International Journal of Research in Engineering, Science and Management
Volume-1, Issue-10, October-2018
www.ijresm.com | ISSN (Online): 2581-5782

A Need of Conjunctive Use of Surface and Groundwater

Navanath V. Khadake
Professor, Department of Civil Engineering, India

***Abstract*—The world's fresh water resources are spatial, varies both in time and in space. Water resource management must focus on reallocating water to when and where it is required, a supply-side or fragmented approach. Nowadays there are signs that water resource availability is dwindling – due to both population growth and increased per capita water use – and ecosystems are being damaged. To face this challenge a new holistic approach is needed. This approach includes the integrated or conjunctive use of surface and groundwater resources and takes account of social, economic and environmental factors.**

Moreover, it recognizes the importance of water quality issues.

This article, discuss about the main aspects and problems concerned with the planning, design, construction and management of conjunctive use of surface and subsurface water resources, along with its environmental impacts and constraints to sustainable development.

***Index Terms*—surface water, ground water**

I. Introduction

Water resource management should preserve or enhance the environment's buffering capacity to withstand unexpected stress or negative long-term trends.

As the environment's carrying capacity is put under increasing pressure, due to the growing needs of the population and improper use of its resources, environmental vulnerability increases too. The mismanagement of water resources, paying only lip service to the environment, has led to water scarcity and water pollution which threaten security and the quality of human life. Giving proper regard to this unsustainable trend, the Second World Water Forum acknowledged the pivotal role that integrated water resource management plays in the process of sustainable development. The term "integrated" embraces the planning and management of water resources, both conventional and non-conventional, and of land. It takes account of social, economic and environmental factors and comprehends surface water, groundwater and the ecosystems through which they flow. Moreover, it recognizes the importance of water quality issues.

II. Conjunctive Use of Surface and Groundwater

A. The Concept of Conjunctive Use

As broadly outlined above, a critical problem that mankind has to face and cope with is how to manage the intensifying competition for water among the expanding urban centres, the agricultural sector and instream water uses dictated by environmental concerns. Confronted with the prospect of heightened competition for available water and the increased difficulties in constructing new large-scale water plants, water planners must depend more and more on better management of existing projects through basin-wide strategies that include integrated utilization of surface and groundwater. Todd (1959) defined this process as conjunctive use. Lettenmaier and Burges (1982) distinguished conjunctive use, which deals with short-term use, from the long-term discharging and recharging process known as cycle storage.

Until the late fifties, planning for management and development of surface and groundwater were dealt with separately, as if they were unrelated systems. Although the adverse effects have long been evident, it is only in recent years that conjunctive use is being considered as an important water management practice.

In general terms, conjunctive use implies the planned and coordinated management of surface and groundwater, so as to maximize the efficient use of total water resources.

Because of the interrelationship existing between surface and subsurface water, it is possible to store during critical periods the surplus of one to tide over the deficit of the other. Thus groundwater may be used to supplement surface water supplies, to cope with peak demands for municipal and irrigation purposes, or to meet deficits in years of low rainfall. On the other hand, surplus surface water may be used in overdraft areas to increase the groundwater storage by artificial recharge. Moreover, surface water, groundwater or both, depending on the surplus available, can be moved from water-plentiful to water-deficit areas through canals and other distribution systems. On the whole the integrated system, correctly managed, will yield more water at more economic rates than separately managed surface and groundwater systems.

B. Water Storage

In conjunctive use, the two most important issues that planners have to face concern the storage of surplus water and the optimal allocation of water withdrawals.

With regard to the first problem, a question that needs to be answered is where to store water and which reservoirs to develop: surface or subsurface?

C. Conjunctive Use and Irrigation Development

With regard to irrigation water, the implementation of sound conjunctive use projects involves a thorough inventory of soil and water resources and proper zoning of areas suitable for irrigation by surface or groundwater, or where one source can supplement the other. All this requires field surveys and investigations aiming at evaluating hydro meteorological, hydrological and hydrogeological conditions, seepage and soil infiltration rates, crop water requirements and crop patterns, water quality, hydrodynamic parameters and behavior of aquifers, well yields, canal flows and stream discharges, along with the assessment of energy costs to sustain both surface and groundwater development projects.

