32nd WEDC International Conference, Colombo, Sri Lanka, 2006

SUSTAINABLE DEVELOPMENT OF WATER RESOURCES, WATER SUPPLY AND ENVIRONMENTAL SANITATION

Integrated Water Resources Management and Sound Information System – Sri Lankan Experience

G.T. Dharmasena, Sri Lanka

Integrated water resources management is the core of the management strategy of national water resources, for which the concept of multi sectoral planning of river basin has to be introduced. In order to meet this objective one of the basic and most important requirement is a sound information base of the resources and analytical tools to support decision making process. In Sri Lanka, quite similar to our neighboring countries in the region, water resources planning, development and management decisions were made spanning for several decades on the basis of achieving self sufficiency in the staple food, rice. However during recent times, while developing lands for agriculture emphasis was also laid on hydro power development.

Once the infrastructure for the water resources development is established, it is also important to realize the sustainability of these assets due to ageing and deterioration. Therefore there is an urgent necessity for the formulation of a national plan to ensure the safety of dams by establishing a mechanism for periodic monitoring and taking timely action for necessary repairs.

Introduction

Since the ancient hydraulic civilization in Sri Lanka, water resources development has focused on achieving self sufficiency in the staple food, rice. Even after the colonization of the country by the British, the attempt had been to increase food production by rehabilitating the vast network of the ancient irrigation infra-structure which went to disuse after the 12 th century. A separate department for irrigation was formed in 1900 to intensify this objective of tank rehabilitation. Successive governments since independence in 1948 also followed the same policy. During the past few decades, while developing lands for agriculture, emphasis was also laid on hydro power development.

Today 35% of the water available in rivers and streams is being utilized mostly for irrigation with 6% of water for drinking and industrial use .However according to ID (June 2002) [6] still 65% of the available surface water in the 103 river basins goes to the sea without any beneficial use. Meanwhile a shortage of water exists in the dry zone during the South-West monsoon (Yala), DHI &LHI (1991) [1] highlighted the frequent floods in major rivers in the Western part of the country. From the available land extent for paddy only 50% is cultivated during Yala. Due to this reason there is a demand by the people requesting to provide additional infrastructure for greater regulation of water for supplementary irrigation and flood control by taming the wet zone rivers to detain flood water and to provide trans-basin diversion to the dry zone.

However due to the absence of a clear water policy and an institution to coordinate the overall activities for water resources development and monitoring, many ill-conceived development projects are being promoted without a holistic approach. Some important projects of national importance do not emerge due to institutional bias and the inadequate capacity of the water sector institutions to formulate integrated multipurpose water projects. Sometimes the lack of vision for an integrated approach to push the rational water resources development projects beyond their area of interest is also a common problem in some of the institutions

Dam safety

Sustainable water resources development and environmental impacts have been a subject of discussion at many international and national fora due to global recognition of hydrological problems that require international cooperation. Therefore a series of international conferences were organized by the global community commencing from Rio in 1979 up to the third world water conference in Kyoto in 2003. While developing the infrastructure for the regulation of water it is also important to realize the sustainability of the system due to ageing and deterioration. In Sri Lanka, the responsibility of dams is vested on a number of state institutions. The Irrigation Department (ID) is responsible for the largest number of major dams (350 earth dams; nearly 20% of them are classified as Large Dams) while the Mahaweli Authority (MASL) is responsible for the rock fill, concrete and earthen dams recently constructed with modern technology and several ancient dams, receiving Mahaweli waters. The original construction of the ID dams dates back from the pre-Christian era to a few centuries ago. The Ceylon Electricity Board (CEB) and the National Water Supply & Drainage Board (NWS&DB) are responsible for the other major and medium sized dams. The Provincial Councils are also responsible for around 12,000 minor earth dams. Another important characteristic is that many important dams are located in cascades while practically every dam has a large settlement downstream vulnerable to dam failure. Many important urban areas, too, are found within the downstream risk areas of Mahaweli, ID and CEB dams. The failure of any of these dams is likely to have consequent adverse effects on property, economy, agriculture and human lives, either within the river basin or even the trans-basin due to the nature of their development.

