# Bhakra Canals and Groundwater in Punjab and Haryana

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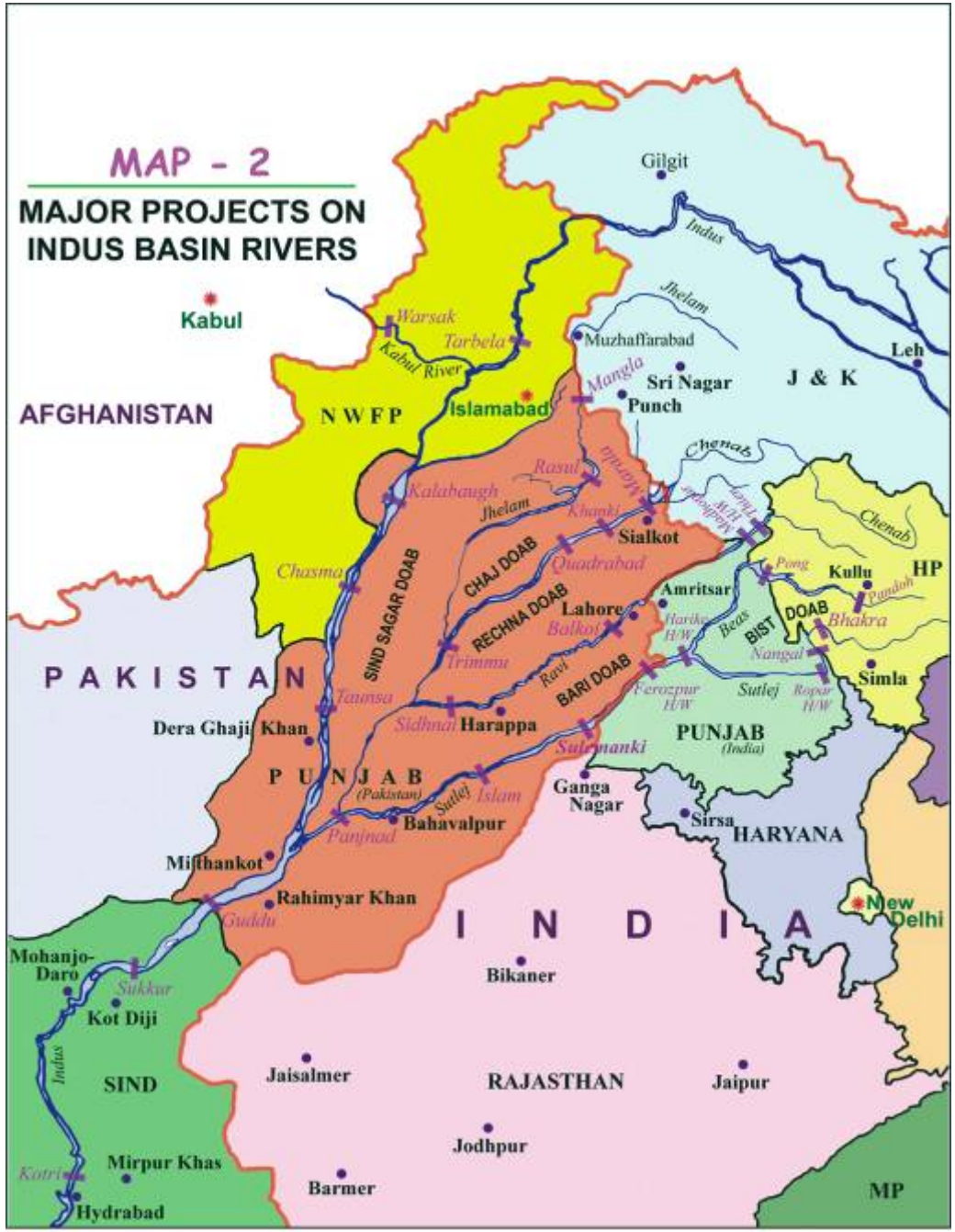
*Manthan, India*

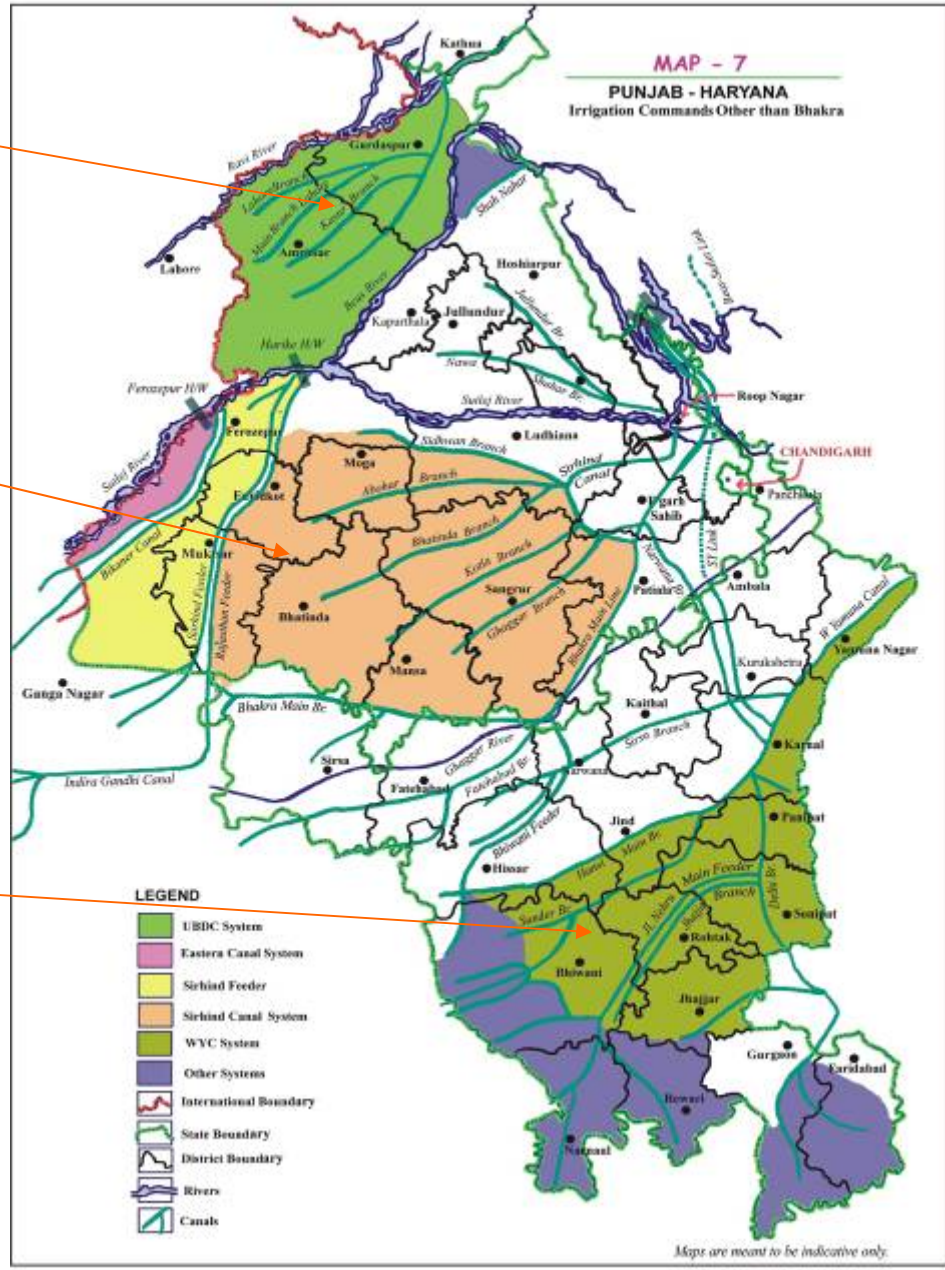

MAP - 2
MAJOR PROJECTS ON
INDUS BASIN RIVERS
Kabul
AFGHANISTAN
NWFP
Islamabad
Gilgit
Indus
Jhelam
Warsak
Tarbela
Kabul River
Muzhaffarabad
Mangla
Sri Nagar
Punch
J & K
Leh
Chenab
Rasul
Kalabaugh
Jhelam
Khanki
Sialkot
Chasma
SIND SAGAR DOAB
CHAJ DOAB
Quadrabad
RECHNA DOAB
Lahore
Amritsar
Pong
Kullu
HP
Pandoh
Bhakra
BIST DOAB
Nangal
Simla
Bolkot
Trimmu
Ravi
BARI DOAB
Ferozpur H/W
Sutlej
Ropar H/W
PAKISTAN
Taunsa
Dera Ghazi Khan
Sidhnai
Harappa
PUNJAB (India)
Sulemanki
PUNJAB (Pakistan)
Ganga Nagar
Sirsa
HARYANA
Islam
Panjnad
Bahawalpur
Mithankot
Rahimyar Khan
Guddu
New Delhi
INDIA
Mohanjo-Daro
Sukkur
Kot Diji
Bikaner
Indus
SIND
Jaisalmer
RAJASTHAN
Jaipur
Jodhpur
Mirpur Khas
Kotri
Barmer
Hydrabad
MP
LEGEND
Dam/Barrage

