Water and Irrigation in Punjab

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Surface water

RIVER WATER FLOWS

(WESTERN RIVERS)

- AVG ANNUAL FLOWS: 144 MAF
  - HIGH FLOW YEARS: 163 MAF
  - LOW FLOW YEARS: 108 MAF

  - WINTER FLOWS (OCT-MAR): 16%
  - SUMMER FLOWS **(APR-SEP):** 84%

  - HISTORIC USE: 103-104 MAF

Surface water

NATIONAL WATER ACCORD (1991)

- **Shares of provinces (MAF):**
  - **Punjab 55.94**
  - **Sindh 48.76**
  - **Balochistan 5.78**
  - **NWFP 3.87**
  - **TOTAL 114.35**

Accord on the basis of 114 MAF water availability

(plus 3 MAF for civil canals NWFP)

- **This quantity is 9-10% higher than historic use (103-104 MAF)**

- **Implicit in the Water Accord is development of new storage reservoirs**

Surface water

Loss of Storage Capacity in Main Reservoirs due to Silt

Reservoir	Live storage capacity (MAF)				Loss of storage capacity since commissioning (%)
	Year Commissioned	Initial	Year 2001	Year 2025	
Mangla	1967	5.3	4.4	4.0	24.5
Chashma	1971	0.7	0.4	0.3	57.1
Tarbela	1974	9.6	7.9	6.2	35.4
	TOTAL	15.6	12.7	10.5	32.7

Source: Cited in National Water Policy –Draft final report, Volume-II December 2002, from 9th Five Year Plan.

Water Infrastructure

- Main reservoirs: Tarbela, Mangla, Chashma
- Link canals: 12, length 700 km
- Main canals: 45 /24 in Punjab

Features	**Punjab**	**Pakistan**
Canal commands (Nos)	24	45
Design discharge of canals (cumecs)	3,227	7,376
Length of canal systems (Kms)	22,700	43,561
CCA (Mha) *	8,363	14,333
Outlet (Nos)	51,990	95,070
CCA per outlet (Ha)	160.8	150.8

