EFFICIENT AND SUSTAINABLE IRRIGATION-MANAGEMENT IN PAKISTAN

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ABSTRACT

Pakistan, with a Geographical area of 796,101 square kilometers, possesses large rivers, like Indus which, along with its 5 tributaries, namely Chenab, Jhelum, Ravi, Kabul and Sutlej, forms one of the mightiest River-Systems of the world. The River-System comprises 2 storage reservoirs, 19 large rivers headworks, 43 Canal Systems measuring 58,000 kilometers, some 1.6 million kilometers of water-courses and field Irrigation Channels. Pakistan has big rivers like Indus, Chenab, Ravi, Jhelum and Sutlej, where discharges in summer season vary from 100 thousand Cusecs to 1,200 thousand Cusecs (3 thousand to 34 thousand cumecs) and can cause tremendous loss to human lives, crops and property. Due to limited capacity of storage at Tarbela and Mangla Dams on river Indus and Jhelum, with virtually no control on Chenab, Ravi and Sutlej, devastating problems are faced between July and October in the event of excessive rainfall in the catchments.

In order to manage the huge Irrigation-System, Planning has been made, in consultation with four Provincial Irrigation Departments and Government of Pakistan, to establish Provincial Irrigation and Drainage Authorities and Former Organizations, which are under way. This paper discusses, in detail, the irrigation-network in Pakistan and the efforts to establish Irrigation and Drainage Authorities, Former Organizations, etc, for efficient and sustainable management of irrigation in Pakistan.

INTRODUCTION

Pakistan, with a Geographical area of 796,101 square kilometers, possesses large rivers, like Indus which, along with its 5 tributaries, namely Chenab, Jhelum, Ravi, Kabul and Sutlej, forms one of the mightiest River-Systems of the world. The River-System comprises 2 storage reservoirs, 19 large rivers headworks, 43 Canal-Systems measuring 58,000 kilometers, some 1.6 million kilometers of water-courses and field Irrigation-Channels. Pakistan has big rivers like Indus, Chenab, Ravi, Jhelum and Sutlej, where discharges in summer season vary from 100 thousand Cusecs to 1,200 thousand Cusecs (3 thousand to 34 thousand cusecs) and can cause tremendous loss to human lives, crops and property. Due to limited capacity of storage at Tarbela and Mangla Dams on river Indus and Jhelum, with virtually no control on Chenab, Ravi and Sutlej, devastating problems are faced between July and October in the event of excessive rainfall in the catchments (see Figure-1).

Pakistan comprises four major administrative units; Punjab, Sindh, North West Frontier Province and Balochistan, besides the Federally Administered Tribal Areas. Pakistan's population as estimated in 2001 is 140 million. The population growth-rate is estimated at 2.1%. The overall density of population is 174.63 per kilometers. However, there is large regional variation in population-density. Pakistan is a country with a very diverse social and geographic landscape. It comprises high mountains in the north, to desolate plateaus, fertile plains, sandy deserts, coastal beaches and mangrove forests in the south. It has the largest share of the highest mountain-peaks in the world and has more glaciers than any other land outside the North and South Poles. Pakistan's glacial area covers some 13,680 sq.km, which represents an average of 13 per cent of mountain-regions of the upper Indus-Basin.

THE IRRIGATION NETWORK

The Irrigation system of Pakistan is the largest integrated irrigation network in the world, serving 34.5 million acres (13.96 million ha) of contiguous cultivated land. The system is fed by the waters of the Indus River and its tributaries. The salient features of the system are three major storage reservoirs, namely, Tarbela and Chashma on River Indus, and Mangla on River Jhelum, with a present live-storage of about 15.4 BM^3 (12.5 MAF), 19 barrages; 12 inter-river link canals and 43 independent irrigation canal commands (Figure-2). The total length of main canals alone is 58,500 Km. Water courses comprise another 1,621,000 Kms.

