Inaugural Session

L to R: (i) Engr. Rana Muhammad Saeed Ahmad Khan, President of the Congress.
(ii) Engr. Ch. Muhammad Amin, Member Water, WAPDA (in Chair)
(iii) Engr. S.M. A. Zaidi, Secretary of the Congress

A Partial View of the Participants

Technical Session

L to R: (i) Engr. Rana Muhammad Saeed Ahmad Khan, President of the Congress.
(ii) Engr. Ch. Muhammad Amin, Member Water, WAPDA (in Chair)
(iii) Engr. Ch. Ghulam Hussain, Vice President of the Congress.

A Partial View of the Participants

TABLE OF CONTENTS

FOREWORD

By

Engr. Ch. Ghulam Hussain*

on

WORLD WATER DAY

Water is life ; the Almighty Allah reveals in the Holy Quran that He created everything from water وَ جَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ ط اَفَلَا يُؤْمِنُوْنَ ○ and what an eye opening testimony that burgeoning population of humans, animals, birds, forests, trees, plants and all kinds of surface and water creatures is seen throbbing and humming at the river banks, water channels, underground reservoirs where water is available. Water is life is also manifest from non-existence of life in great deserts of the world. But water on earth is not limitless. It can, for certain, not keep up with the ever increasing demand. Its supply will continue to dwindle unless all the available resources are tapped, conserved and scrupulously availed of.

It was at the predictions of the "Think Tanks" that future wars would mainly be fought on the sharing of waters more so when it has been often brought out in the Media that with the astronomical evolution of communications, the world has by and large virtually been reduced to a global village and such a possibility would not be a lunatics cry. It is with this sort of trauma that the Nations of the world are seized with the acute problem as to how best to tap, conserve and avail water resources.

The comity of Nations rose to the occasion and in 1992 during the "United Nations Conference on Environment and Development (UNCED)" in Rio de Janeiro took the initiative for observance of World Water Day starting on 22nd March of every year as of 1993.

Further, UNO during its 58th Session declared the period from 2005-2015 as the international decade for Action "Water for Life". Starting on World Water Day – 22nd March 2005 it marks the start of it. The water for life decade 2005-2015 will boost the chances of achieving international water goals including those in U. N. Millennium declaration.

The aspects of available water resources, their conservation and usage are manifold. Every nation is engaged in addressing to the issue in the perspective of its respective requirements. In the context of Pakistan every year the World Water Day is observed with Seminars/Symposia where technical papers on various aspects of the issue are presented and discussed to enlighten and educate the engineers, scientists and the public at large.

The symposium on World Water Day for the year 2005 was held on 22nd March by

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*Convener Publication Committee Pakistan Engineering Congress.

Pakistan Engineering Congress, in collaboration with Water and Power Development Authority (WAPDA). Six technical papers by eminent engineers/experts presented on the diverse fields from Large Dams to drinking water and public hygiene were as under :

(i) Constructing New Dams for Pakistan's Survival by *Dr. Izhar-ul-Haq*, General Manager (Technical Services), WAPDA.

(ii) Implementation of Indus Waters Treaty 1960 by *Engr. Syed Jamaat Ali Shah*, Pakistan Commissioner for Indus Waters.

(iii) Pakistan's Water Resources Development and the Global Perspective by Engr. M. Mushtaq Ch. General Manager P&D Water, WAPDA (Now Member Water) and *Dr. Allah Bakhsh Sufi*, Project Director (WRPO), P&D Water WAPDA.

(iv) Reducing the Impact of Unplanned Urbanization on a Riparian Eco-System : A case Study on Designing a Plan for Sustainable Utilization of Flood Plains on River Ravi by *Dr. Amin U. Khan*, Chairman, Botany Deptt. and Sustainable Development Study Center, Govt. College University, Lahore.

(v) Ground Water Use in Pakistan : Opportunities and Limitations by *Dr. Muhammad Nawaz Bhutta*, Director General (IWASRI) WAPDA.

(vi) Development of Sub-Surface Drainage Data Base System for Use in Waterlogging and Salinity Management Issues by *Dr. Aftab H. Azhar*, *M. M. Alam* and *M. Rafiq* (IWASRI), WAPDA.

There can be many more topics for the technical papers which can be attended to in this specific field at the future moots.

There has been a great demand from the Engineering Congress Members for publication of the above papers in a memorable volume.

Papers published in this volume are open for written discussion where Engineers and Scientists are invited to take part. This is an important issue, which merits continuous attention of the professionals as well as decision makers. Depending upon the volume of discussion papers received, the Congress would also like to publish a Discussion Volume in the intervening period 3 months before the next "World Water Day" on March 2006. ■

ADDRESS OF WELCOME

By

Engr. Rana Muhammad Saeed Ahmad Khan*

on

WORLD WATER DAY

Honourable Chief Guest Engr. Muhammad Amin, Member (Water) WAPDA, distinguished guests. Members of the Congress, Ladies and Gentlemen.

It is my pleasure to welcome you all to this gathering for ceremonizing the World Water Day. I have also to thank the respected Chief Guest and all of you for finding some time to attend this event of global importance.

I am grateful for providing me an opportunity to be with you to address this august body of engineers and scientists all those who are concerned with the protection and conservation of water.

Ladies and Gentlemen

The International observance of World Water Day is an initiative that grew out of the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro. The United Nations General Assembly designated 22nd March of each year as the World Water Day and it was started from 1993. Further UNO during its 58th Session declared the period from 2005 – 2015 the international decade for Action "Water for Life". Starting on World Water Day – 22nd March, 2005 it marks the start of a new United Nations International decade for action on Water. The water for life decade 2005 – 2015 will boost the chances of achieving international water goals including those in U. N. Millennium declaration.

"Water for Life" is a very broad slogan, which gives every body an opportunity to stress upon topics of their interests, the main areas in Pakistan are : Water for Health, Agriculture and Energy, Bio-Diversity and Environment. To achieve the goals we must aim at having a strong focus on implementation a water related programme and management of projects in Pakistan. The Water situation due to growth in population, rapid industrialization and extensive agriculture has been deteriorating day by day. The position has become more serious as the per capita water availability has dwindled down from 5260 Cubic Meter in 1951 to 1234 Cubic Meter in 2004 and if no remedial measures are taken immediately Pakistan is going to face water related disasters in near future.

