

Indian Agriculture : Strides since independence

- *From food shortages and import to self-sufficiency and exports.*
- *From subsistence farming to intensive and technology led cultivation*

- 218 MT total food grain production
- Contributes to 25% of GDP
- Produces 51 major Crops
- Contributes 21% of Exports and raw materials to Industries
- One of the 12 Bio-diversity centers in the world with over 46,000 sp. of plants and 89,000 sp. of animals recorded

Indian Agriculture- Some Facts

- Net Area Sown - 43.3% (142 M.H)
- Gross Cropped Area - 57.9% (190 M.H)
- Net Irrigated Area - 17.1% (56 M.H)
- Area threatened by land degradation - 50% of TGA
- Drought-Prone Area - 57.9% (190 M.H)

STRENGTHS

- Rich biodiversity, ecologically adopted species/breeds
- Arable land
- Climate
- Strong and well dispersed research and extension system

OPPORTUNITIES

- Bridgeable yield gap in all crops
- Large number of food crops due to regional preferences
- Exports
- Agro-based Industry
- Horticulture
- Untapped potential in the N.E.

WEAKNESS

- Fragmentation of land
- Low Technology Inputs
- Unsustainable Water Management
- Poor Infrastructure
- Low value addition
- Declining work force (rural to urban shift)

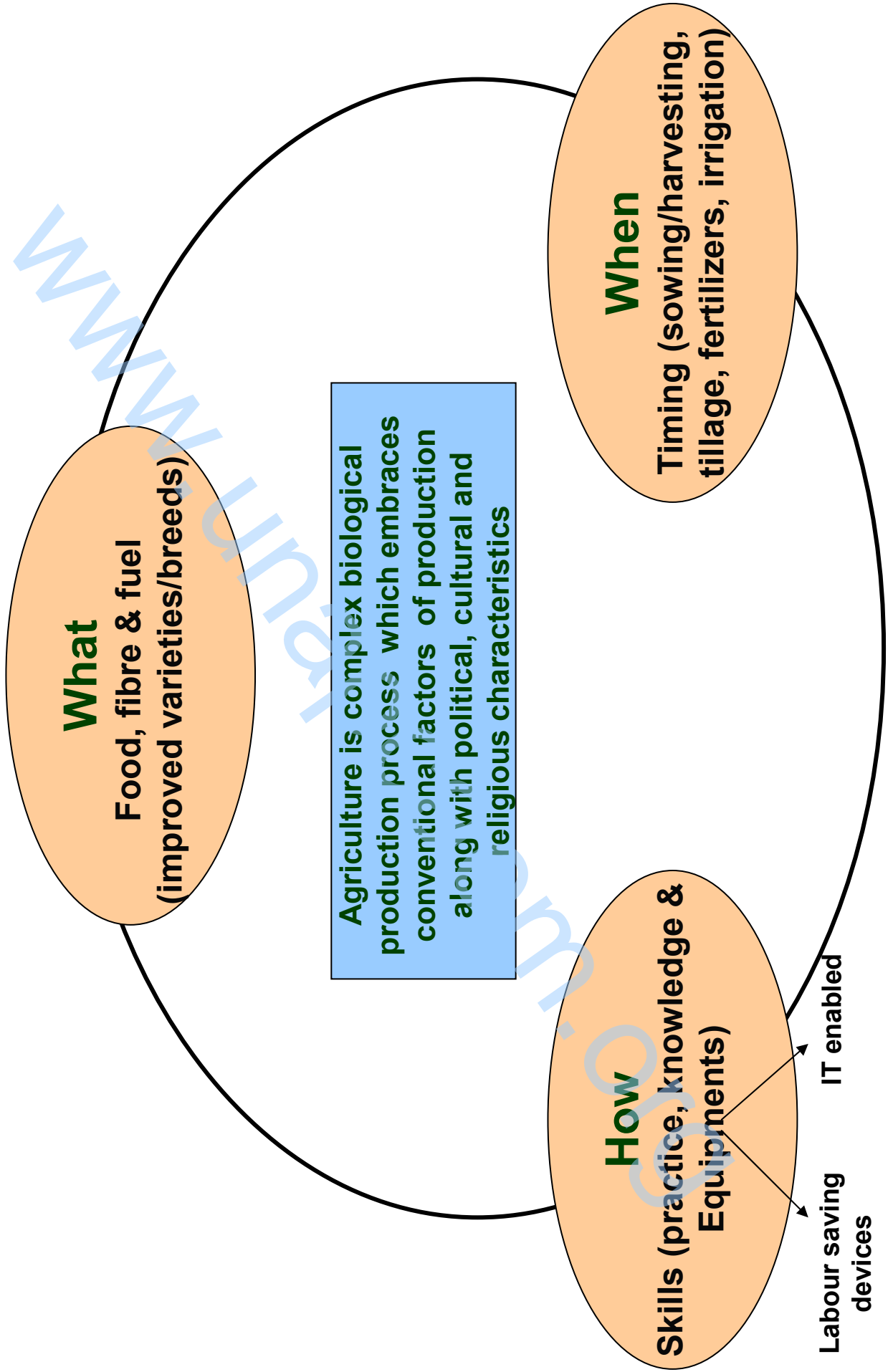
THREATS

- Unsustainable Resource Use
- Decline in productivity under intensive use
- Climate Change/ Global warming
- Unsustainable Regional development
- Imports
- Heavy burden of floods/droughts/pests

