WATER SHORTAGE AND VEGETATION

By

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WATER SHORTAGE

From 1997 to 2002 Pakistan faced a severe shortage of water due to a cycle of drought and reduced storage capacity of the two reservoirs. Pakistan is not alone in going through the experience of water shortage; there are many other countries in similar situation. The world faces crisis of unprecedented level because of the failure of world leaders to take action on population growth, pollution and expected climate changes. According to a UNESCO report, "No region will be spared from the impact of this crisis which touches every facet of life, from the health of children to the ability of nations to secure food for their citizens".

World-wide supplies of water are falling while the demand is growing at an unsustainable rate. This situation shows that over the next 20 years, the average supply of water world-wide per person is expected to drop by a third. Presently, many countries and territories of the world are already in a state of crisis.

The poorest country in terms of water availability is Kuwait, where 10 m^3 is available per person each year followed by Gaza Strip (52 m^3), the UAE (58 m^3), etc. Mostly poorest countries in terms of water availability exist in the Middle East. The richest county in terms of water availability is French Guiana, where 812,121 m^3 water is available per person per year, followed by Iceland (609,319 m^3) Guyana (316,689 m^3), Surinam (292,566 m^3), Congo (275,679 m^3), Canada (94,353 m^3), New Zealand (86,554 m^3), etc.

According to a UN report, even though birth rates are slowing down, the world's population would still reach about 9.3 billion by 2050, compared to 6.1 billion in 2001. Why this world-wide water crisis and increased water pollution? This is due to about two million tons of waste being dumped every day into rivers, lakes and streams. One liter of waste water pollutes about eight liter of fresh water. According to the UN report, there is estimated 12,000 km^3 of polluted water world-wide, which is more than the total amount contained in the world's ten largest river basins at any given moment. Therefore, if pollution keeps pace with population growth, the world will effectively lose 18,000 km^3 of fresh water by 2050. This quantity of water is more than nine times the total amount countries currently use each year for irrigation, which is by far the largest consumer of this resource. Irrigation currently accounts for 70 per cent of all water withdrawals world-wide.

Obviously, **Pakistan** is also the part of the world and unfortunately an underdeveloped country, facing the same problems of water shortage as the world is facing including developed countries. Developed and underdeveloped countries excluding Pakistan,

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are continuously implementing their short term and long term water development policies to overcome these crises. But unfortunately, during the last 50 years we had built only two big reservoirs. Existing population of Pakistan is around 170 million and it is expected to rise to 208 million by 2025. This growth in population will significantly increase the demand for food and fibre while both land and water resources are declining day by day. Pakistan's food import bill is rising on account of population and output is declining as a result of reduced availability of water. The situation of the Indus and other rivers, and our dams and reservoirs is deteriorating and their total storage capacity would reduce by an equivalent to Mangla dam.

What did we do during the last 50 years for development of water resources? What have other countries done during the last 50 years to resolve water crisis? They have built dams and reservoirs to overcome this crisis. China had only 23 large and medium-sized reservoirs in 1949. During the next 50 years, it had developed 85,000 water reservoirs with a total storage capacity of 479.7 billion cubic meters among which 2,953 are big and medium sized dams with storage capacity of 417 billion cubic meters. Similarly India has built many reservoirs.

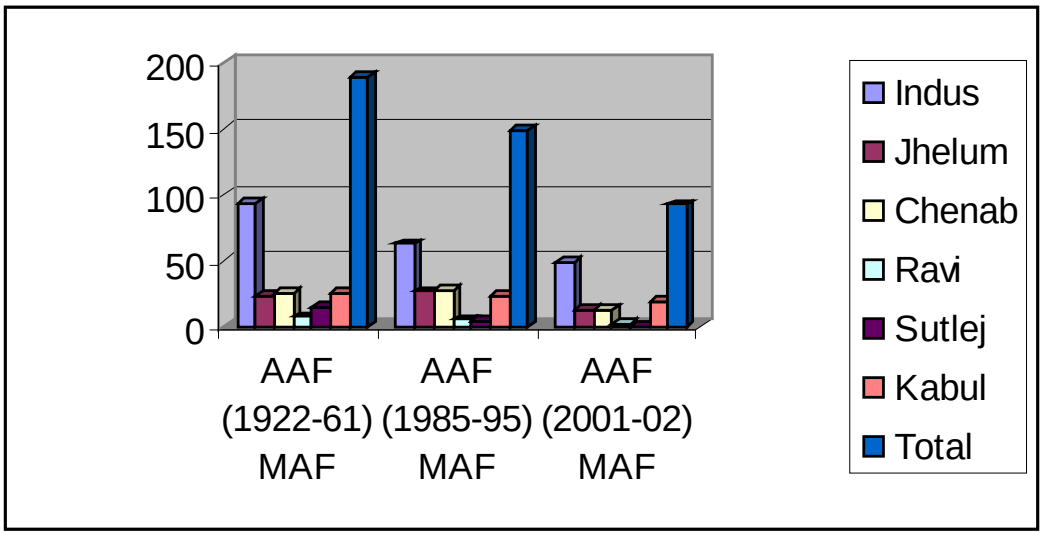
Comparable ratios of Pakistan and India in this regard are as follows:

- Irrigated area by canals and tube wells 1:3
- Large dams 1:62
- Storage capacity 1:11
- Hydro power 1:4
- Canal diversion 1:4

