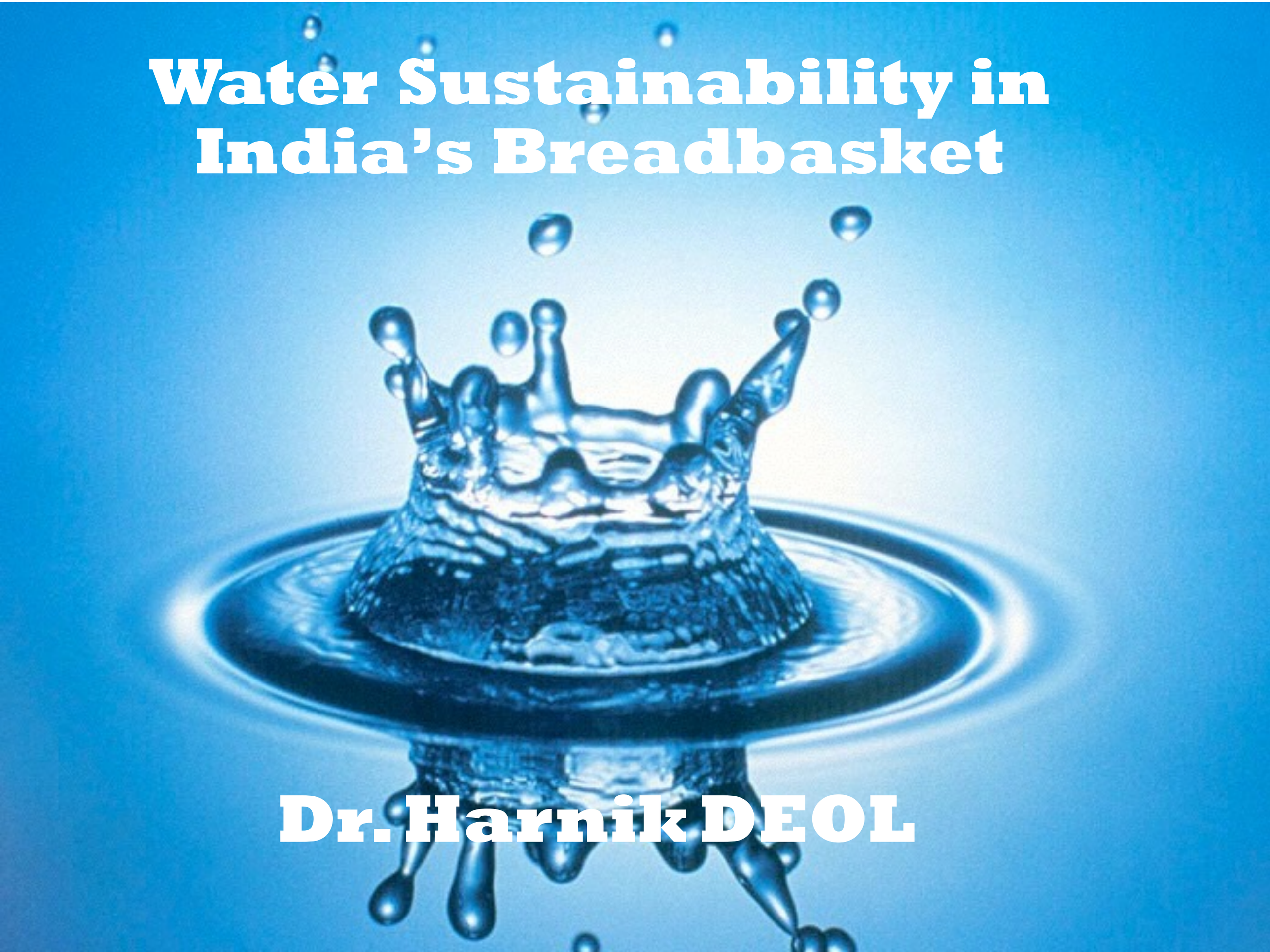
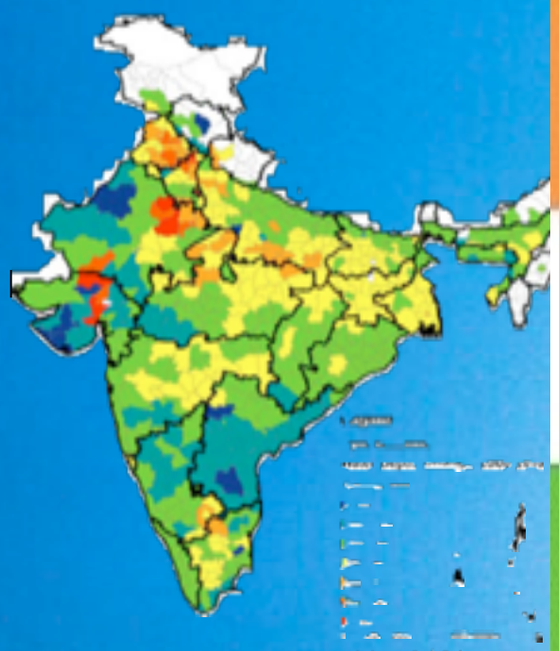
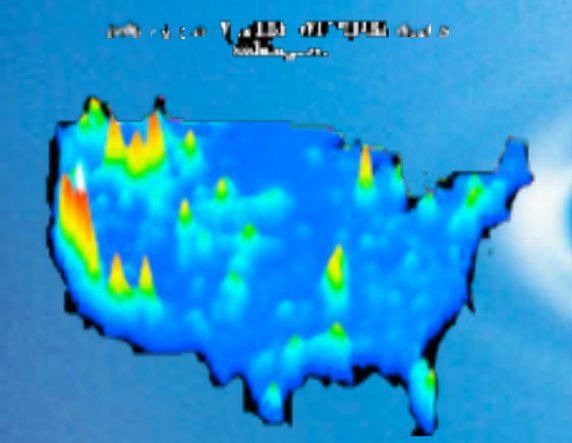
Water Sustainability in India's Breadbasket