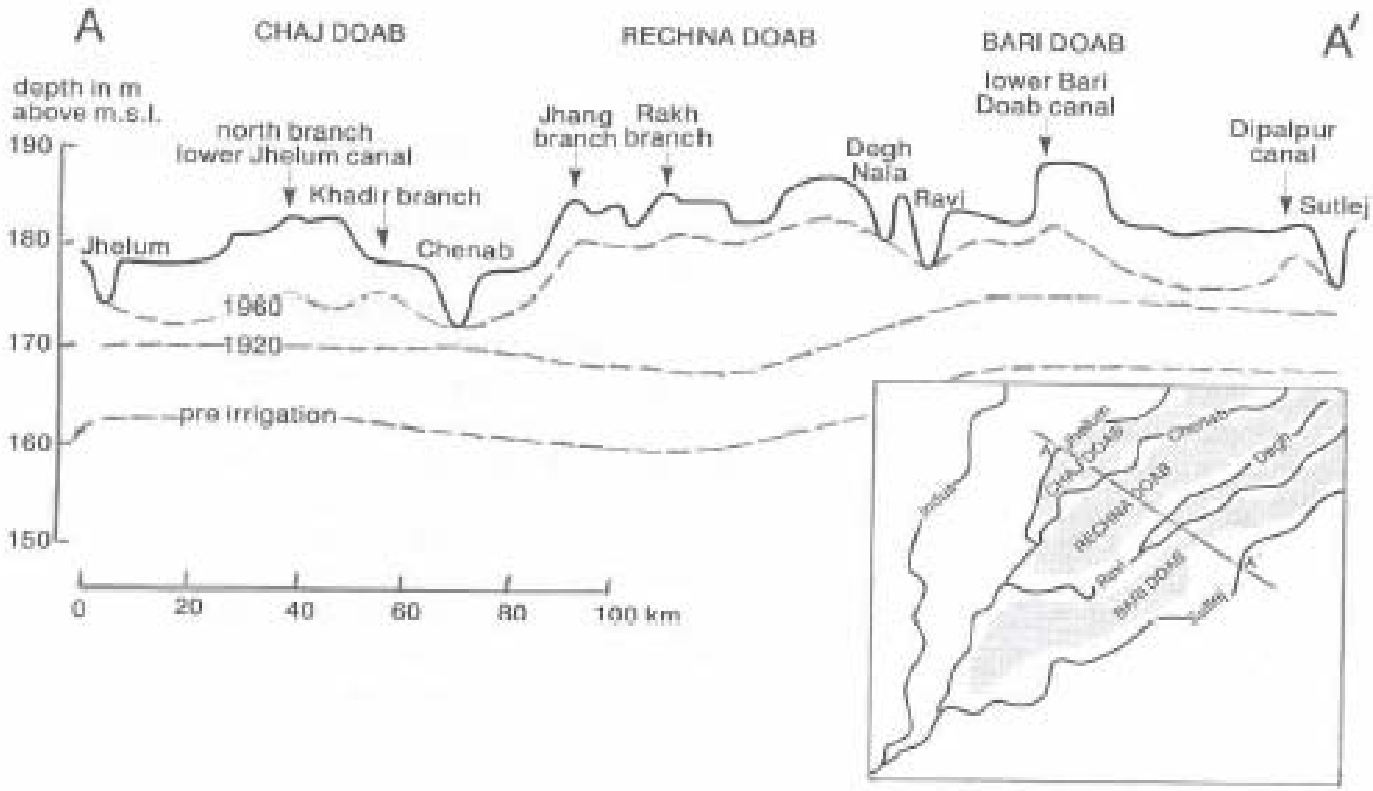
Surface water quality

- Natural surface water quality in Punjab is quite good (TDS 125-250 PPM)
- Man-made pollution is a serious problem

Jehlum	Relatively less polluted. But Downstream Jehlum City DO 7.0 mg/l; BOD 2.2 mg/l
Chenab	12% length depleted of DO; BOD 4.6 mg/l near Faisalabad
Ravi	Most polluted of Punjab rivers. The 62 km length Balloki-Lahore receives most wastewater discharge. BOD 77 mg/l. Devoid of DO under low flow
Sutlej	Due to inflow of effluents, devoid of oxygen over 24% length in low flow; BOD 4.9 mg/l (downstream kasur)
Indus	Less polluted. DO 8.5 in upper reach; BOD 2.9 mg (downstream Attock)

Ground water

Water level dynamics in Punjab



Ground water

Depth to water table (1999)

Water logging situation improving

Water table depth (in meters)	Area (M ha)	Proportion (%)
Less than 1.5	0.62	6.2
1.5 to 3.0	1.89	18.9
3.0 to 4.5	2.92	29.3
4.5 to 6.0	1.47	14.8
More than 6.0	3.06	30.8
Total area covered	9.96	100
Source: SMO. Cited in Steenbergen and Gohar (2005) [1]		

[1] Steenbergen, F.V, and M.S. Gohar "Groundwater development and management" background paper # 11, Country Water Resources Assistance Strategy, World Bank. March 2005

