

Satellite based observations on Human induced changes in regional water balance in Punjab, India

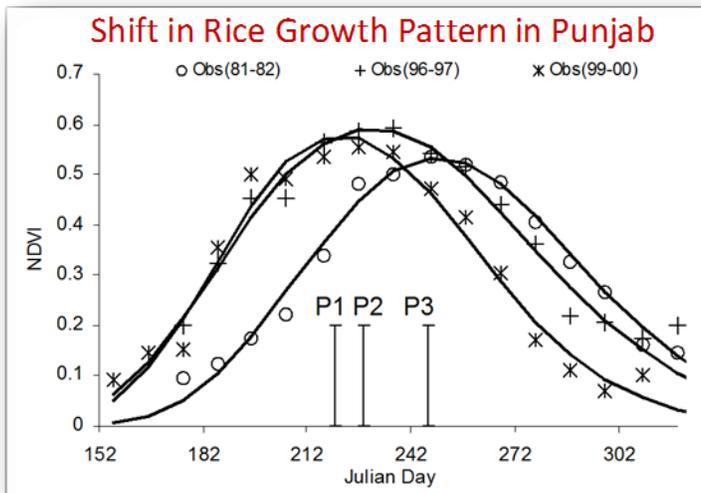
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Hydrological cycle consists of major three components: (1) water input, (2) water output and (3) water storage. Among all, 'water storage component' is considered as the most essential component for agriculture. Water storage component includes soil moisture, which is dynamic in nature and is the most essential element of water resource management practices as it affects water cycle of the atmosphere, earth surface and subsurface. This article reports the remote sensing observations on rice phenology and associated soil wetness patterns over a decade in Punjab and brings out how human induced changes affected the regional water balance.

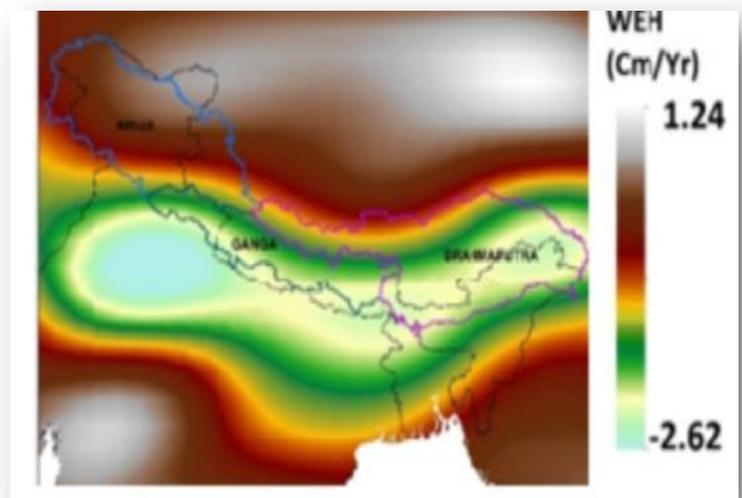


Introduction of irrigated rice in the semi-arid northwest Indian region is one of the major developments in Indian agriculture. Ground water resources has played important role in Green revolution induced rise in agricultural productivity in India. Punjab region has witnessed significant changes in cropping pattern during the last few decades. Initially farmers started early sowing of rice much before the onset of monsoon through ground water as Rice–wheat rotation followed in Punjab left little time for land preparation for wheat after rice.