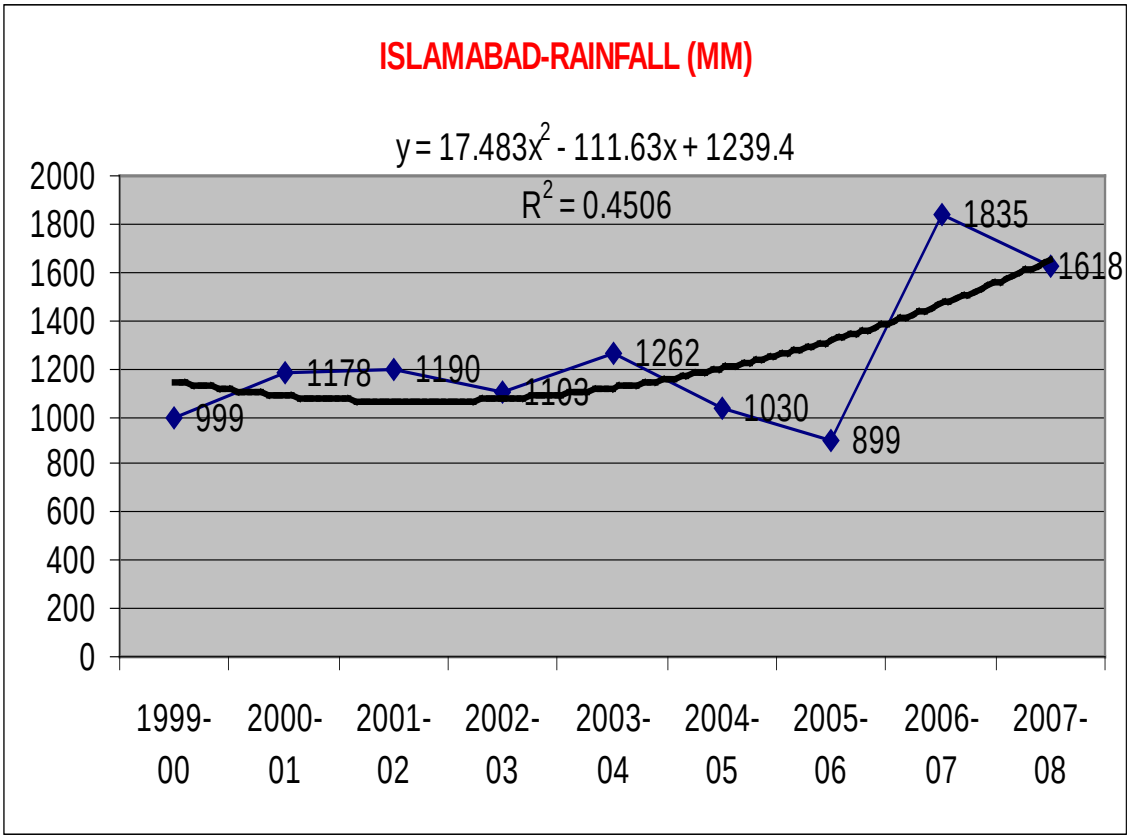
Pakistan is fast becoming a desert because of a drastic fall in water availability from 5,000 cubic meters per capita in the 1950s to 1,000 cubic meters in 2010. The average annual flow-rates of major rivers has been calculated between 1922-61 to indicate water flows before the Indus Water Treaty, 1985-1995 to indicate the post-treaty flows and the 2001-2002 flows to present the situation of drought conditions.

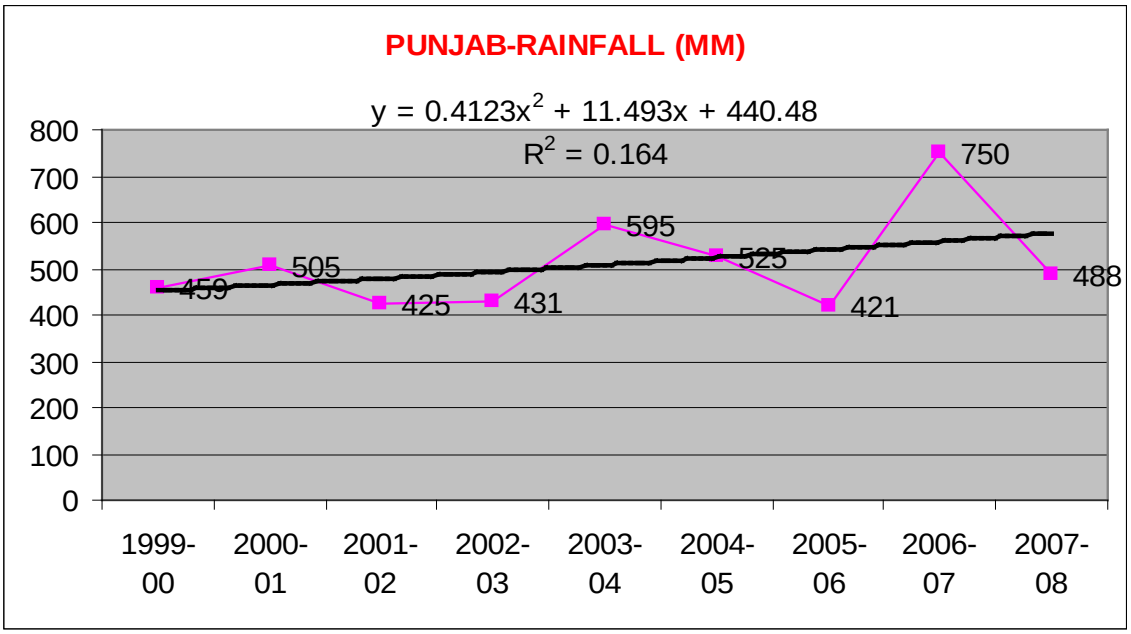
River	Average Annual Flow (1922-61) MAF	Average Annual Flow (1985-95) MAF	Average Annual Flow (2001-02) MAF
Indus	93	62.7	48
Jhelum	23	26.6	11.85
Chenab	26	27.5	12.38
Ravi	7	5	1.47
Sutlej	14	3.6	0.02

