

**IRRIGATION WATER PRICING & ITS SUSTAINABILITY  
IN PAKISTAN**

Dr. Allah Bakhsh Sufi, CE (Water Resource Planning Organization), P&D WAPDA



## IRRIGATION WATER PRICING & ITS SUSTAINABILITY IN PAKISTAN

**Dr. Allah Bakhsh Sufi, CE (Water Resource Planning Organization),  
P&D WAPDA**

### ABSTRACT

Pakistan's economy is heavily dependent on agriculture; which contributes about 21% to GDP. Due to arid and semi-arid climatic conditions, Pakistan's agriculture is dependent on irrigation. Around 90 percent of agricultural output is entirely dependent on irrigation. Pakistan's irrigation and drainage system is in dire straits. Despite substantial budgetary input, it is facing a shortage of resources and suffering from severe and worsening operational problems. A critical analysis of the problem leads to the fact that the system is not properly maintained due to paucity of funds and water is not judiciously used because of its negligible cost. The study was conducted by WAPDA. The objectives of the study are (i) Critical analysis of water rates overtime and O&M cost of irrigation system to determine the gaps and subsidies by the Government; and Calculate and improve irrigation system and agriculture productivity and marketing to reduce Government liability by enhancing farmers paying capacity. The surface resources are received from western and eastern river flows. Pakistan's primary water resource is the Indus river and its tributaries. With division of rivers under the Indus Water Treaty (1960), Pakistan is now dependent on three western rivers of Indus (including Kabul), Jhelum and Chenab. Annual average western river rim station flows (Indus at Kalabagh, Jhelum at Mangla and Chenab at Marala) from 1958-59 to 2007-08 are 138.35 MAF with Kharif inflows as 114.12 MAF (82 percent) and Rabi as 24.23 MAF (18 percent), while post-Tarbela (1976-2008) are 139.56 MAF with Kharif 119.83 MAF (81.9 percent) and Rabi 25.29 MAF (18.1 percent).

Pakistan has not managed its water resources to the optimal level and is now becoming increasingly water stressed compounded by major issues viz-a-viz water availability/ demand gap; low storage capacity; growing demand due to demographic pressure and competition between water use sectors; reservoir sedimentation; deferred maintenance due to low financing; low land and water productivity; low water cost as compared to O&M cost; and low recovery of water rates/Abiana/land tax; etc. and Indiscriminate groundwater pumpage/over mining impacts. Water sector faces severe financial constraints for O&M of irrigation system, for developing new water storages to improve regulation and distribution system etc. The current water rates and their collection is quite insufficient even to meet O&M cost and the gap is widening by the passage of time. There is urgent need to enhance farmers' paying capacity for appropriate water rates to meet O&M needs of the system. Water is highly low priced, mismanaged, wasted and due to low water charges/abiana, funds constraint exists for O&M and future investment in water sector infrastructure.

There is large gap in O&M expenditure and revenue collection i.e. 68, 80 and 77% for Punjab, Sindh and KPK, respectively whereas for Balochistan no gap as per available record. The overall gap is 72% which increased from 44% in 90s. The sustainability of full cost recovery requires financial capacity building of the farming communities alongwith proper service delivery, provision of good quality inputs and favorable production marketing. The analysis indicates that the overall gap between O&M cost and revenue is Rs. 192 per acre of CCA and is Rs. 201/-, Rs. 162/- and Rs. 817/- in Punjab, Sindh and KPK provinces respectively. Net production value per acre is maximum in Punjab province whereas, gap between O&M cost and revenue is maximum in KPK. This gap can be reduced by enhancing the water charges in the provinces keeping in view the production per acre e.g. Rs. 24,750, 9516, 18,921 and 8526 in Punjab, Sindh, KPK and Balochistan respectively. The overall gap between O&M and revenue is Rs. 72 per acre foot of water which is Rs. 54, Rs. 86 and Rs. 110 for Sindh, Punjab and KPK provinces respectively. The net production value per acre foot of water indicates the water use efficiency in different provinces; maximum in Punjab (Rs. 8939) and lowest in Balochistan (Rs. 4248/-). Sindh (Rs. 6050/-) and KPK (Rs. 4764/-) rank second and third position.

## 1. INTRODUCTION

Pakistan's economy is heavily dependent on agriculture; which contributes about 21% to GDP. Due to arid and semi-arid climatic conditions, Pakistan's agriculture is dependent on irrigation. Around 90 percent of agricultural output is entirely dependent on irrigation. Yet Pakistan's irrigation and drainage system is in dire straits. Despite substantial budgetary input, it is facing a shortage of resources and suffering from severe and worsening operational problems. Pakistan's extensive irrigation and drainage systems have been deteriorating because of deferred maintenance and utilization beyond design capacities. Currently, water and drainage charges are deemed to be part of provincial revenues. The gap between O&M expenditures and recoveries through water charges is high which was 44% in nineties and now increased to 72% in 2010. In fact, inequity in the distribution of surface water – due to deliveries less than designed levels, poor O&M, and even illegal diversion – is a major concern.

The productivity of water is low attributed to high water losses, inefficient water application methods, low water availability at critical crop growth stage, sub-optimal mix of crop, poor economic allocation of water etc. High application losses are primarily attributed to negligible water cost of surface water (Abiana), subsidized power tariff of electric tubewells, lack of awareness on the part of farmers etc. Planting of high delta sugarcane in most parts of Punjab, 'Pancho' system of irrigating rice fields, nominal charges of Rs 4,000 per annum for electric tubewells are the glaring examples of wasteful use of scarce water. The electric operated tubewells use pumped water in a much wasteful way. The diesel operated tubewell farmers on the other hand pump water using high cost fuel and make its much efficient use. The impact of subsidised electric power at the Water-Energy Nexus are in the form of indiscriminate use of low cost water pumped by heavily

subsidised electric tubewells and its optimal use by diesel tubewells farmers. In spite of massive investment, water scarcity and inefficient use of water remain the major constraints. It is on account of poorly managed irrigation system, non realisation of the value of water by agriculture as well as from non-agricultural sectors addition of polluted industrial waste/water in the irrigation system, rapid increase in population etc. In addition to decreasing storage due to sedimentation, relating to inefficient water use in agriculture include:, poor maintenance of channels, unreliable irrigation supplies, water shortages at critical crop demand periods, high water pumpage, low Abiana recoveries, increased sodicity etc. A critical analysis of the problem leads to the fact that the system is not properly maintained due to paucity of funds and water is not judiciously used because of its negligible cost. Thus it was necessitated that a critical analysis of water rates overtime and O&M cost of irrigation system to determine the gaps and subsidies by the Government and to develop a base for determining and unifying the assessment of abiana needs on the basis of crop share and farmers paying capacity and improve irrigation system and agriculture productivity and marketing to reduce Government liability. The study scope encompasses to cover water sources inventory, sustainable issues, review of water costing system, historic water rates/abiana, agricultural income tax, its collection, operation and maintenance cost, gaps and subsidies provided by the government to operate the system. The data was collected for the last 10 years from Irrigation and Revenue Departments of four provinces through mail as well as personal visits.

