

Global Analyses of Climate Mitigation for Achieving Net-zero Emissions and Sustainable Development

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[Abstract]

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In 2015, the countries of the world agreed on the so-called 2° C target as a long-term climate goal in the Paris Agreement. After that, the IPCC Special Report on Global Warming of 1.5° C concluded that there would be a significant difference in climate impacts between 1.5° C and 2.0° C. On the other hand, to achieve these long-term climate goals, net zero emissions of greenhouse gases in the latter half of the 21st century or negative emissions through large-scale bioenergy crops and afforestation are expected to be necessary.

This research sought to answer the question, "What kind of society should we create and accept to achieve net-zero emissions without compromising the sustainability of human society and ecosystems?" For the research purpose, we examined global sustainability scenarios considering interrelationships among climate policy, climate impacts, and sustainability.

Subtheme 1 tackled two research issues. First, we improved emissions pathway models reflecting the latest climate science and mitigation research and analyzed emission pathways for meeting climate targets under different socioeconomic development assumptions. Second, regarding the climate impacts under the implemented mitigation policies, we conducted an integrated impact assessment that quantitatively considered uncertainties of socioeconomic and climate change. For the purpose, we developed simplified climate impact projection methods (impact emulators) that could consider flexible scenario assumptions based on existing simulation outputs of complex full-scale climate impact models. The developed impact emulators were used to estimate social costs of carbon under emission pathways. We also conducted a quantitative analysis of inter-regional/generational equity in climate impacts.

Subtheme 2 tried to answer questions related to afforestation and biofuels with carbon capture and storage (BECCS), which would play an important role in net-zero CO₂ emissions. We discussed the possibility of large-scale deployment of afforestation and bioenergy crops while considering sustainability from the perspectives of biodiversity conservation, agricultural technology development, and water resource availability for identifying the policies and measures necessary to achieve net zero emissions without jeopardizing human rights.

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