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Work Package 6 Deliverable D6.2

Visualization of Coastal Areas using Coastal Transects Analysis Model (CTAM)

Ratana Chuenpagdee, Javier Bello Pineda & Kungwan Juntarashote
Coastal Development Centre, Bangkok, Thailand
Robert C. Kay
International Governance Solutions, Ltd., UK.
Graham J. Pierce, Cristina Pita & Jianjun Wang
University of Aberdeen, Aberdeen, UK

In collaboration with:

Rachel Atanacio and Christian Elloran
WorldFish Centre, Los Banos, Philippines

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Preface and acknowledgments

This report is prepared to accompany the second deliverable of Work package 6 (WP6), the Coastal Transects Analysis Model (CTAM). CTAM is a simple *on-line* tool developed to assist coastal practitioners, coastal planners, policy makers and other stakeholders, including resource users, in addressing present and future demands in coastal areas. The first phase of CTAM enables users to communicate and gain common understanding about their coastal areas, using visually attractive image showing key features of the coast. Input data about coastal areas will then be stored and analyzed using agglomerative hierarchical cluster analysis to classify coastal areas into coastal transects (CT) types. Users will then be able to check location of other coastal areas around the world that share similar features (i.e., are of the same CT type). In the future development of CTAM (CTAM Phase II), detailed information about ecosystems (e.g., size of mangrove areas and coral reefs), fisheries and fishing activities (e.g., catch and main species, number of fishers and boats), values from fisheries and labor migration and gender contribution will be required for selected coastal areas representing common CT types. This information will be used to determine the scale and directions of three key flows, i.e., biomass, cash and labor, associated with each CT type. Finally, management scenarios will be incorporated as part of a decision-making process that will be included in the final version of CTAM, which will be ready for testing in May 2007.

We are truly grateful to Eli Agbayani and Josephine Rius-Barile for their inputs and assistance in the development of CTAM Phase I. Thanks also to Rainer Froese for his comments and support. We appreciate the support of Charlotta Jarnmark, Nicolas Bailey and Silvia Opitz which makes this work possible. Finally, we thank Daniel Pauly for inspiring the ‘coastal transects’ concept whereby CTAM is based upon.

Abstract

With about 40% of the world population living in coastal areas, it is not surprising that management of these areas faces many challenges. The task is further complicated by the range of diversity, complexity, dynamics and scale of natural and human systems and their interactions that characterize coastal areas. There is a tendency thus to develop sophisticated, technology-based tools and complex decision-making models for integrated coastal management that capture all. While these tools and approaches are useful, they usually demand large amount of information and expertise, as well as advanced hardware and software, which may not be available, particularly in developing countries. A simple, accessible and user-friendly tool is required. It is with this premise that 'Coastal Transects Analysis Model' (CTAM) is developed. CTAM is an on-line visualization and decision-making tool aiming to assist stakeholders, particularly policy makers, coastal planners and practitioners, in addressing present and future demands in coastal areas. Following a 'transect walk' method often used in rapid appraisal of rural areas, CTAM divides a coastal area into transects from upland to offshore. For each transect, physical, biological, anthropological and governance features are illustrated using symbols and texts. This report describes the first phase of CTAM development and illustrates its potential usefulness for integrated coastal management.

1. Introduction

Coastal zones are one of the most challenging resource systems for management, given their scale, diversity, complexity and dynamics. Related to scale, coastal zones may include a strip of land area of a certain width along the coast and coastal water up to a certain depth of a distance from shore. Coastal boundary may also cover a very large area that includes entire inland watersheds (e.g. hundreds of kilometers landward from shore) and extends seaward to the Exclusive Economic Zones. Coastal zones are sometimes defined based on jurisdiction of a management agency, suggesting that governance scale is used as criteria.

Diversity in coastal areas is observed in the range of physical features characterizing the coasts, habitats and resource systems, and various anthropogenic activities taken place in the areas. For example, some coastal areas are characterized by physical features or shapes, such as beach, cliff, estuary, delta, lagoon, fjord, etc. They can also vary depending on types of habitats, e.g. forests, grass, salt marsh, mangroves, coral reefs, seagrass, kelp and deep sea corals. Finally, a wide range of activities can occur in coastal areas, including logging, agriculture, livestock, fishing, aquaculture, tourism, marine, oil and gas exploration and marine transportation. These multiple coastal stakeholders are also diversified by various characteristics, such as size and nature of operation (e.g. small-scale vs. large-scale fishers), gender, ethnic and culture.