## **2. WATER RESOURCES OF THE COUNTRY**

Pakistan is a semi-arid country with total geographical area of 79.61 million hectares (Mha) out of which 22 Mha are designated as cultivated area. About 19.6 Mha of the cultivated area is provided with irrigation water whereas the remaining 2.4 Mha area is rainfed. The irrigated area is served through a network of canals which is being fed through Indus Rivers System. The rainfed areas lie mostly outside Indus Basin where traditional methods are regulated through man-made system to recharge the groundwater and abstract it through Tubewells, Karezes etc. The water needs are met through surface and groundwater resources.

### **2.1 Surface Water Resources**

The surface resources are received from western and eastern river flows as described below:

#### **2.1.1 Western Rivers Contribution**

Pakistan's primary water resource is the Indus river and its tributaries. With division of rivers under the Indus Water Treaty (1960), Pakistan is now dependent on three western rivers of Indus (including Kabul), Jhelum and Chenab. Annual average western river rim station flows (Indus at Kalabagh, Jhelum at Mangla and Chenab at Marala) from 1958-59 to 2007-08 are 138.35 MAF with Kharif inflows as 114.12 MAF (82 percent) and Rabi as 24.23 MAF (18 percent), while post-Tarbela (1976-2008) are 139.56 MAF with Kharif 114.27 MAF (81.9 percent) and Rabi 25.29 MAF (18.1 percent).

### **2.1.2 Eastern Rivers Contribution**

The three eastern tributaries of the Indus, Ravi, Sutlej and Beas have been allocated to India for its exclusive use. India has constructed the Bhakra Nangal Dam on harness the Sutlej, Pong Dam on Beas and Thein dam for harnessing the Ravi. The spills from these dams and unutilized flows enter Pakistan below Madhopur on the Ravi and below Ferozpur on the Sutlej. At present there is about 4.60 MAF of water which flows from India to Pakistan through eastern rivers. In addition, there is 3.33 MAF of run-off which is generated in eastern rivers catchments within Pakistan, particularly on the Ravi where a number of streams (Deg, Basanter and Bein Nullahs) join the Ravi upstream of Balloki.

## **2.2 Groundwater Resources**

Most of the Indus Basin is formed from alluvial deposits brought by rivers from the mountain ranges in the north. There is vast unconfined aquifer underlying in around 6 million hectares area. The hydrological conditions are mostly favourable for pumping groundwater by tubewells. A virtual explosion in the private sector tubewell development followed the introduction of tubewell technology by the public sector under SCARP Programme. Currently, there are nearly 768346 private tubewells (666035 fresh and 102311 saline) installed for irrigation purpose. As a consequence of this development, the groundwater pumpage in the Indus basin has increased from 5 MAF in 1970 to Over 46 MAF in 2009-10 from private tubewells. In the last about two decades, the private tubewell installation has increased @ 229%. This is causing groundwater level to fall rapidly in many fresh groundwater areas. Mining of groundwater is resulting intrusion of saline groundwater into fresh groundwater aquifers increasing deterioration of groundwater quality in many areas. In addition, pumping cost of groundwater also increases as watertable goes down. This means that more expensive and poor quality groundwater will have to be used for agriculture, domestic, industrial and environment protection purposes. Table-7 represents relationship between groundwater quality and volume of abstraction. The fresh water volume is 47 MAF and saline water volume is 3 MAF (2009-10).

## **3. WATER AVAILABILITY**

Irrigated agriculture is the backbone of the national economy. The level of agricultural production is directly related to the availability and effective use of water as a major input. The demand for water is increasing rapidly while the opportunities for further development of water resources or maintaining their use to existing levels are diminishing. The shortage of water particularly in Rabi season has further aggravated the usual water crises. The per capita water availability during 2010 merely 1000 m<sup>3</sup>/person is low, with Pakistan in the category of a high water stress country.

## **4. WATER SECTOR KEY ISSUES**

Pakistan has not managed its water resources to the optimal level and is now becoming increasingly water stressed compounded by over-use of water resulting in

waterlogging and salinity. The country's current storage capacity at 9 percent of average annual flows is very low compared with the world average of 40 percent. On average 33.2 MAF of water flows to the sea annually during flood season. In addition, extensive damages resulted due to the floods. Without additional storage, the shortfall will further increase to meet the demand of growing population during the next plan. The groundwater recharge where feasible is required which could be exploited, as and when necessary. The construction of large storages and small Dams is imperative otherwise water crisis will over shoot and food security becomes difficult to meet national demands. The massive expansion of private-sector tubewell irrigation in Pakistan has had its serious environmental consequences; 11.8 percent of the 22 million hectares of cultivated land has been declared as 'disaster area' because of severe waterlogging and salinity (watertable 0-5 feet), while another 32.5 percent is moderately waterlogged (water tables 5-10) feet below the surface). The reforms would involve changing the institutional and legal environment in which water is owned, supplied and used with the objective to improve water use efficiency. Pakistan water issues are both in the physical infrastructure (development) and social infrastructure (management) and have to be addressed with equal priorities. Major issues are listed as i) Water Availability/Demand Gap ii) Water scarcity/hydropower generation iii) Low storage capacity iv) Growing demand due to demographic pressure and competition between water use sectors v) Reservoir sedimentation vi) Un-regulated groundwater use vii) Un-captured downstream flows viii) Deferred maintenance due to low financing ix) Low land and water productivity x) Low water cost as compared to O&M cost and low recovery of water rates/Abiana/land tax xi) Transboundary water insecurity xii) Water Management to enhance efficiency and conservation at all levels of its usage xiii) Lack of water demand supply – reducing demand/proper allocation of water in critical demands period xiv) Pollution of water streams and xv) Indiscriminate groundwater pumpage/over mining impacts (aquifer, land and crops).

Water is highly low priced, mismanaged, wasted and due to low water charges/abiana, funds constraint exists for O&M and future investment in water sector infrastructure. The current water rates and their collection is quite insufficient even to meet O&M cost and the gap is widening by the passage of time. There is urgent need to enhance farmers' paying capacity for appropriate water rates to meet O&M needs of the system. In this regard, a multi-pronged strategy in coordinated manner is required to be adopted for meeting the demand of agricultural, municipal and industrial sectors. The irrigation management for meeting the requirement of agriculture will also include measures for improving agricultural productivity. Although irrigation and agriculture are under the domain of two separate provincial departments i.e. irrigation and agriculture, close coordination between these two departments is essentially required for seeking solution of water sector issues. In isolation, no solution will be workable or sustainable.