An urgent necessity for the formulation of a national plan for disaster preparedness arose in 1986, due to the failure of the Kantale dam , a major ID earth dam. The subsequent public hearing of the World Commission of Dams held in Sri Lanka in 1998 and the round of inspections conducted for 32 major dams on risk assessment by national & international consultants under the Mahaweli Restructuring Programme during the years 2003/2004 confirmed the necessity of establishing an effective institution to deal with dam safety. Therefore sustainability of the infrastructure already built is also a management function of the state.

Availability of water

The total land extent of Sri lanka is 65,525 sq.kms and the annual rainfall varies from 900 mm to 6000 mm. There are 103 river basins in the country and the available water from precipitation is 42,869 mcm annually and the annual runoff to the sea is estimated as 27,900 mcm. Therefore 35% of water is utilized and 65% goes to the sea. Of the 103 river basins only 17 river basins have drainage areas of more than 1000 sq.kms. The irrigation sector is the largest water user and the annual irrigation water use has been estimated as 12,000 mcm. Drinking and industrial water use has been estimated as 6% of the total water use. Being an agricultural country with rice as the staple food the total extent under paddy is 735,000 ha under major and minor irrigation schemes including rainfed paddy. The average productivity of rice farming is 3.5 ton/ha in major irrigation schemes where there is sufficient water for irrigation. Before the implementation of the Mahaweli Project, the Mahaweli Ganga was the largest river with 10,000 sq.kms of catchment discharging 10,000 mcm of water annually to the sea. This amount has been now reduced due to large scale water regulations in the basin with large reservoirs. In view of the above, according to ID (2003) [6],today Kalu Ganga discharges the largest amount of water and it is of the order of 4000 mcm. The Kelani Ganga comes second and it carries 3400 mcm of water annually to the sea. The Mahaweli Ganga is third

Need for integrated water resources planning

Having achieved near self-sufficiency in rice by making large investments up-to 1980 , rapid urban development and the expansion of cities shifted the emphasis from sectoral development to multi-sectoral water resources management. Today almost all the major cities in Sri Lanka are confronted with drinking water scarcity even though most of the cities are surrounded by reservoirs. The authorities are unable to supply 24 hours of water for most of the cities. In particular in the city of Colombo, 64% of the population are un-served by piped water and 18 % extract water from unsafe sources. As a result of this, potential conflicts among the major users have emerged. However the conclusions of the ECI (1968) [4] shows that cry for further augmentation of irrigation reservoirs by trans-basin diversion of water from the wet zone rivers has not ended The reason for this situation is inadequate water during the South West monsoon (Yala) in most of the medium and minor tanks as explained above. This is clearly shown in the present government policy and plans are being drawn to carry out feasibility studies for the development of water resources of major rivers in line with the proposals made by the . Ministry of Planning 1972[7], TAMS (1989) [9].

According to ECL 1995[3]the present population of greater Colombo is about 1.5 mn and the projected population in 2025 is 4.0 mn The NWS&DB is now confronted with the problem of meeting this demand due to the shortage of water in the Kelani river during the dry weather flow. The problems of drinking water at Anuradhapura, Kandy,Kurunegala,Trin comalee,Matara and Hambantota are well known.

Due to the reasons given above the necessity of a holistic approach to implement a rational water resources development plan has been now realized and the implications of some of the sectoral planning so far implemented are under review. This can be best illustrated by quoting a few examples .These issues highlight the necessity for a holistic approach in water resources planning with an apex body to coordinate the development and management aspects DHI (1999) [2].

