# 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.