India Water Week 2012 – Water, Energy and Food Security : Call for Solutions, 10-14 April 2012, New Delhi

EVALUATION OF WATER SUPPLY AND IRRIGATION INFRASTRUCTURE DEVELOPMENT

P.L. DIWAN*

1.0 BACKGROUND.

Traditionally, agriculture activity forms the back-bone of rural economy where majority of the population is settled. This sector is the most vulnerable in spatial and temporal vagaries due to monsoon rains. From time memorial prime concern of the rulers had remained around the protection of water resources from against the large variability of monsoon, which inarids amount to events of frequent droughts and occasional flashy floods. Efficient water management along with equity in water distribution has remained a major concern of the past kings and colonial rulers. During the medieval periods major concern was mostly focused around water conservation, transfer of flashy flood waters so that these sources could last the dry season. The rulers in the medieval ages gained stature and became mightier and powerful only when their welfare schemes included building storage structures and main-streaming water conservation policies, tackled water crises as emergency issues and promoted community based rain water harvesting schemes. The limited water bodies served nucleus for cultural and economic activities.

In the following the author confines to the evaluation of the water supply and Irrigation Infrastructure development.

2.0 ANCIENT WATER SUPPLY INFRASTRUCTURE

2.1 Olden Water Conservation practices

The old Temples supported rain water harvesting structures and tanks for storage of seasonal flows from adjoining areas and stored recharge as well as flows from the adjoining aquifers. Ancient rulers promoted ordinary dug wells, Baulies(stepped wells), promoted community based rain water harvesting schemes. Deep wells with large diameter served as storages-cum-recharge wells, were fitted with rope-pulley block arrangement or Persian wheels and utilized animal power. These traditional Water Harvesting Structures (WHS) are found all over the country. Some excellent master piece worksare seen e.g., Panchaki (Aurangabad), here the hydrodynamic force of water was utilized for grinding wheat, even had knowledge to reduce the hydrodynamic force of water by passing the clay pipes over the several arches serving as entrance gates to the city, similarly DhaulaKuan (shallow well) ChhapparwalaKuan (covered well) in Karolbagh, 39000 Nos of tanks of Tamil Nadu,43000 Nos of tanks of Karnataka as storage-cum-recharge ponds had surface area varying from 30 sqm to 1.0 sq Km.Tanks were served with drainage channels for, water collection and distribution storagesexisted inNashik, water harvesting structures in harsh arid region of Rajasthan have withstood successful functioning over centuries. Most of the communities had mastered the art of water management and construction technology which even taken seriously shall show a way out in the present circumstances of resolving water management in water scarce regions.

Ancient text like **"SamaragamSutradhar"** indicate construction technology of wells and stepped wells, water baulies with intricate stone carvings and architectural designs on walls and roof. The successful functioning of these water bodies indicate that the communities of the medieval period had

sufficient knowledge of geology, hydrogeology, soils sciences, construction material, construction methodology, structural engineering which withstood the time testing over centuries.

2.2 Water Quality

With the increase of unchecked population andhaphazard settlement extending to the catchment and recharge areas caused, blockageof recharge channels, surface, impurities reached shallow wells and tanks, water quality suffered due to micro-organism (bacteria, viruses, parasites, fungi, etc.), chemical contamination of recharge, soil salinity became basic causes for dysfunction of the traditional water bodies. The population of the rural communities suffered due to migration for want of employment and lure of urban centers. With the over-extraction of the ground water (GW) in the catchment areas of WHS, the recharge reduced and got further accentuated with the increase of impervious surfacesby massiveconcreting and asphalting resulted in dysfunction of shallow wells and recharge tanks and baulies.

3.0 IRRIGATION INFRASTRUCTURE

3.1 Ancient Irrigation Efforts

Evidences of well developed irrigation system are found in the Indus Valley Civilisation (2500 BC), These were of minor works operated by small households to irrigate small piece of lands as irrigated patches were part of the fertile plains of Indus basin. Civilisationflourished on the river banks of Indus and Indo-Gangetic Plains and diverted riverflows for the sustenance of agricultural fields.**'Brihaspathi',** an ancient scholar of law and politics, states that construction of Dams and repair work of dams wereconsidered as pious works and advised that these should be financially shared by the Rulers and rich people. Even **'Vishnu Puran'**showers praise on those who undertake such pious works of construction of dams, repairs, dig wells, build gardens and plant trees. In the south, also, wherever topography permitted surface flows of the rivers were diverted to ponds and tanks and cultivated low lands. The north, central and south India supported numerous irrigation tanks and found evidences of very well developed cultivation practices in the pre-Christian era also.
Traditional tank irrigation system in the **Bhandara area of Maharastra state**about 400 years ago functioned on community based efforts and played important role in sustaining agricultural economy inthe area. Bhandara has about 43,381 Nos of tanks and support 10 to 50 acres of irrigation per tank and the community based efforts covered finances, construction, operation and maintenances and majority of the tanks are still in operation.