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*President Pakistan Engineering Congress.

The 10 years period of 2005 – 2015 will be critical years to focus attention on matters related to the theme "Water for Life" and assuring that every one is aware of the urgency of the goals to be achieved that there is an urgent need of integral development of water resources and optimizing the use through storage and better regulation.

The "Water for Life" decade starts from today 22nd March, 2005. It's a unique occasion not just to highlight the magnitude of the problem but also to bring all stakeholders together to apply solutions that work in the overall interest of the nation.

Despite efforts by the Government the safe drinking water and sanitation in rural as well as urban areas is not very satisfactory. Hence, there is a need for having strong focus on implementation of drinking water related programme and also to encourage participation of women for the betterment of the people to control water borne diseases in Pakistan.

This decade will be crucial for the nation for intensifying advocacy efforts and action on the ground as integrated water resources management is required to deal with the water issues in a cost effective and environmentally sustainable way. We have to build many more Dams to meet our need for food, fiber and power required for domestic and industrial use. Kalabagh Dam being environmentally sustainable and technically sound warrants highest priority to help control aggravating water situation.

Ladies and Gentlemen : We have assembled here to remind ourselves about the fast approaching water crisis and the urgency of taking appropriate measures to combat such eventuality. I sincerely hope that this seminar on World Water Day will discuss valuable ideas and recommendations to be presented by the participants realizing the importance of the matter and come forward with their active support for environmentally sustainable water storage projects and for providing clean water to the public for better health.

Papers being presented today deal with diverse fields from large dams to drinking water and public hygiene. I will request all of you to kindly participate till the close of this sitting and provide your valuable input.

Thanking you.

PAKISTAN ZINDABAD

CONSTRUCTING NEW DAMS FOR PAKISTAN'S SURVIVAL

By

Dr. Izhar-ul-Haq*

GENERAL

The valleys of the River Indus and it tributaries, called "Indus River Basin" constitute the heart land of Pakistan. It includes the mountain basins of the north and the west, the Indus Plains, the Kachhi Plain, Desert areas of Sindh and the Rann of Kach. Population density is the highest in the canal irrigated areas in the north east of Indus Plains. The arid Plateaus and barren mountains, on the other hand, are least inhabited. The increasing population and the associated social, technical and economic activities all depend, directly or indirectly, on the exploitation of water as a resource.

Water security has been recognized as the principal concern for sustainable development in the 21st century. The availability of freshwater is one of the greatest issues facing mankind today. Human and agricultural demands continue to grow. The regions of the world that face shortages are growing in area and number.

Out of the entire water present on the earth, only about 2.5 percent is fresh and fit for direct use, of which 75 percent is locked up in ice caps and glaciers located in polar areas not easily accessible for use, while 24 percent is contained in groundwater reservoirs which has to be extracted before use. Thus, only one percent of the fresh water is available in lakes and rivers which has to be transported to the areas of use by constructing storage and diversion networks. It should be remembered that God has not blessed any region of the world with a rainfall pattern that would exactly match with the crop water requirements. It has to be appropriately managed to bring it in use for the mankind.

Water in today's context is a critical natural resource on the earth because of inadequate development, competing demands, wastage and degradation due to pollutants. The United Nations Organization (UNO) therefore, decided in 1993 to observe every year 22nd March as the World Water Day (WWD) to focus attention of the world community on the importance, need and urgency of preserving the quality and augmenting the quantity of water available in all places.

Storage capacity of dams constructed on Indus Basin System provided some flexibility to transfer surplus flows from Kharif to Rabi and overall provincial canal supplies increased by over 22 percent under the post-dams scenario. However, due to reduction in storage capacity as a result of silting of reservoirs, this flexibility has considerably reduced

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*General Manager (Technical Services) WAPDA

(Table-1). The total storage capacity is anticipated to decrease by over 6.03 MAF by the year 2010 which is equivalent to a mega dam. In order to meet immediate requirements of water and power, Pakistan should initiate the programme of construction of mega dam storage. On potential sites on river Indus.

WATER DEMAND

Pakistan's population currently at 141 million is projected to increase to 220 million in 2025. The percentage of urban population will increase from the current 35% to more than 60% in 2025.

The total area of Pakistan is 196 Million Acres (MA). Out of which 77.0 MA can be used for cultivation, but only about 54.5 MA is currently cultivated. Remaining 22.5 MA is lying barren for lack of water. (Fig- 1) presents the land use of Pakistan.

Increasing irrigation intensity of the existing cropped land, requires additional water to be available which will have to be achieved through a combination of improved water management, efficiency and additional water availability at critical times of the year. This would require expansion of existing irrigation infrastructure.

Major part (over 80%) of Pakistan is located in Arid to Semi-Arid Regions of the world where rainfall is highly deficient and does not match with crop water requirements. Water has to be appropriately managed to bring it in use for the crops. Analysis of flow of Western Rivers indicates that flows of Indus Basin are highly uneven in terms of time. More than 85 percent of river flows are concentrated during Kharif while only 15 percent flows are available in Rabi as compared to irrigation requirements of 60 and 40 percent in Kharif & Rabi respectively. High flow variations dictate that Pakistan should construct large number of mega dams to optimally meet crop water requirements across Kharif/Rabi, high flow years to low/drought years.

The stored water is already insufficient even to meet the needs of the existing cropped area and there is going to be a gradual reduction in stored water because of siltation of the reservoirs.

The net irrigation water requirement for crops in Pakistan was around 77.4 MAF for the year 2003-04. The water requirement for the period 2010-2011 would be 89 MAF and 114.64 MAF for the year 2024-25 (Table-2)

WATER AVAILABILITY

Pakistan receives water through Western Rivers (Indus, Chenab and Jhelum) which is recorded at the rim stations. In addition to this, Pakistan also gets some water through Eastern River (Sutlej, Beas & Ravi) which is recorded at various points below control points in India and also at different sites within Pakistan. In order to determine the availability of river flow, the post Tarbela flows of Western Rivers at the rim stations and flow of Sutlej River post-1980 and Ravi River post 1993-94 have been used for analysis. In addition, a few

hill torrents/nallahs which originate in the vicinity of Indo-Pakistan border and outfall in Eastern Rivers have been taken into account.