Ground water

Spatial Distribution of groundwater quality

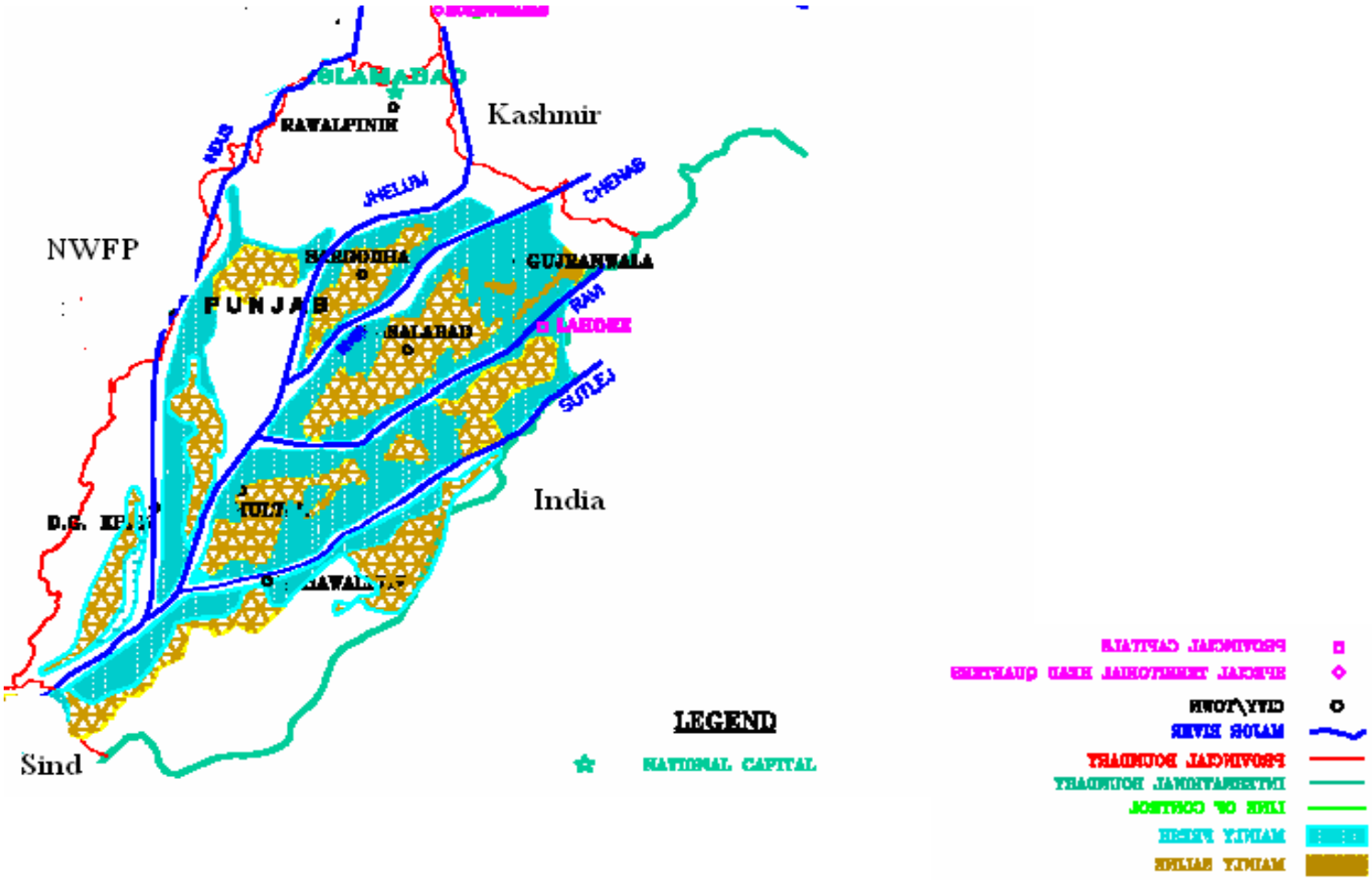
Highest occurrence of saline groundwater in South Punjab

Doab	Gross Area (Mha)	< 1000 PPM (Mha)	1000-2000 PPM (Mha)	>2000 PPM (Mha)
Rechna	3.188	2.436	0.403	0.349
Chaj	1.488	1.102	0.124	0.262
Thal	3.083	1.831	0.672	0.580
Bari	3.312	2.377	0.453	0.483
Bahawalpur	2.677	0.414	0.795	1.469
Total	13.464	8.161	2.447	3.143
% of Total	100	59	18	23

Source: National Water Policy (2002). Draft Final Report (December). Vol. II.