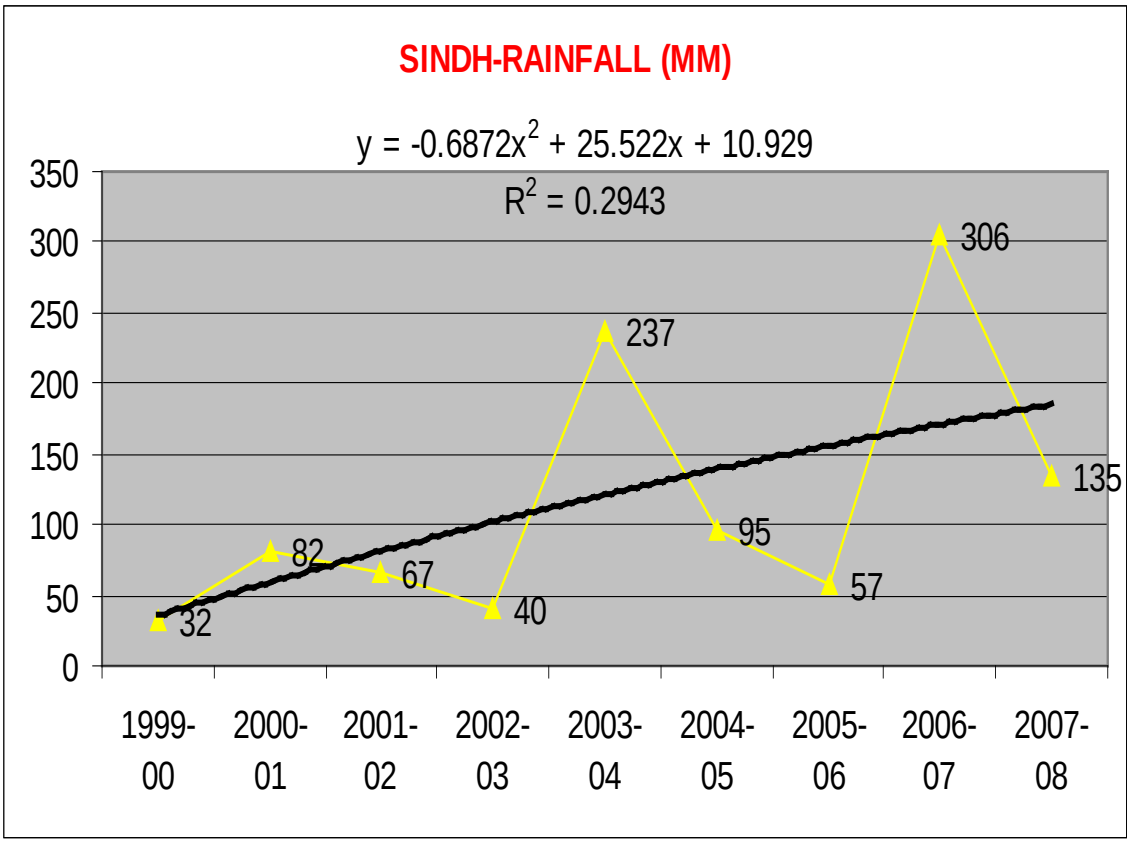
Kabul	26	23.4	18.9
Total	**189**	**148.8**	**92.62**

