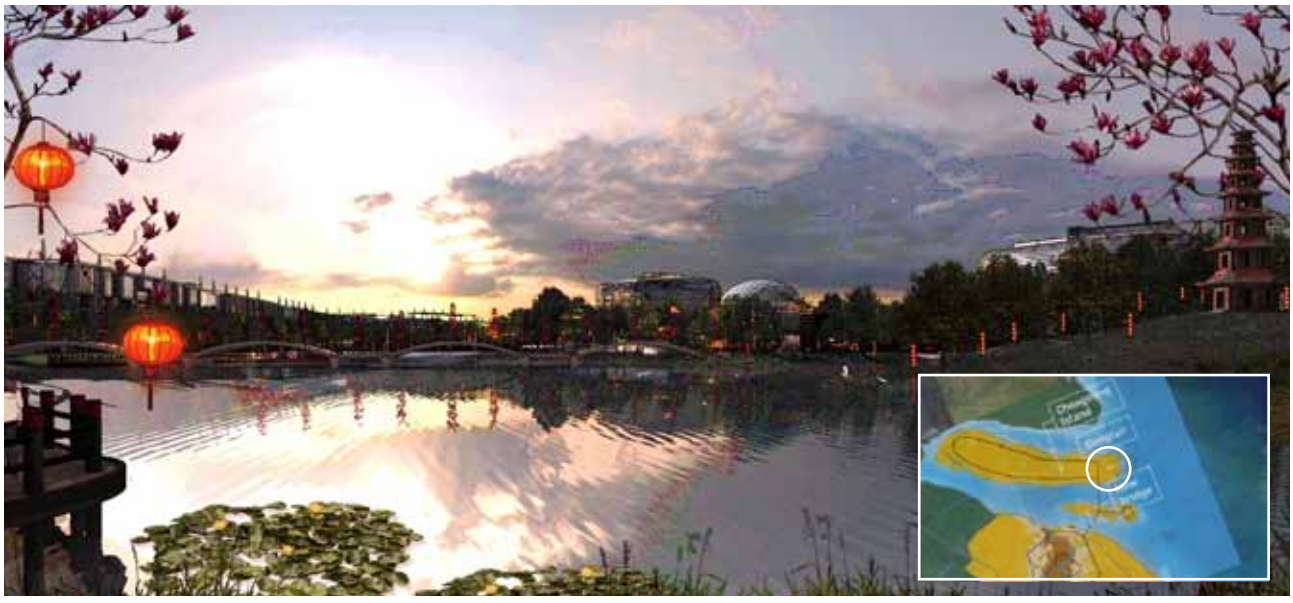
Executing the Chinese Eco-city plans requires careful preparation. The results of these pilot projects will determine whether the concept of Eco-cities is viable and can be implemented on a large scale in China and beyond.

Contents

Fresh water lens on top of saltwater: *The limited rainfall in the north of China necessitates strategies to capture and recycle fresh water in sustainable manner, which is an important element of the Eco-city master plan. (source: DHV)*

Bird's-eye of Master plan of the expansion of Tianjin (western Bohai Bay)*: The Delta Diamond design (Consortium with DHV) - management of scarce fresh water and salt water is of great importance; reintegrating land with water in a controlled manner; once the protective ring – dike is built, islands can be created one at a time, creating flexibility in time and place. (source: DHV)*

Project rendering of the Caofeidian coastal masterplan (Consortium with DHV): *The Eco-city master plan will combine coastal development, renewable energy, water, and transport in an attractive urban design, with a high degree of sustainability. (source: DHV)*



Artist's impressions of Dongtan near Shanghai (Consortium with Arup): *The planned Eco-city Dongtan, projected on Chongming island in the mouth of the Yangtze River (inset map), would produce its own energy from wind, the sun, bio-fuel and recycled city waste, clean technologies would power public transport; the Masterplan connects environment and economy. (source: Arup)*

Conclusions - China

In order to facilitate its enormous growth in the vulnerable coastal area under increasing pressures of climate change, China is very rapidly developing and applying principles of Integrated Coastal Zone Management (ICZM). Over the last decade, such ICZM developments have become clearly visible in a number of ways:

1) Development and application of ICZM knowledge and capacity

China has developed its ICZM capacity through international cooperation and nationwide initiation of ICZM programs, together with the development of institutions, regulations and laws from the nineties onwards. An early example of cooperative projects between China and the Netherlands is the Yellow River Delta project (1995-1997) focused on providing an integrated planning framework and GIS knowledge base for the development of the Delta. This project included environmental quality, social conditions and protection from flooding and formed the base for further coastal cooperation.
Specific attention was furthermore paid to the application of geosciences related to sediment supply, subsoil stability and land-sea interactions in the Chinese coastal development areas. Examples of these applications include:

- The deep-sea port and industrial development of Caofeidian island in Bohai Bay, involving a large land reclamation project and related infrastructure development;
- Shanghai and Yangtze delta including large projects and infrastructure developments such as the Donghai cross-sea bridge, water reservoirs in the coastal area, harbour development (Shanghai and Yangshan harbour) and Pudong Airport;
- The coastal protection of Pearl River Delta.

Recently a formal cooperation between China – the Netherlands has been created by establishing a Dutch-Sino Centre for coastal Geology, linking the China Geological Survey and the Dutch institution Deltares.

2) Large scale rehabilitation of degraded areas

Rapid urban development in densely populated coastal areas in the second half of the 20th century has created severe problems related to the management of land and water resources, in particular water quality. In the last decade, China has taken action to rehabilitate the most degraded areas. An example is the restoration of Suzhou Creek and Lake Tai, the major water supply sources in the greater Shanghai coastal area. An extensive rehabilitation program was developed, using a phased approach, including: hydraulic measures and clean up actions; wastewater flow interception and treatment; removal of polluted sites and embankment reconstruction. An integrated water quality model and a Decision Support System facilitated the identification and selection of measures to be taken. A major restructuring of the institutional arrangements of the water sector contributed considerably to the successful implementation of this rehabilitation project.

3) Large scale coastal developments in anticipation of climate change

In China, in the last twenty years some 100 million people moved from inland areas to the coast. This process of massive coastal urbanisation will continue and accelerate in the next decades, involving another estimated 200 million people. In preparing for the enormous coastal pressures, China is developing and applying the concept of eco-cities, as a holistic approach to sustainable urban living. New land is developed according to the principle of '*Building with Nature*' (see also CCC III-3-3-1), while ensuring control and protection of land and water resources. Supply of water, energy and transport and waste (water) management based on the use of renewable sources and clean technology principles are fully integrated in the urban design concept. Examples of present developments include the cities of Caofeidian and Tianjin Binhai in Bohai Bay and Dongtan near Shanghai. These planned developments are regarded as large scale 'pilot projects'. The results of these projects will help determine whether new eco-cities will be built along the entire Chinese coast . There is considerable enthusiasm in Chinese society for eco-cities. The ambition may set a standard for the rest of the world.

CCC Part II - Chapter 3: India

Integrated management: concepts and practices

Interdisciplinary approach to water management

From the uplands to the coast - Ganges-Brahmaputra-Meghna basin

Jayanta Bandyopadhyay *(Indian Institute of Management, Calcutta)*

The Himalaya *– the upland area, home of the glaciers where the rivers start their journey to the coast. (photo of Annapurna - South, Nepal : Evert Wesker)*

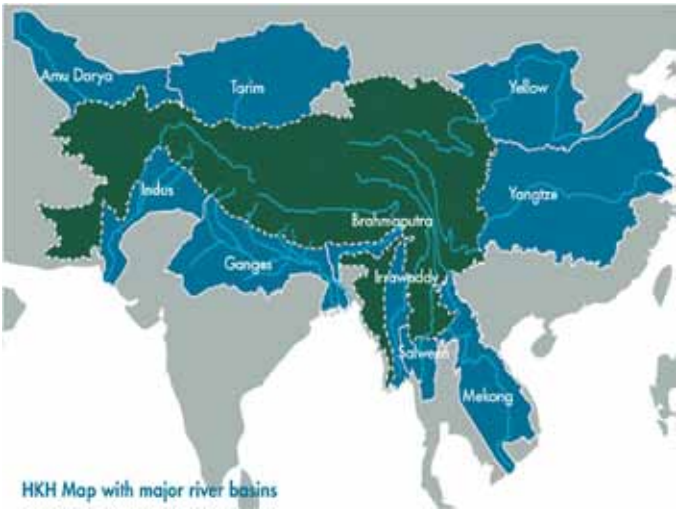
Summary

Many people have stressed the need for a fundamentally new approach to the management of rivers and coastal areas. Water engineering and management need a broadened framework, which includes ecology, social and economic development and integrated institutional arrangements.
This changing perspective provides a very different functional format for developing policies for rivers and coastal areas. These policies should be based on interdisciplinary knowledge of the river from the upland catchment to the coast.
Feasibility studies for large-scale river intervention projects should also take into account the ecological costs of stream-flow diversion, water depletion, and their impact on the ecosystem. Economic analysis and valuation of ecosystem services can support policies for river management especially in trans-boundary cooperation. Such cooperation is important for the survival of people and sustainability of ecosystems in the Ganges-Brahmaputra-Meghna (GBM) river basin. This 1.7 million km² basin will accommodate about 1 billion inhabitants in 2020 and is shared by five riparian countries. Ecologically informed economists can play a new and important facilitating role in such cooperation, through introducing water saving measures such as water markets and providing tools for conflict resolution.

Initial estimates of the likely impacts of climate change at a river basin level are diverse and the STREAM model suggests that the water availability in the Ganges-Brahmaputra-Meghna catchment may decrease. This will effect the growing number of inhabitants and the valuable ecosystems. The overall lack of available water might affect an increasing area, notably in the W – SW of Ganges sub-basin. Upstream diversions and alteration to river discharges may increase salt-water intrusion in the coastal zone, of which indications are already available. This will be further exacerbated by the acceleration of sea level rise and increased flooding by storm surges resulting from the anticipated changing climate. The quality of drinking water, agriculture and natural environment, including the mangrove ecosystems in the Sundarbans may also be affected. This trend is likely to continue if no adaptive measures are undertaken.

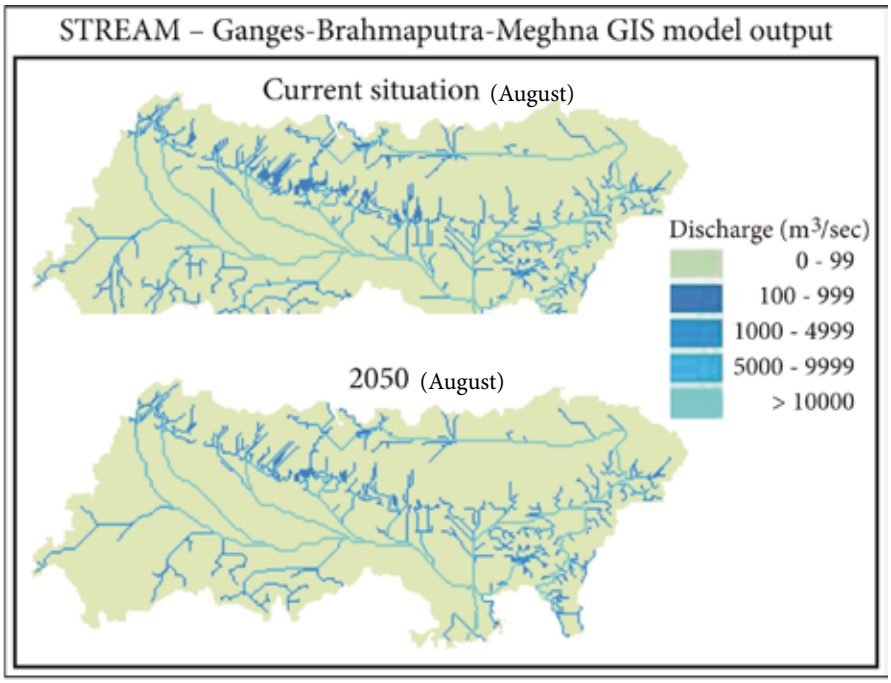
Trans-boundary discussions leading to a common and integrated water management policy for the entire river basin is an important adaptive option. Such international cooperation will help conserve water and increase the resilience of the Ganges-Brahmaputra-Meghna basin and its resident population.

Contents



The Ganges – Brahmaputra: *catchment area forms an important part of the Hindu-Kush-Himalya region. (source: ICIMOD, Kathmandu)*

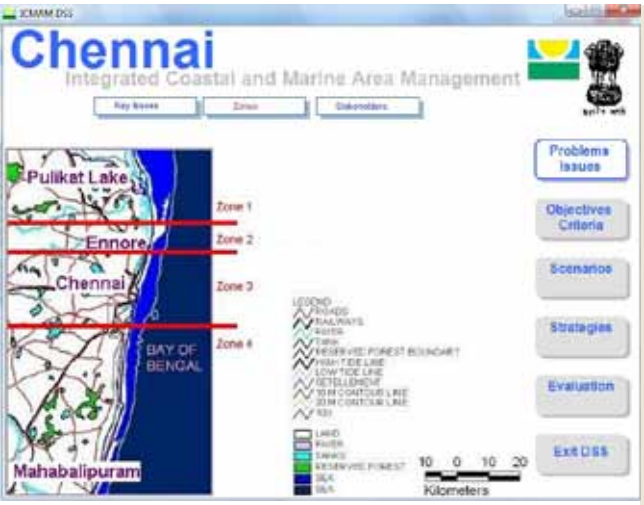
Low lying coastal area of the GBM: *Where the waters and sediments of the Ganges, Brahmaputra and Meghna reach the coast: fertile, densely populated, deltaic plains, intertidal areas, mangrove belt (Sundarban forest) and tidal channels. (photo: NASA)*



STREAM - GIS simulated river pattern and discharge quantities in m³/sec: *this simulation of the effect of climate change on the river discharges for the month of August, may point to a decrease in the foothills of the Himalayas, in the Ganges floodplain and SW part of the basin; the Brahmaputra sub-basin will be less affected.*

Decision Support System for the Integrated Coastal and Marine Area Management

B.R. Subramaniam *(ICMAM PD, Ministry of Earth Sciences, Chennai, India)*
Saskia E. Werners *(Wageningen UR, Wageningen, the Netherlands)*
Joop de Schutter *(UNESCO-IHE, Delft, the Netherlands)*
M.V. Ramana Marthy *(Ministry of Earth Sciences, Chennai, India)*



***Interface DSS showing the four zones** identified for development of ICMAM plan, with the Framework for Analysis.*

Contents

Summary

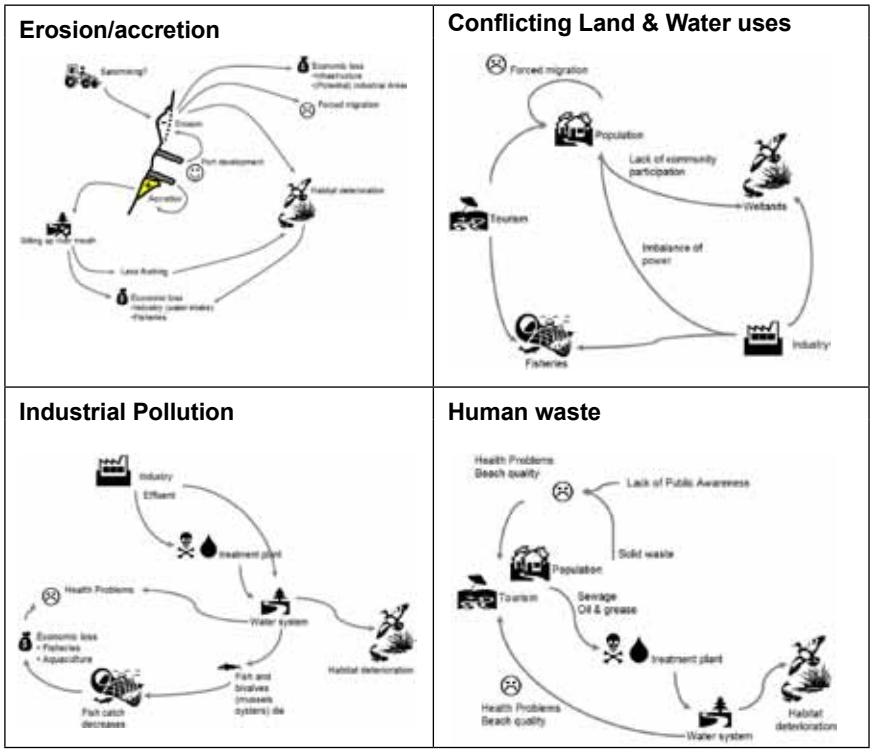
A Decision Support System (DSS) was built for the Chennai coastal zone to support Integrated Coastal & Marine Management (ICMAM). The project area for the Chennai ICMAM Plan was from Pulicat Lake in the North to Mahabalipuram in the South, subdivided into four zones.
The project used a Framework for Analysis consisting of four analytical elements:

i) Identification of the major problems and issues,
ii) Objectives and criteria commonly defined,
iii) Selection of scenarios and policy strategies and
iv) Evaluation strategies and scenarios.

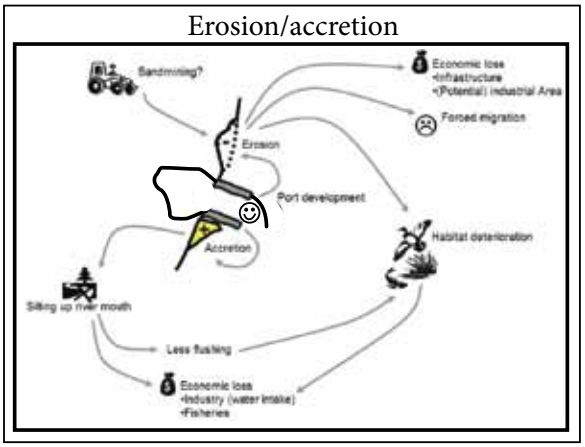
The Framework guided the development of the ICMAM Plan. It was also used as the basis for the DSS and the analysis of alternative strategies. The DSS enabled the user to compare alternative solutions (strategies) for different scenarios (developments beyond the influence of the decision maker).

A large group of stakeholders of the Chennai coastal areas went through the four elements of the Framework at a series of workshops. Their active participation was a prerequisite for success. They prepared alternative strategies, for particular scenarios. This process was facilitated by introducing a 'user-interface' (see ICMAM-DSS below) illustrating the various analytical steps.
The DSS module based on 'cross-impact analyses' quantified and illustrated the various relationships between the stakeholders, the uses and their impacts on the environment and resources.
The co-design of the ICMAM-DSS by the Indian project partners, regional stakeholders and the Dutch experts determined the contents of the DSS and identified the key issues and actions. This required flexibility in the design of the DSS.

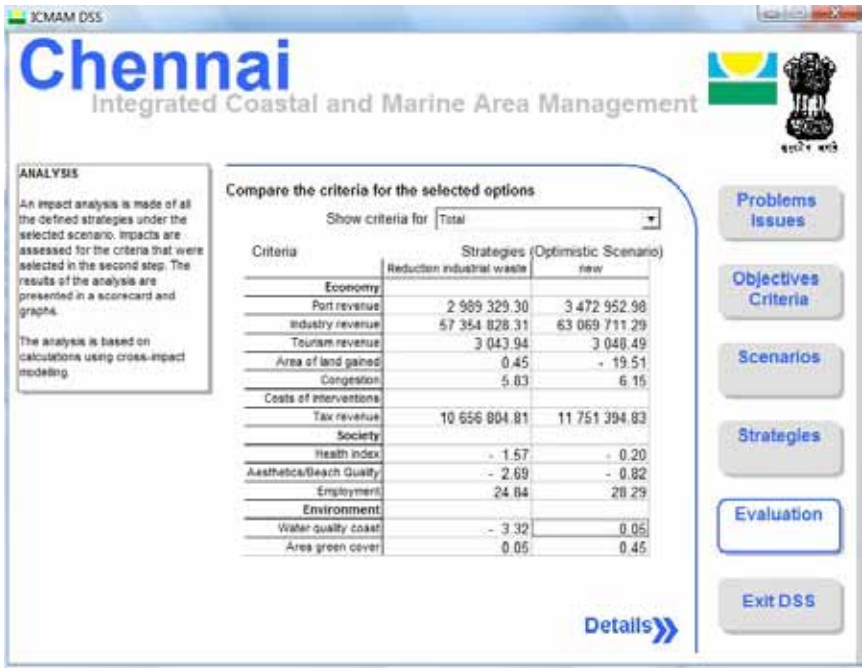
The DSS was successfully used as a structuring tool when making the ICMAM Plans for the coastal zones in Chennai (Tamil Nadu). It was later also applied in Goa and Gujarat (the Gulf of Kachchh). These ICMAM Plans provide the basis for strengthening the institutional ICZM arrangements in India.



Key issues and system diagrams in the Decision Support System (DSS) *The four depicted diagrams, together with 'Institutional Arrangement" and 'Community Participation' captured the key issues identified during workshops for inclusion in the ICMAM plan and DSS.*



The relation between causes and impacts *are shown for the issue: Erosion and accretion. Effect of sand mining, port development and breakwaters, longshore currents impact the economy, habitats and forced migration due to loss of land.*

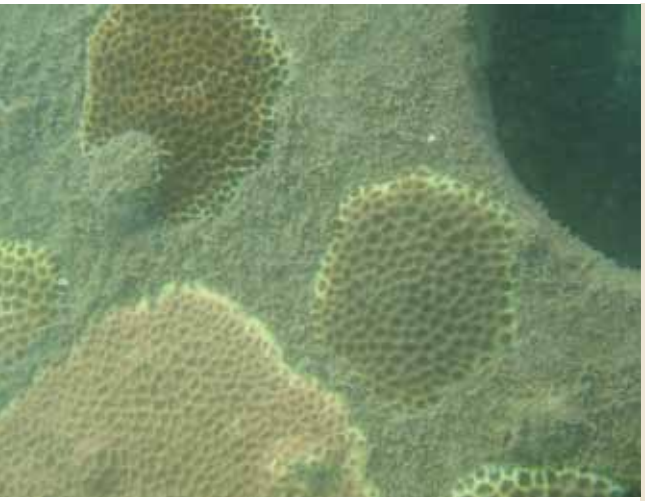


Interface of the DSS for the evaluation of strategies*: comparing a predefined strategy: 'Reduction of industrial waste' with a 'New' strategy defined by the participants of the ICMAM-DSS Workshop III; both strategies are analysed under the same 'Optimistic Scenario'.*

Artificial reefs

Increasing biodiversity and long term coastal fisheries in the Tuticorin region, Tamil Nadu, India

J.K. Patterson Edward *(Suganthi Devadason Marine Research-Institute (SDMRI), TN, India)*
Rob J. Leewis *(Netherlands Centre for Biodiversity Naturalis, Leiden, the Netherlands)*

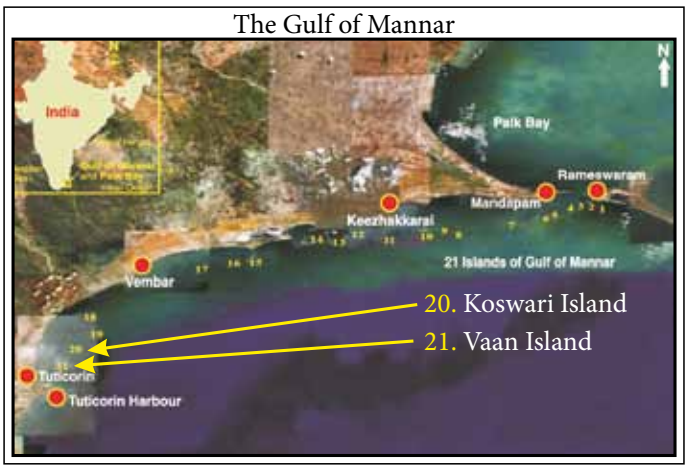


Massive coral recruitment *(2008) on artificial reefs near one of the holes in the slab (upper right corner of the photo) in a short period of less than five years. (photo: SDMRI)*

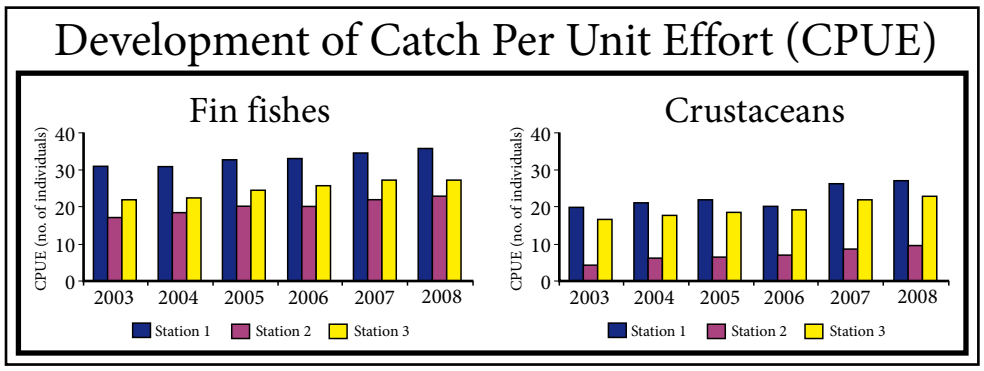
Summary

In 2002, a community-based artificial reef programme began, which aimed to restore a lost fishery and to increase marine biodiversity within the framework of a Netherlands-Indian coastal cooperation. The artificial reefs were constructed locally and placed in the Gulf of Mannar (Tamil Nadu).
In total 105 artificial reef modules were made of ferro-cement and deployed, spread over three stations located around Vaan and Koswari Islands.
The effects were monitored and show conclusively that artificial reefs enhance coastal fishery stocks, coral recruitment and help create new food chains. It also became clear, that although designed for a variety of biological uses, artificial reefs can provide important services and resources to user groups. This ultimately enhanced the socio-economic status of the poor, traditional fishermen who gradually became more enthusiastic about the positive effects of the artificial reefs.
Awareness raising programmes informed the fishermen and their families in the two target fishery villages about increased species diversity and density in the artificial reefs stations. They were impressed by the fishery yield in the artificial reefs area. The villagers of Tharuvaikulam and Vellapatti requested the deployment of additional artificial reefs, around the islands in the Tuticorin region, in order to increase fish production. This would also enable them to fish more easily and help avoid inshore trawling.
Eco-tourism opportunities are clearly present in the Tuticorin coastal area; however, these have not yet been followed up. There are indications that eco-tourism could play a greater role in this area in the near future. If this happens, artificial reefs could play a major role in attracting diving tourists, which in turn would help to support the livelihood of the local fishermen and strengthen conservation initiatives.
The success of this project can be deduced from the fact that the monitoring of the artificial reefs, essential for evaluating the results of the programme, continued after the Dutch assistance ended in 2006, and that the reefs continue to provide a high yield of fish in a flourishing marine environment.

Contents



The Gulf of Mannar *with the locations of its 21 uninhabited islands. In total 105 artificial reef modules were placed and monitored in three locations around the Islands of Vaan and Koswari, near Tuticorin. (source: Patterson Edward, J.K. et al,2008)*



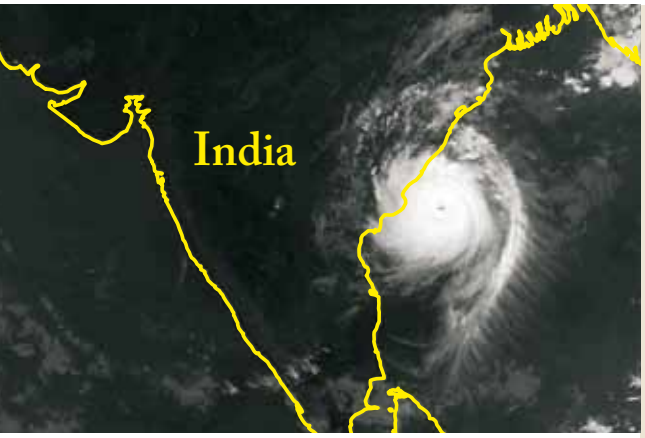
Development of Catch Per Unit Effort (CPUE) *for fish and crustaceans, the two most important groups for the fishermen, from the artificial reef area (2003-2008). (source: SDMRI)*

Artificial Reef Modules: *transport of modules parts (slabs) on raft and assembling the modules parts prior to deployment in three locations at water depth between 3 – 6 m. (photos: SDMRI)*

Tropical cyclones and the added value of ICZM:

an integrated approach reducing vulnerability

Marcel Marchand *(Deltares, the Netherlands)*
Peter Winchester *(Divi Seema Foundation, AP, India)*



***Cyclone 07B** - over the Godavari Delta, Andhra Pradesh State, during 6-7 November 1996, with wind speed to 230 km/hour. (photo: National Geophysical Data Center / National Oceanic and Atmospheric Administration)*

Summary

Strengthening early warning systems and planning Integrated Coastal Zone Management (ICZM) were simultaneously applied on the Andhra Pradesh (AP) coast of India. The number of casualties and damage caused by cyclones can be reduced by implementing these forward-looking approaches.

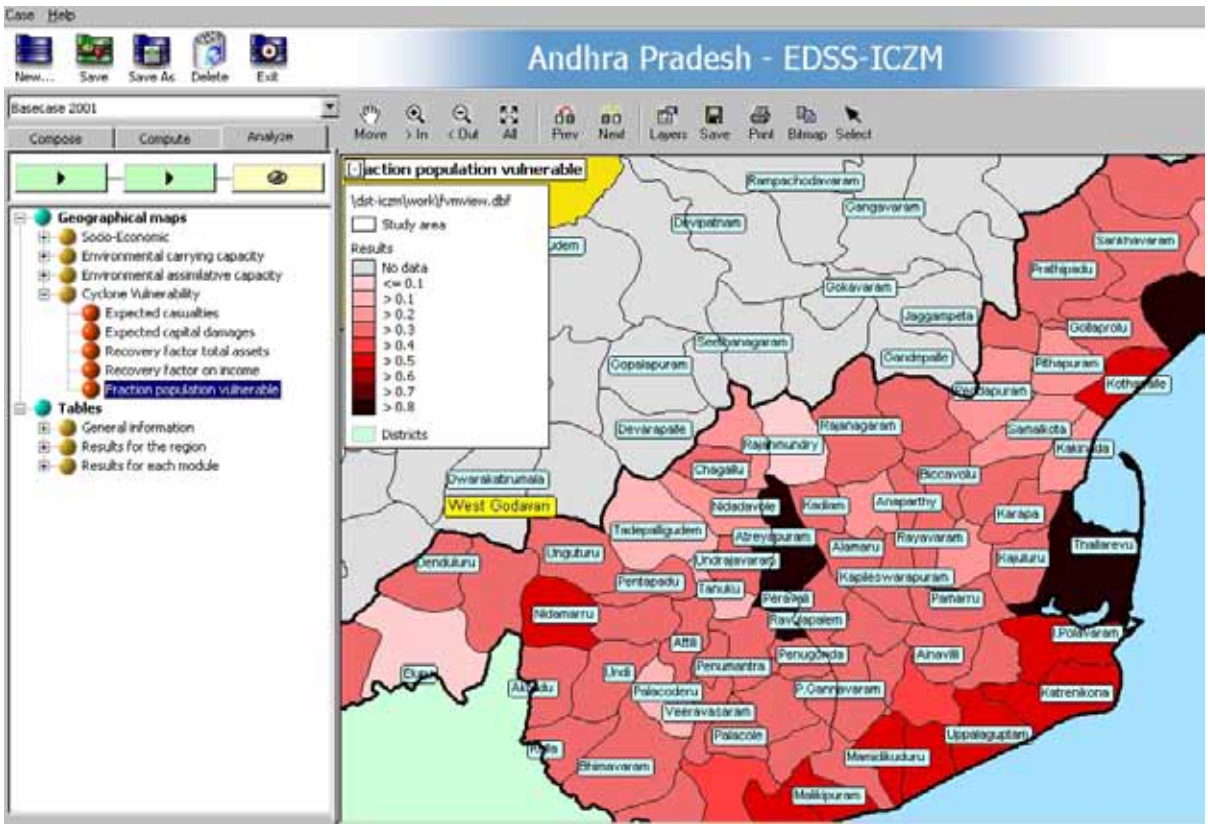
In this example the ICZM programme centred on the development of a decision support model, providing integration of disciplines, structure and synthesis of complex data and predictions for the future. It brought together a considerable variety of information on natural processes, hazards and socio-economic issues. Indian and Dutch experts from both the natural and social sciences, working in one project team, developed this integrated interdisciplinary approach. They also contributed to an improved understanding of the complex problems and feasibility of potential solutions.

This formed a solid basis for the Expert Decision Support System (EDSS)-ICZM, which allowed an exploration of future long-term scenarios and strategies, as well as providing estimates of loss of life and damage from hazards such as cyclones. Building the EDSS for the Godavari Delta (AP), helped synthesise expert knowledge of the relationship between the coastal environment, its inhabitants and hazards.

The benefit of such a combined and integrated approach is also demonstrated by improved decision-making related to spatial planning and efforts to reduce poverty. Poverty is one of the dominant factors in post-cyclone recovery.

Contents

The location of the Godavari Delta, in the State of Andhra Pradesh: *Twenty cyclonic depressions and tropical storms have crossed the Andhra Pradesh coastline between 1977 and 1996; the Expert Decision Support System (EDSS) was set up and calibrated in the Godavari delta.*



Godavari Delta – an output of the Expert Decision Support System (EDSS): *the fraction of population vulnerable for cyclones. The population is multiple vulnerable: in the inland district Atreyapuram the inhabitants are vulnerable for wind damages and in the near coast district Thallarevu for severe flooding associated with the landfall of cyclones; the poor inhabitants endure a longer post-cyclone recovery period than the somewhat wealthier families.*

Coastal Protection Guidelines

A guide to cope with erosion in the broader perspective of Integrated Coastal Zone Management

Kees Dorst *(Rijkswaterstaat/Ministry I&E, the Netherlands)*

***Severe coastal erosion** affecting the coastal road, north of Chennai, Tamil Nadu, India. (photo: R. Misdorp)*

Summary

As with many countries in the world, India suffers from coastal erosion. This can have a considerable influence on both the natural and the socio-economic systems of a country. Vulnerability assessment helps establish whether an area has a serious erosion problem and help to develop response strategies to combat them. It is advisable to put any anti erosion strategy into a broader perspective. Drawing up an Integrated Coastal Zone Management plan, is one way of achieving this. Implementing such a plan, which takes account of the many interests in the coastal zone, can help ensure coordination between different activities, both in the short and long term.

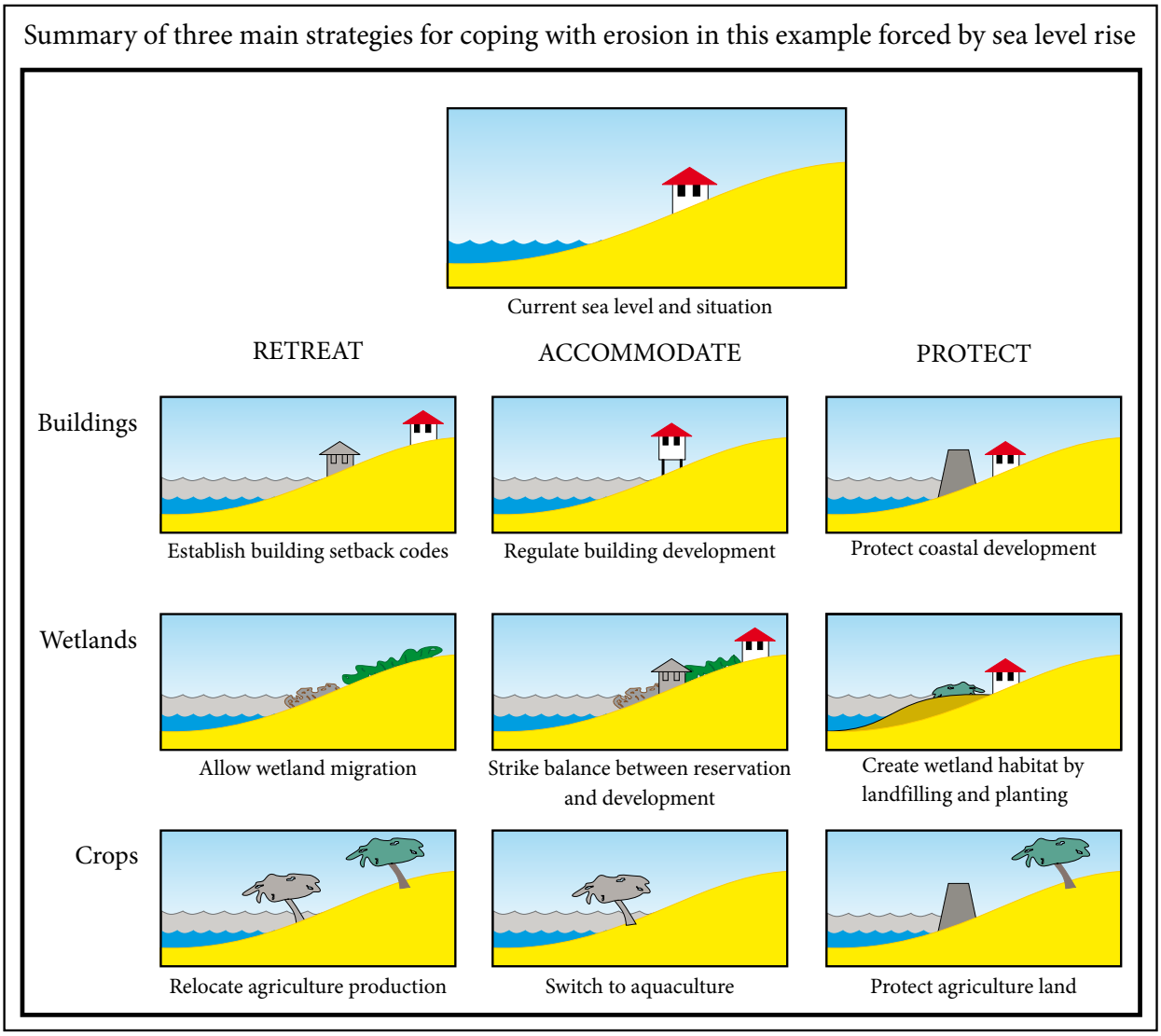
A coastal guide has been produced to help coastal managers understand what measures they can take to reduce or arrest coastal erosion. It discusses the entire spectrum of (hard and soft) coastal defence measures and the relationship to integrated coastal management. The guide is general in character and based on long term experiences. Three main types of response strategies to coastal erosion are distinguished:

- Retreat: allow the erosion to take place, people and habitats to move landward;
- Accommodate: allow erosion to take place and accommodate change by changing land-use;
- Protect: several options are identified including both hard or soft solutions for arresting acute or chronic coastal erosion.

During the selection process determining the most appropriate measures, several assisting tools are available: Environmental Impact Assessment, Cost-Benefit Analysis and Multi-criteria analysis. The criteria and indicators needed for selection, can also be used later for monitoring and evaluating the efficiency of the executed coastal protection measures.

The Coastal Protection Guidelines, downloadable via the CCC-website (see CCC V-1), may be helpful for this process of selection.

Contents



***Summary of three main coastal strategies: Retreat, Accommodate and Protect** addressing coastal erosion.*

Conclusions - India

Important examples of ICZM development and initiatives in India relate to the following topics:

1) Integrated approaches to river and coastal management to reduce vulnerabilities

Integrated, interdisciplinary water management of the Ganges Brahmaputra Meghna (GBM) river basin including its coastal zone is proposed to start with trans-boundary discussions. Such trans-boundary cooperation, based on economics, would have beneficial effects for all the riparian countries, faced with increased future droughts and flooding. Economical valuation of water for use for people and ecosystems is regarded as a common base for discussion focused on measures to reduce vulnerabilities and increase resilience of the river system. Examples of successful riparian cooperation and negotiations can be found in Europe e.g. the International Commission of the Rhine Basin.

In the last decade, several developments in ICZM planning have taken place in India supported by international cooperation. The Indian Department of Ocean Development with support of World Bank and the Netherlands, started the Integrated Coastal and Marine Area Management (ICMAM) project, in 1999. The project focused on producing a development plan and strengthening institutional capacity, in the Chennai area (State of Tamil Nadu). The first results included the development and application of a framework for analysis and an integrated modelling system based on intensive participation of stakeholders, to identify solutions. In about the same period and also with the support of the World Bank and the Netherlands, a project commissioned by the Andhra Pradesh Government involved the development and application of the ICZM approach in the Andhra Pradesh (AP) State, focusing on using ICZM to reduce vulnerability to cyclones. This project included a model of coastal development and an assessment of vulnerability for the Godavari Delta, describing the impacts of cyclones and flooding on the coastal community and their possible recovery over time.

The results led to the identification of promising measures to reducing vulnerability and provided a basis for integrated spatial planning of the AP coastal area exposed to cyclone and flood hazards. Although these developments have enhanced the capacities at the planning level it also became clear that the 'real' problems in protecting the coast are those that are less visible. The coordination and harmonisation among and between stakeholders can strongly be improved through strengthening the community participation, while effective management needs improved legislation, clear mandates and financial resources.

2) Coastal protection Guideline available on the CCC website

ICZM applications have focused on measures to cope with coastal erosion. This has led to the development of a coastal Guide for the protection of sandy coasts considered from a broad ICZM perspective. The coastal Guide was developed in a number of logical steps, which involved analysing the erosion problems (by the collection and interpretation of data), the identification of developments and evaluation of possible solutions. The Guide stresses the need to consider the trade-offs between hard engineering structures and other solutions taking a long term, land use planning and ICZM perspective in order to achieve sustainable solutions.

3) Local initiatives for improving environmental and livelihood conditions

The variety of specific coastal problems and local circumstances requires tailor made approaches at the grass root level. An excellent example of such an approach is the programme to install artificial reef (AR) modules in the Gulf of Mannar (the South-Eastern tip of the State of Tamil Nadu), which took place in the period between 2002 and 2008. The modules consisted of triangular slabs of ferro-cement with holes of different diameters, which were produced from locally available materials. A monitoring programme revealed clear beneficial effects on fishery production, coral recruitment and creation of new food chains. Hence, it was concluded that such small-scale applications have significant potential for improving the livelihoods of local people. The strong involvement of the local fishery communities, greatly increase awareness of the AR benefits. It contributed to the reduction of the destructive fishing and coral mining. The cooperation between the local Marine Biological Research Station (SDMRI) and Netherlands (expertise and funding) was a healthy one, illustrated by the fact that after the Dutch left, the monitoring and the high sustainable yield of fish continued.

CCC Part II - Chapter 4, 5 and 6

Chapter 4: Indonesia

Sustainable restoration

Chapter 5: Seychelles

The pearl of coastal conservation and sustainable development

Chapter 6: Sri Lanka

The Asian country with the longest ICZM history

Sustainable post tsunami restoration of Aceh, Indonesia

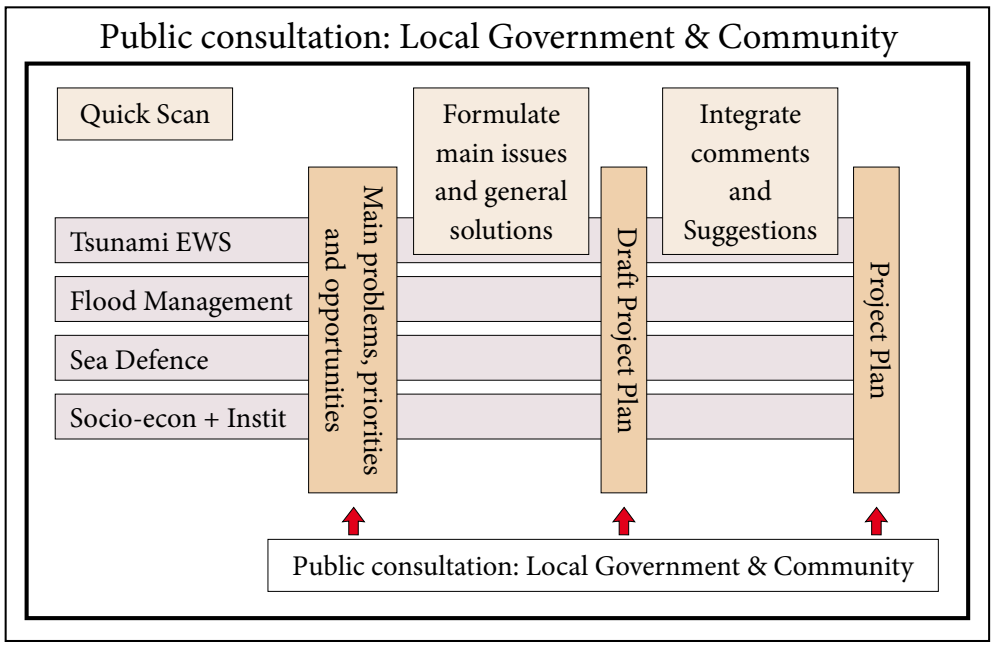
Odelinde Nieuwenhuis *(DHV, the Netherlands)*
Ibrahim Salwa *(Nanggroe, Aceh)*
Jeroen Alberts *(DHV, the Netherlands)*

Tsunami destruction Banda Aceh, *satellite images before and after the 2004 Tsunami. (photos: © United Nations Environment Programme © Digital Globe)*

Summary

The Indian Ocean tsunami of 26th of December 2004 hit the Province of Aceh in Indonesia hard, causing massive casualties and destruction of houses and infrastructure. An Indonesian - Netherlands consortium (Sea Defence Consultancy) developed a strategy for coastal restoration focusing on sea defence, flood protection, multifunctional refuge buildings and a regional early warning system (EWS). Formulation of a restoration strategy in a post – disaster area faces many challenges. By adopting an integrated approach using the knowledge and experience of different disciplines, a coastal restoration strategy can be developed in which prevention and adaptation measures are combined. This comprehensive strategy integrated the results of vulnerability assessments, base-line surveys, modelling and flood mapping, to aid disaster management and raise public awareness. The consortium worked closely with local government, NGOs and local research centres in the formulation of the restoration strategy.
The strategy included a number of different guidelines and tools, which were adopted by national government departments. Sustainability is achieved by working with local governments and community. A series of consultations were organised during the different phases of the project.
The strategy formed the basis for the formulation and design of infrastructure investment packages with a value of about US$ 120 million. These are currently being developed and support the people of Aceh and Nias in the establishment of a safe habitable environment, enabling economic recovery and sustainable development.

Contents



***Public consultation - Local Government and Community**: leading to demand-based, integrated strategies for a sustainable restoration of Aceh and Nias, combining four fields of activities Tsunami Early Warning System (EWS), Flood Management, Coastal Defence and Socio-economic issues and Institutional arrangements.*

***Sea Defence Consultancy (SDC):** design for escape building (above), and constructed escape building in Banda Aceh (below). (source: SDC)*

Introductory Statement – Seychelles

Rolph Payet

Special Advisor to the President of the Republic of the Seychelles,
President & Vice-Chancellor of the University of Seychelles

The Republic of Seychelles practices coastal conservation, preserving coastal vegetation and valuable habitats to help safeguard the livelihood of our population.
We take care of our environment through programmes that range from the mountains to the coral reefs.
The public at large actively supports these programmes, which provide a balanced use of natural resources, protection against hazards and attracting tourists in an environmentally friendly way.
The experience of the 2006 tsunami shows that an uninterrupted coastal vegetation belt is very effective, helping to save lives and minimise damages to houses and other capital investments.
There is an urgent need for better understanding of coastal processes and the impacts of global climate change, in order effectively prepare adaptive responses.
This need is particularly true for all small island nations and the least developed low-lying coastal nations.

