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Sustaining groundwater irrigation for food security in the northwest region of Bangladesh

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Abstract: The northwest region of Bangladesh is crucial to the country's food security. The region supplies about 35% of the dry season rice and more than 60% of the country's wheat and maize. These crops are grown in the dry season mainly using groundwater irrigation (about 97%). Falling groundwater levels (GWL) are a major concern, particularly in the southern Barind area. However, it is not clear whether the declining GWL result from a decline in rainfall, from unsustainable use, or from some combination of these and possibly other factors. The objective of this study was to define the sustainable level of water (particularly groundwater) use for irrigation and their impacts on the socio-economy and livelihood of the farmers.

The study involved: (i) developing catchment/district scale understanding of the surface water and groundwater resources through water balance analysis and surface water and groundwater modelling; (ii) assessment and validation of the long-term water use in dry season irrigation using remote sensing and statistical techniques; (iii) analysis of cost and benefit of dry season crops and (iv) assessment of gender involvement in decision-making process in farm practices and analysis of livelihood conditions.

Assessment of crop areas for the period of 1985–2015 suggested that dry season rice is the major user of extracted groundwater. The dry season rice area expanded gradually over the years, the expansion tapered-off in the last decade, but GWL continued to decline in the southern half of the region, whereas GWL were steady in the northern half. Climate played a major part in the trends in observed GWL between 1985 and 2015. Rainfall declined throughout northwest Bangladesh during this period, with statistically significant declines in mean annual rainfall of >20 mm/yr in most districts in the north. Conversely, evapotranspiration increased significantly (>3 mm/yr) in only 7 (mostly northern) districts out of 16 districts, and there were non-significant declines in 4. Other factors contributing to GWL decline include changing land use conditions, upstream river regulation, changing cropping patterns, reduction in wetland areas, and low flows in the rivers in the dry season. Overall, the analyses indicated that while increasing pumping is likely to contribute to GWL decline, especially in areas like the Barind Tract, a blanket reduction in pumping may not provide a universal solution for groundwater management across the northwest region.

Scenario analysis showed that increased pumping with decreasing rainfall does not deplete GWL significantly everywhere. Climate change is expected to impact both rainfall and crop water use, but the direction and amount of change are uncertain. Therefore, the rate at which GWL fall is projected to change. However, the impact is likely to be confined to the southwest part of the region. Conjunctive use of river water with groundwater leads to a substantial improvement. The analysis revealed that the surface and groundwater resources are in a dynamic equilibrium in all districts of the northwest, i.e., the aquifer receives water from and loses water to the river depending on the water level changes in the river and the aquifer. So surface water and groundwater must be managed together.

Socioeconomic analysis suggested the inadequacy of 'one size fits all' policies for climate change adaptation. Location-specific policies are required. New insights into family dynamics and farm decision-making processes showcased that women play a substantial role in farming and are increasingly involved in farm management. However, they are mostly overlooked or undervalued by their male counterparts.

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