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A two-stage approach for assessment of distributional impacts in model-based delta planning: exploration of plausible inequality patterns and justice-based evaluation of policies

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Climate-related inequality can arise from the implementation of adaptation policies. As an example, the dike expansion policy for protecting rice farmers in the Vietnam Mekong Delta in the long run backfires to the small-scale farmers. The prevention of annual flooding reduces the supply of natural sediments, forcing farmers to apply more and more fertilizers to achieve the same yield. While large-scale farmers can afford this, small-scale farmers do not possess the required economics of scale and are thus harmed eventually. Together with climatic and socioeconomic uncertainties, the implementation of new policies can not only exacerbate existing inequalities, but also induce new inequalities. Hence, distributional impacts to affected stakeholders should be assessed in climate change adaptation planning.

In this study, we propose a two-stage approach to assess the distributional impacts of policies in model-based support for adaptation planning. The first stage is intended to explore potential inequality patterns that may emerge due to combination of new policies and the realization of exogenous scenarios. This stage comprises four steps: (i) disaggregation of performance indicators in the model in order to observe distributional impacts, (ii) performance of large-scale simulation experimentation to account for deep uncertainties, (iii) clustering of simulation results to identify distinctive inequality patterns, and (iv) application of scenario discovery tools, in particular classification and regression trees, to identify combinations of policies and uncertainties that lead to a specific inequality pattern.

In the second stage we attempt to assess which policies are morally preferable with respect to the inequality patterns they generate, rather than only descriptively explore the patterns which is the case in the previous stage. To perform a normative evaluation of the distributional impacts, we operationalize five alternative principles of justice: improvement of total welfare (utilitarianism), prioritization of worse-off actors (prioritarianism), reduction of welfare differences across actors (two derivations: absolute inequality and envy measure), and improvement of worst-off actor (Rawlsian difference). The different operationalization of each of these principles forms the so-called social welfare function with which the distributional impacts can be aggregated.

To test this approach, we use an agricultural planning case study in the upper Vietnam Mekong

Delta. Specifically, we assess the distributional impacts of alternative adaptation policies in the upper Vietnam Mekong Delta by using an integrated assessment model. We consider six alternative policies as well as uncertainties related to upstream discharge, sediment supply, and land-use change. Through the first stage, we identify six potential inequality patterns among the 23 districts in the study area, as well as the combinations of policies and uncertainties that result in these types of patterns. From applying the second stage we obtain complete rankings of alternative policies, based on their performance with respect to distributional impacts, under different realizations of scenarios. The explorative stage allows policy-makers to identify potential actions to compensate worse-off actors while the normative stage helps them to easily rank alternative policies based on a preferred moral principle.