



## **Reducing greenhouse gas emissions in agriculture without compromising food security?**

Stefan Frank (1), Petr Havlík (1), Jean-Francois Soussana (2), Antoine Levesque (1), Hugo Valin (1), Eva Wollenberg (3,4), Ulrich Kleinwechter (1), Oliver Fricko (1), Mykola Gusti (1,5), Mario Herrero (6), Pete Smith (7), Tomoko Hasegawa (1,8), Florian Kraxner (1), and Michael Obersteiner (1)

(1) IIASA, Laxenburg, Austria, (2) INRA, Paris, France, (3) CGIAR Research Program on Climate Change, Agriculture and Food Security, (4) Gund Institute, University of Vermont, Burlington, USA, (5) University of Lviv, Lviv, Ukraine, (6) CSIRO, Commonwealth Scientific and Industrial Research Organization, St Lucia, Australia, (7) Institute of Biological and Environmental Sciences, University of Aberdeen, Aberdeen, UK, (8) Center for Social & Environmental Systems Research, National Institute for Environmental Studies, Tsukuba, Japan

To keep global warming possibly below 1.5 C and mitigate adverse effects of climate change, agriculture, like all other sectors, will have to contribute to efforts in achieving net negative emissions by the end of the century. Cost-efficient distribution of mitigation across regions and sectors is typically calculated using a global uniform carbon price in climate stabilization scenarios. However, in reality such a carbon price could substantially affect other Sustainable Development Goals. Here, we assess the implications of climate change mitigation in agriculture for agricultural production and food security using an integrated modelling framework and explore ways of relaxing the competition between climate change mitigation and food availability. Using a scenario that limits global warming to 1.5 C, results indicate a food calorie loss in 2050 of up to 330 kcal per capita in food insecure countries. If only developed countries participated in the mitigation effort, the calorie loss would be 40 kcal per capita, however the climate target would not be achieved. Land-rich countries with a high proportion of emissions from land use change, such as Brazil, could reduce emissions with only a marginal effect on food availability. In contrast, agricultural mitigation in high population (density) countries, such as China and India, would lead to substantial food calorie loss without a major contribution to global GHG mitigation. Increasing soil carbon sequestration on agricultural land using a comprehensive set of management options, would allow achieving a 1.5 C target while reducing the implied calorie loss by up to 70% and storing up to 3.5 GtCO<sub>2</sub> in soils. Hence, the promotion of so called “win-win” mitigation options i.e. soil carbon sequestration, and ensuring successful mitigation of land use change emissions are crucial to stabilize the climate without deteriorating food security.