## 5. WATER PRICING: BACKDROP AND THEMATIC FRAMEWORK

Irrigation has become pivotal investment options for developing countries for feeding the masses, providing income opportunities to rural population, balancing regional developments and alleviating poverty, and hence building self sufficiency in food and fiber and state legitimacy. Massive capital outlays are allocated for irrigation infrastructure mainly on large Dams, irrigation schemes, flood control structures and other water projects. Efficiency pricing of irrigation water has always been a key challenge for policy makers recognizing that recovery of all costs may not be possible. Like other commodities, water has an economic value in all its competing uses. A water charge can be; financial tool aiming to recover all or part of capital and recurrent costs, an economic tool to conserve water and raise water productivity, an environmental tool to counter water pollution and improve water quality and saving of water quantity.

Agriculture sector is the largest user of water worldwide averaging 69% compared with 23% used by industry and 8% used by households. In developing countries, the share used by agriculture is even higher reaching 80%. Governments have usually played an active role in the ownership and management of water resources. Because of water's special characteristics such as a combined public good, economies of scale etc several problems relate to the resource including fragmented public sector management, neglect of water quality and inadequate pricing of water resources. Pricing water well below its economic value is prevalent throughout the world, even in developed countries. Many countries have historically considered water as free. Pricing and demand management approaches have therefore received much less attention. Similarly, farmers in the developing countries often pay little or nothing for publically supplied irrigation water. The economists therefore argue that they have little incentive for efficient and economical use of water especially towards conserving water or refraining from growing water intensive crops.

### 5.1 History of Water Rates in Pakistan

British Government transformed the inundation canals into weir controlled irrigation system and introduced occupier's rates to generate income. These rates were based on the volume of water required to mature a crop in term of depth in inches of water. Crops needing less water were charged at lower rates than crops needing more water. The Government also kept in view the cropping pattern and food crops were subsidized by rationalization of rates. The rates were different for different canal systems. Water rates, known as abiana are charged by the Provincial Governments for canal water supplied to irrigators. This is not a tax, but a service charge recovered from the farmers. The history of the modern water rates structure dates back to 1873, when the Canal and Drainage Act was enacted. Section 36 of this Act prescribed that "The rates to be charged for canal water supplied for the purposes of irrigation to the occupiers of land shall be determined by the rules to be made by the Provincial Government and such occupiers as accept the water shall pay for it accordingly". The first schedule for irrigation water charges was prepared for the Upper Bari Doab Canal (UBDC) in 1891. Similar schedules were prepared for other projects upon their completion.

The declaration of the pre-independence government of the Punjab was that it was the government's duty to see that the burden on canal water users is no heavier than they could bear. Irrigation water has always remained a critical, but low-priced input in the agriculture sector. Only in the interest of farmers welfare have water rates not been increased commensurate with rises in rates of other commodities. After the imposition of the earliest schedule of water rates in UBDC in 1891, the first revision of rates was effected in 1924, when increased by 25 %. The rates were reduced in 1934 due to a slump in the prices of agricultural produce. The reduced rates remained in force for quite a long time, despite the fact that the prices of agricultural commodities displayed an increasing trend. In 1955, the Punjab Government revised the schedule of the occupier's rates to the pre-1934 level.

## 5.2 Prevailing Water Rates

Indus basin irrigation system (IBIS) comprises 45 canals with 22 in Punjab, 16 in Sindh, 2 in Balochistan and 5 in KPK. Prior to the establishment of Provincial Irrigation and Drainage Authority (PIDA) during 1998, occupier's schedule of water rates were in vogue which were increased time to time to meet the expenditures. In the past, the water rates varied from crop to crop and from canal to canal which increased from time to time to meet the expenditures incurred on maintenance of irrigation system. With the passage of time, the establishment expenditures increased manifold which necessitated the revision of schedule rates. However, considering the payment capacity of the beneficiaries, and creating incentive for increased production, Govt. started to subsidize water rates which contributed about 5% to the cost of production of an average subsistence holding of 12.5 acres. In 1959, during the One-Unit period, the Government of West Pakistan decided to increase water charges on a uniform basis throughout the province. After 1959, there have been successive increases in water charges for major crops, as presented in Table-1.

**Table-1:** Successive Increases in Water Charges of Major Crops in Punjab

Item	1977-78	1980-81	1981-82	1993	1994	1995	1996	1997	1998	2003
Increase in Abiana	25 %	25%	25 %	25 %	10 %	10 %	37.5 %	10 %	10 %	Flat Rate System

Proper operation and maintenance of any system demands participation of beneficiaries sharing the responsibilities. During the recent past, government established Provincial Irrigation and Drainage Authorities in each province to look after operational system of irrigation network. Water Boards at divisional level were established to supervise and guide the Water Users Association. PIDA has modified the procedure of abiana and announced flat rates in Punjab and KPK. In Punjab a flat rate of Rs.85/- cropped acre during kharif season and Rs.50/- acre during Rabi is being charged. Since Kharif 2003, these rates are prevailed since then. The flat rate of abiana has been perceived to help the farmers' community escape from the high-handedness of revenue staff and to bring the large scale landowners into recovery net without compromising the total recovery from abiana in the province of Punjab. The flat rate system also makes the leakages from the

system of collection difficult and thus contributes to a higher sense of efficient utilization and equitable distribution amongst small landholders.

In KPK, the water rates (abiana) were enhanced by 25% with effect from Rabi 2002-03. These rates were double for lift irrigation schemes and tube-wells. These rates remained prevalent upto 2007-08 and from 01-07-2008 flat rates of abiana were introduced i.e. food crops (wheat, maize and rice Rs. 150 per acre and other Rs. 200 per acre. The flat rates of 2008 were changed during 2009 with effect from 01-07-2009 as Rs. 200 per acre for food crops and Rs. 250 per acre for other crops. In the province of Sindh water rates for various crops in different canal commands which come into effect since Rabi 1998-99. These rates are quite less as compared to KPK e.g. rice Rs. 88.78/acre, cotton Rs. 93 and sugarcane Rs. 120 per acre. Balochistan's occupier rates (abiana) effective from Kharif 1999 and afterwards have uniform continued annual increase @ 13%. These rates for rice (Rs. 124), cotton (Rs. 126), sugarcane (Rs. 242), wheat (Rs. 70) and gardens (Rs. 198) were subject to annual increase of 13%. These rates remained effective upto 2009 and then were revised during October 2009. The new rates are rice (Rs. 88.78), cotton (Rs. 83.09), sugarcane (Rs. 181.87), wheat (Rs. 53.30) and gardens (Rs. 142.14) which are even less than rates prevalent during 1999.

