IPCC Special Report on Climate Change and Land

Makino Yamanoshita
Natural Resources and Ecosystem Services
Institute for Global Environmental Strategies (IGES)

IGES
Institute for Global Environmental Strategies

In August 2019, the IPCC[1] Special Report on Climate Change and Land[2] (SRCCL), which synthesises the latest available scientific knowledge on the relationship between climate change and land use, was released. When we think about land use, the concept sounds somewhat distant from our day-to-day lives; however, various resources, including food, water, wood, fibre and minerals, are derived from "land," which comprises of local flora and fauna, the soil, and underground resources. Our way of life is based on the "blessings of the Earth," and we have developed nature and used land to improve our lives. The SRCCL focuses on anthropogenic large-scale changes to nature that have had substantial impacts on the climate system through changes in processes such as greenhouse gas emissions and absorption, heat exchange between the atmosphere and land, and hydrological cycles. At the same time, on the contrary, climate change impacts have manifested on land through heavy rain, droughts, soil runoff and degradation due to heat waves, forest wildfires, and other phenomena. Synthesising the best available scientific knowledge on countermeasures, the SRCCL sheds light on the fact that the "blessings of the Earth" that we have received up to now – especially with respect to food production – will no longer be the same.

1. Climate change impacts on land and risks to societal systems

As of 2015, roughly three-quarters of the total land area of the Earth have been used as residential, pasture and agricultural land, and only 28% of land remains untouched and "natural" (of which 12% is unusable for humans) [SPM Figure SPM 1].[3] During the 2006-2015 period, global mean land surface temperatures have risen by 1.53℃ from 1881-1990 levels [SPM A.2.1], and the effect of global warming on society is becoming apparent. Global warming affects processes related to desertification (water shortages in dry areas), land degradation (soil erosion, vegetation loss, forest fires, and the thawing of permafrost), and food security[4] (instability in tropical crop yields and food supply). As a result, changes in these processes become risks to social systems via food systems, livelihoods, land value, human and ecosystem health, and infrastructure (Figure 1) [SPM Figure SPM 2]. The effects of recent increases in temperature are already starting to be seen in all of these areas. Exceptionally, the thawing of permafrost and the decline of crop yields in the tropics are shown to be affected by lower increases in temperature. Even if warming is limited to 1.5℃, the food supply may still become unstable, causing a crisis in the global food system.

[1] IPCC: Intergovernmental Panel on Climate Change

[2] The report is also known as the IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystems.

[3] References point to the IPCC Special Report on Climate Change and Land. Here, "SPM" refers to the Summary for Policymakers for the report. The full report can be downloaded here: https://www.ipcc.ch/srccl-report-download-page/.

[4] Food security is defined as the state in which all people have access to sufficient, safe, and nutritious food in order to lead active and healthy lives.

