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Analytical Framework Planning For IWRM

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The analytical framework is to support the formulation, analysis and evaluation of alternative water management strategies. Operated by analysts, the analytical framework should provide relevant information to planning agencies enabling them to assess and compare alternative courses of action in preparation of final decision-making. The framework thus connects three important parties or stakeholders in the planning process: analysts, planners and decision makers. An important aim of the analytical framework is to provide a structured approach based on consensus on the required information.

The traditional approach to management of the WRS in Bangladesh has been based largely on structural interventions designed for flood protection. The schemes have typically been aimed at flood control, drainage and irrigation. This approach has bestowed significant benefits, but has also given rise to unexpected problems, such as increased flood height in drainage channels, water logging in agricultural areas, interruption of the ongoing cycle of nutrient replenishment from inundation and deposition, impediments to navigation, and destruction of habitat for the migration and breeding of native fish species.

More recently, increasing emphasis has been placed on other kinds of management interventions, including flood warning systems, flood proofing of buildings and infrastructure, and adaptive responses to hazardous conditions. It is necessary to develop tools and adopt a systematic approach for the updating of a country's national water management plan. The exercise is undertaken with the intention of reviewing and adapting national water management strategies to assess the problems of water resources systems and for the analysis of alternative strategies.

Objectives

The analytical framework for IWRM is to support the formulation, analysis and evaluation of alternative water management strategies. This IWRM framework should reflect the changes in the utilization and availability of the water resources and in the water resources system itself. It should also be able to predict the relevant impacts on ecosystems and on the social and economic conditions of the different users of the resources and the society as a whole. Changes can be a result of exogenous developments such as changes in the upper water shed or in the climate or in the water levels in the Bay of Bengal. Such changes are beyond the control of the decision makers, but changes can also be brought about through structural or non-structural management interventions. The IWRM framework should be able to account for all such changes. It is important to realize that the IWRM framework is not only a structured set of components and their interrelations but when visualized through a systems diagram, it also creates a structured process for its development and implementation. Analytical frameworks are situations and are problem specific and thus have to be developed to meet the requirements of specific decision-making contexts. Figure 1.1 show the input output matrix of Analytical framework.