Dr. Harnik DEOL

The World's Largest Consumers of Water





India 251 B cm3 (2010)

USA 108 B cm3 (2005)

China 101 B cm3 (2005)

Groundwater contributes about 70 percent of irrigation

Food

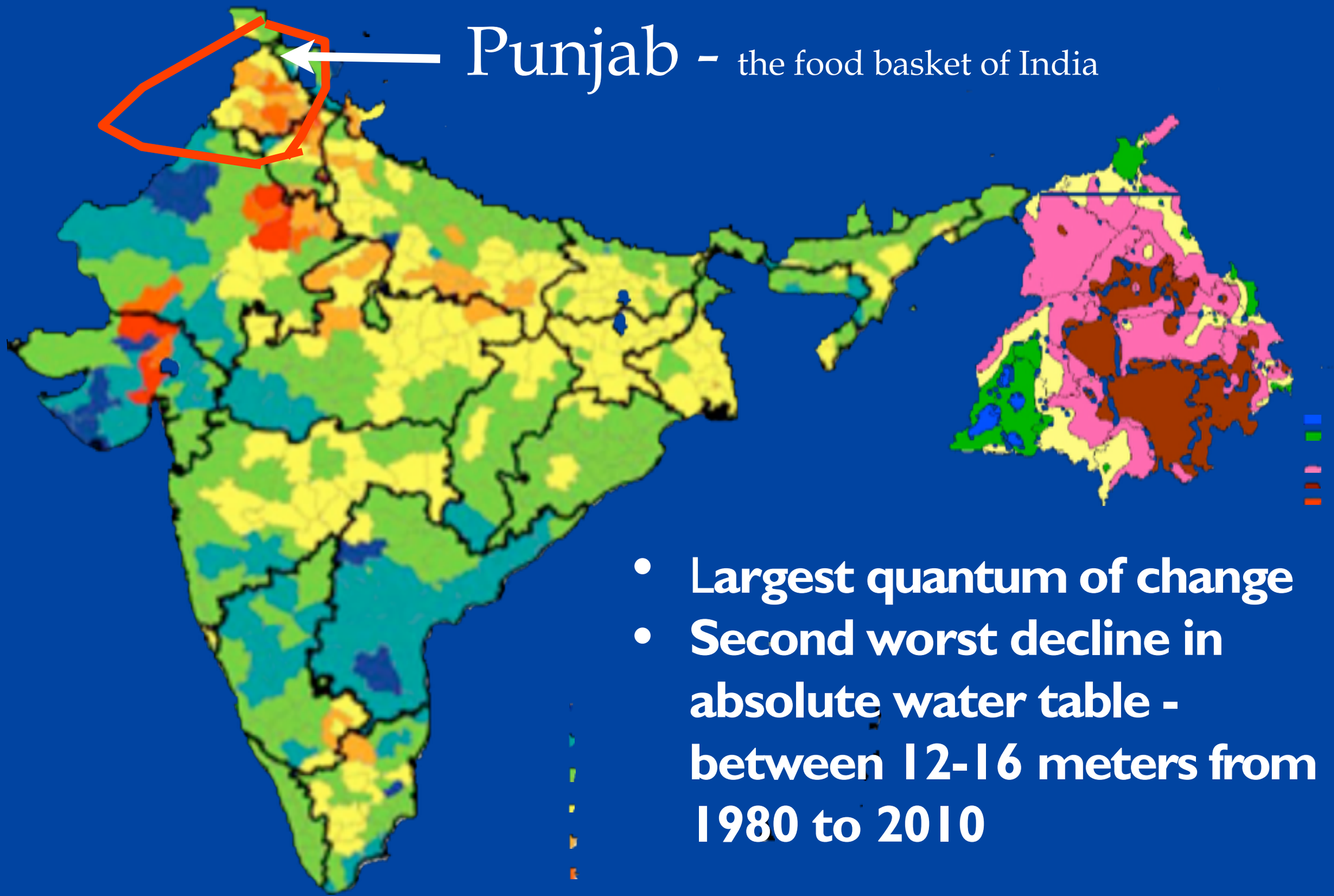
Energy

27 million tube-wells

Water

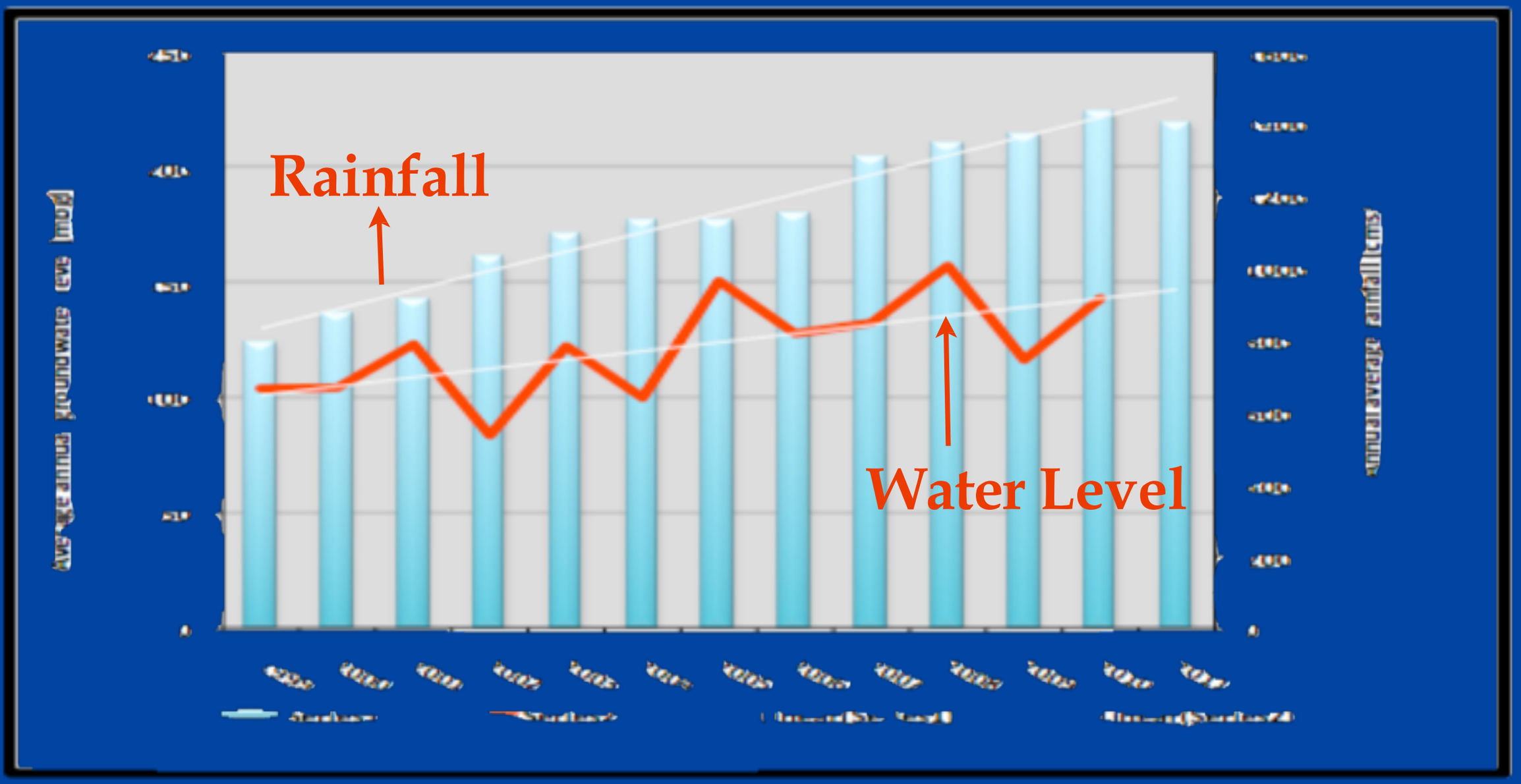
Changes in the Indian District Groundwater Depth, 2000-2010