Ground water

Saline groundwater tends to be in central parts of Doabs



Ground water

Groundwater Budget of Punjab

Recharge – Discharge Components in BCM	Normal Year	Drought Year
Recharge Components		
Recharge from rainfall	7.99	5.99
Recharge from irrigation system	25.46	19.10
Return flow from GW abstraction	5.7	6.23
Recharge from rivers	4.00	1.00
Total	43.15	32.32
Discharge components		
Groundwater abstractions (public + private)	38.00	41.25
Non-beneficial ET losses	2.00	1.00
Base flow to rivers	3.15	0.5
Total	43.15	43.00
Net change	0	-10.68

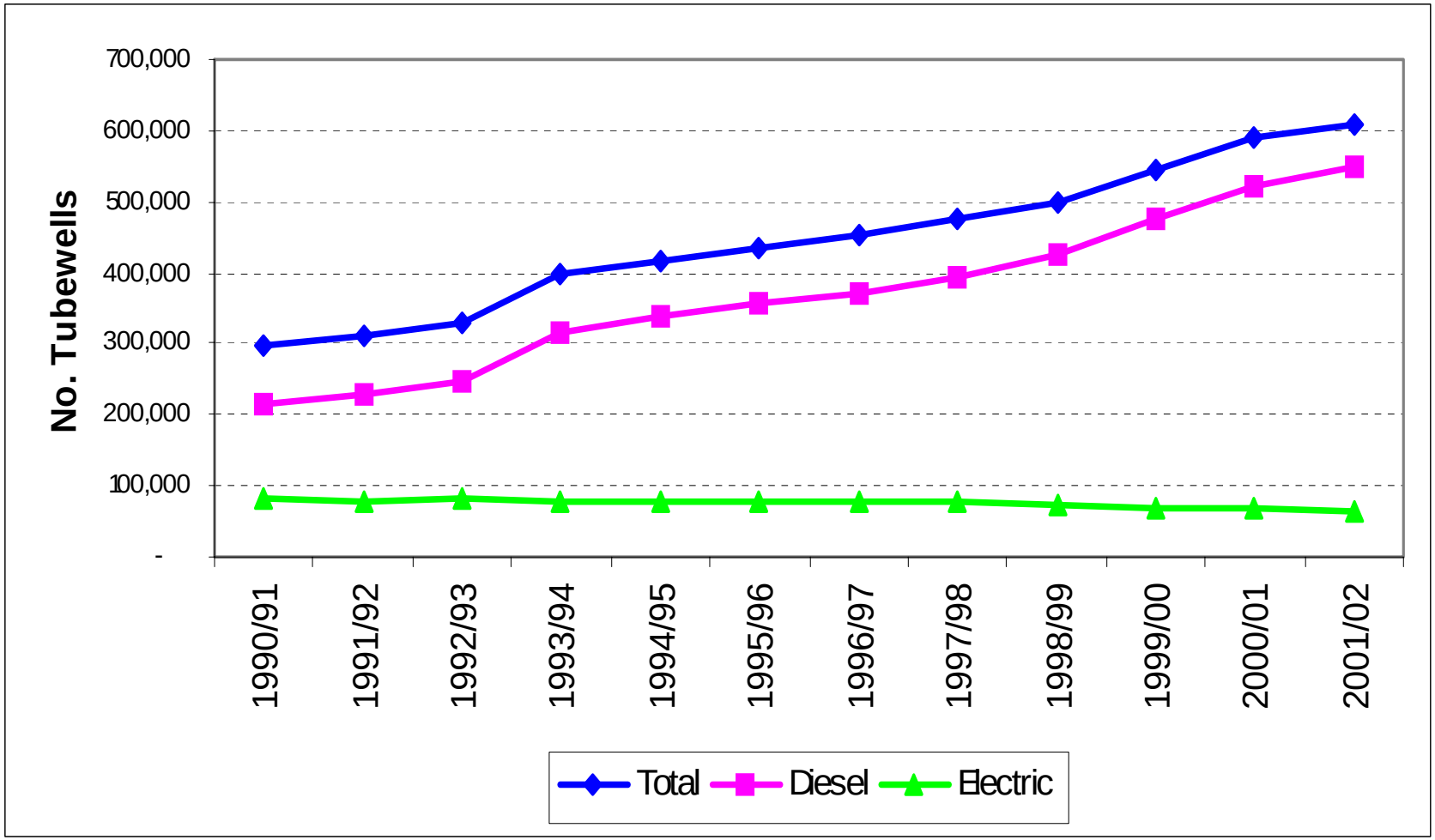
Source: PPSGDP. Cited in Steenbergen and Gohar, pp.9. ibid.

