AGRICULTURAL DEVELOPMENT IN PUNJAB – THE WATER WOES –

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Agricultural Development in Punjab started with the management and development around the water resources. These included:

- The land consolidation, which was completed by early 1960s that made private investments in irrigation tubewells economical for farmers
- Electrification of all villages by early 1970s to make it easier and even more economical
- The institutional credit, particularly the cooperatives to begin with, which supported it
- The government policies and the HYVs of wheat and rice in 1960s boosted the process

The irrigated area increased from 54 % in 1961 to 71 % in 1971, with the number of tubewells increasing 16 times during this period, from 12 to 192 thousands. By 1990-91, the irrigated area was more than 91%, and soon reached the closest to potential of above 95-96 %. Out of some 1250 thousand tubewells now, more than 80% are electrically operated. And the electricity is free for agriculture; so is the canal water.

However, agriculture is and it will continue to be a gamble in the rain, even in the highly irrigated agriculture. In a year of poor rainfall, as of 2009, farmers had to pump out more water, the electricity supply became scarce and the expenditure on diesel increased manifolds.

The supply of water, in addition to rainfall, includes that from

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rivers and streams channeled through canals to the fields; the balance being met from the underground water. Some 10 % of underground water is for domestic and industrial purposes; the major chunk - 90% is for agriculture.

The ground water is recharged through seepage of rain water, seepage from rivers and canals and the reverse seepage of the applied irrigation water. In an irrigated agriculture system, the groundwater balance is determined by the equation of withdrawal of the underground water and the total seepage. Various studies have reported the status of water balance as follows:

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Year	Supply million hectare metres: (mHaM)	Demand mHaM	GAP mHaM	Source
1990	G =3.12, MF=0.24, UF=0.46 Total = (3.82) Usable = 3.36	4.90	1.54	Prihar, et al, 1993
2004	3.23	4.50	1.27	Hira, et al, 2004
2008	Total = 3.939 Ground water = 2.114	GW draft 3.116	0.989	D o Irrigation, GoP State Water Policy-2008
Av 02-08	Punjab, Haryana, Rajasthan including Delhi: Depletion = 17.7 $\pm$ 4.5 km^3			NASA, 2009
2004	Punjab, Haryana, Rajasthan including Delhi: Depletion = 13.2 km^3			CGWB, 2006
	The live storage capacity of Bhakra reservoir is 6.91 km^3			

NASA scientists' estimates of water depletion based on Gravity Reduction and Climate Experiments (GRACE) for Punjab, Haryana and Rajasthan including Delhi for 2002 to 2008 show it to be 17.7 + 4.5 km^3 / year. (1 km^3 = 0.1 mHaM).

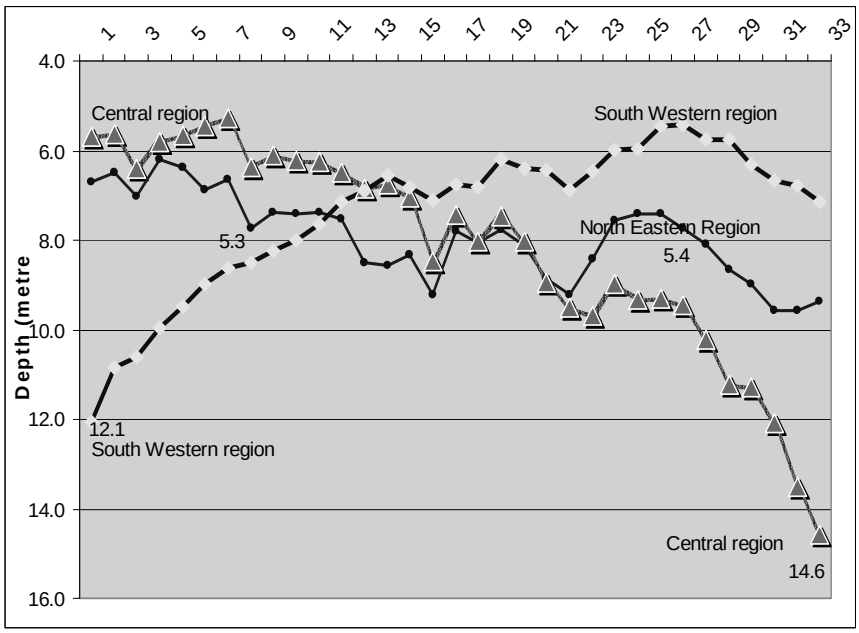
NASA WARNING:

"….Severe shortage of potable water, reduced agricultural productivity, conflict and suffering surely would accompany the supply-limited solution" (Rodell *et al,* 2009).

There is no doubt that the water table is receding in Punjab,

particularly its Central region, where rice is the dominant, almost the only crop in the summer season

Region-wise water table behaviour, Punjab: 1973 to 2005



The average per year depletion of water during 1999-2005, estimated from the actual fall in water table, is 5.444 km^3, which is lower than the earlier estimates reported earlier.