Diversion of river waters into offtaking canals is made through barrages, which are gated diversion weirs and a system of link canals

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(Figure-2). The main canals, in turn, deliver water to branch canals, distributaries and minors. The water-courses get their share of water through outlets in the irrigation channels. Distribution of water from a watercourse is effected through a time-schedule or "warabandi", under which each farm gets water for a specified period once a week. The time-share of "wari" is proportionate to the farm area owned by a farmer under the command of the water-course.

The system draws an average of 106 MAF (131 BM^3) of surface-water each year for irrigation. Supplemented by an annual groundwater pumpage of some 50 MAF, the average depth of water available at the farmgate is 3.07 feet per acre. Approximately 3 million individual farms, with an average size of about 12 acres (5 ha), benefit from this system.

WATER AVAILABILITY & UTILIZATION

Pakistan has a diverse agro-ecological setting and is divided into three hydrological regions; (a) the Indus-Basin, which is the major source of Pakistan's water, (b) the Kharan desert in west Balochistan, with inland drainage and (c) the arid Makran coast along the Arabian Sea in the southern part of Balochistan. The deserts in the south (Thar and Cholistan) have no water-resources. Most of the Indus-Basin has been formed as a result of alluvial deposits brought by rivers from the mountainous ranges in the north. The flows in the Indus River are from glacial snow melt, as well as rainfall outside the Indus Plains. Under the Indus-Water Treaty (1960), the flows of the three eastern rivers, the Sutlej, Beas and Ravi, have been allocated to India and water from the three western rivers, the Indus, Jhelum and Chenab is available for Pakistan.

The flow of the Indus River and its tributaries constitutes the main source of surface-water for the country. Based on 74 years of historic data from 1992-93 to 1996-97, the average annual inflow of the western rivers at the rim-station amounts to 140 million acre feet MAF (173 BM^3). The flow varies from year to year; the maximum was 186.79 MAF (230 BM^3) in 1959-60 and the minimum was 86 MAF (106 BM^3) in 1999-2000. This presents a variation of more than 65% in the annual average-flows.

The groundwater storage-capacity in Pakistan is estimated to be around 55 MAF (67.8 BM^3). The hydrogeological conditions are mostly favourable for pumping by tube-wells. It is estimated that 15,504 large-capacity public tube-wells and 469,546 private tube-wells of low capacity are currently installed in the country. Thus, the groundwater pumpage in the Indus-basin has increased from 33.4 MAF (41 BM^3) in 1959 to about 50 MAF (62 BM^3) in 1999-2000. Quality of groundwater is variable, with about 79% of the area in Punjab and 28% in Sindh as fresh groundwater suitable for irrigation. However, indiscriminate pumping, without proper monitoring, and lack of knowledge about the chemistry and hydrodynamics of the aquifer has already contributed to the pollution of the aquifers in certain pockets.

At the time of independence of Pakistan in 1947, about 64 MAF of water was being utilized annually in the irrigation canals in the country. With the construction of more barrages, link canals, and storage dams, water-use has increased to an average of 106 MAF (131 BM^3). Per-capita availability of water has gone down from 5,104 cubic meter in 1950 to around 1,200 cubic meter currently- Out of the 35,040 MAF flowing to the sea, a total of about 20 MAF (25 BM^3) can be used for future development through construction of multi-purpose storages, remodeling of canals and irrigation extension schemes. There is little potential for increase in water availability for Pakistan from surface or groundwater sources. However, the 9th Five-Year Plan envisages that about 4.32 MAF can be made available through conserving measures and installation of tube-wells in fresh groundwater areas.