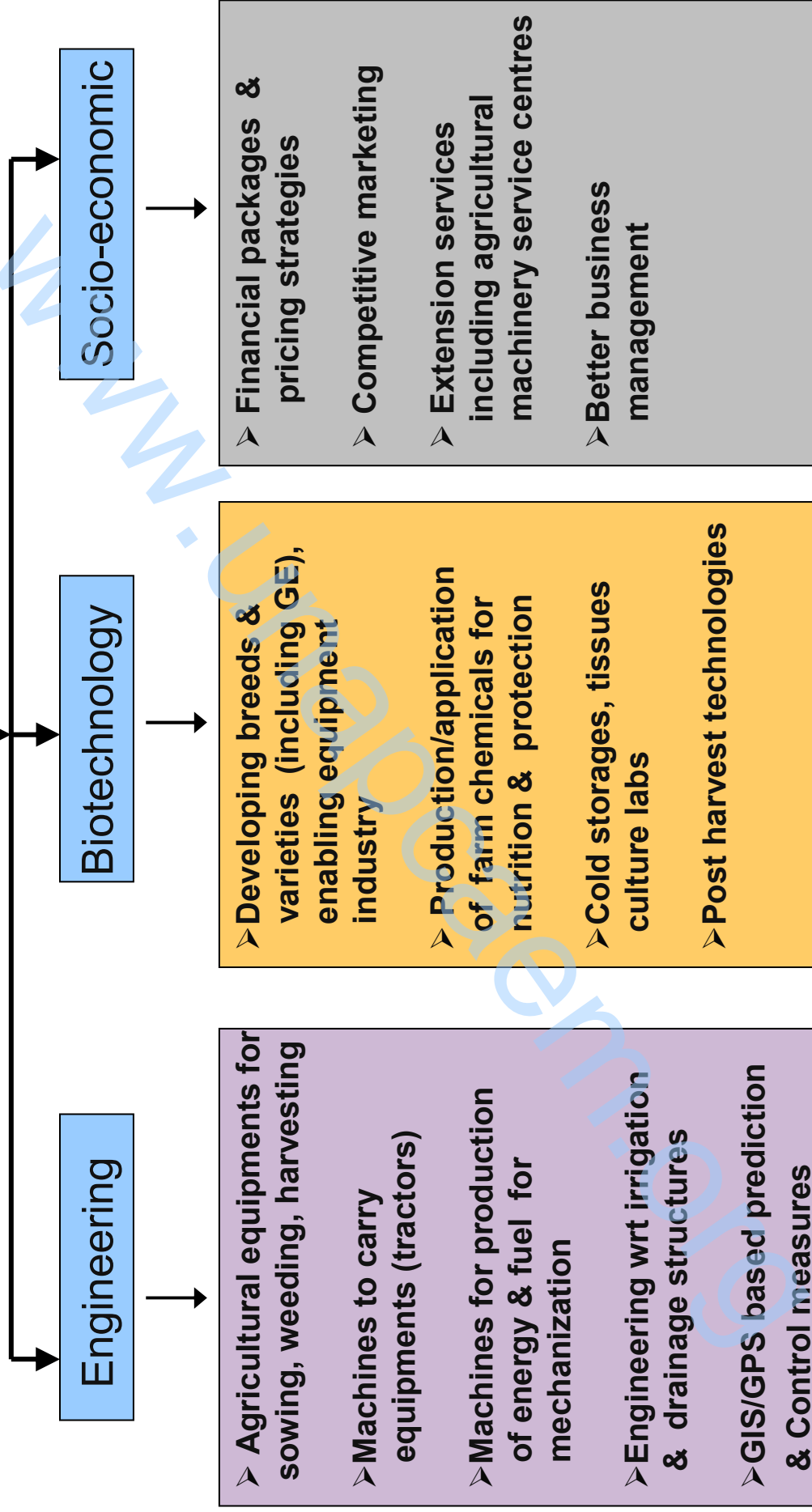
Development of Agriculture in Punjab

- Thrust to green revolution in late 1960s for National Food Security(Multi-cropping → wheat/rice rotation)
- Increased MSP, fertilizer subsidy, improved irrigation facilities, mechanization and HYVs → intensive agricultural practices.
- Food grain production in state increased from 3.16 MT in 1960 to 27 MT in 2010.
- With 1.5% of geographical area of India, state is producing 21% wheat, 11% rice, 11% cotton and 12% of the total food grain production in the country.
- Change in average land holding size
(increased upto eighties, decreased thereafter)

The Dynamics of Agriculture



Approaches to Mechanization in Agriculture



Merits & Demerits

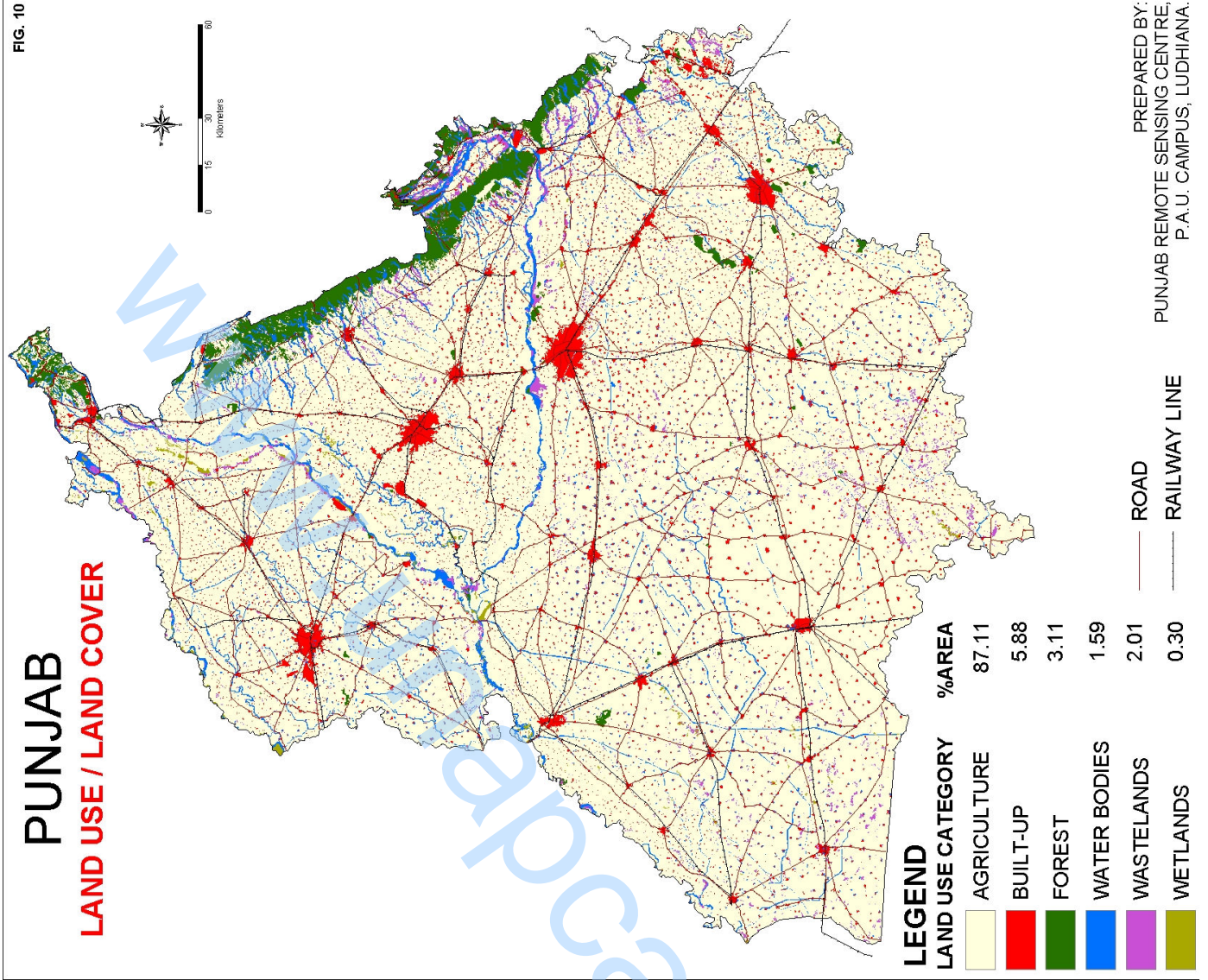
Merits

- Reduced reliance on unpredictable weather conditions
- Reduced reliance on labour
- Year round production - self sufficiency
- Improved entrepreneurial capacity
- Quality improvement

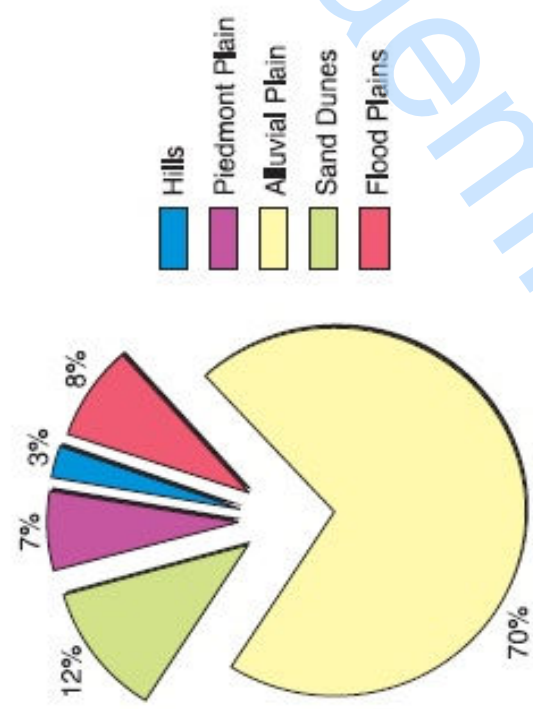
Demerits

- Abandoning traditional cropping practices (multi-cropping with legumes → monoculture)
- Pesticide abuse → environmental health issues
- Dependence on external sources of energy
- Social imbalances
- Reduced crop diversity index
- Labour and farm waste mgmt issues including GHGs from livestock waste
- Imposing external costs on society [UK £ 208/ha (2005), USA \$ 30-96/ha (2005)]