During the high flow periods, (July-September), large amount of water flows to the sea because of inadequate capacity of existing reservoirs. However, the average annual flows to the sea for the post-Tarbela period is around 35 MAF (Fig. - 2). This water flows down during two months of July, August and some times the floods create damage to property of the order of $ 1 Billion per annum.

EXISTING WATER RESOURCES

Pakistan possesses one of the world largest contiguous irrigation system known as Indus Basin Irrigation System (Fig- 3). This system mainly comprises the Indus main river and its five major tributaries. After Indus Basin treaty with India in 1960, Pakistan was allotted the flows of three western rivers namely Indus, Jhelum and Chenab. The flows in these rivers are quite variable. About 84% flows occur in Kharif (Summer) season. The great variability of water flow has urged to develop and manage irrigation system in such a way so that assured and regular water supply for agriculture can be made available.

The system is comprised of two large reservoirs Mangla and Tarbela Dam, 23 barrages, 12 inter-river link canals and 48 perennial & non-perennial canal commands. The total length of main irrigation canals including distribution system is 60,000 km. The whole canal system serves about 90,000 water courses with approx length of 1 Million km. (Table-3) shows the Existing Water Storage Projects of Pakistan. In addition to this there are about 5 dozen small dams built, operated and maintained by the Provincial Small Dams Organizations. These dams supply water in the local areas both for irrigation and drinking.

After the construction of Mangla, Tarbela and Chashma reservoirs, the provincial canal diversions increased as:

Province	Pre-Dams	Post-Dam	% Increase *
Punjab	47.69	54.02	13.27
Sindh	35.56	44.47	25.06
NWFP	4.66	6.16	32.19
Balochistan	0.62	1.80	190.32
Pakistan	88.53	106.45	22.24

* The increase in canal diversions is primarily during Rabi season.

With the completion of Indus Basin Project, including three on-line storages, the Irrigation System attained a significant facility for integration of river supplies. As a consequence, the canal head diversions attained a peak of 106 MAF in Post-Tarbela period as compared to 67 MAF at the time of independence. Incidentally this reduced the flood damages frequency also.

Reservoir sedimentation is a major problem in Pakistan. Indus River brings on the average about 200 million tons of sediments per year at Tarbela and the reservoir is losing its capacity at the rate of 0.11 MAF per year. By the year 2010 these storages would lose 33% (6.03 MAF) of their capacities (Table-1). This virtually means loss of one mega storage project.

With the increased population, Pakistan is fast heading towards a situation of water shortage. Per captia surface water availability was 5650 m3 per person in 1951, which reduced to 1234 m3 per person in 2004 (Fig-4). According to Dr. Falken Mark criteria, water availability less than 1000 m3 per person creates acute shortage of water which effects the health of human beings. In the year 2012, Pakistan will be reaching the state of "acute water shortage" if no large dam is built. Pakistan would require nearly $ 1.0 Billion per annum to import food and other agricultural requirements.

HYDROPOWER PROJECTS

At 8% power demand growth rate, Pakistan would face power shortages from year 2006. Based on the present generation capacity the hydel: Thermal mix in the country is 34:66, which is almost the reverse of an ideal hydel-Thermal mix which should be 70:30 for overall economic development of the Pakistan. The induction of thermal generation in nintys helped in overcoming load shedding but it resulted in substantial increase in power tariff.

For Pakistan, the corner stone of self reliance in power sector development is optimal utilization of hydel resources. Hydropower is the most important, non polluting renewable source of energy. Pakistan is fortunate to be endowed with economically exploitable hydropower potential of 43,000 MW (Table-4). It is a pity that Pakistan's power shortages are being largely met through thermal power rather than cheaper hydel alternative, which is eternally available source of energy and a bounty of nature in contrast to environmentally hazardous and non renewable sources of energy. If hydel power stations are not built, the country shall have to import furnace oil worth $ 1.5 billion per annum for thermal power generation. The tariff would increase exorbitantly.

Small hydel power stations can not meet the demand and increase the hydel Thermal ratio. Therefore, a sizable injection of cheap hydropower through multipurpose storage is required to meet the demand and keep the cost of electricity within affordable limits.

CONSTRUCTION OF DAMS

After completion of Tarbela Dam project since 1976, the development of water storages has been at stand still. Although Ranking study of Hydropower Projects on river Indus & its tributaries was carried out in early eighties and Detailed Engineering Design & Tender Documents of Kalabagh Dam Project were prepared in mid eighties yet no project came up for implementation. Storage capacity of on line reservoirs is reducing due to siltation. The present storage capacity is only 11% of total surface flows.

Projects under execution are as follows:

Water Sector Projects	Hydro Power Projects
• Gomal Zam Dam	• Jinnah Barrage
• Mirani Dam	• Allai Khwar
• Raised Mangla Dam	• Khan Khwar
• Satpara Dam	• Duber Khwar
• Kurram Tangi Dam	• Golen Gole
• Greater Thal, Kachhi & Rainee Canals	• Neelum Jhelum

The following projects are under various phases of study:

- Basha Diamer Dam Project – Feasibility Detailed Design & Tenders
- Akhori Dam Project – Feasibility
- Sehwan Barrage – Feasibility
- Skardu Dam – Prefeasibility
- Bunji Hydro Power Project – Pre-Feasibility
- Dasu Hydro Power Project. – Pre-Feasibility

Enough water is available as discussed above in river Indus for storage. The sizeable (about 6 MAF) storage sites on river Indus are Kalabagh D/S of Tarbela, Basha and Skardu U/s Tarbela. There are other sites such as Bunji, Dasu, Pattan, Thakot etc. where run off the river Hydro Power projects can be built but the storage is less than 1 MAF. On tributaries of river Indus there are sites with very little storage but considerable head can be created by Tunnels. Three sites Khan Khwar, Duber Khwar and Alai Khwar are under construction.