### 5.3 Agriculture Income Tax/Land Revenue

Agriculture Income tax was imposed through an ordinance during the year 1996-97 after abolishing of land revenue. Different rates of agricultural income tax in various provinces were introduced. The rates were amended during 1998, 2002-03 and last amendment was made during 2003 and upto 12.5 acre of irrigated land tax is exempted from 12.5 to 25 acres Rs. 150 per acre and exceeding 25 acres it is Rs. 250 per acre. In KPK, the Agriculture Income Tax rates are Rs. 50 per acre upto 5 acres of cultivated land, Rs. 72 per acre upto 12.5 acres, Rs. 100 per acre exceeding 12.5 acres and Rs. 300 per acre for matured orchards and for Sindh the rate is Rs. 200/-.

## 6. WATER RATES ASSESSMENT AND COLLECTION

The Irrigation Department used to be a revenue-earning department with a significant positive balance sheet during the colonial era. The irrigation revenues, apart from covering full O&M costs, also used to finance the capital cost of irrigation schemes in phases. With the passage of time, revenues started to decline as water rates could not keep pace with the rising inflation. Till the early 1970s, however, revenues were still meeting the full O&M cost of the irrigation system. The situation could not be maintained in the subsequent years due to a number of reasons; the gradual build up in the O&M cost of public tube wells, flood works and establishment, stagnation of water rates, and declining collections. Abiana against demand in Punjab province from 1999-00 to 2008-09 is given in Table-2. The recovery ranges between 47 to 87% with average of 59.71. The status of water rates and collection in KPK province for the period 2002-03 to 2009-10 is shown in Table-3. The recovery is between 51 to 66% with an average of 59% over the last eight years. Table-4 shows abiana collection against current demand in Sindh province

for the year 1999-00 to 2009-10. The recovery range is 51 to 98% with an average of 90.4%. Abiana collection against current demand in Balochistan province is depicted in Table-5. The recovery ranges is between 3.3 and 35.6% with an average of 10.1%.

**Table-2:** Abiana Collection against current demand in Punjab Province  
(Million Rs.)

Year	Assessment / Demand	Collection	Recovery (%)
1999-2000	1917.12	1346.47	70.23
2000-2001	2259.80	1357.32	60.06
2001-2002	2155.39	1210.90	56.18
2002-2003	2046.94	1167.07	57.02
2003-2004	2305.91	1205.01	52.26
2004-2005	1967.00	1205.00	61.00
2005-2006	2355.00	1107.00	47.00
2006-2007	2196.00	1032.00	47.00
2007-2008	1686.00	1246.00	74.00
2008-2009	1497.00	1296.00	87.00
Average	2038.62	1217.28	59.71

**Source:** Irrigation & Power Department, Govt. of Punjab, Lahore.

**Table-3:** Abiana Collection against current demand in Khyber Pakhtunkhwa Province  
(Million Rs.)

Year	Assessment / Demand	Collection	Recovery (%)
2002-2003	197.50	100.37	51.00
2003-2004	364.76	240.57	66.00
2004-2005	356.50	200.82	56.00
2005-2006	340.18	205.84	60.00
2006-2007	342.90	207.45	60.00
2007-2008	341.59	193.75	56.00
2008-2009	228.91	132.49	58.00
2009-10	244.09	155.37	63.00
Average	302.05	179.58	59.00

**Source:** Irrigation Department, Govt. of Khyber Pakhtunkhwa, Peshawar.

**Table-4:** Abiana Collection against current demand in Sindh Province  
(Million Rs.)

Year	Assessment / Demand	Collection	Recovery (%)
1999-2000	624.05	597.91	95.81
2000-2001	453.50	428.92	94.57
2001-2002	380.24	341.73	89.87
2002-2003	362.86	290.25	98.00
2003-2004	293.66	223.83	72.00
2004-2005	276.78	245.29	62.00
2005-2006	276.00	255.46	55.00
2006-2007	240.45	227.30	51.00
2007-2008	268.20	247.99	92.45
2008-2009	183.25	159.13	86.84
2009-10	260.65	254.21	97.53
Average	329.06	297.46	90.40

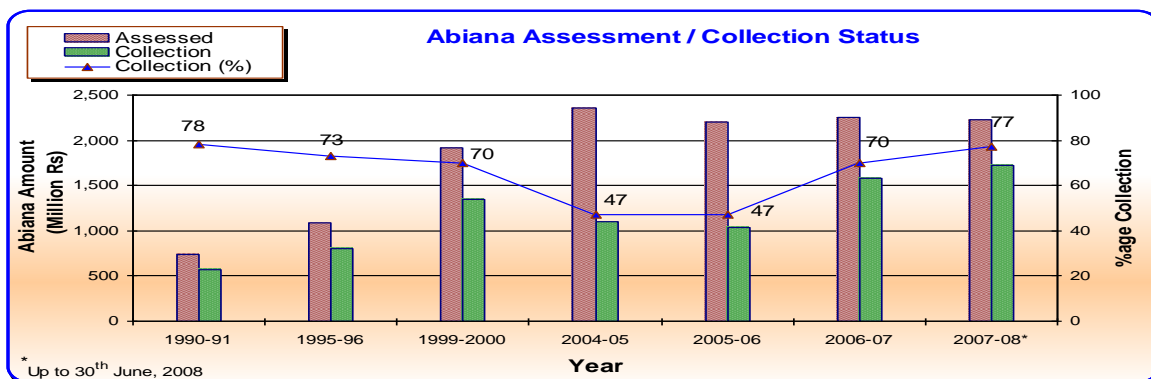
**Source:** Board of Revenue, Sindh, Hyderabad.

**Table-5:** Abiana Collection against current demand in Balochistan Province  
(Million Rs.)

Year	Assessment / Demand	Collection	Recovery (%)
1999-2000	38.37	13.66	35.60
2000-2001	49.45	11.44	23.13
2001-2002	56.87	11.48	20.19
2002-2003	68.37	11.35	16.60
2003-2004	298.82	9.99	3.34
2004-2005	110.22	10.42	9.46
2005-2006	126.77	11.48	9.05
2006-2007	126.66	9.22	7.28
2007-2008 (Rabi)	37.07	1.01 (0 for Kirther Canal System)	2.73
2008-2009 (Kharif)	27.97	5.46	19.51
Average	94.06	9.55	10.15

