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Adaptation to extreme heat in the agricultural sector – SSP-dependent scenarios for mechanization deployment

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Climate change and increasing heat stress reduces labour productivity and supply all across the globe. In a global warming scenario of 3°C, effective labour (i.e., the combination of productivity and supply) is expected to decrease by up to 50 percentage points relative to the period 1986-2005. Central Africa, Southeast Asia and Latin America will be most affected. In these regions, the agricultural sector is still of paramount importance for livelihoods and food security and outdoor work is more common. When heat stress further increases, the capability for physical activity will reduce across a wide range of working places, primarily outdoors. Especially in low- and middle-income countries the effects of climate change will lead to a reduction in economic activity and decrease the capacity for economic growth.

Automation and mechanization of outdoor work could greatly reduce the economic costs of heat stress and counts as the most effective adaptation strategy in the agricultural- and construction sectors to climate change, but scenarios of potential future deployment of mechanization are in their infancy. Here we propose a Mechanization Deployment Index (MDI), which builds on the concept of constrained adaptive capacity reflecting a level of mechanization under the presence of socio-economic constraints compared to the maximum mechanization potential in the absence of constraints to adaptive capacity. By identifying socioeconomic variables within the framework of the Shared Socioeconomic Pathways (SSPs) that correlate with the current level of mechanization deployment, we are able to project five scenarios for future mechanization implementation alongside the SSPs. For the first time, we will be able to show how different socio-economic trajectories strongly modulate future heat stress impacts in the agriculture sector. These scenarios can be included in integrated assessments of climate change and improve the economic risk assessment in the 21st century.