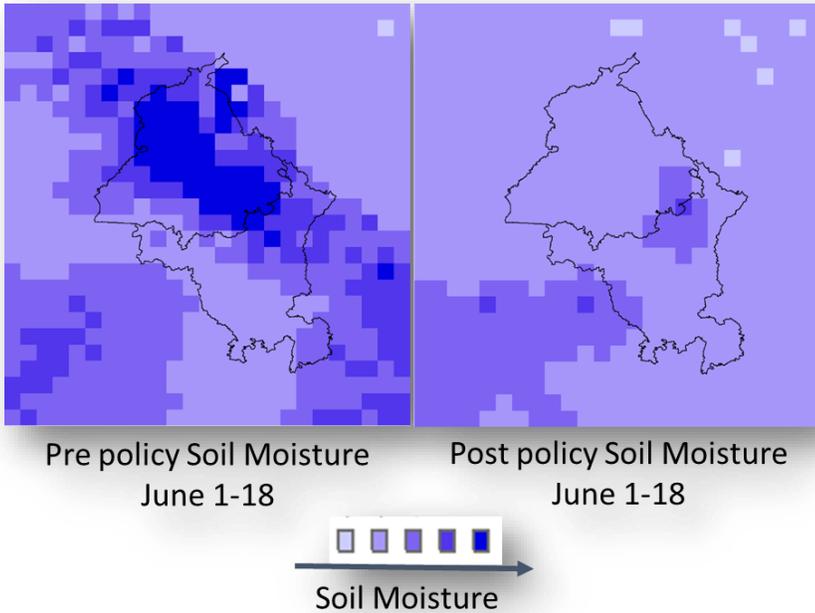


Due to this practice, Punjab region which experienced an intensive farming through groundwater irrigation caused a serious depletion in the water table of the area. Unregulated exploitation of water resource particularly for rice cultivation during summer season resulted into falling water tables in majority of areas. This phenomenon was observed by GRACE satellite data.

Recognizing over exploitation of groundwater as a serious concern, the Government of Punjab enacted the Punjab Preservation of Subsoil Water Act in 2009 to slow groundwater depletion. The Punjab Preservation of Subsoil Water Act-2009 is aimed to conserve groundwater resource by mandatory shifting of the transplanting date (beyond the due date) of paddy to avoid loss of water (Evapotranspiration) from flooded field in hot weather before Monsoon.



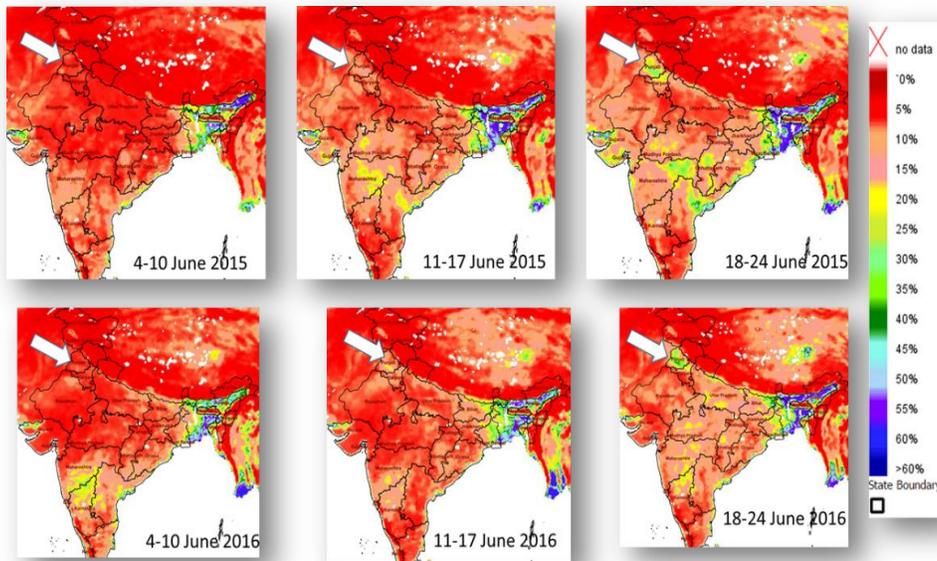
Observations of GRACE data showing Spatial secular changes over Northern India (Source: Agrawal et al. 2014).



A recent study based on Multi-year passive microwave (AMSR-E and SMAP) soil wetness analysis showed an overall delay in irrigation practices in the Punjab and Haryana after the policy in 2009 in comparison to pre policy period.

Observations of soil moisture from Passive Microwave Radiometer showing reduced soil moisture in first fortnight of June after Punjab Preservation of Subsoil Water Act in 2009 .

Recent Observations from SMAP derived soil moisture in 2015 and 2016 shows prominent changes in surface wetness in second fortnight of June.



Observations of soil moisture from Passive Microwave Radiometer (SMAP) showing sudden increase in soil moisture in Punjab in second fortnight of June. (Source: VEDAS/SAC webportal)