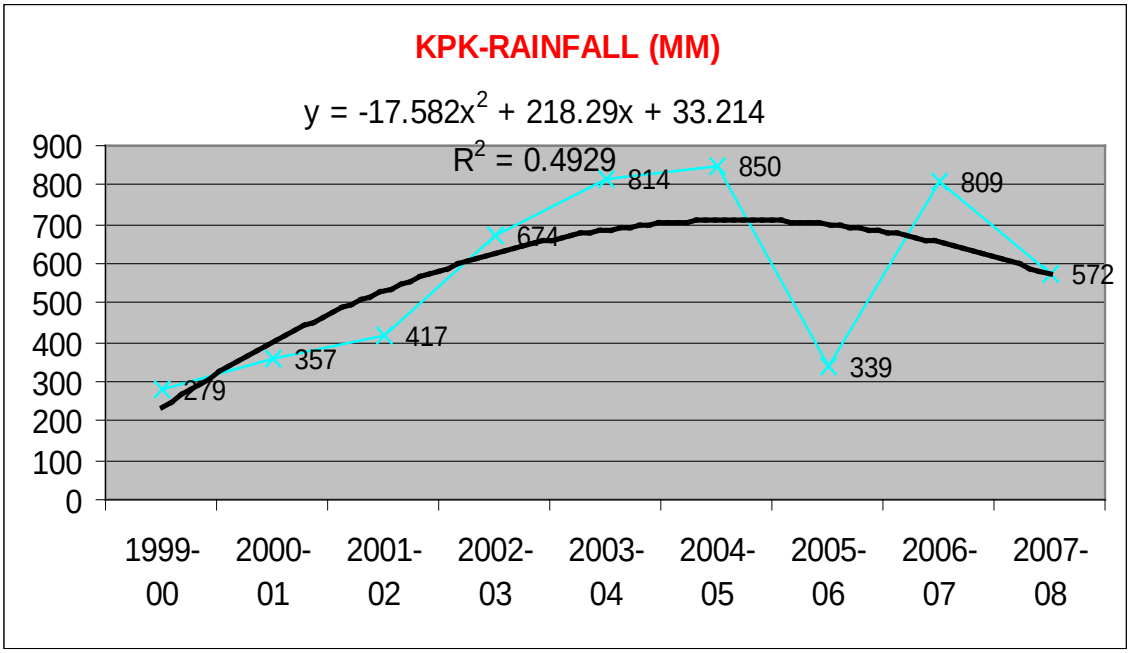


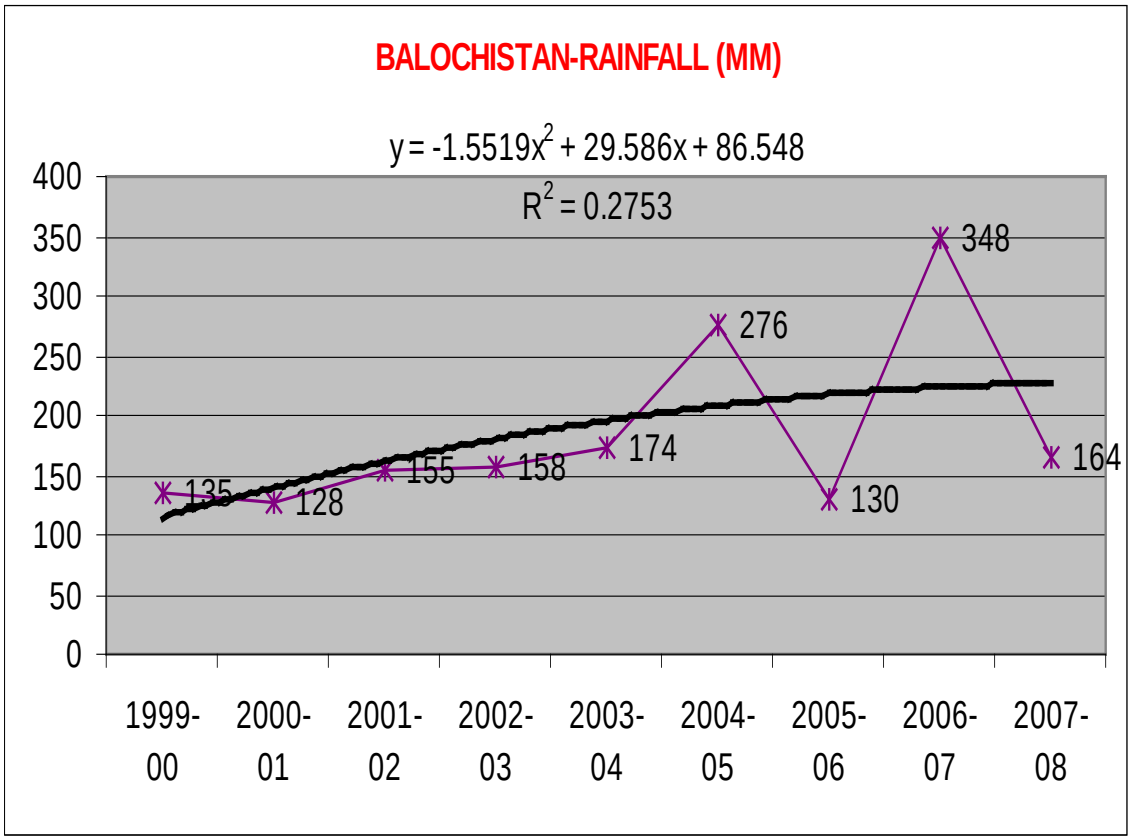
The rainfall during the years (1998 to 2000) over Pakistan was occurred in great deficiency. The rainfall was over all significantly below normal and largely below normal in some parts of the country. This deficiency of rainfall has caused severe drought conditions, crop failure and shortage of water in rivers & reservoirs and depletion of under ground water.