Currently, 97% of the fresh water in Pakistan is used in the agriculture-sector and only 3% is available for domestic and industrial use. The competitive demands from different sectors has not yet emerged as a key issue in Pakistan but is likely to become a major issue in the future. A review of growth trends shows that as the income of a country increases, the use of water by different sector changes dramatically, and the water needs of the industrial and domestic sector changes dramatically and the water needs of the industrial and domestic sector grow rapidly until in high-income countries water requirements are 47% of the available water. In the immediate future, Pakistan needs to review strategies for reallocation of water from irrigation to domestic and industrial use to harvest economic benefits. The rate of return of a cubic meter of water used for

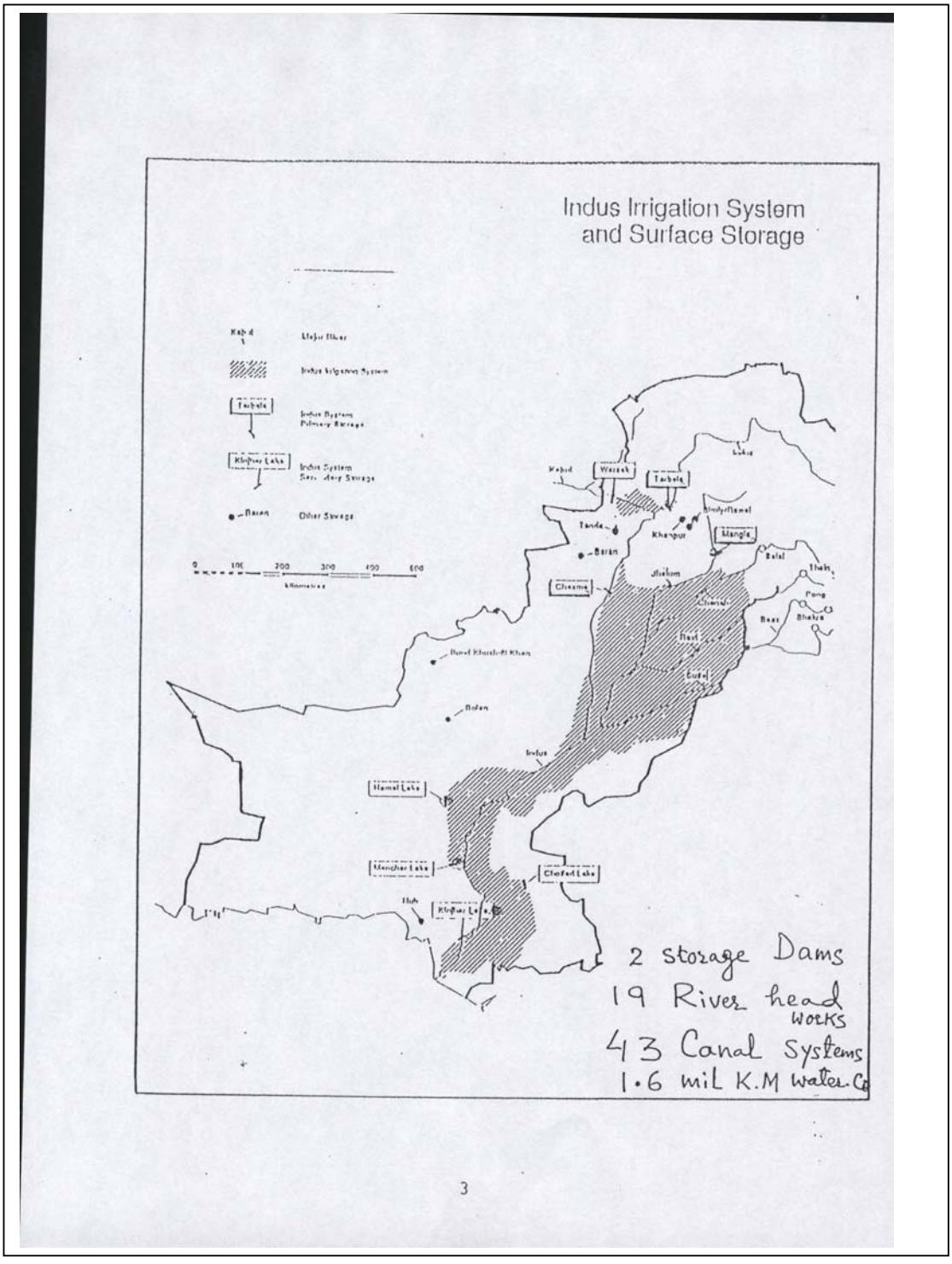

Figure - 1: Indus Irrigation-System and Surface-Storage

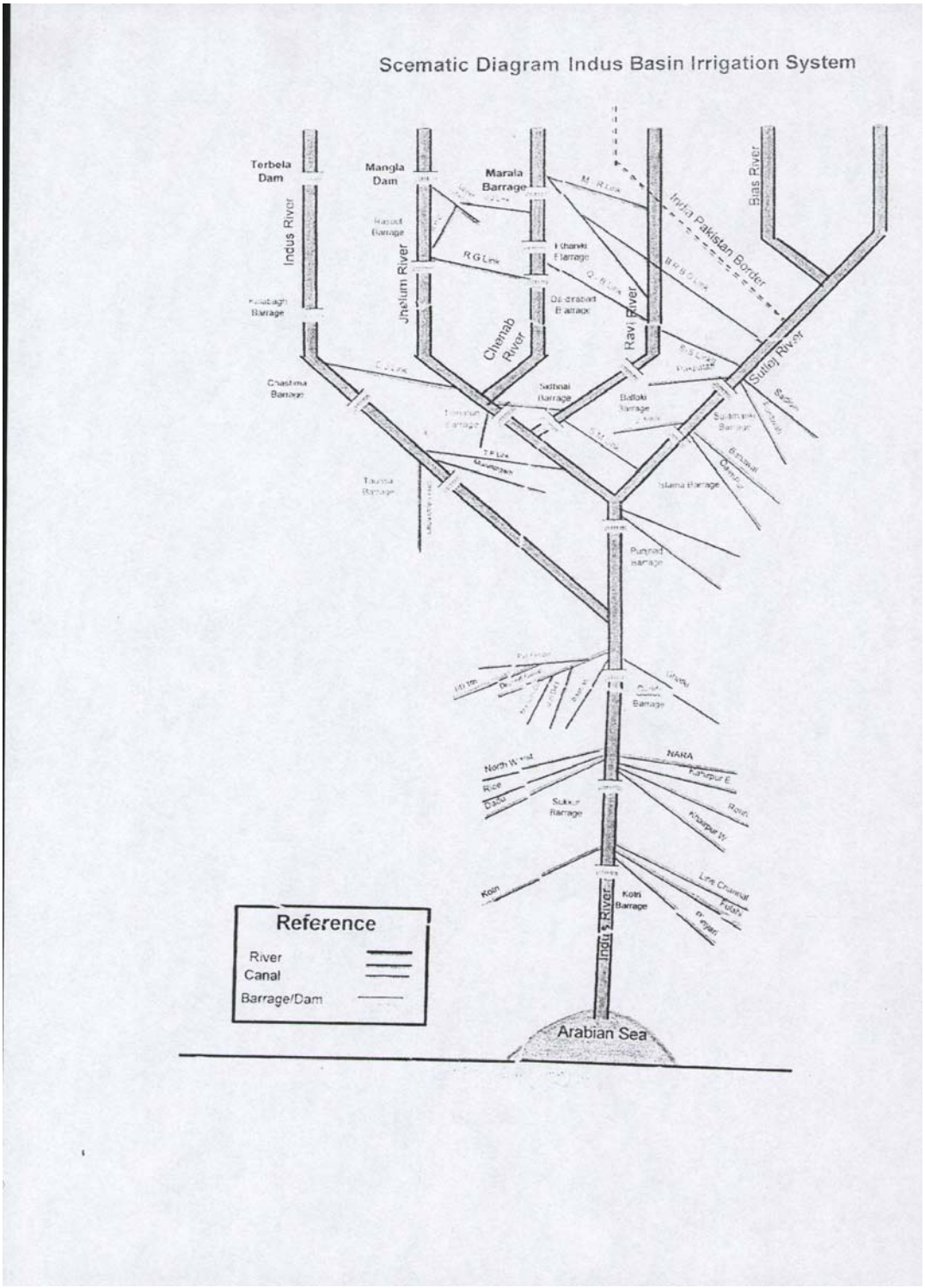

Figure - 2: Schematic Diagram Indus-Basin Irrigation-System

agriculture is less than 10% of return on municipal and industrial use. Conservation measures in agriculture can therefore help in increasing the productivity of water.

IRRIGATION AND WATER-MANAGEMENT ISSUES

Water-resources development and management has acquired new dimensions in Pakistan. A host of factors constrain the performance of irrigation, which are multi-faceted and multi-dimensional. The major constraints facing the irrigation management broadly include; Physical Constraints, Financial Inadequacies, Institutional Issues and Environmental Problems. The Physical Constraints have been caused by the agricultural development beyond the system design capacities, scarcity of irrigation water, lack of storages, and gradual deterioration of the network due to the overstressing