Groundwater Recharge Estimates Vary

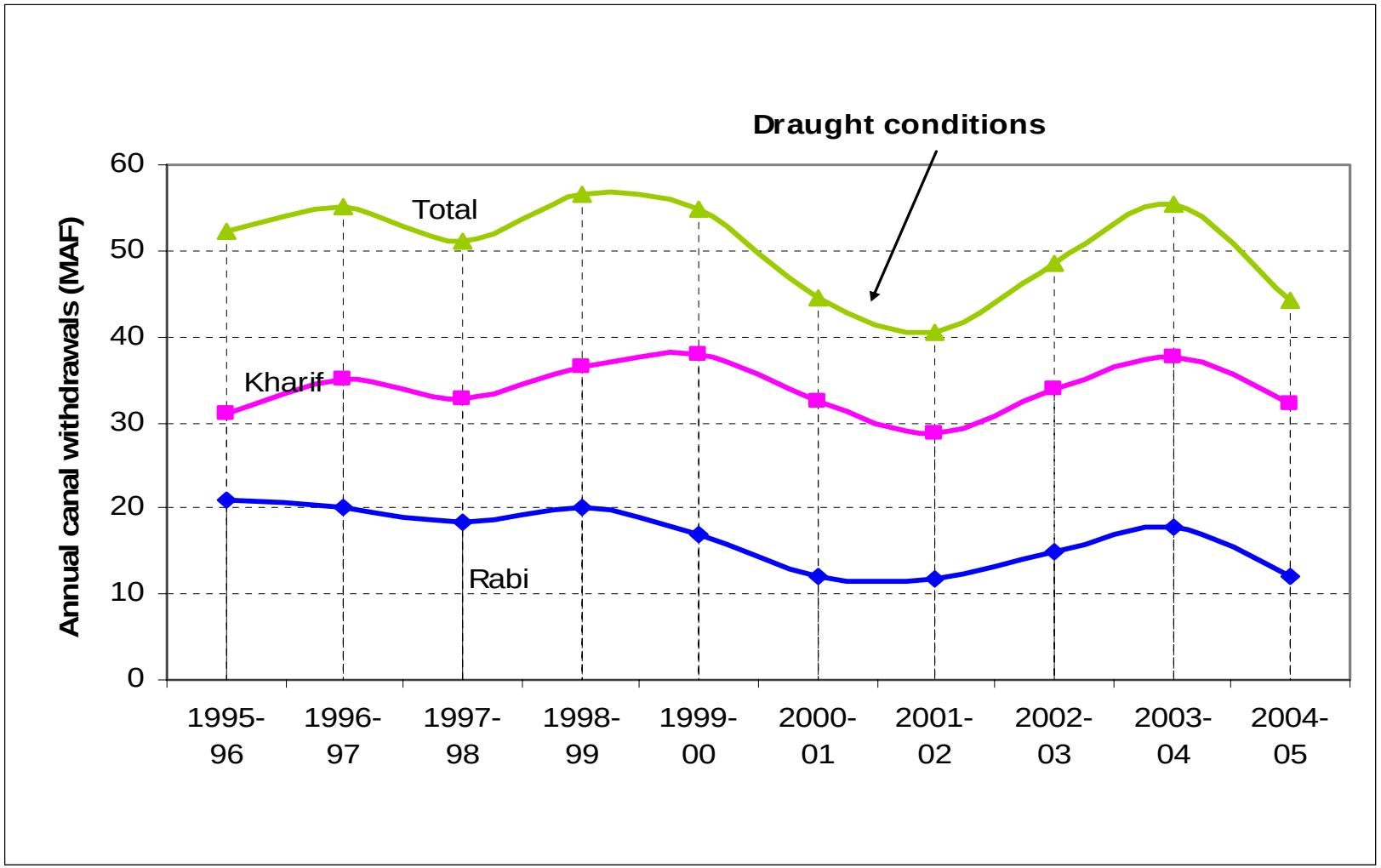
Punjab GW Recharge

- Water Sector Investment Planning study (1990): 27.4 MAF
- NESPAK (1991): 31 MAF
- ACE/HALCROW (2001): 40 MAF
- Punjab Irrig Dept. 12-15 MAF

