

SUBJECT : WATER RESOURCES SYSTEMS

MTECH 2ND SEMESTER (CIVIL)

WATER RESOURCES ENGINEERING

SYSTEM COMPONENTS, PLANNING AND MANAGEMENT

INTRODUCTION (lecture 1,2)

The main sources of water supply are surface and ground water which have been used for a variety of purposes such as drinking, irrigation, hydroelectric energy, transport, recreation etc. Often, human activities are based on the „usual or normal“ range of river flow conditions. However, flows and storage vary spatially and temporally; and also they are finite (limited) in nature i.e., there is a limit to the services that can be expected from these resources. Rare or „extreme“ flows or water quality conditions outside the normal ranges will result in losses to river-dependent, human activities. Therefore, planning is needed to increase the benefits from the available water sources. The purpose of water resources planning and management activities is to determine

- (i) How can the renewable yet finite resources best be managed and used?
- (ii) How can this be accomplished in an environment of uncertain supplies and uncertain and increasing demands, and consequently of increasing conflicts among individuals having different interests in the management of a river and its basin?

NEED FOR PLANNING AND MANAGEMENT

Planning and management of water resources systems are essential due to following factors:

(1) Severity of the adverse consequences of droughts, floods and excessive pollution. These can lead to

- a. Too little water due to growing urbanization, additional water requirements, instream flow requirements etc. Measures should be taken to reduce the demand during scarcity times
- b. Too much water due to increased flood frequencies and also increase in water requirements due to increased economic development on river floodplains
- c. Polluted water due to both industrial and household discharges

(2) Degradation of aquatic and riparian systems due to river training and reclamation of floodplains for urban and industrial development, poor water quality due to discharges of pesticides, fertilizers and wastewater effluents etc.

(3) While port development requires deeper rivers, narrowing the river for shipping purposes will increase the flood level

(4) River bank erosion and degradation of river bed upstream of the reservoirs may increase the flooding risks

(5) Sediment accumulation in the reservoir due to poor water quality

Considering all these factors, the identification and evaluation of alternative measures that may increase the quantitative and qualitative system performance is the primary goal of planning and management policies.

SYSTEM COMPONENTS

Water resources management involves the interaction of three interdependent subsystems:

1. **Natural river subsystem** in which the physical, chemical and biological processes takes place
2. **Socio-economic subsystem**, which includes the human activities related to the use of the natural river system
3. **Administrative and institutional subsystem** of administration, legislation and regulation, where the decision, planning and management processes take place

Inadequate attention to one subsystem can reduce the effect of any work done to improve the performance of the others

PLANNING AND MANAGEMENT – APPROACHES

Two approaches which lead to an integrated plan and management policy are

- From the top down or the command and control approach
- From the bottom up or the grass-roots approach

Top down approach: Water resources professionals prepare integrated, multipurpose „master“ development plans with alternative structural and non-structural management options. There is dominance of professionals and little participation of stakeholders. In this approach, one or more institutions have the ability and authority to develop and implement the plan. However, nowadays, since public have active participation in planning and management activities , top-down approaches are becoming less desirable or acceptable.

Bottom up approach:

In this approach there is active participation of interested stakeholders – those affected by the management of the water and land resources. Plans are being created from the bottom up rather than top down. Top down approach plans do not take into consideration the concerns of affected local stakeholders. Bottom up approach ensures cooperation and commitment from stakeholders. The goals and priorities will be common among all stakeholders by taking care of laws and regulations and by identifying multiple alternatives and performance criteria. Tradeoffs are made between conflicting goals or measures of performance.

INTEGRATED WATER RESOURCES MANAGEMENT (IWRM) According to Global Water Partnership (GWP, 2000), IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of the vital ecosystems. An integrated water management model develop solutions by involving all the essential components into an optimization scheme. The resources are used in relation to social and economic activities and functions. There is a need for laws and regulations for the sustainable use of the water resources. Dublin principles for a good water resources management as described by the United Nations Water Conference in 1977 are:

- The “ecological principle” – to treat water as a unitary resource within river basins, with particular attention to ecosystems.
- The “institutional principle” – to respect the principle of subsidiarity through the involvement of government, civil society and the private sector.
- The “instrument principle” – to recognize water as a scarce economic community by imposing various penalties for excessive usage.

A management policy must be developed only after considering the factors such as cost effectiveness, economic efficiency, environmental impact, ecological and health considerations etc.

PLANNING AND MANAGEMENT ASPECTS Technical aspects

It is first necessary to identify the characteristics of resources in the basin, including the land, the rainfall, the runoff, the stream and river flows and the groundwater Technical aspects of planning involves

- Predicting changes in land use/covers and economic activities at watershed and river basin levels
- Estimation of the costs and benefits of any measures being and to be taken to manage the basin’s water resource including engineering structures, canals, diversion structures etc.
- Identification and evaluation of alternative management strategies and also alternative time schedules for implementing those measures

Economic and Financial aspects

Water should be treated as an economic commodity to extract the maximum benefits as well as to generate funds to recover the costs of the investments and of the operation and maintenance of the system. Water had been treated for long as a free commodity. Revenues recovered are far below the capital cost incurred. Financial component of any planning process is needed to recover construction costs, maintenance, repair and operation costs. In management policies, financial viability is viewed as a constraint that must be satisfied; not as an objective whose maximization could result in a reduction in economic efficiency, equity or other non-monetary objectives

Institutional aspects:- Successful project implementation needs an enabling environment. National, provincial and local policies, legislation and institutions are crucial for implementation

of the decisions. The role of the government is crucial since water is (i) not a property right (ii) a resource that often requires large investment to develop and (iii) a medium that can impulse external effects. The main causes of failure of water resources development project are insufficient institutional setting and lack of a sound economic evaluation and implementation.