3.2 Medieval period efforts.

The Grand Anicut, also known as **Kallanai** build on river Cauveri in Tamil Nadu by**Chola King Karikalan around 2nd century AD.** This is considered as one of the **oldest dam in the world** and is still in use. It is one of the greatest engineering marvel of the Dravidian Engineering,it is 329 m long and irrigates about 1.0 lac acres. Further, **Sir Arthur Cottons 19th Century dam** across the Kolhidam, a major tributary of river Cauveri is yet another excellent example of the development of planned irrigation system in India.
In around 100 years time period between 1900-2000 AD about 4525 dams of various sizes were build with maximum of 1651 No in Maharastra and 803 Nos. in MP.

3.3 Revival Programme

Several programmes have been undertaken for revival and clearing of the traditional water harvesting structures and expansion of similar schemes to other areas by NGOS and local communities and have gained considerable success. A recharge storage tank near Ajmer Dargah has been restored after several decades byan NGO group, it required clearing the heavy deposition of debris of several meters in the fractured rock zone. Several water tanks in the south have been taken up for revival by clearing the siltation from the bed of the tanks and drainage channels restored by self help groups in Karnataka, Andhra Pradesh, Aravali's in Rajasthan by Tarun Bharat Sangh have daunted a movement of revival of

small streams and ponds in rural areas by local communities. Several programmes are supported by NABARD, World Bank through GOI under **JalSamvardhanYojana.**

In 1994, Gram Vikas (GV) and **Self Help Group (SHG)** of women formed alliance known as**GrameenMahilaOkkutta**or **Rural Womens's federation** for restoration of Tanks in Karnataka and gained remarkable success in Karnataka. This federation today is a powerful networking body and have emerged as leaders at community level. Apart from the tank restoration work they have under taken several welfare measures for girls, children, immunisation, night schools, etc.
A model tank restoration measure comprises of a) Desilting (excavated material transported to fields in the catchment area.), b) Soil conservation, c) Repairing of the tank banks, d) check dams and gully plugs to arrest soil erosion checking siltation of tanks, e) Agro forestry, f) Fodder development (trees), g) Repair of waste weir and channels, h) Repair of distribution channels in the command area i) fisheries.

The winds of change have set in by the **73rd constitutional amendment**which empowers**Gram Sabha** at village level to decide the affairs of water management including maintenance, repairs, distribution and construction of structures and distribution associated with water harvesting structures. This theme extends to the participatory community management andcoversall other states.

4.0 Planned Water Supply Infrastructure

4.1 PRESENT WATER SUPPLY STATUS

After independence, the water supply and irrigation infrastructure development and maintenance came under the ambit of government. The planned development started by the 1st FYP (1951).

The planned development in the Water Supply Sector from 1st FYP (1951) to 9th FYP (2002) ranged from sporadic development to transitional phase from technology to policy frame work and finally to restructuring and sector reforms.

4.2 Rural Water Supply Scenarios till 9th FYP

As regards rural water supply system, of the total of 1.42 million rural habitats, 1.27 million habitats were fully covered, 0.13 million were partially covered, and 15,917 Nos. were not covered. The coverage refers to installation of hand-pumps. However, it did not include the sustainability of the sources both from quality and quantity aspects which have become very vital in the subsequent planned development requirements.
GW quality problems occurred due to over exploitation of wells in rural areas. In urban areas, generation of waste water from domestic and industries, inadequate sewerage system, and lack of awareness among users have become the major sources of pollution.
During the systematic planned development of about almost 50 years the impact of development remained partial due to ever increasing urban population. The urban population from 62.0 million (17.3% of the total population) in 1951 grew to 285 million (27.8% of the total) by 2000. The number of towns increased from 2795 Nos. to 4378 Nos. Similarly, the number of metros increased from 12 Nos. (1981) to 35 Nos. by the year 2000 with population growth from 26% to 37.8% of the total population. It is estimated that by the year 2020, more than 50% of the Indian population will live in urban centers.
The emerging issues which were of great concern were that of **high fluoride** concentration in GW, of about 1.5 ppm in large rural areas. The affected population was about 25 million (in 2000) spread over 200 districts in 17 states. (Ref. 6)
Further, the **arsenic affected areas** were mostly in West Bengal covering about 13.8 million population in 75 blocks. The poorly maintained hand pumps and cemented platforms with poor hygiene around the drinking sources, the GW has become poor in water quality due to **higher iron level, turbidity, taste, heavy metals, nitrates and wide spread of bacteriological contamination.**