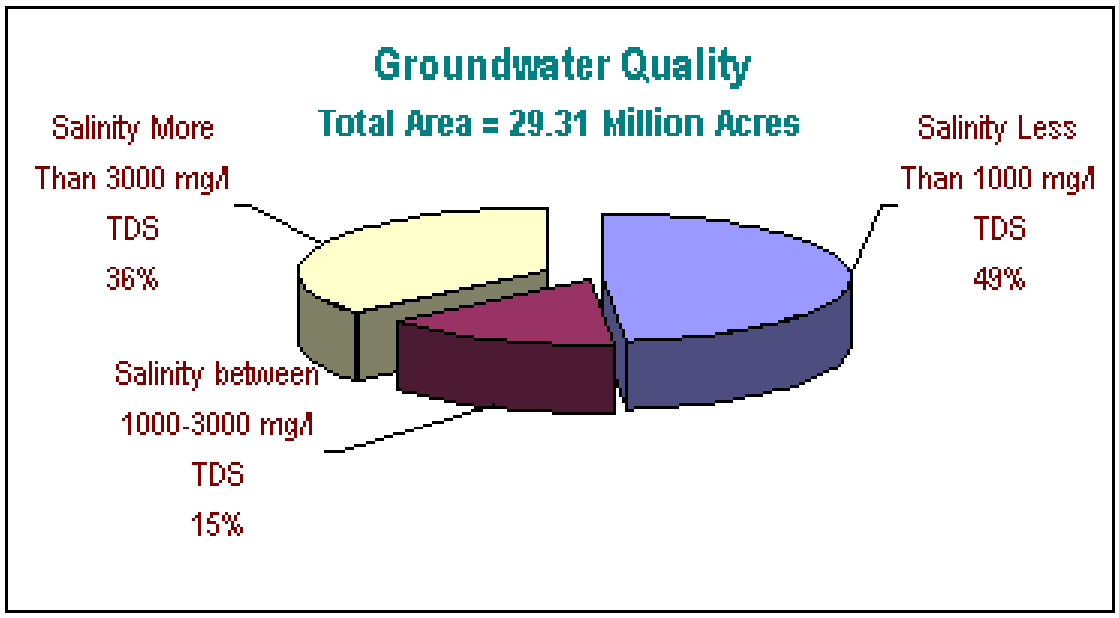


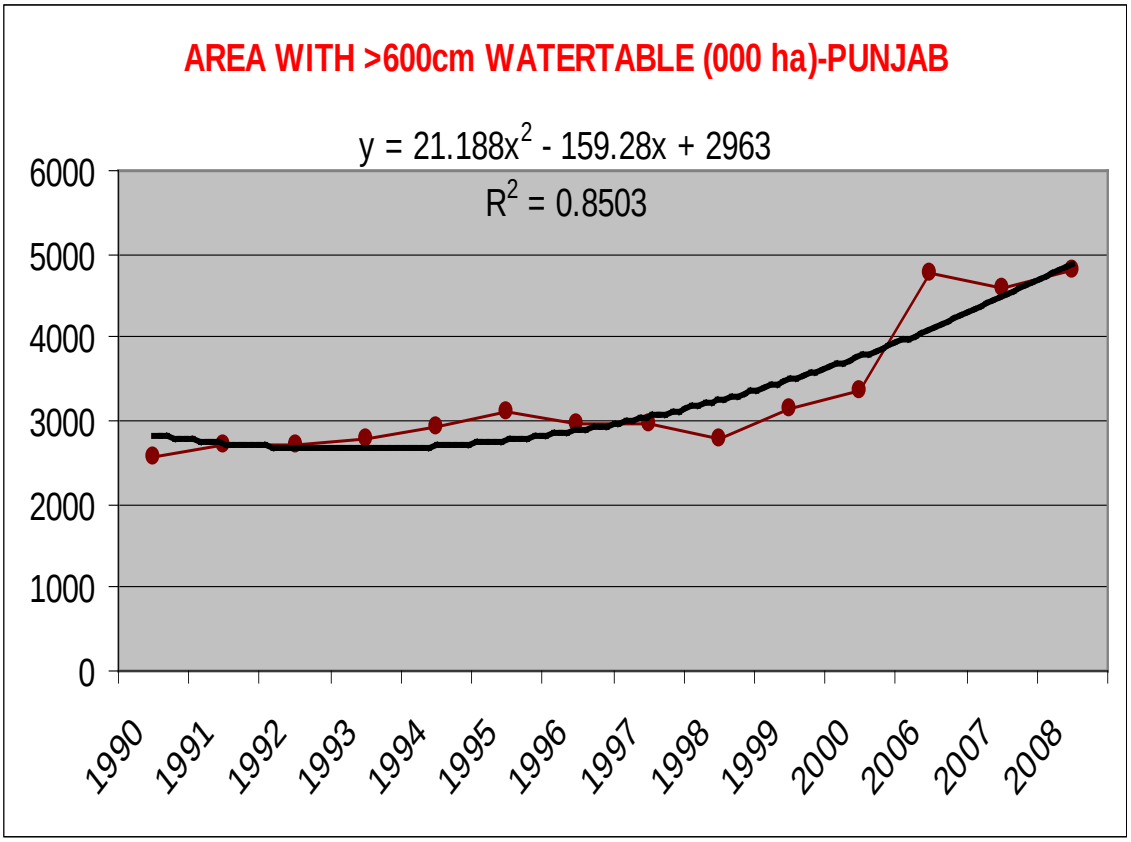

PUNJAB-RAINFALL (MM)
y = 0.4123x2 + 11.493x + 440.48
R2 = 0.164
800
700
600
500
400
300
200
100
0
459
505
425
431
595
525
421
750
488
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08

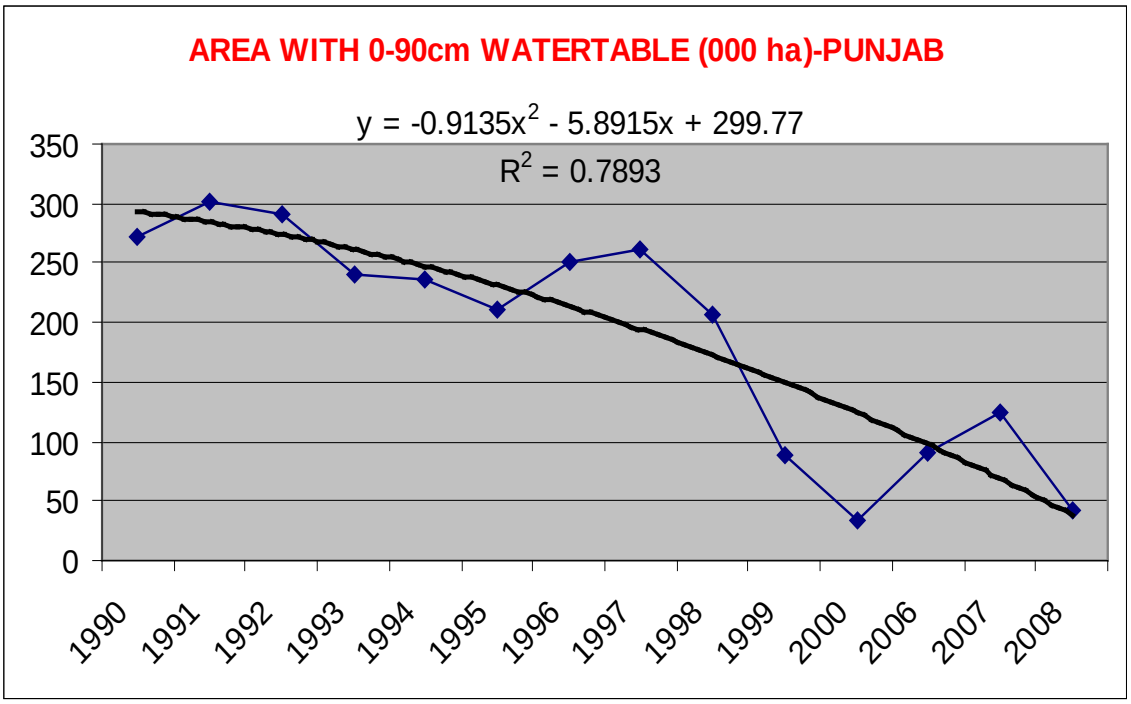

SINDH-RAINFALL (MM)
y = -0.6872x2 + 25.522x + 10.929
R2 = 0.2943
350
300
250
200
150
100
50
0
32
82
67
40
237
95
57
306
135
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08