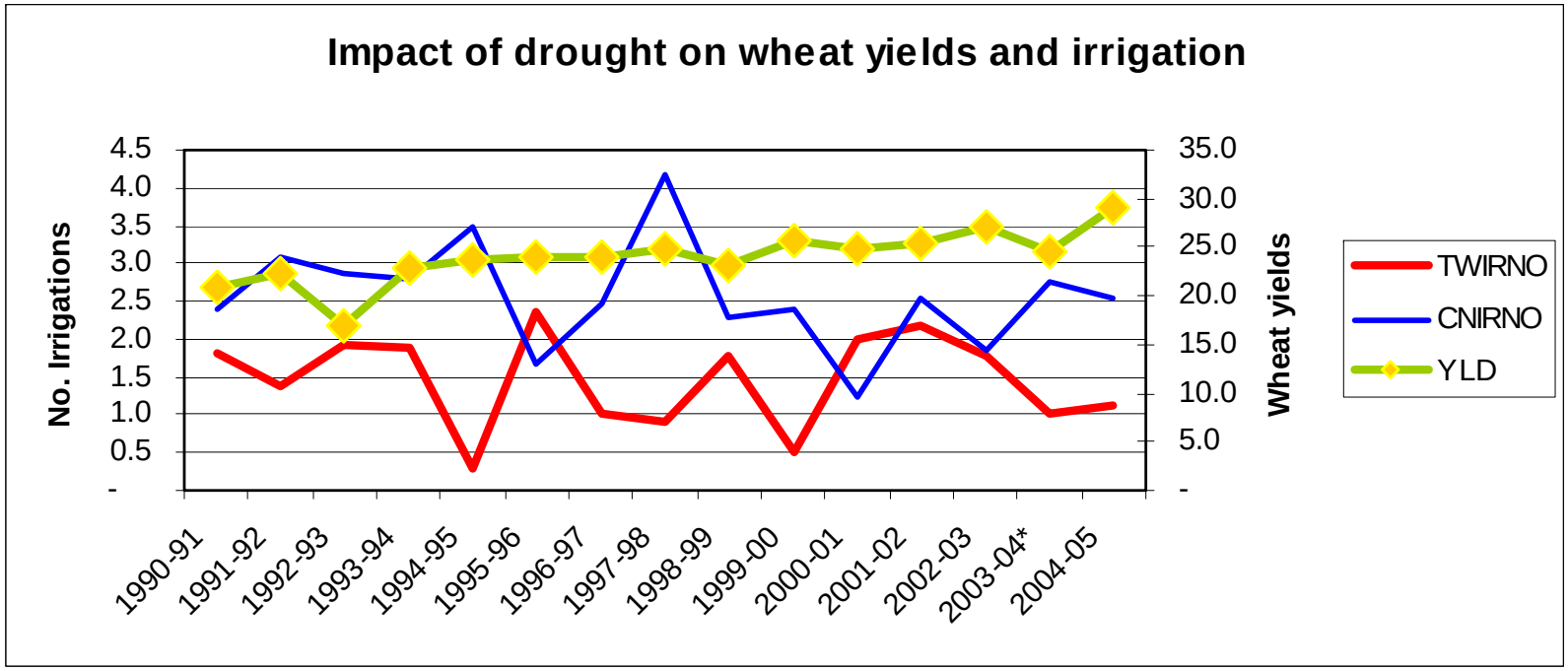
Growth of private tube wells has made conjunctive use environment more robust



