Agrotechnol 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2168-9881.C1.022

How yield gaps and food security analyses can help address policy to feed increasing population?

Jagadish Timsina
University of Melbourne, Australia

Food insecurity is a global issue, and especially in South Asia and sub-Saharan Africa where population is increasing at an alarming rate, croplands and crop yields are decreasing for various reasons, and climate change impact is predicted to be substantial. Food security analysis will thus be highly important for countries of these regions to help policy and allocate resources to address this challenging issue of feeding the growing population. A South Asian country, such as Bangladesh, has huge challenges in achieving food security due to its high population, diet changes, and limited room for expanding cropland and cropping intensity. This paper first discusses the concepts and principles of yield gap analysis and food security, and then provides a case for Bangladesh showing results on yield gaps and food security through maize, rice and wheat, three major cereals needed for achieving food security. The objective of such analysis is to assess the degree to which Bangladesh can be self-sufficient for maize, rice and wheat by year 2050 by closing the existing gap between yield potential (Yp) and actual farm yield (Ya), accounting for possible changes in cropland area. Yield potential and yield gaps (Yg) were calculated for the three crops using well-validated crop models and site-specific weather, management, and soil data and results were up scaled from location to country following a bottom-up approach. We assessed potential grain production in years 2050 for six land use change scenarios (general decrease in arable land; declining ground water tables in the north; cropping of fallow areas in the south; effect of sea level rise; increased cropping intensity; and larger share of cash crops) and three levels of Yg closure (no yield increase; Yg closure at a level equivalent to 50% (moderate Yg closure); Yg closure to a level of 85% of Yp (irrigated crops) and 80% of water-limited yield potential or Yw (rainfed crops) (full Yg closure)). In addition, changes in demand with low and high population growth rates were also examined. Total all-grains demand (in milled rice equivalent) in 2050, based on the UN median variant, is projected to be 24% higher than in 2010. Current Yg represent, 50% irrigated rice, 48-63% rainfed rice, 49% irrigated wheat, 40% rainfed wheat, 46% irrigated maize, and 44% rainfed maize of their Yp or Yw. With a moderate Yg closure and for various land use changes, self-sufficiency rations (SSRs) will be about 1.0 for rice but well below one for maize and wheat in 2050. With full Yg closure, SSRs will be well above one for rice and all-grains but below one for maize and wheat for all scenarios, except for scenario where drastic decrease in boro rice area occurs to provide areas for cash crops in future. Full Yg closure of all cereals is needed to compensate for area decreases and demand increases, although some maize and large amounts of wheat imports will be required to satisfy demand in future. This analysis has important implications for Bangladesh and other similar countries with high population growth rate, shrinking arable land due to rapid urbanization, and highly vulnerable to climate change.

jtimsina@unimelb.edu.au

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