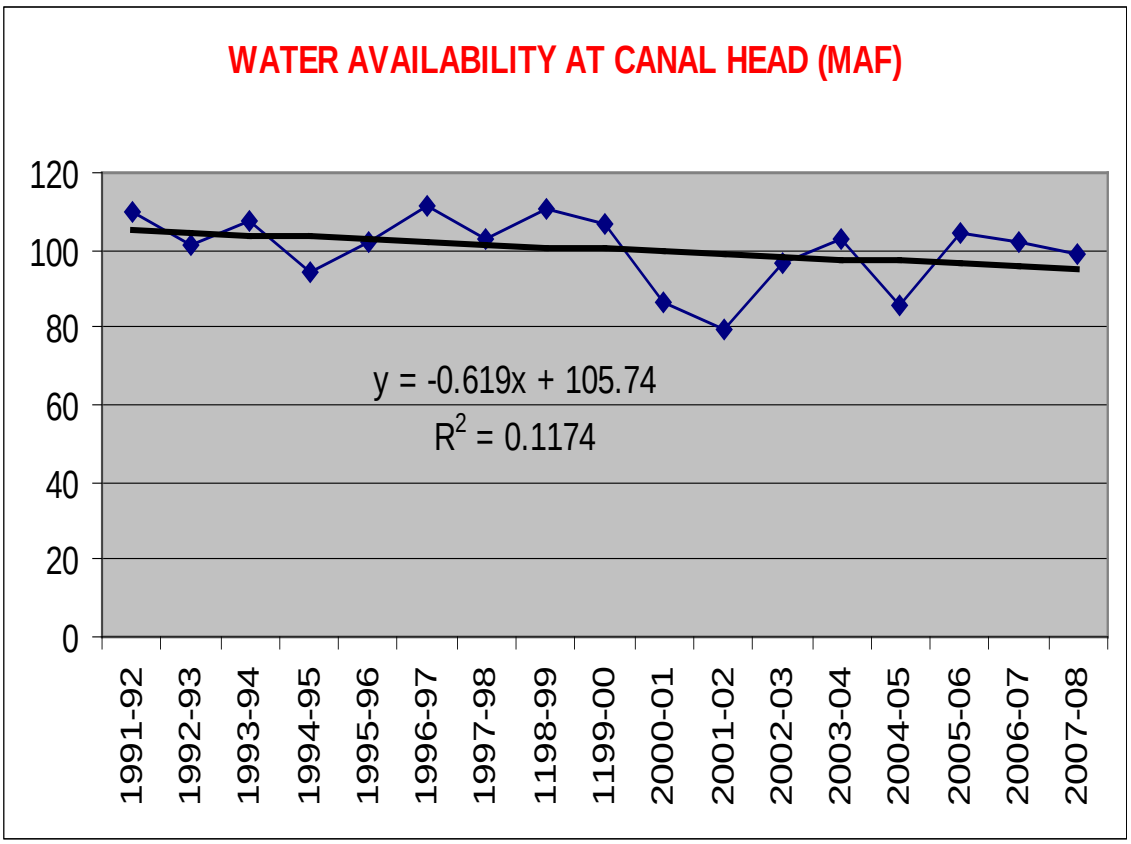

KPK-RAINFALL (MM)
y = -17.582x2 + 218.29x + 33.214
R2 = 0.4929
900
800
700
600
500
400
300
200
100
0
279
357
417
674
814
850
339
809
572
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08


BALOCHISTAN-RAINFALL (MM)
y = -1.5519x2 + 29.586x + 86.548
R2 = 0.2753
400
350
300
250
200
150
100
50
0
135
128
155
158
174
276
130
348
164
1999-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08


Groundwater Quality
Total Area = 29.31 Million Acres
Salinity More Than 3000 mg/l TDS 36%
Salinity Less Than 1000 mg/l TDS 49%
Salinity between 1000-3000 mg/l TDS 15%


AREA WITH >600cm WATERTABLE (000 ha)-PUNJAB
y = 21.188x2 - 159.28x + 2963
R2 = 0.8503
6000
5000
4000
3000
2000
1000
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2006
2007
2008


AREA WITH 0-90cm WATERTABLE (000 ha)-PUNJAB
y = -0.9135x2 - 5.8915x + 299.77
R2 = 0.7893
350
300
250
200
150
100
50
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2006
2007
2008


WATER AVAILABILITY AT CANAL HEAD (MAF)
120
100
80
60
40
20
0
y = -0.619x + 105.74
R2 = 0.1174
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1198-99
1199-00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08

IMPACTS OF WATER SHORTAGE ON VEGETATION

Plants are 90 percent water and they require water for all growth processes. Drought may produce several effects on plants, including reduced growth and vigour, wilting and nutrient deficiencies. Effects may still be noted five years after a water shortage.

Decreased Vigour

Plants use water for photosynthesis and temperature regulation. Drought inhibits these processes and decreases the growth and vitality of the plant.

Nutrient Deficiencies

Water transports minerals from soil to the plant. Without water, plants become nutrient deficient.

Plant Structure

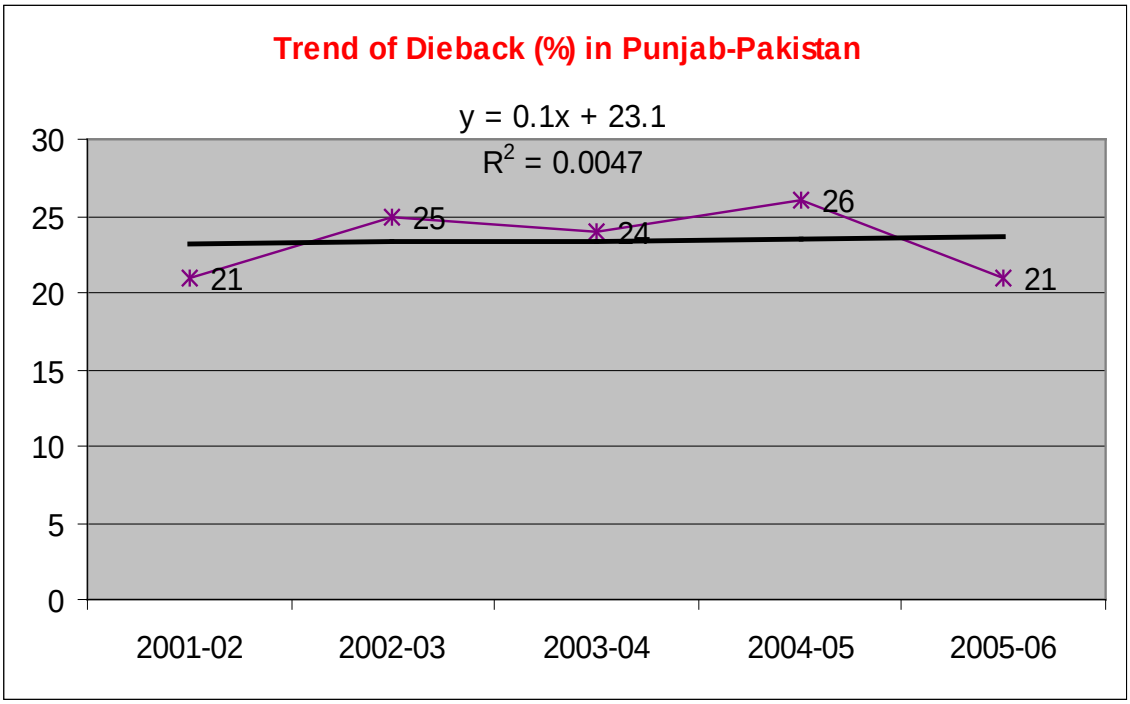
Water maintains cell structure and holds plants erect. A deficit of water in the plant causes wilting.