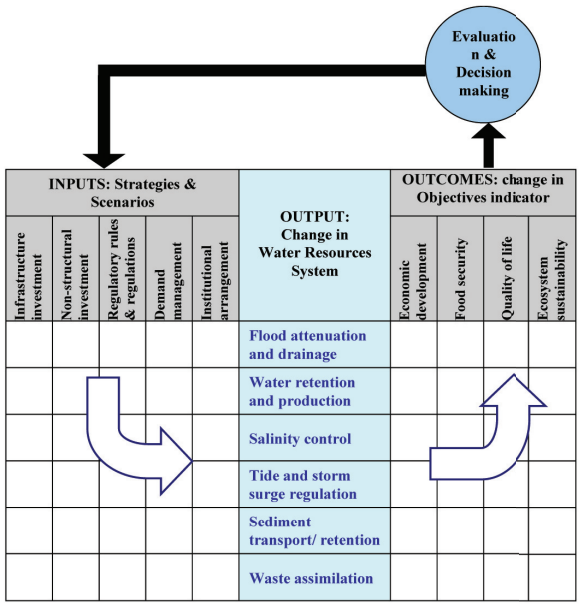

Figure 1.1. Input-output matrix

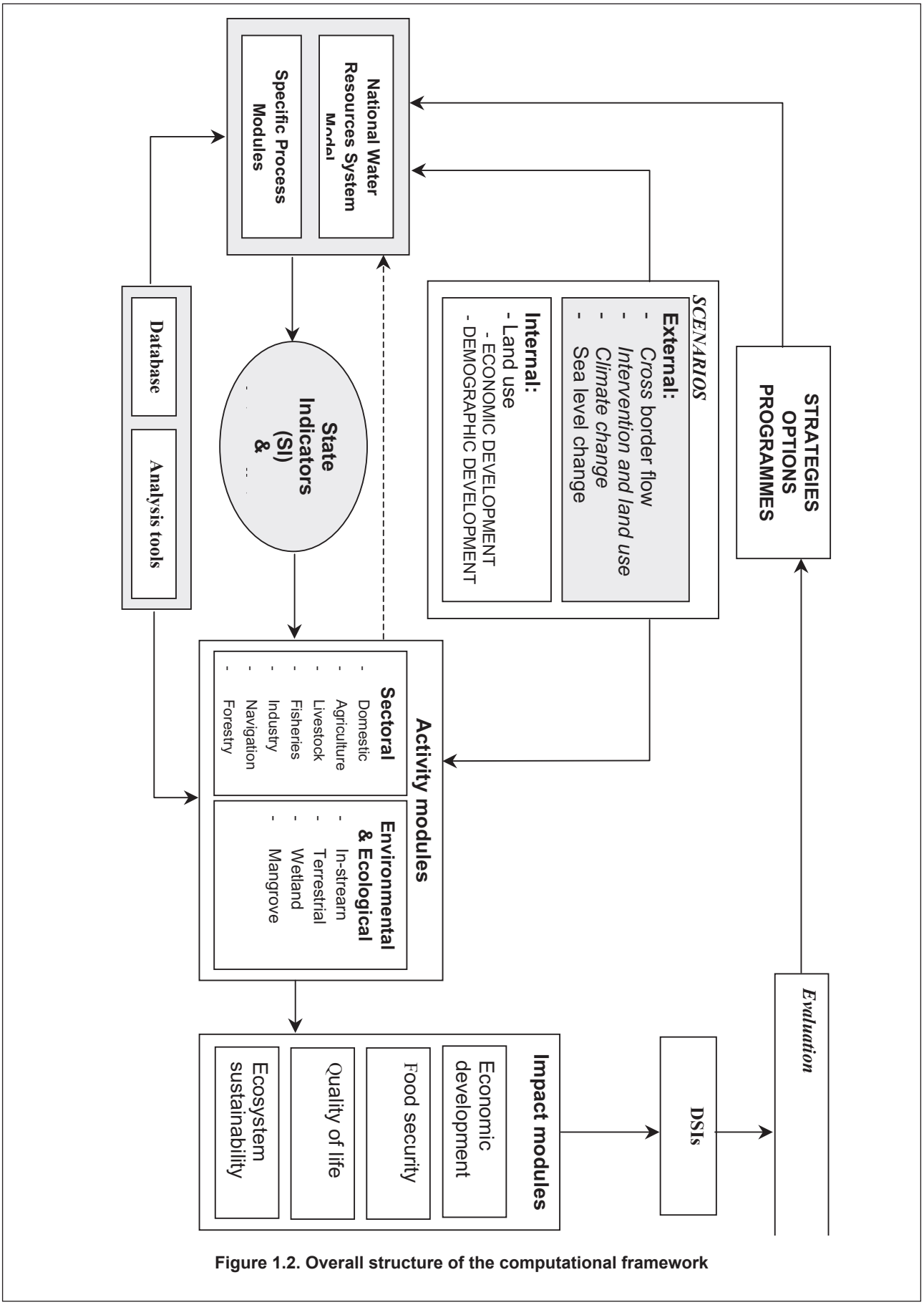

Figure 1.2. Overall structure of the computational framework

Overall structure of the computational framework

A modular structure has been adopted to keep the flexibility to add new modules and change approaches. It is emphasized that the presented outline only depicts the framework in its broad set-up, tentatively identifying modules, their functions and boundary conditions for their developments. Each of the identified models needs detailed and separate analyses.

The general structure distinguishes the following categories or "levels" (see Figure 1.2).

- *Strategies*. On this level, special techniques, even computerized, could be developed that support the formulation of complicated strategies -- being a combination of, e.g., structural and non-structural measures.
- *Scenarios*. The purpose of this level is to generate the scenarios. Two types of scenarios, external and internal, could affect the overall system. These models would be used for making boundary data as input for NWRS for the effect of cross border flow and sea level rise. Also the projections of land use, economic and demographic developments or to feed data in NWRS and activity modules (see Figure 1.2)
- *National Water Resource System Model*. It will simulate the hydrologic- and hydraulic processes at a coarser level for the whole country in order to produce the effects of various alternatives for management strategies or other events in terms of water resources state indicators, as the change from a reference state. NWRS consists of Main River Model (MRM), Water Balance Model (WBM), and some process modules e.g. salinity intrusion and water quality models.
- *Specific Process modules*. These modules receive inputs from NWRS models or from database to generate water resource state indicators or IVs for activity models or impact models. These modules are more problem specific and to reduce computational time for planning purposes. Analytical, empirical, statistical, regression or characterization methods should be the basis where mass balance is not feasible. The main focus is on producing State Indicator (SI) s and Intermediate Variables (IV) s, which may be the parts of the mathematical expressions linking the SIs and the Decision Support Indicators (DSI)s
- *Activity modules*. These modules will compute needs and allocation of water driven by sectoral and environmental uses as domestic, agriculture, fisheries, etc. in terms of quantity and quality. These are crucial for IWRM planning as they determine the impacts of measures and strategies in terms of the DSI's. There are hardly any generic models available for this.
- *Impact modules* will be developed to translate changes in SIs and IVs, to DSIs of the management objectives (economic development, food security, quality of life, and ecosystem sustainability). This module will determine the response of the users (economic sector) in case they get too much (e.g. flooding, water logging), too little (drought) or too dirty (e.g. salt, BOD) water and the associated costs and damages involved.
- *Evaluation (DSS) module*. Once impacts on DSIs are known, an assessment has to be made to what degree of changes in the WRS contribute to the management objectives. For this purpose, a broad range of tools and techniques is available. They encompass benefit-cost analyses and multi-criteria approaches. Decision support systems can be used to better visualize and present results of the impact assessments. Such systems "package" the different models to facilitate a quick analysis and comparison of many alternatives under different assumptions; so that policy makers can take their decision.

How the framework is used

Decision Support Systems (DSS), which use outputs pregenerated by means of the previous tools and present them in such a way that easy comparison between various alternatives is possible. Planning for WRM and in particular on a national level, considers a variety of different structural and non-structural interventions, which serve many interests and have to be analyzed under different scenario and system assumptions. This results in a "wealth" of information, which has to be ordered in order to facilitate trade-offs and decisions to be made rationally. After properly organizing the results of the analyses in terms of the original objectives and criteria (for example in a scorecard), results can be standardized and eventually weights can be allocated to allow a process of ranking of the considered alternatives. The allocation of weights can be done from different perspectives. For example, from a the national government's point of view, from an environmental action group's point of view or from a farmer's point of view. The whole mechanism of generating, comparing and weighing impacts can be "packaged" in so-called decision support models, which facilitate system analysts and decision makers to quickly compare alternatives.

Conclusion

Analytical frameworks are situations and are problem specific and thus have to be developed to meet the requirements of specific decision-making contexts. Thus IWRM framework has a significant useful for decision making at macro level planning. It can be applied and can cover the relevant aspects. The impacts can be expressed in terms of National Development Objectives and also it can be expresses in terms of the Water Resources System.

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