Interactions within humans and coastal ecosystems and between these systems create complexity in the coastal areas, particularly since these interactions are most likely conflicting, not complementing. Coastal development that attracts urban and industrial settlement and tourism may result in degradation of coastal areas and changes in access to the sea, affecting thus livelihoods of coastal communities, particularly those involved in traditional small-scale fishing and reef gleaning. For all types of coastal resource systems, complexity figures prominently in ecological, social, economic and governance perspectives.

The diverse ecosystems, the wide range of activities, and the continuing flux of people to settle on the coast induce changes and alteration to coastal zones, creating high dynamic system. Changes to coastal zones can be permanent or semi-permanent such as building breakwaters and seawalls to provide storm protection and construction of roads and other infrastructure. Others are more dynamic and fluctuate with market incentives, but with irreversible and lasting impacts. Two examples in Gulf of Thailand are the introduction of trawlers that resulted in ‘fishing down the food web’ (Pauly and Chuenpagdee 2003) and the ‘boom and bust’ of intensive shrimp farming industry (for giant tiger prawn, *Penaeus monodon*) in the early 1990s that involved clear-cutting of large mangrove forests (Patmasiriwat et al. 1999).

Management concepts and principles known as integrated coastal zone management (ICZM), integrated coastal management (ICM) or sometimes referred to simply as integrated management (IM) have been developed to deal with diversity, complexity, dynamics and scale of coastal natural and human systems (see Cicin-Sain and Knecht 1998; Visser, 2004; Kay and Alder 2005). These concepts aim similarly to develop and implement integrative and coordinated management plans taken into account ecological, economic and social considerations using holistic, interactive, iterative and transparent processes. Combinations of tools and approaches used in coastal management include technical tools such as remote sensing and Geographic Information System (GIS), assessment tools for environmental and social impacts, economic tools such as valuation, legislative and policy tools, social, community-based and stakeholder engagement tools. The latter, as described in Kay *et al.* (2006), involves uses of a range of simple visual aids to advanced computer-assisted visualisation tools.

The advancement in GIS technology and computer software leads to a general tendency to develop sophisticated, technologically-based tools and spatial decision-making models for ICM, based on the premise that the more complicated the tools, the better they are to address complex issues in coastal areas. Virtually, these tools are developed to closely resemble reality and are considered useful in facilitating communication and discussion with coastal stakeholders. Unfortunately, they often require large sets of data and costly software development, resulting thus in limitations of use and application, particularly in data-sparse and resource-poor situations. In other words, such tools may be applicable in some developed countries but are of limited uses elsewhere. A simple, accessible and user-friendly tool with wide-ranging applications is required.

In 1992, Pauly and Lightfoot developed a concept that involved cross-section analysis of coastal areas. The 'coastal transect' analysis takes into consideration flows and interconnectivity of resources and activities that occur in each cross-section of a coastline from upland areas to offshore. This simple representation is the inspiration for the development of 'Coastal Transects Analysis Model' (or CTAM) as an on-line visualization and communication tool that can be used, first and foremost, to compare different coastal systems around the world, enhancing and standardising thus our understanding about coastal areas. Secondly, it offers coastal practitioners and managers an interactive decision-making and learning tool that enables discussion about coastal zone issues, such as trade-offs and integration of multiple demands, with a range of stakeholders.

The biggest challenge in developing a tool such as CTAM is to find a balance between optimal data requirement and useful interpretation. A 'tier system' for data requirement is therefore applied to enable its use with the simplest set of information to the most advanced. This report is the description of the first phase of CTAM development, where minimum data is required. It also illustrates the usefulness of CTAM as ICM tool once it is fully developed. In the following, we provide a summary of theoretical background for CTAM, description about model development and data analysis. We then conclude with an explanation about next steps in the development of CTAM.

2. Theoretical background

Management of coastal areas focuses largely on integration. There are at least six different kinds of integration that are important to consider in ICM. *Horizontal* integration deals with different economic sectors (e.g. fisheries, tourism and forestry) and the associated units of government operating at the same level of management, while *vertical* integration is concerned with coordination at all levels of governance, including non-governmental organizations. *Spatial* integration addresses cross-cutting problems related to physical and administrative boundaries, while *temporal* integration considers issues of lag-times, including concerns for future generations. Finally, ICM involves integration of scientific *disciplines* and *approaches* in all phases of development.