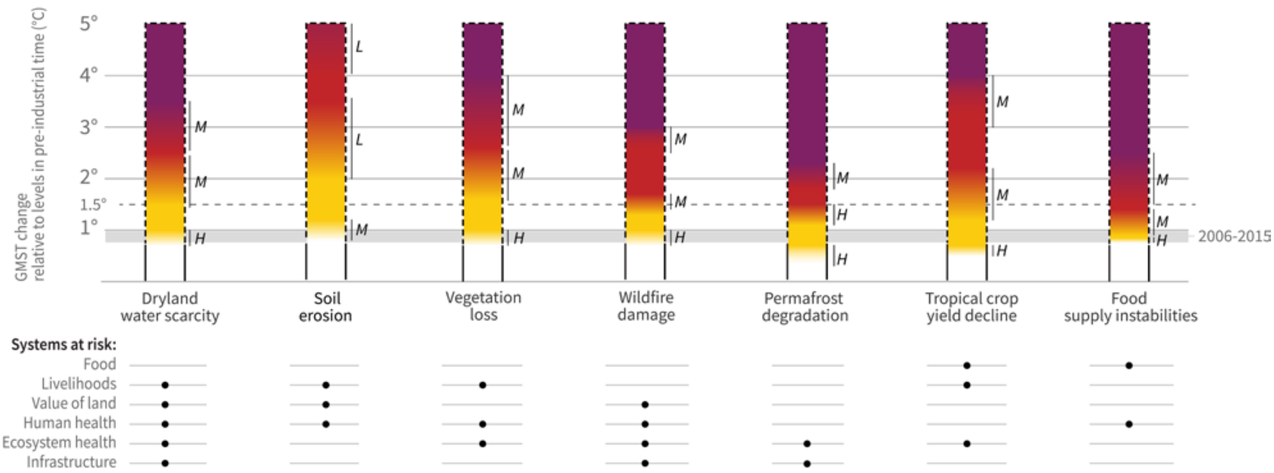

Figure 1: Risks to humans and ecosystems from changes in land-based processes as a result of climate change [SRCCL SPM Figure SPM 2A]
Global warming affects processes related to desertification (water shortages in dry areas), land degradation (soil erosion, vegetation loss, forest fires, and the thawing of permafrost), and food security (instability in tropical crop yields and food supply). Darker colours on the diagram at the top demonstrate greater magnitudes of effect. Changes in such processes will create risks for the food system, livelihoods, infrastructure, land value, and human and ecosystem health (● indicates which systems are at risk in the bottom schematic).

2. Countermeasures to address risks associated with the effect of climate change on land

With respect to countermeasures to address societal risks due to the effect of climate change on land, measures to counter desertification, land degradation, and food security issues (Figure 1) are necessary, on top of climate change mitigation to minimise climate change as well as adaptation actions.

2-1. Land-based climate change mitigation measures

The Agriculture, Forestry and Other Land Use (AFOLU) sectors emit approximately 12.0 GtCO2eq (including CO2, N2O, and CH4 from 2007-2016) of greenhouse gases (GHG) annually, which is equivalent to 22% of global emissions [SPM Table SPM.1]. The sector's high emissions rival those of the transportation and industrial sectors [SPM Table SPM.1]. At the same time, roughly 1.2t CO2 are being absorbed from the atmosphere per year, mainly by forests. The SRCCL also mentions the emissions of the food system in addition to the traditional AFOLU sector. When processing, transport and consumption are considered in addition to emissions directly associated with food production (agriculture and land use change due to agriculture), the food system emits roughly 14.8Gt CO2eq annually, equivalent to 21-37% of global GHG emissions [Table 5.4]. GHG emissions due to food loss (food lost from production to consumption, as well as food that has gone to waste) are estimated to be approximately 3.3Gt CO2eq per year, or 8% of the emissions of the food system [5.5.2.5]. Reducing food loss and changing dietary habits (e.g. reducing meat consumption) limit not only food system emissions, but also the expansion of agricultural and pasture land [SPM B6.2]. The IPCC may have decided to shed light on the food system because agriculture (food production and supply) is closely related to food demand, and it is important to take action, not only on the supply side but also on the demand side. Moreover, the food system is globalising and no longer bounded by national borders; thus, it is necessary to implement initiatives that lead to emissions reductions across the global value chain.

2-2. Co-benefits and trade-offs for measures in the land sector

The SRCCL emphasises that many land-related measures to counter climate change risks are able to contribute simultaneously to (i.e. have co-benefits with) food security, prevention of land degradation and desertification, and solutions to other environmental and social problems (Figure 2) [SPM Figure SPM.3]. Such initiatives can even contribute to sustainable development through poverty alleviation and resilience-building (Figure 2) [SPM Figure SPM.3]. For example, the SRCCL shows that increased food productivity has large-scale positive impacts on climate change mitigation, adaptation, prevention of desertification, prevention of land degradation and food security. Yet, measures that require more land can instigate competition with food production and have the potential to negatively impact food security. For instance, the promotion of biomass energy and afforestation are effective climate change mitigation measures. Diverting food to biomass energy and securing new land for biomass crop cultivation or afforestation can, however, destabilise food security. In order to implement large-scale initiatives in the land sector, trade-offs (for example, initiatives that are effective as climate change mitigation measures, but have the possibility of reducing food production) must be sufficiently considered, and measures to prevent such negative impacts are needed. The SRCCL claims that, to address such complex problems, rather than implementing a single policy (for instance, solely implementing a policy promoting biomass energy), it is prudent to take a holistic approach, consisting of a mix of policies that address the potential negative impacts (for example, the inclusion of food security policies when considering the promotion of biomass energy) [SPM C1.4]. The SRCCL argues that, in this way, such initiatives can contribute to building a sustainable, resilient social system [SPM C1.4].