**Source:** SE, Pat Feeder Canal & Drainage Circle, Dera Murad Jamali; I&P Department, Govt. of Balochistan.

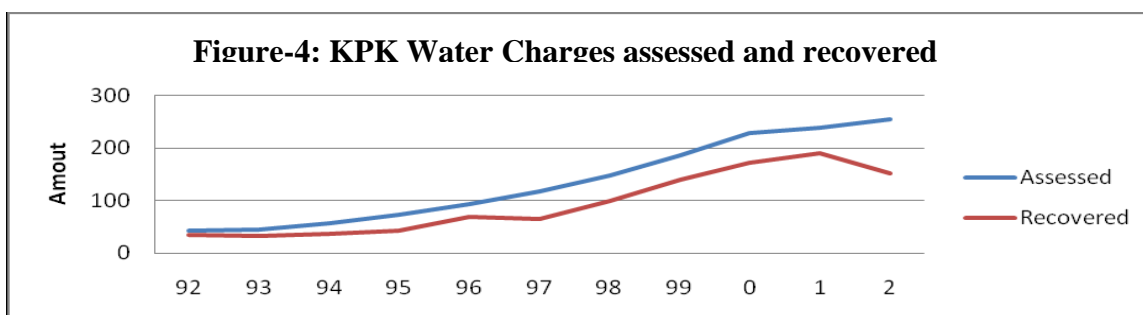
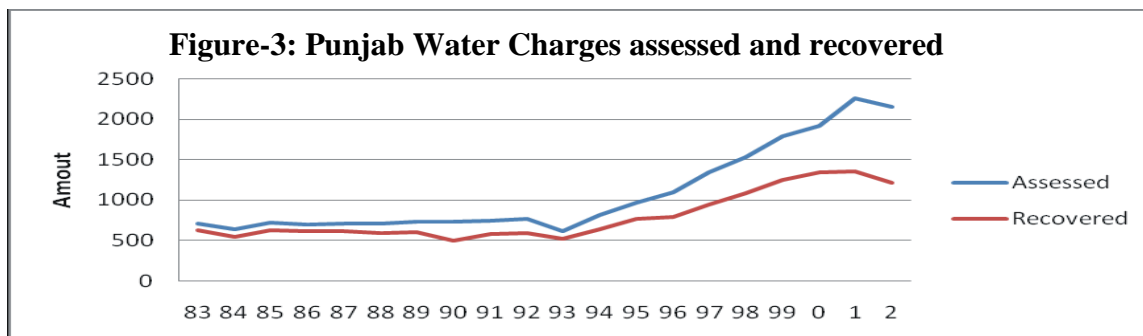
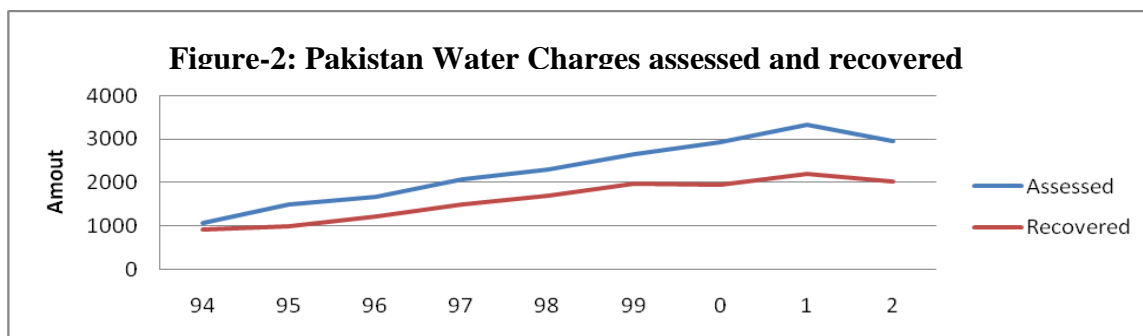
The recovery has gone down continuously in both the provinces during the last 13 years, which may be attributed due to political and socio-economic situation prevailing in the country. The trend of reduction in Abiana recovery is almost similar in the two provinces and it cannot be attributed to the system of assessment. Rather other factors like lack of political will contributed significantly in the reduced recovery of Abiana. The abiana is assessed by the Irrigation Department and collection is made by the Board of Revenue through the District Governments. Abiana collection against the current demands has been progressively declining in the recent past. The collection had declined from 79% in 1993-94 to around 47% by 2004-05 and 2005-06, while abiana assessment / collection status is presented in Figure-1 for Punjab province.



**Figure-1:** Abiana Assessment / Collection in Punjab

To address the issue of declining abiana collection, special efforts were made by I&P Department during 2006 and Provincial Government of Punjab was requested for according the highest priority to abiana collection. The progress was regularly monitored by the Chief Secretary Punjab in the DCOs monthly meetings. As a result of concerted efforts, the declining trend in abiana collection was reversed and abiana collection during FY 2006-07 and FY 2007-08 significantly improved to over 70%. In order to sustain the improved abiana collection, the Punjab Government has put in place the system of monthly and quarterly monitoring of provincial receipts including the abiana dues.

To cover the O&M costs, Abiana is imposed in canal commands of IBIS which is based on a system of varying water charges for different crops. It neither reflects the relative consumptive requirement nor takes into consideration the inequitable water supplies in various reaches of the system. It also does not reflect the cost of maintaining the system. The extent of canal command area (CCA) determines the amount of water supply to farms and water charges of individual farms. This practice continued till Kharif 2003 in all the provinces and since then flat rate of Abiana on the basis of CCA was introduced in Punjab. The recovery of expenditure in KPK as reported in Pakistan Water Sector Strategy was 38% in KPK, 32% in Punjab, 22% in Sindh and only 12% in Balochistan. Water charges assessed and recovered for Pakistan for the period 1994 to 2002 is shown in Figure-2. Water charges assessed and recovered for Punjab for the period 1983 to 2002 is shown in Figure-3. Water charges assessed and recovered for KPK for the period 1992 to 2002 is shown in Figure-4.



**Source:** Based on data provided by Planning Commission of Pakistan (2008)

In Punjab, Abiana is assessed by the IPD and the recovery is made by the Revenue Department. The collection as a proportion of assessment was better in 70s but it decreased gradually. The amount assessed as Abiana is roughly half of the O&M expenditure in Punjab. While the assessment is increased gradually, the recovery dropped significantly since 2000-01. The recovery as a percentage of demand decreased to 42% in 2004-05 compared to 79% during 1993-05. The average collection is 49% of demand for the period 2001-06. The recovery for Balochistan canal commands was abysmally low as of 13% for the same period.

## 7. WATER RATES RECOVERY IN OTHER COUNTRIES

In most of countries, water rate recovery is based on: a) O&M cost; b) interest on capital alongwith O&M cost, c) capital recovery in installment alongwith O&M cost. The system of water rates prevailing in some of the countries is summarized as i) In India the interest on capital cost and O&M cost is recovered, ii) In Turkey capital cost is recovered in full over a period ranging from 16 to 100 years payable in the following year, iii) In Egypt, Norway & Thailand no charge is levied, iv) In

Australia, New Zealand, France, Argentina, Portugal, South Africa and Zambia only O&M charges are recovered, v) In Iraq, Malaysia, Mexico, Philippines the beneficiaries have to pay their share of capital cost and O&M cost, vi) In Chili, the irrigators to pay back the full cost in 30 years, vii) In Peru, the irrigators pay all costs for new works; in addition they share 1/3<sup>rd</sup> of the costs for improvement of old works and viii) In USA the capital cost is recovered over a period of 50 years in addition to the yearly payment of O&M costs.