and aging. The main Financial Issues include inadequate maintenance funding, rise in maintenance expenditure of public tube-wells, and flood works, as well as escalating expenditures on establishment, stagnation of abiana rates, and a widening gap between the expenditure and cost recovery. The Institutional Issues have emerged because the changes in the institutional set-up have lagged behind the changes that have taken place in the resource-base and socio-economic context over the years. On the Environmental Front, the main problems are waterlogging and salinity, salt-imbalance, and increasing pollution of water-bodies.

A small fraction of the population pays tax; agricultural income tax has never been imposed on full-scale basis, despite its potential to generate resources for the country. The revenue from abiana (water tax) is also not collected seriously and there is massive leakage in the system. There is a legal framework in place for the organization of Water User Association (WUA), as the Punjab (1981) and Sindh (1982) Water-User Association Ordinances provide for such associations at the water-course level, while the Punjab Irrigation and Drainage Authority Act (1997) and the Sindh Irrigation and Drainage Authority (1997) provides for establishing Farmers Organizations (FOs) at distributary and minor levels. Despite this, the WUAs do not feel empowered to undertake the responsibility of operating and maintaining their watercourses or have any autonomy in the management of their water-resources. Similarly, a uniform policy exists for the water supply and sanitation sector, but it is not fully implemented. The National Environmental Quality Standards exist, but these are not enforced seriously.