The President of the Republic of the Seychelles took the initiative of creating an international Foundation: "Sea Level Rise", to promote international exchange of knowledge, experience and technology for effectively designing adaptive responses suitable to apply in our islands and coastal countries, and introducing forms of renewable energy to help to mitigate climate change.
International cooperation is essential for the future of our nations, therefore I hope that through the "Climate of Coastal Cooperation" publication the transfer of tools, instruments and technology for adaptation will be stimulated.

Seychelles: *white beaches and green vegetation belt help to decrease coastal erosion and flooding (photo: R. Misdorp)*

Tsunami Mitigation: Nature Conservation pays off

Rolph Payet *(University of Seychelles)*
Alain de Comarmond *(Ministry of Environment & Natural Resources, Seychelles)*

Crushed coastal vouloutier *in front of the dense coastal vegetation which provided solid protection. Anse Royale beach, Seychelles, hours after the Tsunami struck with 4 m high waves. (photo: A. de Comarmond, 26 December 2004)*

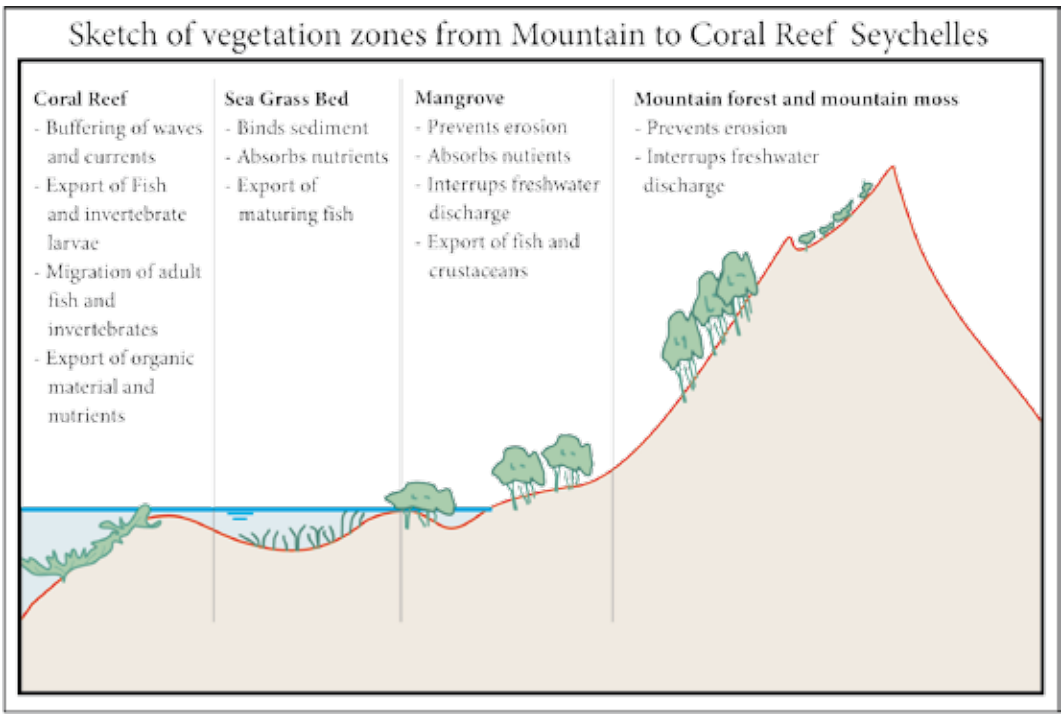
Summary

The Republic of the Seychelles pays particular attention to maintaining its vegetation on the mountains slopes, the coastal plateau and in the coastal areas offshore.
Protecting the vegetation helps protect the population against hazards and reduces the potential impact of climate change. At the same time, the valuable natural resources provide the basis for attracting tourists making a considerable contribution to the national income.
The coastal vegetation belt absorbed the waves associated with the major 2004 Tsunami, provided effective shelter for the people living close to the shore and prevented large scale flooding and erosion.
An holistic vision for sustainable exploitation of the coastal resources is in place, based on legislation and cooperation.
Preparing for future global changes is a challenge for the island community as a whole and international cooperation is actively pursued.

The Department of Environment is the responsible agency in the Seychelles for the management of coastal vegetation through its day-to-day activities. This management is covered by several managerial instruments, policies, regulatory measures, legislatures and management programmes. One of the day-to-day activities is directed to plant annually about 50,000 coastal plants, which are prepared in nurseries.
There is a broad public understanding of the natural values that need to be preserved. This includes the awareness of the ability of coastal vegetation to reduce the impacts of hazards, such as were demonstrated during the 26th of December 2004 Tsunami, and adapt to future impacts of Climate Change.

The Seychelles provide a good example of integrated coastal cooperation in an effective economic and ecologically beneficial way.
Valuable ongoing integrated coastal management endeavours will be strengthened. This will involve increasing training of young professionals, improving the capability to monitor the anticipated impacts of climate change, developing adaptive responses and creating a legal framework as an umbrella for these long term and complex activities. The recent creation of the international Sea Level Rise Foundation by the President of the Republic of the Seychelles is an example of the high-level awareness and commitment to preparing adaptive strategies in the face of future global change.

Contents



***Sketch of related vegetation zones** from Mountain to Coral Reef – Seychelles. (source: Robbert Misdorp)*

***Upto 1.5 m 'cliff' erosion of back beaches at Anse Kerlan**, north east Praslin Island, Seychelles, demolished turtle nests and palm trees - six weeks after the Tsunami struck the coast. (photos: Robbert Misdorp, UNEP Tsunami Damage Assessment Mission)*

Decades of ICZM experiences, Sri Lanka

Dianeetha Sadacharan *(Consultant, Coastal and Marine Resources Management)*

***For many years coastal erosion** continued to be a critical problem causing serious damage to infrastructure, the road and railway network, degradation and loss of coastal land and natural habitats and disrupting coastal livelihoods. (photo: Coastal Conservation Department - CCD, Sri Lanka)*

Contents

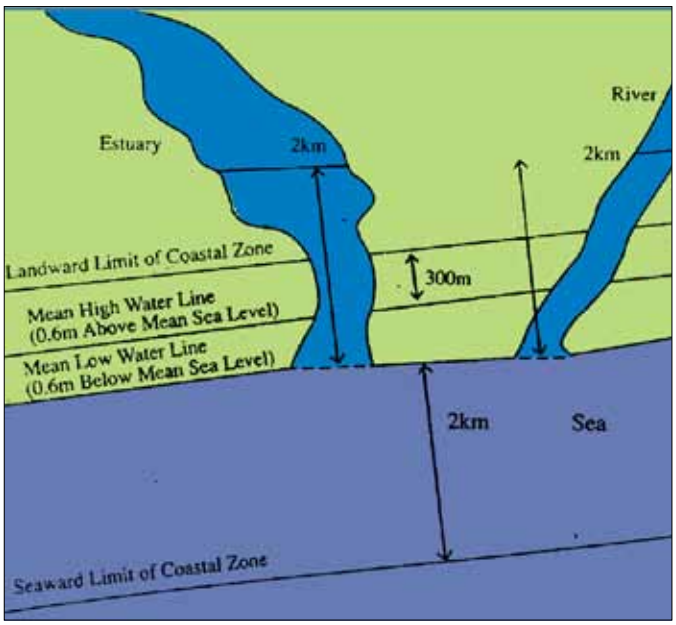
Summary

Since the Sri Lanka Coast Conservation Act came to operation in 1983 and the first Coastal Zone Management Plan (CZMP) was adopted in 1990, Integrated Coastal Zone Management (ICZM) has been strongly embedded in Sri Lankan environmental management agenda. Over the years, the policy and management frameworks for ensuring sustainable development of the coastal areas have been improved, a more holistic and integrated approach to coast erosion management adopted and a significant proportion of the highly erosion prone areas stabilised. The regulatory framework for managing coastal development has been refined and awareness of coastal issues and need for action created at the political and policy levels. The ICZM programme has broadened to cover a wider range of issues such as water quality, coastal fisheries and aquaculture.

The programme has focussed attention on mitigating coastal erosion, reducing the impact of coastal development by regulating the location of new development and, to a lesser extent, managing coastal habitats. The Sri Lankan ICZM programme has also been the testing ground for emerging planning approaches such as Special Area Management Planning that provide for greater involvement of the stakeholders and the local level administration.

The low-lying parts of the coastal zone are vulnerable to impacts of climate change and coastal hazards. The Tsunami of December 2004 inundated large areas along the east, south and southwest coasts. Climate change will pose a series of extra challenges due to increasing storm surges and sea level rise. Intensified coastal monitoring and a long-term vision are prerequisites for timely adaptive responses.

Continued cooperation at international, national and local levels is a key factor in the success of the Sri Lankan ICZM programme, now and in the future.



'Coastal Zone' *as defined in the Coast Conservation Act - 1981. (source: Coastal Zone Management Plan, 2004)*

Sri Lanka: *its topography and the coastal zone. (photo: NASA/JPL/NGA)*

The low lying coastal areas *exhibit considerable variety of landscape types bays, lagoons, headlands, marshes with lush coastal vegetation, beaches and dunes. Sri Lanka is the most biologically diverse country in Asia per unit area , UNEP 2005. (photo: Rekawa Lagoon, Sri Lanka: © Chandana Gunasena)*

Coastal zones are attractive for tourists, *providing at present about 1% of Sri Lanka GDP. (photo: Tjark van Heuvel)*

Conclusions - Indonesia, Seychelles and Sri Lanka

Although all quite different in nature, Indonesia, Seychelles and Sri Lanka represent typical examples of island states, all three being vulnerable to the effects of storm surges and tsunamis. The latter is certainly true for Indonesia being situated in a particularly active earthquake zone. However, recent events have also shown the vulnerability of more remote areas such as the Seychelles. The three island states, each in their own way, have taken steps to reduce their vulnerability to these damaging events.

Sustainable, post tsunami restoration in Indonesia

Triggered by the big tsunami at the end of 2004, Indonesia has taken steps to improve their system for sea defence, involving the development of flood protection measures; construction of multifunctional refuges; and regional early warning (linked to a national early warning system). The improvements for flood protection include design guidelines for sea defence and urban drainage measures, including dikes, drainage channels, outfall structures, seawalls, breakwaters, sand nourishment and the 'regreening' of coastal areas. Other improvements relate to the use of integrated spatial planning and zoning principles (based on flood hazard maps from tsunami flood modelling), evacuation routes, training and awareness building.

Seychelles: tsunami mitigation by nature conservation

The Republic of Seychelles is a vast archipelago in the western Indian Ocean, including 115 small islands with less than 500 km^2 within a sea area of more than a 1 million km^2. Some 40 islands are granitic. The others are low-lying coral islands. The number of inhabitants is less than 90,000. Most people live on the 3 largest granitic islands (Mahé, Praslin and La Digue). The main islands are protected by distinctive vegetation zones from the mountain ranges to the beaches. Coastal vegetation is important for coastal protection. Mangrove belts in particular are also multifunctional and valuable ecosystems.

The Seychelles have been able to protect and maintain their valuable vegetation belts because of effective and enforced legislation, capable institutions and public awareness. The 2004 Tsunami hit the island with 4 metre waves causing only very limited damage. The Seychelles will be vulnerable to storm surges aggravated by the effects of sea level rise and particular the southern islands, may become more effected by tropical cyclones, as temperature increases.

The continuation of the present spatial planning and vegetation protection policies provide a solid basis to help cope with the problems that lie ahead. The Seychelles provide an excellent example of the great benefits derived from their integrated spatial planning approach and nature conservation, its successful implementation and enforcement. Efficient nature conservation management results in effective protection against erosion and flooding, and appreciation by tourists contributing for about half to the GDP of the Seychelles.

Sri Lanka: the ICZM cradle in Asia

Sri Lanka has a high population density particularly in its coastal zone. There is also a large variation in coastal areas, which suffer from a variety of coastal problems. The country has a long history of coastal zone management, with ICZM programme development beginning in the 1970s. The first focus was on solving coastal erosion problems. Later on, attention was broadened to include degradation of habitats such as valuable coral reefs and mangroves, water quality issues and sustainable development of fisheries and aquaculture. Developments of the ICZM approach went hand in hand with institutional developments. In addition to these top down planning and institutional developments, special area management (SAM) planning provided a greater involvement of stakeholders and local administration. The range of activities has produced successful examples of improvements for example promotion of ecotourism, the establishment of marine reserves and enhancement of shrimp production by improving water quality and restoring larvae exchanges between the coastal and lagoon waters. However, the experiences in ICZM implementation have also shown severe limitations, for instance in the knowledge base, and weaknesses in the power and mandates of coastal authorities and in the underlying legislation. The experiences in Sri Lanka show that the establishment and implementation of ICZM can be seen as a series of battles, which are not always victorious.

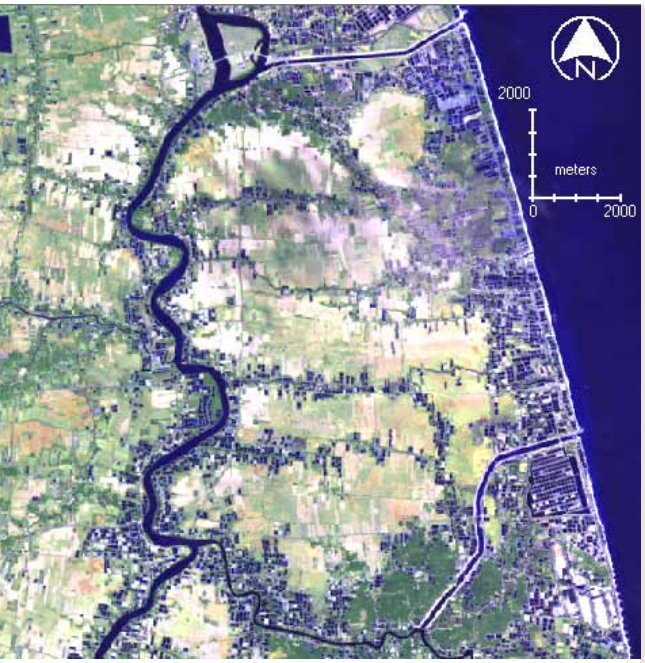
CCC Part II - Chapter 7: Thailand

Aquaculture and Fisheries in an ICZM frame

Thai aquaculture: lessons for shrimp farming

Gains and losses, rehabilitation, integrated coastal cooperation and capacity building

Somsak Boromthanarat *(Asian Coastal Resources Institute Foundation, Bangkok, Thailand)*
Rob Leewis *(Netherlands Centre for Biodiversity Naturalis, Leiden, the Netherlands)*
Robbert Misdorp



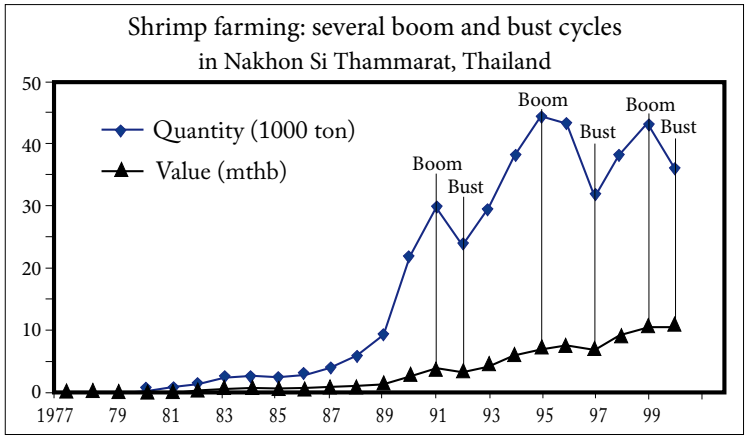
***The river Pak Phanang and the coastal** zone, in the Nakhon Si Thammarat provinces. Areas after abandonment of the no longer productive shrimp farms in the coastal zone, the barren coastal plain does not provide any livelihood for the original coastal inhabitants. (source: Processed Landsat ETM Image 2002, GLCF website)*

Summary

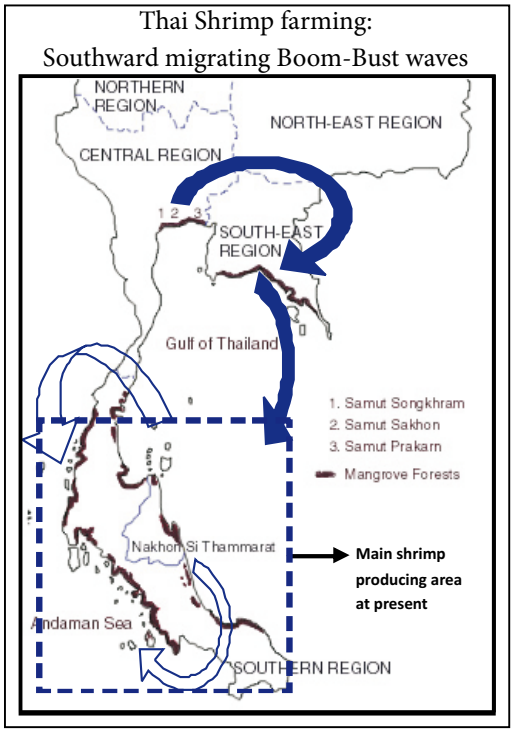
Thailand is one of the world's leading shrimp farming nations, which adds to economic development, contributing 2 % to the Thai GDP and accounting for 3% of national export value. The number of shrimp farmers exceeded 20,000 during the 1990's boom. Shrimps provide protein-rich food. With the depletion of the ocean fishery resources, shrimp and fish farming become increasingly valuable.
Most of the farms are of the intensive type with an average annual production of more than 4 metric tons of shrimps per hectare. A cycle of intensive shrimp farming on one coastal area can only be carried on for a short time.
After only a few years, it moves from: boom → bust → abandonment of barren ponds → move to exploit new coastal areas. This takes the form of a shrimp farm migratory wave. These migratory cycles have moved towards the south and west of Thailand. The abandonment of non-producing shrimp ponds is a major issue with more than 40,000 ha of the coastal areas in the southern Gulf of Thailand alone left barren.
Rehabilitation is not always possible and if undertaken, can be very expensive. The shrimp farming industry has brought wealth to a few people (mainly the investors), but the negative effects are on the coastal ecosystems, the local communities and national government, which spends large sums of money for rehabilitation.
In order to minimise the negative impacts, it is necessary to protect the natural environment.
This is not only important for people and the environment, but also for the continuity of shrimp farming itself as discussed in CCC III-3-3-7.

Thailand has more than 70 years of experience with shrimp farming. Experiments are being explored by the Thai government in new ways of cultivation, focussing on integrated approaches to management of coastal resource exploitation, based on ICZM principles. These 'new ways' demand an improving knowledge base of natural coastal processes and socio-economic conditions, as well as strengthening integration between relevant national and provincial institutions and local stakeholders. Extensive shrimp culture may be combined with other kinds of land use, such as rice production and mangrove plantations. The experiments in Thailand help increase our knowledge of sustainable shrimp farming.
Capacity building at national and local level is important, some tools are provided: SAMPAK and the Training Manual: 'Aquaculture experiences of Thailand' with lessons from Thailand, see CCC III-3-2-2 and CCC V-1. Both tools can be downloaded from the CCC Website.

Contents

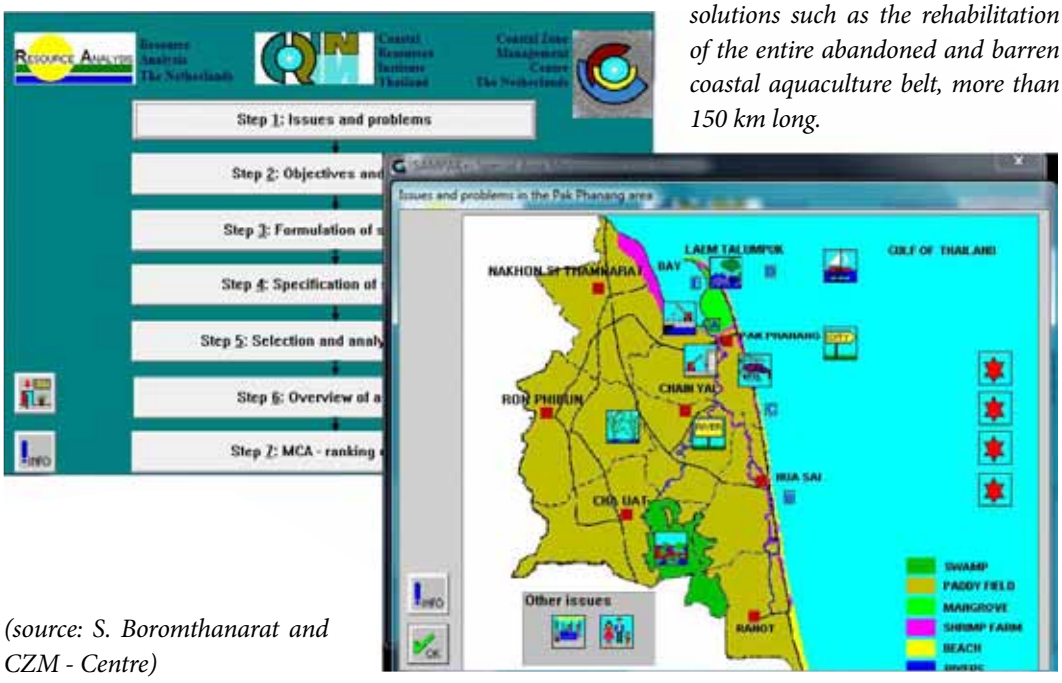


Several boom and bust cycles: *shrimp farming development in the province Nakhon Si Thammarat (1977-2000). The smooth increasing value curve (mthb = million Thai Baht) is also influenced by external world market prices. Major causes of the bust are often environmental degradation and subsequent diseases threatening the exploitation of the shrimp ponds.*
(source: S. Boromthanarat, Somsak & Ayut Nissapa, 2000, adapted)



Shrimp farming development *in Thailand with southward migrating Boom-Bust waves, reaching the southern province of Nakhon Si Thammarat along the Gulf of Thailand and the coastal areas of the Andaman Sea. (source: S. Boromthanarat)*

SAMPAK is an integrated planning tool supporting the Special Area Management of Pak Phanang, a district in the Nakhon Si Thammarat province. It is a member of the COSMO family and is GIS based. It interactively evaluates alternative solutions such as the rehabilitation of the entire abandoned and barren coastal aquaculture belt, more than 150 km long.



(source: S. Boromthanarat and CZM - Centre)

Fisheries and co-management in practice, Thailand

Yves Henocque *(French Research Institute for Exploitation of the Sea, IFREMER, France)*
Sanchai Tandavanitj *(Department of Fisheries, Bangkok)*

***Many faces of the sea** – a tropical slug. (photo: CHARM)*

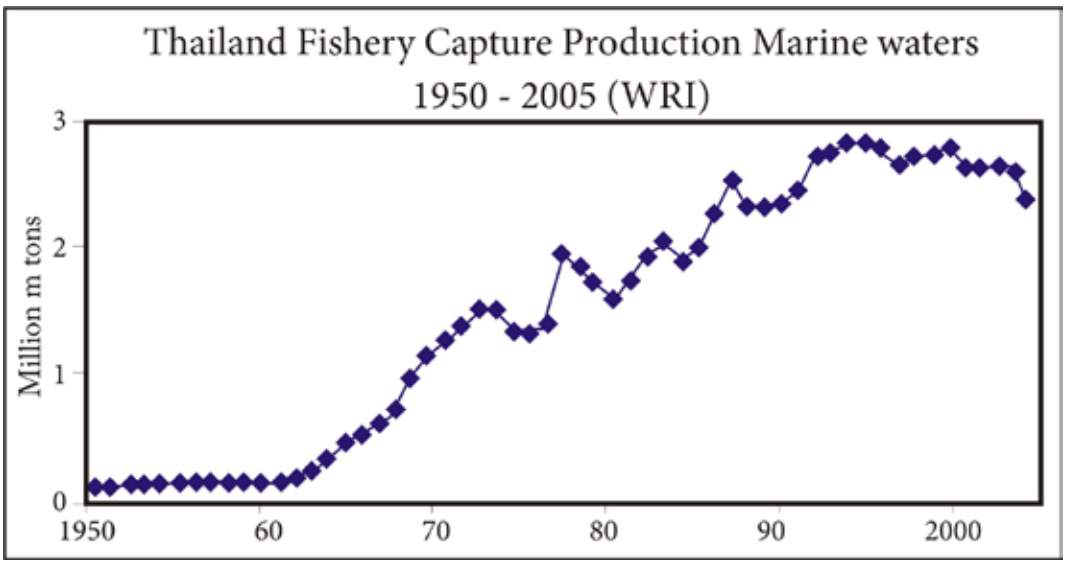
Summary

The Coastal Habitats and Resources Management (CHARM) has developed its approach around five attributes of co-management: participation, partnership, capacity building, development of integrated approaches and methods, and learning and adaptation.
Co-management is a dynamic partnership between resource users and the government. It works at the interface between the ecosystem and the social system and is seeking changes in the state of the first by bringing about changes in the behaviour of the second.
The main reason for the creation of the CHARM project was the recognition that overfishing of the marine waters of Thailand caused negative effects on the marine fish stocks, ecosystems and the coastal fishermen. The total marine annual catch is double the estimated maximum sustainable yield. The Thai government responded, in partnership with the European Commission, by carrying out the large-scale CHARM project between 2002 and 2007

The achievements of fisheries institutions observed in Southern Thailand highlight the validity of co-management in addressing conflicts and gaps in fishery management. Co-management and rights-based fisheries offer a working decentralised system, sustainable at a national level and include some management rights entrusted to the local fishery institutions. This establishes them as partners of the government in management, with user rights, which aim to change their behaviour toward becoming more responsible for local marine resources.
CHARM supported over 200 local fishery projects and showed that the future of coastal resources co-management for better coastal governance in Thailand lies on the one hand with skilled self-organised community-based organisations and on the other with strong, committed and enlightened local government. An example of results of this co-management approach is provided in the improvement of fishery status in the Phang-Nga Bay during 1997-2005.

Self-organization and collective action do not always come easily to fishermen, which often follow local traditions. Because of this, capacity building by government agencies is a prerequisite for ensuring the involvement of most communities in local fisheries management, including conflict resolution. Institutional capacity building, begins at the national level, but must include provincial management bodies and fishing communities. The future fields of engagement should also be broadened to enhance community based tourism and small enterprises. This is a long-term process that will take years and require lasting political will and endeavour.

Contents



Thai capture fishery *in marine waters in metric tons 1950 – 2005, with several interruptions, but with a gradual decline after the 1995 maximum production of 2.8 million m ton (WRI). This recognition of gradually decreasing fish production accompanied by an increased fishery fleet, was one of the reasons why CHARM - project was created. (source: WRI, adapted by R. Misdorp)*

Learning, discussing and adapting *to a changing fishery culture.*
(photo: CHARM Annual Booklet, 2005)

Conclusions - Thailand

Aquaculture and fisheries have been very important drivers of economic development in the coastal areas of Thailand during the last few decades. However, due to a number of unsustainable practices, these developments have not brought continued prosperity and led to severe problems especially, for the local and poor communities, and for the coastal environment. Experiences from the past have provided valuable lessons, which could provide a better basis for future development in Thailand and in other coastal areas in the world.

Lessons from shrimp farming

From the 1990s onwards aquaculture and especially shrimp farming has been booming in South East Asia. Thailand has become one of the major producers. These developments were based on a transition from extensive to highly intensified forms of shrimp production, triggered by high prices and good domestic and export market potential (Japan, USA). Unfortunately, the intensive methods proved to be detrimental to the production systems themselves and their environment and led to several 'boom and bust' cycles. The boom was achieved by rapid exploitation of vast coastal areas, the following bust resulted from degradation of shrimp ponds and the occurrence of diseases. There were also wider effects on the environment such as salinisation of surface water and groundwater, water and soil pollution (from fish food, fertiliser, antibiotics, pesticides and sludge), acidification of soils and destruction of natural vegetation (mangroves) and agricultural lands. As a result, large contaminated and barren coastal areas were abandoned as they could not provide a livelihood for local people. This disrupted local societies and especially affecting the poor. Investors would take short-term profits and move on to the next coastal area. The main conclusion is that the shrimp farming practices in the past have brought wealth to a few rich investors at an extremely high cost to the local community as well as to the national government bearing the rehabilitation. There are a number of lessons.. Firstly, there is an obvious need for sustainable, less intensive aquaculture practices, which can provide a lasting income. This requires investment in spatial planning, improved farm management and environmental protection (including pond refreshment by sea water irrigation and treatment of shrimp pond effluents). Secondly, future aquaculture developments should be under the jurisdiction of local communities, allowing them to protect and exploit their own resources. Because of the harm done in the past, there is a strong requirement to rehabilitate abandoned areas (in Thailand an estimated area of 40,000 ha was abandoned in the Upper Thai Gulf area alone). Rehabilitation is very costly, but necessary to retrieve valuable, indispensable coastal areas. Capacity building is an important element of coastal management. The Training Manual: "Aquaculture experiences in Thailand" is made available, through the CCC website, to promote the application of the Thai lessons in other coastal areas.

Co-management in fisheries

The coastal waters of Thailand (Gulf of Thailand and Andaman Sea) suffer from severe overfishing. The total annual catch in these waters is estimated to be double the maximum sustainable yield. Community-based management (co-management) is considered a powerful way of improving the situation. Co-management is a dynamic partnership between resource users and the government, leading to a community-based and rights-based system of fisheries. The CHARM project (Coastal Habitats and Resource Management) helped with the development and establishment of a framework, which could serve as a model for replication elsewhere in the country. The project identified a number of major co-management issues and developed a scheme to strengthen and liaise with committed local governments and skilled self-organised communities. CHARM supported over 200 projects involving a variety of community initiatives, innovations and developments creating partnerships between government agencies, local community organisations, local resource users and NGOs.
This resulted amongst other things in an increase of fishery catches in an area where decrease due to overfishing is common. Furthermore the most devastating manner of fishing was abandoned.
Major recommendations include the continued strengthening of community enterprises, the enhancement of community based tourism, the engagement of the private sector and further cooperation and integration of the various parties.

CCC Part II - Chapter 8: Vietnam

Holistic approach for coastal problems

Introductory Statement - Vietnam

Pham Khoi Nguyen

Minister of Natural Resources and Environment, Vietnam

Our country has a long and beautiful coast, rich in coastal and marine resources. We exploit these resources at an increasing pace, contributing to our growing national income. The coastal zone of Vietnam is, however, not only an economically important zone but also vulnerable to the environmental consequences of rapid exploitation and impacts of global change.

Vietnam has taken important steps in the last few decades towards managing and developing the use of these resources in a sustainable way. Legal frameworks for balancing coastal economic development with environmental protection are provided. These include the enacted national Strategy for Environmental Protection 2001 – 2010, and the Regulation on the Survey and Management of Marine Resources and Environment 2010, both accompanied by a long-term vision.

As well as providing the legislative base, we have taken important steps in the process of managing our coast in an integrated manner. We realise that the present and the future coastal challenges are complex and need to be addressed in a holistic way. The knowledge of coastal processes is being improved through increased efforts in monitoring and dissemination.

ICZM programs take place at the national level and in pilot provinces, through international and bilateral cooperation. These ICZM programmes delivered a wealth of products and experiences, which have been extended to other coastal provinces in Vietnam.

We also strengthened the institutional ICZM arrangements through creating a dedicated coastal management centre within the newly established Vietnam Administration of Sea and Islands of my Ministry. This focuses on the application of ICZM, on integrated coastal zone planning including sea use and coastal fisheries.

Much effort is needed to keep pace with the rapid modernisation of our country, balancing the economy and environment, and at the same time preparing adaptive, resilient coastal measures to combat the impacts of climate change.

We are looking forward to continuing the important cooperation with the Netherlands in order to identify, plan and implement adaptive responses for our valuable and vulnerable coastal areas.

We welcome this “Climate of Coastal Cooperation” publication reflecting a number of important results obtained in the last two decades of international coastal cooperation.

Vietnam: two decades of Coastal Cooperation

from VA to ICZM, from planning to implementation

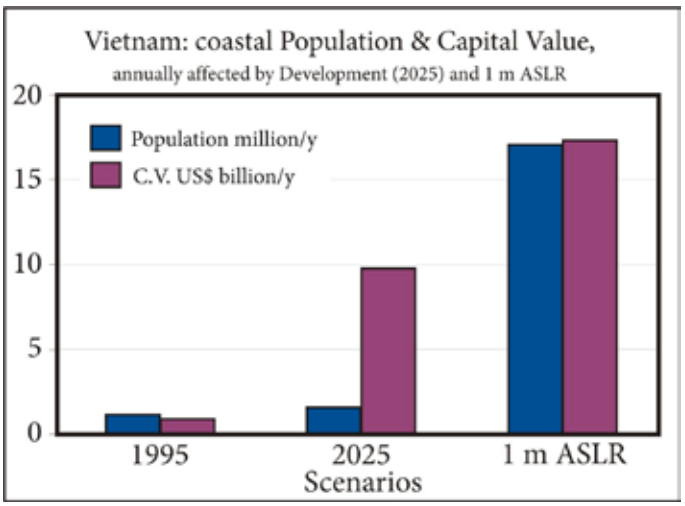
Hua Chien Thang *(VNICZM&CCP National Coordinator, MONRE Ministry, Vietnam)*
Robbert Misdorp *(Coastal Cooperative Programme CCP - Manager)*
Harrie Laboyrie *(VNICZM Co-Director, Royal Haskoning Asia)*
Hans Pos *(VNICZM LRA, Royal Haskoning)*
Rien van Zetten *(Rijkswaterstaat/Ministry I&E, the Netherlands)*
Nguyen Ngoc Huan *(Hydro-Meteorological Service, Vietnam)*

***Coastal erosion** Thuan An, TTHue Province, due to the November 1999 typhoon "Eve". (photo: Robbert Misdorp)*

Summary

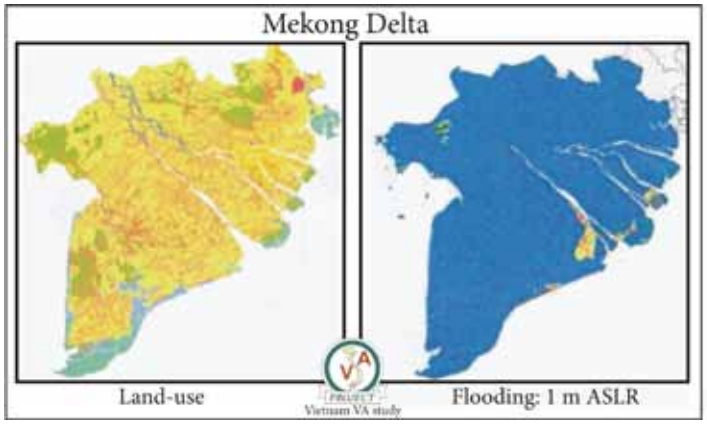
Vietnam has a highly dynamic coast. Its strong socio-economic development, has left it critically vulnerable to the typhoons that regularly reach the coast. The projected impact of climate change makes the coast even more vulnerable. The IPCC Vulnerability Assessment (VA) of a 1 metre sea level rise showed that, if no adaptive coastal measures are taken, millions of people and billions US$ of capital investment would be at risk of annual flooding and rice production would be at serious threat, particularly in the low lying flat deltas of the Mekong and Red River.
Recognising this, the Vietnamese Government has enlisted the aid of others in developing ICZM.
A decision-making process based on holistic Integrated Coastal Zone Management (ICZM) provides a flexible approach to achieving more sustainable management in the interests of the population, economic development and the environment. Following the Vulnerability Assessment, Vietnam has made great strides in developing institutional mechanisms and coastal policies, simultaneously executing ICZM programmes at national and local level, through the Vietnam - Netherlands ICZM project (VNICZM) and the Vietnam Dutch Coastal Cooperative Programme (CCP) These efforts provided valuable experience to help cope with the present and prepare for adaptation to the potential future impacts of global changes, realising the importance of natural ecosystems to coastal resilience.
Concrete results of this cooperation include CZM Strategies and Action Plans at national level and in the three ICZM pilot provinces, and the establishment of a Coastal Management Centre for Vietnam, as well as a variety of achievements related to databases and tools, and dissemination; monitoring programmes; Remote Sensing analyses and application of Geographic Information Systems; intensive capacity building; and awareness raising among schoolchildren, their parents and teachers.
This chapter describes the approaches adopted by the Vietnamese and the collaborative efforts with the Netherlands in preparing the framework and executing coastal projects during the last two decades. The success of these endeavours can be measured by the self-reliant and ongoing efforts of the Vietnam government to start the ICZM process in an increasing number of provinces, supported by the Vietnamese Coastal Management Centre.

Contents



Millions of people in the coastal zone and Capital Value (CV) *will be annually affected due to 30 year socio-economic Development scenario (1995 – 2025) and to the effects of a 1 metre accelerated sea level rise (ASLR) , in case no adaptive measures are taken. (source: Global Vulnerability Assessment, 1993, adapted by R. Misdorp)*

← ***Three pilot ICZM provinces:*** *Nam Dinh – Red River Delta (#1), Thua Thien Hue (#2) and Ba Ri Vung Tau – Mekong Delta (#3). (source: VNICZM-Atlas, 2006)*



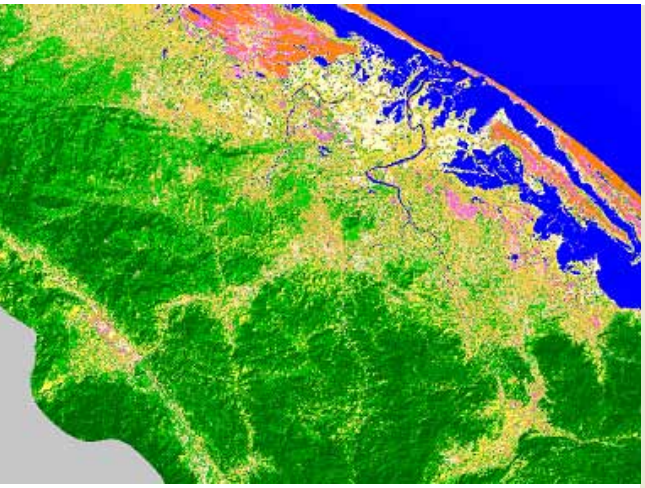
Mekong Delta – Land-use and Flooding.
Land-use: dominant rice cultivation and mangrove belts.
Flooding: the Mekong Delta will be annually flooded under a 1 m ASLR scenario and no adaptive coastal protection measures. (source: Vietnam Vulnerability Assessment, 1994 – 1996)

ICZM Strategy: *Cover page of the ICZM Strategy - Nam Dinh province. (source: VNICZM, 2003)*

Awareness raising: *One of the winning drawings of the primary school drawing contest: "The role of water", which was the start of an educational programme in TTHue province aiming at awareness raising – on water : a friend and foe and on integrated water and coastal management. This programme culminated in the creating of an Introductory Booklet, with the same title as the drawing contest and a comprehensive Training Manual for teachers. The Booklet in Vietnamese and English language was distributed among all 5000 teachers of primary and secondary schools of the TTHue province. Both documents are downloadable from the CCC website, see CCC-Part V. (source: CCP, 2002)*

Remote Sensing applications in TTHue Province

Tran Dinh Lan *(Institute for Marine Environment and Resources (IMER), Haiphong, Vietnam)*
Tom Bucx *(Deltares, Delft, the Netherlands)*
Robbert Misdorp



Satellite image showing the different forms of land-use in the Thua Thien Hue province. (source: © IMER)

Summary

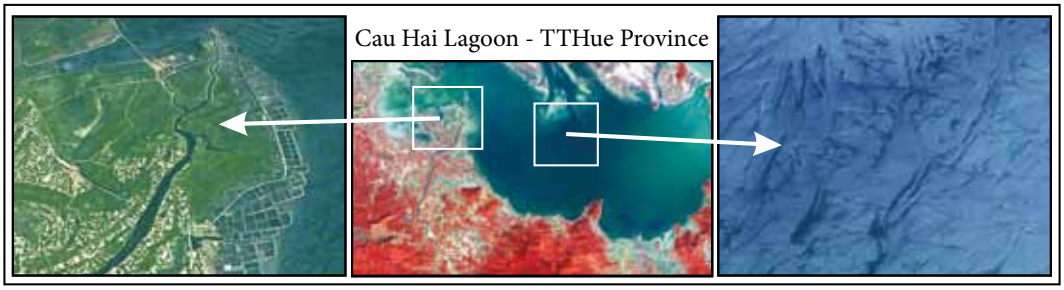
Remote Sensing (RS) combined with GIS (Geographic Information System) is a powerful tool for coastal managers and policy makers. Recognising the value of these tools at a central level, efforts were made to introduce the use of RS at the provincial level through pilot applications and intensive training courses in Hue, capital of the Thua Thien Hue province. These training courses, executed in the framework of the Vietnam-Dutch Coastal Cooperative Programme (CCP), delivered concrete RS & GIS products included a variety of thematic maps on topography and land use, and sequential and spatial RS analyses used for the detection of:

- Changes in land cover and development of soil erosion maps;
- Shoreline changes;
- Rapid aquaculture development;
- Impacts of the November 1999 flooding.

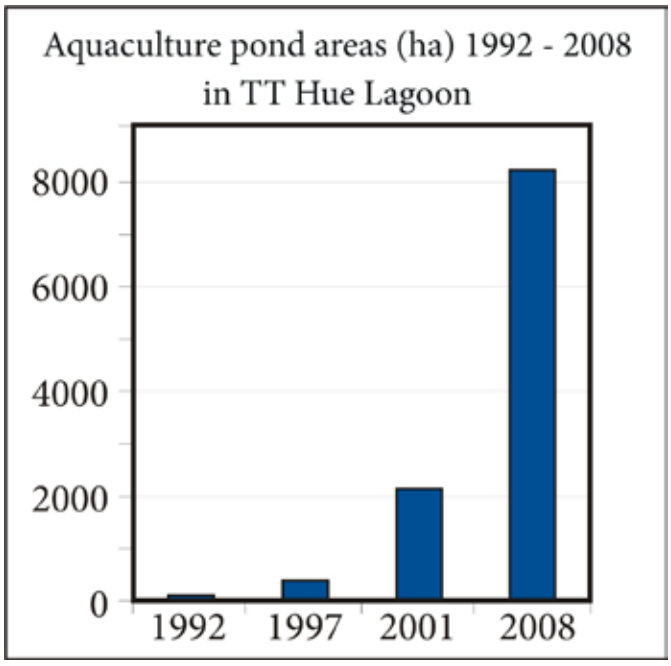
Provincial trainees in TTHue province demonstrated the value of the various applications to the high-level provincial authorities. RS data combined with 'ground surveys' were proven to be very suitable for monitoring, modeling, integrated spatial and sequential analyses in support of ICZM planning and implementation. In particular, the monitoring of flooding events provided a powerful tool to understand flooding mechanisms and to support flood damage assessments, risk analysis and integrated spatial planning of vulnerable low lying areas. However, the use of RS requires skills, knowledge and facilities to be supported at the proper technical and administrative authority levels. Therefore, training courses for coastal managers, policy makers and applied scientists and the development of primary RS facilities are essential requirements for the sustainable management of coastal resources now and in the future. The successful RS experiences in TTHue Province were transferred to other Vietnamese provinces (like in Nam Dinh province, where RS analyses were undertaken in 2004). The Vietnam National RS Master Plan aims to increase RS capabilities both at the national and the provincial level.
Remote sensing interactions between the international, national and provincial experts were shown to be useful for ICZM in the TTHue province.

Contents

Flooding: Composition of Landsat (01-09-1999) and Radarsat (06-11-1999) *to identify flooded areas surrounding the Tam Giam-Cau Hai lagoon (purple shaded) in TTHue province; the deeper the purple the larger the water depth on top of the ground level. More than 2700 mm rain fell in the first four days of November 1999, following the cyclone Eve. The Radarsat image shows the flooded areas. RS combined with flood modelling can assist effectively in rescue operations, damage assessment and post hazard risk analyses. (source: © IMER / Ministry of Agriculture and Rural Development)*



Cau Hai Lagoon, *the southern part of the TTHue Lagoon system with intensive rice cultivation and aquaculture plots (left), and an abundant number of > shaped fish nets (right). (source: © IMER)*



Aquaculture: Strong growth of aquaculture pond area *in the TT Hue Lagoon. Results obtained by sequential RS analyses, a strong instrument for fishery management and determining the carrying capacity of the Lagoon. (source: CCP 2002, adapted)*

Awareness raising: 'Where waters and land meet'

through an educational programme in the Thua Thien Hue province

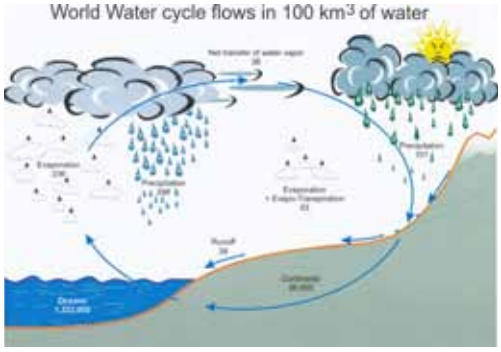
Marta Vahtar *(Institute for Integrated Development and the Environment, Slovenia)*
Le Van Thu *(VNICZM & CCP TTHue Coordinator, Hue, Vietnam)*
Le Thi Anh Dao *(Department of Education and Training, Hue)*
Pham Toan *(Educational Consultant, Hue)*
Robbert Misdorp *(Coastal Cooperative Programme - CCP Manager)*

Flooding! *Red Cross life buoys provide protection.*
(source: drawing contest, CCP2002)

Summary

One of the crucial conditions of an ICZM programme is the participation of the coastal inhabitants, NGOs and stakeholders at the local level. Such participation can be triggered by awareness raising and education. With an eye to the future, children are an ideal target group. Awareness raising and education of children can be achieved very effectively by training teachers of primary and secondary schools. The highest provincial authority, the Provincial People's Committee (PPC) of Thua Thien Hue Province welcomed an Awareness Raising project as a part of the Vietnam - Dutch Coastal Cooperative Programme (CCP). This project was executed through direct involvement of teachers, parents and children on four selected schools and contained a number of elements, including a drawing contest, the creation of a booklet, the creation of training material and the inclusion of material in the national educational curriculum. The participating schools were supported by the educational community of the province and the Ministry. An Introductory Booklet for teachers was produced in the Vietnamese and English language, illustrated with the price winning drawings from the contest and distributed among all teachers of the primary and secondary schools in the Thua Thien Hue province. The next product was a comprehensive Training Manual developed also for the teachers with sections showing a conceptual model of the water cycle, the role of water and a part on the use and management of water, exemplified with many practical exercises. The success of this awareness-raising educational programme is illustrated by the fact that the two other Vietnam- Netherlands ICZM pilot provinces: Nam Dinh and Ba Ria Vung Thau have applied this Manual in their provinces.
Both, the Introductory Booklet and the Training Manual are made available and can be downloaded through the CCC website (CCC-V).
The next step is for the national Ministry of Education to make these products available for all coastal provinces in Vietnam.