Most ICM frameworks reflect the need for integration, although with varying focus. One of the well-known models is based on the 'Pressure-State-Impact-Response' (P-S-I-R) framework developed by Land-Ocean Interactions in the Coastal Zone (LOICZ) Project of the International Geosphere-Biosphere Programme. P-S-I-R framework lies on a basis that for any given coastal area, there exist spatial distribution of socio-economic activities and related land uses, which serve as drivers to coastal systems, creating environmental pressures and changes in environmental state, measured largely in terms of nutrient and sediment fluxes (Turner *et al.* 1988). These environmental changes result in changes in process and functions of ecosystems and have consequential impacts on social welfare, including health, amenity and values, triggering thus management actions and responses, directed mainly at controlling pressures (e.g. population growth, urbanization). Overall, P-S-I-R is an analytical framework that integrates spatial distribution of socio-economic activities and biophysical considerations in order to provide information about future environmental states and inform policies.

Another ICM model that is gaining popularity is based on an ‘expert-based’ approach. Spatial Decision Support System (SDSS) is one such approach that combines GIS with multi-criteria analysis (MCA). It is an iterative and interactive process that draws upon expert knowledge in providing alternative solutions to a decision problem. Use of GIS allows handling and analysing of complex, dynamic and spatial nature of coastal systems, while MCA enables evaluation of alternatives according to a set of criteria (Fabbri 1998; Bello 2004). The basic requirements of this model are the GIS software and the experts with knowledge on both coastal issues and GIS.

Similar to SDSS, SimCoast™ is developed using a combination of fuzzy logic, a rule-based expert system and issue analysis to address ICM issues (Hogarth and McGlade 1998). It is a powerful tool that can be used to identify dominant processes and issues that have significant impacts on coastal environment. Taking into consideration natural, social and economic elements, SimCoast™ offers an interdisciplinary decision-making framework for weighting of impacts of various coastal activities based on a set of goals and targets. Inspired also by Pauly and Lightfoot (1992), results of impact assessment in SimCoast™ are presented as a 2-dimensional transect.

Despite the attempt to enable users from different sectors and countries to find key words, determine inferences and derive new information, SimCoast™ has been developed as a ‘soft intelligence’ system where demands for data and expert knowledge are generally high. Further, the software and information generated through several user workshops conducted in the early phase of the project are no longer available in the public domain. While it is likely that SimCoast™ remains very useful for ICM, it faces similar challenges that other sophisticated, computer-assisted software face related to data requirement and accessibility for coastal practitioners in developing countries.

SimCoast™ provides a good starting point for the development of CTAM. The ultimate goal of CTAM is similar to SimCoast™ which is to benefit users worldwide in the exchange of knowledge and information concerning issues and problems pertinent to coastal zone. The main differences in CTAM are the simplification of software that relies modestly on quantitative data and computation, the use of phase development where inputs from users are critical to the process, and the communication and learning focus of the tool. As described in the following sections, the complete development of CTAM software depends to a large extent on information provided by users CTAM Phase I. Yet, even at this early phase, CTAM serves as a visualization tool that facilitates common understanding and generates discussion about coastal zones.

3. Model development

Development of CTAM requires several steps. Prior to software development, three independent exercises were conducted. First, a questionnaire was designed and tested with selected coastal colleagues to determine the appropriate type and amount of information required from users. Secondly, an 'Analytic Hierarchy Process' (AHP) was performed among WP6 members using multi-criteria decision support software Expert Choice^{TM} to provide ranking of priorities and importance of a range of variables (see details in Bello 2004). Third, existing coastal classification systems was reviewed to provide some guidance about inclusion of grouping and choices. The key classified systems relevant to CTAM are coastal land cover (Clemas *et al*. 1993), coastal geomorphological properties (Finkl 2004), shorelines (Boak and Turner 2005) and marine habitats and coral reefs (Mumby and Harborne 1999). Information from these three sources is used as a basis to develop the final online user survey (Step 1, Figure 1).