The above analysis reveals that some countries are recovering both the capital and O&M cost, while the others are recovering 100% of the O&M cost, whereas few countries are not charging at all. Higher water charges, would lead to greater water-use efficiency upto certain extent. Higher water-use efficiency will lead to increased cropped area and high water rate under a crop based assessment system which is to the disadvantage of small farmers. However, under the flat rate system, it will lead to higher cropping intensity and increased production across the board. In fact service delivery counts much alongwith optimal agro-marketing in building capacity of farmers.

## 8. O&M EXPENDITURE AND REVENUE

The O&M expenditure including establishment cost for provinces of Punjab, KPK, Sindh and Balochistan are given in Tables 6, 7, 8 & 9 respectively. Shortfall in O&M cost of irrigation system & recoveries for the provinces and on Pakistan basis is given in Tables-10 to 11. The total O&M of the Indus Basin Irrigation System is Rs. 9410/- million whereas the recoveries are to the tune of Rs. 2648/- million which cover only 28% of O&M expenses. The shortfall of 72% is to be subsidized by Government. The shortfall is 68% in case of Punjab, 77% in KPK, and 80% in Sindh province. The recovery percentage of water rates assessment is 60% in Punjab, 50% in KPK, 90% in Sindh and 10% in case of Balochistan.

**Table-6:** O&M Expenditure of Irrigation Department in Punjab Province

(Million Rs)

Year	Establishment	O&M	Total
2003-2004	2886	1377	4263
2004-2005	3127	1369	4496
2005-2006	3611	1792	5403
2006-2007	4163	2089	6252
2007-2008	4371	2055	6426
2008-2009	4665	2646	7311
2009-10	5098	2788	7886
Average	3989	2017	6006

**Source:** Irrigation & Power Department, Govt. of Punjab, Lahore

**Table-7:** O&M Expenditure of Irrigation Department in Khyber Pakhtunkhwa Province  
(Million Rs.)

Year	Establishment	O&M	Total
2000-01	261.174	232.674	493.848
2001-02	276.866	431.723	708.589
2002-03	297.345	3303.751	601.096
2003-04	334.879	212.178	547.057
2004-05	400.946	246.553	647.499
2005-06	487.521	268.320	755.841
2006-07	517.990	237.195	755.185
2007-08	570.238	269.410	839.648
2008-09	570.026	282.386	852.412
2009-10	780.265	297.617	1077.882
Average	449.725	278.181	727.906

**Source:** Irrigation Department, Govt. of Khyber Pakhtunkhwa, Peshawar

**Table-8:** O&M Expenditure of Irrigation Department in Sindh Province  
(Million Rs.)

Year	Establishment	O&M	Total
1991-92	568	692	1260
1992-93	712	791	1503
1993-94	713	877	1590
1994-95	882	972	1854
1995-96	1053	2050	3103
1996-97	982	2051	3033
1997-98	1215	1029	2244
1998-99	1497	938	2435
1999-2000	1530	1102	2632
2000-2001	1637	1514	3151
2001-2002	1826	2347	4173
2002-03	2194	2226	4420
Average	1234	1382	2616

**Source:** Irrigation & Power Department, Govt. of Sindh, Karachi.

**Table-9:** O&M Expenditure of Irrigation Department in Balochistan Province**(Million Rs.)**

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
O&M	10	10	10	10	10	10	10	10	10	10

**Source:** SE, Pat Feeder Canal & Drainage Circle, Dera Murad Jamali**Table 10:** Shortfall in O&M Expenditure of Irrigation System & Revenue in Pakistan**(Million Rs.)**

Item	Punjab	Sindh	KPK	Balochistan	Pakistan
<b>O&amp;M</b>	<b>6006</b>	<b>2616</b>	<b>778</b>	<b>10</b>	<b>9410</b>
Recoveries -Amount	1921	536	181	10	2648
-%age	32	20	23	100	28
Shortfall -Amount	4085	2080	597	-	6762
-%age	68	80	77	-	72

**Table 11:** Average Abiana, Demand / Collection and Recovery in Pakistan**Million (Rs.)**

Province	Demand	Collection	Recovery (%)
Punjab	2038.62	1217.28	60
Sindh	329.06	297.46	90
KPK	302.05	179.58	59
Balochistan	94.06	9.55	10
<b>Pakistan</b>	<b>2663.79</b>	<b>1703.87</b>	<b>62</b>

**Table 12:** Average O&M Cost of Irrigation System in Pakistan**(Million Rs.)**

Province	Establishment	O&M Works	Total
Punjab	3989.00	2017.00	6006.00
Sindh	1234.00	1382.00	2616.00
KPK	499.73	278.18	777.91
Balochistan	0.00	10.00	10.00
<b>Pakistan</b>	<b>5722.73</b>	<b>3687.18</b>	<b>9409.91</b>

**Table 13:** Average Agriculture Income Tax Demand and Collection in Pakistan  
(Million Rs.)

Province	Demand	Collection	Recovery (%)
Punjab	1044.00	704.00	67
Sindh	273.81	238.26	88
KPK	2.09	1.24	60
Balochistan	0.00	0.00	0
<b>Pakistan</b>	<b>1319.90</b>	<b>943.50</b>	<b>71</b>

The average shortfall in O&M cost of irrigation system and recoveries over the last ten years for the province of Punjab, Sindh, KPK and Balochistan are 32, 20, 23 and 100% respectively. On Pakistan basis, the shortfall is 28%.

## 9. AGRICULTURAL INCOME TAX ASSESSMENT AND COLLECTION

The agricultural income tax assessment and collection for the provinces of Punjab, KPK and Sindh are given in Table-14, 15 & 16 respectively. The average total demand of agricultural income tax in Punjab is Rs. 1044 million and the collection is Rs. 704 million with recovery percentage of 67 over the last six years. In KPK the average total demand over the last four year was Rs. 2.088 million and collection was 1.244 million at the rate of 60% recovery. In Sindh the agriculture income tax demand over the last nine years was Rs. 273.81 million with collection of Rs. 238.26 million with an average recovery of 88%.

**Table-14:** Agricultural Income Tax Collection against current demand  
in Punjab Province

(Million Rs.)

Year	Demand	Collection	Recovery (%)
2004-2005	1161	604	52
2005-2006	1312	658	50
2006-2007	1493	724	48
2007-2008	700	675	96
2008-2009	600	789	131
2009-2010	1000	771	77
Average	1044	704	67

**Source:** Board of Revenue, Govt. of Punjab, Lahore.

**Table-15:** Agricultural Income Tax Collection against current demand in Khyber Pakhtunkhwa Province

(Million Rs.)

