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Management of declining groundwater in the Trans Indo-Gangetic Plain (India): Some options

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Abstract

The average productivity of rice–wheat sequence is quite impressive in the Trans Indo-Gangetic Plain (India) but these gains are over-shadowed due to declining groundwater, particularly in the areas, where groundwater quality is either good or marginal. The groundwater decline can be reversed through artificial groundwater recharge and by adopting suitable land and water management practices. Groundwater recharge is found technically feasible through vertical shafts conducting water from the ground surface directly to aquifers, after it has been passed through a sand-gravel filter. The recharge rate through this system is almost equal to a shallow cavity/filter well yield (about 11 l/s) and its cost is estimated at about INR 10/100 m^3 (1 US$ = 45 INR). Further study in the Kaithal and Karnal districts of Haryana for stabilizing watertable within 6–7 m, which permits continuous use of shallow tubewell technology, indicated that the rice area could be supported at 60% of cultivable command area (CCA) and wheat between 65 and 80% of CCA with the existing management practices. The cultivation of wheat crop is sustainable in larger area, mainly due to its medium water requirement, salt resistance characteristics and consistent market demand resulting in assured returns. There is a possibility of supporting rice at a higher level, if part of the area (up to 10%) is left fallow and used for rainwater conservation and recharge. The fallow area may be subsequently put under early *rabi* (winter) crops like mustard, gram and other pulses. The effect of varying irrigation and fallowing would increase 23% equivalent wheat yield by changing land and water management practices. The analysis further indicated that the adoption of proposed irrigation management

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practices might stabilize watertable at desired level of 6–7 m in 10–15 years in high (3–4 m), 5 years in medium (5–10 m) and 40 years in deep (>10 m) watertable areas.

Keywords: Groundwater management; Rice–wheat cropping; Artificial recharge; Rainwater conservation; Irrigation management; Salinity; Trans Indo-Gangetic Plain

1. Introduction

Rice–wheat cropping sequence is the major food production system in the Indo-Gangetic Plain (IGP) of India (Fig. 1). In the trans Indo-Gangetic part of the plain (States of Punjab and Haryana), which earlier supported upland crops like maize, cotton and sorghum during *kharif* (summer) season and wheat during *rabi* (winter) season, introduction of rice crop was largely a consequence of waterlogging in canal irrigated areas and development of intensive network of shallow tubewells. The cultivation of wheat is practiced in about 80% of the area, which even includes marginal quality groundwater areas, mainly due to its low water requirement, salt resistance characteristics and consistent demand resulting in an assured return (Tyagi et al., 2004). Therefore, rice–wheat cropping sequence in the region has evolved due to specific regional climatic and geo-hydrological conditions. The average productivity of 7–8 t/ha for rice–wheat cropping sequence in the trans IGP is quite impressive against the average of 4.0 t/ha in the IGP. In fact, the region contributes about 52% in national food production (Abrol, 1999). However, these significant gains are overshadowed by the emerging land and water management problems on regional scale.

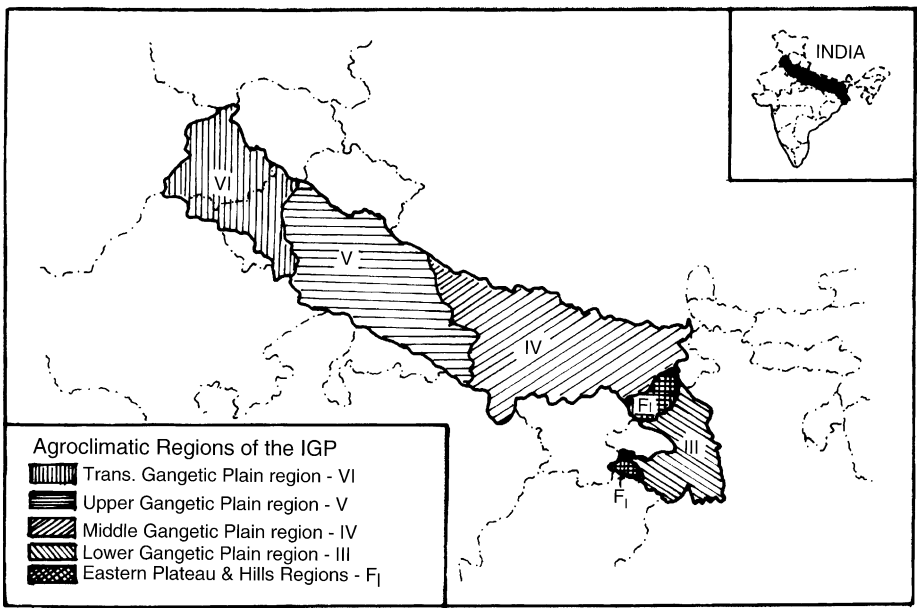

Fig. 1. Indo-Gangetic Plain showing agro-climatic regions.