Sectoral water use: Agriculture



Risk mitigation through conjunctive use of surface and groundwater



Crop Water Requirements

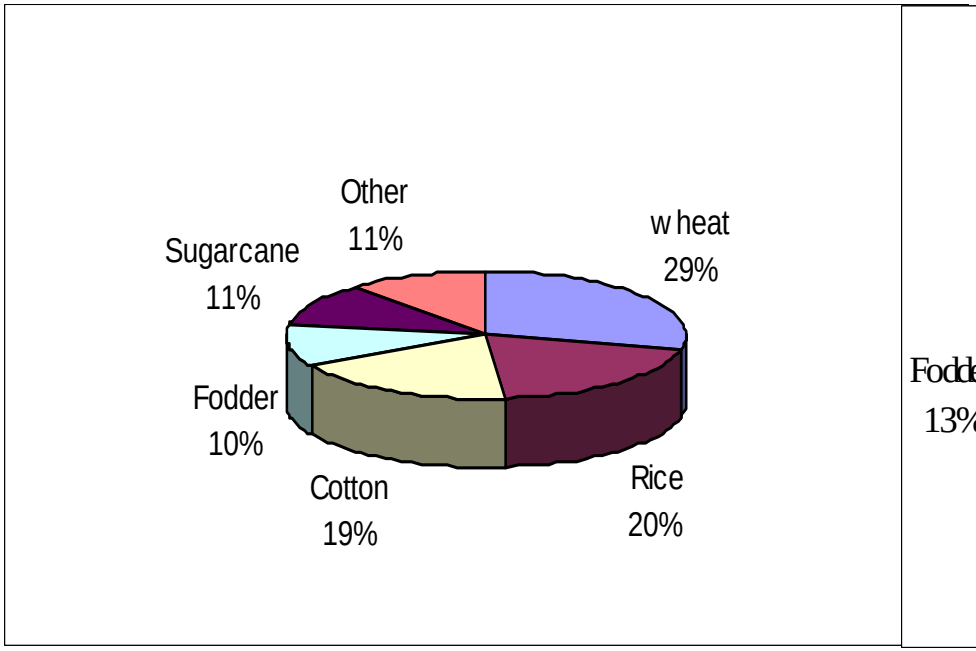
(1998-02 cropped area)

Water Demand		
Requirements at Canal head :		106.6 MAF
	Kharif	70.9 MAF
	Rabi	35.7 MAF
Water Availability		
Average annual withdrawals		49.0 MAF
	Kharif	33.9 MAF
	Rabi	15.1 MAF
Contribution of tube wells		38.0 MAF
Total availability		87.0 MAF

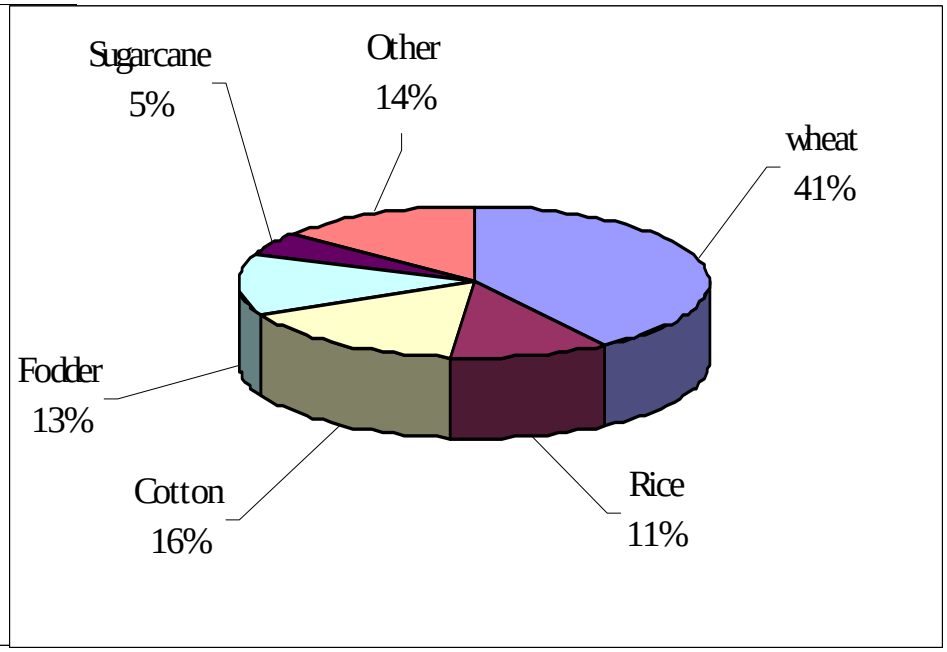
Irrigation of high delta crops places demands on water resources