Off channel storage sites have been investigated. The preferred site which has storage of about 6 MAF and has comparatively less environmental effects, is Akhori dam site which is under feasibility study.

CONCLUSIONS

- If a major dam is not built by year 2010 to replace the storage lost, Food import bill would amount to $ 1.0 Billion/year and survival of the country would be at stake.
- Without building another major storage dam by the year 2015, it would not be possible to feed the growing population.
- If a mega hydro power project is not built, the fuel import bill would amount to $ 1.5 Billion/annum.
- Because of high cost of imported fuel, the electricity tariff would be exorbitant. Pakistan's Industrial and Agricultural sector would not be competitive and would be eliminated.
- Mega storage project would alleviate the flood damages which are of the order of $ 1 Million/annum.

RESERVOIR SEDIMENTATION (MAF)

Table-1

RESERVOIR	GROSS STORAGE CAPACITY (MAF)		GROSS STORAGE LOSS		
	ORIGINAL	YEAR 2003	YEAR 2003 (MAF)	YEAR 2010 (MAF)	YEAR 2025 (MAF)
TARBELA	11.62 (1974)	8.48 (73%)	3.14 (27%)	3.95 (34%)	5.51 (47%)
MANGLA	5.88 (1967)	4.67 (79%)	1.21 (21%)	1.60 (27%)	1.97 (34%)
CHASHMA	0.87 (1971)	0. 49 (56%)	0.38 (44%)	0.58 (55%)	0.50 (57%)
TOTAL	18.37	13.64 (74%)	4.73 (26%)	6.03 (33%)	7.98 (43%)

WATER DEMAND

Table-2

"	**POPULATION**	**2005** **2025**	**141 million** **220 million**
"	**URBAN POPULATION**	**Currently** **2025**	**35%** **60%**
"	**TOTAL AREA**	**196 M ACRES**	
	CULTIVABLE	**77 MA**	
	CULTIVATED	**54.5 MA**	
	REMAINING	**22.5 MA Needs Add. Water**	
"	**To increase the crop yield requires additional water.**		
"	**Net Crop Water Requirement**	**2003-4** **2010-11** **2024-25**	**77.4 MAF** **89 MAF** **114.64 MAF**
"	**Domestic Demand**	**CurrentlyH** **2025 H**	**4.0 MAF** **10.5MAF**

EXISTING SURFACE STORAGES

Table-3

PROJECT	RIVER	HT. OF DAM (FT.)	LIVE STORAGE (MAF)	POWER (MW)	PURPOSE
TARBELA(1976)	INDUS	485	9.30	3478	I,P
MANGLA (1966)	JHELUM	380	4.82	1000	I,P
CHASHMA (1971)	INDUS	-	0.61	184	I,P
WARSAK (1960)	KABUL	250	0.04	240	I,P
BARAN DAM (1962)	KURRAM	107	0.03	4	I,P
HUB (1983)	HUB	151	0.76	-	I,W
KHANPUR (1984)	HARO	167	0.09	-	I,W
TANDA (1965)	KOHAT TOI	115	0.06	-	I
RAWAL (1962)	KURANG	114	0.04	-	W
SIMLY DAM (1972)	SOAN	215	0.02	-	W
BKD KHAN (1900)	PISHIN	35	0.04	-	I
HAMAL LAKE	-	-	0.08	-	I
MANCHAR LAKE	INDUS	-	0.75	-	I
KINJHAR LAKE	INDUS	-	0.32	-	I,W
CHOTIARI LAKE	INDUS	-	0.78	-	I
		TOTAL	17.74	4906	

I- IRRIGATION P- POWER W- WATER SUPPLY

Table-4

PAKISTANS HYDROPOWER POTENTIAL

SR. NO.	STATION/PROJECT		CAPACITY (MW)
1.	HYDEL STATIONS IN OPERATION		6463
2.	UNDER IMPLEMENTATION	Allai Khawar 121 MW Khan Khawar 72 MW Duber Khawar 130 MW JinnahKhawar 96 MW	419
3.	PROJECTS FEASIBILITY STUDY COMPLETED		9321
4.	PROJECTS FEASIBILITY STUDIES IN HAND		10371
5.	PROJECTS FOR WHICH FEASIBILITY STUDIES ARE TO BE CARRIED OUT		16910
	TOTAL		43,484

LAND USE IN PAKISTAN

CATEGORY	AREA (MA)
GEOGRAPHICAL AREA	196.0
AREA SUITABLE FOR AGRICULTURE	77.1
CULTIVATED AREA (IRRIGATED + BARANI)	54.5
AREA UNDER IRRIGATION (BY ALL SOURCES)	44.4
ADDITIONAL AREA THAT CAN BE BROUGHT UNDER IRRIGATED AGRICULTURE	22.5