Bari Doab System 1859

Sirhind Canal 1882

<u>Western Jamuna Canal</u> –

Precursor 1355
Used for Irrigation 1568
Restored 1821
Tajewala Weir 1873



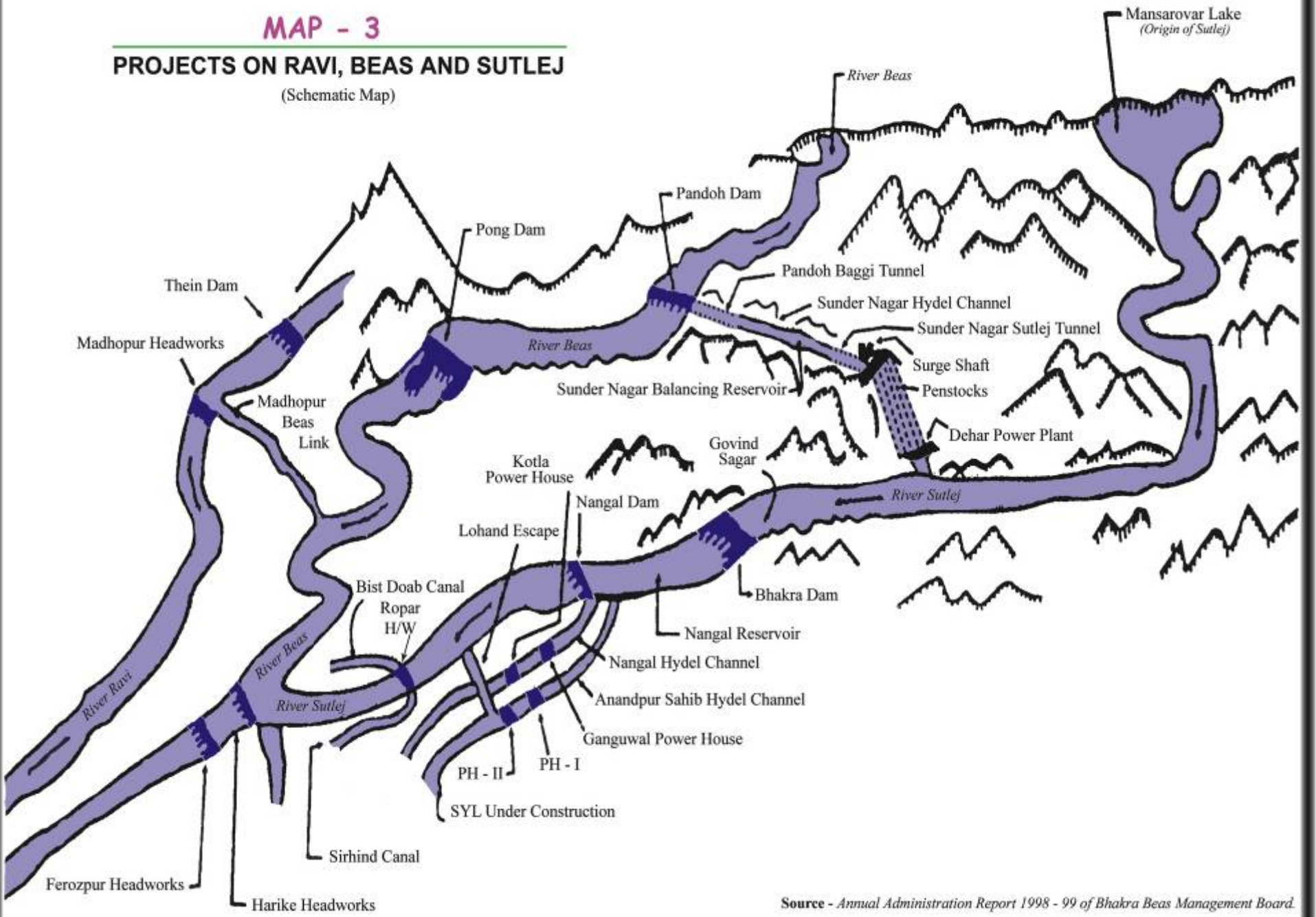
# Time-line : Bhakra

- 1908: Proposal made to construct a dam on the river Sutlej
- 1946: Construction at Nangal begins
- 1954: Nangal Hydel Channel and network of Bhakra Canal becomes operational
- 1958: First Impoundment
- 1963: Construction of dam completed, irrigation fully developed