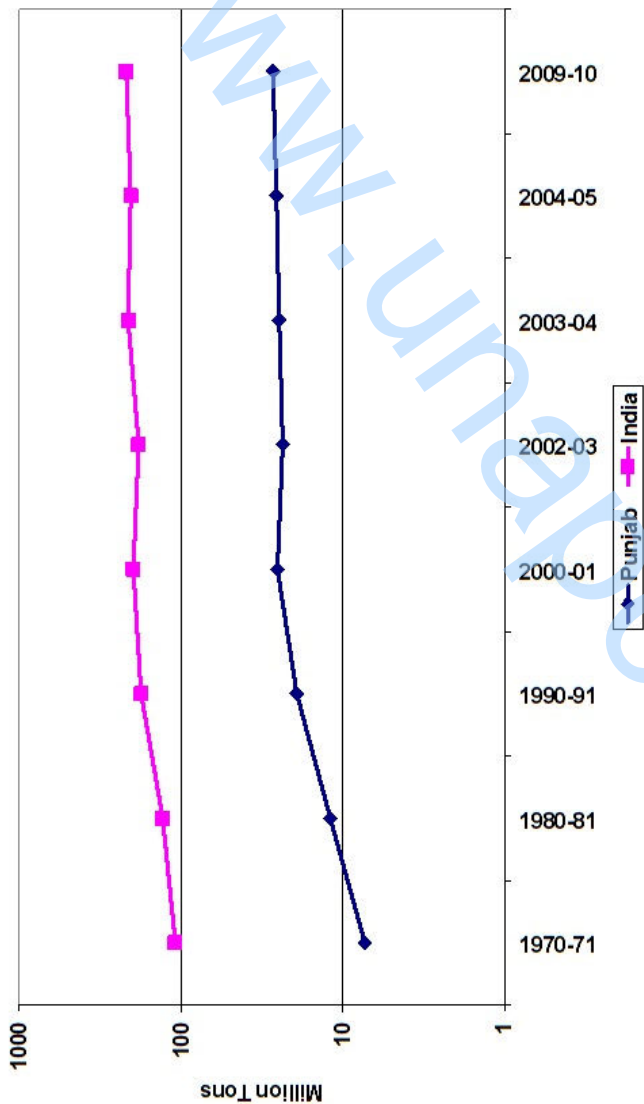
FIG. 10



Area (%) under different land forms of Punjab



Production of foodgrains (cereals and pulses) in Punjab and India from 1970-2010



Percentage distribution of GDP at factor cost by sectors in Punjab at current prices

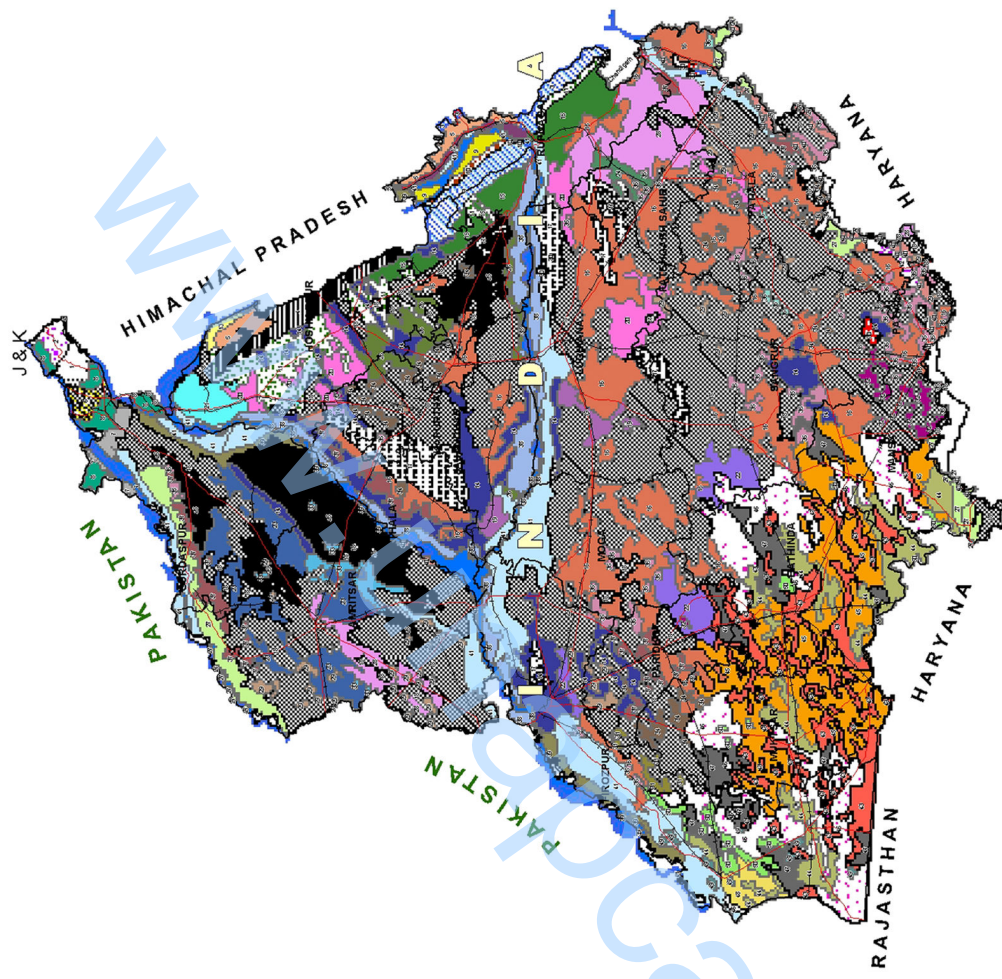


Major Soil Types of Punjab

Soil Map of Punjab



- WESTERN SHIVALIK HILLS & PODZOLIK SOILS
- NORTH PLAINS, ALLUVIUM SOILS DRY SUBHUMID
- NORTH PLAINS, ALLUVIUM SOILS SEMI ARID
- DESERT SOILS, ARID, LGP 60-90 DAYS
- DESERT SOILS, ARID WITH LGP <60 DAYS



DESCRIPTION OF CODES	
FAMILY PARTICLE SIZE CLASS	SOIL DRAINAGE
C.L. - Coarse Loamy	Dy2 - Poorly Drained
F.L. - Fine Loamy	Dy3 - Imperfectly Drained
F.S. - Fine Silty	Dy4 - Moderately Well Drained
S.Sk. - Sandy Skeletal	Dy5 - Well Drained
L.Sk. - Loamy Skeletal	Dy6 - Somewhat Excessively Drained
	Dy7 - Excessively Drained
CALCAREOUS CLASSES	SOIL EROSION
Cal. - Calcareous	e1 - Slight Erosion
(other units are non-calcareous)	e2 - Moderate Erosion
	e3 - Severe Erosion
	SOIL SALINITY (EC dS/m)
	S1 - Slight Salinity (0.8-1.6)
	S2 - Moderate Salinity (1.6-2.5)
	S3 - Strong Salinity (2.5-5.0)
	SOIL SODICITY (pH 1:2)
	N1 - Slight Sodicity (8.7-9.2)
	N2 - Moderate Sodicity (9.2-9.8)
	N3 - Strong Sodicity (>9.8)
	FLOODING (% AREA FLOODED)
	F1 - Slight Flooding (<25%)
	F2 - Moderate Flooding (25-50%)
	F3 - Severe Flooding (>50%)

General Legend
 Major Roads
 Railway Line
 District Boundary

Source: PRSC, Ludhiana

Punjab at Crossroads

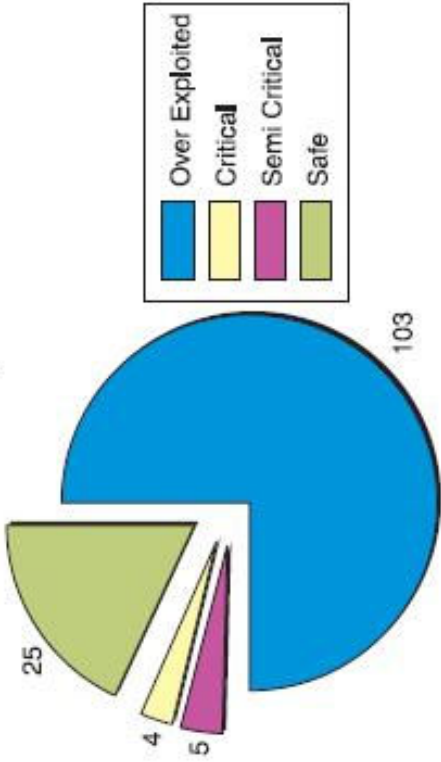
- Present Agricultural system in state becomes unsustainable and non profitable
- Reached at highest production levels possible under available technologies and natural resources base and growth has stagnated
- Gains resulting from ever increasing food production, not been without consequent environmental and social costs
- Over intensification of agriculture over the years