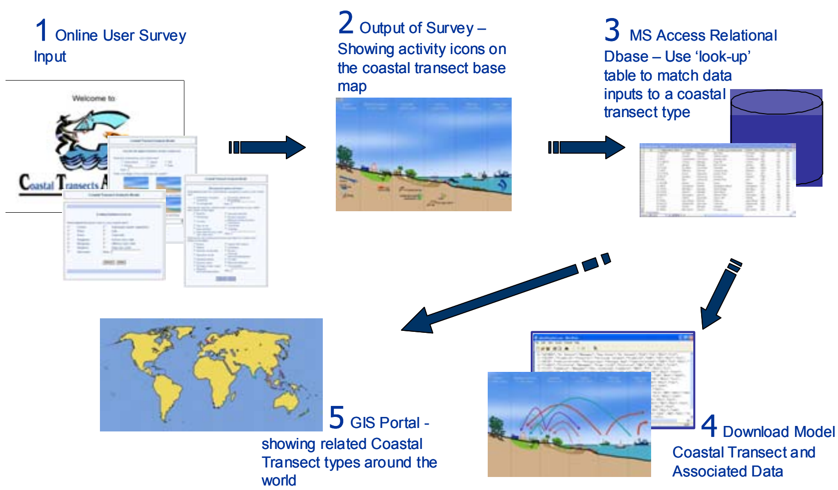

Figure 1 Flow diagram showing various steps in CTAM development

Web interface and delivery specifications (Appendix 1) were prepared to guide software development up to Step 2 of Figure 1.

In the first phase of development, CTAM describes coastal areas from upland to deep-sea by cross-sections in terms of physical structures, habitats, resources and activities. Consequently, only descriptive information about a coastal area is required. For example, users are asked to provide information about coastal shape and slope and to indicate habitat types, existing resources and activities. To ensure that users maintain their interest throughout the model, 'rewards' are given at the click of 'next' button at the bottom of each page in the form of 'images'. Users will be able to see how their coastal transect (CT) is built with information that they provide. They will also be allowed to revise their input as often as they like without losing information they have already entered. Finally, users can choose to print a report summarizing the description of their coastal areas and the final image of their CT. Before leaving the software, users are asked to provide comments as well as to indicate whether they would like to be informed of the new development of CTAM (see details in http://www.incofish.org/CTAM/default.htm).

4. Data analysis

The current version of CTAM Phase I will be revised once sufficient data has been entered by users. Cluster analysis will be performed to classify described coastal areas into specific CT types (Step 3, Figure 1).

Classification of CTAMs will be done using an agglomerative hierarchical cluster analysis which includes the use of the Gower general similarity coefficient (GGSc) and the weighted pair group average method (Digby and Kempton 1987; Legendre and Legendre 1983). GGSc is chosen to calculate similarity among described coastal areas since it allows combining binary, multi-state and quantitative data in the analysis. Similarity matrix will be produced as a result of the GGSc test. The weighted pair group average method is selected because data are anticipated to vary in cluster size (e.g., some cluster will be much smaller than others).

A test analysis was performed based on information about 35 coastal areas collected during the testing of electronic questionnaires and from existing literature, as well as some arbitrary cases to provide variation in data. Data were grouped into three types of variables, i.e. (1) physical features, including geomorphology, type of sediments, terrain and seabed slopes, influence from oceanographic conditions (frontal systems and upwelling), (2) habitats, including terrestrial and submerged habitats, and (3) human uses and activities taken place in the coastal zone.

Figure 2 displays the dendrogram resulting from the cluster analysis, which shows that seven major classes of coastal areas (CT type) can be discriminated at similarities of 40 – 50 %. A posterior analysis of raw data of the cases grouped in each cluster was used to find out what variables were the most important in defining those classes and to assign a label to them as shown in Table 1.