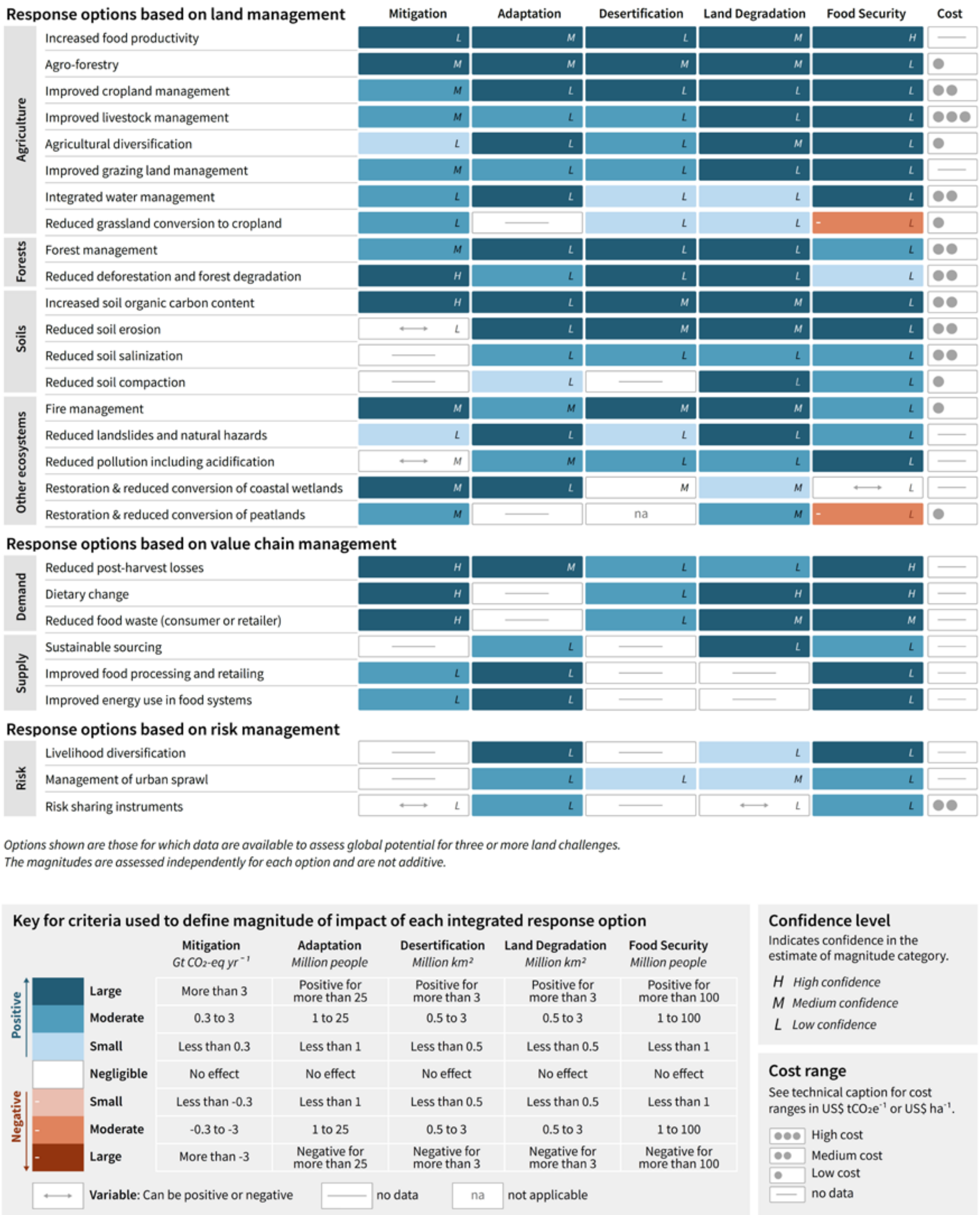

Figure 2: Co-benefits and trade-offs associated with land management options for climate change mitigation, adaptation, the prevention of desertification, the prevention of land degradation, and improvements in food security

Almost all measures will have co-benefits, but options that potentially cause competition for land may elicit trade-offs. [IPCC SRCCL SPM Figure SPM 3A]