Environmental Issues

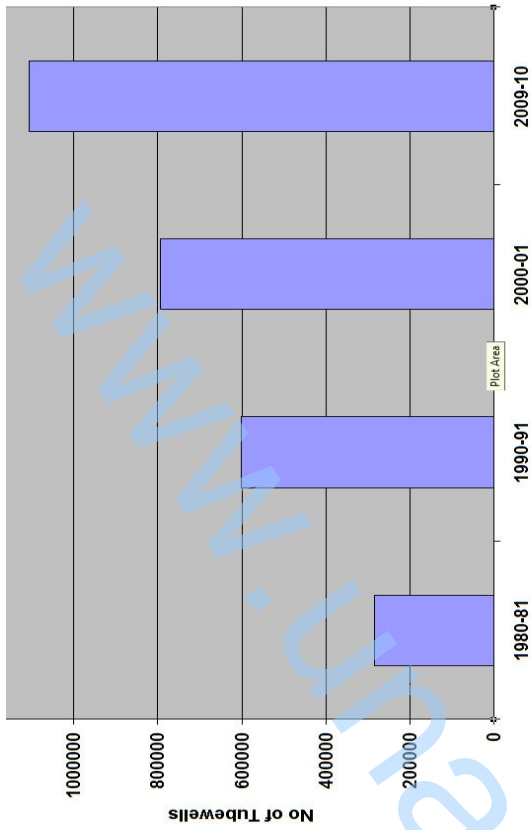
- **Water quality & quantity**
- **Reduced soil fertility and micro nutrient deficiency**
- **Non judicious use of farm chemicals & problems of pesticide residue**
- **Reduced genetic diversity**
- **Soil erosion**
- **Atmospheric pollution due to straw burning**
- **Water pollution from non point sources**
- **Overall degradation of fragile agro-ecosystem of state**
- **Affect on socio-economic conditions of farmers due to high cost of production and diminishing economic returns**

Water

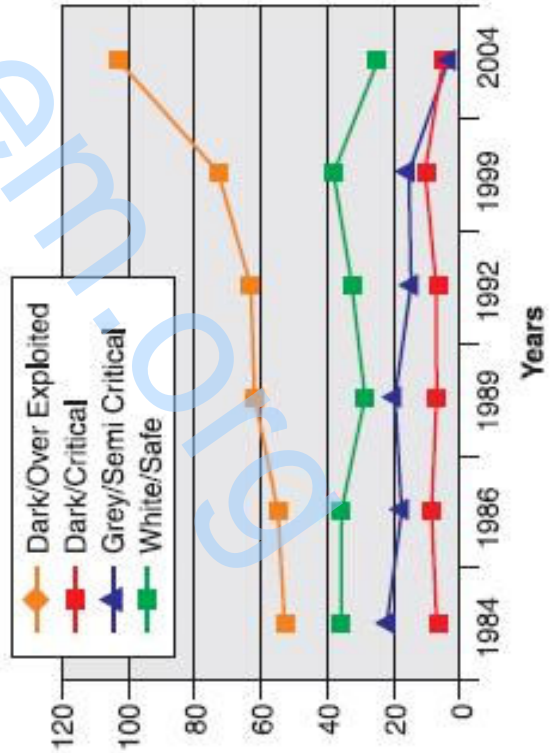
Categorization of Blocks in Punjab based on Ground Water Development



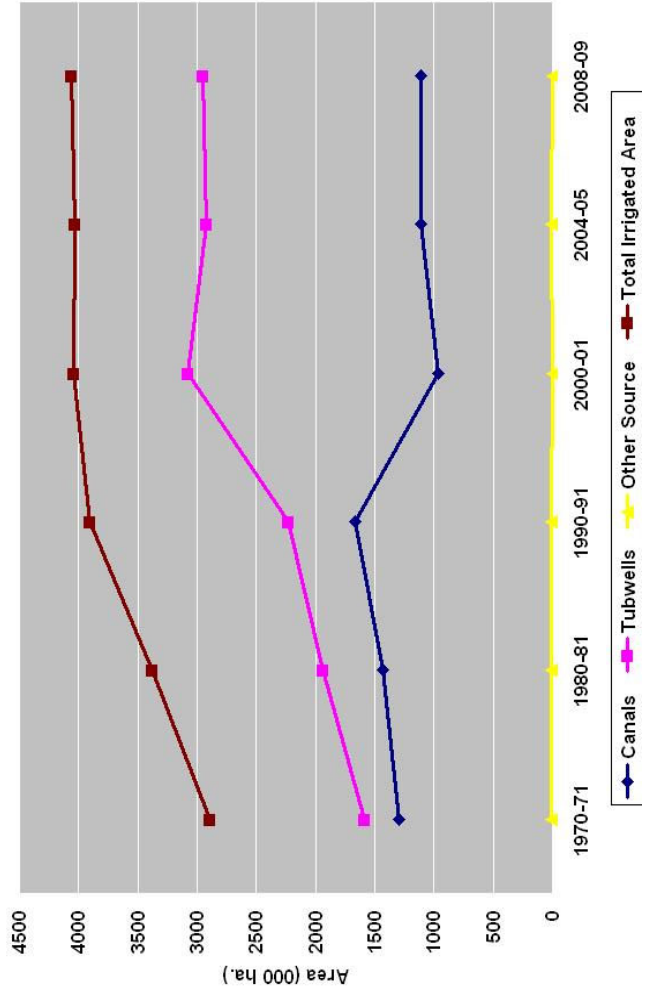
Tubewells in Punjab(1980-2010)



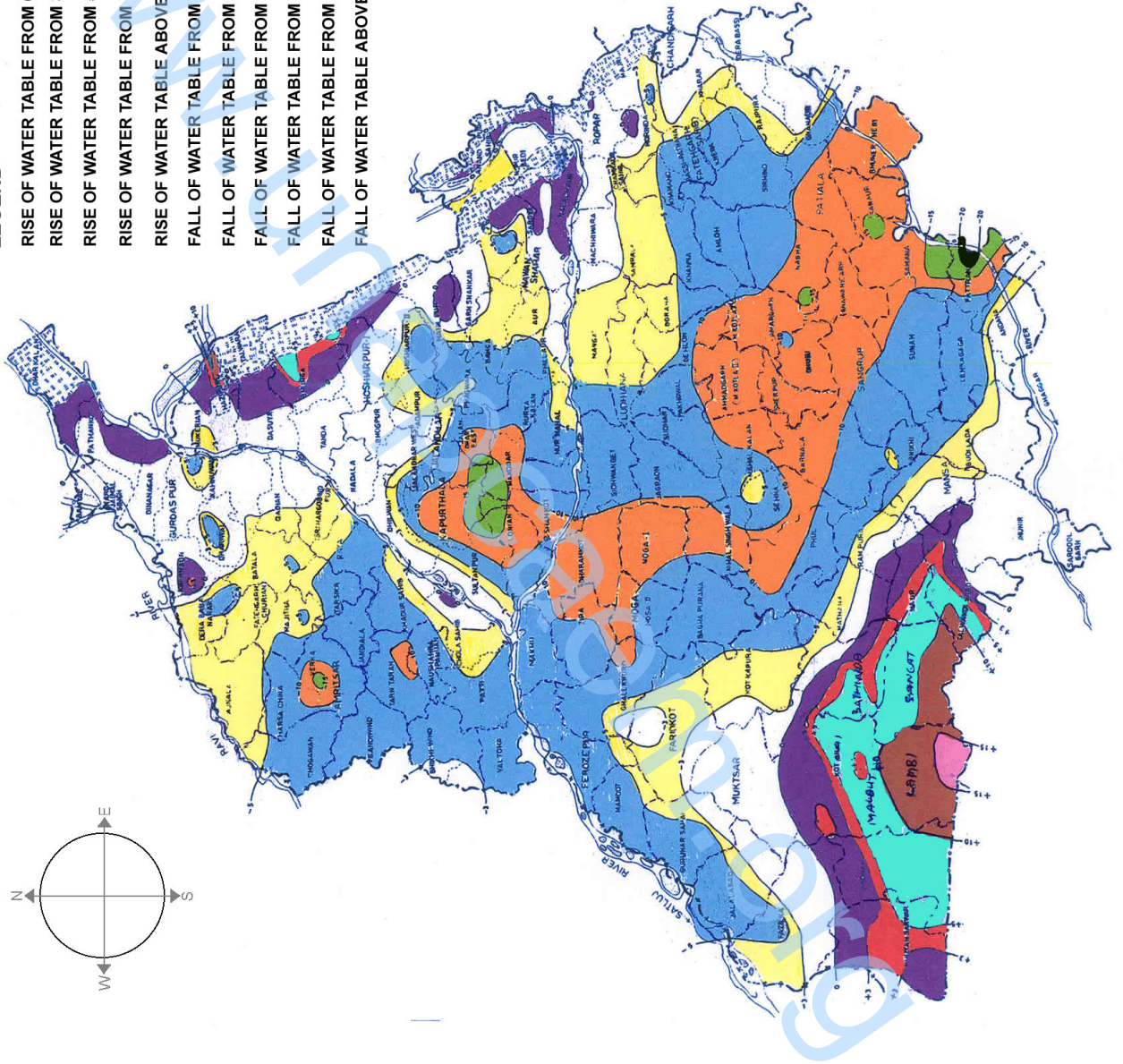
Increase/decrease in number of various categories of blocks in Punjab from 1984-2005