Table. Estimate of Total depletion of groundwater in Punjab, 1990 to 2005

Region	June 1990 to June 2005		June 1999 to June 2005	
	Total	Average / year	Total	Average / year
North Eastern	2.95	0.20 (6)	3.68	0.61 (2)
Central	**41.17**	**2.74 (2)**	32.33	**5.39 (0)**
South Western*	2.03	0.14 (6)	**10.79**	1.80 (0)
Total Punjab	46.15	3.08 (4)	46.80	7.80 (0)
The live storage capacity of Bhakra reservoir = 6.91 km^3				

Notes: 1. The figure in brackets is the number of years when the recharge was more than the withdrawal

* Most of the South Western region has unfit or marginally

fit water; the region showed the following trend in water depletion or addition, though, in this region, the depletion is the one that is being looked for:

Depletion (Falling water table): June 1991 to June 1994 = 1.39 km^3 per year

Addition (Rising water table): June 1994 to June 1999 = 1.81 km^3 per year

Depletion (Falling water table) :: June 1999 to June 2005 = 1.80 km^3 per year

THE WATER WOES

North – sub-mountain: Controlling run off

South-west: Earlier cotton, now rice too. Water-logging is the major problem

- Canal water + rainfall > ecological ETR – extra seepage unused —-
- GW: not fit, low use
- Canal irrigated area has increased, and it is no longer a protective irrigation water supply; the rice area is increasing very fatly here, which means 4-5 times canal water supply (than in case of cotton). In Muktsar, it increased from 68 tha in 2007 to 95 tha in 2008 and 118 tha in 2009; in Bathinda, it fatted as 86, 97 and 107 tha during these years respectively

STARTEGIES:

- Increase the Ground Water use
- Rationalize canal water supply
- Drain-out excess water
- Adopt policies to make it mainly cotton zone again

Central: Water table going deeper by the day

- Rice ? zero to hero ?to hero-cum-villain
  Area: 1.5 m ha mid 80s ? >2.5 m ha mid 90s
- Rice transplanting advanced to early May
  ET: early May: 80+cm ? 56 cms end June
  (20 cms water is a metre of water-table)
- Canal water supply declined

• Water-use efficiency measures lagged

Starategies: The appeals and advice did not work: There was hardly any respite to early transplanting of rice, nor there was decline in rice area, which rather increased to more than 2.7 million ha in 2008 and 2009.

The Punjab State Farmers Commission proposed "The Punjab Preservation of Sub Soil Water Act, 2009" in 2006, which was promulgated as ordinance in April 2008 and made the ACT in March 2009. The Neighbouring state Haryana followed it straightway in 2009. The Main provisions are:

– Not to sow paddy nursery before May 10
– Not to transplant paddy before June 10

The ACT received a welcome response, the area transplanted up to June 10 came to be negligible and that upto June 15 came down to just 22% in 2008 from the earlier of as high as 66 % in some years and even 42 % in 2007.

2008 was a good rainfall year, 2009 was a poor rainfall year with the monsoon being 30 % below normal. The rainfall expectation enters as a variable in the transplanting pattern after the ACT. It was:

– June 20: 2008: 42 % 2009: 22 %
– June 30: 2008: 85 % 2009: 72 %

Total rice area in 2008 and 2009 is >2.7 million ha

The impact on water table can also be approximated. The monsoon rainfall during 2007, 2008 and 2009 was 355, 600 and 324 mms respectively, as against the normal of 502 mms. The additional monsoon rainfall required for water balance over the normal one, with rice area at > 2.5 m ha and without the ACT, is 103 mms. If there were no ACT, then during 2008, the estimated rise in water table would have been far lower, almost close to nil when in fact there was the rise in water table by about one metre. Likewise during 2009, the fall in water table would have been 2.68 metres over 2006, 1.79 metres over 2007 and about 3 metres over 2008.

Improving the water use efficiency is even more important; it yields more crop per drop. The Laser leveling saves about 30 % water and the ridge / trench planting sugarcane also saves about 30 %. The happy seeders, which helps wheat sowing without rice straw burning

and thus saves organic matter, also impacts some savings of water for wheat through its mulching effects. These technologies also improve productivity, save on fertilizer and electricity subsidies. The added productivity earns taxes too, which makes these even worth for free distribution, provided these are used.

- The Overarching Conclusion is that agricultural development started around the management of water resources; it should not be allowed to end with its mismanagement.
- The ACT is the prime force BUT there is need to use surface water more judiciously and promote the water use efficiency measures vigorously
- The KEY WORD is accord top priority to restore the groundwater balance, whatever are the means, measures and policies necessary.

BRIEF

Agricultural development in Punjab started around the management and use of water resources, but it over-exploited the groundwater and the annual depletion from Punjab is close to the live-storage capacity of the Bhakra reservoir. It would be too suicidal if it is allowed to end with its mismanagement. Excessive rice area going deep into the heart of the cotton region with generally unfit groundwater, early transplanting of rice, which now has been checked with 'the Punjab preservation of sub-soil water Act, 2009', and scanty measures for improving the water use efficiency and allocation of surface water to different regions in the state had been the main causes. There are now technologies available, such as laser levelers, ridgers/ trenchers and happy seeders, whose social economics is overriding for these to be stocked, even free with the cooperatives, and monitored to be used by the farmers. The research on water use efficiency needs to be strengthened manifolds. The utmost priority needs to be accorded to restore the groundwater balance whatever are the means, measures and policies necessary; it is the key word.

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