SOURCE: AGRICULTURAL STATISTICS OF PAKISTAN 1998 -99

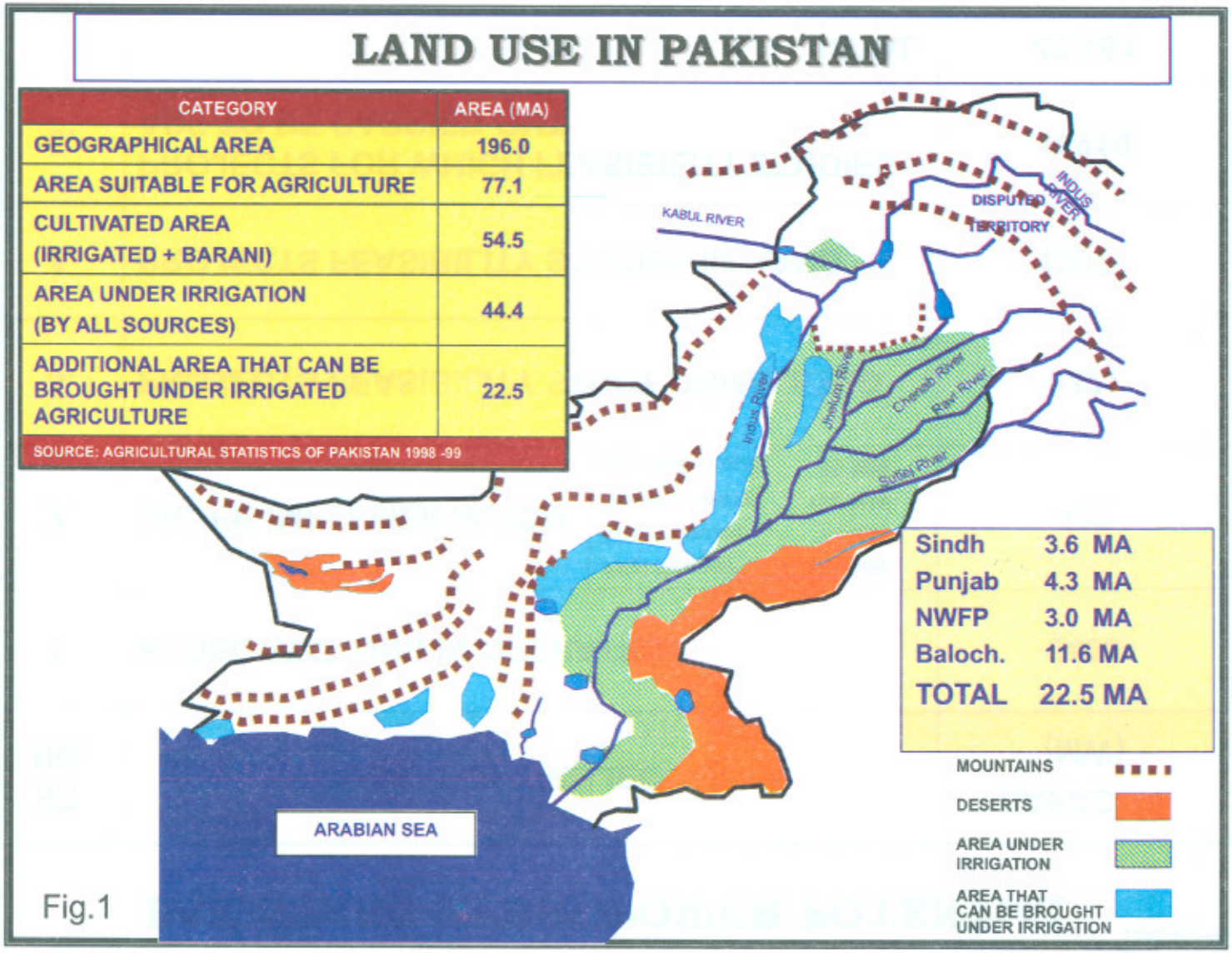


Fig.1

ESCAPAGE BELOW KOTRI

(HYDROLOGICAL YEAR FROM APRIL TO MARCH)