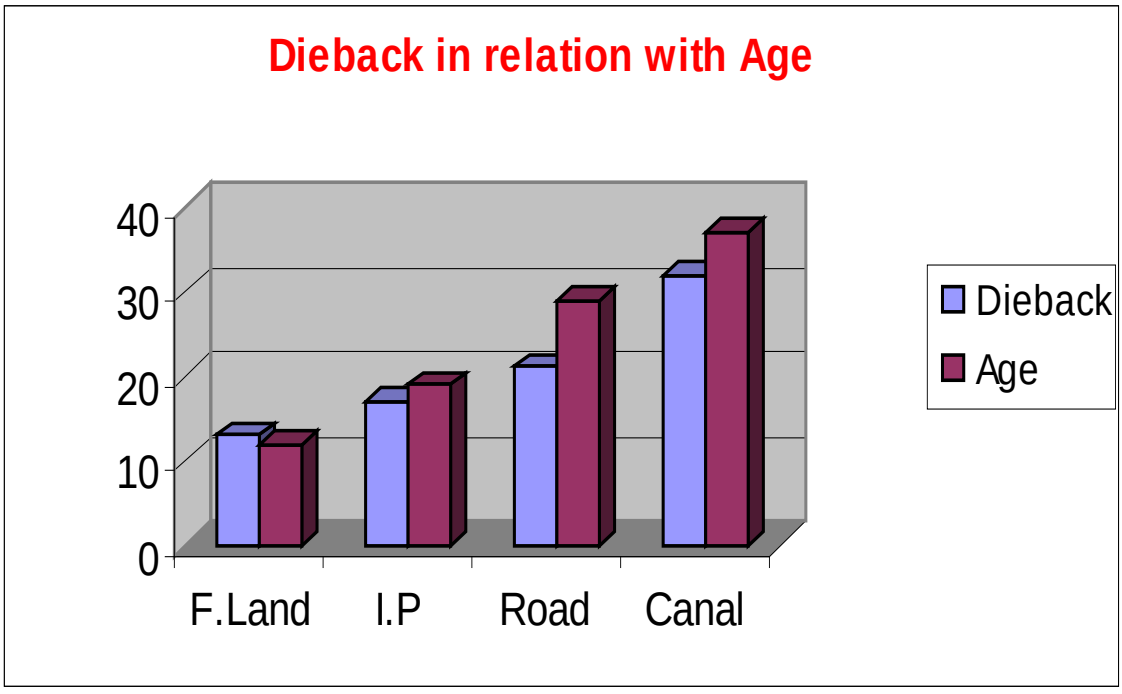
Shisham Dieback

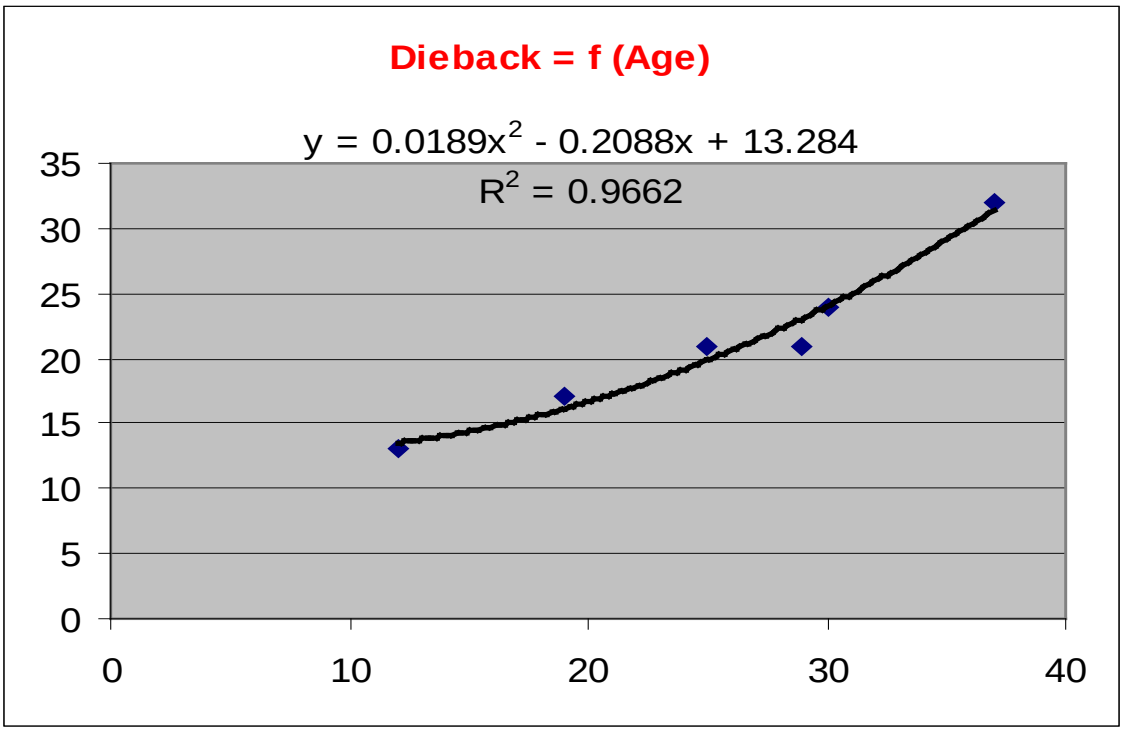
Study conducted by Shukla (2002) at Forest Research Institute (FRI), Dehra Dun, India highlights the following factors responsible for Shisham dieback: **Environmental factors**; include global warming which appears to be the major causal factor due to increase in mean temperature. **Hydrological factors**; include erratic rains responsible for change in atmospheric humidity and sub-surface water level. **Pathological factors**; include *Fusarium solani* and *Ganoderma lucidum* responsible for root rot in Shisham causing large-scale destruction. Survey report indicates 10-40% mortality in block plantations, road and canal sides. State level surveys indicate 60-90% mortality in UP and 70-87% in Punjab (India).