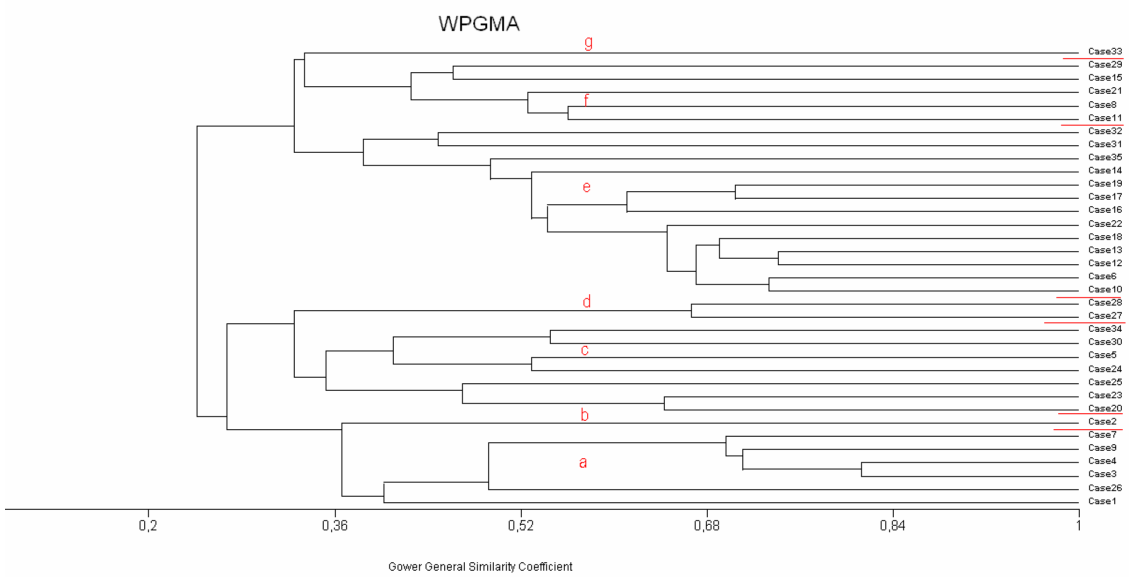

Figure 2 Dendrogram showing seven major types of CTs

Table 1 Label and description assigned to each CT type.

Type	Label	Description
a	Tropical estuary with medium human use	Tropical shallow estuarine system with presence of mangrove, seagrass, submerged aquatic vegetations (SAV) and coral reefs, medium human use, small- and large-scale fisheries and fish processing facilities
b	Temperate estuary with low human use	Temperate shallow muddy estuary with SAV, low human use, agriculture, small-scale fisheries and fish processing facilities
c	Tropical beaches with low human use	Tropical sandy or mixed shallow beaches with influence of upwelling or frontal system with seagrass, SAV, low human use, and small- and large-scale fisheries
d	Temperate beaches with high human use	Temperate mixed beaches with salt marshes, high human use and small- and large-scale fisheries
e	Tropical estuary with high human use	Tropical muddy estuary shallow with river or upwelling influence, with salt marshes and mangroves, high human use and small- and large-scale fisheries
f	Tropical cliffs with high human use	Tropical steep rocky cliff with upwelling influence, SAV and rocky reefs high human use and small- and large-scale fisheries
g	Temperate fjord with high human use	Temperate steep fjord frontal system and river influence with slat marsh, SAV, deep sea corals with high human use and small- and large-scale fisheries

This cluster analysis will be periodically performed as data are obtained through online user survey, and CT classification will be identified until clusters are stable. Once CT type is identified, the coastal area that the user describes will appear as a dot on a world map, which also contains locations of other identified CTs (Step 5, Figure 1). Users will be able to compare their coastal areas with others around the world. More importantly, users can continue to use CTAM Phase II even if they do not have detailed information about their coastal areas by selecting a prototype model with the same CT type.

5. Future development

In the second phase of development, CTAM relates natural and human systems with arrows indicating flows of biomass, cash and labour. This stage requires qualitative and quantitative information about the described coastal area such as size of mangrove forests, health of coral reefs, number of small-scale fishers, catch by species, landing values, labour migration pattern, etc. Data will be drawn also from other Work Packages of INCOFISH project, such as WP4 (Ecosystem Modelling) and WP8 (Ecosystem Valuation). To the extent possible, linkages will be made to FishBase (www.fishbase.org) and *Sea Around Us* Project (www.seaaroundus.org) in order to extract existing information. As in the previous phase, a user questionnaire will be designed (modified from the one used to develop CTAM Phase I) and tested in order to provide appropriate specification for software development. The result of CTAM Phase II will be arrows showing flows of biomass, cash and labour (Step 4, Figure 1).

At the final stage of development, greater details about fisheries and coastal ecosystems, including governance system, management measures and issues, will be required. The aim of this phase will be to assist policy-makers, coastal practitioners, resource users and other stakeholders in understanding the interconnectedness between coastal ecosystems and human activities through policy exploration and decision-making process. Management scenarios will be developed based on common issues submitted by users. A few coastal sites will be selected to test CTAM in its final phase. Preferably, these will include sites in the four large marine ecosystems (LMEs) identified as key areas for INCOFISH project, i.e. Gulf of Thailand, Benguela Current, Gulf of Californai and North Sea. Different approaches will be employed in this step, such as expert choice exercise, focused group discussion and stakeholder workshops. As before, users with limited information can still benefit from learning about ICM through selection of appropriate prototypes.

Model testing and modification will be an important part of the development process. In all phases of development, the ethos for CTAM is to keep it simple, user-friendly and applicable particularly in data-sparse situations. For example, description of CT using 2.5 dimensional pictures, for better illustration of the three flows, will be explored, but within the limit that the software is still easily accessible online by users in developing countries. The final version of CTAM developed within the project phase will also be made available as a CD-ROM and distributed widely to coastal practitioners whose access to Internet is limited.