- The shortage of drinking water in the cities of Anuradhapura, Kandy and many other cities is experienced while these cities are surrounded by large reservoirs. This is due to conflicts between drinking water and irrigation sectors.
- The problem of water diversion at Polgolla from Mahaweli Ganga is experienced when there are water shortages in Anuradhapura, Polonnaruwa and Kantale for irrigation. This is due to the conflicts of interests between the irrigation and hydro power sectors.
- The problem of drinking water supply to Colombo during the months of February and March is experienced due to salinity intrusion. This can be overcome to some extent if there is an operational policy to obtain water

from Maussakelle and Castlereigh hydro power reservoirs located upstream, during these periods. According to GERSAR (1998) [5] this again is not possible due to conflicts between the drinking water and hydro power sectors
- The NWS&DB is planning to construct a salinity barrier across Kelani Ganga to prevent salt water intrusion without realizing that the ID is planning to construct a major reservoir as planned by Tecno (1961) [10] across the same river for flood protection and hydro power .In case the second proposal is implemented the first one will become obsolete
- The Board of Investment (BOI) developed plans to set up an industrial zone in 200 ha of land in the lower Kalu Ganga basin without realizing the fact that the NWS&DB has a plan to have the drinking water intake for greater Colombo supply just downstream of the industrial zone where industrial effluents are planned to be discharged.

Hydrometric network

Safety assurance for dams and rational water resources development plans are founded largely on a sound information system. The hydrometric network and the hydrological data base are vital elements in an information system. Therefore a critical review of the hydrometric network is essential to examine the viability of the above objectives. It is also evident that some of the major water resources projects implemented during the recent past performed below the design expectations due to the usage of unprocessed hydrological data.

In spite of short-comings in the quality of field data , the processing of hydrological data is being done in the ID by manual means. The hydrological data base has not been established to a standard international format, but a certain percentage of historical data has been computerized in an ad hoc manner.

Flood forecasting is a mandatory function of the ID and the ID has to provide forecasts during an emergency. At present there are only about 5 stations with satisfactory instrumentations with facilities to transmit data to Colombo via a radio link. However the application of these facilities yet to be seen with an issue of a scientific forecast during a flood.

Both rain gauges and river gauges are mostly concentrated in the wet zone,but the density in the dry zone and particularly in the North East province is very poor. The examination of the number of measuring stations in 1964, 1974 and 2006 shows the gradual deterioration of the network density from 1974. Under the accelerated Mahaweli programme in 1980 a hydrological crash programme(NEDECO) was launched under the Dutch aid to update the hydrological data related to Mahaweli ,Kelani Ganga basins and in certain adjoining river basins NEDECO (1980-1984) [8]. Under this programme, selected stations were upgraded with automatic water level recorders and facilities for measuring high flows.

Regarding water management in major reservoirs under the MASL, the Water Management Secretariat (WMS) maintains a computerized data base at a satisfactory level for Mahaweli reservoirs and has also published a quarterly report for users. Regarding the reservoirs maintained by the ID, tank replenishment data for selected reservoirs are being monitored by the Hydrology division. Seasonal yields from the reservoir catchments and tank duties are published in the year book. However it was observed from the field inspections that the quality of field observations of the water levels of tanks is poor and tank staff gauges were not maintained and calibrations of the sluice discharges were not attended to.

The water management division of the ID which is responsible for water management also obtains reservoir data from the field, but uses it only for operational aspects. No dissemination of information regarding the system performances is published.

In view of the above the following specific comments on the hydrometric network can be made.
- Present capacity and ability of the hydrometric network to meet national water resources development and management is inadequate and needs major rehabilitation and modernization.
- Hydrological and water management data base is seriously deficient in terms of coverage, adequacy, accuracy and reliability.
- Data collection, processing, storage and dissemination are outdated and poor.
- Application of modern software for analytical works, decision making processes, flood forecasting and trained man power for data management and modelling are seriously inadequate.
- Certain unsuccessful water resources development works already implemented had been the result of inadequate data processing and quality assurance.