Bakhshi and Singh (1954) and Bakhshi (1957) found mature trees over 20 years in age were suffered from a wilt disease. Infected trees died within a few months after symptoms of wilt on the crown became evident. On the basis of evidence set forth in the article, *Fusarium solani* appeared to cause this condition. It was found to be a soil borne fungus whose distribution in the soil was general and not localized. It was found to survive best in sterile loam soil containing up to 20% moisture. The pathogen declined rapidly with increase in soil moisture above this level. Khan et al. (1956) reported that mortality of Shisham in Daphar plantation was noticed as early as 1917. An investigation was undertaken during 1956, which indicated that the mortality of Shisham is a

physiological problem brought about by soil cum irrigation factors. The temperature and wind play an indirect role. The remedies suggested are more water, change in composition of the plantation.







WATER CONSERVATION

Water conservation is the most cost-effective and environmentally sound way to reduce our demand for water.

- Instead of flooding, trench irrigation system be adopted in irrigated plantations and the size of trench be improved from (12"+8")/2 x 9" to (12"+8")/2 x 12" to utilize scanty canal water economically, efficiently and effectively (improving >100% water efficiency).

- Trenches be reopened annually or maximum biennially to the original size.
- Choose shrubs and groundcovers instead of turf for hard-to-water areas such as steep slopes and isolated strips.
- Water your lawn and garden in the morning or evening when temperatures are cooler to minimize evaporation.
- Spreading a layer of organic mulch around plants retains moisture and saves water, time and money.
- Check the root zone of your lawn or garden for moisture before watering using a spade or trowel. If it's still moist two inches under the soil surface, you still have enough water.
- Use drip irrigation for shrubs and trees to apply water directly to the roots where it's needed.
- Reduce the amount of lawn in your yard by planting shrubs and ground covers appropriate to your site and region.
- Water your plants deeply but less frequently to encourage deep root growth and drought tolerance.
- To decrease water from being wasted on sloping lawns, apply water for five minutes and then repeat two to three times.
- Group plants with the same watering needs together to avoid over watering some while under watering others.
- Use a layer of organic material on the surface of your planting beds to minimize weed growth that competes for water.
- Support projects that use reclaimed wastewater for irrigation.
- Use sprinklers that deliver big drops of water close to the ground. Smaller water drops and mist often evaporate before they hit the ground.
- Water only when necessary. More plants die from over-watering than from under-watering.
- Apply water only as fast as the soil can absorb it.
- Aerate your lawn at least once a year so water can reach the roots rather than run off the surface.

- Water your lawn only when it needs it. Step on your grass. If it springs back, when you lift your foot, it doesn't need water. So set your sprinklers for more days in between watering.

- Set lawn mower blades one notch higher. Longer grass means less evaporation.

- The tree growers be imparted technical know-how for adopting measures to conserve water.

Drip irrigation in New Mexico

BIBLIOGRAPHY

100 ways to conserve. (www.wateruseitwisely.com).

Afzal, M., M. Rafique, A. Ali, A. Rashid and A.M. Akhtar, “Dieback research at PFRI”.

Proceedings of third national seminar on shisham dieback, PFRI, Faisalabad, May 2006.

Asian Development Bank - TA, Water Resources Sector Strategy, "National Water Sector Profile", April 2002.

Asim, R.K., M. Kaleem Ullah, S. Muhammad, "Water Availability and Some Macro Level Issues Related to Water Resources Planning and Management in the Indus Basin Irrigation System in Pakistan", 2002.

Bashir, A.C. and N. Yasmin, “Achievements and Issues in 20th Century and Challenges for the Next Millennium". Proceedings of the National Workshop on Water Resources, Pakistan Council of Research in Water Resources, June 1999.

Centre of Excellence in Water Resources Engineering, Lahore, "Proceedings - Water for the 21st Century: Demand, Supply, Development and Socio- Environmental Issues", June 1997.

Colorado State University Extension: Plant Growth Factors-Water

Federal Bureau of Statistics, Statistics Division, Govt. of Pakistan, "Pakistan Statistical Yearbook 2001", April 2001.

Global Water Partnership, "Draft South Asia - Water Vision 2025" Country Report - Pakistan, 2000.

International THE NEWS, February 7, 2010.

MacDonald, M. & Partners Ltd, National Engineering Services Pakistan (Pvt) Ltd, Harza Engineering co International LP, Associated Consulting Engineers ACE (Pvt) Ltd, "Water Sector Investment Planning Study" Provincial Investment Plans, December 1990.

Nazir, A., "Water Resources of Pakistan", Mirajuddin Press, Lahore September 1993.

Pakistan Water & Power Development Authority, "Annual Report 1999-2000", 2001.

Pakistan Metrological Department.

Partial data acquired from Indus River System Authority for flows of rivers in Pakistan.

Planning Commission, Govt. of Pakistan (Sep. 2001), "Ten Year Perspective Development Plan 2001-11& Three Year Development Programme 2001-04".

Proceedings of a Symposium at Burlington House, London, "The Indus River - Biodiversity, Resources, Humankind", Oxford University Press, July 1994.

SCARPs Monitoring Organization (SMO), WAPDA.

Texas A&M Extension: Efficient Use of Water in the Garden and Landscape

Water conservation. (www.monolake.org).

World water crisis and Pakistan. (www.Pakissan.com).