6. Conclusion

A need for a simple, user-friendly, on-line visualization tool like CTAM is acknowledged as an alternative to sophisticated, computer-assisted, data-driven software currently available for integrated coastal management. CTAM is developed based on the ‘coastal transects’ concept proposed by Pauly and Lightfoot in 1992, and benefited from the early model called SimCoast™ that was based on the same concept. Development of CTAM is an iterative process and it is deliberately designed to use as both a communication and data gathering tool. Independent data gathering process is taking place along side data collection through online users of CTAM to ensure sufficient data for the cluster analysis that will be performed to classify coastal areas into different coastal transect types. The next steps in CTAM development require gathering of detailed information about fisheries and main coastal activities in order to reflect the interconnectedness of human and resource systems using three main flows (biomass, cash and labor). Ultimately, CTAM software will be available as a decision-making tool to help coastal practitioners address issues concerning multiple demands in coastal zones.

The launching of CTAM Phase I at the Coastal Zone Asia-Pacific Conference (CZAP06) in Batam, Indonesia on August 29, 2006 generated interests and discussion among more than 200 coastal practitioners and scientists from several developing countries in Asia-Pacific participated at the conference. This suggests a potentially high contribution of CTAM to addressing challenges faced in ICM around the world.

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APPENDIX 1:

COASTAL TRANSECT ANALYSIS MODEL
WEB INTERFACE AND WEB DELIVERY SPECIFICATIONS

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1 INTRODUCTION

1.1 PURPOSE

To document the audience requirements and functional specifications of the Coastal Transect Analysis Model (CTAM) web interface and middleware to enable the successful delivery of Work Package Deliverable 6.2.

1.2 INTENDED AUDIENCE

This document is intended for the project developers, project managers, testers, and writers.

1.3 PROJECT SCOPE

INCOFISH (Integrating Multiple Demands on Coastal Zones with Emphasis on Aquatic Ecosystems and Fisheries) is a three-year project supported by the Commission of the European Communities, and involves 35 institutions and private enterprises from 22 nations worldwide (12 European, 12 Latin America, 6 Asian, 5 African). The aim of INCOFISH is to conduct specifically targeted strategic research towards reconciling multiple demands on coastal zones, with special emphasis on developing countries. It will evaluate and integrate data, tools and concepts suitable to contribute to the goals set by the World Summit for Sustainable Development in Johannesburg, such as restoring healthy fish stocks and ecosystems by 2015.

INCOFISH will focus its research activities on issues in Integrated Coastal Zone Management (ICZM) as follows. It will:

(a) Document historical performance of ecosystems to deal with the 'shifting baselines' syndrome and provide sound reference points for resource restoration;
(b) Provide electronic maps for all coastal species to establish authoritative species inventories and explore scenarios of global change and invasive species;
(c) Create spatial ecosystem models for the coastal systems treated in this project as a basis for understanding the resource
(d) Provide guidelines and tools for best sizing and placement of marine protected areas;
(e) Research the impact of ecotourism on coastal ecosystems and provide best-practice guidelines;
(f) Identify suitable simple indicators to promote and monitor sustainable fisheries;
(g) Provide valuation of coastal ecosystem products and services and of different management regimes;
(h) Evaluate legal instruments with regard to their usefulness for sustainable fishing in coastal zones;
(i) Revisit coastal transects as a tool for structuring and understanding multiple demands on coastal zones;
(j) Provide an archive and web portal for public access to all data and tools relevant for ICZM.

The tools and concepts resulting from INCOFISH research will be tested in real-world scenarios in selected coastal systems worldwide. They will together form a package with the potential to impact on solving societal problems in the coastal zone.

INCOFISH is comprised of 10 Work Packages:

1. Data, Tools and Outreach
2. Shifting Baselines
3. Biodiversity Mapping
4. Ecosystem Modelling
5. Marine Protected Areas
6. Coastal Transects
7. Indicators of Sustainable Fisheries
8. Valuation of Coastal Ecosystem Products and Services
9. Impact of Ecotourism on Ecosystems
10. Legal Instruments for Sustainable Fishing

The web-based tool described in the present document is part of Deliverable 6.2 from **Work Package 6** (WP6)**.** The overall goal of WP6 is to provide a framework for compilation and analysis of data relevant to the understanding of interactions, impacts and flows in the coastal zone from mountains to the continental shelf. It aims also to provide coastal managers with a decision-making framework and communication tool for integrated coastal management, with particular emphasis on fisheries. The work package will provide a framework for compilation and analysis of data relevant to the understanding of interactions, impacts and flows in the coastal zone. Although all human uses of the coastal zone are within the scope of this work package, the major focus of the work package and its deliverables concerns coastal fisheries.