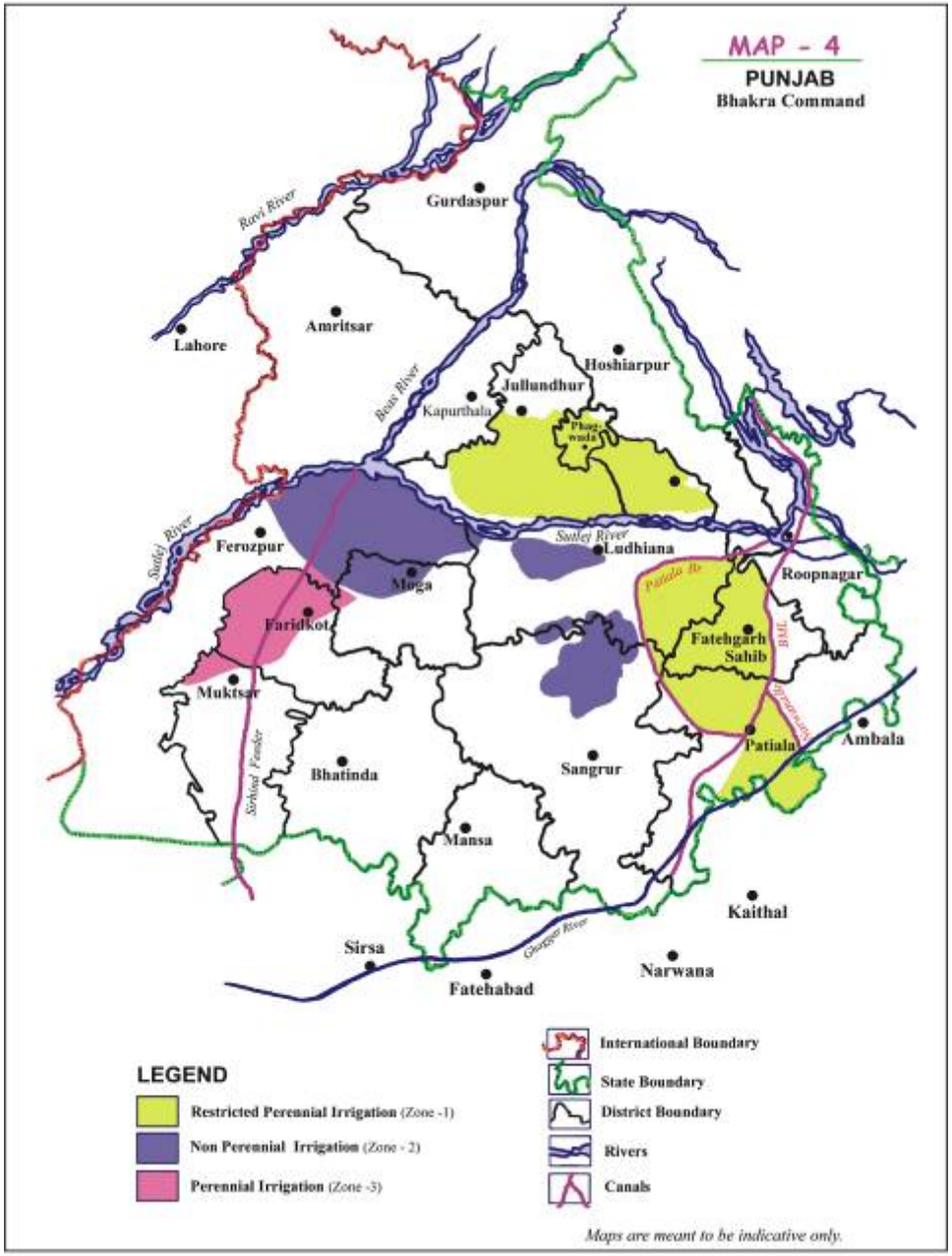
# MAP - 3

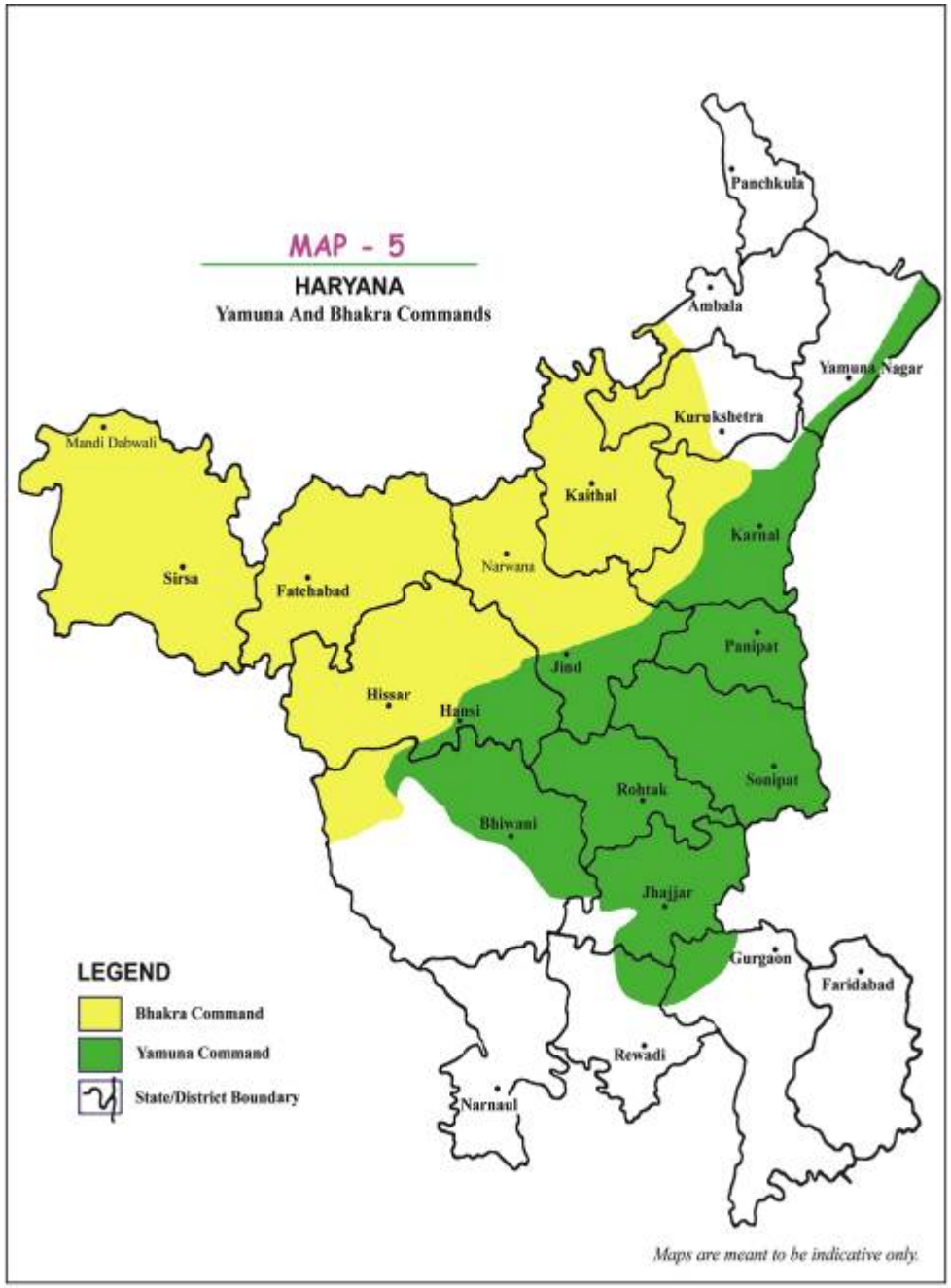
## PROJECTS ON RAVI, BEAS AND SUTLEJ

(Schematic Map)




**Source** - *Annual Administration Report 1998 - 99 of Bhakra Beas Management Board.*


MAP - 4
PUNJAB
Bhakra Command
Ravi River
Gurdaspur
Amritsar
Lahore
Beas River
Hoshiarpur
Jullundhur
Kapurthala
Phagwara
Sutlej River
Ferozpur
Sutlej River
Ludhiana
Roopnagar
Moga
Patiala By
Faridkot
Fatehgarh Sahib
Muktsar
Bhatinda
Sangrur
Patiala
Ambala
Sirhind Feeder
Mansa
Kaithal
Sirsa
Ghaggar River
Narwana
Fatehabad
LEGEND
Restricted Perennial Irrigation (Zone -1)
Non Perennial Irrigation (Zone - 2)
Perennial Irrigation (Zone -3)
International Boundary
State Boundary
District Boundary
Rivers
Canals
Maps are meant to be indicative only.


MAP - 5
HARYANA
Yamuna And Bhakra Commands
Panchkula
Ambala
Yamuna Nagar
Kurukshetra
Mandi Dabwali
Kaithal
Karnal
Narwana
Sirsa
Fatehabad
Panipat
Jind
Hissar
Hansi
Rohtak
Sonipat
Bhiwani
Jhajjar
Gurgaon
Faridabad
Rewadi
Narnaul
LEGEND
Bhakra Command
Yamuna Command
State/District Boundary
Maps are meant to be indicative only.

# Bhakra Command

| State | Geographical Area (m Ha) | Bhakra GCA (m Ha) | Bhakra GCA as % to State Area |
|---|---|---|---|
| Haryana | 4.421 | 1.309 | 29.6% |
| Punjab | 5.033 | 0.934 | 18.6% |

# Irrigation from Bhakra Project

| | |
|---|---|
| Gross Commanded Area: | 2.68 m ha |
| Cultivable Commanded Area: | 2.37 m ha |
| Annual Irrigation: | 1.46 m ha |

# Significant Features

- Construction on Canal ahead of the dam to allow early irrigation benefits
- Irrigation begins 1954, Impoundment 1958
- Command Area divided into 3 zones
- Maximum Intensity of Irrigation 62%, Average 55%

# Significant Features

No explicit planning of conjunctive use in the command area. Probable Reasons:

- –Belief that waterlogging could be addressed by drainage
- –T/W seen as not cost effective in long term for waterlogging problem
- –Beas-Sutluj-Ravi system would have ample water