Contents



Book cover of the Introductory Booklet for teachers *of primary and secondary schools, 5000 copies in Vietnamese language distributed to all teachers in the TT Hue Province (Vahtar et al 2003; Photo: Le Van Thu). This booklet introduces the cycle of water, water as a valuable resource and as foe, and how integrated management approaches contribute to a sustainable use of water. (source: CCP2002)*

Children living near the lagoon *seeing their father fishing. (source: drawing contest, CCP2002)*

Children of the world holding the line*, preventing the pollution to spread from the land to the healthy blue water and safeguarding the fishes. (source: drawing contest, CCP2002)*

Resilient Vietnamese family during flooding. *(photo: International Federation of Red Cross and Red Crescent, Vietnam)*

Integration of knowledge for quality advice in TTHue province:

predicting impacts on the state of the coastal ecosystem

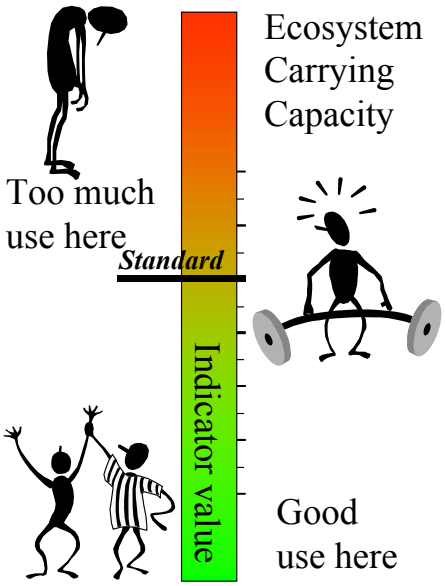
Mindert de Vries *(Deltares, the Netherlands)*
Le Van Thu *(VNICZM and CCP TTHue Coordinator, Hue)*
Ton That Phap *(University of Hue, Hue, Vietnam)*
Thi The Nguyen *(HWRU, Faculty of Coastal Engineering, Hanoi, Vietnam)*
Robbert Misdorp *(CCP Manager)*

The Thua Thien Hue province *with the main rivers and the largest lagoon of SE Asia which is intensively used: rice cultivation, fisheries, aquaculture and navigation. (source: Vietnam-Netherlands ICZM Project Atlas)*

Contents:

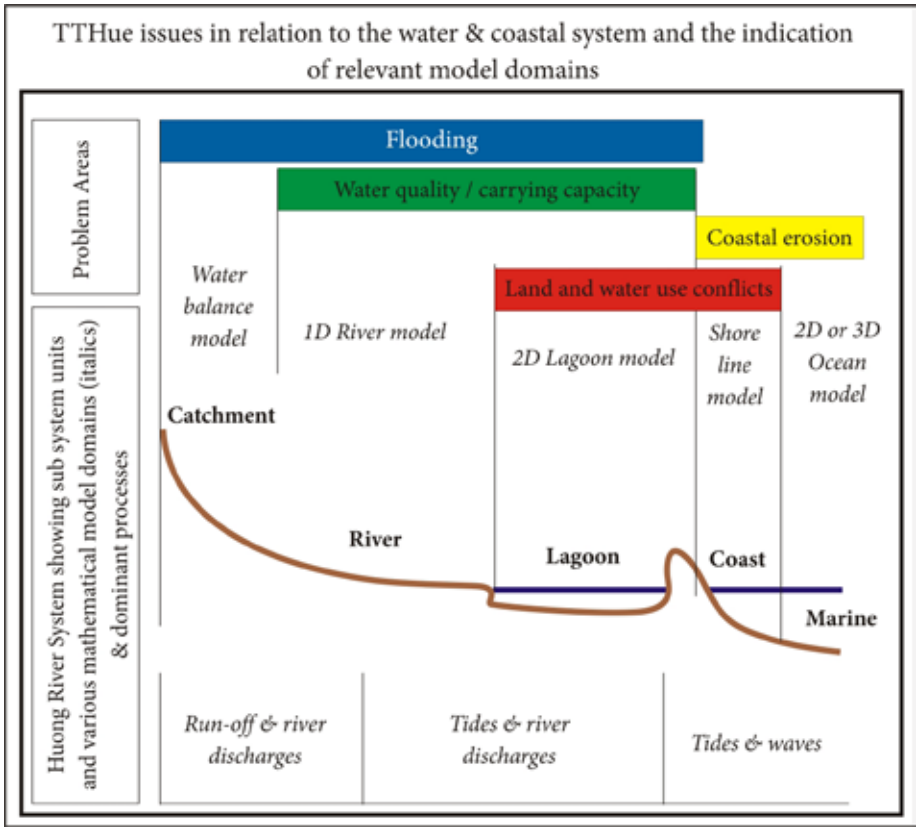
Summary

One of the main aims of the Vietnam-Netherlands ICZM project and Coastal Cooperative Programme (CCP) in Thua Thien Hue was to provide the province with ICZM tools. This to strengthen the capabilities and to improve the quality of the decision making processes for the management of the TTHue Lagoon area and its surroundings. The TTHue Lagoon is the largest lagoon of SE Asia and provides livelihood to about one hundred thousand families. The lagoon is a highly dynamic and sensitive system governed by a complex set of interacting processes. Extreme flooding and coastal erosion are causing major problems. The rapid development of economic activities, such as aquaculture, fishing, rice production, transportation, tourism are seriously threatening the state of the lagoon through overexploitation and water pollution. Methodologies were introduced and developed to quantify the state of the Tam Giang – Cau Hai - Thuy Tu Lagoon ecosystem and the impacts of human interventions through integrated modeling, based on the concept of ecosystem carrying capacity. Coastal hydraulic models and a GIS water balance model of the TTHue river basins, supported by the results of morphological, chemical and biological CCP monitoring of the lagoon and remote sensed aquaculture developments were important building blocks of the integrated ecosystem modeling. Training was a fundamental part of the project. The modeling efforts culminated during one of the hands-on training CCP workshops in Hue. The water quality of the rivers and lagoon deteriorated during monitoring period, meaning that the resource use of the lagoon exceed its capacity for natural purification. Some historic trends regarding fish catches, bird counts and macrophyte coverage confirm the heavy pressure on the Lagoon.
The impacts of the strongly growing human activities, especially aquaculture and fishing, exceed the carrying capacity of the Lagoon. Preliminary modeling results based on scenarios of future human activities and climate change were also demonstrated.
A series of recommendations to improve future use of the Lagoon based on the future scenarios of human use were provided. One of these advices involved the creation of an inter-university and international coastal cooperation in the field of integrated ecosystem monitoring, modeling and policy preparation in order to support sustainable exploitation and good governance of the TTHue Lagoon. The results were presented to and welcomed by the high level provincial authorities.



Depicting the concept of carrying capacity *of an ecosystem in relation to its use and self restoring capability.*
How to quantify this concept in modelling terms attractive for policy makers preparing sustainable uses of the TTHue Lagoon.
That was the question. (source: CCP2002)

Intense use of the borders *of the Lagoon: rice paddy fields next to aquaculture ponds in the Tam Giang - Thuy Tu Lagoon, TThue province, 2004. (photo: Mindert de Vries)*



TTHue issues *in relation to watersystem and indication of relevant model domains. (source: CCP 2002, adapted)*

Capacity Building: Hydraulics & Coastal Engineering

in Vietnam within an ICZM frame

Gerrit Jan Schiereck *(Delft University of Technology, the Netherlands)*
Vu Minh Cat *(Water Resources University (WRU), Hanoi, Vietnam)*
Marcel Stive *(Delft University of Technology, the Netherlands)*
Robbert Misdorp

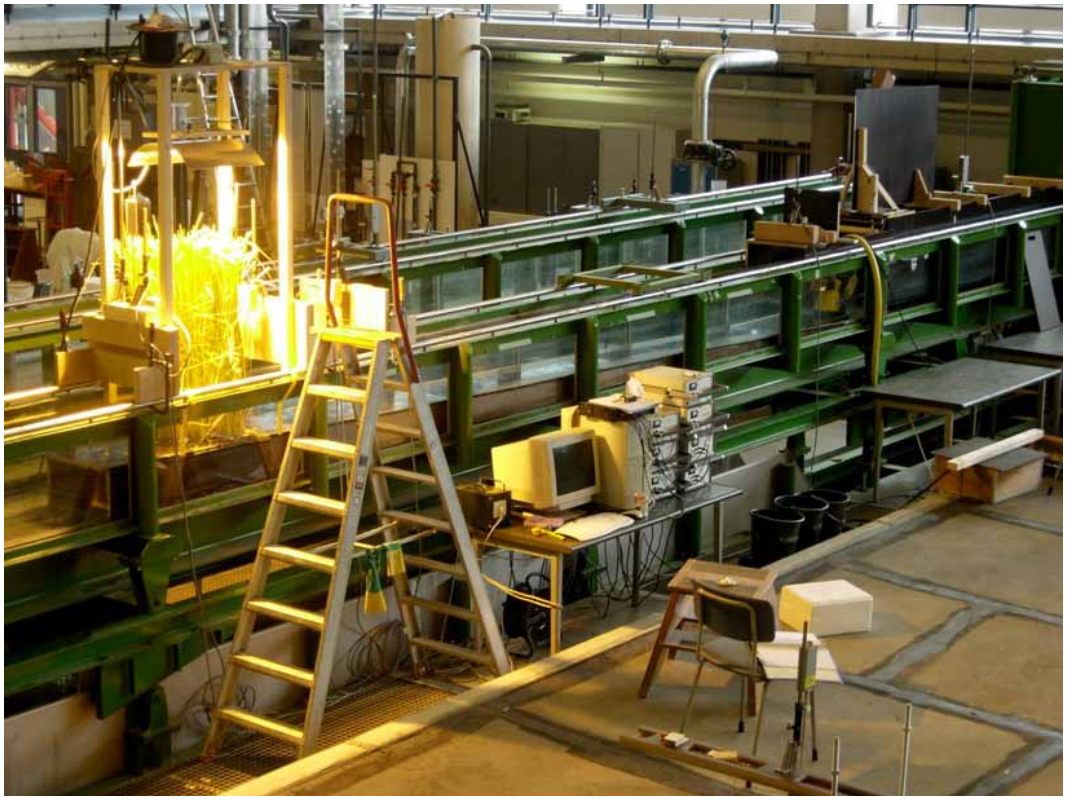
The strength of inner dike slopes *cannot be tested on a small scale and tests have to be done on real dikes. Realistic overtopping volumes are simulated with a Wave Overtopping Simulator in the same way as is done in the Netherlands. (photo: G.J. Schiereck)*

Contents

Summary

Vietnam has a long coastline including two large river deltas and about 20 smaller estuaries in between. Much of the country is a "coastal zone". The need for education in coastal issues in Vietnam became evident.
Two decades ago a coastal education programme between Vietnam and the Netherlands began. This cooperation resulted amongst other things, in the establishment of a coastal engineering education faculty at BSc-level at the Water Resources University (WRU) in Hanoi in the period 2001 – 2005. Staff members were trained and more than 50 BSc students graduate annually. In the second phase of the cooperation (2005-2009), the focus shifted to research in two fields: sea dikes and estuaries. In the framework of these two fields of applied research: MSc education and research in Hanoi and PhD training in Delft, the Vietnamese knowledge base of coastal engineering and ICZM is strengthened. Continuously increasing the educational level parallel with the strong economic growth is the desire of Vietnamese authorities. This will provide the answers needed to address global change in a sustainable way.

***Coastal dynamics** play an important role along the Vietnamese coastline. Here in Nam Dinh, part of the Red River Delta coast, complete villages have disappeared due to coastal erosion. (photo: G.J. Schiereck)*



***Laboratory wave flume:** tests to study the reduction of damages of wave overtopping, by Vetiver grass. (photo: H-J.Verhagen)*

Capacity building and training for ICZM

Experiences from Vietnam

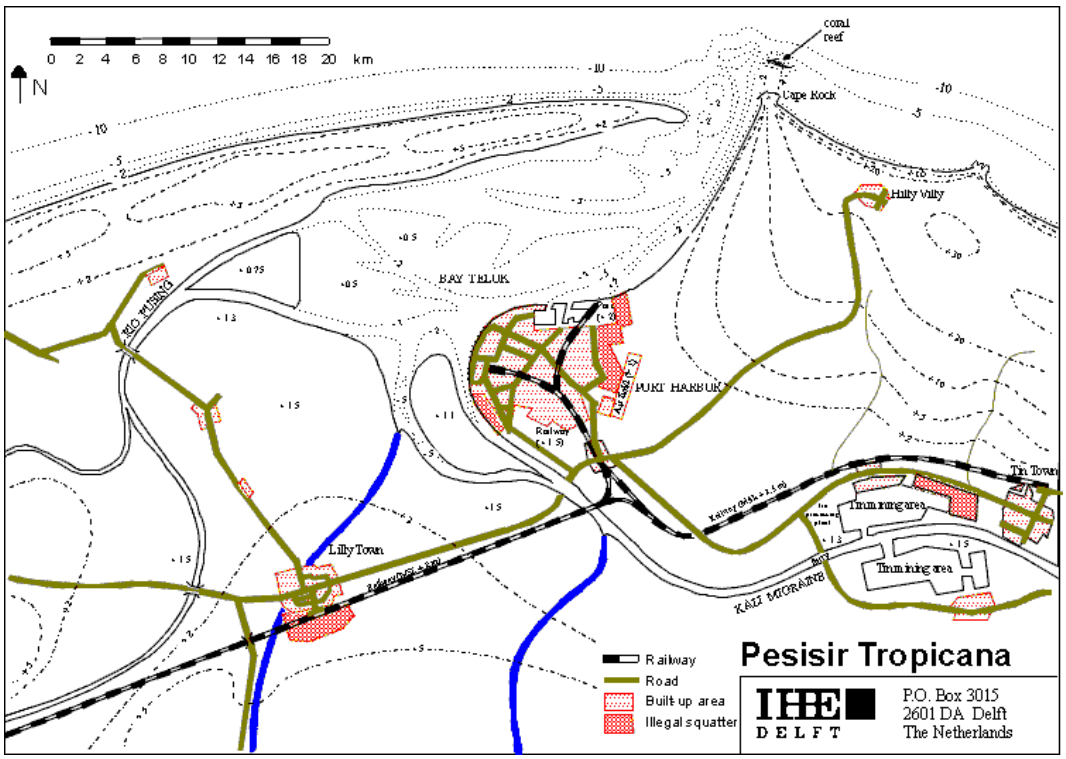
Marcel Marchand *(Deltares, the Netherlands)*
Ho Thi Yen Thu *(Centre Marinelife Conservation & Community Development, Hanoi)*
Henk-Jan Verhagen *(Delft University of Technology, Delft, the Netherlands)*

Training the new generation ICZM trainers. *(photo: Marcel Marchand)*

Summary

Any Integrated Coastal Zone Management (ICZM) programme is based on knowledge of the socio-economic development and understanding of natural coastal processes. Increasing the knowledge base through training is a crucial element in the establishment of effective coastal management. During the Vietnam-Netherlands ICZM project, much attention was given to the training aspects and a lot of experience in was obtained. More than 500 people, active at all governmental levels and in non-governmental organisations, were trained in the principles of ICZM. It proved to be important that the programme was tailor made, with different objectives for each target group. Training should not only be for the transfer of knowledge, but also for imparting training skills and tools. Valuable training tools such as the 'Pesisir Tropicana' simulation game and role-playing were used. In addition, training in new interdisciplinary work, creative thinking and problem-based learning, is important for effective ICZM planning and implementation. Finally, it is essential that the training programme is the start of a capacity building exercise and awareness-raising process that can continue after the training programme has ended. Therefore, ample attention was paid to the aspect of 'training-the-trainers' and the provision of training material in the local language.
This approach proved to be highly successful. The new trainers are now teaching the next generation of ICZM managers in Vietnam, facilitating the implementation of new ICZM programmes at national level and in other coastal provinces.

Contents



The exercise 'Pesisir Tropicana' *is a simulation game facilitating decision making in coastal resources allocation. Decision makers have to decide on an investment plan in the Pesisir Tropicana area, making choices between various alternatives, and have to overcome several dilemmas, all under a certain time pressure.*

Netcoast Open Learner - UNESCO-IHE website provides a short manual and introduction of the principles of policy analysis – Pesisir Tropicana: http://www2.ihe.nl/we/dicea/polanaly/pes04/default.htm?http://www2.ihe.nl/we/dicea/polanaly/pes04/jesew.htm

Conclusions - Vietnam

In the period from 1993-2006 a number of large cooperative projects were carried out, in Vietnam with Dutch expertise and financial support of the Netherlands Ministries of I&E and Foreign Affairs through its Embassy in Hanoi. This contributed significantly to the development and application of ICZM practice in Vietnam on both the national and regional/local levels. The main developments relate to the following topics:

- From vulnerability assessment to ICZM, introduction and development of ICZM;
- Practical ICZM applications at a regional level;
- Capacity building, awareness raising and education.

From vulnerability assessment to ICZM: introduction and development of ICZM

The Vietnamese contribution to the World Coast Conference – 1993, marked the beginning of a long lasting cooperation between Vietnam and the Netherlands. This was followed by the execution of the Vietnam Vulnerability Assessment (VVA) from 1994-1996. The VVA was undertaken according to the UN-IPCC Common Methodology. The VVA concluded that Vietnam is very vulnerable to a wide range of impacts and in a way is comparable to the small island states of the world. The Vietnam-Netherlands ICZM project (VNICZM - 2000-2006) supported by the Coastal Cooperative Program (CCP - 2001-2006) marked the next steps in coastal cooperation, with the VNICZM covering the national and provincial planning level and the CCP aiming at developments and projects at the provincial and local level. In the TTHue province several ICZM tools were introduced, monitoring programmes executed, awareness raised and capacity built.

The achievements of VNICZM include: a national and three provincial CZM Strategies and Action Plans (SAP); the establishment of a CZM Centre for Vietnam; improved accessibility of databases and GIS; capacity building and awareness raising. These national activities were simultaneously executed with the ICZM programmes in three Vietnamese provinces: Nam Dinh (Red River Delta), Thua Thien Hue (central) and Ba Ria Vung Tau (North part Mekong Delta). Pilot projects in these provinces included: coastal dynamics; ecotourism potential; lagoon management; commune level evaluation; subsistence fisheries; and oil spill contingency planning.
The CCP was involved with deepening of a number of ICZM tasks, focusing on Thua Thien Hue province and included a variety of tangible projects at the provincial and local level. The CCP – TTHue projects contained morphological, biological and chemical monitoring of the dynamic coastal system, RS&GIS hands-on training, awareness raising through an educational programme and lagoon ecosystem modelling, In addition, attention was paid to strengthening the relationship between the two national governments, and the local governments.
The cooperation program was involved with the whole range from ICZM planning to the first phase of implementation, establishing an integrated management framework and identifying adaptive coastal measures.

2) Practical ICZM applications on regional level

Remote sensing application in Thua Thien Hue province

Remote sensing (RS) techniques can provide valuable support to coastal planning by establishing ICZM databases (using Geographic Information Systems - GIS), the creation of maps of various types drafting zoning plans and for environmental and coastal monitoring. Thua Thien Hue province had limited RS knowledge and no practical experience with RS. The challenge was to provide the relevant TTHue provincial institutions with practical RS & GIS knowledge in possession of the national RS institutes of Vietnam and the Netherlands. Two intensive, hand-on training courses were prepared and organised in Hue and delivered a wealth of results dealing with various digital maps of the province, mapping of flooding, changes in land use, soil erosion, aquaculture and shoreline developments. All this information culminated in an integrated ecosystem lagoon model estimating the carrying capacity in relation the resource uses of the lagoon.

The RS results illustrate the potential for RS in combination with ground analysis, to be a very powerful and useful tool. However, the use of RS also requires adequate resources to be provided by the appropriate authority to ensure continuity.in the application of RS.

Ecosystem approach to Tam Giang-Cau Hai Lagoon
An ecosystem approach was applied to Tam Giang-Cau Hai Lagoon in Thua Thien Hue province focusing on the assessment of the carrying capacity. It was based on a comprehensive description of the system combining the physical, biological, social and economic information into a framework for decision making. The framework was applied at various levels, addressing and facilitating communication between stakeholders, planners, managers and decision makers. The carrying capacity depends on the pressures inflicted by the various users (farmers, fishermen) and on the natural dynamics. Extensive consultation took place with local people in the fishery village Thuan An on the border of the lagoon. Tools were developed and applied to support a comprehensive model of the lagoon area (water balance model and 2D model of the lagoonal water quality). These valuable results were presented to and appreciated by the provincial authorities.

3) Capacity building, awareness raising and education

Capacity building, awareness raising and education are a necessity to ensure continuity in ICZM development and implementation. In the Vietnam – Netherlands coastal cooperation these elements were explicitly included on different levels and in different forms. A broad and multilevel training programme was included as an integral part throughout the programme. In addition, a number of specific activities were undertaken aimed at capacity building in hydraulics and coastal engineering and the education of children at primary school.

Awareness raising through practical education of children
With an eye to the future, children are important for raising awareness. They are also enthusiastic communicators, promoters and ambassadors. The most effective way of awareness raising in children is to train primary school teachers. This was the subject of an educational program in primary schools in Thua Thien Hue province as part of the Coastal Cooperative Programme (CCP), involving all the relevant educational institutions and four schools in TTHue Province. The program took place through direct involvement of teachers and children, their parents and included a drawing competition, the creation of a introductory booklet for teachers, the creation of two sets of comprehensive teaching material for training the teachers. This training manual is available through the CCC website.

Capacity building in hydraulics and coastal engineering
One of the requirements identified was the need for an adequate Faculty of Marine and Coastal Engineering in order to solve the problem of lack of staff with adequate knowledge of coastal issues. Cooperation between the Water Resources University (WRU) of Hanoi, the Technical University of Delft, Unesco-IHE and WL-Delft Hydraulics/Deltares enabled the establishment of a coastal engineering faculty at WRU. Following an inventory of specific demands, the focus of the new faculty was on sea dikes (flooding, typhoons) and estuaries (sediment dynamics) together with a number of other aspects like ICZM.

The training component within the ICZM cooperation program
The training activities within VNICZM involved over 500 people, aiming at both capacity building and awareness raising. The training program was set up as part of a continual process, with specific attention paid to 'training the trainers'. Training needs of various types were identified at all governmental levels focusing on civil servants. Types of training included training courses, career planning, on-the job training, feedback and practical experience, and role-playing. One example of a practical role-play exercise for decision making in coastal resource allocation, was based on a hypothetical situation of a tropical island ('Pesisir Tropicana'). The success of 'training the trainers' is demonstrated by the fact that the new trainers are now teaching the next generation ICZM managers of Vietnam.

Synthesis – CCC Part II: Asia

ICZM progress and achievements in the CCC Asian nations and Island States

There is a lot of common ground between different countries and their coastal zones.
The exponentially strong growth of population and economic development is present in most countries and particular in the coastal zones. High population density is often caused by coastal urbanisation. Poverty is being combated by strong increase in economic productivity of the Asian population.

These common developments are often accompanied by problems, especially problems in the coastal zone. Among the most general of these are coastal erosion, water and soil pollution, degradation of habitats and natural resources (unsustainable use and overexploitation) and natural hazards related to storm surges, cyclones and tsunamis. Furthermore impacts of climate change will exacerbate these challenges.
Compared with other continents, Asia has a highly valuable but also critically vulnerable coastal zone now and more over in the future. This is why the Asian continent has such a prominent place in this CCC publication.

In Asia, there is a wide variety of development stages with respect to ICZM experience, application and implementation in individual countries. These conditions relate to differences in the seriousness of threats and the potential of the country, region or community to cope with them (in terms of financial resources, technical capabilities and institutional structures).
The examples of the three island states, show that all are quite different in nature, but all three are highly vulnerable to the effects of storm surges and tsunamis. The three island states, each in their own way, have taken steps to reduce their vulnerability to these hazards.

All countries wish to increase their knowledge in coastal and hydraulic engineering, sediment transport mechanisms, bio-geosciences, water quality, integrated ecosystem modelling and the development of decision support systems, and data management. Capacity building, awareness raising and education have been adopted as essential elements in ICZM development programmes in all countries.
The potential for educating children at primary school by involving teachers merits particular attention. Data collection, monitoring and dissemination are also critical factors in ICZM application. As was shown in the Vietnam example, the use of Remote Sensing techniques at a local level is a particularly powerful and promising tool. These common needs in ICZM development thus provide a large potential of sharing knowledge among countries.

All countries considered here have adopted the ICZM approach as a guiding principle for the planning and management of coastal resources. The history and stage of ICZM development may be quite different, however. Sri Lanka and to a lesser degree also Bangladesh have a long history of experience in ICZM. Most other countries have adopted the concept more recently, particularly in the last decade. Depending on the specific situation, solutions and courses of action may be quite different. Although the application and implementation of ICZM is based on a general approach to common problems, the outcome of the process should always lead to tailor made solutions.

Generally getting ICZM to work requires continuity in coastal planning in order to ensure the implementation stage is reached. ICZM is a continuous process that needs to be embedded in planning procedures and administrative and institutional systems. This is a long-term process which may take several decades. The implementation stage has not been reached in most of the Asian countries. Even in Sri Lanka, where a Coast Conservation Act came into action as early as 1983, experience still show important weaknesses in the powers and mandates of the coastal authorities and the underlying legislation, which is also true for the other Asian countries. This seriously hampers the implementation of the steps beyond the planning stage. Consequently, institutional difficulties and the lack of national focus, effective leadership and coordination, results in many cases in the ICZM policy

and strategy directives remaining unimplemented. Lack of resources (funds and technical capabilities) reinforce these problems.

A very serious common threat comes from the unsustainable use and exploitation of coastal resources. This is manifest in the explosive growth of intensive aquaculture (shrimp farming), which began in the 1990s. The resulting boom and bust cycle in aquaculture development has caused severe damage to the coastal system and the livelihood opportunities of local communities. This illustrates the conflict between maximizing short-term profit for investors with the long-term requirements of the local population. From these experiences, important lessons have been learned but at high cost. The challenge is to prevent the same thing happening again.

An important difference in a particular country and approaches to managing the coastal zone is one of scale. China is an example of a fast growing economy that can generate the resources and skills for large-scale approaches to solving existing problems and to developing new coastal infrastructure. An example of the first of these is the successful, large-scale rehabilitation of water quality in Suzhou Creek and Lake Tai. Examples of the second are the coastal developments following the eco-city concept, which aims to avoid future problems by integrated environmental planning. There are other examples, e.g. related to flood protection structures as in Bangladesh. However, in most cases the causes of problems and the possible solutions are considered at a much smaller scale when it is important to involve local communities and organisations. In the various country cases, there are many examples, which stress the need and potential of such a local approach.

A number of country cases focus on the possibilities of reducing the vulnerability of coastal areas to natural hazards (storm surges, cyclones and tsunamis). Examples of these come from Andhra Pradesh (cyclone vulnerability) and Indonesia and Seychelles (tsunami mitigation). From these cases, it is clear that the possibilities for reducing the vulnerability of coastal regions can and should be an explicit part of ICZM planning and implementation. The Indonesia example reinforces the need for enhanced tsunami protection and preparedness. Whilst the example from the Seychelles demonstrates the enormous benefits that can be achieved if appropriate spatial planning result in successful implemented of measures (e.g. conservation of the vegetation belts).

At last, two important lessons from Vietnam are: Mix the long term, rather abstract ICZM activities with the rather down to earth activities directed at solving a number of short term coastal problems in a no regret way, and secondly plan and implement an ICZM programme simultaneously at national, provincial and local level, strengthening vertical integration enabling problem solving by (inter) national funding and handing (RS) knowledge intensive technology to local level, there where the problems are most manifest.

The commonality of the problems and the differences in ICZM approaches to overcoming them means there is an opportunity to exchange information, knowledge, data and modelling tools.

CCC Part III

Concepts, Tools and Measures

What is ICZM?

Basic elements of coastal cooperation

Robbert Misdorp

The CCC-Production highlights in Parts I and II the results of a number of coastal projects which were or are actually being executed within an cooperative, integrated framework.
Part III deals with a number of ICZM concepts, planning tools and coastal measures. This chapter 'What is ICZM?', shortly discusses the basic elements of such an integrated framework.

Coastal characteristics

Coastal zones are diverse, valuable and productive areas attractive to people who live, work and recreate there. They occupy only 15 % of the land, but are home to about half of the world population. They are dynamic places with interactions between, land, sea, rivers and atmosphere and serve many important socio-economic functions. It is here that many human activities are concentrated, increasing the standard of living but at the same time causing serious environmental problems.
The narrow coastal zone can be considered as triple squeezed: from the land and from the sea side through socio-economic pressures and unsustainable resource use, and in time. The spatial squeeze will be felt more intensively by the coastal inhabitants in the future, because of global change e.g. anticipated impacts of climate change (Figure 1).
The coastal system is subsystem of the entire world ecosystem, including the land and the fresh water systems (Figure 2).
Understanding the interactions within the ecosystem is important to both scientists and policy makers and is the subject of scientific programmes such as IGBP (International Geosphere-Biosphere Programme), and ICZM programmes. Increased natural and socio-economic knowledge is more and more applied in integrated spatial planning, where marine planned activities and their impacts are connected with those in the terrestrial part of the coastal zone (see CCC I-2-3 North Sea and CCC I-3-1 EU-Plancoast).

***Crowded sandy beaches squeezed between the land and the sea**. Beach recreation and tourism are economically important contributing about 4 % to the world's gross domestic product, which in some coastal (island) nations can be as much as 50 % of the national GDP. (photo: Harry van Reeken)*

***Coastal wetlands, such as mangrove ecosystems**, are very valuable resources providing a buffer against hazards such as typhoons and tsunamis, breeding and nursery grounds for many (commercial) fish stocks, acting as pollution sinks, providing natural herbs and medicines and subsistence livelihood for many coastal inhabitants. (photo: Tjark van Heuvel)*

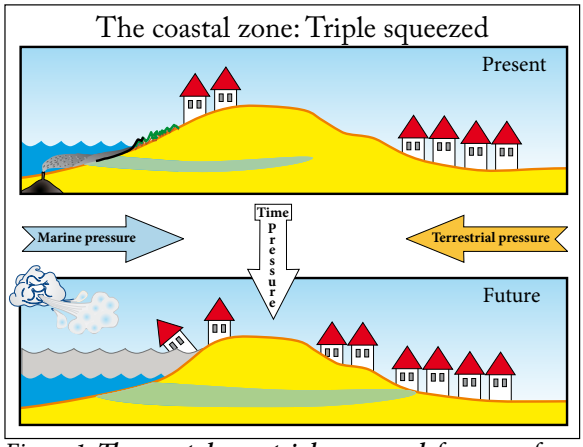


*Figure 1: **The coastal zone triple squeezed**: from sea, from land and in time. (source: R. Misdorp en H. van Reeken)*

Integrated Coastal Zone Management

The densely populated coastal zones are valuable ***and*** vulnerable areas: a challenge to manage. Sustainable management of such complex systems requires a holistic, integrated approach to decision-making for long-term sustainable exploitation in the face of the challenges of global climate change.

This approach is based on spatial integration between the rivers, coasts and marine areas finding solutions to short and long term problems.

ICZM 'formalises' coastal cooperation, promoting the structured application of a management system for transparent governance and stakeholder involvement.

Space is becoming a scarce coastal resource, also in the USA. This led to adoption of the US Coastal Zone Management Act (a legal framework for the entire country) as early as 1972. The coastal states of the USA also set up CZM authorities and developed their own CZM programmes (http://coastalmanagement.noaa.gov/).

Many European and Asian coastal countries followed in planning ICZM programmes.

A definition and elements of an ICZM programme

Many definitions of ICZM exist. Most involve an integrated approach with both vertical and horizontal coordination. The 1993 World Coast Conference (WCC'93) recognised that: "ICZM has been identified as the most appropriate process to address current and long term coastal management issues, including habitat loss, degradation of water quality, changes in hydrological cycles, depletion of coastal resources, and adaptation to sea level rise and other impacts of climate change".

The WCC'93 defined ICZM as follows: "ICZM involves the comprehensive assessment, setting of objectives, planning and management of coastal systems and resources, taking into account traditional, cultural and historical perspectives and conflicting interests and uses; it is a continuous and evolutionary process for achieving sustainable development" (see WCC, 1994).

A cycle of ICZM consist of a strategic ('Governance') and operational ('Tasks') level and four stages/phases (Table 1). The ICZM cycle is an iterative process taking many years and with the involvement of many stakeholders. Understanding coastal, natural and socio-economic processes is fundamental to balanced decision-making.

Another form of cooperation, often in a smaller area, is called Integrated Coastal (& Marine) Area Management with examples in India (Chennai, CCC II-3-2) and in Rotterdam (CCC I-2-2).

The coastal system captured in an abstract model thinking

Structured analyses of coastal systems form the basis for ICZM planning tools, facilitate decision-making and include four major interacting components:

- The *agents of change* are driven by the socio-economic demands, natural processes and impacts of climate change;

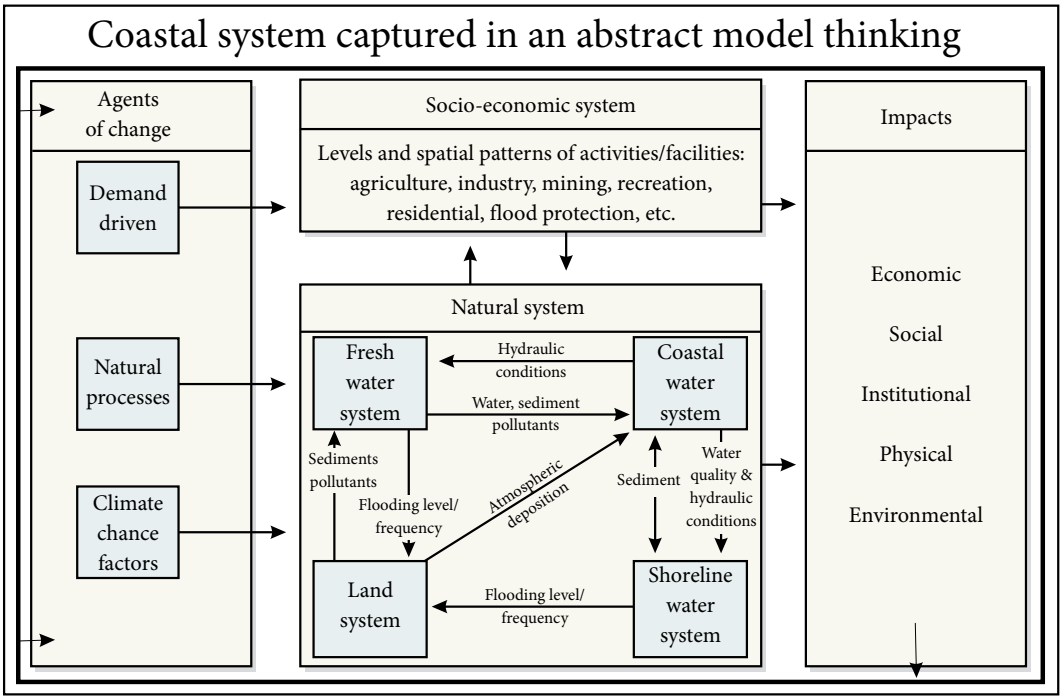


Figure 2: ***A coastal system representation*** *with interacting (main) components. (source: WCC'93)*

- The *socio-economic system* encompassing the many functional uses and activities;
- The *natural coastal system*, subdivided into four subsystems;
- Five *fields of impacts* looped cyclic back to the agents of change.

This conceptual model helps quantify the relationship between the dynamic, interactive and highly complex components of the coastal system.

Common concepts for coastal cooperation

There are a number of common concepts, which lay the foundation for coastal cooperation. Sustainable development of coastal resources, increasing coastal resilience, working with nature and working together, form the basis for effective integrated management. Using the analogy of 'Playing Rugby' (Figure 3): It is clear that a successful team is one where individuals work together. This holds true when undertaking ICZM. It requires meticulous teamwork, it takes time, the end result counts and

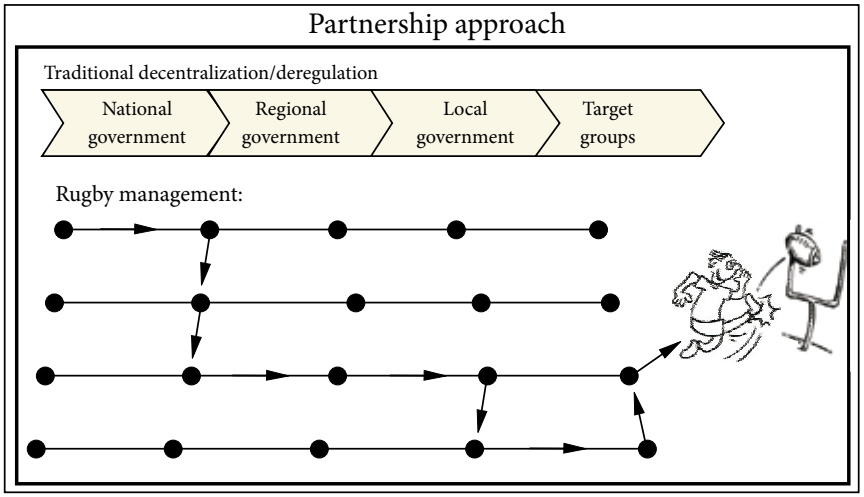


Figure 3: ***The Playing Rugby Management*** *approach through team-playing: Scoring, reaching the goal is important, who scores is less important = the essence of coastal cooperation; by P.Winsemius, former Minister of Environment, The Netherlands. (source: WCC'93, adapted)*

Main Elements of Coastal Zone Management

Coastal Zone Governance							
Arrangements			Objectives			Ethics	
Organizational structure	Legal framework	Tradition and social norms	Safety Resource Management Sustainable Development			Integration Harmonization Participation	
Coastal Zone Management Tasks Iterative cyclic process							
Problem Recognition	Planning			Implementation			Evaluation
Problem Analyses	Data Collection	Policy Development	Decision Making	Plan Execution	Operation & Maintenance	Monitoring	Assessment & Outlook
Coastal Zone Management Instruments and Capacities							
Applied knowledge of coastal system	Physical, Chemical, Biological	Systems analysis: - Natural system - Socio-economic - User functions - Management system	Decision Support Systems	Regulatory & Non-regulatory Measures	Operational procedures - Enforcement - Maintenance - Hazard Management	Objective oriented monitoring	Objective oriented evaluation
Public Consultations	Demographic, Economic		Cost and Benefit analysis	Funding mechanisms		Research and analysis facilities	Open procedure with users
Education & Awareness Programs	Natural resources accounting	Multi disciplinary Cooperation	Open planning with users	Guidelines		Remote Sensing & GIS databases	Public consultations

Table 1: Main Elements of a Coastal Zone Management programme (source: CZM-Centre -1996)

it is not important who finally scores the goal. The rugby analogy emphasises the importance of joint responsibility for the result. Central management, provides the initial vision and leadership, retaining the main responsibility and most importantly helping the partners in passing the ball. These concepts are important for the successful implementation of any ICZM programme.

The CCC cases and planning tools placed in ICZM perspective

The activities, the cases and tools, which are described in the CCC-Publication cover many of the fields of ICZM. Most of the CCC Chapters cover one or just a few of the ICZM elements. Only a few of the CCC chapters cover (almost) all the fields. One of the examples of planning ***and*** implementation is the sustainable development of Rotterdam harbour (1993 – 2010). A complete ICZM cycle takes time, considerable effort, endurance and money. The last of these is not always available for the long period of time necessary to complete a cycle of an ICZM programme. However, once fully executed coastal cooperative programmes and ICZM reveal that these efforts are worthwhile in both an economic and environmental sense.

Conclusions

The natural and socio-economic processes in the coastal zone are complex and interactive. ICZM and coastal cooperation help to manage such challenging areas of work in a sustainable way. The CCC-cases and tools cover many of the identified ICZM fields of activities, some cover more than one ICZM fields, but only a few cover a complete ICZM cycle.

References

WCC'93 – World Coast Conference'93 – Proceedings – Technical Document: 'How to account for Impacts of Climate Change in ICZM: Concept and Tools for approach for analysis', p.35 – 99, CZM-Centre Publication # 4, p. 1050, ISBN 90-369-0305.

CZM-Centre - 1996: 'Egyptian Coast: Development and Challenges" – Hurghada ICZM Workshop Report, Nat. Com. for ICZM Egypt/Egyptian Env. Affairs Agency, Cairo, and CZM-C/The Hague.

PDF reports

WCC – World Coast Conference Report, 1994: "Preparing to meet the coastal challenges of the 21 st century", IPCC & Ministry I&E / CZM-Centre 1994; ISBN 90 3690 1448.

Winsemius, P – WCC'93: 'Integration is necessary for coastal zone management', p 417 – 425, in the WCC Proceedings, CZM-Centre Publication # 4, ISBN 90-369-0305.

Why ICZM?

Triggers, impacts and long time series

Robbert Misdorp

Greenland: Summer melt water stream *flows into a large 'moulin'= a tubular hole transporting the melt water and associated heat down through the ice sheet to the bedrock.*
An important question for low lying coastal countries is whether the Greenland Ice Sheet will be melting 'abrupt' or linear. (photo: Roger J. Braithwaite, University of Manchester, UK)

Contents

Summary

The coastal zone is a complex area to manage and requires a holistic integrated approach. The need for integrated approaches is incited by various triggers, such as the impacts of the unprecedented, strong growth of population, economic development, and concentration of atmospheric greenhouse gases.

Population growth: the world population is increasing exponentially (Figure 1) and the growth was particularly strong during the second part of the 20 th century with a doubling of the world population in about 40 years.
The present population of Asia amounts to about two-third of the world population and is rising rapidly, especially in coastal conurbations.
Will this exponential population increase continue in the 21th century? It is estimated that in the year 2030 the world population will be more than 8 billion inhabitants (WRI) and that is more than 4 times as many inhabitants as in 1930 - a very rapid growth rate.
This rate of population growth may possibly continue to 2050.
In addition to the fact that our planet has an increasing number of people, many are also becoming increasingly productive.

Economic growth is wide spread around the world. Global economic wealth, expressed as Gross Domestic Product (GDP) per capita has an unparalleled growth (Figure 2). The average world GDP/capita doubles approximately every 30 years, during the last part of the 20th century and has a 2005 value of US$ 5,500. This economic development is an important factor in combating poverty, which is important for may reasons, e.g. it increases the recovery rate for the coastal inhabitants in the aftermath of hazards, as demonstrated in Andhra Pradesh, India. The rapid economic development is, however, all too often accompanied by unsustainable resource use and environmental degradation.

These two triggers combined represent an enormous stressor on the environment to such a degree that the exploitation of the resources is threatened by the unsustainable growth. This is for instance illustrated in the world wide declining fish catches.

The strong rise in emissions of greenhouse gases (such as carbon dioxide and methane) in the atmosphere is the third trigger. The natural carbon dioxide concentration in the atmosphere ranged between 180 and 280 parts per million (ppm) for more than the last 0.5 million years. During this long period several cycles of glaciation and deglaciation alternated, as did the sea level. During the maximum of the last ice age (18,000 years

ago), the global sea level was about 120 metres below the present level.
The recent rapid increase of carbon dioxide from 280 to 380 ppm (in 2009) began around 1850, is very likely caused by human activity and is expected to further rise during the next decades and possibly thereafter. The sea is expected to rise with 35 - 40 cm in the 21st century according to IPCC mid-estimates, based on linear melting of the Ice Sheets of Greenland and Antarctica. However abrupt melting of the Ice Sheets should not be disregarded and may have very serious consequences for coastal states.

Moving so far beyond known, long term, natural levels of greenhouse gases and a record number of people living in the coastal zone, urge for strong measures:

- Mitigating measures should be aimed at strongly reducing the use of the finite fossil fuels, to be replaced by renewable energy forms,
- Adaptive measures for coastal areas: ICZM is regarded as an adaptive response mechanism aiming at sustainable use of resources and employment of multiple beneficial coastal measures.

The impacts of these three triggers combined are severe. To mention one example: natural hazards seem to increase both in number and the extent of damage caused during the last part of the 20th century (Figure 3).

The rate of growth of these triggers and their impact is a plea for action by governments for coordination to manage their resources and coastal zones in an integrated and sustainable fashion. An integrated approach is needed, for instance to control the development of land, tourism and fisheries, and thus our ecological assets more wisely. ICZM is an appropriate tool. It helps address present and future challenges, is directed toward sustainable development of the coastal resource and forms an integrated framework for combating hazards, and planning and implementing mitigation and adaptive, no-regret coastal measures.

The large economic and environmental benefits of ICZM may be, however, the most convincing driver to plan and implement an ICZM programme. During the World Coast Conference 1993, a concept on the benefits of ICZM was discussed (Figure 4): "The economic and environmental benefits in terms of monetary and non-monetary values are larger than the costs of integrated management efforts executed within an ICZM framework." That concept was soon proven to be right. In this CCC publication some examples of highly beneficial ICZM, coastal cooperative efforts and multiple-use coastal measures, are mentioned:

- The positive results of the EU ICZM Demonstration programme (CCC I-1-1),
- The extra added values by the sustainable Rotterdam harbour development (CCC I-2-2),
- The large scale mangrove planting in Vietnam (CCC II-3-1-1, III-3-3-7) and
- The conservation of the attractive and protective coastal vegetation belts in the Seychelles (CCC II-5-1).