Punjab - the food basket of India

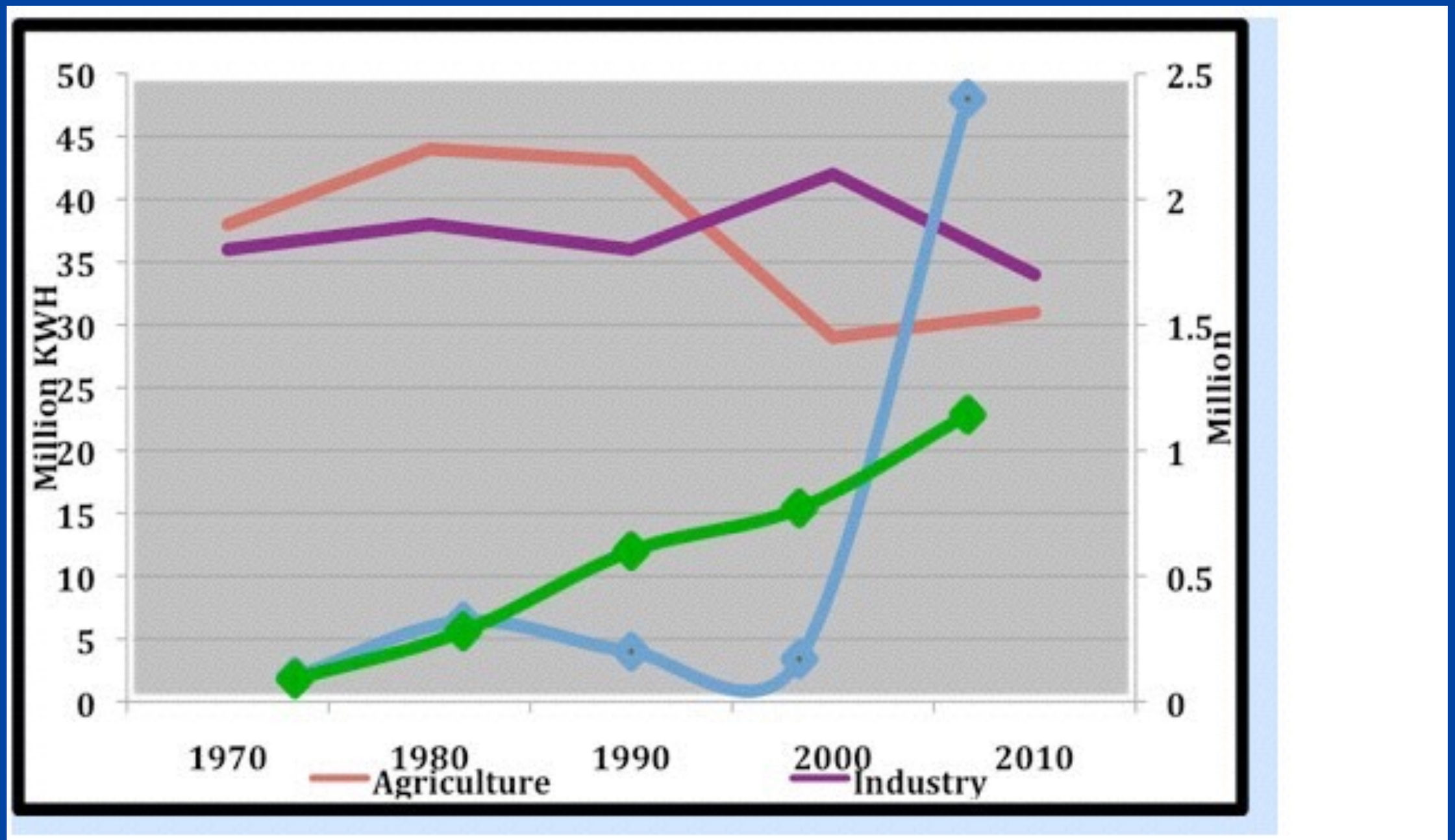


- Largest quantum of change
- Second worst decline in absolute water table - between 12-16 meters from 1980 to 2010

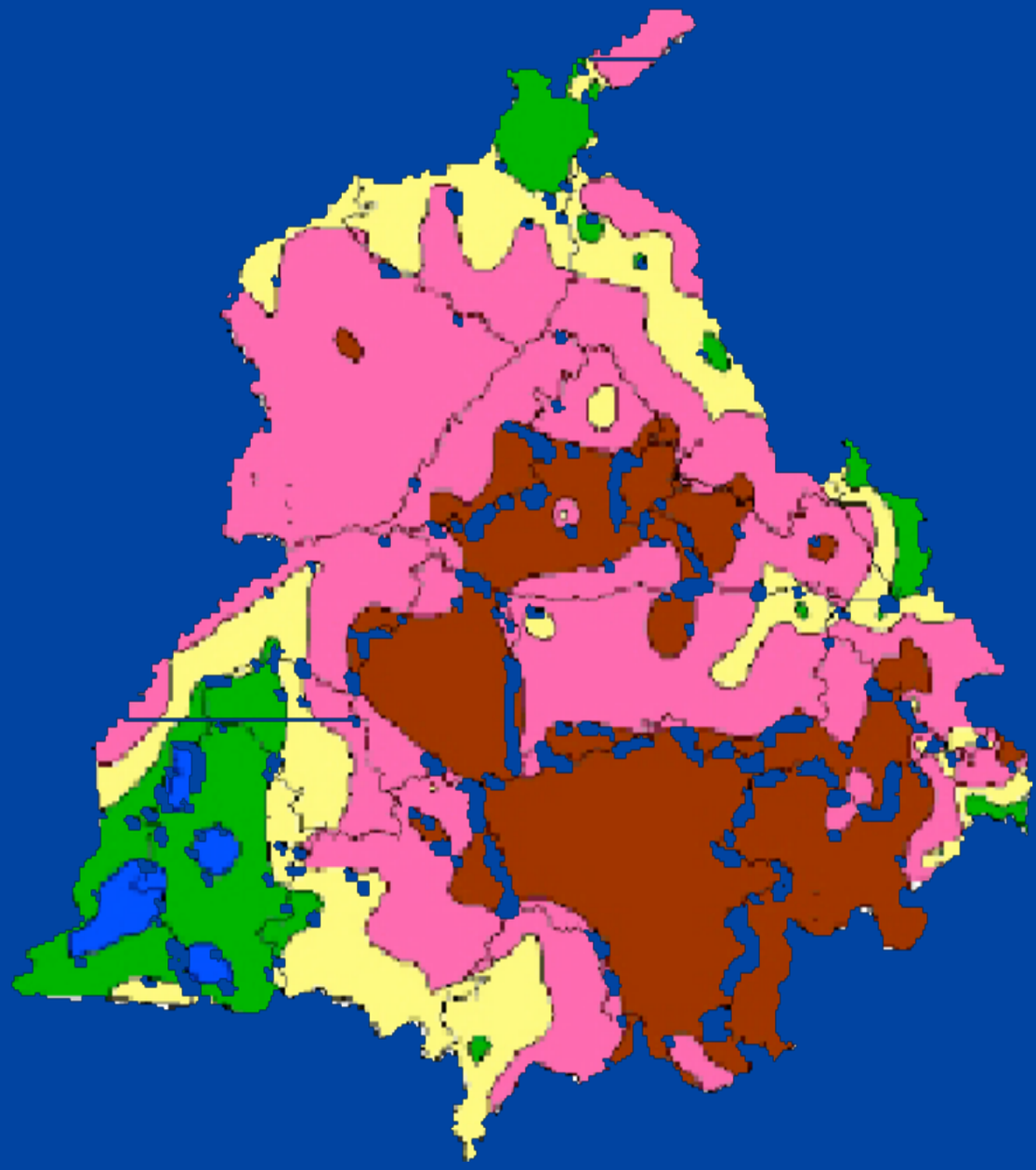
Groundwater Levels and Precipitation Time Series for Punjab (1999-2011)