But groundwater was a major source and continued to be part of

# Irrigation Prior to Bhakra

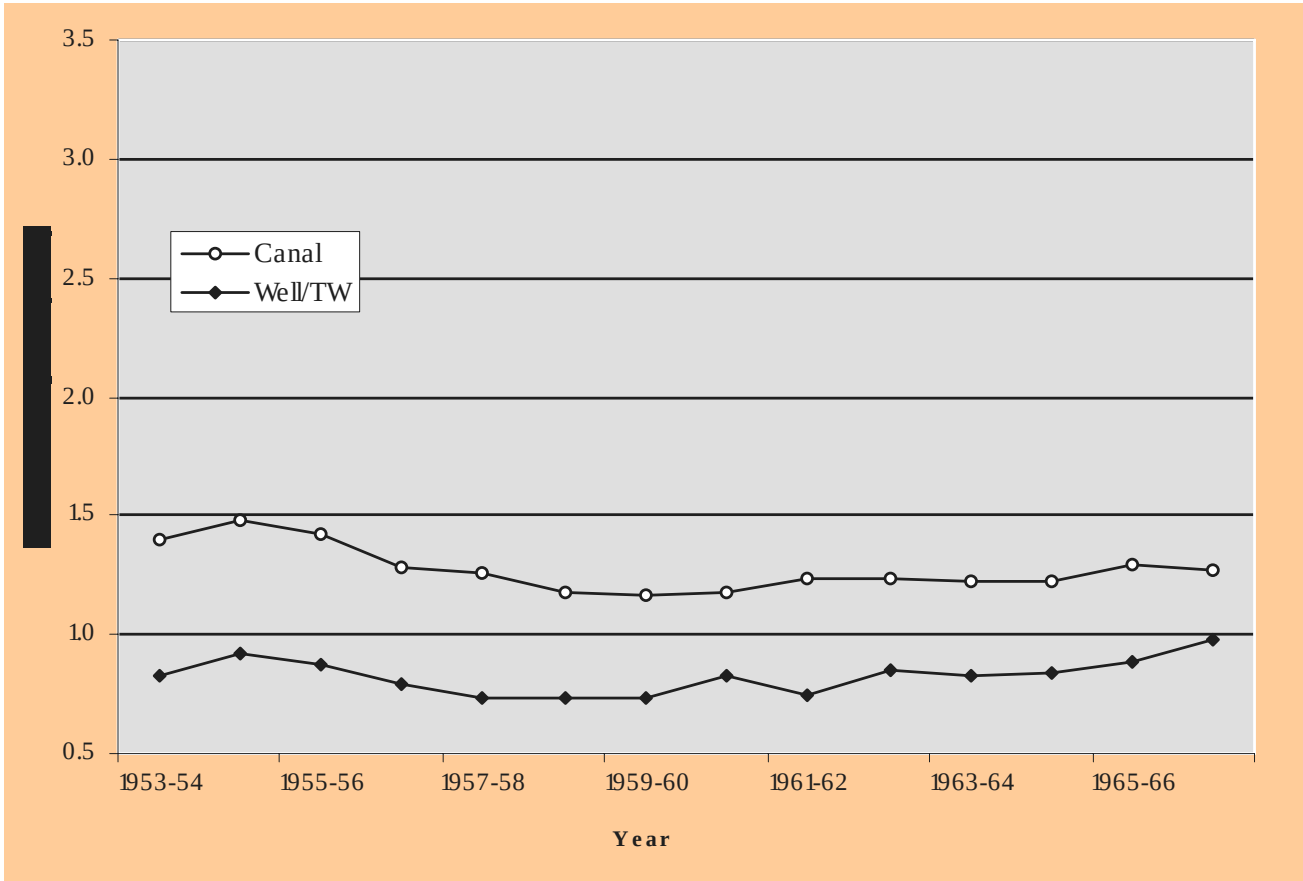
Punjab (today's Punjab and Haryana) in 1953-54:

Total net irrigated area - 3.028 m ha

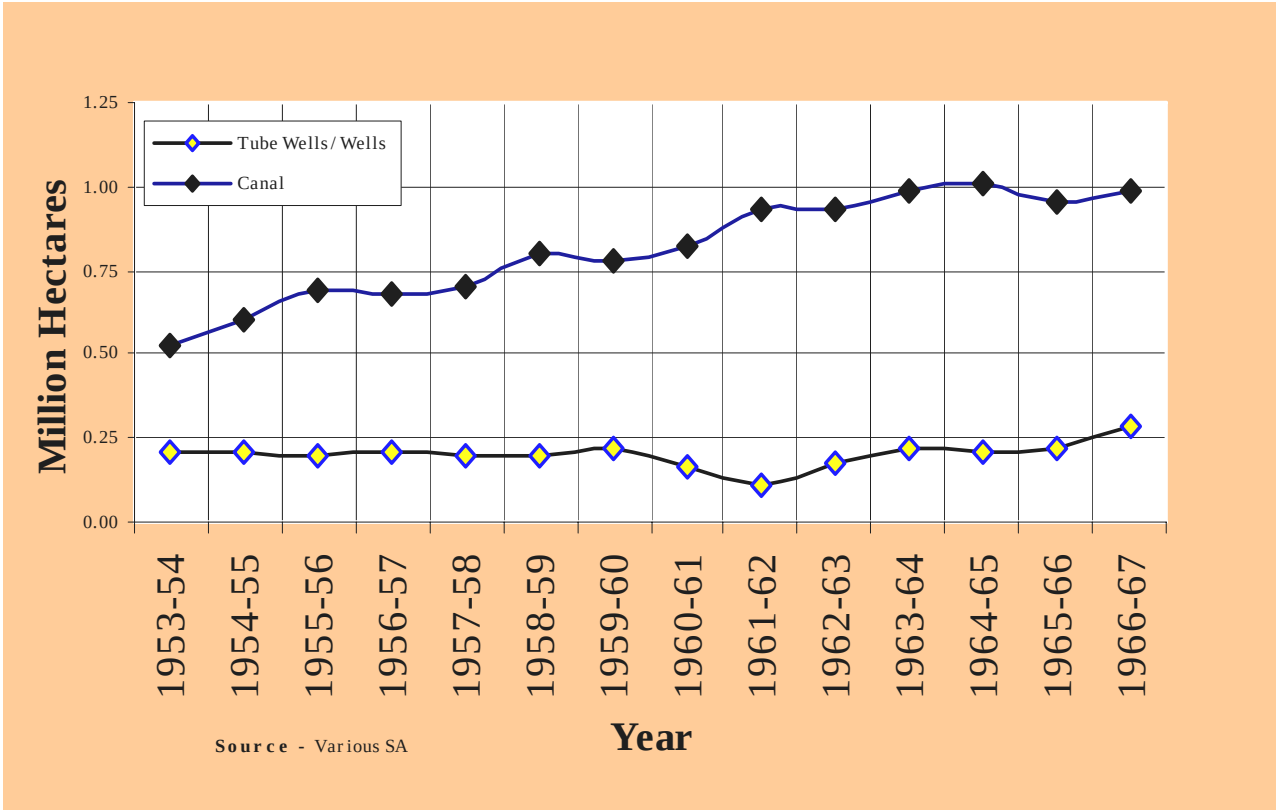
By Canals - 1.912 m ha (63%)

By wells - 1.036 m ha (34%)

