The global yield gap is a concept to assess the difference between the actual yield and the maximum potential yield that could be achieved by applying optimal agricultural techniques such as irrigation. Climate change and socio-economic development, including population growth, call for addressing the yield gap to increase global production and to adapt to climate change as irrigation in many circumstances is a very effective adaptation measure. On the regional level, the irrigation yield gap can thus be interpreted as an indicator linked to adaptive capacity of the agricultural sector to climate change impacts. At the same time, effective deployment of irrigation is linked, among other things, to the socio-economic development including economic capabilities, but also institutional and water governance frameworks.

Based on a detailed assessment of the irrigation yield gap, taking into account water availability constraints such as environmental flow requirements, we here establish as sustainable irrigation adaptation index for the agricultural sector. In a next step we link this sustainable irrigation index to socio-economic indicators provided by the framework of Socio-Economic Pathways (SSPs) on the national level. Doing so allows us to project the closure of the yield gap alongside the quantitative SSP narratives of socio-economic developments. We find that even under very optimistic scenarios of socio-economic development, it will take decades to close the irrigation yield gap in many developing countries, while without substantial development improvements our results suggest limited improvement in many tropical countries. Our projections present a first attempt to consistently link future irrigation expansion to socio-economic scenarios used in climate change research. We report a substantial scenario dependence of this expansion that underscores the need to incorporate socio-economic projections into projections of future agricultural impacts.