The Panchayati Raj Institutions (PRI)were created by the **73rd constitutional** amendment and they were entrusted with the responsibility and O&M of drinking water in the rural areas. It paved way for users involvement, **decentralization of the development from the government control to the peoples control,** which became the major paradigm shift of the Sector Reforms. It laid the very foundation for the "people – oriented demand-driven approach", there by **changing the role of the government from service provider to a facilitator.**

4.3 Water Supply Infrastructure till IIth-FYP.

By the end of 10th – FYP, the progress was reported in 2008 by the Joint Monitoring Programme. The **improved urban water supply** infrastructure had **reached about 96%** which comprised **48% as piped system** and **48% as other improved sources.** The same in the **rural areas was 84%** which comprised **11% as piped system** and **73% as other improved water resources.** The overall average for the **country reported was 88%** which comprised 22% as piped system and 66% as other improved sources.

The accepted norms for the rural areas are to provide improved water supply a quantity of **40 lpcd of safe drinking water within a distance of 1.6 Km or 100 m of elevation difference.** One pump caters to about 250 persons. Further, similar norms for the cities are on the basis of without sewerage provision, with sewerage provision and **metros are 70,135 and 150 lpcd respectively.**

With the Sector Reforms, Haryana and Rajasthan states have created Urban Local Bodies(ULB's) responsible for operation and maintenance of water supply schemes. Some states e.g. Maharashtra, Tamil Nadu, Karnataka, have full-fledged state level Water Supply and Sewerage Boards including city level Corporation in the state capitals. In **Ahmedabad, Nasik, Mumbai, Pune, the Municipal Corporations are responsible for capital investments and maintenance.** Similarly, **Delhi has DWSSB,** an undertaking under NCT of Delhi. It has also framed its own state water policies and has encouraged private sector participation.

Water being a State subject and States have created variety of institutions both state wise and city wise. An institutional study in seven states (UP, Haryana, Delhi, Karnataka, Tamil Nadu, Kerala, AP) was carried out during 2000-2002 by JBIC. It examined the city based state wise water utilities and adjudged their performances on major parameters of efficiency and deliverance and found that except one Bangalore Water Supply & Sewerage Board (Scored 6.0), all of these utilities achieved 3 to 4 on scale of 10.

Some of the results at micro level are given below to gauge the health of the water supply schemes.

4.4 Achievement in Water Supply Infrastructure

- Jamshedpur could provide 25% of its population with continuous water supply, reduced non-revenue water from 36% to 10% and metered connection increased for 2% to 26% by 2009
- Navi Mumbai could provide 50% of its population with continuous water supply by 2009
- Thiruvananthapuram could provide continuous water supply by 2001
- Hubli, Belgaum and Gulbarga increased water supply from once every 2-15 days for 1-2 hours to 24 hours per day for about 12% of the population by 2008
- Private water projects are successfully operating in Visakhapatnam &Tiruppur water supply since 2005
- Bangalore & Vijayawada have introduced accounting reforms, e-governance, etc.
- Ahmedabad, Hyderabad Municipal Corporation have introduced property tax reforms
- Tax free status for Municipal bonds is granted to Municipal Corporations of Ahmedabad, Hyderabad, Nasik, Chennai, Visakhapatnam, Karnataka covering water supply and sanitation activities

- Out of the 300 cities (2001) 62% urban water customers in metropolitan areas and 50 % in smaller cities had metered supply (average of 55%), other customers were charged on flat rate basis
- Bangalore and Pune were the first to have 100% metered connections
- Cost recovery in rural areas is low, majority of rural hand pumps are defunct for lack of maintenance. State governments subsidizes the rural water supply system
- Rural areas in Punjab have shown a cost recovery of 20% only. Those drawing water from public stand posts do not pay any water charges, although official tariff is Rs. 15/- per month per house hold.