Need to rationalize water use on sugarcane vs. fodder

Shares of major crops in water requirements



Shares of major crops in cropped area



ISSUES

- Storage capacity is inadequate and decreasing due to siltation. Need for additional storage –as per water accord
- Stock of irrigation infrastructure needs regular maintenance for efficient operation.
- Canal water allowances need to be rationalized
- *Abiana* collections are low making it difficult to improve service. Poor performance results in lower recovery – vicious circle
- Water distribution lacks transparency – Serious equity issues due to rent-seeking activities
- Farmer's participation in irrigation management is minimal, although this is beginning to change (PIDA, AWB, WUAs)
- Pollution of irrigation supplies because effluent discharged in rivers, link canals and distributaries.

ISSUES

- Need to re-think role of IBIS: from gigantic surface water supply network to intricate recharge mechanism
- Rapid groundwater development in last few decades has created genuine conjunctive use environment- risk mitigation
- In some areas rapid depletion of aquifers is taking place due to excessive pumping. Especially, freshwater lens is depleting (nalka bores)
- Groundwater recharge heavily dependent on surface water distribution
- So called saline water zones are where surface water recharge is limited
- Most efforts such as lining, water conserving technology reduce percolation, not save water from basin perspective

ISSUES

- Surface water has rigid *Warabandi*
- Groundwater is free for all, completely unregulated => tragedy of commons
- Need **more flexibility** in surface water allocation, between uses, between regions
- Need **more regulation** of groundwater

Issues

- Water Productivity in Punjab is low. Crop yields are low. Wheat yields half those in Indian Punjab water productivity ratios 5:8
- Irrigation efficiency is only 40%. Land leveling and other efficiency improving practices and technologies not widely adopted
- Crop mix is includes high delta crops such as sugarcane where the province has questionable comparative advantage
- On the other hand there is scope for augmenting productivity in livestock sector by allocating water for improved fodder productivity
- Integrating water conserving, low-pressurized technologies into existing gravity flow system is a challenge for research and extension establishment

The way forward

- Create consensus for developing additional storage capacity.
- To ensure physical sustainability of the irrigation system clear backlog of deferred maintenance.
- Rationalize water duties in line with crop water requirement of various canal commands. Remodel, redesign the system infrastructure accordingly.
- Enhance crop productivity. Develop draught-resistant, salt tolerant varieties. Revamp agri extension services and emphasize irrigation extension
- Encourage transformation of agriculture to producing high-value non-traditional crops to increase value added per drop
- Encourage water conserving cropping patterns. Sugarcane area should not expand, consider sugar beet. Enhance livestock productivity by increasing fodder production

The way forward

- Irrigation efficiency should be viewed from a basin perspective rather than focusing on farm level efficiency only.
- Many water conserving technologies prevent percolation losses and do not save as much water from Basin perspective. Nevertheless these technologies improve water adequacy at farm level, especially during critical stages. Investment decisions regarding water conserving technologies should be based on these benefits rather than farm level efficiency calculations
- Equity in irrigation system should be increased as a means of enhancing productivity and alleviating poverty
- Irrigation in Punjab takes place in truly conjunctive use environment, surface water allocation should be geared towards recharge management
- Groundwater use should be regulated through community-based organizations
- Clear guidelines should be formulated and enforced for re-use of treated wastewater. Irrigation with untreated wastewater should be checked.

The way forwards

- Awareness raising campaign should be launched to disseminate water resources information to public for creating better understanding of water issues and build support for water resources management options
- Comprehensive Doab level water management plans should be prepared

- Sector architecture
  - Institutional architecture of water sector should be rationalized by creating capacity for integrated water resources management
  - National Water Resources Management Authority should be created at federal level. Provincial Water Resources Management Authorities (PWRMA) should be created.
  - The mandate of WRM agency should include regulatory oversight over all water using sectors/agencies, planning formulation of policies and strategies. Most importantly the agency would be responsible for controlling unsustainable water use patterns and protecting water resources from pollution
  - WRM authority would leave Implementation of water projects in the hands of concerned sub-sectoral agencies and perform regulatory functions