Year	Demand	Collection	Recovery (%)
2006-07	1.769	1.000	57
2007-08	1.484	1.442	97
2008-09	2.483	0.569	23
2009-10	2.615	1.965	75
Average	2.088	1.244	60

**Source:** Board of Revenue, Govt. of Khyber Pakhtunkhwa, Peshawar.**Table-16:** Agricultural Income Tax Collection against current demand in Sindh Province

(Million Rs.)

Year	Demand	Collection	Recovery (%)
2001-02	488.548	397.027	81
2002-03	316.774	251.033	79
2003-04	247.079	201.121	81
2004-05	254.933	225.164	88
2005-06	256.456	234.289	91
2006-07	187.186	179.589	96
2007-08	250.301	224.675	90
2008-09	211.963	195.998	92
2009-10	251.084	235.483	94
Average	273.81	238.26	88

**Source:** Board of Revenue, Govt. of Sindh, Hyderabad.

## 10. WATER COSTING AND VALUATION

### 10.1 Total Net Value of Production

Province-wise crop budgets covering total gross production value, cost of production, total net crop income calculated from the crop budgets combined with the reported irrigated area in each province to provide a measure of income at economic prices from irrigated lands. The net income values divided by the reported quantities of irrigation water, both surface water and groundwater give estimated value of water per acre foot.

## 10.2 Value of Water

Net crop income from the crop budget was related to the reported irrigated area in each Province to provide a measure of income at financial from irrigated lands.

The net income values divided by the reported quantities of irrigation water both surface water and groundwater provides a measure of value of water per acre foot. The calculations regarding value per acre foot of water (both surface and groundwater) at root zone as well as source (Dam site) for each province are shown in Table 17. The overall value per acre foot of water in the Indus Basin or Kharif and Rabi water has been worked out. The value of water per acre foot in the Indus Basin for irrigated agriculture, at root zone comes to Rs. 7867/- and at source comes to Rs 3508/-.

**Table-17:** Value Per Acre Foot of Water for Irrigated Agriculture in Indus Basin

Sr. No.	Description	Punjab			Sindh			KPK			Balochistan			Indus Basin		
		Kharif	Rabi	Annual	Kharif	Rabi	Annual	Kharif	Rabi	Annual	Kharif	Rabi	Annual	Kharif	Rabi	Annual
1	CCA(MA) <sup>1</sup>	-	-	27.40	-	-	6.38	-	-	0.62	-	-	0.77	-	-	35.17
2	Cropped area(MA) <sup>2</sup>	16.75	19.26	36.01	4.37	3.94	8.31	0.43	0.59	1.02	0.38	0.48	0.86	21.93	24.27	46.20
3	Average canal withdrawals MAF <sup>3</sup> (2001-10)	33.48	13.83	47.31	27.63	10.62	38.25	3.35	2.04	5.39	2.04	0.81	2.85	66.50	27.30	93.80
4	Canal water availability at root zone (MAF) assuming efficiency @ 37 to 51% <sup>4</sup>	17.07	7.05	24.12	10.22	3.93	14.15	1.54	0.94	2.48	0.86	0.34	1.20	29.69	12.26	41.95
5	Punpage (MAF)															
	i) Farm gate	21.60	18.40	40.00	4.05	3.45	7.50	0.43	0.37	0.80	1.08	0.92	2.00	27.16	23.14	50.37
	ii)Rootzone@ 80% efficiency	17.28	14.72	32.00	3.24	2.76	6.00	0.35	0.29	0.64	0.86	0.76	1.62	21.73	18.53	40.26
6	Total water availability (MAF)															
	i) Rootzone{4+5(II)}	34.35	21.77	56.12	13.46	6.69	20.15	1.89	1.23	3.12	1.72	1.10	2.82	51.42	30.79	82.21
	II)Source after adding losses	67.35	42.68	110.03	36.38	18.08	54.46	4.11	2.67	6.78	4.10	2.62	6.72	111.94	66.05	177.99
7	Total NVP <sup>5</sup> (Billion Rs.)	246.86	254.81	501.67	80.63	41.29	121.29	6.71	7.13	13.84	4.91	7.46	12.37	339.11	310.69	649.17
8	Value of water (Rs per acre foot)															
	i) Rootzone	7130.00	11.71	8939.0	5990.00	6172.00	6050.00	3550.00	5797.00	4436.00	2855.00	6782.00	4386.00	6595.00	10091.00	7896.00
	II)Source	3665.00	5970.00	4559.00	2216.00	2284.00	2238.00	1633.00	2670.00	2041.00	1198.00	2847.00	1841.00	6595.00	4704.00	3647.00
9	NVP (Rs/Acre CCA)			18312.00			19026.00			22467.00			14202.00			18458.00
10	NVP (Rs/Cropped acre)	14738.00	13230.00	13931.00	18451.00	10480.00	14596.00	15605.00	12085.00	13568.00	12921.00	15542.00	14384.00	15463.00	12801.00	14051.00

## Source

<sup>1</sup> Adopted from Basha Diامر Dam Project Feasibility Report Volume-XII, Economic and financial evaluation, August 2004

<sup>2</sup> Agricultural Statistics of Pakistan 2000-2009 (various issues)

<sup>3</sup> Indus River System Authority

<sup>4</sup> Value for Punjab is 51, for Sindh 37, for KPK 46, for Balochistan 42 and for Indus Basin is 44.6, adopted from WAPDA Basha Diامر Dam Project Feasibility Report, Volume-XII, Economic and financial evaluation, August 2004

<sup>5</sup> Adopted from Basha Diامر Dam Project Feasibility Report Volume-XII, Economic and financial evaluation, August 2004

## 11. IRRIGATION MANAGEMENT THROUGH FARMER ORGANIZATIONS (FOS)

The reforms in the Punjab province started with promulgation of the 'Punjab Irrigation and Drainage Authority (PIDA) Act 1997. For implementation of the reforms initiatives, a legal framework has been evolved by the PIDA, which is based on the participation of farmers at all levels of irrigation management that is at provincial level, canal command level, and at distributary level. The framework legitimizes the reforms process and set up for the establishment of Farmers Organizations and Area Water Boards through Rules and Regulations under PIDA Act. The financial sustainability is one of the corner stones of the institutional reforms. The Farmers Organizations are being established for taking over O&M of distributary canals. The FOs were also given responsibility for assessment and collection of abiana. As a first step, 84 FOs were established in LCC East canal command in 2005, and the irrigation management was transferred to these FOs in three groups. The institutional reforms had been planned and implemented on the promise that the increased farmer participation in management of irrigation services will have a positive impact on overall physical and financial sustainability of the irrigation system through increased abiana collection and ensuring equitable water distribution. At the beginning, most of the FOs showed abiana collection of 80% or even higher but this trend did not continue and FOs abiana collection gradually declined. The same trend has also been reported in case of FOs in Nara Canal AWB of Sindh, Province. The crop wise progress of FOs of LCC (East) command regarding assessment and collection of water charges is given in Table-18.