The objectives of work package 6 (each associated with a deliverable) are:

1. To review of concepts and tools for ICZM, with a special focus on stakeholder involvement (D6.1);
2. To categorize coastal areas using coastal transects and related software (D6.2); and
3. To develop and test decision-making framework for integrated coastal management based on coastal transects using selected cases around the world (D6.3).

The web-based tool, part of deliverable 6.2, will serve both to collect the (expert knowledge) data necessary to finalise the categorization of coastal transects and to deliver information to scientists and stakeholders. Through a user-friendly on-line interface, users (scientists, coastal practitioners, managers and stakeholders) will be able to enter information about coastal areas that are of interest to them and that they are knowledgeable about. The interface will enable a user to describe the characteristics of coastal system he/she works in and to obtain an image of a coastal transect that represents his/her coastal area. During the next phase of the project (not described in detail in this document), the tool will be further developed to inform users of a ‘coastal type’ (CT) that their coastal areas are classified and enable users to access relevant information about this coastal type, including locations of coastal areas with similar CT around the world. They will also be able to enter their own data or to learn from CT prototype about the interactions and flows between natural and human systems in terms of biomass, cash and labour. In the final stage, users will be able to access advice about the likely consequences of different management actions and other kinds of perturbation including natural phenomena (objective 3, deliverable WP6.3).

Objective 2 of WP6 envisages development of a simple model to describe and classify coastal areas using “coastal transect analysis”, which shows the interconnectedness between physical and biological processes and human activities and their impacts on coastal systems. Some of the key variables include (1) main resource uses/activities, (2) main environment issues and impacts on coastal zone, (3) main users/stakeholder groups, and (4) main policy/regulations, for each section of the coast, from adjacent upland areas to the sea. A key feature of the transect classification is that it will incorporate expert knowledge (from INCOFISH project members and the wider scientific community) in addition to making use of objective classification techniques based on multivariate statistical analysis.

The initial classification scheme used in the web-based tool, as described here, is based on expert knowledge, as formulated during the INCOFISH project meeting held in Thailand, May 2006. The web-based tool will additionally function as a data gathering tool, accumulating information to be used in revising and updating the classification scheme. The tool will ultimately be made available to coastal zone managers and stakeholders as an aid to decision-making.

In the next phase of WP6 work, an enhanced model/tool will be developed. Users will be able to input quantitative data about their coastal areas, such as number of fishers, number of vessels, target species, etc. Arrows indicating interactions and flows of fish, cash and labour will then be added to the coastal transects. Ultimately, users will be able to run simulations based on alternative management decisions to see the possible consequences, or learn about coastal decisions using different pre-identified ‘management scenarios’. The framework will be tested on selected representative coastal ecosystems from around the world, through workshops with coastal practitioners and stakeholders. The final stage of the work will be the modification of the decision-making framework based on the test results and the development of communication tools for ICZM.

2 BUSINESS OBJECTIVES

2.1 BUSINESS DRIVERS

The web interface is a contractually stipulated deliverable from WP 6. In addition, it will facilitate as data gathering in support of project deliverables.

2.2 RICHER EXTENDED SCOPE

The proposed web site has several functions and will be required to evolve, as feedback from users is received. The functions are:

(a) To inform users about their coastal systems. Users will be presented with simple descriptors of coastal systems in an easy-to-understand hierarchical format and allow them to enter choices that best describe their coastal system. Choices entered will then be used to extract images and textual descriptors of the coastal systems from an underlying database;

(b) To allow users to submit comments about the system to WP6 members;
(c) To inform the project team about user identity, user choices, user feedback and user suggestions about issues, facilitating evaluation and further development of the interface, revision of transect classification based on analysis of data received, and improvement of the information delivered to users;
(d) To inform the project team about user suggestions on issues to be addressed in the next project deliverable (e.g. management issues and concerns they face in their coastal areas).