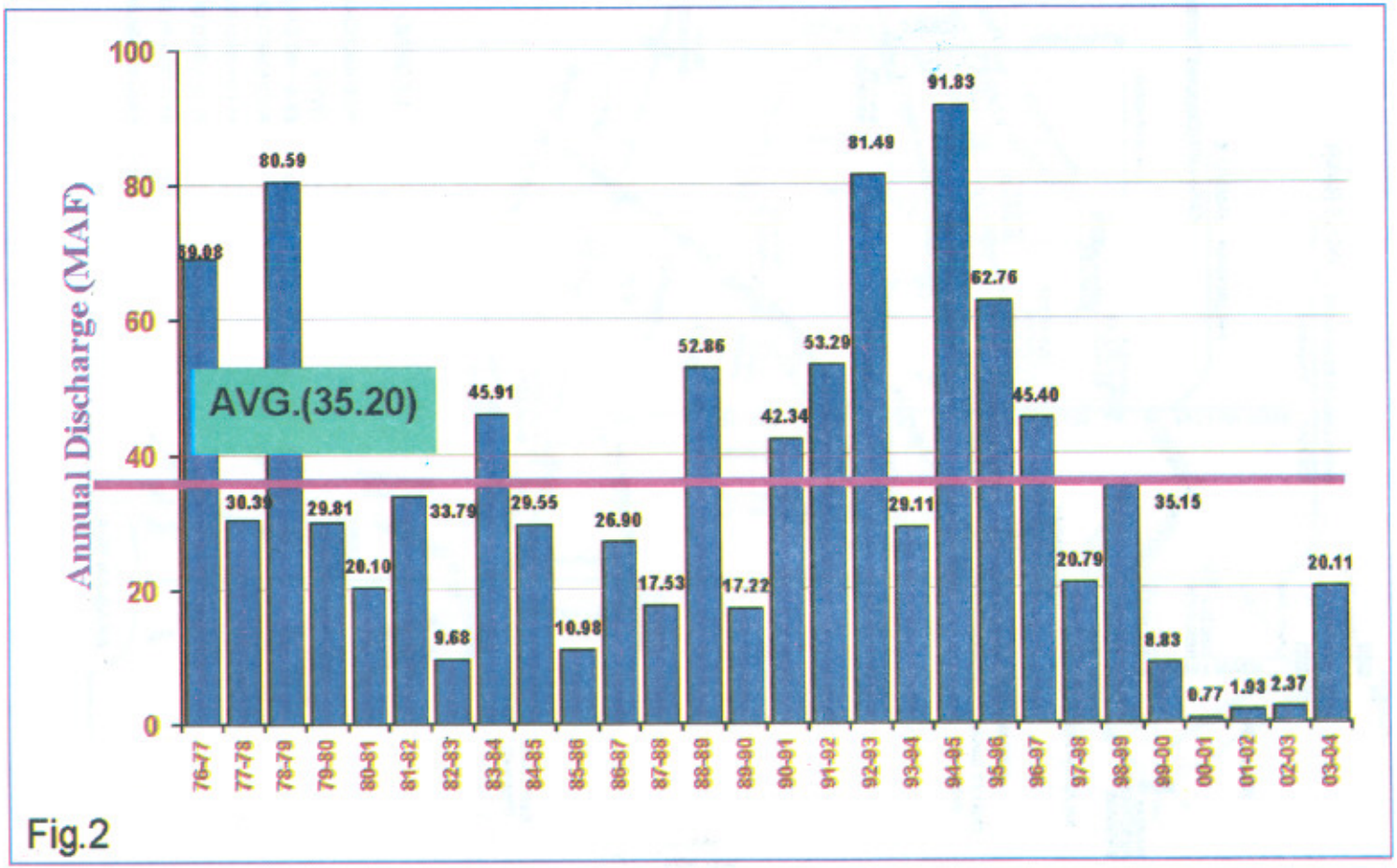
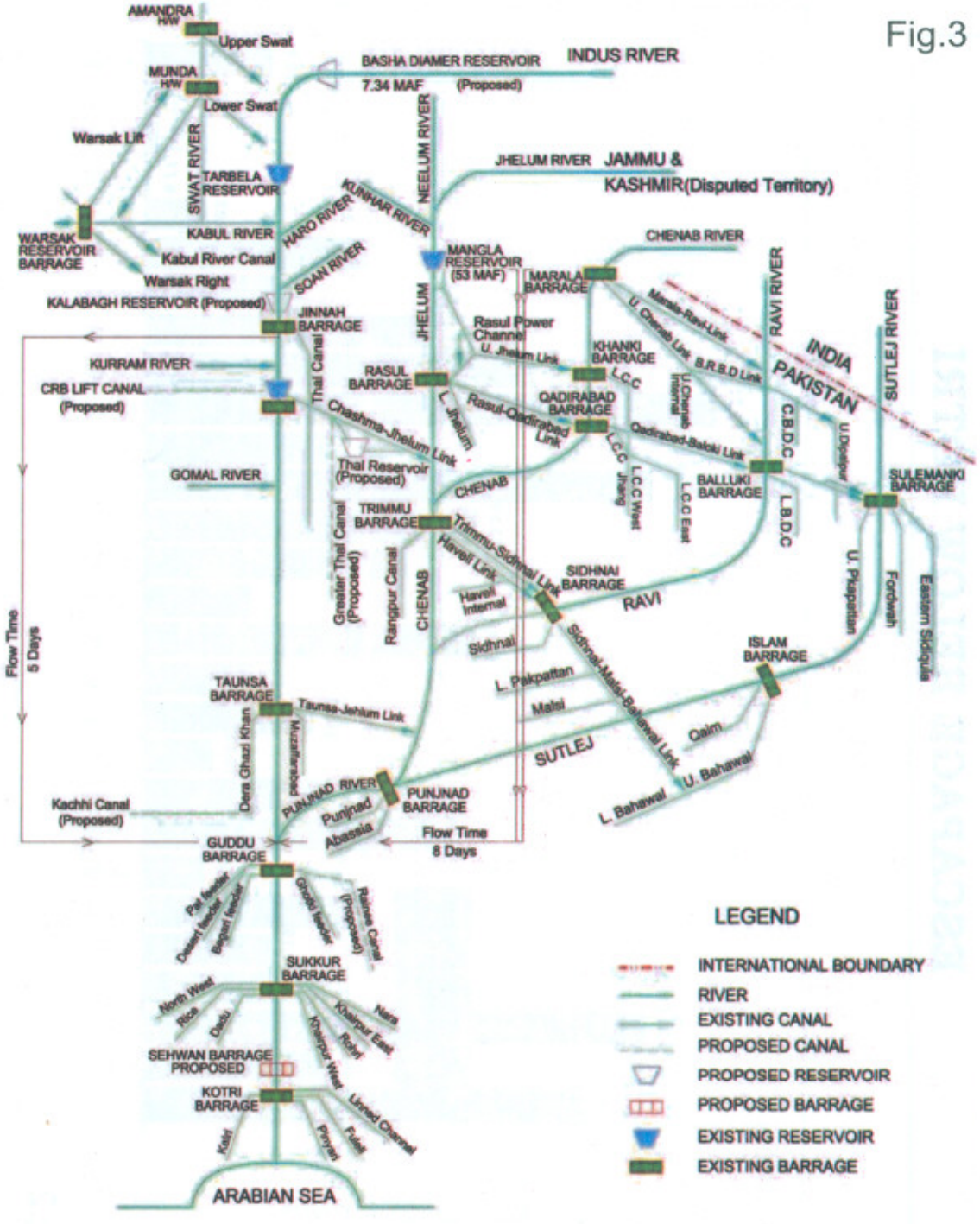


Fig.2

Fig.3


AMANDRA HW
Upper Swat
MUNDA HW
Lower Swat
Warsak Lift
SWAT RIVER
TARBELA RESERVOIR
BASHA DIAMER RESERVOIR
7.34 MAF
(Proposed)
INDUS RIVER
NEELUM RIVER
JHELUM RIVER
JAMMU & KASHMIR(Disputed Territory)
KUNHAR RIVER
HARO RIVER
KABUL RIVER
WARSAK RESERVOIR BARRAGE
Kabul River Canal
Warsak Right
SOAN RIVER
KALABAGH RESERVOIR (Proposed)
JINNAH BARRAGE
MANGLA RESERVOIR (53 MAF)
JHELUM
CHENAB RIVER
MARALA BARRAGE
Marala-Ravi Link
U. Chenab Link
B.R.B.D Link
RAVI RIVER
INDIA
PAKISTAN
SUTLEJ RIVER
Rasul Power Channel
U. Jhelum Link
KHANKI BARRAGE
L.C.C
Hamal
U.Chenab
KURRAM RIVER
RASUL BARRAGE
L. Jhelum
Rasul-Qadirabad Link
QADIRABAD BARRAGE
Qadirabad-Balloki Link
C.B.D.C
U.Depalpur
CRB LIFT CANAL (Proposed)
Thal Canal
Chashma-Jhelum Link
Thal Reservoir (Proposed)
GOMAL RIVER
CHENAB
L.C.C West
L.C.C East
BALLUKI BARRAGE
SULEMANKI BARRAGE
TRIMMU BARRAGE
Trimmu-Sidhnai Link
Haveli Link
Haveli Internal
SIDHNAI BARRAGE
RAVI
L.B.D.C
U. Panjnad
Fordwah
Eastern Sidiqia
Greater Thal Canal (Proposed)
Rangpur Canal
CHENAB
Sidhnai
Sidhnai-Mailsi-Bahawal Link
ISLAM BARRAGE
L. Pakpattan
Mailsi
Qaim
U. Bahawal
L. Bahawal
SUTLEJ
Flow Time 5 Days
TAUNSA BARRAGE
Taunsa-Jehlum Link
Muzaffargarh
Dera Ghazi Khan
PUNJNAD RIVER
PUNJNAD BARRAGE
Punjnad
Abassia
Flow Time 8 Days
Kachhi Canal (Proposed)
GUDDU BARRAGE
Pat feeder
Desert feeder
Begari feeder
Ghotki feeder
Rainee Canal (Proposed)
SUKKUR BARRAGE
North West
Rice
Dadu
Khairpur East
Nara
Khairpur West
Rohri
SEHWAN BARRAGE PROPOSED
KOTRI BARRAGE
Kalri
Phitti
Fuleli
Unnad Channel
ARABIAN SEA
LEGEND
INTERNATIONAL BOUNDARY
RIVER
EXISTING CANAL
PROPOSED CANAL
PROPOSED RESERVOIR
PROPOSED BARRAGE
EXISTING RESERVOIR
EXISTING BARRAGE

