
Abstract

Limitations to human livelihoods remain a problem in many regions of the world and climate change impacts are expected to exacerbate such limitations in the future. While a large body of research is devoted to the topic of human well-being, human needs and livelihood requirements, a systematic and applicable framework to assess livelihood limitations in the context of climate change is so far unavailable. This thesis first develops an approach to assess *Adequate Human livelihood conditions for well-being And Development (AHEAD)* on a global scale. The approach allows to relate sectoral impacts of climate change to an integrated measure of livelihood limitations, taking into account important determinants of the society as well as the environment. Two additional detailed sectoral studies on water availability and human health show how local and regional studies of specific livelihood aspects can complement generic, global assessments and provide an overall indication of the nature, severity and spatial distribution of limitations to human livelihoods.

On the basis of a qualitative literature review to derive determinants of adequate livelihoods, a total of 16 elements are identified allowing to assess the fulfilment of AHEAD. Two methodological approaches to operationalise AHEAD elements are presented, each contributing to improve our understanding of livelihood limitations. The first implementation to assess AHEAD fulfilment uses a systems thinking approach, which outlines the degree of activity and connectivity of each element and reveals how climate change impacts may propagate through the system and lead to indirect effects on many system components. The second approach uses the method of fuzzy logic to assess the global state of livelihood conditions, analysing in which regions of the world changes in water availability affect AHEAD in the coming decades. The subsequent sub-national studies serve to assess limitations to the sectors water and human health in detail, again employing a fuzzy logic methodology.

The results of the system thinking assessment show, that water as an element of AHEAD is one of the most active system components. Impacts of climate change on water may have strong indirect effects on livelihood adequacy. The potential impacts of changes in water availability are quantified in the second implementation of AHEAD, showing that water scarcity limits livelihood adequacy in many regions of the world. The utilisation of an ensemble of climate change and water models further allows to assess the relevance of model related uncertainty in this regard. As water availability plays a crucial role for the fulfilment of livelihood needs, the global assessment is complemented by a detailed analysis of the adequacy of water availability for relevant sectors. By taking into account sector-specific determinants, including aspects of water quality, infrastructure as well as detailed accounts of sectoral water resource needs, the approach allows to depict limitations in detail, also giving indications as to how water adequacy may be improved. Similarly, the analysis of heatwave impacts on human health provides a novel methodology to assess the multiple environmental and human influences which affect vulnerability and provides specific information on potential adaptation measures to reduce climate impacts.

The findings provide knowledge of limitations to human livelihoods at a new level detail and disaggregation. By identifying the most decisive limiting factors, applicable information on how to most effectively improve human livelihoods is generated.