# Net Area Irrigated by Source in Punjab 1953-1967



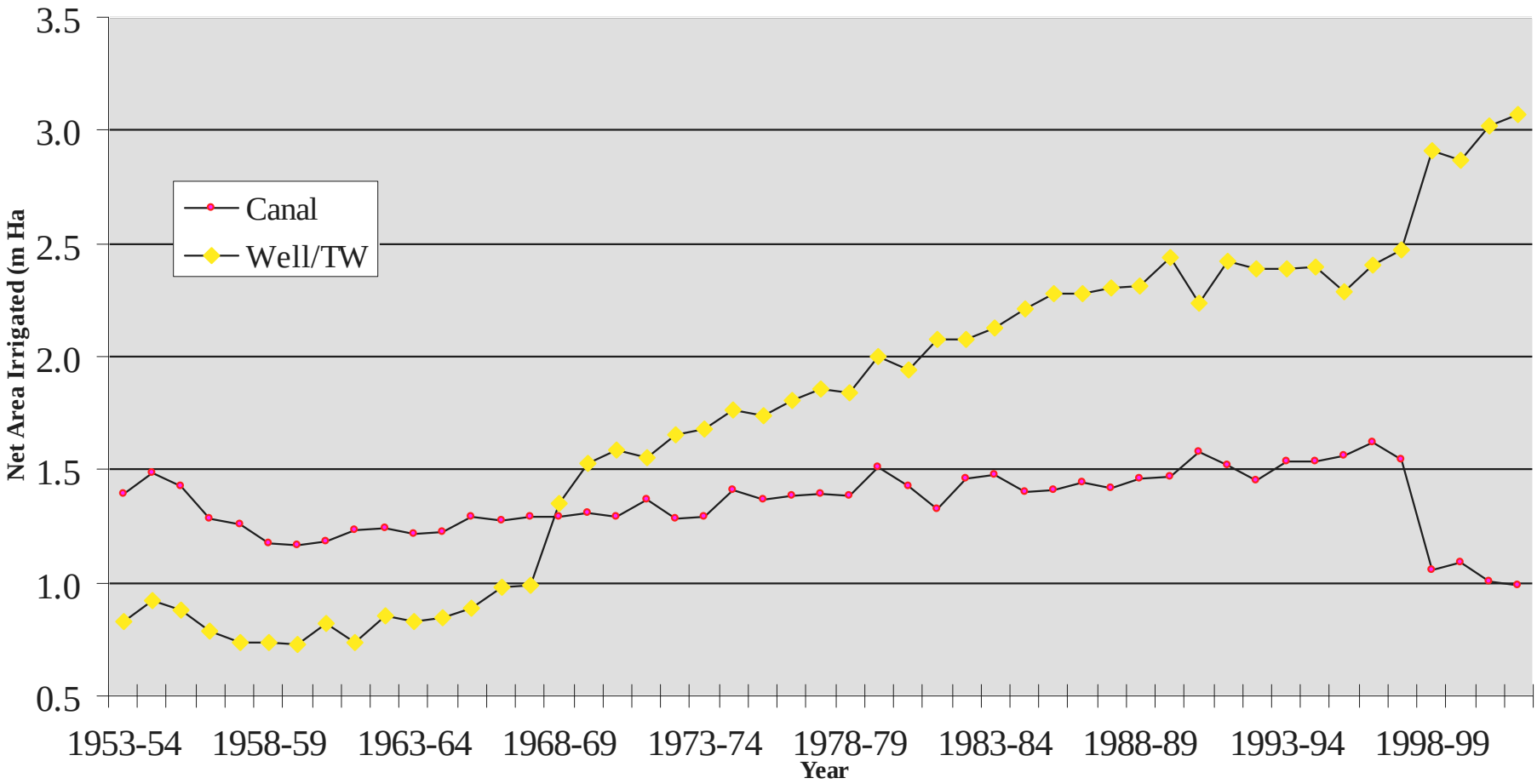
# Net Area Irrigated by Source in Haryana



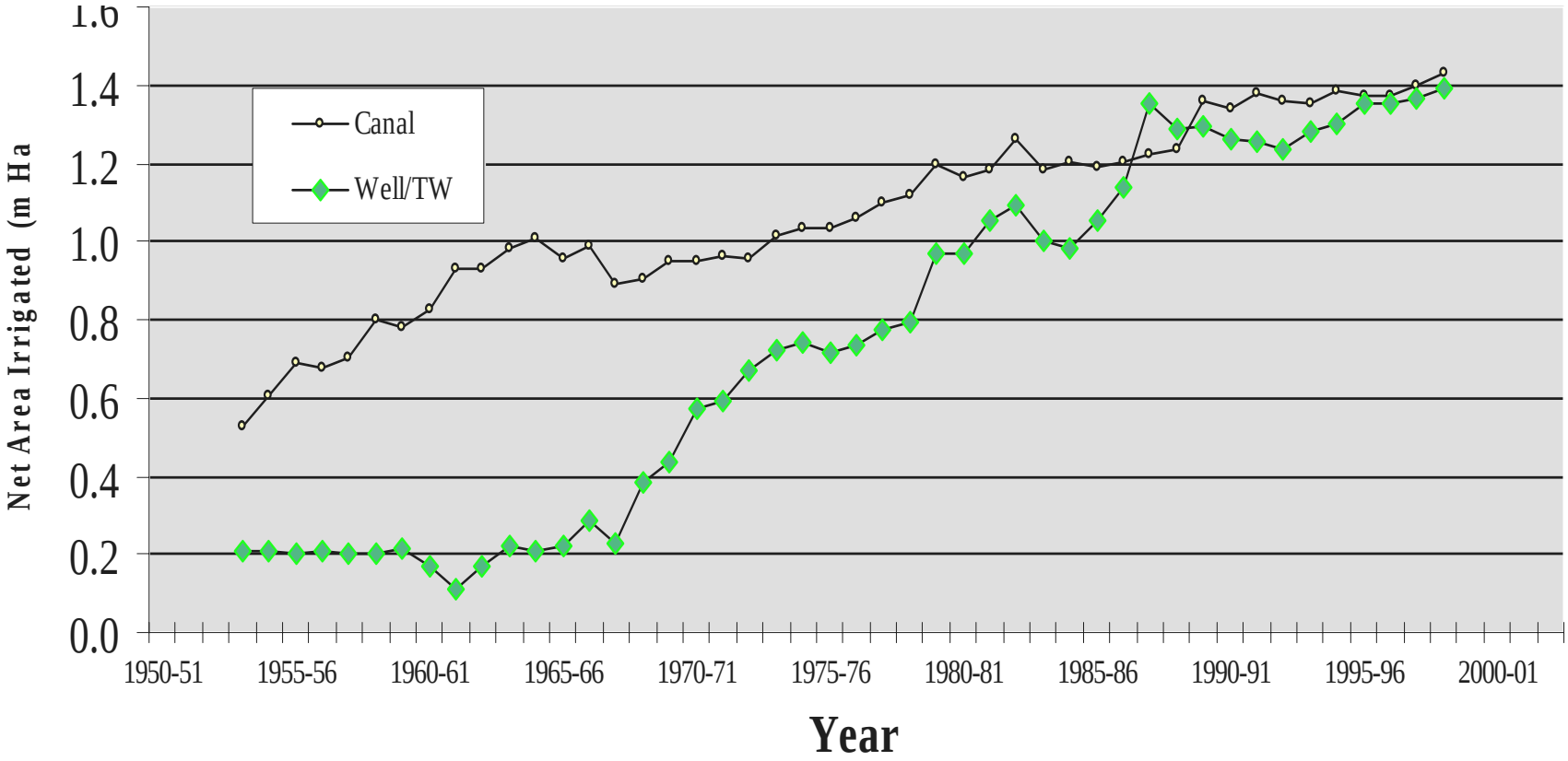
# Dramatic Shift

- Advent of Green Revolution in 1965-66
- Introduction of High Yielding Variety of Seeds major trigger
- Seeds sensitive to quantum and timing of water
- Groundwater provided exactly the kind of control required

# Net Area Irrigated, by Source, in Punjab



# Net Area Irrigated by Source in Haryana



# Canal Irrigation in Various Districts in Punjab

| S.N. | Name of District | Total Net Area Irrigated in Year 2001-02 (000 Ha) | Net Area Irrigated by Canal in Year 2001-02 (000 Ha) | Net Area Irrigated by Canal as % to Total Net Irrigation |
|---|---|---|---|---|
| 1 | Kapurthala | 136.2 | 12.0 | 8.8% |
| 2 | Jullundhur | 237.5 | 7.0 | 2.9% |
| 3 | Nawanshahar | 84.6 | 3.0 | 3.5% |
| 4 | Ludhiana | 305.3 | 6.1 | 2.0% |
| 5 | Ferozepore | 473.5 | 144.8 | 30.6% |
| 6 | Faridkot | 130.5 | 25.7 | 19.7% |
| 7 | Moga | 199.5 | 11.3 | 5.7% |
| 8 | Muktsar | 217.5 | 4.3 | 2.0% |
| 9 | Bhatinda | 294.9 | 229.5 | 77.8% |
| 10 | Mansa | 199.2 | 152.1 | 76.4% |
| 11 | Sangrur | 455.5 | 140.2 | 30.8% |
| 12 | Patiala | 290.7 | 9.5 | 3.3% |
| 13 | Sirhind (Fatehgarh Sahib) | 103.5 | 1.6 | 1.5% |
| 14 | Rupnagar | 104.9 | 16.4 | 15.6% |
| Total for 14 Districts | | **3233.3** | **763.5** | |
| **Total Punjab** | | **4057** | **987** | **24.33** |