Alpha version of CTAM Phase I: The initial user group will be experts from the INCOFISH, FishBase and SAUP project team members. Data and feedback from these users will be used by WP6 members to modify the site design, in particular the choices presented to users, the "help" system, the mapping of choices onto stored text and pictures, the content of stored text and images and the underlying transect classification scheme. Several iterations will be required to optimize web site functionality. [Time-scale: initial launch, internal review and data gathering: July 15[1]]

Beta version of CTAM Phase I: the updated website will be made available to a wider selection of scientists and (possibly) stakeholders. Once these users have visited the site and entered their data, further optimization will be undertaken [Time-scale: August 29, 2006, CZAP06 Conference]

Gamma version of CTAM Phase I: the gamma version will be made available at INCOFISH portal [Time-scale: September 15, 2006]

[1] Due to time constraint, the actual testing of Alpha version (conducted on August 15) was restricted to WP6 members, some FishBase team members and INCOFISH project team leader.

3 DATABASE AND CONTENT SPECIFICATIONS

The various pages visible to users, and the underlying data, are described here. There will be at least four underlying databases: (1) a storage area for user-entered data, (2) lookup tables to allow user-entered data to be linked to other databases, (3) a database of text to populate text boxes displayed to users, (4) a database of images, maps and icons for display to users.

3.1 FRONT PAGES OF USER INTERFACE

The front page will contain the software title and logo (Coastal Transects Analysis Model or CTAM) and a link to page 2. Page 2 contains a brief description of the purpose of the interface tool, a link to the main INCOFISH page, credits (logos of all WP6 member organizations, INCOFISH logo, and WorldFish Center logo), a statement about data confidentiality, and a link to page 3 of the interface tool.

3.2 QUESTIONNAIRE PAGE(S) – UNTIL THE END OF 'ACTIVITIES' SECTION

Users will see a series of questions for which they must provide an answer, as one choice only, multiple choices or as free text. The choices (and free text) entered will be stored internally and at the end of each page, users will be asked to press the 'next' button. A 'result' page will then appear based on data provided by users, generally as images and text of coastal areas that users describe.

For clarification, a definition box with icon and legends is available at the bottom of each page. The page should be set up so that all required fields are answered. If any other answers are missing, the user will be prompted to fill in the missing values. Previously entered data are retained throughout the process unless 'clear' button is pressed.

Once users reach the end of the online survey, they will be asked to 'submit' or 'revise'. Data are stored in the underlying relational databases as a unique record with user id, at the click of the 'submit' button.

3.3 DATA STORAGE

Answers to every question will be stored in as tables in relational databases. They should be checked, cleaned and sent (preferably as MS Access) to Ratana on a weekly basis.

3.4 THE DATABASES OF IMAGES AND TEXT

Every answer to every question will be associated with images and texts, and a set of coordinates for their position on each transect. After the 'next' button at each page is pressed, images and texts will be displayed. Data are not recorded, however, until users press 'submit' button at the last page of the online user survey.

3.5 DISPLAY OF ANSWERS

Display of answers is done incrementally. The first display comes after users describe 'physical' characteristics of their coastal areas. This first display serves as a base map for the other displays. The second display will show various 'icons' and 'texts' associated with habitats and resources, on top of the first display. The third and final display will show various 'icons' and 'texts' associated with activities, on top of the second display.

3.6 QUESTIONNAIRE PAGE – MANAGEMENT ISSUES

After the third and final display, users are asked to continue by pressing the 'next' button which will bring them to the User Questionnaire page – Management Issues. Once all answers are provided and users press 'next', a screen with the 'summary report' will appear.

3.7 SUMMARY REPORT

Summary report page is designed to capture all information that users enter since page 1 of the user survey. The title at the top of the page will be 'Coastal Transect of [location name], [country]'. The final image will be shown at the bottom of the page. Users are asked to either 'submit' or 'revise' the report as appropriate. The 'revise' button will bring users back one page at a time. Once satisfied, users can choose to 'print' the report as displayed.

3.8 COMMENTS AND FEEDBACK PAGE AND THE FINAL PAGE – THANK YOU

This page will allow users to enter comments and feedback as well as select whether they would like to be kept informed of the next development of CTAM.

4 AUDIENCE REQUIREMENTS

4.1 IDENTIFICATION OF AUDIENCE

The audience for this software will change as the software is evolved. The initial audience will be researchers belonging to the INCOFISH project and those invited to provide inputs (c. 100 scientists). The beta version will be made available on INCOFISH portal, thus accessible by a broad range of coastal zone stakeholders, including scientists, coastal practitioners and decision makers.

4.2 ANALYSIS OF USAGE

In alpha and beta versions, the maximum number of concurrent users is unlikely to reach double figures very often. The total target audience at the beta stage is unlikely to exceed 1,000 people and is more likely to be around 200-300, each of whom may visit the site a few times. Ultimately the possibility of handling a larger number of simultaneous users (e.g. 100) should be available.