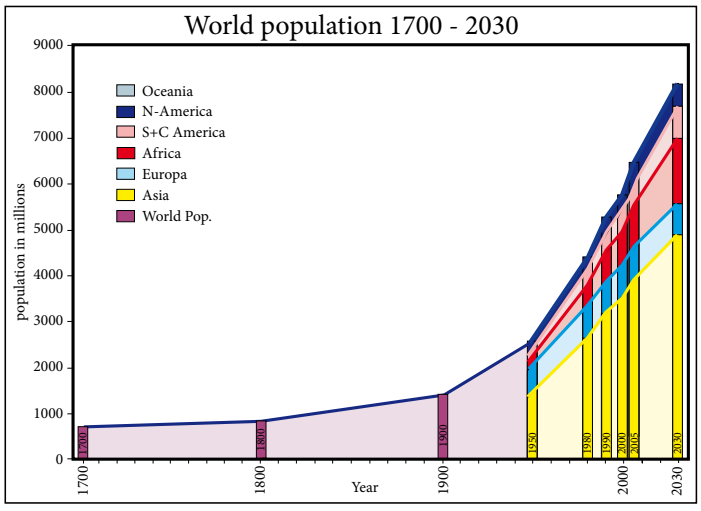


Figure 1: ***World population 1700 – 2030****: an exponentially growing trigger. (source: Robbert Misdorp based on www.j-bradford-delong.net + WRI database)*

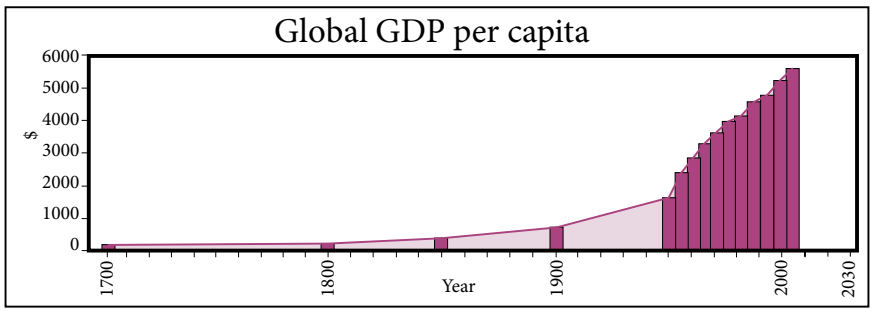


Figure 2: ***World Gross Domestic Product per capita 1700 – 2005*** *(in 2000 constant US$): strongly in increasing during 20 century and particularly in the second half, with an unprecedented known short doubling period of about 30 years. (source: R.Misdorp based on www.j-bradford-delong.net: 1700 – 1950; WRI database in 2000 constant US$:1960 – 2005)*

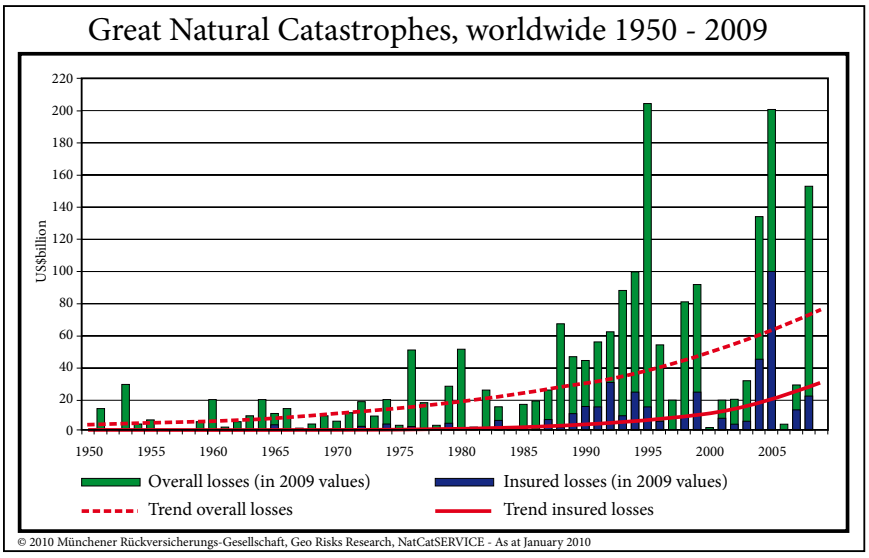


Figure 3: ***Natural hazards: worldwide strong increasing annual losses:*** *in US $ billion of the 'Great natural catastrophes', during 1950 – 2009. (source: Munich Re, 2010)*

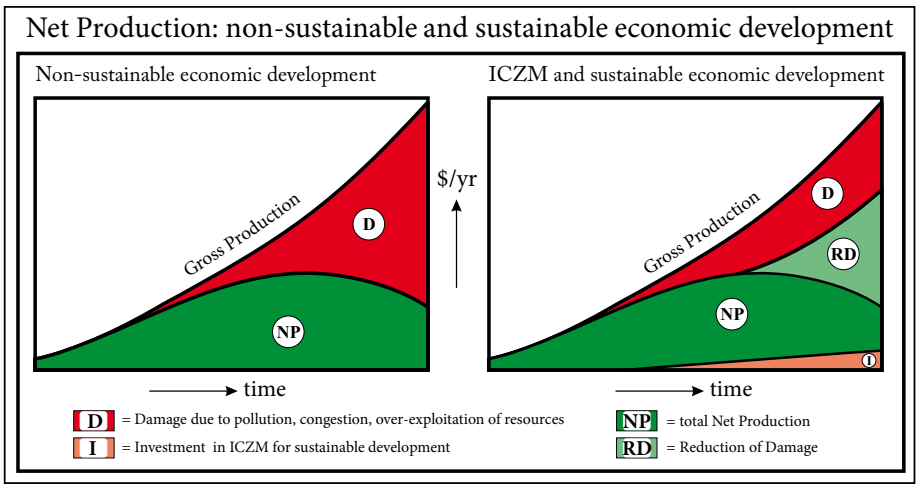


Figure 4: ***The benefits of ICZM and sustainable economic development****: in terms of reduced damages and increased added values resulting from a relative small investment in ICZM efforts. (source: Hulsbergen & Eid, 1990, IPCC-CZMS 1992). This WCC'93 concept was confirmed to be valid by examples of ICZM and coastal cooperation applying resilient, adaptive coastal measures, as demonstrated in this publication.*

In order to facilitate the application of ICZM, some planning tools and examples of innovative, adaptive coastal measures are discussed and made available in the following chapters.

CCC Part III - Chapter 3: How ICZM

III-3-1 Introductions

III-3-2 Downloadable Management Planning Tools

UNEP Statement: "How to plan and implement ICZM"

Ibrahim Thiaw

Director,
Division of Environmental Policy Implementation,
United Nations Environment Programme – UNEP, Nairobi

Humanity has long had a love affair with the narrow coastal fringe where both terrestrial and marine resources are easily accessed and economic activity is vibrant. Approximately 3.4 billion people – more than half the world's population – currently live there, and by 2025, that number will increase to 75 percent. The majority of large metropolitan centres are located near coastal harbours and on low-lying coastal plains. Both subsistence and broad-scale agriculture flourish on the productive coastal floodplains – 25 per cent of global primary production takes place in the coastal zone and 90 percent of the world's fish is either caught or farmed in coastal waters.

Unfortunately, disjointed or short-sighted coastal management can result in un-checked urban expansion, ribbon development, poor management of coastal watersheds and the destruction of fragile habitat. As much as 90 percent of all inhabited coasts will be heavily impacted by development by 2050, while more than 80 percent of pollution in coastal waters stems from land-based activities in cities, towns and farms.

This requires urgent attention due to the fact that coastal and near shore habitats provide important and valuable ecosystem services, including the sequestration of carbon. Yet these habitats are being lost four times faster than our rain forests and the rate of loss is accelerating. While humanity extends its love affair with the coast, the ecosystems services that are the very foundation of development are showing signs of stress and fatigue, putting at risk our livelihoods, our security and our quality of life.

At the inaugural World Oceans Conference in Manado, Indonesia, May 2009, governments again expressed their concern that coastal and marine ecosystems continue to be threatened by land-based and sea-based pollution and socio-economic pressures.
Governments also recognised that "healthy and productive coastal ecosystems … have a growing role in mitigating the effects of climate change on coastal communities and economies in the near term" and that "an integrated coastal and ocean management approach is a key in promoting resilience, and thus fundamental to preparing for and adapting to the effects of climate change … "

In this context, UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations (www.unep.org).

One of UNEP's significant achievements is the Regional Seas Programme which was launched in 1974 and aims to address the degradation of the world's oceans and coastal areas through the sustainable management and use of the marine and coastal environment. Today more than 140 countries participate in 18 Regional Seas programmes.

One of the first Regional Seas to develop an Integrated Coastal Zone Management (ICZM) Protocol was the Mediterranean. Signed in January 2008, the ICZM Protocol encourages Mediterranean countries to improve the management of their coastal zones and to deal with emerging coastal environmental challenges, such as the climate change.

The ICZM Protocol is a unique legal instrument because:

- It represents innovation in international law – there was no precedent of such a regional initiative;
- It is forward-looking – it aims at preventing as well as reacting to coastal problems;
- It covers key emerging issues crucial for improving coastal management and protection;
- It helps to ensure better coordination of national, regional and local authorities and includes NGOs and other interest groups; and
- It ensures reporting on the implementation of the Protocol, including measures taken, their effectiveness and the problems encountered in implementation.

A Global Environment Facility funded project entitled "The Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem" is implementing the agreed actions for the protection of the environmental resources of the Mediterranean Sea and its coastal areas (2009-2013) and is supporting the implementation of the ICZM Protocol.

The ICZM Protocol was developed as a response to countries asking for a legal instrument to help improve management of the marine and coastal environment. Its success is being followed up by other Regional Seas e.g. the Western Indian Ocean.

Given its unique position within the UN system, as the voice for the environment, UNEP can act as a broker to bring the scientific community and decision-makers closer together.
UNEP does this for the coastal and marine environment in two ways:
First, it provides information to convince policymakers about the economic value of marine and coastal environment. We are aware that marine ecosystems are multi-trillion dollar assets linked to sectors such as tourism, coastal defence, fisheries and water purification services, however it becomes more and more clear that these ecosystems are also our natural allies against climate change (the Blue Carbon Report: http://www.unep.org/pdf/BlueCarbon_screen_english.pdf).
UNEP stimulates an approach, which take costs & benefits into account as well as trade-offs between economic development and the conservation or improved management/restoration of marine and coastal areas.
Examples of trade-offs include the negative effects of water pollution in England & Wales reducing the value of waterfront property and tourism losses valued at US$100 -160 million per year, which far outweighs the water treatment costs mitigating the water pollution. Another example concerns an investment of US$ 1.1 million to restore nearly 12,000 hectares of mangroves in Vietnam, which is estimated to have saved US$ 7.3 million per year in dyke maintenance, increasing the physical protection of coastal communities and the productive fisheries. This is also an important adaptive measure helping to address the potential impacts of climate change.
Second, it helps convince policymakers that the protection and sustainable development of coastal and marine environments depends very much on human activities on the land. Management therefore demand a multi-disciplinary and cross-sectoral response, i.e., an integrated ecosystem-based or Hilltops-2-Oceans (H2O) approach. UNEP provides the Secretariat to the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA-Marine), a multilateral initiative launched in 1995. The GPA-Marine emphasises the importance of the link between watersheds, river systems, coastal estuaries and the marine environment, and focuses on the development of comprehensive, continuing and adaptive programmes of action within a framework of ICZM. This requires changes in policies, institutions and practices in the member countries.

Through multilateral initiatives such as the Regional Seas Programme and the GPA-Marine, UNEP will continue to bring different interests together. It will also bring to the table best practice and successful case studies to guide and 'show the way' to countries and regions, which have expressed a desire to improve their marine and coastal environments.

We wish the CCC publication success in its efforts to increase communication between coastal stakeholders through showing excellent examples of coastal cooperative projects and to strengthen the exchange of the needed knowledge on coastal concepts, tools and measures.

Introducing several Tools and Measures

Robbert Misdorp

Leadership, long-term vision and funding are required to set up an ICZM or a coastal cooperative programme for a particular area.
In order to facilitate the first phase of an ICZM programme, which deals with planning activities, specifically identifying and analysing coastal problems, collecting data, preparing policies and decision-making, we have developed a number of tools. These tools, supporting the ICZM planning phase, are related to an imaginary area and to natural and socio-economic developments and are mostly GIS based. They facilitate the analysis of problems and provide possible solutions related to spatial planning and include the impacts of different functional uses. The tools also contain building blocks for Cost - Benefit analysis and Environmental Impact Assessments.
The tools support policy making as well as capacity building. Training is an important element of any ICZM programme particularly for the management of specific coastal regions such as Marine Protected Areas (MPA). A training manual for MPA managers was therefore also developed.
All these tools are described by their developers and made available in this CCC publication (see CCC V-1-1 & 2).

The second stage from planning to implementation faces often serious obstacles.
Adaptive coastal options are subdivided into three categories: Retreat, Accommodate (people continue to use the land, no attempts to prevent flooding) and Protect (IPCC – 1990). These can be applied for different types of land use, such as built-up areas, wetlands and agriculture/aquaculture (see figure : CCC II-3-5).
In order to help address some of the current pressures on the coastal zone and the possible future impacts of climate change, a limited number of examples are provided. These include innovative, adaptive coastal measures, presented by those who have helped develop the techniques.
Most of the examples belong to the second category: Accommodate.
The list is not exhaustive but is concerned with practical and applied innovative technology or methods. These options help increase coastal resilience, are environmental friendly and economically beneficial. They are so-called 'no-regret' measures, often with multiple benefits, such as mangrove planting, which increases bio-diversity, provides protection against flooding, generates food from subsistence fisheries, and is an innovative way of adapting to the anticipated impacts of climate change. Mangrove planting, is also very beneficial from a macro-economic perspective, see UNEP – Statement.

You can contact the developers/authors for more information about the planning tools and the adaptive measures; see List of Authors for contact details (CCC V-2).

Introduction: The role of Geospatial Technology for ICZM

Henk J. Scholten *(Geodan and Free University, Amsterdam)*
Tjark van Heuvel *(Rijkswaterstaat / Ministry I&E, the Netherlands)*

Introduction

Geographic information systems are computer systems for the collection, storage, analysis and display of both spatial and temporal information. Spatial information is composed of sets of overlapping single-theme layers. Analysis allows the user to compare different situations over time. These information systems facilitate the analysis of rapidly changing and complex geographic reality in much more comprehensive way than traditional cartography (Scholten et al 2009).
A modern variant of GIS is the Geographical Information Infrastructure (GII), which offers even greater in-depth support to decision makers based on the fact that data and information are shared between the users (Hofstra et al 2008).
Integrated Coastal Zone Management also addresses complex natural and socio-economic issues in a specific geographic area. GIS and GII often and successfully support ICZM programmes.

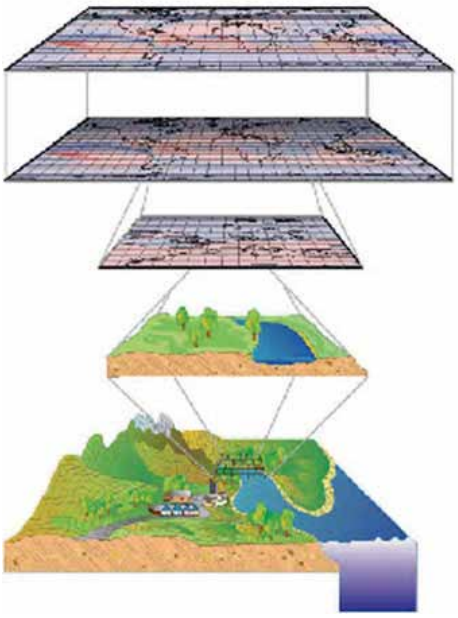


Figure 1: ***Geographic Information Systems (GIS)*** *facilitate spatial analysis of sets of single-theme layers coupled to temporal analysis of changes in time. (source: United Nations Economic Commission for Europe, 2009)*

(photo: //beeldbank.rws.nl, Rijkswaterstaat)

Geographic Information Infrastructure *(GII) offers real-time responsiveness and supports fast and effective decision-making during energencies.*

Geographical Information Infrastructure

In the coastal zone, decision makers often deal with special limitations, conflicting land use and involving many different sectors. Coastal management issues can be particularly complex as they often transgress political and physical boundaries, and incorporate a multitude of interconnected disciplines. The complex planning processes require interdisciplinary and integral data. GIS is a tool of choice to help understand, monitor, anticipate, plan, and to illustrate and communicate management options in the medium and long term.
Not all geographic information systems are able to deal with huge databases and models. A Geographical Information Infrastructure (GII), however incorporates meta databases, large spatial databases, visualisation techniques and tools, spatial models, spatial and temporal analyses, decision supporting systems, and evaluation methods. This range of tools improves the use of geographic information and is particularly valuable in coastal zone management.
The use of the GII evolved from a stand-alone PC, to a Local Area Network (LAN) and is now often web-based and can be accessed by mobile devices.

Two examples of Geographical Information Structures

Monitoring of the Dutch coast

Visualisation is an important part of any Geographical Information Infrastructure helping to present, explore and analysis geographical information (Romao et al 1999). These information systems are used during the processing of coastal monitoring data and result in coastline charts. Coastal monitoring is essential to assess the need for coastal defence measures, particularly of sandy beaches and dunes. Every year coastal measurements are carried out, along coastal profiles with a spacing of 200 to 250 metres. The results of these annual measurements are stored in the so-called JARKUS file. Analysis of these data provides an insight into coastline fluctuations. The sections of coastal accretion (sedimentation) and recession (erosion) are determined and displayed.

The Dutch 1990 dynamic preservation policy has as a reference point, the 1990 coastline, the so-called basal coastline. The position of the coastline is assessed annually. If the surveyed coastline moves from the basal coastline landwards over a wide coastal frontage then there may be a need for sand nourishment. Moreover, it is possible to calculate the trend in coastline movement and predict the year in which it will move from the basal coastline for a specific coastal section. These annual results are shown in the form of "coastline charts" (Figure 2, an example from 1999). This annual coastal atlas of the 350 km long Dutch coast is presented to the coastal managers of the Netherlands only a few months after the coastal survey.

Figure 2: ***Monitoring the Netherlands' coastal zone including the GIS data processing*** *of the marine part and the terrestrial part (beach and dunes), results in the "coastline charts" comparing the surveyed coastline with the 'basal' coastline.*

Figure 3: ***Coastline Charts on the web****, accessible for professionals and public. Screen shot of the Rijkswaterstaat GIS web application:*
Geotool: http://www.rws.nl/geotool/geotool_kustlijnkaart.aspx?cookieload=true

Recently, the Rijkswaterstaat (RWS)/Ministry of Transport, Public Works and Water Management has made the RWS Geotool website (in Dutch language) available. It contains information on the coast, waterways, roads and other infrastructure works. The coastal element of this web-based GIS encompasses information on all 50 coastal sections of the entire coast of the Netherlands. The coastline charts (Kustlijnkaart) from the last few years (Kaart), accompanied by oblique air-photographs, the coastal profile data (Tabel) and the results of the analysis (Report) of each of the coastal sections (kustvak) are displayed for the public (Figure 3).

Risk management: 'Eagle Suite'

A considerable amount of the information required for risk and emergency management, for example from flooding by rivers, is geographical in nature (Scholten et al 1998). Often this information does not reach the right people at the right time. For this reason the Ministry of Defense and Homeland Security, Vrije Universiteit, Geodan, ESRI and Microsoft developed a new concept in close cooperation with the Middle Gelderland Emergency Service Region (Figures 4,5,6). It consists of a suite of applications and services that allow multiple agencies to collaborate seamlessly in order to increase responsiveness and support fast and effective decision-making in a highly complex environment. Based on the experience of the emergency responders, a list of requirements was provided, which the system had to meet:

- Situation awareness: all organizations involved must be aware of the seriousness of any particular situation. All staff must have access to the same, geographic information, displayed in a standard way in a Geographic Information System (GIS);
- Real-time location awareness: when trying to manage a disaster, recording the real-time locations of staff, citizens, victims, volunteers or response teams is essential;
- Sharing data among different organisations: different organisations must work together and this requires management of communication and exchange of information.
- Large data flows: information has to be aggregated and responsive to the type and scale of the disaster, and the amount and type of organisations involved;
- Allow collaboration between (different) organisations: security restrictions such as firewalls impede the essential collaboration;
- Support strategic, tactical and operational levels: each level has specific requirements for the type and scope of information;
- Work under extreme conditions: a disaster management system must be flexible and able to deal with extreme conditions by ensuring alternative access to data. This requires a good data backup strategy.

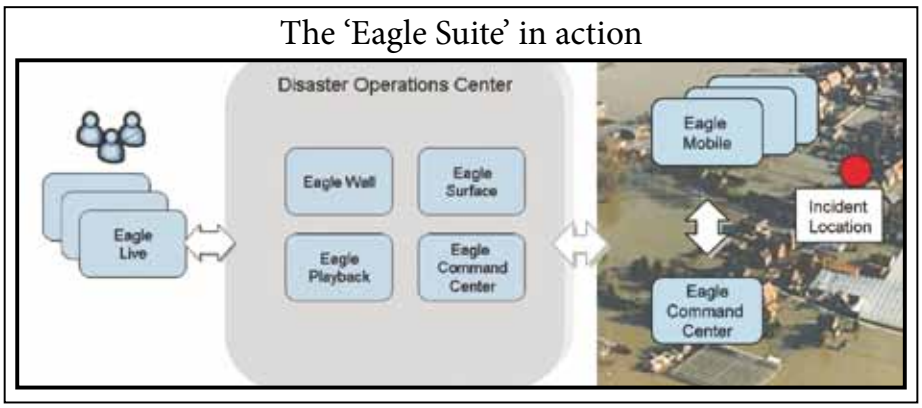


Figure 4: ***The 'Eagle Suite' in action***

To meet such a diverse set of requirements ''the Eagle Suite" was developed (Figure 4). This suite consists of the following components (see also Geodan Eagle Suite website):

- The Eagle Command Centre: the command centre staff can share, add and edit both geographical and textual data. This information is exchanged automatically between all users. The main entry point is a map, showing the current situation in the disaster area;
- Eagle Mobile gives ground staff, fighting the crisis in situ, the opportunity to add and edit geographical and textual data over a mobile data connection;

- With Eagle Surface Table tactical or strategic command can view the incident as a map on a Microsoft Surface table device, and is an easy-to-use conference tool;
- With Eagle Wall, a read-only view of the status of the incident is shown on wall-mounted displays in the command centre. It is updated automatically as changes in the status of the incident occur;
- Eagle Live is publicly available, as a read-only view. Since this is a website containing both spatial and textual information, it is visible to anyone online;
- Eagle Playback is a user-friendly playback tool for the command centre, with which the incident can be analysed and evaluated minute by minute.

'Eagle One' emergency drill

In March 2008, a special emergency drill took place in the Safety region Gelderland Midden in the Gelderland province in the east of the Netherlands (Figure 6). The exercise, focussed on the regional level. The idea behind this drill was to assess whether the use of geo-information in crises leads to better understanding and hence better decision-making. The Eagle Suite was applied and had a prominent role in the regional drill with the emergency services 'playing' four different emergency scenarios. The police, the fire brigade, medical services and municipalities had immediate and direct access to each other's information. Sharing information about the ongoing situation and providing access to national geo files were both tested successfully. It was concluded that the Eagle system contributed to both a common operational picture and a shared operational awareness. This was most obvious during the multidisciplinary meetings. Little time was needed to explain the situation, and the participants were able to begin planning their actions immediately.

Based on positive evaluations of the emergency drill, the 'Eagle – Geographic Information Infrastructure' has won the prominent Dutch Public Safety Award 2008 (Neuvel et al. 2010).

The flood disaster in Pakistan that started in August 2010 might be the largest disaster ever, in numbers of people involved, in recent history. The provincial government of Punjab responsible for the disaster management encounters many problems with the information infrastructure, like in all other large disasters has happened (e.g. Haiti). The government of Punjab has asked Geodan to implement Eagle for fighting this disaster (see www.eagle4pakistan.com).

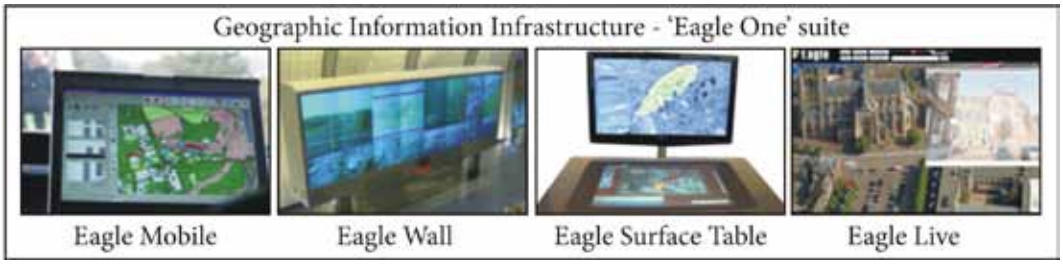


Figure 5: ***Geographic Information Infrastructure****: the main components of the 'Eagle One' suite.*

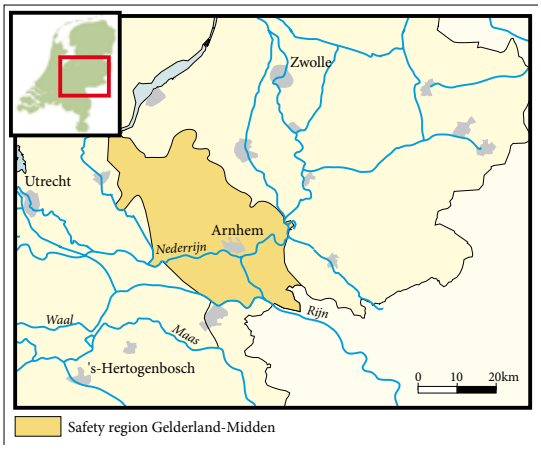


Figure 6: ***The 'Eagle One' emergency drill area:*** *Safety region in the province Gelderland - Midden, dissected by the rivers Rijn, Waal and IJssel*

(photo: Harry van Reeken)

Concluding remarks

Integrated Coastal Zone Management addresses complex natural and socio-economic issues in a specific geographic area.

A Geographical Information Infrastructure has much in common with ICZM: both are interdisciplinary and facilitate the interpretation and integration of data. The tool allows users to create interactive queries, analyse spatial information, edit data, maps, and present the results of all these operations. Such a system is applied to the processing of the yearly monitoring of the fluctuations of the Dutch coastline and assists coastal managers in answering the questions: When and where to apply sand nourishment?

A Geographical Information Infrastructure is also very suitable for risk and emergency management activities e.g. during critical river flooding situations. It is a tool for sharing of information during emergency plan preparation. Distributing geographic information through a network leads to improved communication, better and faster decision-making and a more effective emergency response.

GIS and GII often and successfully support ICZM programmes.

In the following chapters the developers of GIS tools introduce their use for ICZM planning and training. Demonstrations of the tools can be downloaded through the CCC website.

References

Hofstra, H., Scholten, H.J., Zlatanova, S., Scotta, A., 2008: Multi-user tangible interfaces for effective decision-making in disaster management, in: Nayak, S., Zlatanova, S. (eds.), *Remote Sensing and GIS Technologies for monitoring and prediction of disasters*, Springer-Verlag, Berlin Heidelberg;.

Neuvel, J., A. van de Brink, H.J. Scholten, 2010: From spatial data to synchronised actions: the network-centric organisation of spatial decision support for risk and emergency management, Applied Spatial Analysis and Policy, forthcoming, 2010.

Romão T., Câmara, A.S., Molendijk, M.A., Scholten, H.J., 1999: CoastMAP: aerial photograph based mosaics in coastal zone management, in: Câmara, A.S., Raper, J. (eds.), *Spatial Multimedia and Virtual Reality*, Taylor & Francis, London,

Scholten, H.J., van de Velde, R.J., van Manen, N. 2009: *The role of Geo-ICT and Spatial Approaches in Science*, Springer, Dordrecht;

Scholten, H.J., LoCashio, A.J., Overduin, T., 1998: Towards a spatial information infrastructure for flood management in The Netherlands, in: Visser, J., Misdorp, R. (eds.), *Special Feature in Journal of Coastal Conservation: "Coastal dynamic Lowlands"*, Opulus Press, Uppsala;

Websites

Geodan: www.geodan.com

Geodan Eagle Suite: www.geodan.com/markets/public-order-and-safety/eagle

Pakistan Eagle Suite: www.eagle4pakistan.com

RWS (Rijkswaterstaat) Geotool – Coastline Charts: www.rws.nl/geotool/geotool_kustlijnkaart.aspx?cookieload=true

UNECE - UN Economic Commission for Europe, 2009: Guidance on Water and Adaptation to Climate Change: www.unece.org/env/water/publications/documents/Guidance_water_climate.pdf

Vrije Universiteit – Free University, Amsterdam: www.feweb.vu.nl/gis/spinlab_website

The COSMO-line: Interactive tools for ICZM

Marcel Taal *(Deltares, the Netherlands)*

The introduction of COSMO

In 1993 the Word Coast Conference took place in Noordwijk, the Netherlands and the principles of Integrated Coastal Zone Management (ICZM) were presented. During the conference, the Coastal Zone Management Centre/ Ministry I&E and the consultancy firm Resource Analysis introduced COSMO (COastal zone Simulation MOdel) to all the participants.

COSMO is a computer GIS-based model that helps familiarise coastal zone managers with methods for evaluating potential management strategies under different scenarios, including long-term climate change. The positive response from the participants, many of whom were high-level civil servants, led to further development of a family of similar software tools (the COSMO-line). These tools have been used to help managers to determine the advantages and disadvantages of alternatives solutions for regional development and climate change adaptation. COSMO is also used worldwide for ICZM capacity building at 'hands on' workshops.

COSMO facilitates a structured approach

COSMO demonstrates the main steps in the preparation, analysis and evaluation of Coastal Zone Management plans. Potential users are introduced to the various principles of ICZM. Long-term issues such as climate change are considered alongside short term and local effects such as regional economic development and other uses of the coastal zone. The strength of the tools is that the user is 'forced' to take a structured approach to problem solving.

Figure 1: ***Example of COSMO output:*** *current activities in the fictional territory of Catopia*

Using the demo-application (learning by doing), involves explaining in simple terms the framework for policy analysis, the trade offs between different policy options and alternative strategies.

An interactive tool, it allows coastal zone managers to explore the impacts of development projects on the economy and environment. The user can also investigate a number of predefined cases as an educational tool, or specify new development scenarios and combinations of measures. COSMO-tools offer an opportunity to experience the power of an analytical approach to solve coastal problems.

Steps of the Framework for Policy Analysis

The user interface of COSMO, and the members of its family, developed around the steps of analysis. These steps are now, more than fifteen years after the introduction of COSMO, as valid as they were in 1993:

- The first step is problem analysis. Before considering actions the coastal manager know the state of the coastal zone, its dynamics and all its challenges;
- The second step is the formulation of objectives and the criteria (variables) which can be evaluated if objectives are (or will be) met;
- Definitions of possible measures (strategies, e.g. CZM-plans including different coastal measures) follow and areas of uncertainty to the future situation (scenarios, including e.g. climate change) identified;
- The evaluation of various strategies under different scenarios is possible using a simple simulation tool. Tools, such as Multi Criteria Analysis, facilitate evaluation and valuation of strategies, are included in some members of the COSMO-line.

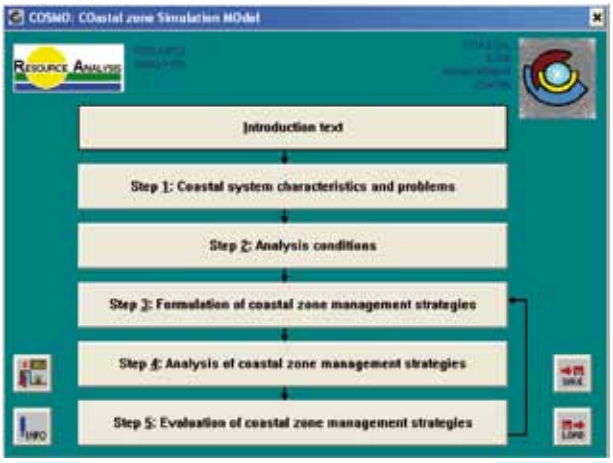


*Figure 2: **The steps of analysis***

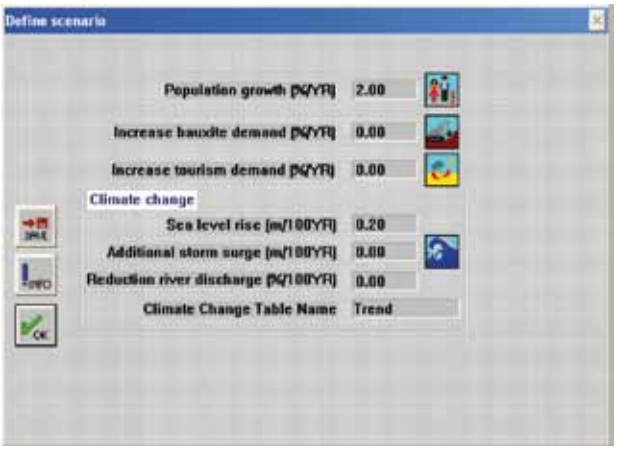


*Figure 3: **Definition of scenarios***

*Figure 4: **The input of strategies in COSMO***

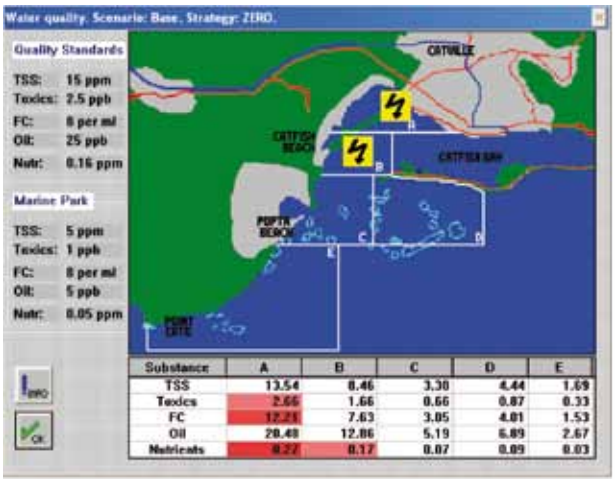


*Figure 5: **The evaluation of strategies in COSMO***

Box: Overview of the different COSMO-tools used around the world:

- COSMO-W was developed for the area of the Western Scheldt. It also served as a prototype of a DSS for estuary management, focusing on typical West European CZM issues.
- NATWEST. This is an application following COSMO-W. It supports the evaluation and selection of projects for the Nature Rehabilitation Plan for the Scheldt Estuary.
- SAMPAK. This was developed for training purposes, focusing on a typical situation in Thailand, with soft coasts and restoration of shrimp farming areas (CCC-II-7). In this tool a Multi-Criteria Analysis module is included. SAMPAK has also been translated into Spanish.
- COSMOBIO. This tool was created to illustrate the role of biodiversity in coastal zone management and was introduced during the 1998 Jakarta UNBDC-Conference of Parties, and has been translated into Polish.
- COMA was the first version of a CZM Decision Support System for West Africa (from Senegal to Nigeria), to evaluate developments at a strategic level. It is available in both French and English.
- CORAL is a tool that incorporated a methodology for analysing the cost-effectiveness of coral reef protection and management. It was tested in Jamaica, Curaçao and the Republic of the Maldives.
- DSMOZ, is a training tool that was developed for the southern coast of Mozambique and Inhaca Island (near by Maputo), it is available in English and Portuguese.

COSMO-Demo available on CCC-website

The COSMO-Demo version will be made available on the CCC website, allowing you to practice with this ICZM tool. If you are interested and would you like to obtain more information please contact Marcel Taal, one of the developers of the COSMO-line: marcel.taal@deltares.nl

CoastLearn: a training tool that facilitates international cooperation

Maria Ferreira & Carolina Perez *(Coastal & Marine Union - EUCC)*
Hugo Niesing *(Rijkswaterstaat/Ministry I&E, the Netherlands)*

Summary

CoastLearn is an innovative pilot learning package that meets the needs of those requiring a free, multilingual, user-friendly Integrated Coastal Zone Management (ICZM) vocational training tool. CoastLearn's prime objective is to introduce ICZM principles, benefits, options and processes in countries where they are not yet widely used; to transfer the experiences and lessons learnt; support ICZM processes in central and eastern Europe countries and beyond and develop and test new technologies. The course materials, even though not yet complete, may continue to act as the starting point for an exploratory learning process.

The development of CoastLearn

During an inter-ministerial meeting in Split, Croatia, in summer 2000, 18 governmental representatives of the Baltic, Black, Mediterranean and Caspian Seas made a call for a distance vocational training tool to communicate ICZM information, experience, and ideas. EUCC took responsibility for this request and began the development of CoastLearn, in cooperation with a large international partnership composed of 22 partners from 15 countries. The former Coastal Zone Management (CZM) - Centre of the Netherlands Ministry of Transport, Public Works and Water Management, was one the partners at the beginning of the CoastLearn process. The development of CoastLearn has also been built on the CZM-C's NetCoast Open Learner.

What is CoastLearn

CoastLearn is a multilingual distance vocational training programme for ICZM. It is openly and freely available on CD-ROMs and the internet (www.coastlearn.org).
CoastLearn targets are primarily:

- Professionals working for the public sector, e.g. coastal councils, administrations (national and local) and planning institutes. Civil servants need to not only be trained in ICZM, but also gain insights into the benefits of involving NGOs, citizens groups, businesses, and other non-institutional organisations or individuals interested in or affected by the management of the coast. They also need to gain insight into the importance of collaboration between central and local authorities;
- NGOs dealing with the sustainable development of the coast. NGOs need to be acquainted with the principles and procedures of ICZM, in order to know when and how to become involved in the process;
- University level students are another target audience.

CoastLearn has been tailored to the training and technical needs of countries in transition, especially in Europe and neighbouring regions, but has also proven to be of value for non-target countries in the EU, Latin America, Asia and Northern Africa as well. CoastLearn currently exists in ten European languages, and features eight modules (Principles of ICZM, Policy Analysis, GIS, Planning, Environmental Risk Assessment, Sustainable Tourism, Public participation, Biodiversity) and CoMPAS/ The CoastLearn Simulation Game. The multilingualism of the tool is highly valued and requests are received constantly for the production of additional language versions. The production of further versions is mainly a matter of identifying the national partner and obtaining the necessary funding. In this way, the Sustainable Tourism module was recently translated into Arabic. Funds have been made available recently for an Albanian version and for producing a western Black Sea version involving Turkey, Bulgaria and Romania.

Free of charge available on internet

CoastLearn makes an original contribution to existing European and international vocational training systems and practices. Other ICM training courses are expensive, very much tailored to western European and US situations and problems, and in most cases, they are part of an academic education programme. CoastLearn has become the first widely available course that is available on the internet free of charge.

The main feature of distance learning is that students can study at their own pace and anywhere they want. CoastLearn is moreover a simple tool that does not require sophisticated computers or software for its use. In order to counteract Internet connection problems, CoastLearn is also available on CD-ROM.

The English version of CoastLearn has currently 800 visitors (and many more hits) monthly with a clear upward trend; a conservative estimate for all languages is 2000 visitors/month. CoastLearn's main sponsors so far have been the European Commission through its *Leonardo da Vinci* and TACIS programmes and the Dutch Government through the MATRA and Pin MATRA programmes.

Multi-national and multi-discipline

The most original aspect of the CoastLearn approach is the co-operation between western European ICZM training experts and their colleagues in neighbouring (including accession) countries of the European Union to develop new CoastLearn products, where the needs of the non-EU partners are paramount.

CoastLearn has also been innovative in developing interdisciplinary training material. Usually, one expert or group of experts who work under the guidance of an editor develop such teaching material. In the case of CoastLearn, a multi-discipline and multi-national partnership has developed new modules. The development process itself was also a learning experience and strengthened network development.

The Tool

CoastLearn has a modular structure. The modules can be studied independently, are illustrated with figures, exercises, and good & bad practice examples and can be supported by tutorial services.

All eight CoastLearn modules present a standardised structure, with intended learning outcomes explicitly presented. All the modules include self-assessment exercises and questions to provide a motivating and stimulating learning tool for the user. The questions relate to the training materials in the package and are included within the text. The answers to the questions are given with explanations. Modules are further illustrated with figures, tables and practical examples, which take the user as close to reality as possible. The practical examples can be accessed either via each module they relate to, or via a separate entry point where all the examples are displayed. Links to other websites, original tests, tools and information sources encourage the user to delve deeper into the subject. CoastLearn provides printing versions of some modules so the needs of those professionals who have no continuous access to a computer or internet can also be met.

Simulation game

CoastLearn partners have also jointly produced a Simulation game – CoMPAS *Coastal Management Practices to Achieve Sustainability*. The game is freely downloadable

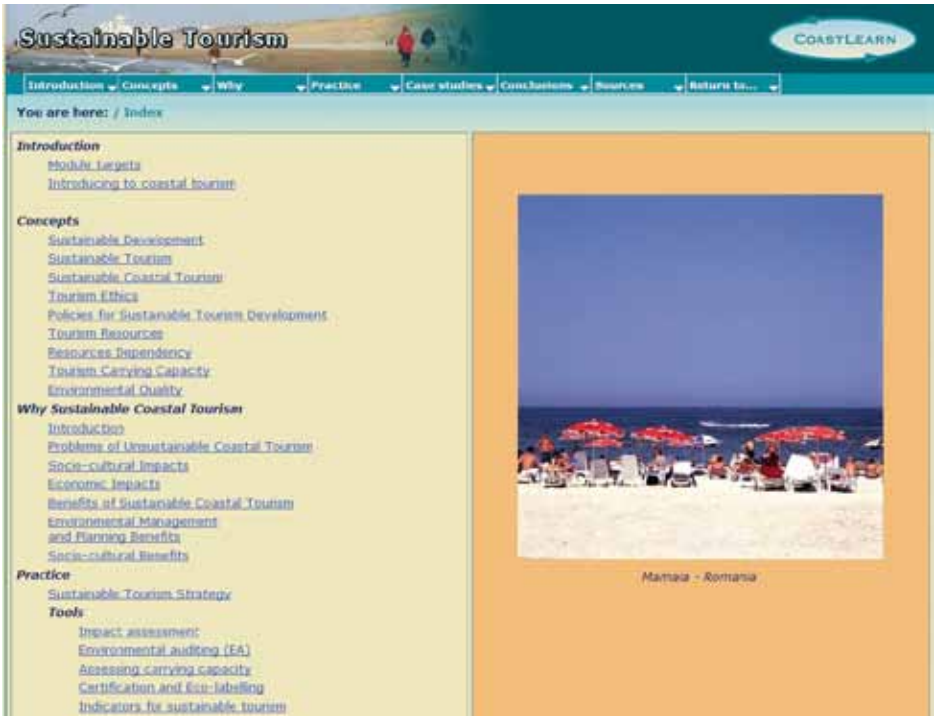


Figure 1: ***Screen shot CoastLearn Sustainable Tourism Module,*** *www.coastlearn.org*

and can be played by one person, but preferably a small group of users. The CoMPAS game aims to give the player insight into essential processes related to sustainable coastal development such as the inter-relation between economy, ecology and society. The game is played in an imaginary coastal area with sectors typical of the maritime economy, such as paper industry, tourism, water treatment, fishery and aquaculture Players are requested to invest money in different sectors on a yearly basis over a period of 20 years. After that period, it will become clear whether it was possible to develop the coastal area in a sustainable way or not. Each game session lasts for about 20 minutes, but it is always possible to improve the results in another session.

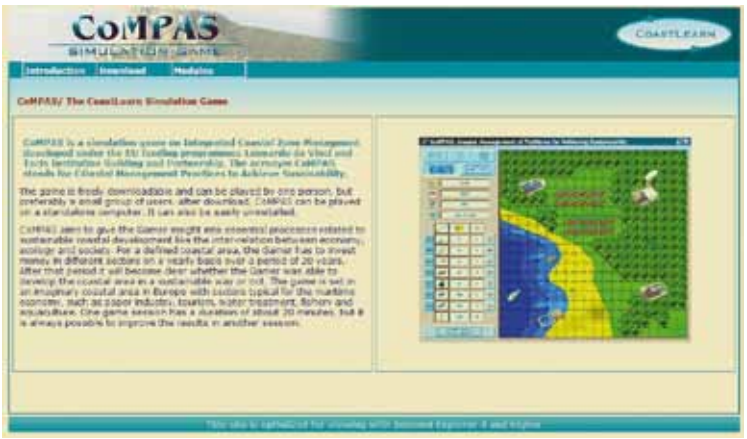


Figure 2: ***Screen shot of the Simulation game CoMPAS***

Future

CoastLearn is not the final product. An innovative pilot learning package will continue developing according to the needs of its users. So far it seems to have responded to the need for a free, multilingual, user-friendly ICZM vocational training tool. CoastLearn will also support trans-national networks, both of ICM practitioners and trainers Europe-wide and promote trans-sectoral dialogue nationwide, in all the key elements of the ICZM process.
The Coastal & Marine Union - EUCC hopes to continue developing, updating and creating new modules while establishing and strengthening network partnerships within CoastLearn.

Try the CoastLearn out at www.coastlearn.org

For more information please contact us

Maria Ferreira, Coastal & Marine Union - EUCC
m.ferreira@eucc.net
Carolina Perez, EUCC Mediterranean Centre
c.perez@eucc.net

Website links

www.eucc.net
www.eucc.net/medcentre
www.coastlearn.org

Malta coastal view *with tourist accommodations under construction. (photo: Erik Devilee)*

RamCo: An integrated assessment tool for sustainable coastal zone management

Hedwig van Delden & Roel Vanhout *(RIKS, the Netherlands)*

Introduction

RamCo (Rapid Assessment Module for Coastal Zones) is a prototype of an information system for the rapid and integrated assessment of sustainable solutions to coastal zone management problems. It helps policymakers to test alternatives in the wider context of climate change, demographic growth or changing economic demand.

RamCo describes the natural and anthropogenic processes in a coastal zone under the influence of the dynamic behaviour and interaction of agents, such as inhabitants of the coastal area and economic activities (fishery, cultivation of shrimps, agriculture, industry, tourism and commerce). Characteristic of **RamCo** is the way in which processes are linked on different levels to form one system, and how these sub-models use very detailed data layers from a built-in Geographical Information System (GIS). It is possible to design policy alternatives and to assess their impacts.

The quantitatively defined relationships between the different elements of the natural and socio-economic processes are based on large scale 'field observations'. Each of these relationships can be changed through expansion and aggregation functionalities. The period under analysis time (in years) can be also be defined.

Application

The current version of **RamCo** has been applied to a coastal zone near Ujung Pandang in south-west Sulawesi (Indonesia). It shows how, in the next 25 years, the coastal zone will become urbanised under the influence of a growing population (annual growth ± 3%) driven by external economic growth. It shows how this results in increasing pollution of rivers and coastal waters. It also illustrates how the increasing demand for food leads to destruction of the forests, how this in turn increases soil erosion in the mountains, causing river floods in the coastal zone. Policy makers can intervene in these dynamic processes by choosing other settings such as rehabilitation of mangroves, treating sewage waste, management of the Bili-bili dam and reforestation, and with fishery regulations and the development of marine parks. In this way, they can test policy alternatives.

RamCo differentiates between influences that can be controlled by 'policy makers', and those that cannot, such as precipitation.

After configuring **RamCo** with the input values, the calculations will yield results in various formats such as maps, graphs and numerical values that give the policy analyst insight into the evolution of factors such as human welfare or river sediments. These outputs are viewable in **RamCo** itself, or written to files to be analysed by generic tools such as spreadsheets or GIS software.

Further developments

The CZM-Centre of the Dutch Ministry for Transport, Public Works and Water Management financed the development of **RamCo.** A consortium consisting of Research Institute for Knowledge Systems (RIKS), INFRAM, University of Twente and Maastricht University, Delft Hydraulics (Deltares) and the Memorial University Newfoundland developed the product.