# Canal Irrigation in Various Districts in Haryana

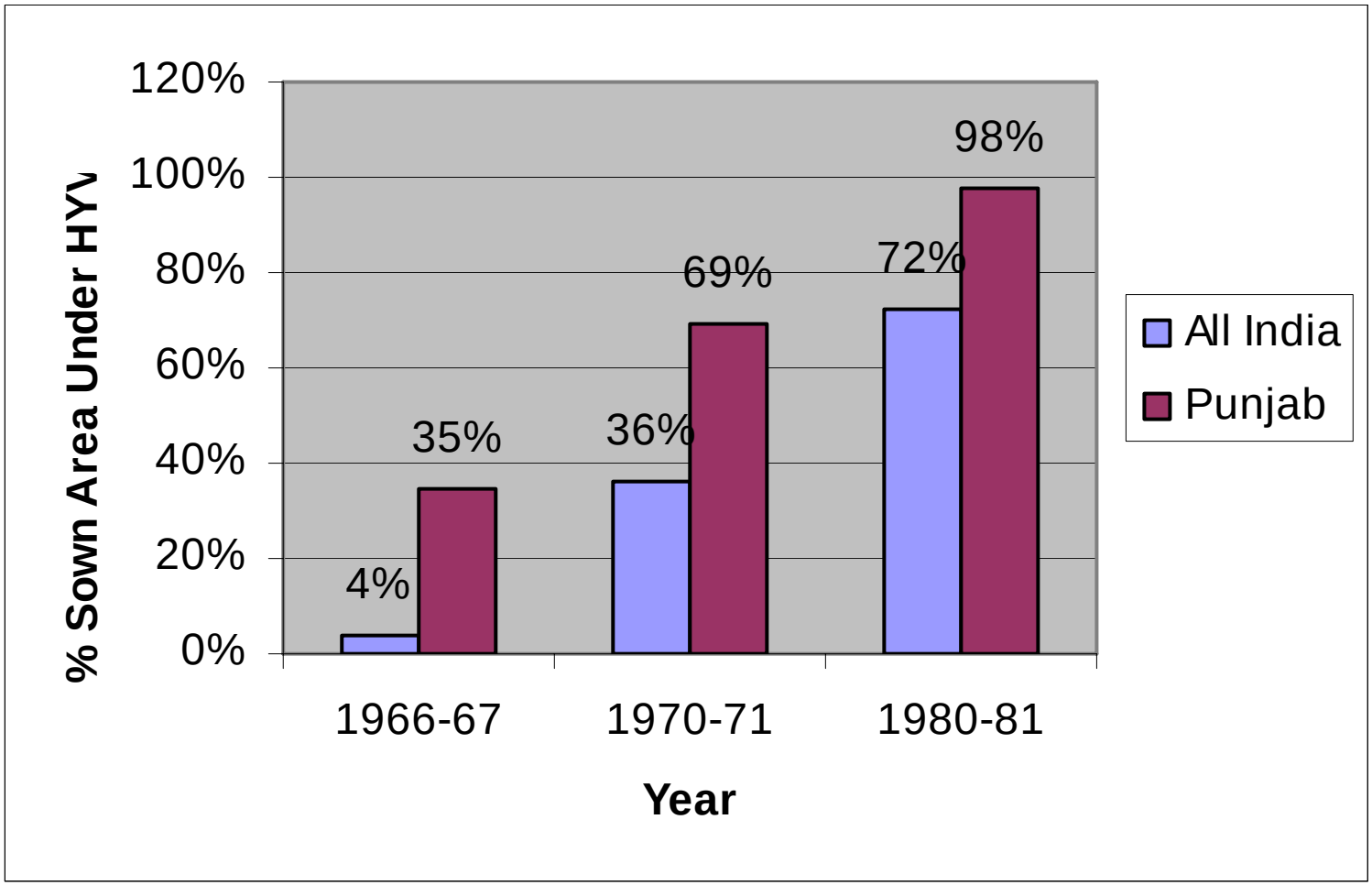
| S. No. | Name of District | Total Net Area Irrigated in Year 1998-99 (000 Ha) | Net Area Irrigated by Canal in Year 1998-99 (000 Ha) | Net Area Irrigated by Canal as % to Total Net Irrigation |
|---|---|---|---|---|
| 1 | Hissar | 252 | 243 | 96.43 |
| 2 | Bhiwani | 212 | 129 | 60.85 |
| 3 | Sirsa | 309 | 262 | 84.79 |
| 4 | Fatehabad | 196 | 136 | 69.39 |
| 5 | Karnal | 206 | 42 | 20.39 |
| 6 | Kurukshetra | 148 | 8 | 5.41 |
| 7 | Kaithal | 197 | 100 | 50.76 |
| 8 | Ambala | 94 | 14 | 14.89 |
| 9 | Jind | 217 | 129 | 59.45 |
| | **Total 9 Districts** | **1831.0** | **1063.0** | |
| | Total Haryana | 2842 | 1433 | 50.42 |

# Reasons for Explosive Growth of Groundwater Use - 1

**HYV Seeds Triggered the Growth**

- **Much Higher Yields**
- **Quick Adoption**
- **Demanded Control of Irrigation**
- **Needed higher quantities of water**
- **Higher Returns due to MSP and Procurement**

# Spread of HYV in Punjab: Wheat



HYV triggered growth in groundwater use.

Social and historical factors were responsible for the widespread adoption of HYV in Punjab and Haryana.

Policies and other support sustained and pushed continuation of HYV adoption, changing cropping pattern and associated groundwater extraction in the two states - and are now locking farmers into this path.

# Historical and Social Factors

- Existing Irrigation since decades
- Land Reforms – Better Distribution, Elimination of middlemen, consolidation
- Better Land/Person Ration
- Entrepreneurial Spirit
- Implementation of IADP in Ludhiana
- Better Assimilation of Technology

# Policies and Other Support

- Concentration of inputs
- Marketing Support – Assured Procurement, MSP
- Availability of Electricity (Punjab was No. 3 after Maharashtra and W. Bengal but better distribution)
- Free / Low Priced Electricity
- Very Successful – but now blocking other choices