The Indus-Basin Irrigation System was installed almost a hundred years ago and, now, its efficiency has come down to such an extent that more than 50 per cent of the irrigation-water is lost in transit and during application to the crops. The quantum of wastage of precious irrigation-water is not only the limiting factor for expansion of the irrigated area and realizing the maximum benefits per unit of already irrigated land, but it also has aggravated the severity of the twin menace of waterlogging and salinity. Crop-yields on average Pakistani farms are considerably lower than the average yields attained by many other countries of the world, under similar agro-climatic conditions. The mounting pressure of population has furthered the importance of conservation and better management of the scarce resource. Thus, the low productivity of irrigated agriculture and ever-increasing pressure of population present a major threat to the country's food- security in the future. Therefore, this underscores the dire need to save every drop of water wasted in the irrigation-system and at the farm-level, through active participation of the end-users.

The importance of water for Pakistan can not be under-estimated, particularly for irrigated agriculture in the country. In Pakistan, irrigated agriculture covers 16.2 million hectare (74%) out of the total cultivated area of 22 million hectare. Irrigated agriculture uses 97% of the available water and provides over 90% of agricultural, produce; it accounts for 25% of GDP, earns 70% of the export revenue and employs 50% of the work-force directly and another 20% indirectly. Although the share of agriculture in GDP has declined over the years, it is still the largest single contributor to GDP. However, despite its importance, the level and growth of agricultural production falls short of its real potential. The sustainability of irrigated agriculture is threatened by continuous deterioration of the irrigation infrastructure.

