Transformation of the agricultural sector will play an important role to improve food security and achieve some of the sustainable development goals (SDGs). Intensification through irrigation is often mentioned as a good option to make progress towards achieving the SDG 2 goal (“End hunger, achieve food security and improved nutrition and promote sustainable agriculture”) and to reduce the pressure on land (SDG 15 “…sustainable use of terrestrial ecosystems”). Expansion of irrigation is also considered an adaptation option in the face of climate change, expected to strongly affect rainfed agriculture (Leclère et al., 2014; Müller et al., 2011; Roudier et al., 2011). However, in water stressed regions, an increased role for irrigation poses challenges for water availability (SDG 6 “Ensure availability and sustainable management of water and sanitation for all”). Transforming traditional rainfed systems or upgrading water inefficient irrigation systems into productive irrigation systems will require investments that may be beyond the economic means of farmers in vulnerable regions.

In this paper we quantify the impacts and costs of investment strategies for maintaining, upgrading and expanding irrigated agriculture globally using a global economic and land use model GLOBIOM (Havlik et al., 2014). For this purpose, we model the supply and demand of agricultural products at a high spatial resolution in an integrated approach that considers the impacts of global change (socioeconomic and climatic) on food, feed, and fiber markets by 2050. Our approach models the conditions and investment required to transform rainfed cropland into more productive and efficient irrigated cropland, taking into account the biophysical availability of water, the growing competition for water from other sectors (domestic, energy and industry) as well as the impacts that upgraded and expanded irrigation systems have on regional crop production, land use change and emissions, as well as food security and water availability. Under an ambitious irrigation scenario, we find that 154 million hectares of additional irrigated land would be feasible to deploy at the horizon from 2010 to 2050, which corresponds to a 60% increase in irrigated areas in developing countries. Such deployment would require public investment costs of about 50 to 60 billion USD per year. Multiple benefits would accrue under such deployment scenarios: These investments in irrigation would lead to improvement in the efficiency of irrigation systems, improvement in food availability, and contribute to land sparing although the effectiveness and efficiency in achieving this goal through expanded irrigation differs substantially across regions.