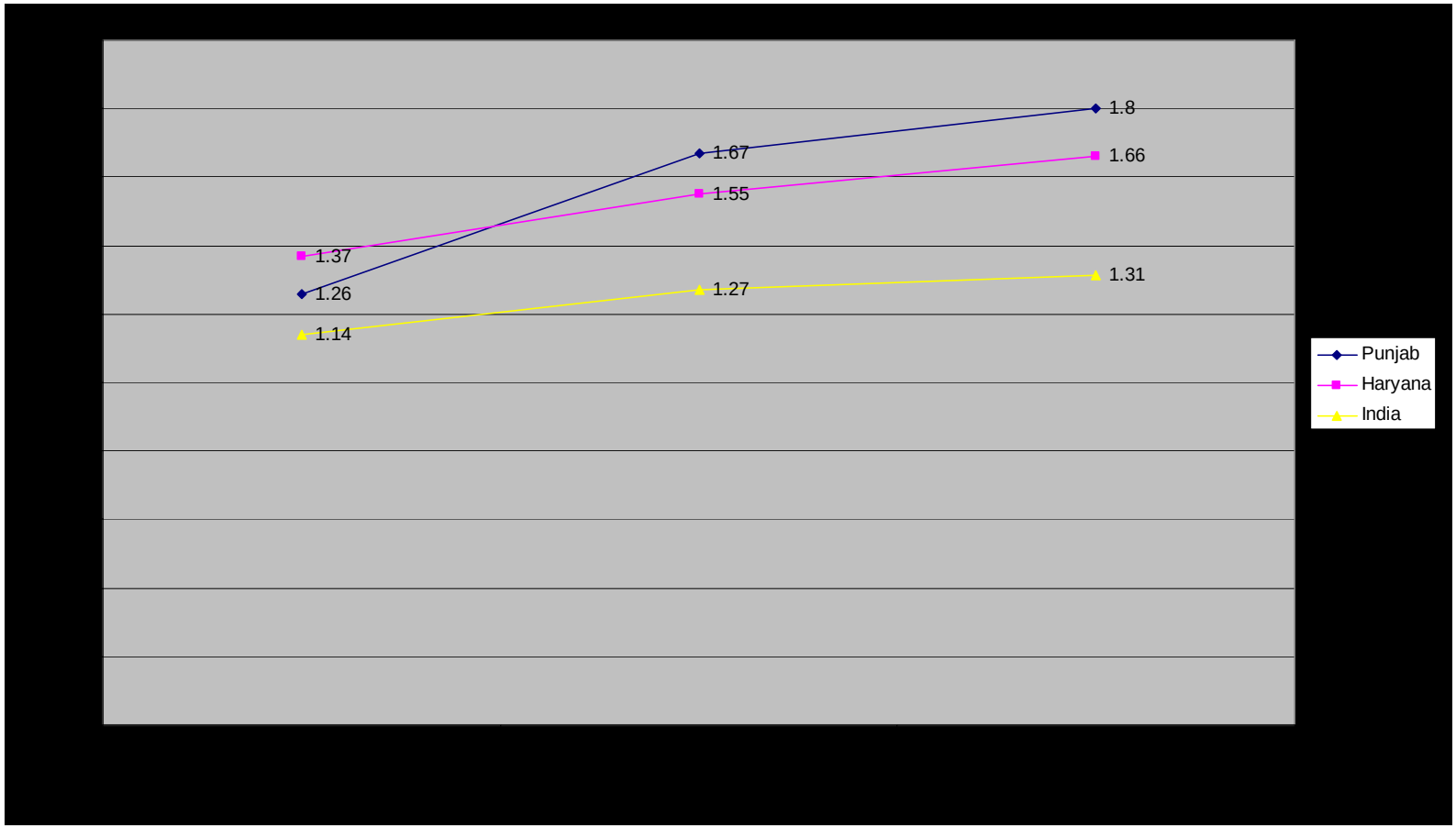
# Policies Force Farmers' Choices

- Even in Saline groundwater area people compelled to use t/w as other crops do not give adequate returns
- About 25% of t/w in Punjab and 44% in Haryana run on diesel
- Rice introduced for tackling waterlogging, but policies made it profitable everywhere

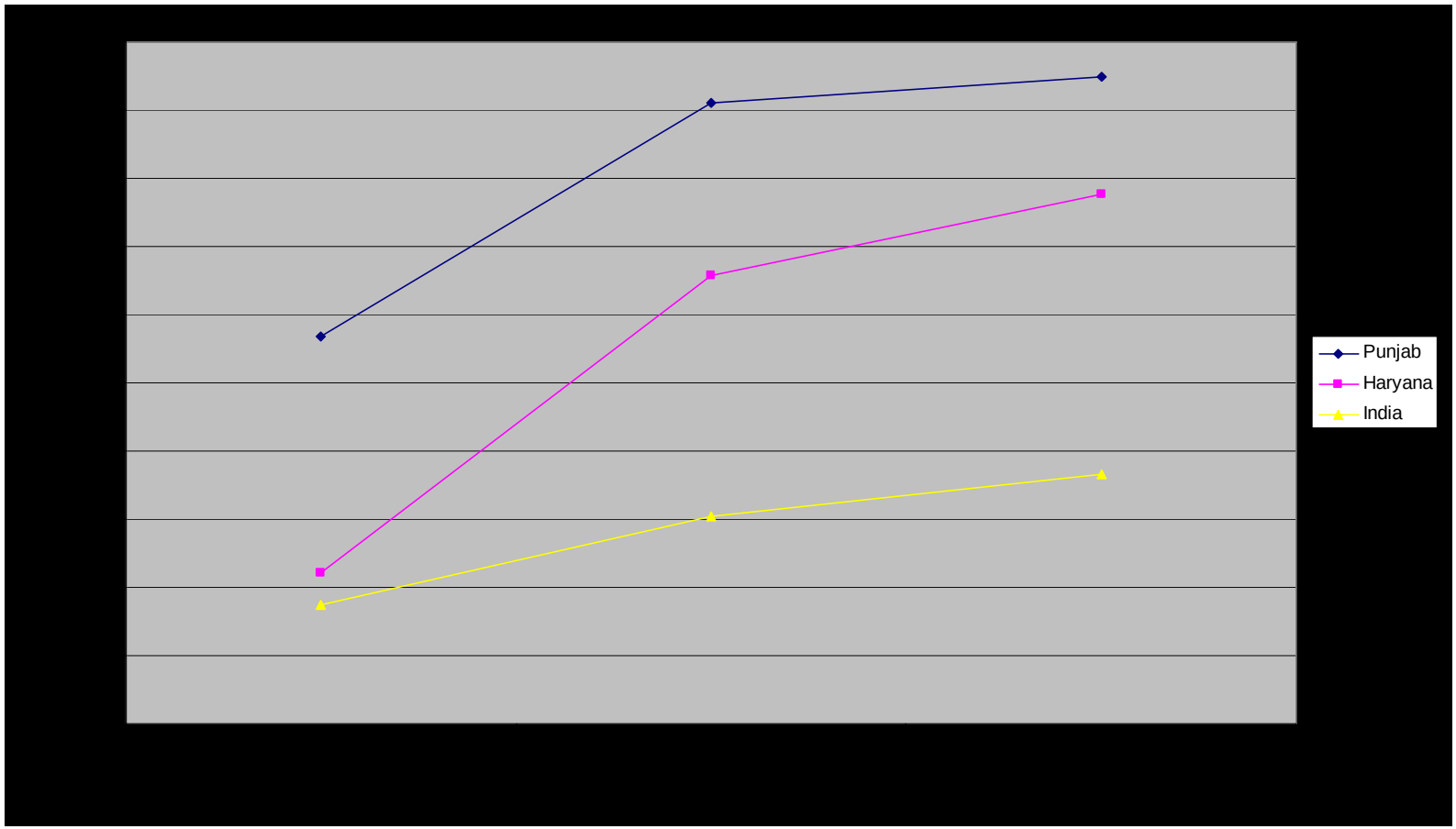
# Reasons for Explosive Growth of Groundwater Use - 2

- **Increase in Cropping Intensity**
- **HYV made possible double cropping due to shorter duration**
- **HYV and the Changing Cropping Pattern Needs Excessive Waters – Bhakra designed for maximum irrigation intensity of 62%**
- **Canal Waters Declining and Unreliable**
- **Inherent Advantages of Groundwater**