The need for improvement and up-gradation of the irrigation system has become imperative Indeed, over the last three decades, some damages have occurred due to floods, causing stoppage of irrigation-water to large areas, with huge economic losses. Recent surveys have revealed that numerous important hydraulic structures are in a precarious state

and the need for rehabilitation is urgent. Besides rehabilitation, the system also needs overall improvements to allow efficient operation and equitable water-delivery, in order to cater for the enhanced water-demand and to meet the challenges of 21st century.

In order to address the sustainability issues, a number of policy-interventions have been proposed. While the main thrust of the policy-framework remains on institutional reforms, other policy interventions like Global Water Law, Dis-investment of Fresh Groundwater Tube-wells, Groundwater Regulatory Framework, Optimizing Irrigation-Water Allocations and Alternative Rate Mechanisms, are also proposed for optimizing the overall Irrigation Management. A sectoral strategy and National Water Policy are also being formulated, to have a historic approach for development and management of the water sector.

At the moment, the irrigation and drainage system of Pakistan suffers from a number of fundamental problems, notably;

- Unsatisfactory planning and programming of public expenditure on drainage;
- Delays in Implementation;
- Unsatisfactory planning, funding and execution of operation and maintenance
- (O&M);
- Deteriorating capabilities of key-institutions;
- Lack of public participation;
- Inadequate investment in drainage;
- Poor monitoring of drainage projects and infrastructure, and
- Inadequate investment in research on drainage, and lack of application of research-results to policy and planning.

FARMERS' PARTICIPATION IN CANAL-IRRIGATION AND WATER-USERS ASSOCIATIONS

Nature has blessed this country with the World's largest and most integrated system of irrigation. This network was installed almost a hundred years ago and now its efficiency has been reduced to such an extent that more than 50 per cent of the irrigation-water is lost in transit and during application to the crops. The quantum of wastage of precious irrigation-water is not only the limiting factor for expansion of the irrigated area and realizing the maximum benefits per unit of already irrigated land, but also has aggravated the severity of the twin menace of waterlogging and salinity. Water-Users Organizations were not a part of the agricultural system in Pakistan till the late 1970s. With the onset of the On-Farm Water-Management (OFWM) Pilot Projects, their involvement was experimented upon, at times when it was considered a politically explosive and socially vulnerable issue, and it proved successful. Under various OFWM Programs, efforts were exerted to involve them at tertiary levels of the irrigation-system and, by now, they are contributing 55 per cent of the cost of the civil works on the watercourse. The usefulness of farmers' participation in other countries fostered the testing of some pilots on their participation at secondary levels of the system. A few pilot-surveys have been conducted so far and the results have shown that the WUA's participation can play a promising role in the operation and maintenance of the already deteriorating irrigation-systems, not only in improving productivity but also in sustaining the environment. Their performance will, nevertheless, hinge upon effective organizational efforts, imparting necessary training to them, proper recognition and adequate legislative support from the government as well as commitment from operating agencies.

The Government has recently taken strategic initiatives to address the longstanding issues of irrigation-management that had been reflecting on the performance of the sector. The new strategies primarily focus on better governance, decentralization, participatory management and sustainability. Under the institutional reforms agenda, Provincial Irrigation Departments (PIDAs) are being transformed into Provincial Irrigation and Drainage Authority (PIDA). The responsibilities of management would be decentralized at canal command level to Area Water Boards (AWBs), while most of the existing functions at the distributary / minor level would be performed by the Farmers Organizations (FOs). The focus of most of the above activities would initially be on pilot AWB and pilot FOs on the System. Subsequently, the reforms package will gradually be extended to other AWBs and FOs, on the basis of the results of monitoring and learning- experience

of the pilot programmes. The Government has enacted the legal framework and the reform agenda is under implementation, to varying degrees in all Provinces.