Since the development of **RamCo**, its model integration concept and the underlying Geonamica software platform (Hurkens ea, 2008) have been used and further developed in a wide range of products. It has evolved into a platform for spatial dynamic modelling for policy support in an integrated context called Metronamica. This modelling framework is used for developing integrated impact assessment software tools worldwide, in fields such as:

- Impact assessment of agricultural policies and land use changes (LUMOCAP PSS);
- Integrated spatial planning for multi-scale integrated land use (**Xplorah**);
- River basin management: analyses of scenarios and policy options (**Elbe-DSS**),

- Desertification (**MedAction PSS - Policy Sup-port System** and **DeSurvey IAM**);
- Shifting cultivation in the Ruhunupura area in Sri Lanka (Wickramasuriya, et al 2009);
- The metropolitan area of the city: Belo Horizonte, Brazil.

Recent versions of **RamCo** include several tools, facilitating the work of policy analysts to define, adjust and compare different assumptions more easily. This uses a flexible model configuration and integrated statistical tools such as Monte Carlo analysis for uncertainty analysis and generating probability maps.

Lessons learnt

From the design, development and use of Decision Support Systems in a wide range of countries and policy contexts, important lessons have been learnt regarding the user interface and the design and development process of these systems (Van Delden, e.a. 2010). Sharper definition of the specific roles of the four parties (end-users, resource scientist, IT specialist, system architect) and improved communication between the parties resulted in a product more suited to the end-user.

A demo of Ramco

A **Ramco** module **for Rapid Assessment for coastal zones**, including a short user-guide (www.riks.nl/projects/ramco) is available for demonstration, training and evaluation. The module allows the various functionalities of the GIS based model, including the comparisons of the chosen policy options (strategies) and the scenarios (socio-economic, climate change), and it's geographic and macro-dynamic, schematic computational representations to be trialled.

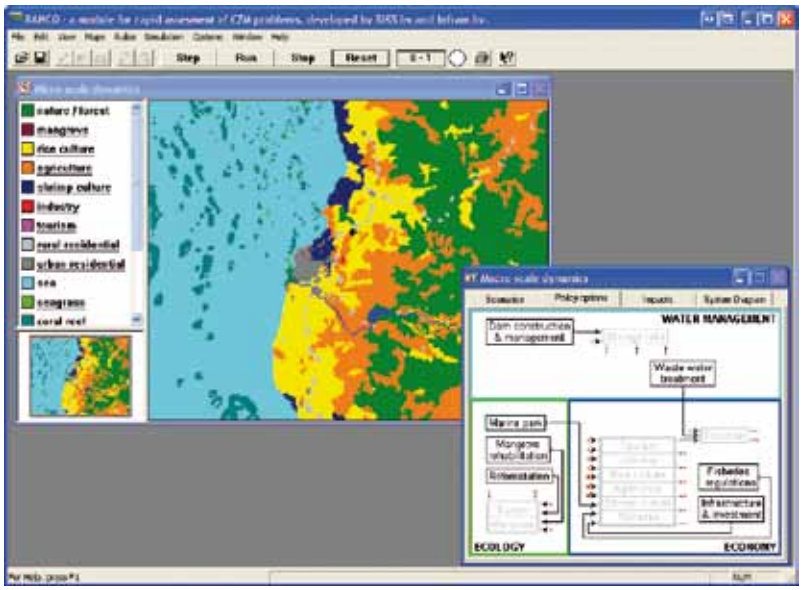


Figure 1: ***The initial land use map and available policy options*** *for the coastal zone of Sulawesi, Indonesia.*

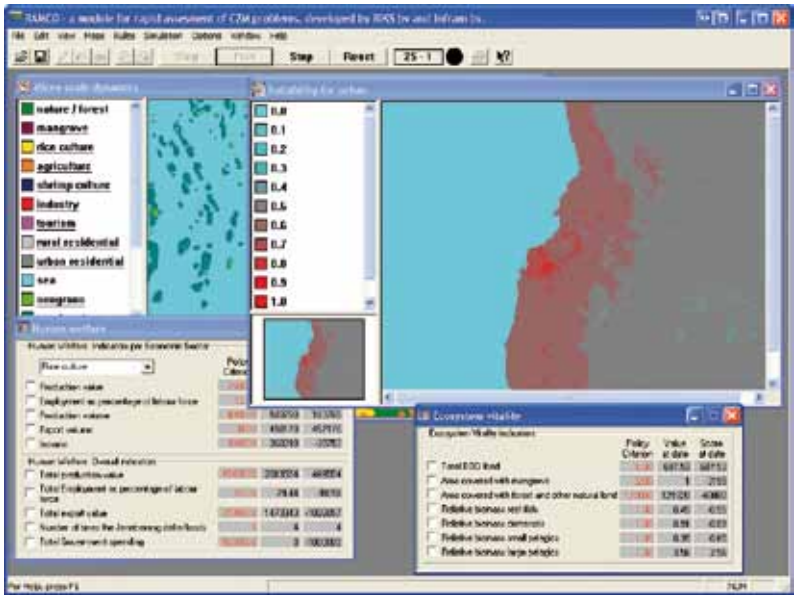


Figure 2: ***Output values showing suitability for urban development,*** *simultaneously shown in a map and a number of indicators regarding human welfare and ecosystem vitality - Sulawesi.*

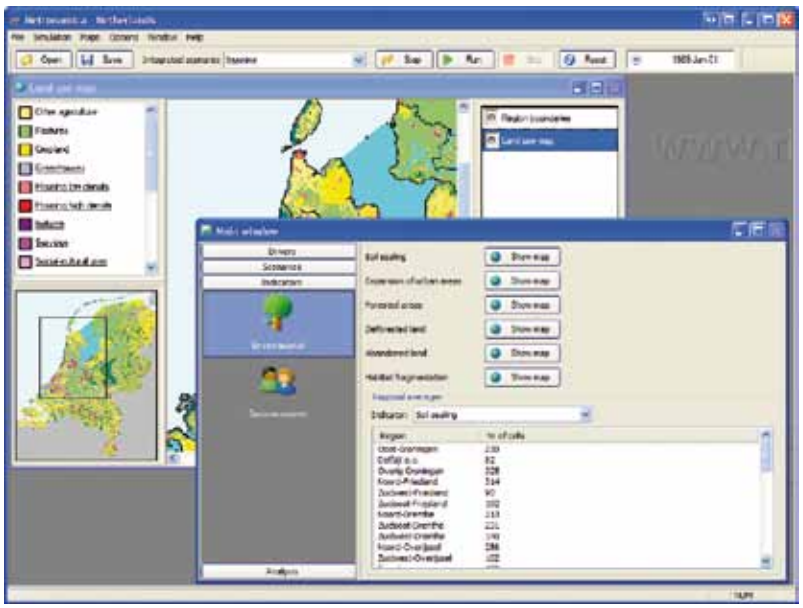


*Figure 3: **The Metronamica** generic integrated impact assessment tool, a next generation of spatial, dynamic modelling, applied to coastal zones in the Netherlands.*

For more information about the **RamCo** system, its approach and recent developments in Decision Support System application please contact:

Hedwig van Delden
Research Institute for Knowledge Systems (RIKS)
Witmakersstraat 10
6200 AL Maastricht
The Netherlands
Tel: + 31 43 350 1750
E-mail: hvdelden@riks.nl

Website to download the **RamCo** software and user manual: www.riks.nl/projects/ramco: and the **Metronamica** brochure: www.metronamica.nl

References

Hurkens, J., Hahn, B.M., Van Delden, H., 2008: Using the Geonamica® software environment for integrated dynamic spatial modelling. In: Sànchez-Marrè, M., Béjar, J., Comas, J., Rizzoli, A., Guariso, G. (Eds.), Proceedings of the iEMSs Fourth Biennial Meeting: Integrating Sciences and Information Technology for Environmental Assessment and Decision Making. International Environmental Modelling and Software Society, Barcelona, Spain

Wickramasuriya, R.C., Bregt, A., Van Delden, H., Hagen-Zanker, A., 2009: The dynamics of shifting cultivation captured in an extended Constrained Cellular Automata land use model. Ecological Modelling. 220, 2302-2309.

Van Delden, H., Seppelt, R., White, R., and Jakeman, A.J., 2010: A methodology for the design and development of integrated models for policy support. Environmental Modelling and Software, doi: 10.1016/j.envsoft.2010.03.021.

DR-EIA

Document Retrieval and Expert system for Environmental Impact Assessment

Joop L.G. de Schutter *(UNESCO-IHE, the Netherlands)*

What is an Environmental Impact Assessment?

An Environmental Impact Assessment (EIA) is an assessment of impacts – positive and negative – that a proposed human intervention or project may have in a particular area. It represents a procedure for improving decision-making and helping to ensure that the development project under consideration is both environmentally and socially sound and sustainable. The EIA is concerned with identifying, predicting and evaluating the environmental consequences and social effects, both beneficial and adverse, of public and private (development) activities. It considers alternative policies and mitigation strategies, which aim to eliminate or minimise the negative effects, and optimise the positive ones.
EIA is an important tool within an Integrated Coastal Zone Management process, as it visualises long-term impacts and promotes sustainable development of coastal zones.

DR-EIA project

A major challenge for the EIA community is the improvement in both the efficiency and the effectiveness of the EIA process in support of planning and decision-making. For this reason, in 1997 a start was made on the Document Retrieval and Expert System for Environmental Impact Assessment (DR-EIA). It originated from an idea of developing a computerised, internet-based tool, for expert staff at financing agencies in developing countries. The challenge was to develop an appropriate and cost-effective impact assessment tool in support of internet based, participatory decision making. The Netherlands Ministry of Foreign Affairs commissioned the development of the DR-EIA instrument, in order to stimulate the development of understanding of the use of EIA.

The target user group for DR-EIA are representatives from all stakeholder groups in the EIA process including project proposers, competent authorities, EIA experts and representatives of NGOs. The product consisting of a trainings manual, user manual and software package was first introduced to the international impact assessment community during the International Association for Impact Assessment (IAIA, 2001) conference in Cartagena, Colombia. Information at the DR-EIA website, which is maintained at www.dr-eia.org .

The product

The product consists of software-facilitated procedures for screening and scoping projects and plans in combination with databases that structure information on legal requirements. In this way the existing relationship that between proposed activities in a project, as well as physical changes because of these activities and their impacts can be described. A similar structure is used to identify social impacts that may occur as a result of a proposed project or plan.

In the present version, the DR-EIA instrument is suitable for planning and analysing projects on the land and in the water sector. Specific country modules have been developed for the Ministries of Environment of India and Bangladesh. The screening database holds information on many different financing organisations including EU, World Bank and Asian Development Bank. Apart from the procedures for screening and scoping, the instrument also facilitates writing terms of reference (ToR) for a full scale environmental impact assessment study based on the standards applied by selected financiers. One particularly interesting option is the "expert judgement based" procedure for screening and development of an EIA-ToR. This option is based on years of experience by an international team of experts working on the production of the DR-EIA instrument.

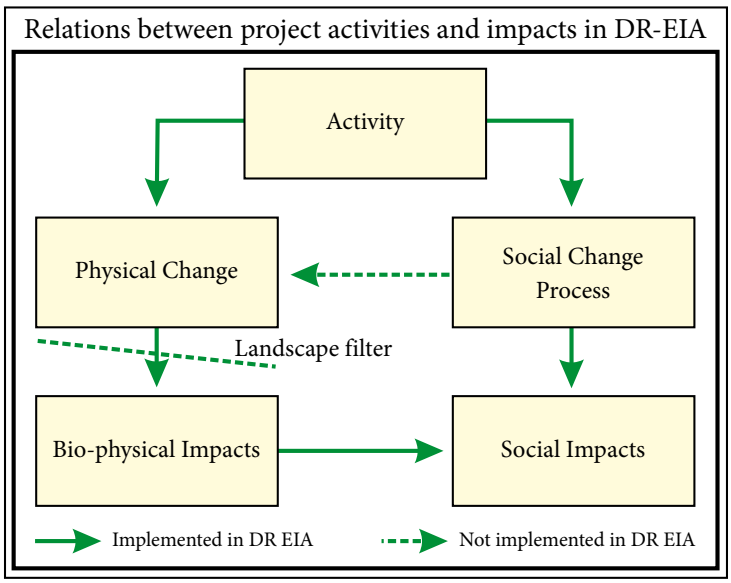


Figure 1: ***Relations between project activities and impacts in DR-EIA***

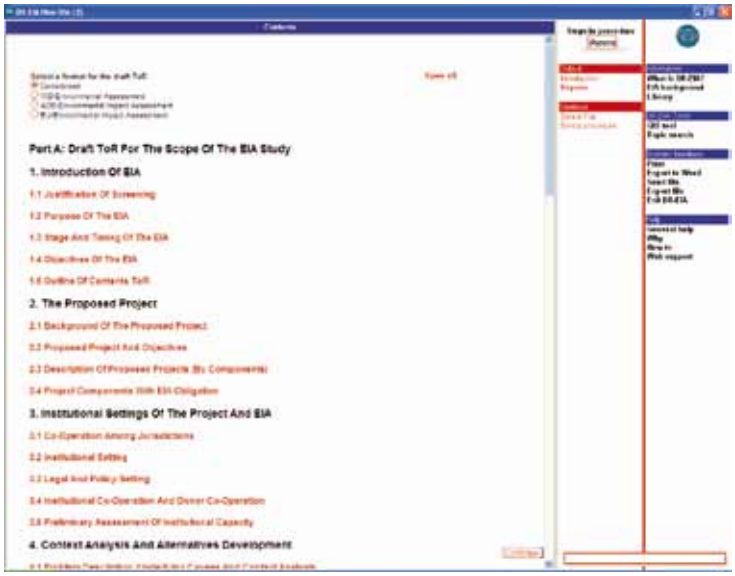


Figure 2: ***Terms of Reference*** *for an EIS study , one of the outputs of DR- EIA)*

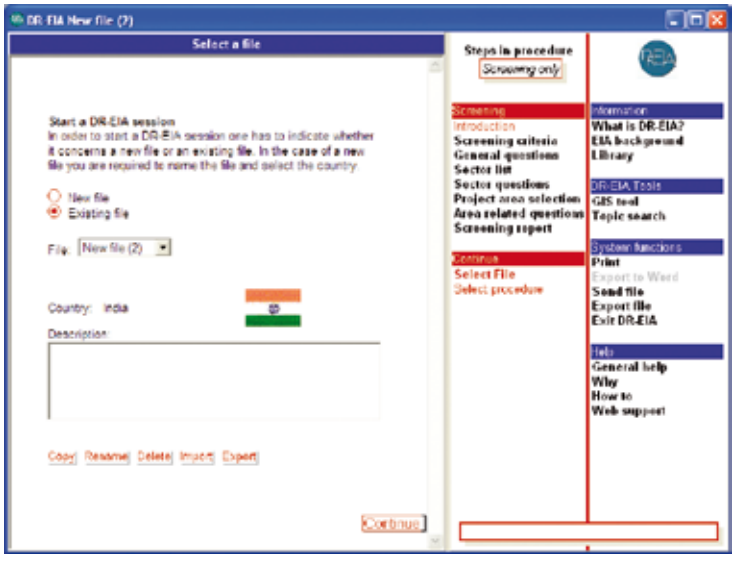


Figure 3: ***Implementing*** *a project in DR-EIA*

Instruction and learning tool

DR-EIA is a valuable instruction and learning tool and has become part of training in Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) in the international MSc curriculum of UNESCO-IHE. Plans exist to continue development of the tool in an open-source environment. This is the preferred approach in view of the complexity of the work that still needs to be done.

One of the achievements of DR-EIA is that many countries are now developing internet-based procedures for policy and planning purposes, including EIA.

A demo of DR-EIA is available through the DR-EIA website at: www.DR-EIA.org

More information

More information concerning structure, input and output of the DR-EIA instrument can be obtained through:

Joop de Schutter, Deputy Director of NESCO-IHE Institute for Water Education, Delft, the Netherlands: j.deschutter@unesco-ihe.org

Website UNESCO-IHE Delft: www.unesco-ihe.org

STREAM: a spatial tool for analyses in river basins

Jeroen Aerts and Hans de Moel *(IVM, Free University, the Netherlands)*

What is STREAM

STREAM (Spatial Tools for River basin Environmental Analysis and Management) is a GIS-based water balance model, covering an entire river basin including the coastal zone. STREAM is a raster based hydrological rainfall-runoff model for Windows computers. The model provides a user-friendly interface, uses an easy-to-learn script language, and can be used in a Decision Support System (DSS). STREAM was developed in response to the specific demand for models that could be coupled to other models. It allows the input of free of charge, spatial data, from GIS databases and satellite observations. It is easy to use, integrates the water and land components of river basins and land uses. It is therefore a unique tool for integrated coastal zone management.

The model simulates impacts of both climate change and land use change on river discharges and soil moisture availability. The model simulates human activities in the river basin, such as deforestation or reservoir dam construction. STREAM has been used in a variety of catchments worldwide, in combination with climate change scenarios, developed by the Intergovernmental Panel on Climate Change (IPCC). It is used in small river basins and at a global level, modeling the past, present and future situation, as well as over a geological timeframe.

Some technical information

The model is based on a raster GIS calculating the water balance for each grid cell of the basin. The resolution of the model application depends on the size of the river basin and varies between 300 x 300 m to 50 x 50 km. The larger the basin, the coarser is the minimum level of detail in the model. A digital elevation model (DEM) determines the direction of water flow. In STREAM, the water balance is calculated using temperature, rain, snowfall and snowmelt, soil water content and groundwater storage.

The spatial character of the model allows the analysis of water availability patterns and changes in these patterns caused by human activities (e.g. deforestation and drainage) and external influences such as climate change. The model uses so-called Blaise script-files in a Windows interface environment. Experienced modellers can easily modify these script files.

Input of STREAM

The simplicity of the model makes the model suitable for areas where data is difficult to obtain as most of the required data can be downloaded freely from the internet. Different equations for evapotranspiration are used such as the simple Thornthwaite & Mather (1957) equation. This equation uses temperature and precipitation as the major input variables. It calculates evaporation depending on land use and soil moisture. The model runs on a monthly basis generating direct runoff, delayed runoff, groundwater storage (shallow and deep), snow water equivalents and snow melt. The model uses the following five global GIS datasets as input:

- A digital elevation model (DEM);
- Total monthly precipitation;
- Average monthly temperature;
- Crop factors; and
- Maximum soil-water holding capacity.

The basin outlines and flow directions are based on a global digital elevation model at a resolution of 1x1 km Digital Elevation Map (GTOPO30, US Geological Survey 2004). Monthly climate data (precipitation and temperature) can be taken from the global CRU TS 2.0 dataset, which covers the entire globe for the period 1901-2000 on a 0.5 x 0.5 degree grid (Mitchell *et al.,* 2003). The water holding capacity is derived from the FAO soil map. Crop factors used for adjusting the reference

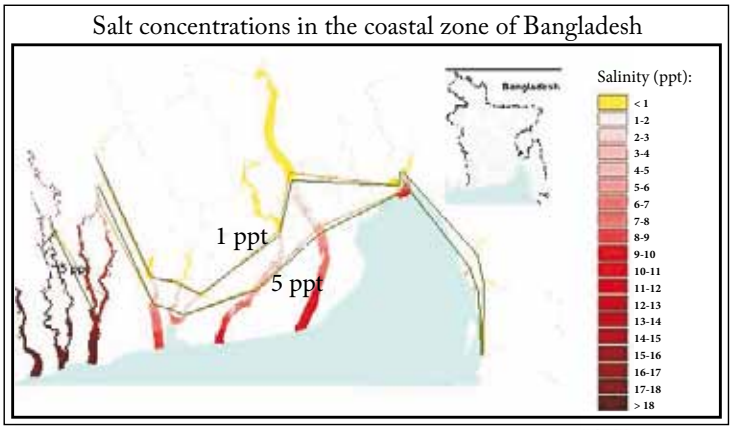


Figure 1: ***Example of STREAM output:*** *Salt concentrations (ppt= parts per thousand) in the waters of the coastal zone, Bangladesh.*

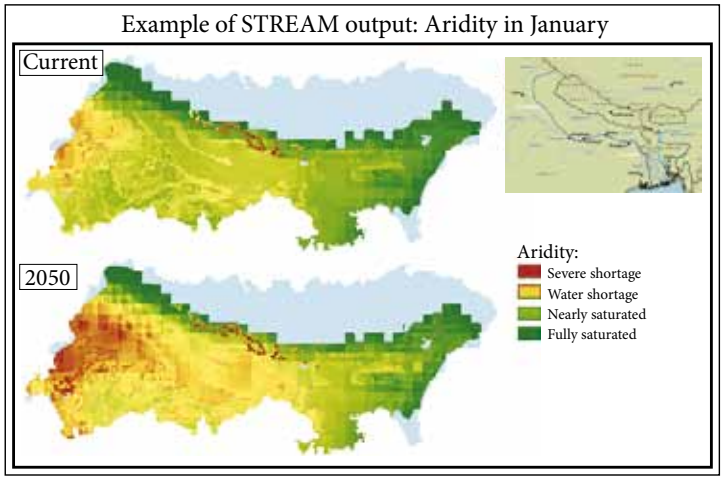


Figure 2: ***Example of STREAM output: Ganges, Brahamaputra, Meghna basin:*** *Aridity map for the month of January for the current situation,1960-1990, (Top) and under climate change, year 2050 (Bottom) The blue colour in the figure means that data was not available or that water is mainly stored as snow.*

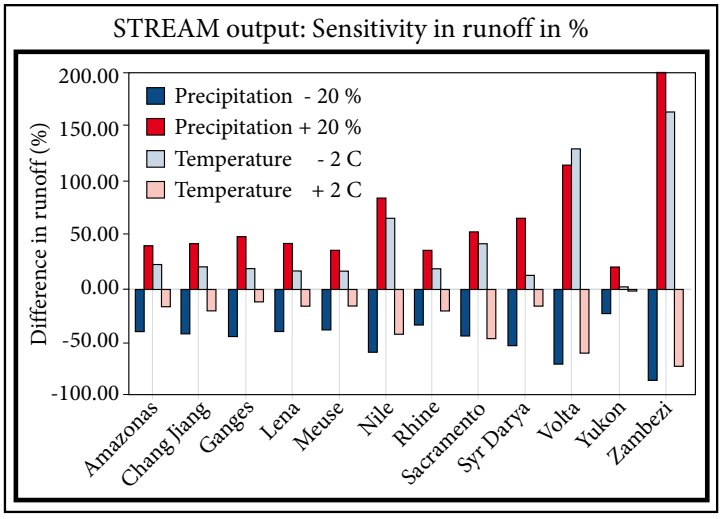


Figure 3: ***Example of STREAM output:*** *Sensitivity of the modeled runoff to changes in Temperature (+2 and –2º Celsius) and Precipitation (+20% and –20%) both relative to the present situation.*

potential evaporation, were adopted from FAO factors for different crop types (Doorenbos and Pruitt,1977).

STREAM applications worldwide

The STREAM model has been used in numerous projects. A flood modeling application of STREAM is set up in the central province of Vietnam - the TT Hue province: the Huong River Basin (Villegas 2004).

A number of STREAM projects around the world are highlighted in Figure 4. For more information on these projects, please see the publication section on the website of CWA – Cluster on Water and Adaptation.

Download the model

The model, as well as the manual and some additional files, can be downloaded from this website or ordered from the Institute for Environmental Studies (IVM). Researchers are encouraged to contact the authors to stay in touch on updates of the model. For questions or additional information, they can also be contacted. The website link is: http://www.adaptation.nl/ à STREAM

References

Aerts J.C.J.H., M. Kriek and M. Schepel, 1999: STREAM, spatial tools for river basins and environment and analysis of management options: 'Set up and requirements'. Physics and Chemistry of the Earth Part B, 24(6), 591-595.

Aerts, J.C.J.H., Hassan, A., Savenije, H.H.G., & Khan, M.F., 2000: Using GIS tools and rapid assessment techniques for determining salt intrusion: STREAM, a river basin management instrument. Physics and Chemistry of the Earth Part B, 25, 265-273.

Aerts, J.C.J.H., Renssen, H., Ward, P.J., de Moel, H., Odada, E., Bouwer, L.M. & Goosse, H., 2006: Sensitivity of global river discharges under Holocene and future climate conditions. Geophysical Research Letters, 33(19), L19401.

Bouwer, L.M., Aerts, J.C.J.H., Droogers, P. & Dolman, A.J., 2006: Detecting the long-term impacts from climate variability and increasing water consumption on runoff in the Krishna river basin (India). Hydrology and Earth System Sciences, 10(5), 703-713.

Bouwer, L.M., Aerts, J.C.J.H. & Misdorp, R., 2003: STREAM Report Vietnam 2003. Modeling the impact of land-use change on the runoff of the Perfume river basin (Vietnam) using STREAM. IVM-report (R-03/09), Institute for Environmental Studies, Amsterdam, 8 pp.

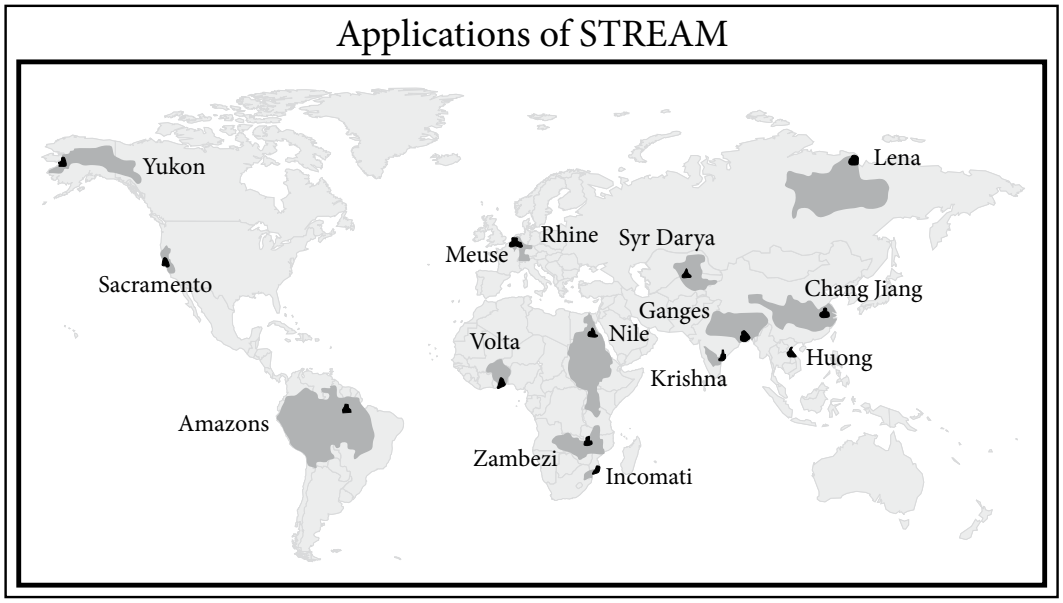


Figure 4: ***Location of the major STREAM application areas.***

Bouwer, L.M., Aerts, J.C.J.H. & Van Grol, E., 2003: STREAM Krishna Report 2003. The relative impact of climate variability and increasing water-use on the runoff of the Krishna River (India) during the past 100 years. IVM-report (R-03/10), Institute for Environmental Studies, Amsterdam, 21 pp.

Bouwer L.M., J Aerts, G M van de Coterlet, N van de Giesen, A Gieske and C Mannaerts, 2003: Evaluating Downscaling Methods for Preparing Global Circulation Model (GCM) Data for Hydrological Impact Modelling. In Climate Change in Contrasting River Basins: Adaptation Strategies for Water, Food and Environment (Eds J. Aerts and P. Droogers), CABI Press, London, UK.

Doorenbos, J., Pruitt, W.O., 1977: Crop water requirements. Irrigation and Drainage Paper No.24, (rev.) FAO, Rome, Italy, 144 pp.

Misdorp, R., Wulffraat, K., Aerts, J.C.J.H., 1999: Report of the International Workshop: "From river to coast" Chennai - India, December 1 and 2 1999 Work-document CZMC 2000.01.

Van Deursen, W.P.A. & Kwadijk, J.C.J. 1994: The impacts of climate change on the water balance of the Ganges-Brahmaputra and Yangtze Basin. Report RA94-160, Resource Analysis, Delft, The Netherlands.

Ward, P.J., Renssen, H., Aerts, J.C.J.H., van Balen, R.T. & Vandenberghe, J., 2008: Strong increases in flood frequency and discharge of the River Meuse over the late Holocene: impacts of long-term anthropogenic land use change and climate variability; Hydrology and Earth System Science 12, 159-175.

Ward, P.J., Aerts, J.C.J.H., de Moel, H., Renssen, H., 2007: Verification of a coupled climate-hydrological model against Holocene palaeo-hydrological records. Global and Planetary Change 57(3-4), 283-300.

Website and PDF reports

CWA- Cluster on Water and Adaptation: www.adaptation.nl

IVM - Institute for Environemnetal Studies, Free University Amsterdam: www.ivm.vu.nl

Mitchell et al., **2003**: Table of climate grids and derived data-sets: www.cru.uea.ac.uk/~timm/grid/table.html

Villegas, Piero, 2004: 'Flood modelling in the Perfume River Basin, Hue,Province Vietnam'; International Institute for Geo-information Science and Earth Observation, Enschede, the Netherlands: www.itc.nl/library/Papers_2004/msc/wrem/villegas.PDF

Capacity building essential for management of Marine Protected Areas

Carien van Zwol *(Directorate General Water, Ministry I&E, the Netherlands)*
Julius Francis *(Western Indian Ocean Marine Science Association, Tanzania)*

Marine wetlands threatened

Marine wetlands are important areas for people who live on the coast and inland. They provide essential life-support systems, play a vital role in controlling water cycles and help to clean up the environment (Maltby, 1986). About two thirds of the shellfish, commercial and sport fisheries rely on coastal marshes for spawning and nursery grounds. Marine wetlands also deliver many other goods for local inhabitants in the form of medicines, food and security against flooding. Today more and more tourists visit some of the remoter coastal wetland areas. The existence of these wetlands, so vital for coastal inhabitants, is increasingly threatened. Dams and barrages, providing electricity and irrigation, often have impacts on downstream floodplain fisheries, wildlife habitat and bio-diversity. In the hinterland excessive use by agriculture of artificial fertilisers and industrial pollutants, as well as large-scale non-selective deforestation, degrade downstream wetlands. Draining wetlands, to improve agricultural production, further decreases the area of wetland habitat. The estimated annual area loss of the world coastal wetlands varies between 1 – 2 % over many decades (GVA, 1992).

***Subsistence fishing by local fishermen** is allowed within the borders of this Mafia Island Marine Park, Tanzania. MPAs yield many benefits to fishermen and biodiversity e.g. foster natural age structures in fish populations, increasing fish catches and prevent bycatch of non-target species. (photo: © WWF-Canon / Peter Dento; WWF-MPAs: http://assets.panda.org/downloads/marineprotectedareas.pdf)*

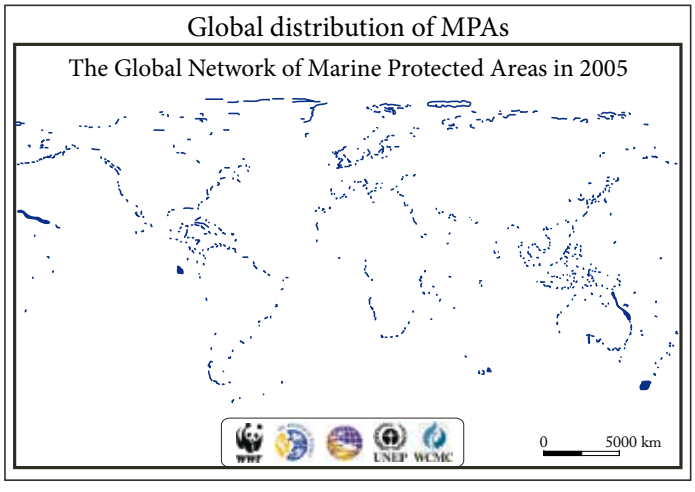


*Figure 1: **Global distribution of MPAs** (blue dots): 4600 MPAs covering 2.2 million km². (source: UNEP, WWF; adapted)*

Need for wetland protection

Wetlands are in great need of protection. The signatories to the international 1971 Ramsar Convention agreed the inclusion of wetland conservation in their national planning. The concept of Marine Protected Areas (MPA) was identified by IUCN and further promoted by UNCBD (UN-Convention on Bio-Diversity, Rio de Janeiro 1992) to improve their management around the world.

According to the widely accepted definition of the IUCN, a MPA is: "Any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment."
MPA is thus a generic term for any marine area that is protected by means of regulating human activities, and includes protected areas differing in purpose, design and management approach.

They include areas where regulation of exploitation, rather than conservation is the primary objective, as well as areas under integrated coastal management programmes, where sustainable use of the marine ecosystem is the primary purpose (multiple-use MPAs).
There are MPAs all around the world. They can be very large (Great Barrier Reef) but also quite small and can be found in arctic, temperate zone and tropical climate zones. Tropical MPA's will often include mangroves, sea-grass fields and coral ecosystems.

Capacity building is important to ensure effective management

Strong support for the management of MPAs will contribute to sustainable development of coastal and marine areas. The UN-Jakarta Mandate (1995), outlining the programme of actions for marine and coastal biodiversity within the UN Convention on Bio Diversity (UNCBD, 1992), stressed the importance of capacity building to ensure effective management of these areas. The availability of skilled personnel is fundamental to the success of establishment and management of MPAs. Quite often, protection of these areas has shown an increase in the numbers and diversity of marine life and improvement of the overall health of the system.
The Dutch Coastal Zone Management Centre (CZM-Centre) began a capacity building initiative for MPA personnel in 1998. Training opportunities and modules to improve the management of MPAs were particularly lacking in the East African Region.
It was therefore decided to develop a MPA training programme for the Region in close cooperation with experts from the region, international organisations and with the support of the World Bank.
The geographical distribution of MPAs around the world (Figure 1) offers ample potentials for interregional sharing of increased MPA's management capabilities. The positive results of MPA training activities obtained in the Western Indian Ocean region are used in the Caribbean Islands and in South Asia.

Development of a regional training programme

Before this MPA Programme began, an analysis was made of training needs and existing capacities. Much of the existing material had a strong focus on nature protection and marine biology and less on integrated planning, legislation, enforcement, surveillance and management.
After consultation with prospective students and other regional experts during a workshop on Zanzibar in 1999, it was decided to develop a very practical and hands-on curriculum, which would cover a broad spectrum of subjects, from communication and fund-raising to monitoring and surveillance, aimed at mid-level managers.
Through close co-operation with regional organisations, namely with the Western Indian Ocean Marine Science Association, the UNEP Regional Seas Programme for East Africa, the Institute of Marine Sciences of the University of Dar es Salaam and the regional offices of IUCN and WWF, the CZM-Centre was able to develop a truly regional training programme. Courses were organised in the regions rather than inviting participants to attend courses in the Netherlands.
A comprehensive MPA Training Manual was produced using the experiences of the East African MPA training programmes.

***Julius Francis teaching** at one of the regional training courses in MPA Management (photo: C. van Zwol)*

Many valuable lessons were learnt by active participation:

- A regional programme has several advantages over national training programmes. Firstly, it is more cost-efficient because the number of potential trainees increases, secondly the students can exchange national experiences, and last but not least, management of marine areas covers cross-boundary issues, best considered within their regional context. Alumni of the course were able to participate in a regional network of MPA managers established under the programme;
- The curriculum was developed mainly by regional experts, and later supplemented with regional case-studies presented by students during the first courses;
- A two-week training programme was developed and carried out three times (Kenya (2000 and 2002) and South Africa (2001) with financial support from the World Bank and the co-operating regional organisations. Either students were sponsored by these organisations, or their government paid the course fees. The courses were as interactive as possible, with plenty of exercises, role-playing and presentations by the students;
- With the closure of the CZM-Centre in 2006, a regional programme for internships for MPA managers and a French-language curriculum were planned but has not been implemented;
- The success of the programme was demonstrated by the fact that it was adopted by regional marine and coastal organisations in East Africa, while other MPA Regions such as the Caribbean have also benefitted from the MPA Training Manual. The South Asian region have created a MPA Training manual, based on the East Africa Region one.

The CZM-Centre also supported regional initiatives to promote policy dialogues on the issue on MPA management and its linkage to Coastal Zone Management. MPAs can be promoted as stepping stones within a broader Coastal Zone Management Programme. Political support for integrated management is an important precondition for the success of MPAs. The training programme was presented at the Ministerial Meeting of the Nairobi Convention (2003). The CZM-Centre has facilitated the production of a video and a vision document to enhance the public and political awareness on the importance of MPAs.

Download the MPA Training Manual

The CCC-web production belonging to this book, contributes to the interaction between East African region with other MPA regions such as in Asia, Pacific and Caribbean Islands. From this CCC-website (www.coastalcooperation.net) you can easily obtain the latest version of the entire MPA Training Manual in the English language. (see CCC V-1-1-4)

A related initiative by IUCN, the MPA toolkit for the Western Indian Ocean, is available at the WIOMSA-website.

Further information

For further information you can contact:

Carien van Zwol: c.vzwol@inter.nl.net
Julius Francis (WIOMSA): julius@wiomsa.org

References

GVA – Global Vulnerability Assessment, 1992: Vulnerability Assessment for Population, Coastal Wetlands, Rice Production on a global scale. Rijkswaterstaat & Delft Hydraulics, the Netherlands

Maltby, E. 1986: Waterlogged wealth; London: Earthscan, International Institute for Environment and Development.

Websites

Western Indian Ocean Marine Science Association (WIOMSA): www.wiomsa.org

CCC Part III - Chapter 3: How ICZM

III-3-3 Examples of Adaptive Measures

III-3-4 Conclusions on concepts, tools and measures

'Building with Nature': principles and examples

Ronald E. Waterman
(Senior Advisor and Member of the Parliament of the Province South-Holland)

Introduction to the principles

'Go with the Flow'. Find integrated solutions which make use of less invasive techniques and are more in harmony with the natural dynamics. This is the essence of the concept: '*Building with Nature*'.
Although this principle was first applied in the Netherlands, it has gradually been recognised worldwide as a harmonious means of creating land areas for living, working, tourism and recreation, and infrastructure, whilst ensuring the preservation or expansion of valuable environmental resources, nature and landscape. In addition, it also takes into account: climate change and the resulting in sea-level rise, more frequent and intense storm-surges, as well as land subsidence and salt-water intrusion.

Today implementation of this concept is gradually being pursued in a wide range of cities, ports and along beaches throughout the world. In recent years, *'Building with Nature'* has steadily gained more and more acceptance. This is spurred on by the growing awareness on the impacts of climate change, by the increase in natural disasters like the tsunamis in the Far East and hurricanes in New Orleans, and by the loss of low-lying lands, such as the Sundarban Islands in the fragile delta area near the Bay of Bengal.
This approach to innovative coastal measures, with emphasis on soft solutions provides the best hope for long-term sustainable solutions for the restoration of coastlines and habitats and land reclamation.

With approximately 80 percent of the largest population centres in the world situated on coasts and deltas, the need for sound, integrated coastal zone development via *'Building with Nature'* is urgent and appropriate. The flexible integration of land-in-water and of water-in-land (working with nature) is an environmentally friendly and economically advantageous system which is gaining more and more acceptance worldwide. Implementing this approach can help create a new flexible coastline in a dynamic equilibrium using sand from the sea, which consists of a new primary range of dunes with a new beach in front and with a minimum of solid sea-wall elements. The emphasis is no longer on inflexible solid bulkheads against the sea, like dams & dykes, but instead on flexible soft structures in harmony with the sea, like dunes & beaches.

The Netherlands is a good example of a low-lying coastal country with a high population density. It also has a high motorcar density, a high waste production and a high energy usage per capita. The need for new building sites for living, working, recreation & tourism, for an adequate infrastructure and for a continued town renovation process is clear. At the same time the preservation and expansion of valuable environment, nature and landscape is important. In short there is a need for multifunctional space, which is in short supply.
Apart from the necessity of population stabilisation in due time, in principle three spatial solutions exist to cope with this scarcity of space:

- Making better use of the 3rd dimension (sky-scraping & underground development);
- Using space in the existing hinterland;
- The seaward option with flexible integration of land in water and of water in land.

The emphasis here is on the seaward option, which is based on two important principles: *Integrated Coastal Policy* and *Building with Nature.*
Integrated Coastal Policy with a sustainable, integrated approach for many coastal and delta regions worldwide, and to achieve this, many functions, using many different disciplines, have to be considered carefully. The final development should be such that the overall economy is strengthened and the environment is improved. There are many specific functions in the coastal zone which are of great importance and which should be addressed in cohesion, requesting an integrated, holistic approach.

Where nature allows it, the principle of *'Building with Nature'* should be applied as much as possible in the creation of new land. The essence of this principle lies in understanding the natural forces and interactions between the land and the sea. Being flexible and working with rather than against natural forces and taking into account existing and potential natural values of the coastal zone and the seabed, is essential. *'Building with nature'* uses the mobile material sand/silt and the forces/interactions to which they are exposed being the action of tides, waves, currents, river outflow and interaction vegetation - sand/silt.
Multifunctional master concepts including nature reserve areas and careful zoning, can achieve a net gain in coastal areas. These coastal zone developments can be carried out phase after phase, segment after segment, all fitting in a flexible master plan, leading not only to cost-effectiveness and flexibility but also to environmental improvement. The environment, including nature, has four important basic functions:

1. *Carrier Function,* providing space and habitat/substrate for all living organisms encompassing inorganic matter, landscape and seascape, energy systems and the interactive processes;
2. *Production Function,* through exploration, exploitation, harvesting of inorganic and organic resources;
3. *Regulatory Function,* maintaining essential eco-systems and processes, including the bio-geochemical cycle, the climate and hydrological cycle.
4. *Information Function,* providing information in many forms for increasing the knowledge base of the socio-economic and natural coastal sub-systems enhancing the quality of decision-making.

Strengthening the economy and improving the environment are achieved through the application of the method of *Building with Nature,* the creation of new nature reserve areas, careful zoning of the various functions and the introduction of a Triple-C approach: *Clean Technology, Clean Products, and Cleaning-up Technology.*

Advanced technologies, specially dedicated environmental equipment like drag and cutter dredging heads, improved working methods and technologies for site investigations, environmental impact assessments and sophisticated monitoring and database management, have made it possible to undertake the enormous land-creation projects in the Netherlands, Dubai, Singapore, Hong Kong, in a way that supports responsible socio-economic growth.

Some examples of *'Building with Nature'* projects in the Netherlands

Most of the projects have a dune-beach protection in harmony with the sea. They all strive successfully for net nature gain in agreement with economic and social functions.
Two examples are realised integrated multi-functional

Figure 1: ***Index map: Locations of two of the realised integrated multifunctional coastal 'Building with Nature' projects*** *(blue circles) : #1) Slufterdune area and #3) IJmuiden,* ***and one project under construction****: #2) Hoek van Holland – Scheveningen/The Hague (green oval). (source R. Waterman)*

projects Slufterdune and IJmuiden, and one is under construction.

The Slufter dune area (800 ha) with its successor Maasplain 2 (Maasvlakte 2 – 2000 ha) form together a multi-functional peninsula attached to the Port of Rotterdam (Figure 2).
The north side is an area designated for port and port-related activities developed in accordance with environmental standards. This includes a container handling area, chemical factories, roll-on-roll-off, bulk storage and distribution area, with pipeline, railway and road systems, cranes, quay walls and harbour basins, and an environment-friendly storage and processing facilities for all types of wastes such as fly ash, slag, waste gypsum.
The large containment reservoir, 90 million m^3 (internal depth - 28 m Mean Sea Level and surrounded by 25 m high dunes) is gradually filled with contaminated dredged harbour sediments. The 35 million m^3 sand released during the construction of this deep reservoir is used for the construction of the sandy ring walls of the peninsula. The walls and bottom of the special storage basins are impermeable, preventing leakage to the environment. Excess water is pumped into special treatment unit.

South east of the large reservoir is a triptych of newly designed and existing nature reserves for terrestrial flora and fauna. Next to this is an existing valuable nature

reserve with over 700 species of plants, varying from the pioneer vegetation near the shore to the climax vegetation in the wooded inland area. Adjacent is a developing seascape (clearly visible in air photo) consisting of shoals and beaches with high water resting areas for birds and nursery habitat for marine organisms, like seals.
In both areas provisions have been made for tourism and recreation facilities. A special designed area is used for sea kite- and wind surfing.