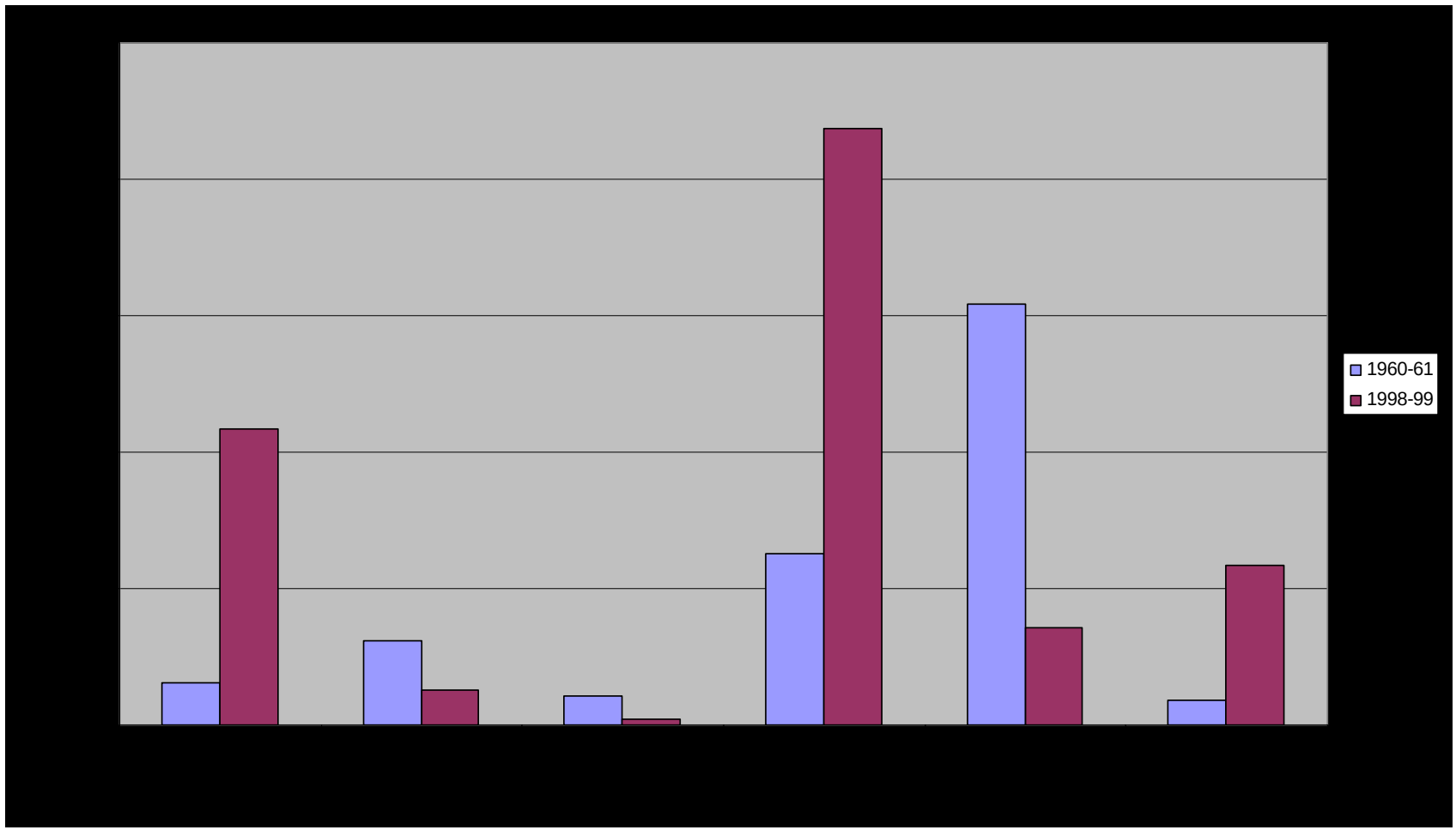
# Increase in Cropping Intensity



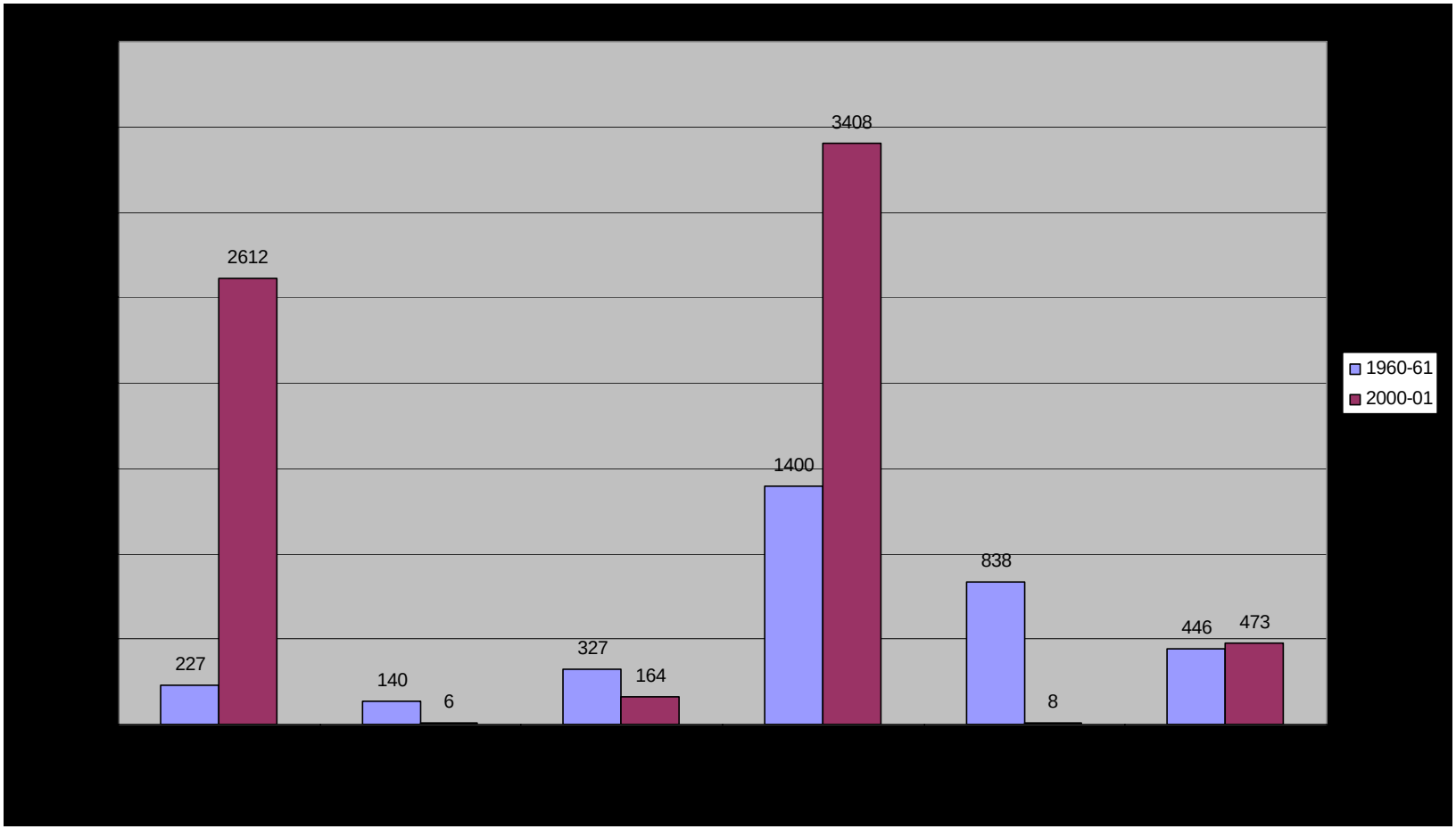
# Gross Irrigated Area as % of Gross Sown Area



# Cropping Pattern Changes - Haryana



# Cropping Pattern Changes - Punjab



# Canal Water Declining and Unreliable

- Warabandi system ensure equity but at cost of timeliness
- Farmers complain of declining supplies and unreliability
- Problems in canal maintenance
- Siltation at Bhakra – now 10% live capacity has been lost
- Lowering delta to spread waters wider

# Impacts

- Overexploitation of groundwater
- Unsustainable Agriculture – Huge Dependence on mining
- Falling Groundwater levels
- Higher costs, lower t/w yields
- Economics of Farming seriously affected

# Sources of Water for Agriculture in Punjab

| | |
|---|---|
| Total water used by the current cropping pattern = | 34 MAF |
| Available from Canals = | 12-14 MAF |
| From Groundwater Recharge (net of recharge in saline areas, in areas like Kandi where extraction is not possible) = | 8 MAF |
| Rest Being Mined from Groundwater | 14-12 MAF |

Source: Punjab Agricultural University Committee, Figures for 1988-90

This is almost twice the gross storage of Bhakra Dam –

Two Bhakras are being mined every year

The mining of Palaeowater in Libya – the so called “Great Man Made River” is about 3 MAF per year

# Agriculture Dependent on Mining of Groundwater

Consumptive Use of Water in Agriculture Provided by Mined Water

31% in Punjab

31.5% in Haryana

# Crisis for Farmers

- Lower Yields
- Higher Cost of Lifting Water – More Capital investment, higher running costs
- Impact magnified in context of already threatened economics of agriculture
- Smaller Farmers worst affected
- Economic cost to the country
- Quality Impacts

# Options to Tackle Crisis

- Pricing of Electricity – Likely to have limited impact on groundwater, but high impact on farmers

# Changing the Cropping Pattern

- Johl Committee 1985, 2002
- Water Impact of Changed Cropping Pattern
  - Paddy Replacement - Net Water Use of Paddy not very high relative to others?
- Returns to Farmers of Changed Cropping Pattern
- Marketing Support for Changed Cropping Pattern
- Overall impact of changed cropping pattern – foodgrain production, impact on total value of output
- Ecological Issues

# Options to Tackle Crisis

- Need for holistic assessment of cropping pattern, cropping intensity and irrigation intensity suitable to geo-climatic and ecological situation
- Groundwater crisis has to addressed as a part of solution to wider agricultural crisis
- Has to be a Participatory Exercise

# Options to Tackle Crisis

Assessment in context of national agricultural strategy – if a small part of – Punjab and Haryana have to be the granary of the nation, then there is no alternative to over-extraction. Of Water, of Soil.