The beneficial effects of conjunctive use in canal commands can be summarized as follows (Karanth, 1987):

- Use of groundwater helps cope with peak demands for irrigation and hence reduce size of canals and consequently construction costs;
- Supplemental supplies from groundwater bodies ensure proper irrigation scheduling, even if rainfall fails or is delayed;
- Groundwater withdrawals lower the water table thus reducing the risk of water-logging, soil salinization and consequent wastage of water for leaching the soils;
- Surface and subsurface outflows are minimized, causing reduction in peak runoff;
- When conjunctive use is integrated with artificial recharge the need for lining canals is reduced, as seepage from canals feeds groundwater;
- Conjunctive use allows the utilization of saline or brackish ground – or surface –water resources, either by mixing them with freshwater, or by using alternate water resources for irrigation events.

III. Financial Issues

Operation of water resource systems requires an agency capable of managing surface and groundwater flows and levels. If the system is to be financially sustainable the costs of developing and managing water resources will need to be recovered from the beneficiaries or from the community.

Levels of service are based on operational standards and quality criteria.

Operational standards regulate system management and serve two purposes:

- To establish criteria for operational performance measurement;
- To establish criteria for service delivery.

The quality of service provision can be defined as a combination of parameters relating to the adequacy, flexibility, convenience, cost and security of the services provided.

To assure service delivery requires the design, construction, operation, maintenance and eventual replacement of a hydraulic infrastructure. The To link all the financial aspects involved in water resource systems, a conceptual framework is needed, based on the “user pays” principle (van Hofwegen, 1997). This entails identifying beneficiaries or clients for the services provided.

IV. Challenges For The Future

At the beginning of the twenty-first century, conjunctive use of surface and groundwater is coming under pressure on a number of fronts. The expected demand for water exceeds available resources, plans fall short of targets, population is increasing, though growth rates are slowing down, and economic crises coupled with environmental concerns further complicate and exacerbate efforts under way to tackle these problem.

V. Concluding Remarks

1. The world's fresh water resources are unevenly distributed in time and space. Until recently water resource management focused mainly on reallocating water when and where it was required, a supply-side or fragmented approach.
2. Now-a-days, it is apparent that water availability is dwindling due to both population growth and increased per capita water use causing often irrepairable damage to the environment.
3. To face this challenge a new holistic, systemic approach, relying on conjunctive use of surface and ground water resources is needed to overcome the current fragmented management of water. This implies long-term planning and management strategies with respect to both water quantity and quality.
4. To ensure sustainability, water resource systems need to be planned, designed and managed is such a way as to fully meet the social objectives of both present and future generations, while maintaining their ecological, environmental, and hydrological integrity. This imposes constraints on every stage of development from project planning to final operation and management.
5. The various interests at stake call for a decision process involving multiple objectives, multiple users and multiple constituencies and stakeholders. In this context, the traditional approach whereby water resources development and management was a “government’s business” needs to be replaced by a participatory approach involving both governments and stakeholders at all levels. Experience shows that stakeholder participation must be genuine and not symbolic, and that user associations must have a decisive role in the decision process as to what is done, how it is done and who pays for it. Experience also shows that partnerships between governments and stakeholders can be effective with governments playing a vital role in creating an enabling environment and in providing technical support and research thrust.

6. Economic constraints are equally important in water resource development. The cost of water system operation and improvement is normally tremendous, and governments, in this era of transition towards a market-oriented economy, will be unable to continue financing activities as they used to. The new philosophy is based on the principle that the services must be paid for by those who benefit from them. Sustainable development, as previously defined, requires a sound financial management framework in which the revenues from service provision cover the costs. And the quality and number of the individuals responsible for pursuing that approach.
7. On the other hand, engineers, economists, ecologists, planners, along with stakeholders, user associations and all sectors of society must be involved in the decision making process. Failure to do so will increase the risk of opposition to projects even once they have been designed or constructed.

REFERENCES

[1] Anderson M.P., Ward D.S., Lappala E. G. and T.A. Prickett. 1992. Computer models for subsurface hydrology. Handbook of Hydrology, Maidment D.R. (Ed). McGraw-Hill, New York.
[2] Cline N. M. 1983. Water supply in Orange County. Operation of Complex Water Systems, Guggino E., Rossi G. and Hendricks D (Eds) NATO ASI Series E n.58
[3] Martinus Nijhoff Publishers, Boston. De Marsily G. 1986. Quantitative hydrogeology. Academic Press Publisher, New York.