Seaport Marine IJmuiden/Kennemer beach –Project
This project illustrates the beneficial application of *Building with Nature* in the area, south of the harbour mole. It was primarily created by the long shore net sand transport in northern direction. Since the 1970s, the sand was trapped by the extended southern harbour mole of IJmuiden. In this way the project started to come into being and *Building with Nature* found its expression. It is a multifunctional land reclamation in IJmuiden, near the entrance channel

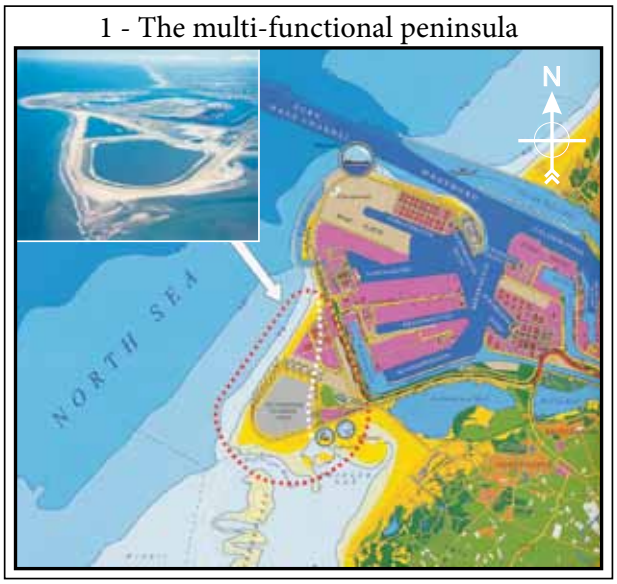


Figure 2: ***#1. The Sulfterdune area*** *connected to the Rotterdam harbour: the large containment reservoir for contaminated dredged material (aerial photograph), the distribution harbour area, and marine and coastal nature reserve area. (source: R. Waterman)*

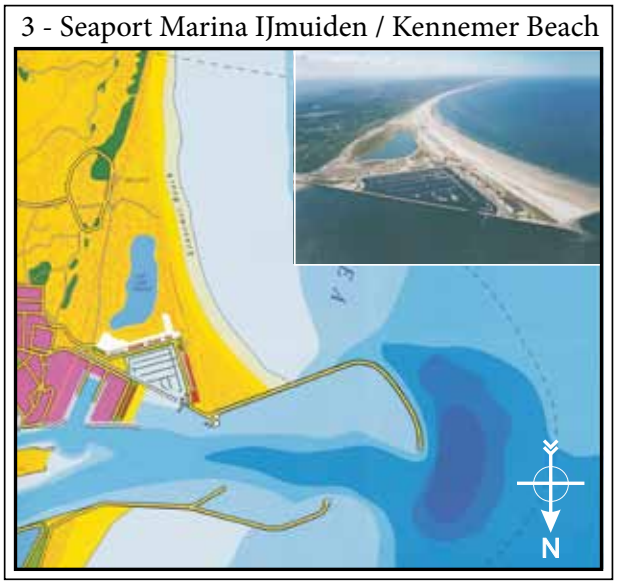


Figure 4: ***#3. Seaport Marina IJmuiden / Kennemer Beach*** *(looking to the south). Nature already developed a new area south of the existing southern harbour mole of IJmuiden, owing to littoral sand transport in a northern direction along the coast. The process was quickened by human induced action – dredging of external and internal waters, and extending of the harbour moles. (source: R. Waterman)*

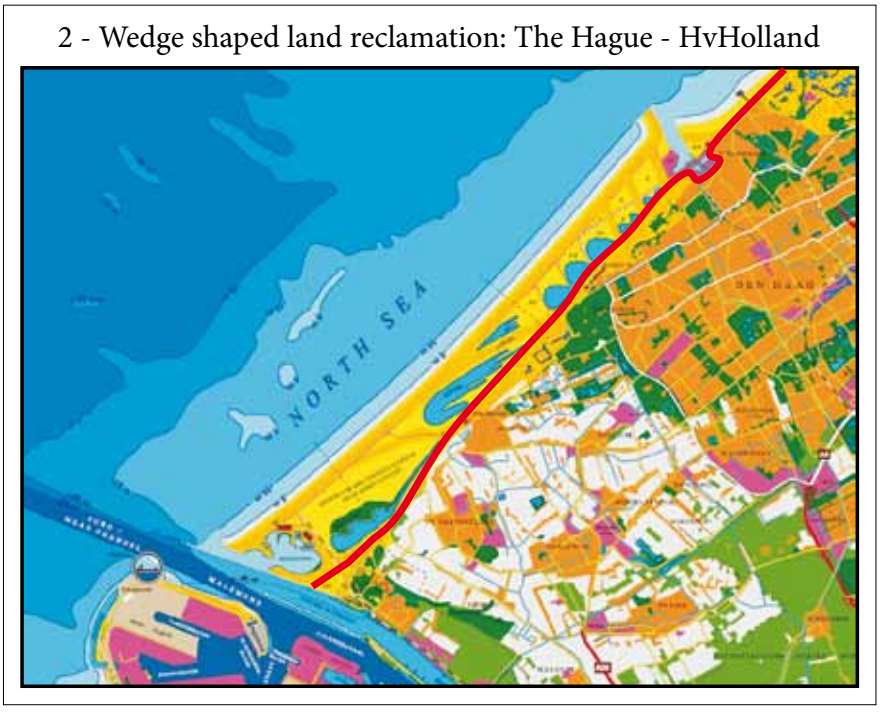


Figure 3: ***#2. Wedge shaped land reclamation*** *between Hoek van Holland/Rotterdam and The Hague (with a length of 21 km and with a maximum width of 4 km) seawards of the red line being the present coast line; with several functions: lagoons, nature reserve area, marina, harbour, residential area, recreation, with increased fresh water lens under the new dunes, and increased coastal protection anticipating climate change. The total project is being executed segment for segment. (source: R. Waterman)*

Figure 5: ***Jakarta proposed land reclamation*** *in purple: port and industry, and in light green: residential area and nature reserve areas. (source: R. Waterman)*

to the Port of Amsterdam, with a marina, a double boulevard, a nautical centre, apartments, restaurants & shops, hotel capacity and an artificial lake, attracting many birds. Parts of the wide beach, close to Amsterdam, is also used for recreation.

Building with Nature in South Asia: Jakarta Waterfront Development Programme: Pantura project

Jakarta is an example of a densely populated coastal urban agglomeration, over 10 million inhabitants, living and working on an area of 650 km^2. Although Jakarta faces enormous current and future problems, it also presents an important opportunity to solve these problems. A holistic, *Building with Nature* approach relied on using the natural hydraulic forces and interactions between sand and silt. This approach to land reclamation is relatively cheap, environmentally friendly and more in harmony with nature and therefore more sustainable. The Pantura project comprises the creation of over 3000 ha of new land along 32 km coastline of Jakarta Bay. The development of this newly acquired land is coupled to a complete urban rehabilitation of 2,500 ha of the adjacent hinterland of North Jakarta (Utara). Included are many different functions ranging from residential areas, industry to establishing a segment for a new nature reserve including indigenous flora and fauna, with in sandy beaches, dunes and mangrove coasts. Special attention has to be paid to ensuring a harmonious transition from old to new, including cultural and historical values. Private and public sectors can work together to realise an integrated vision: the Rebirth of Jakarta.

Conclusions

Over recent years, the necessity of an *Integrated Coastal Policy* via *Building with Nature* has become more apparent, not only in Europe but also elsewhere in the world. The overall investments and maintenance costs of the methods based on these principles are significantly lower than those that neither use an integrated approach nor use the environment as a basis for development. Furthermore, the proposed method improves the environment and simultaneously strengthens the economy. The concept has proved to be applicable in a large number of countries in coastal and delta areas.

Integrated planning aimed at long term sustainable development of coastal areas which addresses complex coastal problems takes time. However this "loss of time" is regained during the execution and the implementation of the comprehensive coastal projects.

References

R.E.Waterman, 2008: *"Integrated Coastal Zone Development via Building with Nature", The Hague, the Netherlands, ISBN/EAN 978-90-805222-3-7.*

Waterman, Ronald E., Misdorp, Robbert & Mol, Arie, 1998: *Interactions between water and land in the Netherlands; p 115 - 127 in Coastland dynamic lowlands: Jan Visser & Robbert Misdorp (Eds) Special Feature - Journal of Coastal Conservation 4 ; EUCC, Opulus Press Uppsala, Sweden.*

PDF reports

R.E.Waterman, 2007: 'Land in water, water in land achieving integrated coastal zone development by 'Building with Nature"; Special Issue: Terra & Aqua Nr 107, June 2007-International Association of Dredging Companies, The Hague; PDF: www.ronaldwaterman.nl/page5/files/page5_2.pdf

Website

Ronald Waterman: www.ronaldwaterman.com

Sand Nourishment

A flexible and resilient, adaptive coastal defence measure

Tjark van Heuvel *(Rijkswaterstaat/Ministry I&E, the Netherlands)*

Introduction

In sandy coastal areas, sand nourishment can be considered as an efficient measure to preserve the shoreline and safeguard coastal functions such as recreation and nature. Nourishment is the supply of sand to the shore, to strengthen the coastal profile and add sediment to the littoral budget. Commonly the sand is extracted from the deeper sea bottoms, which may have large reservoirs of suitable sand. In coastal, deltaic areas where the marine sands may be too fine of structure, the use of coarser grained river sands might be an option. This latter option is being explored for the Romanian coast.
The sand is usually nourished on the beach, although increasingly in the Netherlands on the foreshore. As the cause of erosion remains, the nourished sand is eroded over time. It is thus inherent in the nourishment concept that the nourished sand is gradually lost and that nourishment requires a long-term maintenance programme. How long a particular amount of supplied sand will endure depends on the forces of nature and coastal characteristics. These need to be thoroughly understood.

Monitoring

A dynamic coast needs intensive coastal surveying. This to ensure proper decision making regarding the preservation of the coastline and coastal zone and to safeguard economic development and associated large capital investments.
The Netherlands has a 350 km coastline length (as the crow flies). About 1600 coastal profiles are yearly surveyed since the 1960s. However the position of the Low Water line, High Water line and dune foot has been monitored already since the mid 19th century. Efficient survey systems (Figure 1) and data-base management allows for a quick process-time and in few months time, the so-called Kustlijnkaarten (Coastline-Maps, see CCC III-3-2-1) are produced.
These results are used each year for:

1) Identifying the erosion hotspots;
2) Indicating the sand nourishment locations;
3) Estimating the average life-time of a sand nourishment for a particular coastal stretch;
4) Analysing the economic cost and benefit for each stretch;
5) Evaluating the effectiveness of the national sand nourishment scheme and are used for five-year reporting to the Parliament.

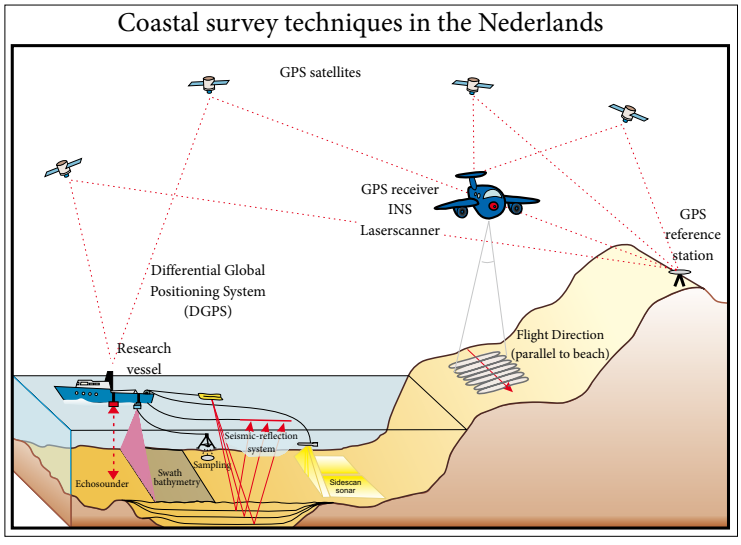


Figure 1: ***Airborne Laser Altimetry & marine multiple Sounding*** *are modern survey techniques and systematically applied during the yearly monitoring of the 350 km long coastal zone of the Netherlands.*

In 2009, a six years research programme began to assess in more detail the impacts and opportunities of nourishment for the coastal ecosystem. This programme covers the whole coastal zone, including the foreshore and the dune area. The programme will result in recommendations for an ecological optimal approach to nourishment.

The coastal manager optimises the coastal defence measures in line with the identified policy goals (Ministry V&W, 1990 – 2005) by means of coastal monitoring and applied coastal research. The development of data sets as well as morphological models supports the analysis and are important tools which contribute to continuous improvement of the way the nourishment schemes are executed.

Efficient method and its effects

In the Netherlands coastal nourishment proved to be successful and efficient. It contributes to a major reduction in maintenance costs of the coastal protection when compared to hard defences. Moreover, it also has benefits for other coastal functions, like recreation and nature conservation. Nourishment is a sustainable method, as it fits within the natural processes of sand transport and sedimentation. The resilience of coastal systems is safeguarded or can even be enlarged.

(photo: //beeldbank.rws.nl, Rijkswaterstaat)

(photo: Van Oord)

Sand nourishment in progress: *rainbow nourishment on the fore-shore is a method increasingly showing its efficiency and is based on many years of special morpho-dynamic surveys.*

It is widely considered that the use of sand is a better alternative than the construction of hard structures, for instance groins and dams, to protect a sandy coast. This is not only from an ecological perspective but also from an engineering point of view. The use of sand causes less serious side effects in the longer term than concrete structures. However, even though nourishment may be the best option from the ecological point of view, it also brings about some changes to the sandy ecosystem. These are being monitored to determine the recovery time on the locations of the sand extraction and nourishment sites.

The nourishment influences the morphology of the foreshore, beach and the fore-dunes. In the Netherlands not only 6 million cubical metres of sand is annually supplied to the beaches and in the near shore zone, but also about 5 million cubical metres in deeper water (up to 8 meters below MSL), in order to compensate the effects of sea-level rise. After 20 years of dynamic preservation of the coastline, the policy is changing into one of compensation the erosion in the coastal foundation, in the deeper part of the coastal profile. New special dredging techniques and contracts are then required.

The 'Sand Engine'

In recent years, the possibilities of using very large nourishments as a new strategy for coastal management are being discussed. An example is the innovative pilot project 'the Sand Engine' in front of Delfland in the Province of South Holland, the Netherlands. The pilot consists of depositing a large amount of sand (21.5 million m^3 - 2011) in a depot just off the coast that will serve a multitude of functions: coastal protection, nature and recreation. The idea is that the natural longshore sediment transport processes will gradual redistribute the sand along the coast towards the North leading to coastal growth and protection and thus increasing space for coastal development (Province of South-Holland, 2009). The pilot Sand Engine will be accompanied by monitoring and research. If this pilot

proves to be effective, then this method of creating large-scale coastal sand buffers can be applied in the future.
This will help to reinforce the coast providing greater resilience and a more flexible way of accommodating the potential impacts of climate change, particularly accelerated sea level rise and increasing storminess. It is a no-regret measure, to be applied after the impacts of climate change are starting to become visible.

References

Arens, Sebastiaan.M, Quirinus L. Slings, Luc HWT Geelen and Harrie G.J.M. Van der Hagen, 2007: Implications of environmental change for dune mobility in the Netherlands. International Conference on Management and Restoration of Coastal Dunes - ICCD 2007.

Min. V&W – Ministry of Transport, Public Works and Water Management 1990, 1995, 2000, 2005: Four Coastal Policy Documents, the Hague, the Netherlands

Province of South Holland, 2009: The sand engine: building with nature; innovation; coastal protection; space for nature and recreation., The Hague.

Taal, Marcel, Jan Mulder, Jelmer Cleveringa and Daan Dunsbergen, 2005: 15 Years of coastal management in the Netherlands; policy, implementation and knowledge framework (RIKZ)

Websites

RWS – Beeldarchief:
www.rijkswaterstaat.nl/apps/beeldbankvenw
Safecoast Brochure:
www.safecoast.org/editor/databank/File/coastline%20management.pdf
Sand-Engine:
www.zuid-holland.nl/overzicht_alle_themas/thema_water/c_zandmotor.htm

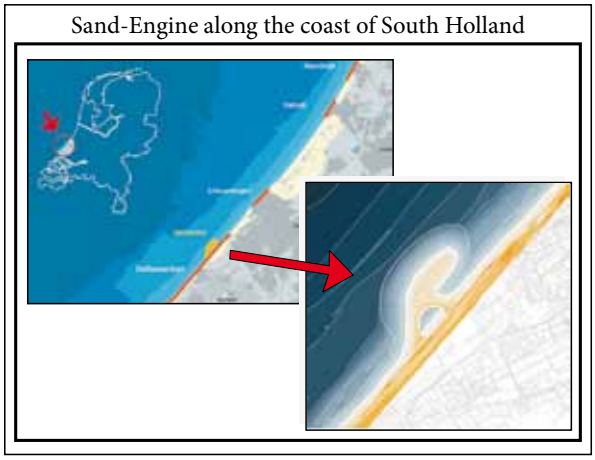


Figure 2: ***The large Sand-Engine*** *of along the coast of South Holland will act as a huge sand buffer, an artist impression. (source: Sand-Engine - Provincie Zuid-Holland)*

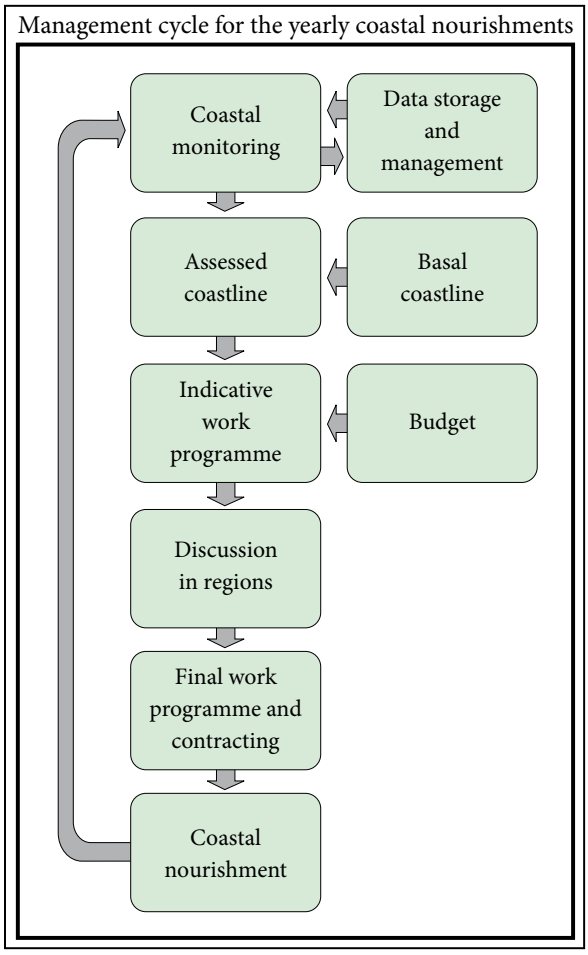


Figure 3: ***Management cycle*** *for the yearly coastal nourishments; monitoring, data management and analyses are important elements.*

Flood proof architecture

Concepts and constructive solutions to adapt to rising water levels

Johan van der Pol *(Dura Vermeer, the Netherlands)*

Introduction

Soil compaction and subsidence, urbanisation and climate change increase the vulnerability of (urban) areas to floods. The government is going to invest heavily in the necessary knowledge development, to be able to face climate change.

For this task, the building trade can and should make a crucial contribution with new concepts of ''building with water'. Especially in highly populated areas, living with water may be a sustainable adaptive solution for future challenges. More and more Dutch designers are getting into 'flood proof' architecture. This has already led to a whole range of concepts and constructive and non-constructive solutions. Noticeable examples of building methods are: floating construction, amphibious construction, construction on piles, elevated construction, dry- and wet proof construction. Practical examples are floating- and amphibious houses, platform houses, artificial islands or reefs, floating offices and floating greenhouses. These items are the specialism of Dura Vermeer, a construction and development company in the building industry. This article illustrates some of their concepts.

Floating greenhouses

Floating greenhouses offer the opportunity to combine two functions on the same square metre: greenhouse horticulture and water storage. There is an increasing demand for this multiple use of space, because space in The Netherlands is restricted, while the demand for living-, working- and recreational locations is increasing. In the years to come many tens of thousands of hectares will be used for water storage, taking up valuable space. Creating space for water storage is not simple in a densely populated country as the Netherlands. Combining water storage with an economic function may more easily create the necessary space.

The concept of floating greenhouses has been developed from the idea that it contributes to the solution of spatial limitations that arise from the redevelopment of greenhouses and will create space/ room for water storage.

A pilot project for a floating greenhouse is to be realised in the province of South-Holland. The lowest point of The Netherlands is situated in this area: 6,76 metre below NAP (NAP = about average sea level). The idea is to plan an area where a pilot project floating greenhouse can be realised on a commercial basis. The pilot will be an example of a sustainable development of glasshouses combined with water storage. Apart from the development of a floating greenhouse, the business case also comprises a research programme covering the environmental effects. A public-private partnership has been working on the business case for two greenhouse growers since 2005. In 2012 we hope to finally celebrate the opening of the five hectares floating Greenhouse: the Floating Roses.

First - built floating greenhouse in the world *- Demonstration version, municipality of Westland (photos: Dura Vermeer).*

***Amphibious homes** (photos: Dura Vermeer)*

***Impression of a residential district on water** (source: Knowledge Project Bouwen met Water)*

Amphibious and floating homes

Unlike the houseboats that line many Dutch canals or the floating villages of Asia, these amphibious homes are being built on solid ground — but they also are designed to float on flood water. They look much like regular houses; the only difference is that when the water rises, they rise.
Each house is made of lightweight wood, and the concrete base is hollow, giving it ship-like buoyancy. With no foundations anchored in the earth, the structure rests on the ground and is fastened to 15-foot-long mooring posts with sliding rings, allowing it to float upwards in times of flood. All the electrical cables, water and sewage flow through flexible pipes inside the mooring piles.

Realisation in Maasbommel

The desire to integrate water management issues in the Netherlands in sustainable spatial planning, has led Dura Vermeer to translate this aim into the development and realisation of 32 amphibious and 14 floating houses in Maasbommel in the Province of Gelderland. The houses are the solution to the demands for living-, working- and recreational space and the need for a sound and sustainable water storage. The location in Maasbommel is just outside the dyke ring in a water recreational area, connected with the river Maas. Recent flood events and the subsequent strengthening of the dykes in the river basin have led to the development of houses by an entirely new concept: houses that will float at high water. In order to enable the houses to move with the fluctuating water level, the houses are fixed on concrete floating platforms with a suspension mechanism. At a low water level, the houses rest upon a foundation of concrete. To keep the houses as light as possible the framework consists of timber. To prevent the houses from floating away at high water they are fixed to flexible moorings, with which tugs can be absorbed. It is expected that once every five years the water level will rise so much (over 70 centimetres) that the houses will indeed float. The houses can cope with a water level difference of up to 5,5 metres. That is above the height of the top of the levee.

Residential district on water

In the framework of expertise development, Dura Vermeer made a design for a residential district on water, applied to a pilot location in the low-lying polder Haarlemmermeer, south west of Amsterdam. In this concept, urban functions are integrated with water retention and storage. The result is an environment that not only respects the water system level, but moreover, creates a high-quality living environment and a net saving on space. To answer questions about the feasibility of a pilot residential district on water, a study is to be carried out. This study will show under what circumstances a residential district on water in the Haarlemmermeer is likely to be successful. Based on this, the parties involved can decide whether they want a pilot residential district on water. The developed expertise on the possibilities to combine water storage and construction will first be applied to the Haarlemmermeer. However, since this expertise is also applicable elsewhere, ideas for other locations can also be submitted.

Conclusions

In recent years, the knowledge and experience in the field of flood proof construction has increased strongly. It is an issue, which is not only relevant to the Netherlands, but has also been taken up by other countries. Some remarkable examples of practical applications have been realised, from which learning points are being shared. These experiences are subsequently used in developing the expertise and concepts further and its translation into daily construction practice. This means that expertise is now available for modelling damage because of flooding, construction concepts have also been elaborated, which are based on a sound financial footing, situation-specific and solutions offered and cost-benefit analyses made.
The concepts of flood proof architecture can be an efficient method for adapting to the potential impacts of climate change.

Websites

www.duravermeerbusinessdevelopment.nl
www.bouwenmetwater.nl
www.drijvendekas.nl
www.floatingroses.nl

English language websites

Flexbase: www.flexbase.eu
Floodprobe-Project: www.floodprobe.eu
Urban flood management, Dordrecht city: www.ufmdordrecht.nl

Shelters and Schools

Adapting to Cyclonic Storm Surges: Bangladesh

Atiq Rahman *(Bangladesh Centre of Advanced Studies, Dhaka)*
Rafiq Islam *(Manly Council, Australia)*

Introduction

Bangladesh is one of the most natural disaster prone countries. Over the last 40 years many cyclones have affected the country accompanied with loss of lives and property. Global climate change will make the country even more vulnerable to cyclones and floods. For low-lying countries as Bangladesh it is very important to adapt to climate change, to reduce impacts, which may lead to increased human misery, social injustice, and damaged ecosystems.

The poor people have the least capacity to absorb shocks and adapt to the adverse impacts of climate change. Thus, the poor are the most vulnerable to climate change impacts and disaster risks (Rahman, 2009).

Adaptation

Adaptive measures are necessary to reduce the vulnerability of people to flooding. The construction of shelters at a household scale save lives and properties, as shown during the last decade. Adaptation should reduce risk and vulnerability from extreme events: cyclones and storm surges and impacts of climate change. Adaptive measures should be geared to increase resilience and provide security in terms of food, water, and energy supply as well as safeguarding livelihoods and social coherence. Some examples:

Shelters as a way to adapt

The construction of shelters save lives and properties.

A cyclone shelter is basically a solid building, an elevated construction that provides security from the cyclones and associated storm surges. The foundations are such that they dissipate energy from upcoming cyclonic storm surges from the sea or from riverine floods. Above it, at some metres from the ground, one or more floors are constructed to provide shelter. Sometimes they are built in a semi pyramidal shape to withstand the storm surges better.

Each shelter is designed to serve approximately 2000 people and also to function as schools. Access ways are major issues. Studies have shown that unless a cyclone shelter is within 1.5 km of a house, it may be too distant. The local people, afraid for theft, postpone their withdrawal to the shelter to the eleventh hour. Moreover, women going at the last moment in case shelters are lacking proper women toilets and are therefore disproportionate victim of last minute drowning. New generation of shelters are better equipped.

A cyclone shelter in Dublar Char, *Bangladesh, recently withstood a cyclone and saved many lives. (photo: Gerhard Tauscher, International Federation of Red Cross & Red Crescent)*

Shelter programme

The first purpose-built cyclone structures were built in 1960s. Since the Great Bhola Cyclone of 1970, a Category 4 cyclone that brought a storm surge of up to 27 feet and killed an estimated 350,000-550,000 people, Bangladesh embarked on program to build concrete cyclone shelters. However, these efforts were insufficient and in 1991 more than 140,000 people died from another tropical cyclone. After this cyclone, the Bangladesh government with the support of different foreign agencies, have been building multi-purpose cyclone shelters so that these can also be used as primary schools during the normal period of time. According to Local Government Engineering Department, in 2006 there were about 2500 cyclone shelters in the country (Islam, 2006). Bangladesh has developed a GIS-based information system for all existing cyclone shelters. Quite a number of cyclone shelters have been neglected, others have been abandoned altogether.

More shelters needed

As the shelters can accommodate only 27% of the population at risk (Islam 2004), 2000 more cyclone shelters are planned to be built soon in the low-lying coastal districts.

The May 2009 Cyclone Aila confirms the importance of shelters. The Cyclone struck the coastal areas of Bangladesh with very high wind speeds. According to the Government of Bangladesh, the cyclone killed 190 people, injured more than 7,000, and damaged or destroyed more than 500,000 houses (www.usaid.gov). The lower death tolls in recent years can be attributed to a network of cyclone shelters after the 1970 disaster and a SMS warning system recently introduced (AFP, June 2009).

Construction of new cyclone shelters has started under different donor-funded programmes.

Raised plinth height

Another example of living with floods is the raising of the plinth height above the flood level. It is a method, which can be promoted at the household level. The plinth, which is often build of earth and tends to be completely washed away during floods, can be made stronger with a little cement and some pieces of stone and brick. In this way, the plinth may last through repeated floods (IFRC, 2008).
Similar raised ground constructions are being integrated into the design of coastal embankments for isolated communities.

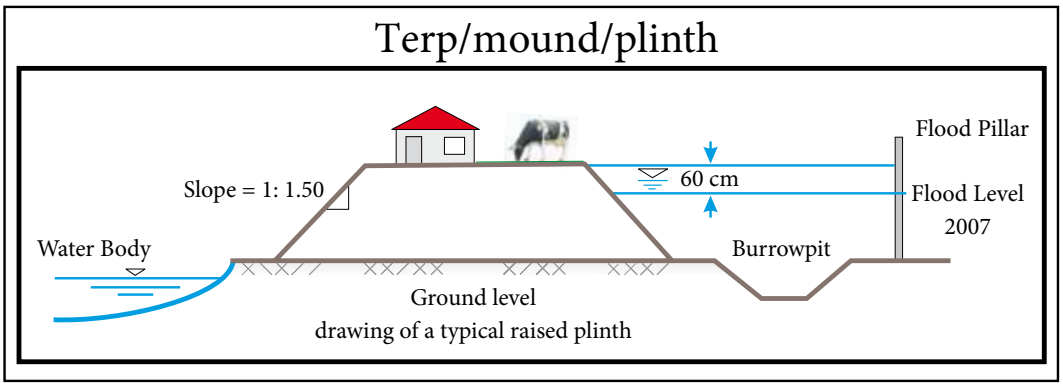


Figure 1: ***A raised terp - plinth (source: Chars Livelihoods programme)***

Installing toilets on raised ground

Most of the toilets in flood prone areas are built by digging the earth and setting up the rings made of concrete in it. During the flood season toilets go under water, cause problems for people especially for women. This creates furthermore water pollution problems. In order to overcome this, people install toilets on raised ground (Rahman, 2008).

Raised tube well

Tube wells are the most common clean water source in Bangladesh. There are an estimated 8 -10 million tube wells throughout the country. The water source can be protected against floods, by raising the suction head of the tube well above the level of rising flood water by using an additional pipe.

Raised mound for toilets.
(source: Chars Livelihoods programme)

***Safeguarding food and freshwater** is an urgent matter during flood.*
(source: Chars Livelihoods programme)

Food preservation

Floods create scarcity of food. For this reason, people of flood prone areas preserve dry foods for use in flood emergencies. The food which is preserved before the flood are Muri (puffed rice), Chira (pressed rice), Sugarcane Molasses, Naru (made of coconut and molasses), dried jackfruit seeds (Rahman, 2008). Clean freshwater is also a scarce commodity during floods. The food and water are stored above averaged flood level.

Conclusions

Adaptive measures such as the construction of (multi-purpose) shelters and measures at a household scale, are important to save lives, property and livelihood. Community-based initiatives empower the communities to build on their existing local knowledge and provide confidence to the most vulnerable people to explore the long-term benefits of investing small amounts on flood-resistant construction towards making safer homes (IFRC, 2008).

References

IFRC - International Federation of Red Cross and Red Crescent Societies, 2008: Building Safer Communities in South Asia, case study Bangladesh; Dhaka and The Hague.

Islam M Rafiqul (ed.) 2004: 'Where Land Meets the Sea' – A profile of the Coastal Zone of Bangladesh; The University Press Ltd. 317pp

Rahman, Atiq, 2009: Presentation on "Bangladesh: Adapting to Flooding Threats on Two Fronts"

Rahman, Muhammad Saidur, 2008: 'Indigenous Knowledge on Flood Risk Management in Bangladesh'.

Tanveerul Islam, B.U.R.P., 2006: Integrated approach to cyclone wind analysis and disaster planning for the Bangladesh coast.

Websites

AFP - Agence France-Presse 2009: 'Bangladesh introduces SMS cyclone alert system': http://www.thefreelibrary.com/Bangladesh+introduces+SMS+cyclone+alert+system-a01611909519

USAID: www.usaid.gov

Chars Livelihoods programme: www.clp-bangladesh.org

BSAC - Bangladesh Centre of Advanced Studies: http://www.bcas.net

Solar energy: desalinating sea water into fresh water

Innovative coastal adaptive & mitigation measure

Hugo Niesing *(Wattpic, Barcelona/Amsterdam)*

Introduction

Lack of fresh water is a general concern and will increasingly become a threat to societies in the future. The Southern European nations like Spain, Italy and Greece, have regions, which are already experiencing serious fresh water deficiencies. This problem is particularly acute during the summer holiday season in the Mediterranean region, when the number of people staying there increases considerably. The number of tourists is expected to double by 2025. Drinking water scarcity is likely to increase because of a changing climate. This represents a massive economic, social and environmental threat to semi-arid regions such as the Mediterranean.

An important technology to tackle this problem is desalination: making fresh drinking water from saline seawater. Most of current methods however are neither cost efficient nor environmentally friendly. Therefore, there is an urgent need to develop a technology that would fulfil both criteria.

As the name suggests, the DeSol (**De**salination by **Sol**ar heat) project will rely exclusively on solar energy to reach this strategic goal.

Objective of the DeSol project

EU - DeSol project (2006-2009) developed an environmentally friendly and efficient method that desalinates seawater using thermal energy provided by solar collectors. Efficiency is increased by running the processing at sub atmospheric pressure. The low, almost vacuum, pressure causes the water to evaporate at low temperature. This characteristic makes the system useful for low-grade heat sources, such as solar heat.

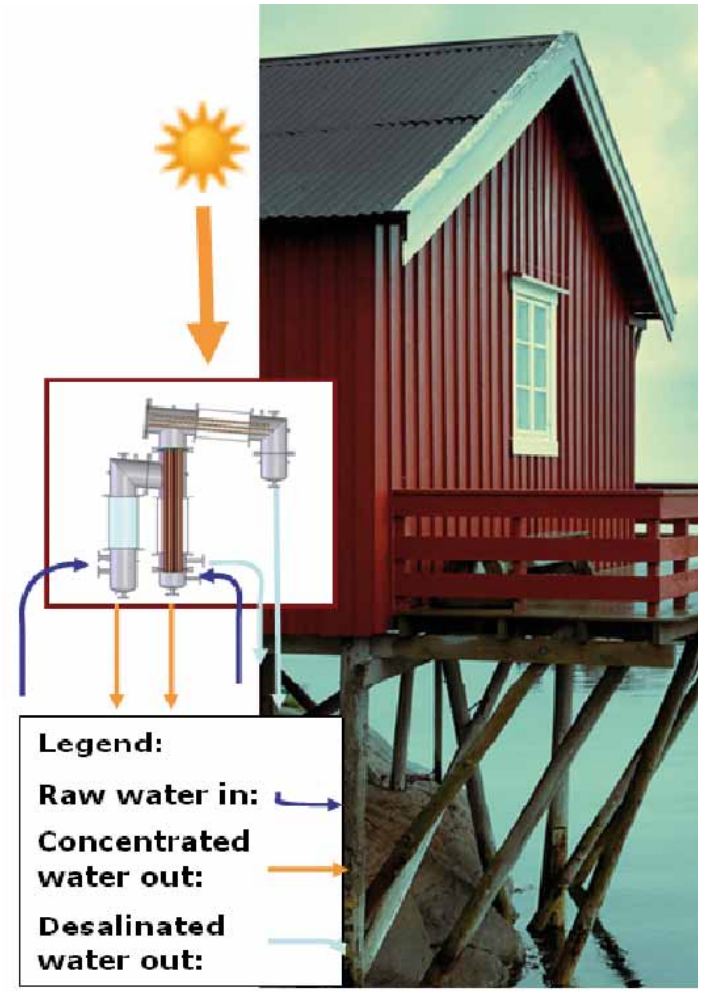
The vacuum is generated by gravity generated by a continue flow of the condensed fresh water falling from a predetermined height. No additional energy or equipment is required to obtain and preserve the vacuum. The desalination system is developed, tested and demonstrated in the Mediterranean climate.

Status of the DeSol Project

The initial developments are completed. The system has been transferred from the two laboratories in Fraunhofer Institute of Physics, Stuttgart and CRIC-Wattpic, Barcelona and jointly installed near

DeSol –laboratory prototype.

DeSol test set-up. *(photo: H. Niesing)*



The DeSol prototype installed at the Mediterranean end-user. (source: H. Niesing)

Barcelona. Desalinated water production rates with the given prototype installation are between 20 to 35 litres per solar hour. A university study on the potential market for this technology, and its developments, has also been carried out. The EU-DeSol project consortium includes a potential end-user.

Future developments

Small-scale simple technologies that do not require fossil fuel can provide a significant contribution towards a more sustainable use of the Earth's natural resources. The DeSol consortium is confident in this technology and is seeking opportunities to optimise the system (components, costs), installation procedures, maintenance requirements (materials, knowledge availability), and the process (dependence of direct sun, heat storage, recovery etc.). Upgrading the system's current capacity to a production level of fresh water of 20 m^3/day is the next step. Applications in developing coastal countries deserve special attention as such technologies converting polluted - salt water into fresh drinking water will improve quality of life, without harming the local ecosystem.

For more information

Hugo Niesing : e-mail: international@wattpic.com

Websites

Cooperative Research projects for SMEs – Volume 3: "17928 DeSol Low-cost Low-energy Technology To Desalinate Water Into Potable Water": www.ec.europa.eu/research/sme-techweb/pdf/sme-coop_3.pdf

Wattpic - Wattpic Energia Intelligent S.L.: www.wattpic.com

Innovative Home Sanitation

saves water, lives and money

Daniel Vandy *(ECOSAVE, Flevoland, the Netherlands)*

Introduction

The rapidly increasing population requires more and more water, which puts enormous pressure on our water resources. Water is thus becoming a scarce product. Fulfilling the ever increasing demand for fresh water requires a holistic approach at all levels from international to local.

ECOSAVE, in the Netherlands, has created an integrated solution to water conservation in the home by linking several approaches:

- **ECO-nomical**: providing water saving device on taps and showers saves 50 – 70% of drinking water;
- **ECO-sanitation**: providing dry- or composting toilets, with closed collection and no or little water use;
- **ECO-purifying wastewater**: providing simple but reliable systems cleaning more than 95% all the waste water from the household;
- **ECO-collecting of natural water sources:** collecting and purifying rainwater.

In this way, a household is made 'self-supporting', requiring 20-30% of normal fresh drinking water usage, producing no wastewater sewage or contamination of the natural habitat and keeping the environment clean.

Using this approach in the rural and coastal areas of the Netherlands and Spain, we have carried out projects where the water usage required only 30 litres of drinking water per person per day instead of the usual 130 litres, without giving up comfort.

Apply this technology on a large scale could mean a huge reduction in the pressure on water resources.

Our ECOHOUSE & ECOSAVE Office, Flevoland, Holland, *trapping the solar radiation in the central greenhouse part of the building, with solar PV and thermal panels and rain water collection and waste water purification in the garden. (photo: D. Vandy)*

Home Sanitation units - Dry Toilets:

ECOSAVE Separett provides toilets in houses, in holiday and garden complexes, boats and campers. After 25 years of development, these toilets are technically very sound. They each contain a built-in aerator and are as a result odourless. They require little maintenance, are noiseless, very efficient and driven by solar energy on request. The aerator prevent odours and therefore does not attract insects. The aerator also contributes to the purification of the human waste converting it into valuable natural compost rich in nitrogen. Within a half to one year the first few litres compost (after >90% reduction of organic mass) can be collected and safely used.

One of the types of Dry Toilets. *(photo: D. Vandy)*

The benefits of the Home Dry Toilets are:

- Simply to install, with no very costly sewage pipe line constructions;
- No water usage;
- Contaminant free;
- Odourless and do not attract insects which diminishes the spreading of diseases.

An additional advantage of this ECO-concept is that the purified compost and compost tea can be safely used in gardens for growing vegetables. Research has shown that the human excrement was safely processed and the quality of the compost was rich and valuable to farmers.
A video of the simple installation is available at our website (www.ecosave.com).

ECOSAVE provides a 5-year guarantee on all the original toilet material. The prices of the different types of Dry Toilets varies between €300 and €700. Shared production of a large number of locally constructed Dry Toilets however is also possible, which will reduce the costs considerably.

Some examples of Home Sanitation Units installed

ECOSAVE is successfully applying the integrated approach to water management in different countries.

Holland

In Holland about a quarter of a million houses are not connected to sewage system. These houses are often located at remote rural areas. Home-sanitation units are well in place in such locations.

Egypt

Ecosave was involved in preparing and executing a sanitation project in Egypt. The large coastal lake Manzalla in the eastern part of the Nile Delta, has a multifunctional use: firstly for drinking water, secondly fishing and thirdly for recreational purposes. The major threat to the functioning and future exploitation of the lake comes from the fact that all sewage of the megacity Cairo (18 million habitants) is dumped in this lake. By introducing ECO-sanitation and ECO-purifying systems, it was possible to realise small-scale improvements, which will have considerable benefits for the quality of life and would help ensure the future of the lake.

USA

In the US, large-scale ECO-sanitation is used in beach clubs and a large nature visiting centre in a nature reserve in Florida, which has more than one million visitors per year. In 2009, a special programme began collecting urine, from a school, for agriculture use. Urine is rich in nitrogen and can be efficiently used in agriculture instead of artificial fertilisers.

Israel and Jordan

Economical use of water in the agriculture by drip irrigation is well known. However, a household may use up to 250 litres fresh water per person per day. The fresh water resources in this region are under increasing pressure. As a result the level of Lake Tibereas (a major fresh water resource for Jordan, Israel and Palestine) is falling dramatically.

By initiating ECO-nomical use of drinking water in the homes and other uses, it was possible to reduce, at a pilot scale, fresh water usage by 50%. Additionally by using ECO-collecting and re-using purified waste water it has been possible to gain another 30% reduction in water usage. Using purified wastewater for the garden or even agriculture was not widely known but can have surprising results, such as has been shown by the date palm nurseries, south of Jerusalem. “Ecological working with water”, sharing new water technology directed at conservation of water and safely re-using water will reduce the pressure on the resource and may even be a building block for peace!

Concluding

We must use drinking water more efficiently. ECO-sanitation using closed toilet systems, which use a little or no water and produce no wastewater. With ECO-purifying and – collecting we re-use all the water that is possibly to be re-used. The result is a cleaner, healthier environment, with opportunities for use of purified water on garden vegetables or agriculture. In this way the ECO-circle is round.

More information

Daniel Vandy, Founder of ECOSAVE since 1991
e-mail: info@ecosave.nl

Website ECOSAVE **:** www.ecosave.com

Mangrove replanting

Disaster preparedness and many other benefits

Dang Van Tao and Nguyen Hung Ha
(International Federation of Red Cross and Red Crescent Societies - IFRC)

Introduction

The Vietnam Red Cross (VNRC) is a mass organisation and is considered the core body in all humanitarian work in Vietnam. Since 1990, the VNRC considers disaster preparedness one of its core tasks with focus on community-based disaster preparedness in order to enhance the communities' capacity to respond to disasters, such as cyclones.

Within this framework, in 1994, Vietnam's Red Cross adopted a pro-active approach to storm surges by launching a programme of mangrove tree reforestation and management. Vietnam's mangrove forests had been seriously degraded by intensive socio-economic development. The main objectives of mangrove planting are to protect sea dykes and people's lives and property, to build the capacity of the Vietnam Red Cross in Disaster Preparedness to improve the coastal environment and to create job and income for vulnerable people.

Since 1994 Red Cross members, volunteers and local people planted more than 22,000 ha of mangrove forest in the coastal zone of Vietnam, which helps provide a defensive ribbon of forest. VNRC has worked with related ministries and governmental bodies and obtained the approval from the Prime Minister of the country to continue caring, managing and protecting the planted mangrove forest.

Role of the community

To replant mangroves, the Red Cross makes use of an integrated approach, in which the community plays an important role and is actively involved. To assist the local community in fulfilling their role, many training courses on, for example, how to plant trees have been given to local staff, teachers and children. Furthermore, local communities organised awareness-raising activities, such as drawing competitions, theatre drama, folklore songs etc. The communities are also involved in the maintenance and protection of the mangroves, by establishing teams, who take care of mangroves just after the plantation. Because of these activities, the people at the commune level, including children, are very aware of the significance and benefits derived from the mangrove forests.

***Children planting mangroves, the trees will help** prevent land erosion. (photo: International Federation of Red Cross and Red Crescent Societies - IFRC)*

***Mangroves are salt-tolerant evergreen coastal forests** providing many services, one of which is protection against cyclones & flooding. They are found in most of the tropical and subtropical countries (photo: Tjark van Heuvel)*

Box: Red Cross/Red Crescent Climate Centre (RCCC)
Madeleen Helmer: Director RC/RC Climate Centre, The Hague, the Netherlands

The Red Cross/Red Crescent Climate Centre (RCCC) was established in 2002 to support the 186 national RC/RC Societies to better address the humanitarian consequences of climate change. The projected increases in precipitation, drought, sea-level rise, heat waves and more intense storms are likely to lead to more disasters, insect plagues and diseases. These will likely affect the most vulnerable people, the poorest of the poor, most. The Preparedness for Climate Change programme of the RCCC is implemented in more than 60 developing countries. Key components of this programme are increased cooperation between the RC/RC and knowledge centres like the meteorological offices. This leads to appropriate adaptation measures in the main RC/RC programmes related to disaster management, disaster risk reduction, food security, health and care.

The RCCC is supporting a strengthened early warning and early action approach, through matching available climate information at all timescales (from climate change scenarios to seasonal forecasts to weather alerts) with appropriate early action (from mangrove planting, to contingency planning to evacuation). Climate change is no longer a distant risk but integrated in existing disaster risk management practice.

The RCCC observes that often adaptation measures are translated into 'hardware' measures like dykes, infrastructure and building codes. Through many years of experience the Red Cross/Red Crescent has learned that a good combination with 'soft ware' (people centered measures: risk awareness education, health and care measures, early warning system) is essential to strengthen the resilience of people against the unavoidable impacts of climate change.

For more information: www.climatecentre.org

Mangrove planting to reduce effects of typhoons and flooding risks: *the Vietnam Red Cross has planted over 22,000 hectares of which nearly 9,000 ha cover muddy sediments along the seaward side of over 100 kilometers of sea dykes in eight provinces (2010). Here, a group of Vietnam Red Cross volunteers from the Hai Phong branch makes a routine check on the condition and growth of the mangrove trees. (photo: Yoshi Shimitzu, International Federation, 2003)*

Benefits

Mitigate dyke erosion

Planting mangroves is a proven technique, which helps to protect coastal communities and environments by reducing the impact of strong waves. The complex root system of the mangrove trees buffers the forces exerted by storm waves, improves the resistance of the earthen dikes and decreases soil erosion. In 1997 a Japanese researcher observed that a sea wave of 1.5 metres high moving through a wide mangrove ecosystem, was reduced to nearly zero. The value of mangroves became clear in 2003, when two typhoons struck Northern Vietnam. Only four people died, no rice fields were flooded and the typhoon forces weakened rapidly.

Socio-economic benefits

Reforestation has brought income for poor families living in coastal areas from directly participating in plantation and forest protection. Most of people state that their economic situation is now getting better than before. The main reason for this improvement is the increased income derived from the programme's activities such as planting, guarding, collecting sea products and the jobs created by fish and shrimp pond service works. All of the pond owners interviewed said that they directly benefited from the mangrove forest.

This economic benefit is one of the most important factors helping to ensure the sustainability of the project.

Fishing industry

Mangrove tree reforestation also benefits Vietnam's fishing industry. The fish, shrimps, prawns, and crabs that populate the coastal areas now have an increased number of secure spawning areas to rear their young. The increase in number of juvenile crabs, for example, has been clearly recognisable in the past years.

Increased pond operation

People were encouraged to invest and develop fish and shrimp farming in areas secured by protective belts of mangroves. In fact, a good number of the fish ponds are now directly protected by the mangrove forests. Due to this protection, each pond owner can save pond maintenance costs from 2 million to 2 million and half Vietnam Dong/ year (data given by pond owners in Thai Thuy District, Thai Binh).

Bio-diversity

The mangroves forest provides a valuable habitat for many species of insects, crustaceans, gastropods, molluscs, amphibians, reptiles, and birds. Local people were very impressed by the re-colonisation of birds in the mangroves forests of coastal and river mouth., especially in mature mangrove areas.

Increase mud flat and land reclamation

The increase of alluvium at the river mouth is a natural phenomenon and it is easy to see that the speed of this process increases because of the presence of mangroves. In muddy areas, an elevation speed of between 5 and 7 centimetres sedimentation per year occurred!

Future

Mangrove forests are becoming increasingly important, as they mitigate the negative impacts of climate change, which is predicted to be especially severe in Vietnam. Disaster preparedness through mangrove plantation and the protection of mangrove forests from logging remains a major activity of the Vietnam Red Cross (IFRC, 2009).

Some programme results in Vietnam

- Over 22 thousand ha have been planted with mangroves in 8 provinces. These mangroves can protect over 100 km of sea dykes (the length of the sea dyke system is about 3,200 km in Vietnam). Mainly three mangrove species were used: Kandelia, Rhizophora and Sonneratia species;
- Over 70 planting ceremonies have been organised in 8 provinces since 1997;
- Over 7,750 of poor households in 89 communes were directly involved in planting mangroves. They earned above USD 20 per hectare;
- Over 130 technical training courses were organised for nearly 10,000 people;
- 160 RC staffs at district and provincial level were trained about disaster management;
- 18,000 teachers at primary schools in 8 provinces were trained and they trained nearly 600,000 children about disaster preparedness.