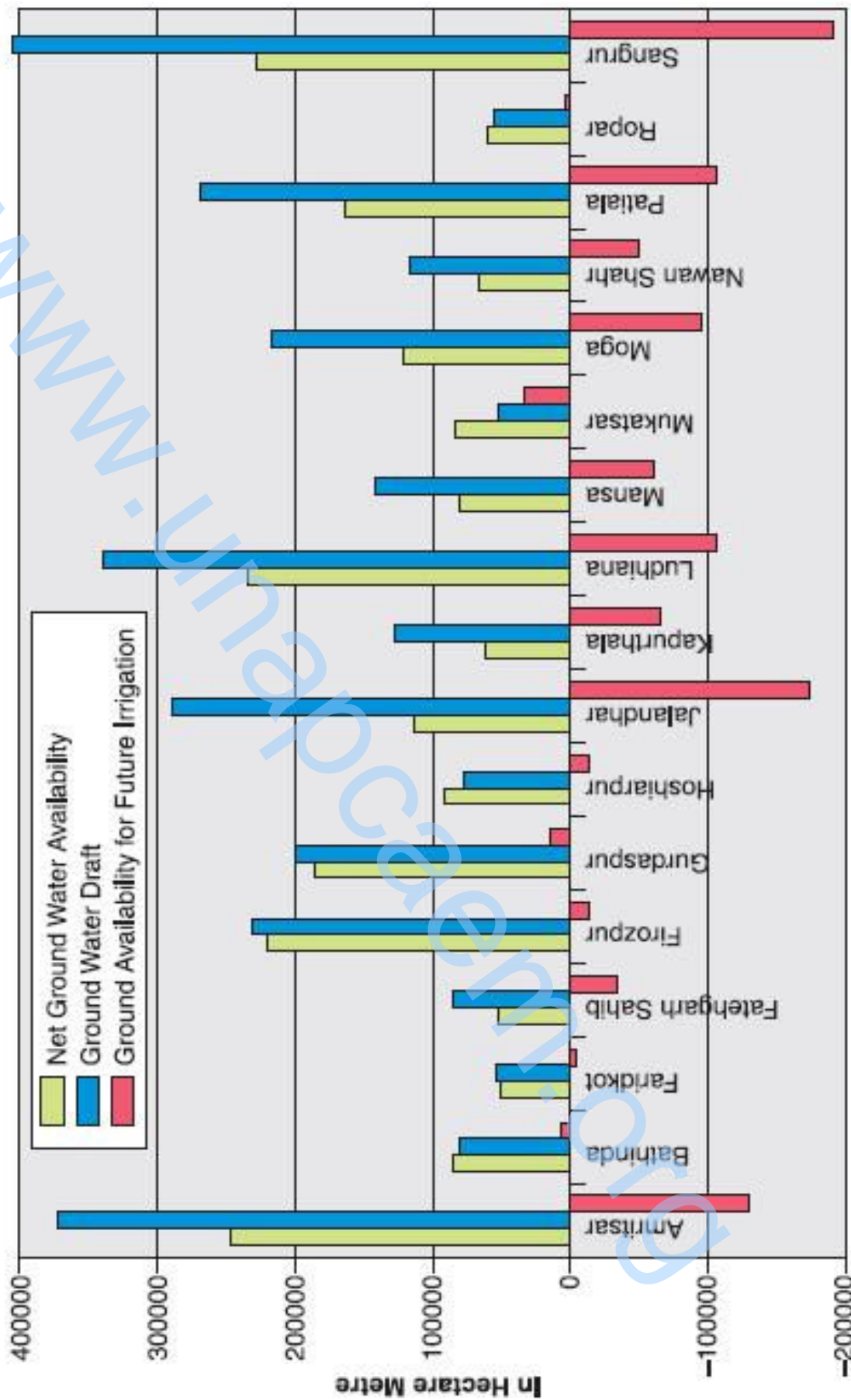
Net irrigated area by different sources in Puniab(1980-2010)



Fall/Rise in water table (in metres) in Punjab (June 1984 to June 2004)

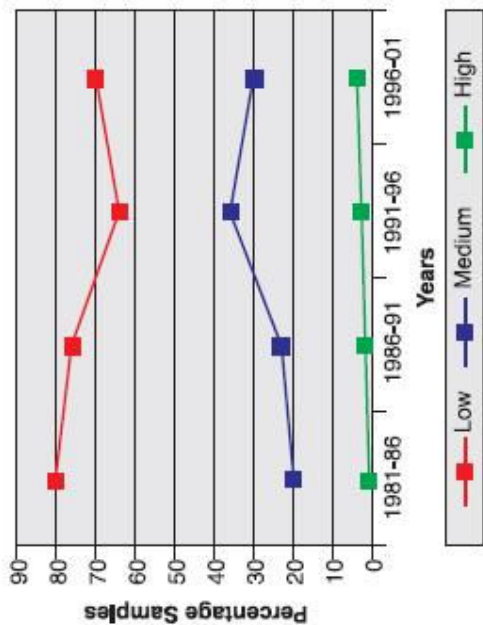


District wise ground water availability, draft and net availability for future irrigation in Punjab

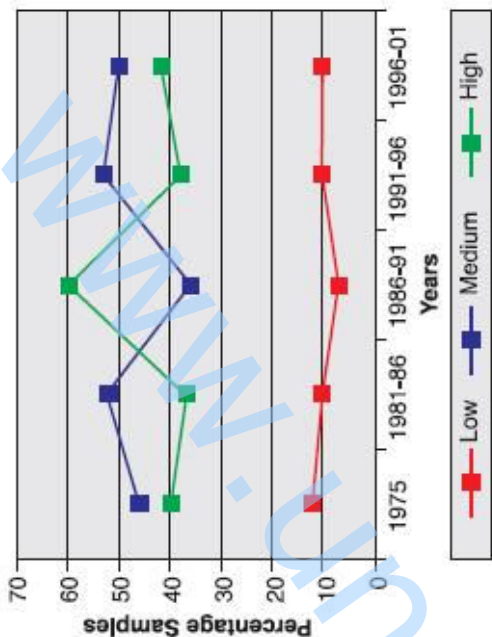


Reduced soil fertility & micronutrients

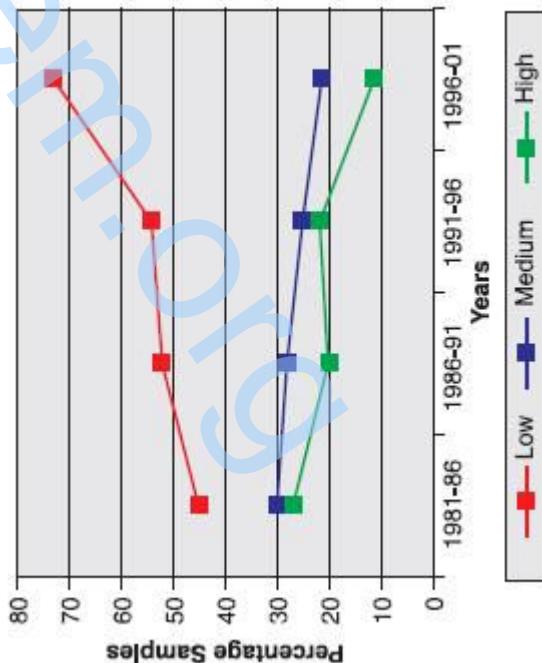
Trends in available organic carbon content in soils in Punjab