Water & Sewer tariffs were set at US$0.1 per M^3 in the year 2007 which met only 60% of the O&M costs as several cities do not have metered Water supply based on the study conducted by JNNURM (2007). In rural areas this is even lower, this sector is highly subsidized whereas the 70% of the population are not poor and can easily afford to pay. The urban water tariffs are highly affordable and differential tariffs for water supply and sanitation increasing with increased use can be introduced but the main hesitation comes from the policy makers.

5.0 IRRIGATION INFRASTRUCTURE

5.1 Old Irrigation Infrastructure Status

Most of the Indian rivers are of monsoon origin and three most common types of traditional irrigation system were practiced,viz the first was diversion of flows by channels leading from the river banks, or from a weir across the river, such system were well developed in Indus and Indo-Gangetic plains. The other system was feeding drainage channels to the tanks and wells distribution through channels were commonly practiced since time memorial in Karnataka, Maharashtra, Rajasthan, Madhya Pradesh, Orissa and West Bengal. Locally, farmers had developed manual-lifting devices for negotiating level differences of fields from the water channels.

About **14 Nos. of old Irrigation System** were fully developed during the British period even before 1900 AD covering the major rivers of India, e.g. Godavari, Krishna, Sone, Yamuna, Mahanadi, Ravi-Beas, Cauvery, Periyar, Ganga. These were mostly constructed during 1850-1900AD and these 14 Nos. of projects could provide irrigation to about 5.0 Million ha.

By about 1900 AD.A total 7.6 Mha were covered by Public works and 5.7 Mha by Private works and by 1945 AD the irrigated areas covered by Public Works had extended to 13.5 Mha and 10.0 Mha under private works.

5.2 Planned Irrigation Infrastructure Development

After 1947 India was left with only 19% of irrigated areas amounting to about 19.4 Mha, and over 50% of the area irrigated by Public Works got shifted to Pakistan. Hence after independence need to develop irrigated area was on the top priority. India's irrigated agriculture is key to economic development and poverty alleviation campaign.

Area Irrigated by tanks and wells form a major percentage in the overall irrigation achievement. The gross irrigated area has increased four folds cropping intensity has developed in last 60 years of planned development. As a result India has gained self sufficiency in food production and exports cereals also. India's ultimate irrigation development till recently was estimated to be 113.5 Mha and has been upgraded to 139.9 Mha. Comprising of 58.46 Mha through Major and medium schemes and 81.43 Mha from minor schemes (17.38 Mha from surface & 64.05 Mha from Ground Water) India has the largest potential irrigated Agriculture of 90 Mha.

This sector contributes to about **1/4th to the GDP and provides 2/3rd of rural employment.** Presently **72% is the rural population of which 80% are poor.** However, during the planned development period, there remained always a gap between the potential created and actual utilization.

In 1996-97 GOI launched **"Accelerated Irrigation Benefit Programme**(AIBP) for Major and medium projects and assisted states for funding of irrigation projects with a view of accelerated implementation, expeditiously complete the projects which are in advance stage of completion and to realize earlier benefits and to reduce the gap between potential and utilisation. Further other funding schemes included **Rural Infrastructure Development Fund** (RIDF), **BijuKushakVikashYojana** (BKVY), **Orissa Integrated Irrigated Agriculture & Water Management Investment Programme** (OIIAWMIP), **Orissa Community Tank Management Project** (OCTMP), **Orissa Water Sector Improvement Programme** (OWSIP), **Dam Rehabilitation and Improvement Project** (DRIP). The results of the achievement till 2009-10 show that 31 Nos. of projects were completed and additional potential created was 0.165 Mha.

5.3 Overall Water Scenario of the country

Water Supply and Irrigation Sector are the main users of water, hence its availability has to be critically reviewed. The availability of renewable fresh water per capita in India has decreased from 6000 cum per year in 1947 to 2300 cum in 1997 and it is anticipated that by 2017 the water availability will decrease further.