References

Nguyen Hung Ha, 2003: Summary of Mangrove Disaster Preparedness Programme and Its Impact. The International Conference on Total Disaster Risk Management, 2-4 December 2003.

International Federation of Red Cross and Red Crescent Societies, 2008: Annual report Viet Nam

Annual Report- IFRC&RCSocieties- Vietnam, Appeal No. MAAVN001, 30 April 2009: http://www.ifrc.org/docs/appeals/annual08/MAAVN00108arn.pdf

Websites

IFRC - International Federation of Red Cross and Red Crescent Societies: http://www.ifrc.org/

Red Cross/Red Crescent - Climate Centre:
http://www.climatecentre.org/site/home

Vietnam Red Cross:
http://chuthapdo.org.vn/redcross/en/home/index.jsp

Floating Vegetable Bed Cultivation

Atiq Rahman *(Bangladesh Centre for Advanced Studies - BCAS, Dhaka)*

Floating Vegetable Bed Cultivation. *(photo: Atiq Rahman / Muslem Uddin Miah, BCAS)*

Adaptation to climate change and risk reduction

A vast area of Bangladesh is situated more than two meters below mean sea level and vulnerable to high tides. Flooding and water logging is a common problem in Bangladesh. Climate change will aggravate this problem. There is evidence already of these adverse impacts, which affect the livelihood of people by reducing crop production and increasing food insecurity. Many communities have developed *baira* cultivation as an adaptive strategy to reduce their vulnerability.

Floating Vegetable Bed Cultivation, an Adaptive Option in Coastal Bangladesh

The Bangladesh Centre for Advanced Studies (BCAS) and its local partners promote floating vegetable beds, which grow in water logged and salinity prone areas along the coast. This provides employment, income, food and nutrition for the farming families and local communities. Furthermore, it helps the coastal flood prone population adapt to the changing environment, which is increasingly influenced by global climate change. Floating vegetable bed cultivation has been a local practice in some villages for many years. It involves planting crops such as water hyacinths and other aquatic plants on soil-less rafts on water and is called a 'floating garden', locally known as *baira.* The platform provides a base to raise seedlings, vegetables and crops on it. The plants grown on *baira* get nutrition and food either from composted organics or from the water. During periods of flood and water logging field crops often perish, but crops on *baira* can survive. The local practice was improved with scientific and technological input in close cooperation with local communities. This resulted in longer and stronger beds, cultivation of diversified vegetable and crop rotation. This is now widely practiced in hundreds of project villages. The BCAS project on 'Climate change adaptation' played a key facilitation role for local innovation and extension of the practices across many villages.

Material for floating beds locally called Baira

In addition to water hyacinth, deep water rice straw and different types of aquatic vegetation (*e.g., Kochuripara-Eichhornia crassipes, Khudipara-Lemna trisulca, kuti pana-Azolla pinnata, Shayala – Bluxa japonica*) and pieces of bamboo are required to make a *baira*. Initially, the farmer lays a bamboo

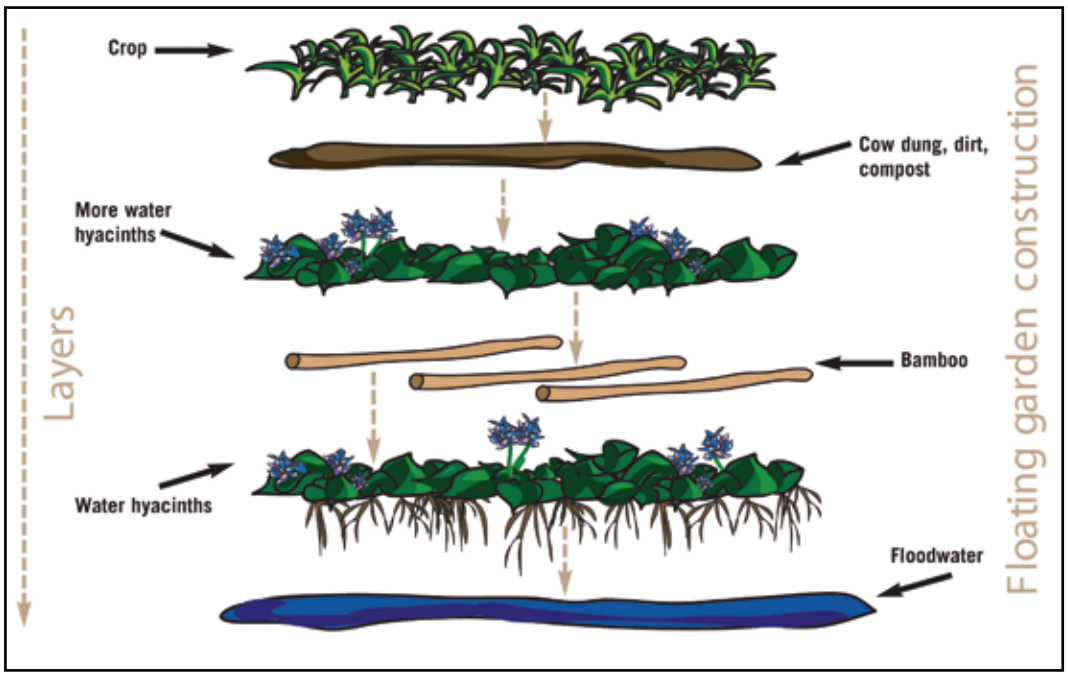


Figure 1: ***Layered floating garden construction.*** *(source: Practical Action: www.practicalaction.org)*

pole on dense water hyacinth to stand on and then piles more water hyacinth to make it compact. The thickness depends on the duration of water logging, as it needs to float for the whole time of inundation. The *baira* is movable so the farmer can choose suitable locations for better management. After selecting a good location, the *baira* are usually fixed with bamboo poles. After 10-15 days, the farmers may transplant seedlings or broadcast vegetable seeds. They usually also plant additional crops between the main cultivation and can harvest crops 2-3 times a year from one *baira.* There is no need to use chemical fertilisers for growing crops on *baira.*

Crops and vegetables on Floating Beds

Crop cultivation varies in seasons. However, more than 20 varieties on vegetables like red amaranth, Indian spinach, coriander leaves, cauliflower, cabbage, tomato, lady's finger, cucumber, bitter, gourd, bottle gourd, snake gourd, ash gourd, sweet pumpkin, bean, radish, brinjal (eggplant), potato and spices including chilli, onion, garlic, turmeric and mustard are grown on *baira* in different locations in Bangladesh. The formation of a *baira* and cultivation starts in the month of June and continues until November. However, *baira* cultivation on permanent water bodies can continue round the year.

Multiple Benefits: Food, nutrition and employment

During flooding and water logging, many people suffer from shortage of food and lack of nutrition due to loss of standing crops and of income. Importantly, people can get food and nutrition from their own grown vegetables on *baira*. In the dry season, composted material from *baira* is used as organic manure for field crops. Usually, there is no employment available during flood periods and life of the poor is difficult. However, by cultivating various crops on *baira*, it is possible for people to meet their household food requirements and earn an additional income.

BCAS with local NGOs provide training and material to local communities to improve the practice of floating bed cultivation. This helps increase the productivity of the bed cultivation, and thus reduces seasonal food insecurity for the flood-prone inhabitants of coastal villages in Bangladesh.

Fore more information

Atiq Rahman – BCAS – Bangladesh
E-mail: atiq.rahman@bcas.net
Website of Bangladesh Centre of Advanced Studies: www.bcas.net.

Conclusions on concepts, tools and measures

Gerrit Baarse *(BB&C the Netherlands)*
Robbert Misdorp

The CCC Publication considers how coastal cooperation contributes to the process of Integrated Coastal Zone Management (ICZM). This is regarded as a key concept in structuring the approach to managing coastal problems, through the identification of coastal zone management tasks and formalising cooperation between stakeholders. Part III of the CCC Publication describes the "what", the "why" and the "how" of ICZM.

The "what" of ICZM

Defining the zone within which ICZM operates is complex. From a physical perspective the zone includes the area governed by the interactions between the land (including the hydrological system) and the sea. From a socio-economic and ecological perspective, the coastal zone is subject to a multitude of different functions, interests and pressures. ICZM provides a way of managing the delicate interplay between the natural coastal system processes and the use and exploitation of the zone as a socio-economic system.

The nature and function of ICZM can be viewed from different angles, as follows:

- IZCM as a concept for identifying and defining the elements of the coastal system and their causal relationships;
- ICZM as a process for identifying coastal management tasks and developing coastal zone management programmes;
- ICZM as a set of instruments and methodologies for the execution of coastal zone management tasks within the coastal zone governance framework.

ICZM as a process includes the main phases: problem recognition, planning, implementation and evaluation. In view of the many stakeholders and interests involved, the ICZM tasks are defined and carried out in a multi-actor setting. The key to successful ICZM application is teamwork and coastal cooperation. This is the focus of this publication.

The "why" of ICZM

The main reasons underlying the need for coastal zone management are:

- The importance of the coastal system;
- The vulnerability of the coastal system;
- The increasing pressures on the coastal system.

Importance of the coastal system

The coastal zone is the home of a substantial part of the global population and directly provides a great many products and services on which society depends. These include providing a livelihood through income generation, food and a place to live. In addition, the state of the natural system is vital for coastal stability, flood protection and the regeneration and productive capacities of ecological systems.

The complexity and vulnerability of the coastal system

The coastal system is highly dynamic and complex. The various processes and interactions are easily disturbed by human action and there are clear limitations to the carrying and productive capacities of natural systems. Adverse effects on coastal systems have become manifest in various ways, posing serious threats to the continuity and sustainability of their essential ecological and societal functions.

The increasing pressures on the coastal system
In the last few decades, the trends in the development of these pressures and their adverse effects have become clearly visible. Population growth, in combination with increasing economic demands, is the main cause of rapidly increasing resource use. These often lead to overexploitation and environmental degradation. The effects of climate change, both through sea level rise and increased storminess, may seriously aggravate these threats.

Sound and effective management practices are required to protect and preserve coastal systems and to ensure their sustainable development. The application and implementation of ICZM is the main vehicle for securing these management practices.
Above all, implementing ICZM and strengthening coastal cooperation are both economically and environmentally beneficial, as illustrated by the application of integrated, multiple functional and resilient methods leading to sustainable solutions.

The "how" of ICZM
The "how" of ICZM mainly concerns the execution and facilitation of the various ICZM tasks aimed at the identification, analysis, selection and implementation of management actions. The focus of the CCC Part III is on:
- Tools and capacity building for ICZM;
- Innovative and adaptive coastal measures.

Tools and capability development for ICZM
A great many tools have been developed in support of ICZM tasks, covering a range of requirements including:
- Development of Geographical (spatial) Information Systems (GIS);
- Analysis of specific coastal problems and their context;
- Undertaking integrated planning analysis and developing decision support systems.

As described in this CCC publication, developments in the last 2 decades have resulted in a wide variety of tools and applications covering the above requirements. Within these developments, supporting policy preparation, emergency planning and crisis management, and training and capacity building have played a dominant role.
The following briefly summarises some of the main developments.

GIS-based modelling systems have become an indispensable tool for data collection and processing and the analysis and monitoring of coastal systems. Ongoing developments are moving in the direction of further integration of GIS applications in interactive planning and management tools and decision support systems, as reflected in the Geographical Information Infrastructure (GII) concept.
Examples of more specific applications include monitoring of coastline development in relation to coastal erosion and accretion and the use of GIS-based tools for risk and emergency management. An important development within the field of GIS-based tool applications includes providing information to the public at large as well as data sharing with professionals through the web.

An important focus for tool development has been providing support for the integrated and interactive planning process within an analytical and structured framework. Developing GIS tools within an ICZM framework has been strongly supported by the CZM-Centre (the Netherlands).
An example of such an approach is the model COSMO (COastal Simulation MOdel). This facilitates all relevant steps in policy analysis aimed at the identification, impact assessment and evaluation of alternative measures and strategies, based on future scenario projections. The COSMO approach has evolved into a 'family' of interactive tools, which have been developed and applied for different areas in the world. RAMCO (Rapid Assessment Model for COastal zones) is an integrated, interactive planning model linking a GIS-based representation of land use and spatial planning with the effects of economic developments at different spatial levels.

Other tools and applications have been developed emphasising more specific aspects of ICZM. One example is DR-EIA (Document Retrieval and expert system for Environmental Impact Assessment),

which focuses on integrating the existing procedures for Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) within ICZM. It provides software facilitated procedures for screening and scoping projects. DR-EIA also facilitates the writing of terms of references (ToR) for executing EIAs according to the standards applied by financing organisations.
Another example is the model STREAM (Spatial Tool for River basin Environmental Analysis and Management). The model facilitates the assessment of water balances and river flow based on a Digital Elevation Model (DEM), integrating the water and land use components of entire river basins in the context of ICZM. In particular, the model is capable of simulating the impacts of land use and climate change on river discharges and availability of surface and groundwater. STREAM has been applied in a wide range of river basins around the world.

Aspects of training and capacity building have been a part of all the above tool developments and led to the development of specific programmes. Following an initiative of the CZM- Centre, the programme CoastLearn was developed by the Marine & Coastal Union-EUCC in cooperation with an international partnership of over 20 parties from 15 countries. This programme is freely available on the Internet, facilitating the training of a wide international audience. The programme has a modular structure covering all major aspects of ICZM (including a simulation game) and is available in ten European languages.
A more specific example relates to the development of a training programme for the management of Marine Protected Areas (MPAs), as it was recognised that the availability of skilled personnel is a key factor in their successful management. A regional training programme and a comprehensive training manual for the East African Region was developed by the CZM-Centre in cooperation with regional and international organisations (United Nations Environment Programme - UNEP, International Union for Conservation of Nature - IUCN, WWF-World Wide Fund For Nature - WWF) and with support of the World Bank. This MPA training manual is also used in the Caribbean and South Asian regions and is now available as an PDF report (see CCC-V-1-1).

From the above developments on tools and capacity building it is concluded that:
- A wide variety of tools have become available in support of policy preparation and execution of the ICZM tasks, ranging from holistic approaches to more specific aspects of ICZM;
- Although the aspects addressed in the various tools have a common base, their use generally requires dedicated applications. The examples provide a broad basis for developing such situation-specific applications;
- When developing tools, there has been considerable emphasis on training and capacity building;
- The joint development and application of tools provides an excellent basis for (inter)national cooperation.

The CCC Production aims to increase coastal cooperation and makes the (demonstration) versions of these GIS-based tools available through its website (see CCC-V-1-2). For more information about the tools, contact the authors, who are the main developers.

Innovative and adaptive coastal measures
In view of the uncertainties of the impact of the increasing pressures on coastal zones, adaptive measures should be the primary focus. Based on past experience there are a number of guiding principles that help to identify promising solutions to problems. These include:
- Working with, rather than against, nature;
- Restoring and preserving essential natural functions;
- Smart combinations of objectives and functions through innovative approaches;
- Involvement and responsibility of local stakeholders;
- Following these principles, the CCC publication has identified a number of examples.

The application of 'soft' solutions through building with nature including sand nourishment schemes provides considerable potential for flood protection and land reclamation, while preserving and restoring natural functions. There are many successful examples from the Netherlands and various other places in the world.

Mangrove planting by the local population (including the maintenance and protection of the mangrove forests) also provides numerous benefits. In addition to flood protection and mitigating coastal erosion, such benefits include increased (shell) fish production by providing spawning areas, protection of fishponds, increase in natural land reclamation and in biodiversity, most of which directly benefit the local population. This multiple functionality of mangrove planting proved not only beneficial for the local inhabitants and the environment, but also for the national and local economy.

Innovative adaptive approaches include the possibility of creating floating structures combining a number of vital functions, such as housing, high-yielding production facilities (e.g. up to 5 ha floating greenhouses) and emergency water storage. Other developments aim to achieve a smart combination of functions responding to local needs and possibilities. Examples of the latter are the development of multipurpose flood shelters combined with school facilities and household scale measures providing essential functions during flood conditions (such as toilets, wells for water supply, storage and food preservation). Floating vegetable beds are increasingly applied in the Ganges-Brahmaputra-Meghna delta, successfully enlarging food security during flooding, generating of jobs and can be considered as an adaptive measure addressing the potential impacts of climate change.

Present and future shortage of freshwater is a pressing problem in coastal zones. In order to reduce this pressure, there are two promising developments:

- Using solar energy to desalinate salt seawater and provide fresh drinking water. This is in a semi-operational phase of development;
- Innovative, water-saving measures, which ensure home water supply and sanitation, while reducing waste water flows to the natural environment. Such measures include the use of water saving devices on taps/showers, dry/composting toilets with closed collection (no water use), re-use of purified wastes, and the use of simple systems to purify household wastewater and to collect and purify rainwater.

Conclusions

- In preparing for future coastal problems, the emphasis should be on adaptive, innovative and resilient measures;
- As much as possible, measures should be based on relatively simple solutions that can be developed, applied and maintained within local means and capabilities;
- Local stakeholders should be directly involved with and made responsible for implementation of management action, while benefits should accrue to the local population;
- Ongoing technical developments can considerably increase the potential for sustaining vital living conditions;
- Communication is an important element in coastal cooperation. The authors of chapters on the innovative adaptive measures are also the 'developers' of these measures and are willing to provide more detailed information to the reader of this CCC Production.

CCC - Part IV

Coastal Cooperation in Action

Learning experiences and recommendations for actions

Gerrit Baarse *(BB & C, the Netherlands)*
Robbert Misdorp

The previous parts of the CCC publication have illustrated a range of coastal problems that have become manifest in many coastal countries in the last decades. A variety of approaches and solutions have been developed to counteract the different problems. Although the specific problem setting in each country or region has to be considered unique, there is a lot of commonality in the types of problems encountered and the potential measures to be applied. Hence, there is great potential in developing a common understanding on promising ICZM strategies by sharing experiences and knowledge, to the mutual benefit of all coastal countries.

Based on the country examples described in this CCC publication, the following summarises a number of main, common learning experiences. These provide an important basis for the identification of recommendations for actions as specified in the second part of this chapter.

1-1 Main learning experiences

ICZM pays off
Considering the economic and environmental benefits of ICZM and coastal cooperation efforts, it follows that the benefits achieved may exceed costs many times over. This was clearly demonstrated by comparing the costs and benefits of a great many projects in the EU demonstration program (2000). The EUROSION project (2001-2004) concluded that the costs for society to counteract erosion problems would only amount to a small fraction of potential benefits. The Netherlands sand nourishment scheme ensures the protection of the natural coast in a sustainable way at relatively low cost. Investments in the Rotterdam harbour area development based on integrated spatial planning of the coastal area were proven to be very beneficial economically and ecologically. The Seychelles have been able to protect and maintain their valuable vegetation belts through effective coastal planning which basically saved the island state from tsunami disaster and provides in the mean time a large contribution to the GDP through tourism.

Considerable improvements of the flood protection situation have also been achieved in other Asian countries such as Bangladesh, Indonesia and India (through flood protection measures, polderisation, re-plantation of forest area and mangroves, early warning systems, evacuation schemes and cyclone shelters). Other important benefits are associated with the protection and restoration of natural production systems, related to e.g. water supply (restoration of the water supply system of the greater Shanghai area in China) and the co-management efforts directed at more balanced fishing practices, combating overfishing and destructive fishing in coastal waters of Thailand.
In addition, there are successful examples of ICZM applications at the grassroots level through direct involvement of local communities and NGOs, such as the enhancement of fish production by applying small scale artificial reef units in the State of Tamil Nadu (India) and the management of Tam Giang-Cau Hai Lagoon in cooperation with the people in Thuan An village in Vietnam.

Integrated spatial planning is a strong instrument for ICZM
Integrated spatial planning exercises provide a strong basis for addressing the complex problems and trade-offs involved in ICZM. In particular, this often legally- based instrument will have a stimulating effect on the implementation of ICZM programs by embedding ICZM in existing national and regional planning procedures. The beneficial effects of spatial planning supporting ICZM have been shown in projects in Romania, the Netherlands and several European regions in the Baltic and

Adriatic Sea and has also been demonstrated in the EU-PlanCoast project. Asian examples illustrating this need, include the experiences with devastating aquaculture developments and the importance of maintaining the protection from coastal natural systems, such as mangrove forests and coral reefs.

ICZM takes time and patience

Due to its complexity, its iterative cyclic nature, and its multi-actor setting ICZM is a slow process with many potential delays and obstacles. For instance, the time spent in preparing an ICZM phase e.g. searching for funding, partners, and office accommodation, can last as long as the actual execution of that ICZM phase.

But the learning experiences and commitments achieved in each step in the cycle, and in each cycle, will ultimately result in speeding up the process.

The integrated planning and sustainable development process for the Rotterdam harbour area took 17 years of cooperation. The process is now entering its second cycle. The results and consensus achieved in the first cycle, which are firmly anchored in regional laws for development, will considerably reduce the efforts required for the further planning and decision making process. The Sri Lanka example shows that after more than 30 years of ICZM practices, the powers and mandates of the coastal authorities and the underlying legislation need strengthening.

Balanced, vertical integration is essential

The participation of relevant actors on all levels is essential for successful implementation of ICZM. However to warrant sustainable long term development of a particular coastal area, the responsible national agencies must remain in control of the decision making process and the application of integrated spatial planning regulations.

An uneven distribution or representation of power, in the absence of clear, authorised development plans or planning procedures, may lead to non-sustainable, coastal development directed at short term profit. Any local or regional plan should fit the long term sustainable, legal frames that are set on national and sometimes international levels.

The benefits of balanced vertical integration is illustrated in Vietnam, where simultaneously at four levels ICZM is practised and efforts to increase awareness raising, communication and capacity building were successfully undertaken.

Monitoring plays an important role in ICZM

A fair amount of knowledge of the coastal system is a prerequisite for integrated planning and proper decision making on coastal zone management. This emphasizes the essential role of *monitoring in all phases* of ICZM. Monitoring data provide the basis for problem recognition. Monitoring data support the planning and implementation of the proper measures at the right place (what to do where?). And finally, the *evaluation of ICZM efforts* is based on monitoring results. This evaluation is to illustrate the effectiveness of the coastal measures applied and to identify the new or remaining problems observed, marking the beginning of a next cycle of adjusted planning, implementation and evaluation. The potential of Remote Sensing techniques in supporting the monitoring function was extensively demonstrated in the Vietnam cooperation projects in the period 1993-2006.

Innovative small scale adaptive measures

Various cases described in the CCC publication provide examples of promising, relatively small scale adaptation measures and activities, including e.g.:

- Local reforestation and afforestation projects;
- Small scale artificial reefs;
- Water quality improvement and waste management;
- Development of early warning systems;
- Cyclone shelters and safe havens for flood protection;
- Decentralised solar energy applications, e.g. for lighting of houses and desalinate sea water;
- Sustainable coastal fishing practices through co-management;
- Establishment and management of coastal, delta and marine reserves;
- Ecotourism developments;
- Subsistence agriculture development in the form of floating bed cultivation.

Proper introduction of these measures have been accompanied with training and awareness raising activities for, and with, the local coastal communities concerned.

Innovative adaptive measures at a larger scale

The need for space is felt in many coastal areas around the world and this urgency for more space will increase in time. 'The building with Nature' concept is being applied by many coastal nations. Large scale land reclamation, creating land in water, may reach more than 300 km^2 in Bohai Bay (China). Large scale soft, resilient and efficient coastal protection, e.g. sand nourishment up to 10 – 25 million m^3/year is being applied in some countries in Europe. Particularly promising is foreshore nourishment. Some examples of applying measures directed at sustainable development and adaptation in the Netherlands are:

- Creating water in land: combining river flood water emergency storage with dwelling and high technological horticulture - floating houses and greenhouses up to 5 ha are being constructed;
- Experimenting with sustainable energy generation at the border of the sea, by means of large scale fresh – salt water interactions which will soon begin;
- Pursuing win – win solutions , e.g. resulting in large, economic and ecological benefits of sustainable harbour development through effective cooperation between all stakeholders.

Knowledge and experiences have to be shared!

The ICZM practices in Europe and Asia have confirmed that ICZM is needed and do-able, and has produced successful results. More importantly, the experiences gained in the various countries provide a wealth of knowledge and insights to be deployed to the benefit of other countries. NGOs play a specific role to facilitate transferring of knowledge and exchanging experiences between the various participating stakeholders as illustrated for instance in the cases of the Baltic Sea, in Bangladesh, Thailand and Vietnam.

GIS based information regarding the annual movement of the Dutch coast-line is nowadays publically available on the web, an astonishing step forward in data dissemination. Geographic Information Infrastructure (GII) provides real time dissemination of information combating natural hazards, such as flooding, exercised in the Netherlands and recently applied during the extreme flooding in Pakistan. Among the coastal countries in Europe and Asia there is a general willingness to share these experiences and take part in coastal cooperation. The initiatives underlying the present publication illustrate this fact.

1-2 Recommendations for actions – the way forward

Required actions should focus on the identification and implementation of measures to prevent or to solve coastal problems. However, for effective ICZM application a number of essential management and implementation conditions need to be met.

Therefore firstly some main conditions are briefly discussed. Secondly attention is paid to the identification and implementation of promising measures in relation to country specific conditions and possibilities for expanding international cooperation.

Ways to improve the conditions for management and implementation

As described, an important part of getting ICZM into action deals with creating the necessary conditions. Based on the many examples and experiences considered in the CCC publication, the following provides an overview of the most important conditions to be achieved:

A long term look ahead

Develop a long-term vision on expected coastal management problems and required actions and developments to ensure continuity within a longer time perspective on a national level. Short and medium term coastal management plans and activities for designated regions or coastal areas are to be developed, merging concrete no-regret actions and nearby targets with long-term activities such as drawing up a strategy and action plan.

Adopt ICZM in spatial planning
Anchor coastal management planning in existing planning and decision-making procedures, using the underlying legal and institutional frameworks. In particular, investigate the possibilities to directly connect ICZM to the process of regional economic development and spatial planning. Water management and coastal development should be considered as leading or guiding principles in integrated spatial planning of low lying coastal and marine areas.

Full participation
Ensure the timely participation of the relevant actors on all levels, including local communities and stakeholders. Provide clarity on leadership and roles, especially in cases of shared competences and responsibilities. National agencies should be in control and provide institutional frames, legal arrangements, knowledge and funding to facilitate the management tasks of regional authorities. NGOs should be involved in assisting problem analyses, dissemination of knowledge to local stakeholders and in the daily management of coastal areas and ecosystems.

Proper monitoring and effective communication
Increase the role of monitoring, including data collection, data management and dissemination of information, and evaluation. Monitoring and data collection is required at all stages of the ICZM process to develop and improve the knowledge base. This knowledge is needed in order to understand the coastal system and the problems observed, to identify, plan, design and implement sustainable measures and to provide the basis for evaluation. This increased knowledge on the natural and socio-economic coastal processes and the analyses of impacts of developments and global changes should be communicated with the local stakeholders, in order to increase the awareness of the coastal problems and in finding local solutions. On the other hand, the coastal knowledge should also be made available in a form that the national and provincial/state policymakers can draw up long term planning and reserve the necessary funds for their coastal zone.

Increase international cooperation
Further develop and facilitate the possibilities to exchange and share knowledge and learning experiences in order to better address the main triggers for ICZM: population growth, unsustainable economic development and anticipated impacts of climate change. Increasing food, health and livelihood security and education will contribute to an early stabilisation of the world population. Integrated river basin and coastal zone management are important mechanisms for sound economic development and ecological and environmental security. Regional cooperation in flood and drought management is already essential and will become even more critical for dealing with the impacts of climate change effectively in the future.
Given the different ICZM development stages in different countries and the common nature of many of the coastal problems observed, there is a great need as well as potential for learning from each other. The exchange of knowledge and experience can be facilitated by improving and expanding already existing mechanisms, such as:

- Regional cooperation projects funded and initiated by the EU and international organisations;
- Bilateral arrangements for cooperation between countries;
- Development of information exchange networks.

In addition, new possibilities are to be investigated. These might include the establishment of broad international expert teams or the development of a global database of coastal management experiences (problems, solutions, successes, failures and determining factors). Another new possibility may be the establishment of internet based communication platforms for on-line ICZM consultation and support.

Identification and implementation of promising measures

This section starts with the description of four categories of ICZM measures. The feasibility of the measures however, will highly depend upon the prevailing country conditions. The key to the success of small scale adaptive measures, is the involvement and cooperation of local communities.

In addition, the emphasis should be on innovative technological developments which may substantially increase the potential for effective, locally operated measures.

Four categories of ICZM measures

Types of measures within ICZM fall into a number of different categories, as follows:

- *Prevention*. The first focus of ICZM should be on the prevention of coastal problems. This category of measures is involved with all aspects of spatial planning including decisions on resource use and exploitation on a national and regional level. Decisions and measures to be taken should be based on the knowledge of all relevant coastal mechanisms and the capabilities and limitations (e.g. carrying capacity) of the coastal system. Measures should aim at avoiding unsustainable use and overexploitation and preventing short term, irresponsible actions disrupting essential coastal functions.
- *Protection.* The category of protection includes all measures that will prevent or reduce the risks of flooding events and natural hazards, such as the building, adjusting and maintaining of man-made and natural flood protection systems. Preferred measures to counteract coastal erosion are to strengthen the natural protection of coastal vegetation belts or maintaining the protective dune systems. Ongoing coastal erosion may also be combated in a soft way by supplying sand to the coast. If absolutely needed many alternative hard coastal constructions can be applied such as to protect harbour entrances.
- *Adaptation.* Adaptation measures include a wide range of possible measures to be associated with human activity and living conditions on different scales, aiming to prevent or reduce the consequences of adverse effects. Examples are: the adaptation of houses and the creation of safe havens for flood protection; adjustments in agriculture, aquaculture and fisheries practices; waste water flow interception and treatment; development of ecotourism.
- *Restoration.* Restoration measures are involved with undoing the effects on the coastal system of undesirable and disruptive activities that have already taken place. These measures may include the restoration of natural systems such as coastal forests, mangroves and coral reefs; cleaning up water and soil pollution sources; limiting destructive coastal fishing and over-fishing in the high seas, and the rehabilitation of destroyed coastal systems such as abandoned aquaculture ponds.

Feasibility of measures depends on country conditions

The various parts of the CCC publication include a wide range of examples and experiences which hold important lessons on the failures and successes of the implementation of coastal measures. It is noted that the feasibility of measures, both from the viewpoint of implementation and functioning, very much depends on prevailing country conditions. In this respect, two more or less extreme country development situations could be considered: (1) a situation where a well developed institutional system is in place and sufficient resources and technical capabilities are available and (2) a situation where most or all of these conditions are basically lacking.

The first situation allows for the application of the whole range of options related to all the above measure categories. In particular, these options include the development of integrated approaches involving long-term planning and large-scale investment schemes. This situation applies to most of the coastal states in the EU and in particular the Netherlands, as described in part I of the CCC publication. However, examples of successful and promising coastal planning approaches can also be found in other countries.

The actual challenge is in the second situation, which unfortunately still applies to a large part of the coastal countries around the world. In this situation there are basically limited options for large investment schemes to prevent, protect or restore. Instead, there is a serious risk that ongoing coastal developments and short term profitability objectives will further disrupt coastal systems. Main threats include the cutting of coastal forests and mangroves; destruction of coral reefs; pollution of natural systems, overfishing of coastal waters; and the degradation of coastal areas by aquaculture development. Numerous examples of such problems have become manifest in the last decades.
The challenge is here to start at a small scale, to enlarge the ICZM efforts stepwise and to propose simple solutions to be executed and maintained by the local coastal inhabitants.

Emphasis on small scale adaptation measures

Obviously, the first priority is to stop and prevent devastating developments. This can only be achieved by developing sustainable coastal zone management practices, to be founded in appropriate governance and institutional structures. In identifying promising measures, the emphasis should be on relatively small scale adaptation measures aimed at immediate improvements at the grassroots level. In addition to direct costs and benefits, a number of other factors are particularly important in determining the potential success of such measures. These include a range of characteristics in relation to specific country or region conditions, such as:

- Extent and complexity of implementation requirements;
- Implementation time;
- Involvement and responsibilities of local stakeholders;
- Suitability with respect to local culture and customs;
- Maintenance requirements in relation to local maintenance capabilities;
- Opportunities for local implementation (production and construction);
- Simplicity and reliability;
- Proven success under comparable circumstances.

Good examples of such measures are the mangrove planting and the floating bed cultivation.

Need to widely apply innovative measures

The pressure on the coastal zone and its resources will increase strongly in the future.
Innovative, resilient, no-regret measures are needed in order to sustainably develop the coastal zone in the future and to respond to the impacts of anticipated climate change.
Examples of adaptive measure are found in Asia and in Europe. Large scale application of these multiple use measures should be pursued.

Involvement and cooperation of local parties required

Successful adaptation requires the involvement and cooperation of all relevant local parties.
The conditionality for implementation, operation and maintenance is to be provided by the national government. The local community, being the main beneficiary and mostly well aware of the local coastal problems should be involved in proposing solutions and during the execution of the measures. Commitment of all relevant parties is essential in terms of the responsibilities, efforts made and benefits incurred. Strong vertical cooperation is key to the success of the planning and execution of local, adaptive measures.

Possibilities for expanding international cooperation

There is a great need for coastal countries to learn from each other, to increase communication and to exchange experiences. This need for improved communication was also recognised by Jens Sorensen in his 2002 survey of more than 700 ICZM projects throughout the world.

This CCC publication in the form of this Book and the extended Internet edition on the CCC website has been produced through the cooperation of 101 authors. All authors of Part I and II were involved in the execution of the projects described. The authors of planning tools were the developers of these tool, so are the authors of the innovative adaptive measures closely linked with the execution of these measures.

These 101 authors are listed in alphabetical order, with their e-mail addresses in the CCC Part V, this to facilitate communication between the authors and between the reader and the authors.
The cooperation with the 'CCC-dignitaries' was much appreciated, provided a insight in their commitment to the sustainable development of the coastal zone, and to mitigation and adaptation. Their details are public and also listed.
The interested reader can read the CCC Book and the extended version including the full chapters of the Part I and II cases on the CCC website, can download the demonstration version of the GIS based planning tools, can use four full Training Manuals, can scrutinise selected PDF reports and can contact an author.

These activities may be considered as a simple start of a community. We will see how this will evolve in the near future.

During the production of this CCC publication several ideas came up to strengthen the communication and exchange knowledge and transfer technology, such as:

- To establish some broad international expert teams regarding ICZM and coastal cooperation;
- To develop a global database of coastal management experiences (problems, solutions, successes, failures and determining factors);
- To establish an internet based communication platforms for on-line ICZM consultation and support;
- To safeguard very valuable websites loaded with coastal information gathered during many years of hard project work, which could be lost in a split second;
- To organise a second World Coast Conference preferably in Asia in 2013, twenty years after the first one in Noordwijk, Holland, to evaluate the worldwide progress made and how to address the future coastal challenges.

You are invited to communicate your ideas and initiatives related to strengthen international cooperation to for instance the Netherlands Water Partnership, Delta Alliance, UNESCO-IHE or the Coastal and Marine Union - EUCC.

Finally, the two following contributions by Luitzen Bijlsma and Pier Vellinga describe their interesting perspectives on coastal cooperation.

The key for adaptation is development

Development in a sustainable way, governance and an outlook for international cooperation

Luitzen Bijlsma *(Centre for Water Management/Ministry I&E, the Netherlands)*

Water related problems are increasing in low-lying populated coastal areas. Witness the recent typhoon Ketsana, which battered South East Asia and took lives, affected several million people and caused large scale damage to properties in Thailand, Cambodia, Lao, Philippines and Vietnam. In many coastal areas sea level rise will contribute to increased vulnerability. However, mismanagement of local resources and their over-utilisation has in many cases already made them highly susceptible to change. Subsidence in deltaic areas caused by large-scale mining, extraction of oil, gas and groundwater, and intensified drainage, inevitably leads to soil compaction and is one indicator that there is a limit to resource utilisation. In many occupied deltas and other low-lying coastal areas, the rate of subsidence is far larger than the present rate of sea level rise. The ongoing uncontrolled encroachment of unprotected low-lying areas makes them even more susceptible.
The fifteenth Conference of the Parties of UNFCCC in Copenhagen (December 2009) failed to look at the issues of water management in an integrated manner during the discussions on adaptation to climate change.

Development

We are surrounded by uncertainties when dealing with climate change and we have to prepare measures that take account of this. Although there may not be an impending catastrophe, neglect of proper resource use will inevitably lead to hazards and hazards lead to hazard driven responses. If not managed, the burden will shift to the most susceptible individuals, groups, sectors and industries, such as shown in the poverty-stricken and cyclone prone coastal areas of the Indian State of Andhra Pradesh (see CCC II-3-4). If individuals, groups sectors and industries cannot adapt, the threat from exposure to these hazards will increase, leaving them increasingly vulnerable. This is a major problem for the sustainable development of coastal areas and requires urgent action now.

The answer lies in better resource management and better management of related infrastructure for service delivery. This is not about bigger governmental institutions, but better service by public or private providers. A prerequisite to good governance in service provision is an appropriate legal, institutional and financial framework. In many countries, the legal basis for development control is often present. Institutional reform is however still needed for effective implementation of policies to address the complex challenges associated with sustainable development and impacts of climate change. Good governance is the key!

Governance

Good governance is prerequisite for an attractive investment climate. An attractive investment climate is important for economic and social development. Sustainable development increases the resilience of society to future uncertainties, including climate change. Drainage, water supply, sanitation, flood protection, land use planning all require a competent and a public, service and user oriented organisation. As an example the Water Boards in The Netherlands are decentralised public service providers that have been at the grass roots of development for many centuries. In providing drainage, irrigation and flood protection and sanitation, they work in a legal and financial framework, where the user pays for the service and the users have a vote in electing the governing council of the Water Board. In many countries, the water services are centralised. As a result, these organisations tend to become unwieldy and solely oriented towards engineering solutions, with services that are disconnected from local needs and where there is no recovery of maintenance costs from the users. As a result, the growing bureaucracy becomes an obstacle to sustainable development.

There is a long way to go but step by step reform, is possible using experimental situations, pilot projects and improved knowledge. International financial cooperation is partly driven by infrastructure damage, leading to the transfer of financial resources for recovery after an event has taken place requiring rehabilitation, which is sometimes hastily undertaken. Sustainable international cooperation on the other hand should be focused on long term exchange of experience and best practice in organising services at all levels of governance and on professional cooperation between service providers. Coastal countries and deltas that succeed in improving the basic services, including water services, are in a better position to address future uncertainties, especially in relation to climate change. Looking only at the impacts of climate change in an isolated, non-integrated way may lead to inappropriate decisions.

From my professional position as Director of the National Water Service/Ministry of Infrastructure and the Environment (Ministry of I&E) in The Netherlands, dealing with water quality and quantity, flooding and erosion – I can state that professional, international cooperation can have mutual benefits. To learn from each other's experience can hasten the process of reform. For instance South Africa, Ukraine, Indonesia, Egypt and Bangladesh have all developed first steps in decentralisation. The USA, Great Britain and France are rethinking the way they deal with protection from erosion and flooding, in order to reduce the loss of lives, property and economic damage given the recent increase in storm surges. Hazards such as typhoon Ketsana will continue to occur. However, it is possible to reform the way we work and protect both lives and property from natural hazards in a more effective manner. Can we do it without hazards? Yes we can.

Outlook for international cooperation

In December 2009, the Netherlands Cabinet adopted the National Water Plan 2009 – 2015 (see website) created by five Ministries. This plan outlines the policy the State will implement in order to achieve sustainable water management in the Netherlands. Long-term cooperation with other deltaic countries is also addressed. The Cabinet of Ministers wants the Netherlands to cooperate with countries in low-lying delta areas by assisting in protection against floods and in providing sufficient, clean water. The Cabinet is focusing its attention on five deltas: the Jakarta, the Mekong, the Ganges/Brahmaputra, the Incomati and the Nile. The Netherlands will be entering into long-term water partnerships, firstly through the existing "Partners for Water" programme (extended to 2015), but aiming to last 10 - 20 years. The Netherlands is also using a number of other financial instruments to assist water management in other countries.
International cooperation will contribute to climate adaptation and to the millennium goals for creating and utilising mutually beneficial, economic opportunities.

Reference:

Ketsana : http://globalvoicesonline.org/2009/10/02/typhoon-ketsana-batters-southeast-asia

Netherlands National Water Plan 2009 – 2015:
http://www.verkeerenwaterstaat.nl/english/topics/water/water_and_the_future/national_water_plan

A call for action and cooperation

Towards an Alliance of Deltas

Pier Vellinga *(IVM, Free University, Amsterdam, the Netherlands)*

Competing claims on land and resources, subsidence in urban areas and climate change are the most serious issues in coastal zones. It is evident from experience that a sectoral approach is inadequate to address these issues. Innovation across sectors and multifunctional use of land and resources is required. From a technical and macro economic perspective most of the issues can be solved. A major barrier is the development and implementation of solutions across the sectors, not only in government, but also in industry.

I would like to illustrate this with three examples. One, fresh water for industrial and human use is often harvested from groundwater resources, causing subsidence in mega cities such as Bangkok and Jakarta. Major parts are now at or below sea level. As a result, storm surges, typhoons and hurricanes will cause an increasing amount of damage and loss of live in such mega-cities. Macro-economically it will pay to invest in alternative water production schemes, such as conservation, underground storage and desalination. Solar energy can be an attractive energy source to make this happen. But, how to develop a business case for such investments? Some countries are experimenting in this field. We need more attention for successful examples and we need mechanisms to multiply them at international scale.

A second example is food production and habitation in flood prone areas. Interesting concepts are coming up such as floating agriculture and floating urban development. Brackish agriculture is another opportunity. Sharing technical and institutional experience will greatly stimulate such developments and will help to make such solutions more cost effective.

The third example is the double challenge to develop low lying areas in a way that is both climate neutral (no greenhouse gas emissions) and climate proof. Energy, water and food production are separate sectors each with their own rationale. Now that the pressure on space and resources is reaching the limits of sustainability, it pays to develop solutions across these sectors. Food residues, solid waste and waste water are excellent energy sources. Water can be used to store and to transport energy. Heat pumps using water as a medium can be used to heat as well as to cool houses, offices and factories. Where water and energy meet many new solutions can be found.

All three examples illustrate that major resource efficiency gains can be found by linking issues and looking across sectors. Such linkages appear to be difficult as in many cases there is a technical, economic and institutional lock-in within the specific sector. Business cases can only be developed when the investing parties can also become the beneficiary parties. This requires institutional change. Existing power structures are very often a barrier for the institutional change that is required to implement cost effective solutions.

Specific initiatives and efforts to remove such barriers and exchange the knowledge and experience gained at international scale will surely help in the diffusion of innovative cost effective solutions. Fortunately there is a growing number of initiatives in this field. In practise climate change can be seen as an important driver for the development of such initiatives, even when it is not the most pressing issue. However, climate change does provide the inspiration for a long term and international perspective on solutions to shorter term problems. It helps to look beyond traditional boundaries and institutions.
In major parts of the world it is not climate change, but rapid urban development and overexploitation of delta resources such as water, soils and natural resources that cause the most acute problems.

Climate proofing requires taking a longer term and a geographically wider perspective. Experience shows that taking climate change and sea level rise on board in early planning phases generates more robust and more sustainable solutions, with more beneficiaries and benefits than in the case of sectoral short term oriented solutions.

In this article I want to make a plea for the development of an Alliance of Deltas. An Alliance that works as a common interest group, to raise international awareness and generate support for effective solutions. It will help to multiply effective solutions and it provides a common ground for countries and their experts in addressing the issue.

Fortunately, two early initiatives in this direction can already be identified. One is the C-40, the group of Delta Cities cooperating under the umbrella of the Clinton Climate Initiative. The second is the Estuary Alliance launched in Shanghai in June 2010, by the World Wide Fund for Nature (WWF). It promotes the conservation and use of natural habitat for estuarine management and coastal protection. The International Delta Alliance, was launched at the Rotterdam Conference: "Delta's in Times of Climate Change" (September 29 - October 1, 2010.) The Delta Alliance is focussed on the international cooperation among scientists/experts, practitioners and policy makers. It addresses full delta management, including water, food, urban management and development and natural habitat conservation and development.

In this contribution I call on all those involved to reinforce and broaden the mentioned early initiatives towards a truly international effort in promoting and sharing Delta Knowledge and Experience. Specific actions to be included are:

- The development of major international exchange programs,
- The organisation of bi-annual international delta conferences including all low lying countries of the world, international cooperation and funding programme's on climate, sea level rise and delta planning.

I suggest that all governments of low lying countries and all relevant multilateral organisations join efforts in the support of the mentioned initiatives towards a truly international Alliance of Deltas.

www.deltaalliance.org

CCC - Part V

Appendices

V-1 List of downloadable Training Manuals and Tools

The CCC production aims to increase the exchange and transfer of applied coastal knowledge and technology. The reader is encouraged to get acquainted with some concepts and tools through downloading and using the Training Manuals and ICZM Planning Tools – Demos. You can download these manuals and tools free of charge on condition of proper referencing to the developers of the manuals and tools, and with citation to the CCC Book & CCC Website.

V-1-1 List of Training Manuals

Downloadable via www.coastalcooperation.net

V-1-1-1 Coastal Protection Guidelines

A guide to cope with erosion in the broader perspective of Integrated Coastal Zone Management. RIKZ/CZM-C 2001

V-1-1-2 Thai Aquaculture experiences in an ICZM frame

Leewis, R.J. and S. Boromthanarat, 2003:
Report of TPS/CORIN, CRI, Hat Yai and Coastal Zone Management Centre/Min.I&E,The Hague, The Netherlands: 57 pp.

V-1-1-3 Where waters and land meet

Marta Vahtar, Robbert Misdorp, Pham Toan, Le Van Thu, Le Ngo Hung, Phan Thi Le Dong and Maja Zdesar, 2005:
Water, Water-Management and Coastal Zone Management Education in the Context of Regular Primary School Education" - Teaching material for Grade 1 to 12.

V-1-1-4 Training for the Sustainable Management of Marine Protected Areas

Julius Francis, Carien van Zwol, Dianeeta Sadacharan,
A teaching manual for Training Managers – Western Indian Ocean Region; CZM-Centre, WIOMSA, World Bank, The Hague, 2000

V-1-2 ICZM Planning tools – Demos

Demonstration versions of the following Planning tools are downloadable through the CCC website: www.coastalcooperation.net or through the indicated website links

V-1-2-1 The COSMO - Demo version

Information: marcel.taal@deltares.nl

V-1-2-2 The CoastLearn – Link: www.coastlearn.org

Information: m.ferreira@eucc.net
c.perez@eucc.net

V-1-2-3 The RAMCO – Link: www.riks.nl/projects/ramco

Information: hvdelden@riks.nl

V-1-2-4 The DR-EIA – Link: www.dr-eia.org

Information: j.deschutter@unesco-ihe.org

V-1-2-5 The STREAM – Demo version - Link: http://www.adaptation.nl

go to: STREAM, Downloads, download STREAM Demo (77mb) and follow the instructions
Information: jeroen.aerts@ivm.vu.nl

List of CCC Authors

Aerts, Jeroen C.J.H. E-mail: jeroen.aerts@ivm.vu.nl

Positions:
- Professor: Water, risk and insurance, Institute for Environmental Studies, VU, 2008-;
- Associate Professor (UHD): IVM, VU (Free University Amsterdam) 2005;
- Coordinator: Spatial Information Group, Resource Analysis, Delft, 1998.