The strategy consists of the following interlinked parts:

- Restructuring the Provincial Irrigation Departments (PIDs), to form Public Utilities (PUs) around canal commands;
- Actively promoting formation and development of Farmers Ortganizations (FOs);
- Strengthening federal agencies, notably the Water and Power Development Authority's (WAPDA's) Water Wing, so as to better implement their federal responsibilities; and
- Formalizing water markets and individual water-property rights.

PIDAs have been established in all the four provinces; one Area Water Board (AWB) in each province has been notified. Also, Punjab and Sindh have notified rules and regulations for FOs. Other provinces are in the process of doing the same; 30 FOs have been registered in Punjab. Formation of 23 FOs have been completed, following by registration in Sindh Province under PIDA Act.

NWFP has designated the existing Northern Irrigation Circle Mardan as Area Water Board, Swat Canals (Pilot) and its Members have already been notified. The On-Farm Water-Management of the Agriculture Department have already constituted a FO in 31 Lora Canal scheme in Lakki Marwat district and they are busy in forming FOs in Peshawar and Charsadda areas.

The Farmers' Organization for K.K. Bund Irrigation Schemes, in Balochistan, have been registered. FOs registration for rehabilitation of Lasbella Canal is being processed.

The issues of physical / financial sustainability of irrigation and drainage network is assuming increasingly critical proportions. The specific policy-interventions, which are under consideration, include the following:

i) Drainage cess and / or other appropriate measures, including cost-sharing by non-agricultural beneficiaries, to finance the O&M cost of drainage infrastructure.

ii) Mechanisms for financing the O&M costs of flood-works, which may inter-alia include transfer (or cost sharing) of non-irrigation flood-infrastructure to the local bodies / other relevant beneficiaries and/or charging flood-cess, etc.

iii) Redefining water-rates and alternate rate-mechanisms to enhance the incomes and to rationalize assessment costs. For a start, flat-rate assessment could be introduced in pilot FOs.

iv) Redefining water-rates for water-use by non-agricultural users.

v) Adequate O&M funding for proper upkeep of the existing irrigation-infrastructure. Revision of yardsticks, enhanced allocations and shifting of resources from SCARP tube-wells to canals operations.

vi) Need to reassess the impact of the increase in investment vis-à-vis O&M requirements and the increases in “abiana” to sustain such investments.

The following points regarding institutional and environmental issues are now under active consideration of the Government:

i) Willingness to invest in social mobilization and capacity-building of the upcoming new institutions (i.e AWBs and FOs) is absolutely essential for the success of the ongoing institutional reforms. For the new entities to be sustainable, the upcoming FOs would require technical assistance and support for quite some time, which may account for about 20-30% of the Investment Costs.

ii) There is pressing need to take steps for expediting the capacity-building process for the upcoming FOs if the targets, for formation of FOs and transitioning of the management responsibilities to them, are to be met.

iii) In order to optimize integrated resource-management, comprehensive and holistic interventions for rationalizing existing

canal-water allowance need to be undertaken. Appropriate policy also needs to be developed, to address the emerging environmental issues in order to preserve the water-quality and land- base for sustainability of the irrigated agriculture.

CONCLUSION

Owing to scarcity of water, proper management of water-resources is essential for the Agriculture Sector, which is the largest user of water 97%. The development of Pakistan's economy strongly depends on its ability to properly operate and manage its water-resources. The efficient and effective use of all water- resources in Pakistan requires formulation and implementation of an appropriate water-sector policy. The Ministry of Water and Power is formulating a National Water Policy to face the challenges of water-scarcity. The overall objective is to utilize the available water-resources to meet the socio-economic and environmental needs for sustainable development in the country.

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