Trends in available K content in soils in Punjab



Trends in available P content in soils in Punjab

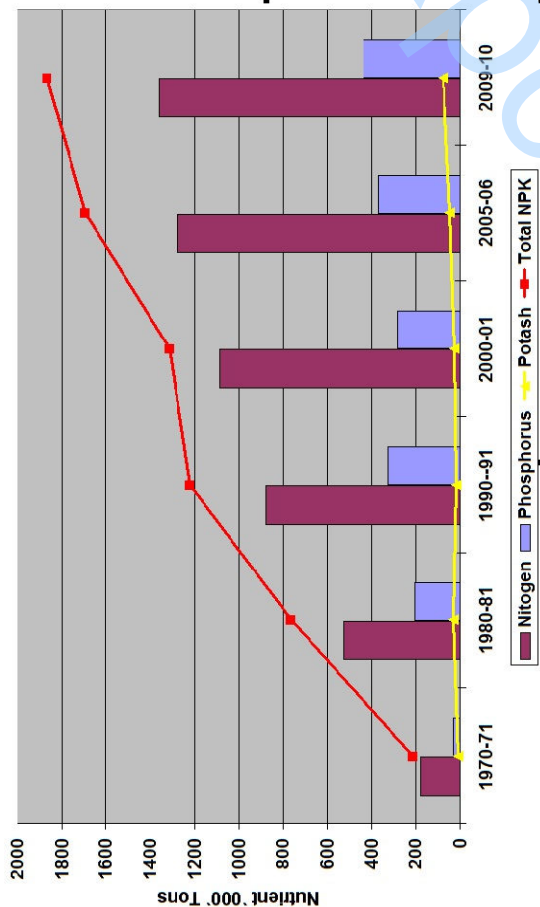


Changes in micronutrient status in various districts of Punjab

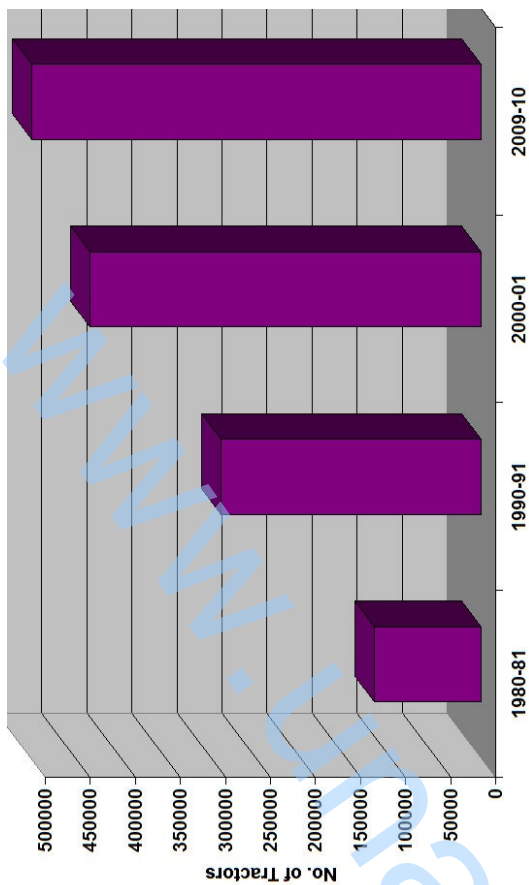
District	Year	Percent samples deficient			
		Zinc	Copper	Iron	Manganese
Ludhiana	1970	56	-	-	2
	1988	12	2	1	5
	2004	7	2	7	22
Jalandhar	1977	45	6	0	0
	1998	14	0	13	39
	1977	71	4	7	0
Patiala	2000	14	0	18	35
	1980	23	1	4	2
	2004	12	1	5	5
Gurdaspur	1982	52	2	2	1
	2000	42	1	1	5
	1983	45	1	4	0
Amritsar	1992	15	0	8	3
	1984	47	0	0	0
	2004	36	0.5	4	5
Hoshiarpur	1985	59	1	13	6
	2004	31	6	24	25
	1992	70	2	61	7
Mukatsar	2004	37	5	31	8

Non Judicious use of farm chemicals and farm mechanization

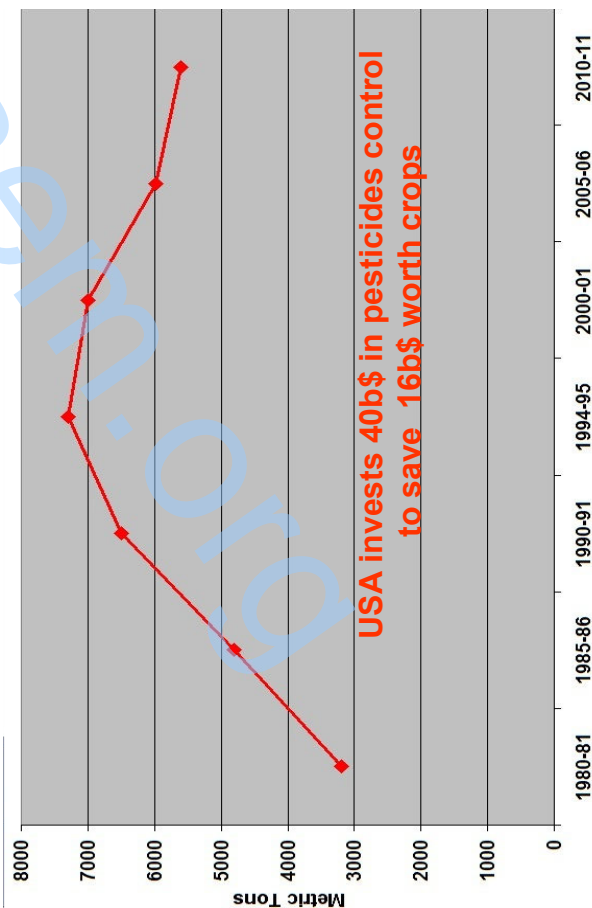
Consumption of Chemical Fertilizers (1970-2010)



Tractors in Punjab(1980-2010)

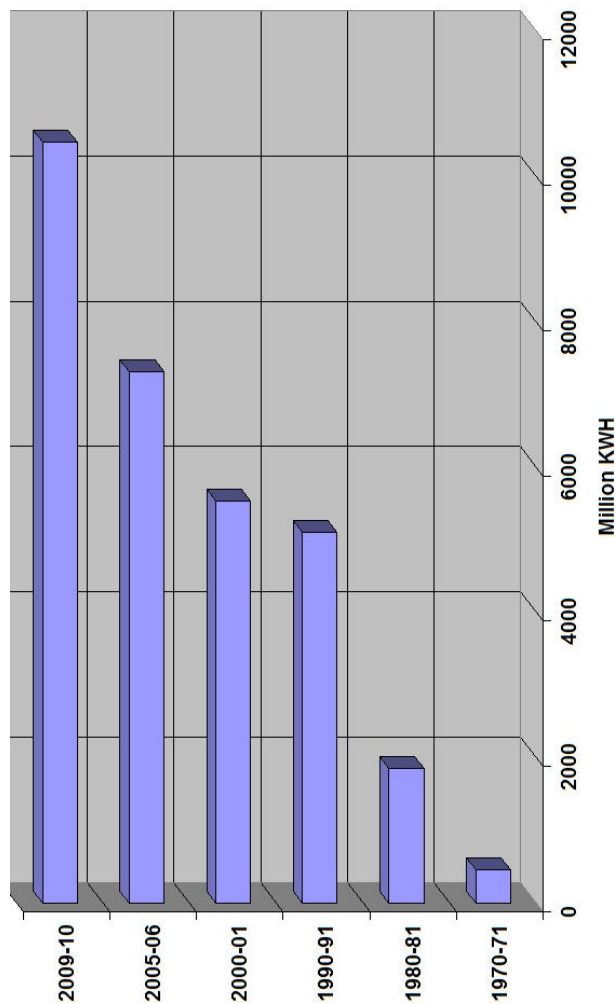


Consumption Trend of Technical Grade Pesticides (1980-2010)



