

## Abstract

India's falling aquifer levels, erratic monsoons, arable land constraints, stagnating crop yields, growing food demand, and rising greenhouse gas (GHG) emissions necessitate that strategic interventions be planned and implemented to maintain food security in the country. In this paper, we present two novel system dynamics simulation models—termed 'Sustainable Alternative Futures for India' (SAFARI) and SAFARI-R (a regionally disaggregated version of SAFARI)—that can be used to develop and analyse specific interventions required at the national and regional levels to sustainably maintain food security. Our simulation results show that increasing micro-irrigation coverage, limiting sugarcane cultivation, and improving water recycling in domestic and industrial sectors can help achieve food production sufficiency within the limitations posed by the availability of natural resources. Alternatively, a behavioural shift towards eating (and cultivating) coarse cereals instead of rice (which is water intensive) is another effective intervention, especially when combined with micro-irrigation or crop yield improvements, and reduced sugarcane cultivation. When compared to a scenario where current practices continue, these alternative pathways to food security can reduce annual water consumption for irrigation by 18%–24%, electricity demand for irrigation by 60%–65%, and the agriculture sector's total (direct + indirect) GHG emissions by 17%–25%, by 2050. Further, simulations on SAFARI-R indicate that the north, centre, and west zones of the country are considerably pressed for water, while the south and east zones could run out of land. As a way to meet the food demand in these zones in future, the possibility of crop redistribution is explored along with other strategies such as reducing groundwater dependence.