Growth in Electricity Use by Sector and by Number of Tube-wells (Diesel and Electric Operated)



THE PUNJAB PRESERVATION OF SUBSOIL WATER ACT, 2009



- What impact, if any, has theAct had on groundwater level?
- What is the effect, if any, of electricity consumption?
- Is the WEF spatial modeling approach useful in evaluating environmental policies?

$$W_t — Wt\text{-}1 = R_t — D_t + S_t + E_t$$

- **Rate of recharge (R_t)** is a function of the geology of the place including precipitation, soil characteristics, slope, elevation and such features. These features are time invariant.

- Demand side variables (D_t) are a function of the crops grown, area under various crops, irrigation, prices of crops, and inputs such as electricity and diesel, as well as, demographic variables such as population, type of industry or sector that is dominant in the district.

- Supply side variables (S_t) include management policies and prevalent institutions.

$$Y_{it} = \beta_0 + \beta_1 W_t + \beta_2 F_{is} + \beta_3 Post * F_{is} + \beta_5 X_{its} + \beta_5 I_{its} + \beta_6 E_d + \varepsilon_{its}$$

Y_{it}: Groundwater level in district i at time t in meters below ground level (mbgl)

W_t : Year fixed effects

F_{is}: Dummy variable which takes value 1 if the district is rice growing district and 0 otherwise

Post: Dummy variable that switches to 1 after the policy of delayed rice transplanting and 0 otherwise. The coefficient β_3 is the parameter of interest

X_{its}: Annual average rainfall in districts in millimeters (mms)

I_{its} : Gross area under irrigation by the agriculture sector in '000 hectares

E_d: Annual average consumption of power by the agricultural sector in million KWH

$$Y_{it} = \beta_0 + \beta_1 W_t + \beta_2 F_{is} + \beta_3 \text{Post} * F_{is} + \beta_5 X_{its} + \beta_5 I_{its} + \beta_6 E_d + \varepsilon_{its}$$

	(i)	(ii)	(iii)
Post policy * high rice growing district	-2.315** (0.839)	-2.315** (0.839)	-2.315** (0.839)
High rice growing district	1.671*** (-o.473)	(-0.816) (-0.476)	1.850*** (0.536)
Consumption of power by the agriculture sector	0.00425 (0.00250)	0.00419 (0.00247)	0.00465* (0.00254)
Number of observations	168	168	185
Adjusted R2	0.614	0.612	0.617

THANK YOU