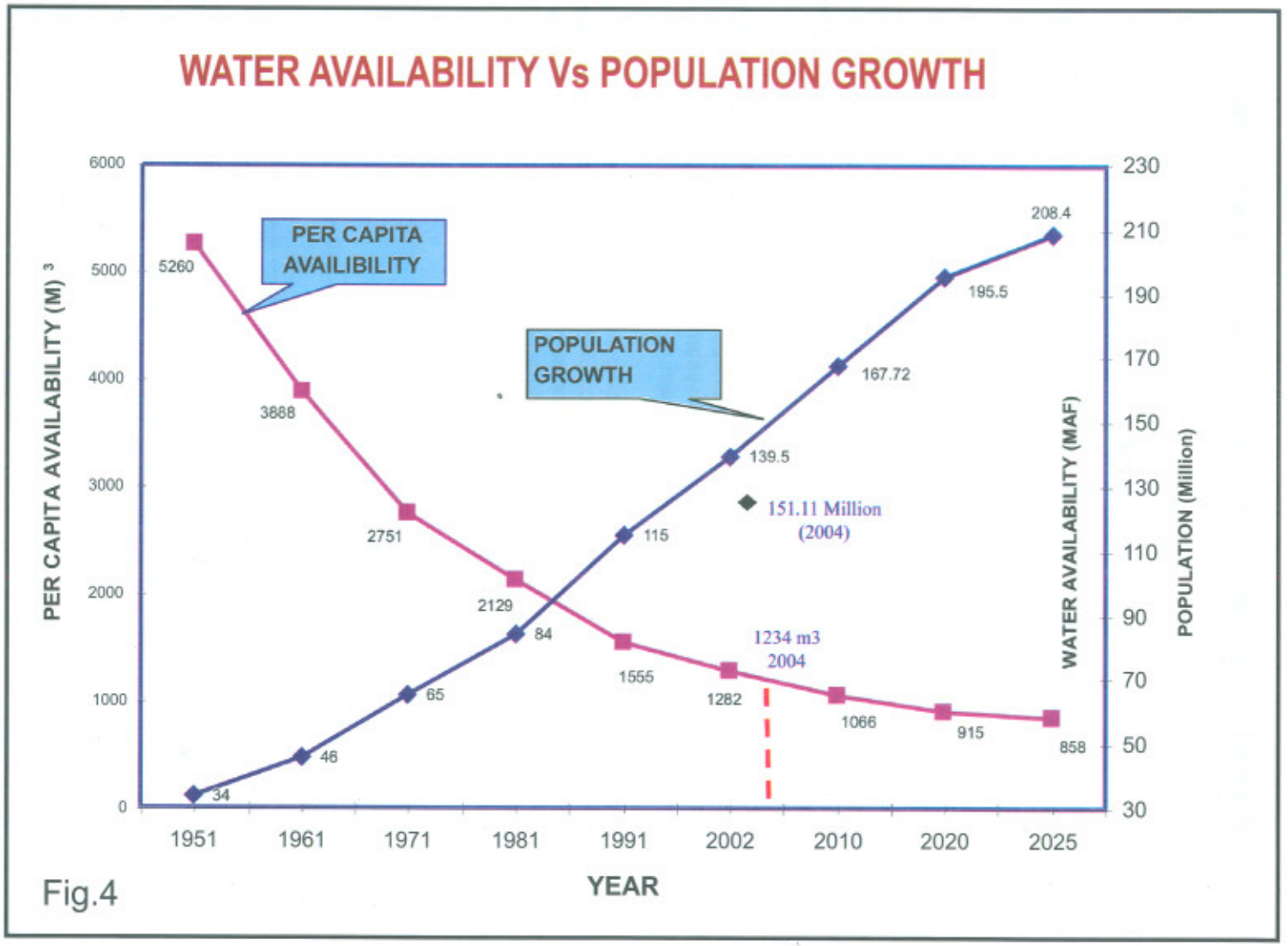

WATER AVAILABILITY Vs POPULATION GROWTH
PER CAPITA AVAILABILITY (M) 3
WATER AVAILABILITY (MAF)
POPULATION (Million)
YEAR
PER CAPITA AVAILIBILITY
POPULATION GROWTH
6000
5000
4000
3000
2000
1000
0
230
210
190
170
150
130
110
90
70
50
30
1951
1961
1971
1981
1991
2002
2010
2020
2025
5260
3888
2751
2129
1555
1282
1066
915
858
34
46
65
84
115
139.5
167.72
195.5
208.4
151.11 Million
(2004)
1234 m3
2004

Fig.4

IMPLEMENTATION OF INDUS WATERS TREATY 1960

By

Engr. Syed Jamaat Ali Shah*

1. Water is the single most important substance on the planet earth. Holy Quran emphasizes its importance through the verse:

وَ جَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ ؕ اَفَلَا يُؤْمِنُوْنَ ○

اور ہم نے پانی سے ہر شے کو زندہ کیا تو کیا پھر بھی وہ ایمان نہیں لاتے۔

2. This implicates that there would be no life without water. Water is the driving force behind all the environmental and ecosystems of our world. It regulates the weather systems, keeps the temperature of earth stable. Water has the ability to clean, absorb and transport other substances including the human beings.