Due to the reasons given above, water resources planning, development and management decisions are made on the basis of unprocessed hydrological data, which need more attention. Therefore, while addressing the other issues the establishment of a sound data base and data management system for multi-sectoral integrated water resources planning is essential. Additionally, attention is also required to use modern computer software as analytical tools. Therefore improvements to the hydrometric network are suggested by taking the above into account.

Improvements to the Hydrometric Network

Improvements to the hydrometric network are considered to enhance the following basic functions:

- Water resources development and management planning
- Flood forecasting in natural rivers
- Safety of dams
- Water allocation and monitoring

Therefore the expansion of the river gauging network to meet future challenges has to be proposed by evaluating the existing network in order to achieve the above objectives. Generally rain gauges and hydrometric stations are required in reservoir catchments to predict floods for the operation of spillway gates. Regarding the forecasting of floods to reservoirs like Kotmale and Victoria the hydrometric network already existing is adequate for most of the catchments. What is required is to develop forecasting models for catchments and to introduce automatic real time data transmission to a central station . Regarding the forecasting of floods in natural rivers only five major zone rivers namely Kelani,Kalu,Gin,Nil and the lower basin of Mahaweli are vulnerable. These factors have to be considered when deciding upon new hydrometric stations.

Regarding the adequacy of the network for water resources planning and development, the coverage of the network is not adequate especially in the North East dry zone. In some river basins like Malwatu Oya,Kirama Oya,Urubokka Oya,Walawe Ganga and Kirindi Oya, water resources are exploited to the maximum ,but it is still necessary to monitor the flow of water to understand water allocation, drainage and reuse. It can be seen that no network exists in these exploited basins.

Conclusions

Integrated water resources development and management also have been aggravated due to the large number of ministries where water related functions are disintegrated to a level where normal coordination between ministries is difficult. Despite the multiplicity of institutions and ministries, the present practice of water resources development, especially during the recent past has not been able to address issues of national interest. Therefore the balance water resources have to be developed very carefully in a holistic manner to solve problems of irrigation ,drinking, industrial, environmental and flood protection while harnessing the much needed hydro-power potential.

Integrated water resources management is the core of the management strategy of national water resources, for which the concept of multi sectoral planning of river basins has to be introduced. In order to meet this objective one of the basic and most important requirements is a sound knowledge and information system of the resources and a decision support system with appropriate analytical tools. In addition, a great emphasis is needed to change the orientation of the professional staff of the key government institutions from sectoral planning to integrated water resources planning.

References

D.H.I. & L.H.I. (1991) Kelani Ganga Flood protection Study

DHI, Sir William Halcrow & LHI - (July 1999) Western River basin Sector Project - River basin Assessments

ECL (July 1995) Pre-feasibility study to develop water resources to enhance dry weather flow in Kelani Ganga

Engineering Consultants INC, Denver, USA(1968) Feasibility report on multipurpose development of the Nil, Gin and Kalu Ganga basins.

GERSAR(1998) Salinity Barrier at Ambatale in Kelani Ganga

ID publication (June 2003) Water statistics

Ministry of Planning (1972). Southern Area Development Plan - Diversion of Kalu Ganga, Gin Ganga & Nilwala Ganga to South Eastern Dry Zone (Hambantota, Moneragala & Ampara Districts)

NEDECO (1980-1984) Hydrological Crash Programme

TAMS Consultants, Binnie & Partners, Central Engineering Consultancy Bureau, Samitar, ECL (1989) Kalu Ganga multipurpose project - Pre-feasibility study

Technopromexport, Moscow (1961) Kelani Ganga basin scheme

Contact address

G.T. Dharmasena
United Nations Office for the Project Services (UNOPS),
17/17 A, Park Avenue,
Colombo 5,
Sri Lanka
Fax:2584984
Tel. No. 0777224801
e-mail-dharmasenat@unops.org.lk