In 1987 **National Water Policy formulated by MOWR, GOI** and later revised in 2002 gave highest priority to domestic needs for **drinking water supply, health, hygiene and addressing environmental issues.**

The basin wise availability of water resources is highly erratic. Rajasthan State with 9% of the population has only 1% of the country water resources while Bihar state with 10% of population has only 5% of water resources. India as a whole is considered reasonable in terms of annual availability of water resources which is highly erratic and uneven and becoming vulnerable with rain fall changes due to climatic factors. This situation warrants all round development of water resources with **much larger and more number of storage, flood water utilization, improve the carry over capacity of reservoirs, interlinking of river system, other the per capita availability of water will go below the threshold value of scarcity level. (1000 cum per capita per annuam).**

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Water Supply Infrastructure

The Sectoral Reforms both for urban and rural areas, which were initiated during 1999, require to be continued further with fine tuning upto grass root level. These are very critical for the sustainability of the water supply and sanitation schemes both for capital investment and recovery of O&M costs. The institutions for the utility services under Urban Local Bodies, Municipal Corporation and PanchayatiRajya Institutions are required to be broad based to include water and sanitation WATSAN developmental activities to be brought under their umbrella other than O&M recovery. They should be empowered to manage plan, design, operate, raise their own funds or get grouped under the cluster of Urban Local Bodies (ULB's) or PanchayatiRajya Institutions (PRI's) to become accountable and raise investment bonds, indemnify the investors for pay back guarantee and become credit worthy entities to access market funds as several of these institutions are hardly capable to handle WATSAN developmentprogrammes.

The major drawback in the functioning of Urban Local Bodies, Municipal Corporations and Panchayati Raj Institutions are lack of proper trained manpower. It is required to arrange for :

i) further institutional development and functioning to enhance technical and managerial capability

ii) use of Information Technology and

iii) crash programmes for training staff various disciplines including financial accounting and periodic audit

iv) raise their own workforce capable of design, plan, operate and maintain the infrastructure

The main aim is to enhance the capacity of these grass root level institutions, to be headed by locally elected people, and to handle larger funds per year.

So far, the planned development in the water supply and sanitation sector has shown very positive indicators both in the rural and urban areas. Apart from the safe drinking water resources through piped water supply or community water kiosks, the status of the village folks have improved. Families served with piped water resources along with better sanitation and drainage system enjoy higher status and the value of land / house has increased considerably.

The Millennium Goal No 7 Targets 10, to half by 2015 stands achievable as assessed by WHO based on the observed urban and rural water supply data given below.

Table 1 : Achievement and Achievable

S.No	Type of work	1990	2002	2015
		Population served in percentage		
1	Urban Water Supply	88	96	100
2	Rural Water Supply	61	82	100

6.2 Irrigation Infrastructure

Weather based challenges are occurring more frequently as regards intensity, timings, spatial variations of extreme events rainfall and floods. These have led to unprecedented floods in the northern rivers, floods in the desert areas and gradually turning arids into greener pastures effecting mangroves and threatened forest ecosystems, salinity intrusion in mangroves have affected marine and biological life, persistent droughts have affected depletion of ground water and its quality.

Vulnerability of water availability on regional basis is the majors concern affecting the state economy as well as the food security. It is well acclaimed that reservoirs on the monsoon based rivers provide major protection from droughts, supplement downstream flows during lean season and moderate the fury of floods. In combating this major cause of concern, a way forward approach is required and some are listed below.

- **Precise study of the effect of recent pattern of flows at river basin level.**
- **Building of larger reservoirs to store more than one year seasonal requirements**
- **Redesigning the reservoir operational schedules of filling and emptying**
- **Provision of flood cushioning effect in the reservoir schedules for monsoon based rivers**
- **Flood water utilization by way of ground water recharge**
- **Under the present context interlinking of rivers are more relevant for transferring of surplus seasonal discharges to deficit areas.**
- **Interlinking of irrigation projects within the same state.**
- **Improvement of overall water use efficiency in Irrigation projects**
- **Water audit of all irrigation projects in the same river basin.**
- **Improvement of demand and supply management**
- **State level water conservation plans.**
- **Preservation of wet lands.**
- **Incentive schemes to be launched for ground water recharge.**
- **Revival of traditional water harvesting structures**
- **Control of unaccounted water in water supply system.**
- **Awareness of adaptive measures for withstanding floods are droughts**

- **Developing consensus on interstate or bring the water resources under the central subject.**
- **Broad basing the international river treaties for optimal use of water resources through consultative process.**
- **Developing frame work for river basin organization and administering pollution control measures more rigorously and restoration of river ecology.**
- **Building up of strong political will to take up the water related important issues as National Agenda.**

These bold steps in the water sector alone will require a realistic action plan addressing short and long term measures involving national level planning beyond the administrative confines of state boundaries as national welfare emergent schemes.