3. Harnessing the water potential for the benefit/development of humanity started from inception of the world. The archeological remains of various old civilizations unearthed so far bear witness to the water collection and distribution systems for municipal and agricultural uses. Holy Quran tells us about the oldest dam in Yemen.

4. With the increase in population, the world is facing the threat of water shortage. It has been observed by the scholars that the future conflicts in the world will base on the water issues. This highlights the importance and need for conservation and effective utilization of the available water resources. Pakistan being an agrarian economy should increase its efforts for developing storage and conservation projects as it is already facing scarcity of water resources. Table-1 below indicates the socio-economic impacts of water scarcity.

Table-1
WATER SCARCITY INDICATORS
(Faulkenmark Indicator)

> 1700 M^3/Capita	Water Scarcity Rare
< 1700 M^3/Capita	Country faces seasonal or regular water-stressed conditions
< 1000 M^3/Capita	Water shortages hamper the health and well being of the human beings. Economic activities are affected
< 500 M^3/Capita	Shortages are severe constraints to human life

5. Pakistan, which at the time of independence had more than 5,000 m^3/capita availability of water, has now only 1000 m^3/capita. This is a very dangerous scenario and

*Pakistan Commissioner for Indus Waters.

needs immediate attention of the planners and decision makers. If concrete steps are not taken for thwarting this threat, the country will face stagnation in Agricultural growth, increasing dependence on other nations for food and hampering of industrial development. Even the municipal supplies would be restricted causing damage to human health and living conditions. The inter-provincial disputes regarding water would further aggravate threatening the national harmony and unity.

6. Pakistan has a long history of water related problems. As a result of partition of sub-continent, the boundary line between India and Pakistan cut across the rivers and the channels of the Indus Basin River System. In the first year of independence, India cut off the supply of Eastern Rivers at Madhopur and Ferozepure Headworks, depriving Pakistan for the supplies through Upper Bari Doab Canal and Dipalpur Canal. The matter was taken up with India and an Inter-Dominion Agreement was signed on 4th May 1948, reviving the supplies conditionally. Negotiations were held to resolve the dispute between the two countries but remained in vain. In 1951, Mr. David, E. Lillienthal, a distinguished American Engineer, after visiting Indus Basin in both the countries, contributed an article in an American Magazine (Collier's) suggesting that instead of political solution, this issue could be easily resolved by common sense and engineering. The matter was further pursued by the President of IBRD, Mr. Eugene R. Black, who offered to help in resolution of the dispute. The matter was ultimately resolved under the good offices of World Bank. The Indus System of Rivers comprises three Eastern Rivers (The Sutlej, The Beas and The Ravi) and three Western Rivers (The Indus, The Jhelum and The Chenab). The annual mean volume of flow of the three Eastern Rivers was assessed at 33 MAF while that of Western Rivers as 135 MAF.

7. The Indus Waters Treaty 1960 was signed on 19th September 1960 at Karachi. President Muhammad Ayub Khan and Prime Minister Jawaharlal Nehru were the signatories on behalf of their countries, while Mr. W.A.B. Iliff signed on behalf of IBRD (World Bank). The signing of the Treaty brought to end the period of uncertainty and opened doors of development in water sector for both the countries. Unfortunately, after completion of Indus Basin Projects, Pakistan did not undertake any major project and is today under the threat of acute water shortage.

8. Indus Waters Treaty is a unique Treaty in the sense that it has divided the rivers between the two countries whereas almost all other Treaties (see Table 2) share the waters of the rivers between co-riparians.

Table 2

TREATIES ON INTERNATIONAL RIVERS

➢ Major Transboundary river basin	=	214
➢ International rivers	=	263
➢ Europe	=	69
➢ Asia	=	57

➢ Africa	=	59
➢ North & Central American	=	40
➢ South America	=	38
➢ Treaties on non-navigational water use(1805-1984)	=	3600
➢ Treaties Since 1945	=	300

9. Under the Treaty, the waters of Eastern Rivers (estimated about 33 MAF) were fully allocated for unrestricted use to India, whereas the waters of Western Rivers (estimated to 135 MAF) were allocated to Pakistan. However, India was allowed some restricted uses for existing and future agricultural supplies, generation of hydroelectric power, domestic and non-consumptive use (See Tables 3 & 4).

Table 3

STORAGE ON THE CONSERVATION STORAGE CAPACITY WESTERN RIVERS ALLOWED TO INDIA

River system		***General Storage***	***Power Storage***	***Flood Storage***
(1)	**(2)**	**(3)**	**(4)**	**(5)**
		.....Million acre feet.....		
(a)	The Indus	0.25	0.15	Nil
(b)	The Jhelum (excluding the Jhelum main)	0.50	0.25	0.75
(c)	The Jhelum main	Nil	Nil	As provided in `Paragraph 9
(d)	The Chenab (excluding the Chenab main)	0.50	0.60	Nil
(e)	The Chenab main	Nil	0.60	Nil

Table 4

INDIA'S ENTITLEMENT FOR AGRICULTURAL USES FROM WESTERN RIVERS

River	**Effective Date**	**Add-Area**	**Total**	**From Flow**	**03-04**
				Figures in Acres	
1	2	3	4	5	6
Indus	42,179	70,000	112,179	112,179	50,766
Jhelum	517,909	400,000	917,909	667,909	644,362
Chenab	82,389	231,000	313,389	157,389	117,446
Total	***642,477***	***701,000***	***1,343,477***	***937,477***	***812,574***