USA invests 40b\$ in pesticides control to save 16b\$ worth crops

Consumption of electricity by agriculture sector in Punjab



Reduced genetic diversity

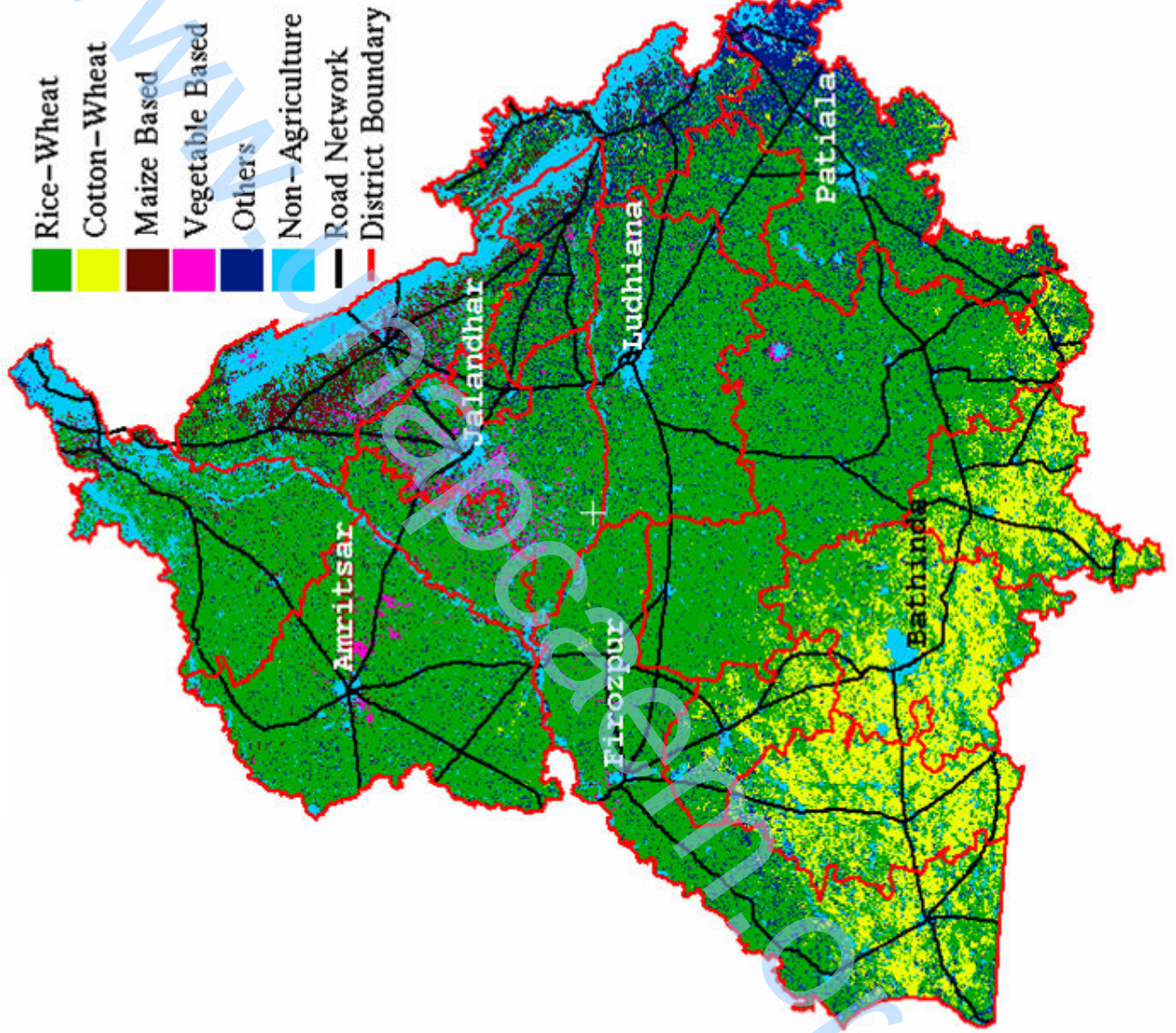
Domesticated Plant Diversity

Crops	Pre-green revolution varieties	Post-green revolution varieties	No. of varieties in use
Wheat	41	49	13 (3 main)
Rice	31	27	9 (4 basmati)
Cotton	17	32	12 (included 4 varieties of BT Cotton)
Maize	4	24	11
Sugarcane	11	16	6
Bajra	3	11	5
Pulses	18	47	24
Oil Seeds	8	35	19
Vegetables	35 spp.	148 var.	-
Fruits	16 spp.	67 var.	-

Total Area & Area Under HYVs of Major Food crops in Punjab (000 ha)

Year	Wheat		Rice		Maize		Bajra	
	Total	HYVs	Total	HYVs	Total	HYVs	Total	HYVs
1970-71	2299	1589	390	130	555	49	207	126
1980-81	2812	2757	1183	1095	382	127	69	34
1990-91	3273	3271	2015	1906	188	160	12	11
2000-01	3408	3408	2612	2506	165	154	6	5
2004-05	3481	3481	2647	2647	154	145	7	7
2009-10	3522	3522	2802	2802	139	133	3	3

Crop Rotation Map of Punjab



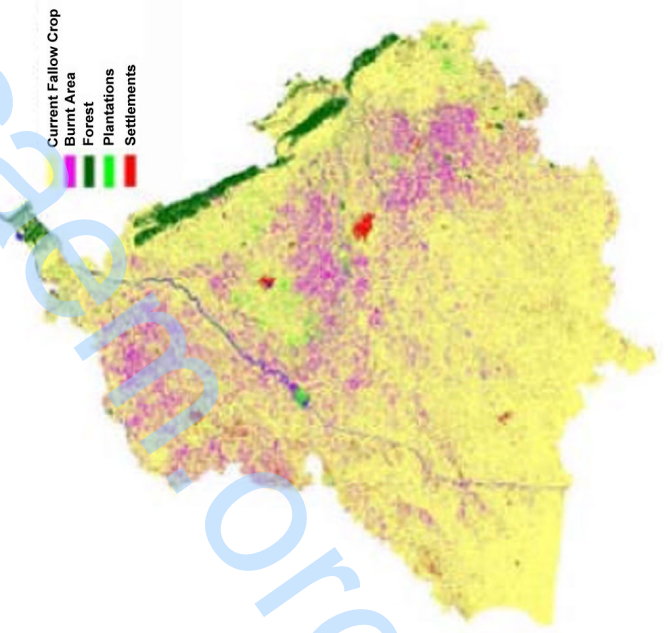
Agriculture Waste Burning

➤ **GHGs Contribution :** **CO** **NOx** **CH₄** **PM10**
(Gg:10 mkg)

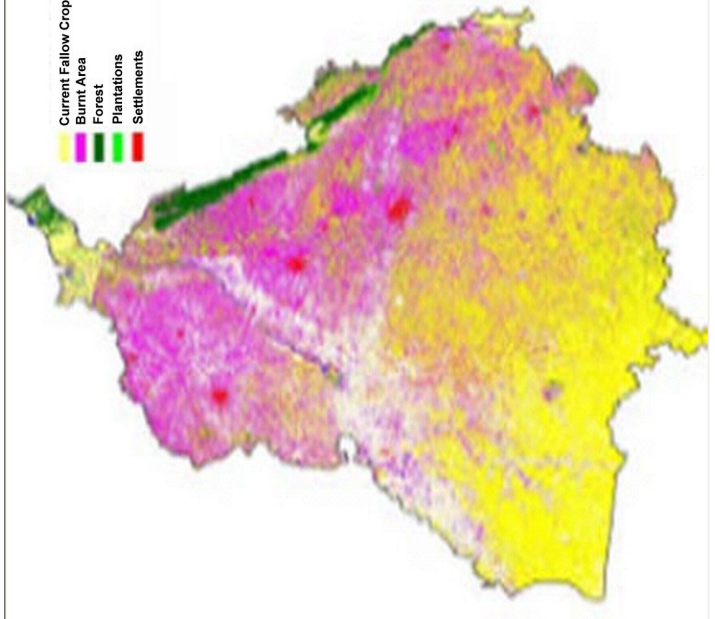
- Wheat straw burning:	113	8.6	1.33	13.0
- Rice straw burning:	261	19.8	3.0	30.0

➤ **Carbon credit potential thru' rice diversification
 Rs. 200 billion in 10 yrs (Rs. 10,000/ha in 3 months)
 presently 2500 th ha under rice**