Fields of interest: Water management, Risk management and insurance and Adaptation to climate change

The Netherlands

Ahmad, Mohiuddin E-mail: mohi2005@gmail.com

Positions:
- Chairperson: Community Development Library , Dhaka, Bangladesh, 2008-;
- Visiting Professor: NGO Studies, SungKongHoe University, Seoul, 2007-08;
- Co-Team Leader Dutch supported ICZM project: Min. of Water Resources, Bangladesh, 2002-06.

Bangladesh

Alam, Mozaharul E-mail: Mozaharul.Alam@unep.org

Positions:
- Climate Change Coordinator: Asia & the Pacific Region of UNEP, Bangkok, 2009 - ;
- Leader climate change team: Bangladesh Centre of Advanced Studies, Dhaka, 2006–09;
- National Project Coordinator of Bangladesh: NAPA, 2004–05.

Fields of interest: Adaptation and development to climate change; Community based adaptation to climate change; Integrated impact assessment.

Bangladesh

Alberts, Jeroen E-mail: jeroen.alberts@dhv.com

Positions:
- Strategic Advisor: Sea Defence Project, Aceh, Indonesia (DHV);
- Project Manager: Integrated Waterplan, Eco-City Caofeidian, China (DHV);
- Process Manager: Sustainable Future Water Treatm., the Netherlands (DHV)

Fields of interest: Water Resources Management; Institutional Development; Innovations in water chain.

The Netherlands

Baarse, Gerrit E-mail: G.Baarse@ba-bv.nl

Positions:
- Private Consultant: BB&C (Baarse Beleidsondersteuning & Consult), 1996 - ;
- Partner Director : Resource Analysis,, Delft, the Netherlands, 1988 – 1995;
- Project Advisor: Delft Hydraulics, Water and Environment Div.1976-1988

Fields of interest: Policy analysis and integrated impact assessment; Water resources and coastal zone management; Air, land and water relatedtransportation systems.

The Netherlands

Bandyopadhyay, Jayanta E-mail: jayanta@iimcal.ac.in

Positions:
- Professor and Head: Centre for Development and Environment Policy, Indian Institute of Management, Calcutta, India

Fields of interest: Science and Water Systems Management; From Knowledge to Environmental Policy; Modern Science and Human Futures.

India

Boromthanarat, Somsak E-mail: somsak.b@corin-asia.org

Positions:
- Director: Asian Coastal Resources Foundation, Hat Yai, Thailand, 2008- ;
- Director: Coastal Resources Institute, 1980 – 2008;
- Coordinator : Wetland Management: Cambodia, Laos, Thailand and Vietnam

Fields of interest: Ecosystem Services Based-ICARM; Livelihood Development Models: poverty reduction and food security; Life cycle analysis: vulnerability and social impact assessment.

Thailand

Brommer, Marit E-mail: marit.brommer@total.com

Positions:
- Geologist: TOTAL E&P Nederland B.V., The Netherlands, 2010 - ;
- Senior Consultant Royal Haskoning: United Kingdom, 2007-2010;
- PhD researcher, Delft University of Technology, The Netherlands, 2004 – '07;

Fields of interest: Geology; Coastal Science and Management; Energy and Society.

The Netherlands

Bucx, Tom E-mail: tom.bucx@deltares.nl

Positions:
- Consultant ICZM: Deltares / WL Delft Hydraulics, Delft, 2010 - ;
- Policy Advisor ICZM: Province of South Holland, the Netherlands;
- Advisor ICZM: CZM - Centre, Ministry of V & W, the Netherlands.

Fields of interest: Integrated coastal zone management; Disaster risk management and risk reduction; International development cooperation.

The Netherlands

Bijlsma, Luitzen E-mail: luitzen.bijlsma@rws.nl

Positions:
- General Director: Centre for Water Management, Min. V & W, the Netherlands, '07 – ;
- Member of the Board : Netherlands Water Partnership, the Netherlands, 2010-
- Managing Director: Coastal Zone Management Centre, 1994 – 2000.

Fields of interest: Management of Public Service Delivery for Water; Infrastructure development for Water supply; Flood and Storm Surge warning.

The Netherlands

Chen, Meifa E-mail: meifachen@vip.sohu.com

Positions:
- President: Shanghai YouWei Engineering Design Co., Shanghai, 2009 –;
- Deputy Director: Science & Technology Committee, Shanghai, 2007 – 2009;
- Chief Engineer: Shanghai Water Authority, 2000 – 2007.

Fields of interest: Planning and design of coastal engineering; Research and design of regulation of river and mouth of river; Research of Hydrodynamics model.

China

Coman, Claudia E-mail: ccblacksea@gmail.com

Positions:
- ICZM Expert: Black Sea Coastal Centre (BSCC), Constanta, Romania, 2009 – ;
- Research Scientist, Oceanography Centre, University of Cyprus, 2009 – ;
- ICZM Advisor ICZM: WG - PTS, Black Sea Commission, 2001 - 08.

Fields of interest: ICZM; Coastal and marine policies/strategies; Oceanography & Data management.

Romania

Comarmond, Alain de E-mail: a.deco@env.gov.sc

Positions:
- PhD researcher: University of Kalmar, Sweden;
- Director: Dep. Environm., Min. Environm., Natural Resources & Transport, Seychelles;
- Member: Seychelles National Climate Change Committee - Coastal Adaptation, 2001 - .

Fields of interest: Climate change; Board of Trustee for the Sea Level Rise Foundation.

Seychelles

Dang Van, Tao E-mail: tao.vandang@ifrc.org

Positions:
- Disaster Management Programme Manager: IFRC & RC, Vietnam 2005- ;
- Mangrove & Disaster Preparedness project officer: IFRC, 1997- 2004;
- Edition member of Banking Magazine of Vietnam, 1994- 1997.

Fields of interest: Disaster Risk Reduction (DRR); Sustainable Development; Emergency Response.

Vietnam

Delden, Hedwig van E-mail: hvdelden@riks.nl

Positions:
- Director: Research Institute for Knowledge Systems , Maastricht, the Netherlands, 2010 -;

Fields of interest: Land use modelling; Design & development of integrated models for policy support; Bridging the science – policy gap.

The Netherlands

Doody, Patrick E-mail: pat.doody@ntlworld.com

Positions:
- Independent Coastal Consultant, Cambridgeshire, UK, 1998 - ;
- Head Coastal Conservation Branch: Joint Nature Conservation Committee, 1991-97;
- Chief Scientist: Directorate, Nature Conservancy Council, UK, 1979-91.

Fields of interest: Coastal conservation, management and restoration; Information and ICZM; Nature conservation and Photography.

The United Kingdom

Dorst, Kees E-mail: kees.dorst@rws.nl

Positions:
- Senior Specialist in Hydraulic Engineering: Centre for Infrastructure, Department of Hydraulic Engineering and Environment, Rijkswaterstaat, Ministry V & W, the Netherlands.

Fields of interest: Marine structures and Coastal Management; Inland hydraulic structures; Fishways.

The Netherlands

Ferreira, Maria E-mail: m.ferreira@eucc.net

Positions:
- Head, Info & Communication Unit: Coastal & Marine Union-EUCC, the Netherl. '08
- Senior Consultant:, EUCC Mediterranean Centre, Spain, 2007- ;
- Project Manager : Policy & Projects Unit, EUCC, 2001-2008.

Fields of interest: Networking and participation in ICZM; Communications for coastal sustainability and development; International cooperation and knowledge exchange.

The Netherlands

Francis, Julius E-mail: julius@wiomsa.org

Positions:
- Executive Secretary: W. Indian Ocean Marine Science Ass., Zanzibar,Tanzania, 2002-
- Director: Institute of Marine Science, University of Dar es Salaam, 1995 – 2001
- Guest Editor in Ambio and Ocean and Coastal Management

Fields of interest:
Coastal and marine resource management; Integrated Coastal Managem. and Marine Protected Areas; Capacity building and development.


Tanzania

Gils, Jos van E-mail: Jos.vanGils@deltares.nl

Positions:
- Researcher & consult: Water quality and management, Deltares, Delft, the Netherlands.

Fields of interest:
Inland and coastal water studies; Water quality modeling: Europe, Hong Kong , the Arabian Gulf Region.


The Netherlands

Graaf, Frank de E-mail: frank.degraaf@dhv.com

Positions:
- Coastal planner and waterfront specialist: DHV, the Netherlands

Fields of interest:
Port City Development; Waterfront Development; Coastal Development.


The Netherlands

He, Qixiang E-mail: qxhe@163169.net

Positions:
- Deputy President: Chinese Association of Sedimentologists, China;
- Chief: Science and Technology Division, CCOP-East and South East Asia, 1991- 2000;
- Director: Institute of Marine Geology, China, 1984—1991.

Fields of interest:
Sedimentology; Marine Geology; Integrated Coastal Zone Management.


China

Head, Peter E-mail: master-planning@arup.com

Positions:
- OBE FREng FRSA – Chairman ARUP Global Planning, London, UK, current
- Independent Commissioner on the London Sustainable Development Commission (current)
- Adviser: to the Chair of the C40 Large Cities & the Clinton Carbon Positive Programme (crrt)

Fields of interest:
Sustainable manufacturing, agriculture & city food production; New economic model of resource efficiency; Use of algae bioreactors: turning CO2 into soil conditioning compost


The United Kingdom

Helmer, Madeleen E-mail: MHelmer@redcross.nl

Positions:
- Head of the Red Cross/Red Crescent Climate Centre, The Hague, since 2001
- Coordinator European Centre for Pacific Issues, Zeist (NL) 1992-2001
- Coordinator Netherlands Pacific Working Group, Zeist (NL) 1985-1992

Fields of interest: Climate change adaptation, disaster risk reduction; dialogue knowledgecentres-end users; linking local actions to global policies.


The Netherlands

Henocque, Yves E-mail: yves.henocque@ifremer.fr

Positions:
- French Research Institute for Exploitation of the Sea (IFREMER), Nature & Society, Prospective and Strategic Scientific Division, France.

Fields of interest:
Regional and national maritime strategies; Integrated coastal and ecosystem-based management; Local development project management.


France

Heuvel, Tjark van E-mail: Heuve707@wxs.nl

Positions:
- Senior Advisor: Coastal protection, Rijkswaterstaat (RWS), Ministry V & W, Netherlands;
- Consultant: river navigability, safety and GIS in Guyana and Surinam;
- Project leader : Hydrodynamic research Dutch coastal zone and North Sea, RIKZ, RWS.

Fields of interest:
ICZM: safety on the long term and physical planning; Photography, GIS and data management; Coastal morphology.


The Netherlands

Ho Thi Yen, Thu E-mail: thu@mcdvietnam.org

Positions:
- Dep. Director: Centre Marinelife Conserv. & Comm. Development , Vietnam, 2006- ;
- Specialist Environmental Management: VNICZM project, Vietnam, 2001-2005;
- Environmental Managem. Specialist: Stanley Consultants, Inc., Vietnam, 2000-2001;

Fields of interest:
Integrated Coastal Zone Management; Environmental Impact Assessments; Ecosystem Conservation.


Vietnam

Hua Chien, Thang E-mail: hthang@nea.gov.vn

Positions:
- Dep.Director: Marine & Coastal Planning Center, Vietnam Adm. of Sea & Islands, MONRE, 2009-
- Director of ICZM Division of Vietnam Environment Protection Agency, MONRE, 2004-2006.
- National Coordinator Vietnam - Netherlands ICZM & CCC projects, Hanoi, Vietnam, 2001 - 2006

Fields of interest:
Environment Management: Pollution Control, Monitoring and Oil Spill Response; Climate change: coastal Adaptation and Mitigation Measures; Marine and Coastal Governance: Policy and Legal Issues.


Vietnam

Huq, Saleemal E-mail: saleemul.huq@iied.org

Positions:
- Senior Fellow: Climate Change Group, Intern. Inst. Environment & Development, 2010
- Director: Climate Change Programme, (IIED), London, UK, 2001 - .

Fields of interest:
Inter-linkages climate change, sustainable development in developing countries; Several applied research activities: climate change negotiator, advisor: Greenpeace UK and BCAS - Dhaka.


The United Kingdom - Bangladesh

Islam, Rafiqul E-mail: rafiq20@gmail.com

Positions:
- Estuary Management Officer, Manly, Australia;
- Team Leader, Integrated Coastal Zone Management Program, Bangladesh;
- Co-Team Leader: Compartmentalisation (water management) Pilot Project, Bangladesh.

Fields of interest:
Integrated coastal management; Institutional development; Policy & strategy.


Australia - Bangladesh

Kerssens, Peter J.M. E-mail: peter.kerssens@deltares.nl

Positions:
- Regional Director South-East Asia: Deltares, Delft, the Netherlands;
- Senior expert: Water Resources Management and River engineering, Deltares;
- Board Member: Water Board Rijnland, the Netherlands, 1988-2005.

Fields of interest:
River engineering; River Basin Management; Integrated water resources.


The Netherlands

Kevelam, Dick E-mail: dick.kevelam@dhv.com

Positions:
- Leading Professional Coastal Development, DHV, 2001 - ;
- Consulting Engineer DHV, The Netherlands, 1989 - 2001;
- Former Team Leader, Integrated Coastal Zone Management Program, Bangladesh.

Fields of interest:
Integrated coastal planning; safety, fresh and salt water management; Coastal Urban Landscape; Nature driven design.


China; The Netherlands

Khanadakar, Md.Abu Taher E-mail: dg@warpo.gov.bd

Positions:
- Director General: Water Resource Planning Organization, Ministry of Water Resources, Dhaka, Bangladesh

Fields of interest:
Disaster Risk Reduction (DRR); Sustainable Development; Emergency Response.


Bangladesh

Koningsveld, Mark van E-mail: MRV@VanOord.com

Positions:
- Lead Environmental Engineer: Van Oord DMC's Eng. Dep., the Netherlands;, 2008-
- Senior advisor: Marine and Coastal Management, Deltares, 2003-2008;
- Senior Researcher: Hydraulic Engineering Section, Delft University of Technology, 2007.

Fields of interest:
Coastal and environmental engineering: "Building with Nature' type solutions; Promoting OpenEarth: open source for data and knowledge management; Matching specialist knowledge end user needs.


The Netherlands

Kramer, Kees J. M. E-mail: kees.kramer@mermayde.nl

Positions:
- Senior scientist: consultant & director of Mermayde Consultancy, the Netherlands;
- Former Senior: scientist, TNO, Den Helder & Delft, the Netherlands;
- Former Scientist: Netherlands Institute for Sea Research, Texel, Netherlands.

Fields of interest:
Marine/aquatic chemistry; Marine and Freshwater monitoring; Quality Assurance and Control.


The Netherlands

Kuijken, Wim Website: www.deltacommissaris.nl/english/

Positions:
- Government Commissioner for the Delta Programme, 2010-;
- Former Secretary-general of the Ministries of the Interior, General Affairs, and Transport, Public Works and Water Management, The Netherlands


The Netherlands

Laane, Remi E-mail: remi.laane@deltares.nl

Positions:
- Senior advisor: Deltares, Delft, the Netherlands;
- Member: Science Board of Deltares
- Professor: Marine Biogeochemistry, IBED, University of Amsterdam.

Fields of interest:
Aquatic biogeochemistry; Aquatic pollution;
Valorization of scientific results to end users and general public.

The Netherlands

Laban, Cees E-mail: Cees.laban@marinegeologicaladvice.nl

Positions:
- Environment and Geosciences, Deltares, the Netherlands, 2009 - ;
- Director Marine Geological Advice, the Netherlands;
- Director Marine Sampling Holland BV.

Fields of interest:
Marine Geology; Marine sampling techniques;
Marine infrastructures.

The Netherlands

Laboyrie, Harrie Jean E-mail: h.laboyrie@royalhaskoning.com

Positions:
- Director : Water and Coastal & Rivers, Asia, Royal Haskoning, Vietnam
- Director: Coastal and Rivers International Royal Haskoning, the Netherlands

Fields of interest:
Delta Technology; Inland Waterway Transport;
Financial Engineering

Vietnam

Le Thi Anh, Dao

Positions:
- Education Expert: Department of Education and Training (DoET), Hue, Thua Thien Hue Province, Vietnam.

Vietnam

Le Van, Thu E-mail: thu_levan@hotmail.com

Positions:
- Director Investment Promotion Department, Chan May, TTHue Province, Vietnam, 2006-;
- Coordinator VNICZM Programme, Thua Thien Hue Province, Vietnam, 2001 –2005;
- Director External Relations Department, Quang Tri province, Vietnam, 1993-1999.

Fields of interest:
Integrated Coastal Zone Management; Adaptation and mitigation of Natural Disasters in the relation with global climate change; Ecological tourism.

Vietnam

Leewis, Rob J. E-mail: r.leewis@casema.nl

Positions:
- Guest researcher: the Netherlands Center for Biodiversity Naturalis, Leiden, the Netherlands
- Former coordinator marine ecology: RIVM, the Netherlands;
- Former head department biology, Rijkswaterstaat Ministry V & W, the Netherlands.

Fields of interest:
Biology and ecology of hard substrates under water; Artificial reefs and their potential role in marine spatial planning; Invasive alien species and their impacts on ecology, economy and human health.

The Netherlands

Li, Jun E-mail: junli741001@gmail.com

Positions:
- Director Marine Hard Mineral Resources, Qingdao Institute of Marine Geology, China;
- Chief Scientist Marine Aggregate Research Project of MLR, China.

Fields of interest:
Geo-environmental assessment of marine aggregate mining;
Deep-sea mineral research; Quaternary geology and deposits formation.

China

Löffler, Moniek E-mail: Löffler, Moniek

Positions:
- Director and specialist writer: Water & Landscape, Bureau Landwijzer, the Netherlands;
- Project manager: Coastal management, Rijkswaterstaat Min. V & W, the Netherlands;
- Physical geographer: University Amsterdam.

Fields of interest:
Communication: structuring information about water, coast and landscape;
Coastal dynamics: sand transport, dune management and its ecological effects;

The Netherlands

Marchand, Marcel E-mail: marcel.marchand@deltares.nl

Positions:
- Specialist ICZM: Deltares, Delft, the Netherlands, 2008- ;
- Advisor ICZM, Delft Hydraulics, 1990 – 2008;
- Lecturer: Centre for Environmental Science, Leiden University, 1984 – 1990.

Fields of interest:
Integrated Coastal Zone Management; Disaster Management; Environmental Impact Assessments / Ecosystem conservation and rehabilitation.

The Netherlands

McGlade, Jacqueline E-mail: Jacqueline.McGlade@eea.europa.eu

Positions:
- Executive Director: European Environmental Agency, Copenhagen, Denmark

Website: www.eea.europa.eu

Denmark

Michel, James A.

Positions:
- President of the Republic of the Seychelles,
- President of the Sea-Level Rise Foundation.

Websites: Statehouse: www.statehouse.gov.sc/

The Seychelles

Misdorp, Robbert E-mail: climecoast@gmail.com

Positions:
- Peer Reviewer: UNEP and IPCC 3 and 4 Assessment;
- Coordinator: CZM-Centre, Ministry V&W, the Netherlands, 1993 - 2004;
- Technical Secretary: WG Coasts IPCC, 1989 – 1994.

Fields of interest: ICZM: integrated planning and sustainable development;
Coastal dynamics: natural and socio-economic processes;
GIS – applications: integrated spatial planning simulation.

The Netherlands

Moel, Hans de E-mail: hans.de.moel@ivm.vu.nl

Positions:
- PhD researcher, Institute for Environmental Studies, Free University Amsterdam, 2006.

Fields of interest:
Flood risk; Uncertainty analyses;
Impact of future developments on hydrology.

The Netherlands

Nguyen Hung, Ha E-mail: hungha.nguyen@ifrc.org

Positions:
- Disaster Risk Reduction Programme Manager, IFRC & RC Societies, Bangkok, 2008 - ;
- Regional Disaster Management Programme Officer, IFRCRC, Bangkok, 2006 - 08;
- Disaster Management Programme Officer, Vietnam Red Cross, 1997- 2006.

Fields of interest:
Disaster Risk Reduction; Community based development and organization; Climate change adaptation

Vietnam

Nguyen Ngoc, Huan

Positions:
- Former Head: Center for Applied Meteo-Hydrological Technology, Hanoi, Vietnam;
- Former National Coordinator: the Dutch supported Vietnam Coastal Zone Vulnerability Assessment project, Vietnam.

Vietnam

Niesing, Hugo E-mail: hniesing@wattpic.nl

Positions:
- Founder & partner: WATTPIC Intelligent Energy, 2005-;
- Senior advisor: Centre for Water Management, Ministry V&W, 2007-present,
- Coordinator: EU research, RIKZ, Ministry V&W, the Netherlands, 2002-2007,

Fields of interest:
Renewable energy and energy management systems; EU applied research and policies; ICZM: integrated planning and sustainable development;

The Netherlands

Nieuwenhuis, Odelinde E. E-mail: odelinde.nieuwenhuis@dhv.com

Positions:
- Senior Coastal Engineer: Sea Defence Project Aceh, Indonesia (DHV);
- Task Manager: Hydraulics and Morphology Estuary Development Program Bangladesh (DHV);
- Senior Coastal Specialist: Tianjin Coastal Development China (DHV).

Fields of interest:
Flood Risk Management; Coastal Engineering;
Coastal Zone Management

The Netherlands

Patterson, Edward, J.K. E-mail: edwardjkpatterson@yahoo.co.in

Positions:
- Director: Suganthi Devadason Marine Research Institute, TN, India, 1999 – ;
- Project Director: Coral restoration Project, CORDIO, India, 2002 – 2006;
- Senior Lecturer: Marine Biology, Annamalai University, India, 1997-1999.

Fields of interest:
Coastal Ecosystem Restoration; Marine Environmental Impact Assessm. and Monitoring; Climate change impact on coastal ecosystem.

India

Payet, Rolph E-mail: rolphap@gmail.com

Positions:
- President and Vice-Chancellor of the University of Seychelles;
- Special advisor to the President of the Republic of Seychelles on sustainable development, biodiversity, climate change, energy, and international environment policy.

Website: SLR Foundation: http://sealevelrise.blogspot.com/p/home.html

Seychelles

Pérez Valverde, Carolina E-mail: c.perez@eucc.net

Positions:
- Director: EUCC Mediterranean Centre, Barcelona, Spain, 2004 -;
- Mediterranean Programme Manager: EUCC, The Netherlands, 2004 - ;
- Projects Officer : EECONET Action Fund Secretariat, The Netherlands, 1997-2003.

Fields of interest:
Good coastal governance and sustainable development; Education, awareness, training and public participation in the field of ICZM; Ecological coastal Networks.

Spain

Pham Khoi Nguyen

Positions:
- Minister of Natural Resources and Environment (MONRE), Vietnam

Websites:
MONRE: http://www.monre.gov.vn/monreNet/
Vietnam Environmental Administration:
http://vea.gov.vn/en/Pages/homepage.aspx

Vietnam

Pham, Toan E-mail:PhoToVidai@netnam.vn

Positions:
- Consultant: Capacity building and training, Thua Thien Hue Province, Vietnam

Vietnam

Pickaver, Alan E-mail: a.pickaver@eucc.net

Positions:
- Head of Policy Unit: EUCC, Leiden, the Netherlands, 1997 – ;
- Head of departments - Greenpeace International: Toxics -1980-1984; Ocean Ecology to 1989 : Science to 1995.

Fields of interest:
ICZM - putting theory into practice; Sustainable development.

The Netherlands

Plas, van der, A.B.M. E-mail: ar.plas@wxs.nl

Positions:
- Permanent Secretary: Ministry Transport, Public Works & Water Management, 1992-98;
- Board Member Philips Dutch Comp./Director Corporate BD & PE, 1985-92
- Director: Public Works of the city of Rotterdam, 1979-1985.

Fields of interest:
Policy and Planning public Infrastructure; Urbanisation and Megacities; Integrated Coastal Zone Management.

The Netherlands

Pol, Johan van der E-mail: j.v.d.pol@duravermeer.nl

Positions:
- Deputy Director : Dura Vermeer Business Development, the Netherlands
- Representative of the Dutch Construction and Infrastructure Federation - DeltaTechnology.

Fields of interest:
CSR and sustainability; Climate change and building in wet areas; Floating structures.

The Netherlands

Pos, Hans E-mail: hanspos.hk@gmail.com

Positions:
- Natural Resources Advisor: Royal Haskoning, 1991 – 2010;
- Functional Specialist Royal Dutch Army, Uruzgan, Afghanistan, 2009;
- Long-term Resident Advisor: Vietnam-Neth. ICZM Project, Hanoi, Vietnam, 2001 – 2007.

Fields of interest:
Promoting interaction between various stakeholders; Promoting interaction between national, provincial and district levels; Development ICZM Strategy and Action Plans.

The Netherlands

Rahman, Atiq E-mail: atiq.rahman@bcas.net

Positions:
- Executive Director : Bangladesh Centre for Advanced Studies (BCAS), Dhaka;
- Visiting Professor Sustainable Development, Tufts University, Boston, U.S.A.;
- Chairman of Climate Action Network South Asia (CANSA).

Fields of interest:
Sustainable development and climate change; North South Dialogue; Ecosystems and Livelihoods Adaptation.

Bangladesh

Ramana Murthy, M.V., Sri E-mail: mvr@icmam.gov.in

Positions:
- Scientist: Coastal Engineering & Development of ICZM Plans, ICMAN – PD, Ministry of Earth Sciences, Chennai, India

Website: http://www.icmam.gov.in/

India

Roode, Niels E-mail: niels.roode@rws.nl

Positions:
- Technical Manager: project FLORIS, Centre for Water Management, Ministry V&W, 2010 - ;
- Policy adviser: Coastal management, Ministry of V&W, the Netherlands 2005- ;
- Project Manager : EU project Safecoast, RIKZ/Ministry V&W, 2005-2008.

Fields of interest:
ICZM: integrated planning and sustainable development; Coastal dynamics: physical, socio-economic; Flood risk assessment and management.

The Netherlands

Sadacharan, Dianeetha E-mail: dianeetha.s@gmail.com

Positions:
- Consultant: Coastal and Marine Resources Management;
- Former Senior Project Manager: RIKZ, Ministry V & W, the Netherlands;
- Former Manager: Coastal Resources Planning & Development, CCD, Sri Lanka.

Fields of interest:
ICZM; Curriculum development & training in ICZM and Marine Protected Area management; International and regional cooperation.

The Netherlands - Sri Lanka

Salman, Albert H.P.M. E-mail: admin@eucc.net

Positions:
- Secretary: Foundation Dolphin Fund, Leiden, the Netherlands, 2007 – ;
- Secretary: EECONET Action Fund (EAF), 1995 – ;
- Director: Coastal & Marine Union – EUCC , 1992 - .

Fields of interest:
Integrated Coastal Zone Management (ICZM, ICM); Coastal ecology; Sustainable tourism development policies.

The Netherlands

Salwa, Ibrahim E-mail: bramsalwa@yahoo.com

Positions:
- PhD Student: Coastal Engineering, University Technology Malaysia, 2009 - ;
- Consultant Coastal Engineer: Nanggroe Aceh Darussalam, Indonesia, 2006 – 2008;
- Hydraulic Engineer: Nanggroe Aceh Darussalam, Indonesia, 2000 – 2006.

Fields of interest:
Coastal Engineering; River Engineering; Drainage.

Indonesia

Schaefer-Preuss , Ursula E-mail: uspreuss@adb.org

Positions:

Vice-President for Knowledge Management and Sustainable Development, Asian Development Bank, Manila, Philippines

Website: www.adb.org

Philippines

Schiereck, Gerrit Jan E-mail: G.J.Schiereck@tudelft.nl

Positions:

Senior Staff Member: Coastal Engineering, Delft University of Technology, the Netherlands

The Netherlands

Scholten, Henk J. E-mail: Henk.Scholten@geodan.nl

Positions:
- CEO: Geodan Holding, Amsterdam, the Netherlands;
- Professor: Free University Amsterdam, the Netherlands;
- Scientific Director: the SPINlab, Free University Amsterdam.

Fields of interest:
Geospatial Information Science; Disaster Management; Innovation in Information Technology.

The Netherlands

Schutter, Joop de E-mail: j.deschutter@unesco-ihe.org

Positions:
- Deputy Director, UNESCO-IHE, Inst. Water Education, Delft, the Netherlands, 2004 -;
- General Manager: Resource Analysis Consultants;
- General Manager: Ecotec Resource Consultants.

Fields of interest:
Integrated Water Resources Management; Integrated Coastal Zone Management; Strategic Environmental Impact Assessment.

The Netherlands

Snoeren, Birgit E-mail: Birgit.Snoeren@ec.europa.eu

Positions:
- Policy officer: Coastal Zone Management, DG Environment, European Commission, Brussels, Belgium.

Fields of interest:
Integrated Coastal Zone Management; Adaptation to climate change; EU policy and legislation.


Belgium

Stanica, Adrian E-mail: astanica@geoecomar.ro

Positions:
- Research Director National Institute Marine Geology and Geo-ecology, Romania, 2009 - ;
- Coordinator coastal studies, GeoEcoMar , Romania, 1999 - ;
- Participant in EC, international and nationally research and consultancy ICZM projects.


Romania

Subramaniam, B. R. E-mail: brs@icmam.gov.in

Positions:
- Project Director: Integrated Coastal and Marine Area Management (ICMAM) - Project Directorate, Ministry of Earth Sciences, India.

Fields of interest:
Coastal Zone Management; Marine Pollution ; Marine GIS.

Website : http://www.icmam.gov.in/


India

Tandavanitj, Sanchai E-mail: sanchaitan@gmail.com

Positions:
- Former Co-Director CHARM project,
- Senior Advisor on International Fisheries Affairs, Department of Fisheries, Ministry of Agriculture and Cooperation, Thailand

Fields of interest:
- Coastal Aquaculture; Coastal Zone Management and Community Base Management


Thailand

Thiaw, Ibrahim E-mail: ibrahim.thiaw@unep.org

Positions:
- Director: Division of Environmental Policy Implementation, United Nations Environnement Programme (UNEP), Nairobi, Kenya

Website: www.unep.org/


Kenya

Tran Dinh, Lan E-mail: lantd@imer.ac.vn

Positions:
- Deputy Director: Institute of Marine Environment and Resources (IMER), Vietnamese Academy of Science and Technology, Hai Phong, Vietnam, 2009 - ;
- Head Department, Marine Database and Remote Sensing, IMER/HIO, 1998-2003.

Fields of interest:
Marine GIS and Remote Sensing; Sustainable indicators for marine ecosystems; Coastal environment and resources management.


Vietnam

Vandy, Daniel, M. H. E-mail: info@ecosave.nl

Positions:
- CEO of ECOSAVE International, Biddinghuizen, the Netherlands;
- Chairman of The Environmental House, Biddinghuizen, the Netherlands;
- County Advisor on water saving issues, Flevoland, the Netherlands.

Fields of interest:
Innovation, production and sales of water saving and purifying products; Dry sanitation, water saving and wastewater purifying in developing countries


The Netherlands

Varga, Ana Lucia E-mail: www.luciavarga.ro

Positions:
- Member of the Romanian Parliament, 2009-
- Secretary of State, Romanian Ministry of Environment and Sustainable Development, '04-08,
- Chair of the Romanian National ICZM Committee, Bucharest, Romania, '04-2008.

Website: www.luciavarga.ro


Romania

Vellinga, Pier E-mail: Pier.vellinga@wur.nl

Positions:
- Prof.: Environmental Sciences & Climate Change, Wageningen University Research Center, 2007 -
- Professor: Institute for Environmental Studies (IVM), Free University, Amsterdam, 1997 - ;
- Advisor, Netherlands Minister of Environment on Climate Change, the Netherlands 1987.

Fields of interest:
Delta cooperation : http://www.delta-alliance.org/nl/25222734-Home.html


The Netherlands

Sommen, Jeroen, van der E-mail: info@nwp.nl

Positions:
- Director: Netherlands Water Partnership, The Hague, the Netherlands

Website: www.nwp.nl/en/


The Netherlands

Stive, Marcel E-mail: m.j.f.stive@tudelft.nl

Positions:
- Professor and chair Coastal Engineering, Delft University of Technology;
- Director: Water Research Centre Delft, the Netherlands;
- Member of Second Delta State Committee, the Netherlands.

Fields of interest: Knowledge management Biogeomorphology, Large scale coastal evolution; Nearshore morphodynamics; Field experiments, Surf zone hydrodynamics.


The Netherlands

Taal, Marcel E-mail: marcel.taal@deltares.nl

Positions:
- Project Manager Estuarine management: Deltares, Delft , the Netherlands, 2008-present;
- Project Manager Coastline management: Ministry V&W , Netherlands, 2005-2007;
- ICZM Consultant, 1996-2005.

Fields of interest: ICZM: integrated planning, institutional aspects; Coastal and estuarine dynamics: morphology, ecology, institutional aspects; Visualisation techniques for decision making.


The Netherlands

Thi The Nguyen, Nguyen E-mail: anguyen.n.t@wru.edu.vn

Positions:
- Lecturer CZM: Fac. Coastal & Maritime Eng, Water Resource University (WRU), Hanoi, Vm, 2004 – ;
- Lecturer Water Quality & Environment: Fac. of Hydrology & Environment, WRU,1998-2004;
- MSc researcher: Water quality TTHue lagoon, UNESCO-IHE, Delft , the Netherlands., 2003 - 04

Fields of interest:
Integrated Coastal Zone Management/Planning; Water quality and environment; Water quality and environment modelling.


Vietnam

Ton That, Phap, E-mail: cmdhus@gmail.com

Positions:
Associate Professor, Department of Biology, Hue University of Sciences, 27 Nguyen Sue St., Hue City, Thua Thien Hue Province Viet Nam


Vietnam

Vahtar, Marta E-mail: marta.vahtar@guest.arnes.si

Positions:
- Project manager: Institute of Sanitary Engineering, University of Ljubljana, Slovenia, 1996- ;
- Managing Director: Institute Integral Development and Environment, Domzale, Slovenia, 1995- .

Fields of interest:
Ecological planning & Environmental assessment; Ecological and cultural tourism; Integrated spatial planning and design simulation.


Slovenia

Vanhout, Roel E-mail: rvanhout@riks.nl

Positions:
- Software Engineer, RIKS, Maastricht, the Netherlands.

Fields of interest:
High performance and distributed computing; User interface solutions for science & policy communication in software; Policy assessment with quantitative systems.


The Netherlands

Veerman, Cees

Positions:
- Chairman of the Second Delta State Committee, 2008;
- Chairman of the largest Dutch NGO: Nature Monuments, 2007 - ;
- Minister of Agriculture, Nature and Food Quality, 2002 – 2007.

Website: www.deltacommissie.com/en/advies


The Netherlands

Verhagen, Henk Jan E-mail: H.J.Verhagen@tudelft.nl

Positions:
- Assistant professor, shoreline protection & CZM, Delft University of Technology, 2000–;
- Unesco-IHE, CZM & Coastal Engineering program, Delft, the Netherlands 1991 - 2000;
- Project managers, Rijkswaterstaat, Ministry V & W, the Netherlands.

Fields of interest:
Coastal protection works (revetments, breakwaters); Decision making processes and policy analysis; Hydraulic aspects of climate change.


The Netherlands

Vrees, Leo de E-mail: leodevrees@gmail.com

Positions:
- Senior expert, Marine Unit, DG Environment, European Commission, Brussels, 2010 -
- Water Manager North Sea, Neth. Min. Transport, Public Works, Water Man. 2003- 2010
- Senior expert, GPA - UNEP, the Hague , the Netherlands, 1998-2001

Fields of interest:
Management of marine natural resources, Integrated management plans for marine areas; ICZM

The Netherlands

Vries, Mindert de E-mail: mindert.devries@deltares.nl

Positions:
- Lector Eco-Engineering, Hogeschool Zeeland, the Netherlands, current position;
- Senior Advisor: Eco system functioning, Deltares, the Netherlands, current position;
- Researcher, University of Twente, the Netherlands.

Fields of interest:
Eco- Engineering; Solutions for safety against flooding; Combining ecology with civil engineering; ICZM.

The Netherlands

Vu Minh, Cat E-mail: vuminhcat@wru.edu.vn

Positions:
- Prof. & Dean: Fac. Marine & Coastal Engineering, Water Resources University (WRU), '05 –;
- Coordinator Project Upgrading training Capacity Coastal Engineering, WRU 2001 – 2009;
- Director International and Scientific Department, WRU, Hanoi, Vietnam ,1996 – 2005.

Fields of interest:
Hydrodynamic Simulation; ICZM: integrated planning and sustainable development; Coastal Civil Engineering.

Vietnam

Waterman, Ronald E. E-mail: re.waterman@statenzh.nl

Positions:
- Member of Parliament the Province of South-Holland, the Netherlands;
- Senior adviser: Neth. Ministry of Transport, Public Works & Water Management;
- Senior adviser: Deltares, Port of Rotterdam, Netherlands Water Partnership.

Fields of interest:
Integrated Multifunctional Sustainable Coastal Zone Development; Co-founder of the "Building with Nature" method; Active application in 38 countries, with vulnerable densely populated coastal areas

The Netherlands

Werners, Saskia Elisabeth E-mail: saskia.werners@wur.nl

Positions:
- Researcher: IWM & Climate Adaptation, Wageningen University, the Netherlands;
- Policy Advisor, Global Environmental Policy Div., Min. Spatial Planning & Environment, the Netherlands

Fields of interest: Climate change & variability, and policy analysis in Europe, Asia and the Americas; European research projects on adaptation to climate change - www.adamproject.eu and adaptive watermanagement - www.newater.info

The Netherlands

Winchester, Peter John E-mail: winchesterpeter@yahoo.com

Positions:
- Founder & Chairman: reg. charity Divi Seema Foundation, Krishna Delta, AP, 1997-;
- Disaster Management: Krishna Delta & Flood Hazard Res. Centre, Middlesex Univ., '81–'02;
- Architect: Sussex University, Nottingham UK and Abuja (Nigeria) 1958-1981;

Fields of interest:
Social housing; Socio economic processes; History

India

Wu, James E-mail: james.wu@dhv.com

Positions:
- Vice General Manager: DHV Engineering Consultancy, Shanghai, China

Fields of interest: Integrated Urban Development

Website: http://www.dhv.cn/ud1.htm

China

Yin, Ping E-mail: pingyin@fio.org.cn

Positions:
- Prof: Qingdao Institute of Marine Geology/China Geological Survey, 2006 -
- Researcher: First Institute Oceanography/State Oceanic Adm., China, 1995 - 2006
- Postdoctoral fellowship: Brest Centre of IFREMER, 2001 – 2002.

Fields of interest:
Climate changes and coastal processes, coastal monitoring and geo-hazards; coastal processes, geomorphology, coastal management; continental shelf Sedimentology

China

Zetten, Rien van E-mail: rien.van.zetten@rws.nl

Positions:
- Senior project manager: Centre for Water Management, Rijkswaterstaat, 2006 – ;
- Former head North Sea Department: RIKZ/Rijkswaterstaat, 1997 – 2004;

Fields of interest:
Large scale projects on ports & water improvement, ICZM, Adaptation to impacts of climate change.

The Netherlands

Zheng Bing, Wang E-mail: zheng.wang@deltares.nl

Positions:
- Expert and advisor hydrodynamics, Deltares, Delft , the Netherlands;
- Associate Professor: Delft University of Technology, Fac. Civil Engineering and Geosciences,

Fields of interest:
Coastal, River and Estuary dynamics: hydrodynamics, sediment transport & morphology, salt intrusion

The Netherlands

Zwol, Carien van E-mail: carien.van.zwol@minvenw.nl

Positions:
- Senior policy advisor: Director General Water, Min. V& W, the Netherlands, 2006-
- Senior project manager: the National Institute for Coastal and Marine Management (RIKZ)/Rijkswaterstaat/Ministry V&W, the Netherlands.

Fields of interest:
Marine Protected Areas; Coastal Zone Management; River Basin Management

The Netherlands

Atsma, Joop

Positions:
- State Secretary, Ministry of Infrastructure and the Environment The Hague, the Netherlands

Website: www.ministryofinfrastructureandtheenvironment.nl/

The Netherlands

Acknowledgements

Producing the CCC Book and Internet edition was a valuable experience and it marked the end of the international CZM-Centre (1993 – 2006) era.

Just at the last moment, in 2006, Richard Jorissen, Director of the National Institute of Coastal and Marine Management - RIKZ/Rijkswaterstaat/Ministry of Transport, Public Works and Water Management (I&E), The Hague, trusted this production to me as an 'Exit Strategy'!

Marcel Stive, Professor Delft University of Technology, deserves much thanks for his contributions to and timely support of the CCC production.

The financial support of the Ministry of Infrastructure and Environment (former Ministry of Transport, Public Works and Water Management) and of the Delft University of Technology is very much appreciated.

Writing together with 100 authors is fun. It took, however, more time than anticipated in the beginning….it was good that I was pensioned. I would like to thank all the 100 authors for their active participation and the time spent for this endeavour. I hope that this collaborative production will contribute to increased communication in the planning and implementation of coastal sustainable development programmes.
Special thanks are due for the warm hearted hospitality received during the numerous missions to the participating coastal countries.

Especially during the last two years of the production, I was totally absorbed and realised that I should have spent more time with my dear wife Fanny, who happily enough continued to care about me. I am very grateful for her understanding and I will make it up to her in the near future!

And that promise holds also for my children and my beloved grandchildren. I always wonder at a strange coincidence: the day my granddaughter was born together with 350,000 other new-borns on this world, 220,000 persons drowned in the 26th of December 2004 Tsunami waves.

Ir. A.B.M. (Seen) van der Plas, former Permanent Secretary of the Ministry I&E, has stood near me during the last years, provided me with much appreciated advices and stimulated the process in a realistic way.

Hugo Niesing, liaised between me, Rijkswaterstaat and the publisher in a very effective way. In critical moments, and there were some, he found innovative and much appreciated solutions to move forwards.

The relentless efforts of Moniek Loffler, structuring and editing the first drafts into readable chapters in a meticulous way, are highly esteemed.

Gerrit Baarse contributed to the concluding and synthesising chapters, overlooking the fields of action and highlighting the essentials, leading to a call for recommendations; thank you so much.

Pat Doody took the task of English correction and editing of all the contributions of the Book and Internet publication very seriously. Thank you Pat for all your efforts, which were more than anticipated.

Eli Birnbaum, Lisette van Hulst and Alan Pickaver: your help with the English translation and correction of bits and pieces, in the beginning, in between and at short notice, was appreciated.

EUCC, dauntlessly directed by Albert Salman, took on the task of publishing the CCC Book and the Internet edition, in a not so simple setting. Thank you Albert and the four Ma's: Malou Alkemade, Maria Ferreira, Marjolein de Lange, and Marijke Kooijman for executing this challenge in such a positive way.

Rob Bijnsdorp, is due thanks for facilitating the very start of the CCC production process.

Rob Leewis, having written and produced many books during the last years, is thanked for his valuable advices in a period I needed them dearly.

Nico Bakker, Dutch Ministries of I&E and Foreign Affairs, is gratefully acknowledged for his enthusiastic support during the execution of water and coastal programmes in India and Vietnam.

René van der Plas, Port of Rotterdam, deserves thanks for his remarks improving the Rotterdam chapter.

I would like to thank all my colleagues of the CZM-Centre and the RIKZ, with whom I worked together with much pleasure for so many years in a fascinating fields of applied coastal research and policy preparation. I would like to mention just a few: Jan Al, Job Dronkers, Tjark van Heuvel, Niels Roode, Joost Stronkhorst, Jan Visser, Kees Wulffraat, thank you for the supporting and encouraging words.
Luitzen Bijlsma, former RIKZ Director, founding father of the CZM-Centre and Lead Author of the IPPC-Chapter on Coasts (1995) enthusiastically supported the applications of ICZM programmes in vulnerable low-lying coastal countries around the world. Thanks for his support of this CCC publication.

Jo-Ann Snel, you have a very special feeling for book and internet lay-out. It is fascinating to see you meticulously and precisely working and moreover to see the wonderful, balanced results. Thank you for the lay-out of the CCC Book.

Harry van Reeken, Peter van Elk and Andre Akkerman, colleagues for more than a quarter of century, thank you for all the efforts to refit the illustrations, for the sharp observations and remarks regarding the lay-out of the book and the illustrations, helping to make the many different constituents to a book.

Andre Akkerman designed, a long time ago, the logo of the World Coastal Conference -1993 symbolising the integration of interacting spheres embracing mother Earth. After the WCC we continued to use 'your' logo as the CZM-Centre logo.
Andre unfortunately passed away at a young age in August 2010.
We appreciated his artistic and enthusiastic input, and hope that his valuable contribution, together with all others, will lead to a more sustainable, long term approach to coastal zones around the world.

Logo of the World Coast Conference 1993 and the CZM-Centre (1993-2006)

Support is received from:

This book should be cited as:
Misdorp, Robbert (editor), 2011: Climate of Coastal Cooperation, 208 pages

Publisher: Coastal & Marine Union - EUCC (Leiden, the Netherlands), www.eucc.net
Webmaster: Erik Devilee, Coastal & Marine Union - EUCC

ISBN number: 978-90-75502-09-1

CCC Project management: Robbert Misdorp and Albert Salman, Coastal & Marine Union - EUCC
Production Supervision: Hugo Niesing, Ministry of Infrastructure and the Environment (Min. I&E), Rijkswaterstaat, Lelystad, the Netherlands
Project assistance: Marijke Kooijman, Malou Alkemade and Marjolein de Lange, Coastal & Marine Union - EUCC
English editing: Pat Doody, National Coastal Consultants, Huntingdon, United Kingdom
Editing assistance: Moniek Löffler, Bureau Landwijzer, the Netherlands, www.landwijzer.nl
General Lay-out: Jo-Ann Snel, OpHonk Design, Barneveld, the Netherlands, www.boekenbent.com
Lay-out illustrations: Harry van Reeken, Min. I&E, Rijkswaterstaat - Centre for Water Management, Lelystad, the Netherlands
Lay-out advisors: Peter van Elk, Dick Brouwer, Min. I&E, Rijkswaterstaat - Corporate Dienst, Utrecht, the Netherlands
Cover design : Harry van Reeken
Cover photos: Robbert Misdorp and beeldbank.rws.nl / Rijkswaterstaat

Printed by: Boekenbent, www.boekenbent.com

Financial Support: - Ministry of Infrastructure and the Environment/ former Ministry of Transport, Public Works andWater Management, Rijkswaterstaat, Centre for Water Management, The Hague, the Netherlands;
- Delft University of Technology, Delft, the Netherlands.

The CCC publication serves an educational, awareness raising and non-commercial purpose. The CCC Books are not for sale, but available at (postage and handling) cost from the publisher at admin@eucc.net

The CCC Book and its extended version are also available on the website www.coastalcooperation.net

This book is printed on FSC paper.

The CCC Book is produced by: