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Climate Change Impact and Adaptation Assessment on Food Consumption Utilizing a New Scenario Framework

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Supporting Information

ABSTRACT: We assessed the impacts of climate change and agricultural autonomous adaptation measures (changes in crop variety and planting dates) on food consumption and risk of hunger considering uncertainties in socioeconomic and climate conditions by using a new scenario framework. We combined a global computable general equilibrium model and a crop model (M-GAEZ), and estimated the impacts through 2050 based on future assumptions of socioeconomic and climate conditions. We used three Shared Socioeconomic Pathways as future population and gross domestic products, four Representative Concentration Pathways as a greenhouse gas emissions constraint, and eight General Circulation Models to estimate climate conditions. We found that (i) the adaptation measures are expected to significantly lower the risk of hunger resulting from climate change under various socioeconomic and climate conditions. (ii) population and economic development had a greater impact than climate conditions for risk of hunger at least throughout 2050, but climate change was projected to have notable impacts, even in the strong emission mitigation scenarios. (iii) The impact on hunger risk varied across regions because levels of calorie intake, climate change impacts and land scarcity varied by region.

INTRODUCTION

Several approaches have been taken in assessments of climate change impact and adaptations on agriculture and food systems, including process-based crop models, economic models and yield response functions.[1] Process-based crop models have advantages in the calculation of crop responses to factors that affect growth and yield (i.e., climate, soils, and management), are useful for testing a broad range of adaptation measures. Economic models have advantages in the calculation of economic performance of agricultural sectors as a result of the equilibrium between supply and demand, take all of the major variables related to global food systems into consideration including trade balances and prices, and are easy to relate the relevant variables with socioeconomic scenarios. Yield response functions are best suited for the study of empirical relationships between observed climate and crop responses and describe well present-day crop and climate variations.

Well-known studies[2−6] have used economic models. Parry et al.[2] and Fischer et al.[3] combined both a process-based crop model and a Computable General Equilibrium (CGE) model to analyze the impacts of climate change and socioeconomic conditions on agriculture and food systems in the future. Parry et al.[2] suggested that Africa is at great risk; CO_2 concentrations stabilizing at levels of 750 ppm avoids some but not most of the risk of hunger, whereas stabilization at 550 ppm avoids most of the risk. They also found that the impact of climate change on hunger risk is greatly influenced by development pathways of income levels and technology, and not amounts of climate forcing. Fischer et al.[3] suggested that agricultural techniques will be critically important in limiting potential damages resulting from climate change. Nelson et al.[4] used a partial equilibrium model (IMPACT) to analyze climate change impacts at a basin level with a detailed description of irrigation practices. Hertel et al.[5] analyzed the impact of climate change on crop yields in 2030 with a static CGE model. Lobel et al.[6] used a global agricultural trade model and indicated that although investing the least developed areas such as Sub-Saharan Africa and Latin America may be most desirable for the main objectives of adaptation, it has little net effect on mitigation because production gains are offset by grater rates of land clearing in the benefited regions, which are relatively low

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