**Wheat
 Straw
 Burnt Area
 (14th May
 2005)**



**Paddy
 Straw
 Burnt
 Area
 (10th Oct
 2005)**



Other Environmental Impacts

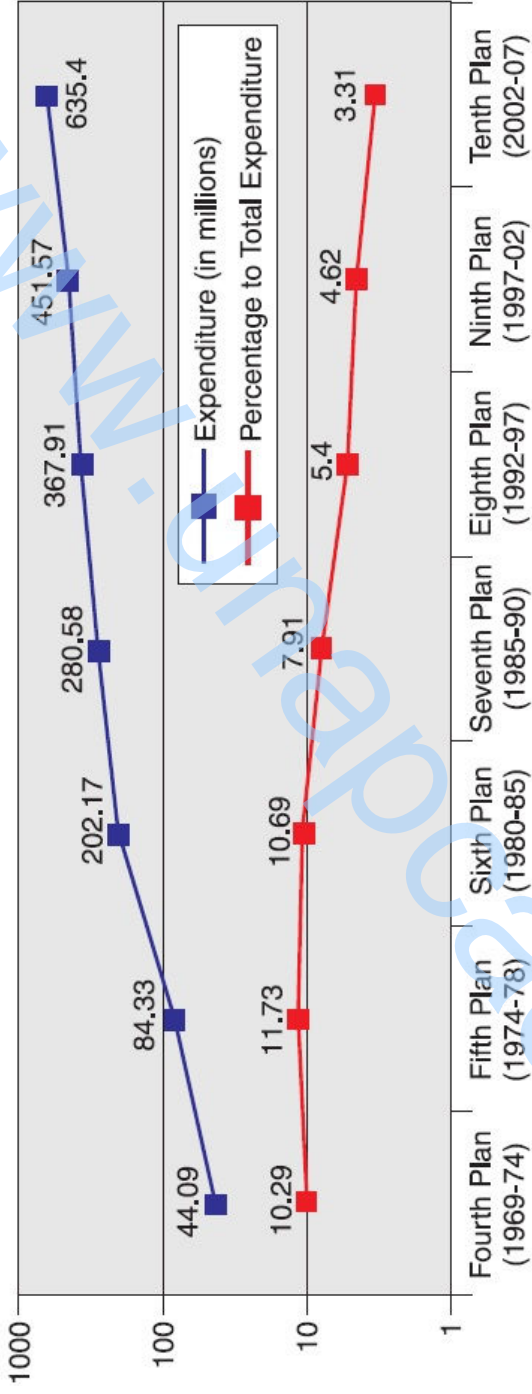
- **Soil erosion**
- **Water pollution and eutrophication from non point sources**
- **Overall degradation of fragile agro-ecosystem of state**
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Secondary Impacts

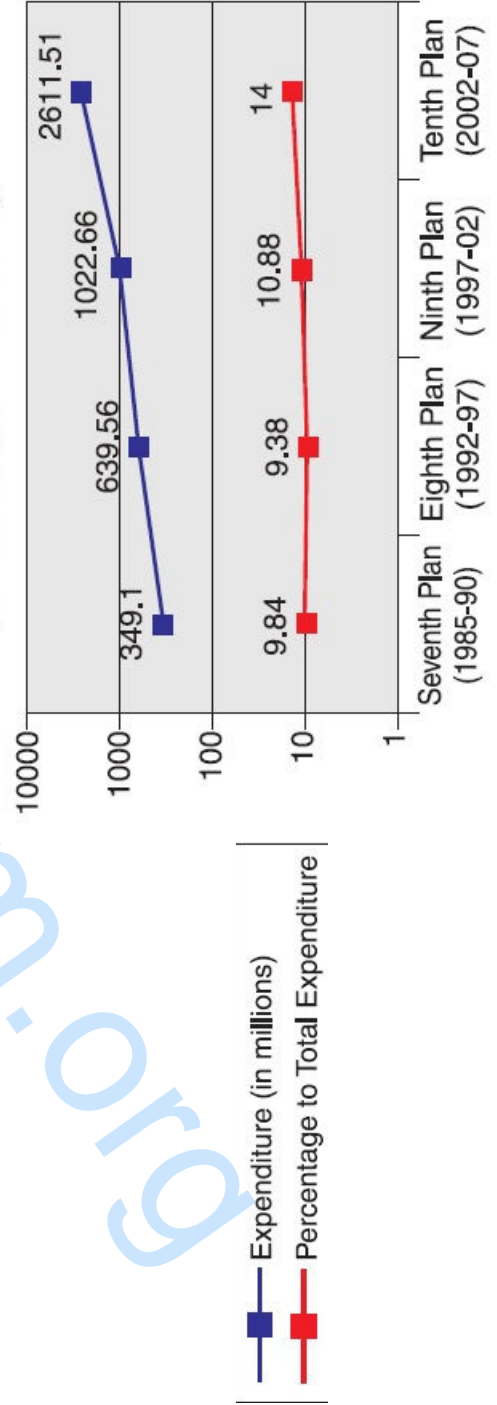
- **Over-exploitation of land & water leading to genetic erosion (including eutrophication)**
- **Pesticides residues in food & effect on human health**
- **Resistance of pests & emergence of new pests**
- **High cost of production & low productivity leading to farmer debts, etc.**
- **Environmental Impacts during production of fertilizers & pesticides**
- **Environmental impacts of energy generation for use in agriculture**

Responses: Administrative responses

Expenditures in the Agriculture & Allied Services Sector in the Various Plan Periods (1969-2009)



Expenditures in the Irrigation in the Various Plan Periods (1985-2009)



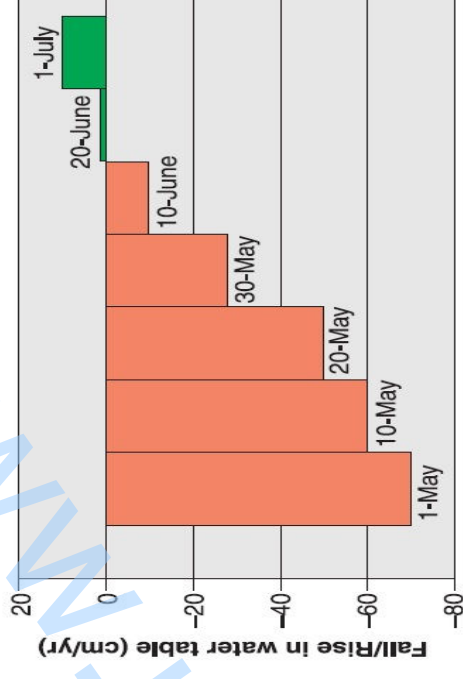
Administrative responses contd..

- Punjab State Farmers Commission
- 4 Agriculture councils
- State Medicinal Plant Board & PBB
- Veterinary & Animal Science Univ.
- Agricultural Diversification, Infrastructure, Research & Dev Fund
- Task Force to Tackle Rice Straw Burning Problem
- Biotechnology Cluster
- State Strategy & Action Plan for Climate Change
 - **Mitigation policies**
 - Shift from non renewable to renewable energy sources
 - Energy conservation programs
 - Demand side management of electricity
 - reducing transmission distribution losses
 - **Adaptation policies**
 - R& D for climate resilient crops
 - R&D for renewable energy

Technological Responses

- Timely Transplantation of Paddy
- Area under zero till
- Rigide planting method of paddy
- Micro irrig. techniques, drip & sprinkler
- Revival of village ponds
- Watershed management
- Organic farming in 4800 ha, vermicomposting (>1500 units), biofertilizers & biopesticides IPM in 514 villages
- Value addition and 46 agro processing units
- Ban on certain chemical pesticides

Fall/ Rise of water table with date of transplantation of paddy



Suggestions

- Freeze prime agriculture land
- Promote sustainable low input agriculture and precision farming
- Cost benefit analysis to include water & environment issues in agricultural system/ crops
- Extend MSP & assured market for alternate crops
- Protect traditional crop varieties & native animal breeds

**Thank you for your
kind attention**

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Inputs or technologies used in 'traditional' and 'modern' conventional farming

DESCRIPTION	TRADITIONAL	MODERN
Land Area	Small (1-5ha)	Large (10-100ha or more)
Tools	Simple: Fire, hoe, axe, digging sticks, matches	Complex: Tractors and implements, threshers etc.
Crops	Many species (5-80) landraces, no genetic improvement, wide genetic base	Few species (1-3) improved narrow genetic base
Animals	Several species	Usually 1 or 2 species
Labour	Manual, human energy or animal power	Mechanical, Petroleum fuels, electric energy
Soil fertility maintenance	Fallow, ash, organic manures	Inorganic fertilizers, sometimes manures, soil amendments, e.g. lime etc.
Pests and Disease management	Physical/ Cultural	Mainly mechanical/ chemicals, (Insecticides, fungicides, etc)
Crop Management	Manual	Growth regulators for defoliation, control of flowering, fruit drop, etc.
Harvesting	Manual or with simple tools	Mechanical-Tractors plus implements: threshers, combine harvestors
Post harvest handling and drying	Simple sun-drying or over fires	Mechanical forced air, artificial drying using petroleum fuels, sometimes refrigeration.