**Table-18:** FOs Abiana Collection in LCC (East) Canal System

Crop Season	No. of FOs	Assessed Amount (M Rs.)	Remission (M Rs.)	Collected Amount (M Rs.)	Av. % age Collection
Rabi 2004-05	65	51.7	4.1	42.2	88.6
Kharif 2005	84	123.6	11.1	90.8	80.7
Rabi 2005-06	80	68.2	6.9	49.2	80.3
Kharif 2006	84	123.5	9.2	69.3	60.6
Rabi 2006-07	80	68.1	2.2	41.9	63.6

In order to improve the abiana collection, PIDA is continuing the capacity building of FOs. The capacity building and training cells are providing on the job training to each FO regarding proper maintenance of abiana assessment and abiana record and guidance for improving recovery of abiana. Efforts are also underway for putting in place the system for recovering the arrears of abiana dues from the defaulting farmers.

## 12. Per unit O&M, Revenue and net production value

The province-wise and commanded area of Indus River System is given in Table-19.

**Table-19:** Province-Wise Canal Commanded Area Of Indus River System

(Million Ha)

Province	KPK	Punjab	Sindh	Balochistan	Total
CCA (Mha)	0.296	8.203	5.184	0.587	14.270

An analysis has been done on the basis of available information collected from the provinces and production value of Economic Survey of Pakistan in 2008-09. The province-wise O&M cost, revenue, gap between O&M and revenue and net production value (per acre and per ha CCA) is shown in Table 20. The analysis indicates that the overall gap between O&M cost and revenue is Rs. 192 per acre which ranges from Rs. 201/-, Rs. 817/- and Rs. 126/- in Punjab, Sindh and KPK provinces respectively. Net production value per acre is maximum in Punjab province whereas gap between O&M cost and revenue is maximum in KPK. This gap can be reduced by enhancing the water charges in the provinces keeping in view the production per acre e.g. Rs. 24,750, 9516, 18921 and 8526 in Punjab, Sindh, KPK and Balochistan respectively.

The Tables 20-21 indicate the province-wise O&M cost, revenue, gap between O&M and revenue and net production value per acre foot of irrigation water. The overall gap between O&M and revenue is Rs. 72 per acre foot of water which ranges from Rs. 54, Rs. 86 and Rs. 110 for Sindh, Punjab and KPK provinces respectively. The net production value per acre foot of water indicates the water use efficiency in different provinces It is maximum in Punjab (Rs. 8939) and lowest in Balochistan (Rs. 4248/-). Sindh (Rs. 6050/-) and KPK (Rs. 4764/-) are at 2<sup>nd</sup> and third position.

**Table 20:** Province-wise per unit O&M, Revenue, Gap and Net Production Value (Rs. Per ha/acre)

Province	O&M		Revenue		Gap		Net Production	
	ha	Acre	ha	Acre	ha	Acre	ha	Acre
Punjab	723	296	234	95	498	201	61157	24750
Sindh	505	204	103	42	402	162	23515	9516
KPK	2628	1064	611	247	2017	817	46753	18921
Balochistan	17	7	17	7	-	-	21068	8526
Pakistan	659	267	186	75	473	192	45251	18313

**Table 21:** Province-wise per unit O&M, Revenue, Gap and Net production Value (Rs. Per Acre Foot of Water)

Province	O&M at Canal Head	Revenue at Canal Head	Gap at Canal Head	NVP at	
				Canal Head	Root Zone
Punjab	127	41	86	4559	8939
Sindh	68	14	54	2238	6050
KPK	144	34	110	2041	4436
Balochistan	3.5	3.5	0	1841	4386
Pakistan	100	28	72	3647	7896

### 13. OPTIONS TOWARDS SUSTAINABILITY

The review of water pricing framework in Pakistan highlights the following main points:

#### 13.1 Facts

- Efficient pricing of irrigation water has always been a key challenge for policy makers recognizing that recovery of all costs may not be possible. Adequate pricing of water is considered desirable in a general economic sense to help in the efficient allocation of water, and also in a financial sense in order to guarantee the financial sustainability of the higher level water supply systems.
- Low pricing of water can result in major misallocation of water, waste of water resources, and fiscal deficit for the government agencies charged with water management responsibilities and poor service delivery to the users. While devising water pricing policy, some of the parameters may be O&M needs of the system, costs associated with infrastructure rehabilitation, incentives for efficient use of water and capital, simple tariff rate structure, and environmental considerations.
- There is large gap in O&M expenditure and revenue collection i.e. 68, 80 and 77% for Punjab, Sindh and KPK, respectively whereas for Balochistan no gap as per available record. The overall gap is 72% which has increased from 44% in 90s.
- In colonial era, the irrigation revenues apart from covering full O&M costs also used to finance the capital costs of irrigation schemes in phases. However, with the passage of time the maintenance and management costs progressively increased but revenue started to decline as water rates could not keep pace with the rising inflation and system O&M needs.

## 13.2 Way Forward

- It is necessary to estimate the Full Cost of water used in a particular sub-sector of water use and this should include the Opportunity Cost of water as well as the Environmental Externalities. The Full Cost should present the context for setting water prices, effluent charges, and incentives for pollution control. Furthermore, it would also help to visualize the value of water. Irrespective of the enforcement, there is a need to initiate estimation of full cost covering all the components.
- For estimating the value of water, it is critical to reflect societal objectives of poverty alleviation and food security, and incorporate the net benefits from return flows and non-irrigation uses of water. However, as the current level of water fee (Abiana) charged is a portion of the O&M cost, there is a need to develop methodology for estimation of full value of water.
- There is a need to develop strategy for costing and charging of water fee so that rapid increase in Abiana and water fee may not affect the users adversely. Furthermore, inter-sectoral strategy is also needed for charging in different sub-sectors of water use. It is evident from the global experiences that raising water tariffs, levying effluent charges and encouraging water markets can play significant roles in improving economic efficiency and environmental sustainability of water use. Therefore, a holistic approach is needed for the estimation of full cost of water and then a phase-wise strategy for charging of water fee.
- The sustainability of full cost recovery requires financial capacity building of the farming communities alongwith proper service delivery, provision of good quality inputs and favorable production marketing.

### REFERENCES:

- Water Costing Seminar Proceedings prepared by Water Resource Planning Organization, P&D WAPDA– March 2007
- Economic Survey of Pakistan – 2008-09
- Agricultural Statics of Pakistan – 2008-09
- Data provided by Planning Commission of Pakistan (2008)
- Data collection from Provincial Irrigation and Power Departments and Board of Revenues of the provinces of Pakistan – official/personal transactions.

