



## Soil water budgeting approach to quantify potential groundwater recharge from croplands and groundwater use in a semi-arid region

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**Abstract** The groundwater resources of semi-arid region in Indo-Gangetic Plain is declining rapidly and necessitates accurate quantification of potential recharge from different agricultural land uses. The potential recharge on a daily basis for three different land uses, such as fallow, rice and non-rice cropped areas for three cropping seasons, was estimated using soil water balance approach. Beside this, the net groundwater use for eight different crops was also calculated. The potential recharge from fallow land was 126 mm year<sup>-1</sup>, which was 14.9 % of total rainfall. The mean potential recharge from kharif (rainy) and rabi (winter) seasons was 527.3 and 81.7 mm season<sup>-1</sup>, respectively. Among the rabi crops, least recharge was observed for winter maize and mustard with 29.3 mm season<sup>-1</sup>, followed by wheat with 108.4 mm season<sup>-1</sup>. Among the kharif crops, least recharge was observed for green gram with 59.7 mm season<sup>-1</sup>, followed by soybean with 113.9 mm season<sup>-1</sup>. Rice had the highest recharge potential of 929.1 mm season<sup>-1</sup>, followed by maize with 149.1 mm season<sup>-1</sup> and cotton with 132.7 mm season<sup>-1</sup>. It was observed that the annual average groundwater use was highest for wheat with 190 mm year<sup>-1</sup>, followed by winter maize with 188 mm year<sup>-1</sup>, mustard with 169 mm year<sup>-1</sup>, paddy with 151 mm year<sup>-1</sup>, kharif maize with 94 mm

year<sup>-1</sup>, green gram with 15 mm year<sup>-1</sup>. Cotton and soybean crops exhibited an additional potential recharge of 8 and 114 mm year<sup>-1</sup> into the groundwater. It was revealed that the maize-wheat cropping system consumed less groundwater than rice-wheat and, therefore, can be considered as a better option for sustainable use of groundwater.

**Keywords** Soil water balance · Groundwater recharge · Indo-Gangetic Plain · Semiarid region · Groundwater use

### Introduction

Groundwater is depleting at an alarming rate in many parts of the world including India. In India, as in other developing countries, agriculture accounts for as much as 85 % of total annual draft (FAO 2012). Projections for the year 2025 indicate that all of northwestern India, the southern plateau and southeastern coastal regions will run into a water-deficit region (IWRS 1997). In semi-arid region of Indo-Gangetic Plain (IGP) in India, especially in the northwest part, the shortage of surface water is a major limiting factor. In these regions, groundwater is the main source of water for irrigation (CGWB 2007). A recent