3. Future land use management that is essential to limit warming to 1.5℃

3-1. The importance of the land sector, as demonstrated in the IPCC Special Report on Global Warming of 1.5℃

The highlight of the SRCCL is that it illustrated predictions of future land use if climate change mitigation measures necessary to limit global warming to 1.5℃ are implemented. According to the IPCC Special Report on Global Warming of Global Warming of 1.5℃[5] (SR1.5), the GHG emission reduction pathway to limit warming to 1.5℃ in 2100 differs depending on society's shared socioeconomic pathway (SSP[6]) as well as the degree of contributions from the land sector (Figure 3, top). For all three SSPs, significant emission reductions in sectors using fossil fuels will not be sufficient to limit global warming. On top of such efforts, carbon dioxide removal (CDR) technology will be necessary to remove large amounts of CO2 from the atmosphere. In other words, in combination with large emission reductions in the AFOLU sectors, it is expected that the carbon fixation capabilities of forests will be put to full use to function as CDR. Moreover, it was shown that removing CO2 from the atmosphere via bioenergy with carbon capture and storage (BECCS)[7] technology will be necessary. While even the sustainability-focused scenario (SSP1) requires that forests and BECCS absorb and fix atmospheric carbon, the dependence on these two CDR methods is colossal under the resource-intensive scenario (SSP5), in which the world continues to escalate fossil fuel use.

3-2. Future land use to limit warming to 1.5℃

This report demonstrates the changes in future land use resulting from the various mitigation measures implemented to limit warming to 1.5℃ under each SSP scenario (Figure 3, bottom) [SPM Figure SPM.3]. As a result, for all SSPs, if warming were to be limited to 1.5℃, forest area and land for biomass fuel production will each need to be increased by 4-7 million km2. For reference, Australia's landmass is approximately 7.7 million km2. Furthermore, to secure this land, agricultural land and pastures (land used to produce livestock feed) will need to be

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[5] https://www.ipcc.ch/sr15/

[6] SSPs (Shared Socioeconomic Pathways): five pathways based on scenarios of socioeconomic development up to 2100. Used initially in the IPCC report, the SSPs are now used for predictions in various fields. Figure 3 illustrates the following three pathways.

SSP1: assumes a sustainability-focused society with rising incomes, less inequality, and free trade for the global population (set at 7 billion people in 2100).

SSP2: assumes a world of 9 billion people in 2100 who are predominantly middle income and maintains the status quo for technological development, production, and consumption patterns.

SSP5: assumes a world of 7 billion people in 2100 with rising incomes and narrowing inequality, free trade, and resource-intensive production, consumption, and lifestyles.

[7] Bioenergy with Carbon Capture and Storage (BECCS): Since atmospheric CO2 is sequestered by biomass crops when they are being grown, the CO2 released when biomass fuel is combusted is offset; thus, biomass energy can be considered a net zero source (zero emissions). If carbon capture and storage (CCS) technology is combined with the use of biomass energy, CO2 can be sequestered from the atmosphere during the use of biomass energy, so BECCS can result in negative emissions.

greatly reduced. However, the process differs depending on the scenario. Less agricultural land will be needed to meet the demands of a society under SSP1 (which takes a circular approach to resources, reduces fossil fuel-based emissions, and prioritises sustainability in land management, agricultural intensification, production and consumption), even if the global population and per capita food consumption were to increase. The newly available land under SSP1 can be used for forestry and biomass fuel production. On the other hand, to limit warming to 1.5℃ in a resource-intensive, fossil fuel-based society (SSP5), it would be necessary to rapidly implement BECCS from around 2030, and on top of this, land area for biomass crop cultivation must be expanded. Meanwhile, agricultural and pasture land will continue to be needed to secure enough food. As a result, what little natural vegetation is left will be further depleted, and there will be competition for land used for climate action. and agricultural and pasture land for food production. Because of this, there is potential for land value and food prices to skyrocket.

4. Conclusion

By focusing solely on mitigating climate change and limiting global warming to 1.5℃ when facing decisions about future land use, we may be forced to choose between climate change mitigation and food security. However, human civilisation is built on the “blessings of the Earth” and, when thinking about sustainable development, it is not realistic to sacrifice food security. Such conundrums must be avoided. The SRCCL emphasises that, to achieve this, all sectors must first implement measures to substantially reduce GHGs [SPM D.3]. In so doing, the impacts of climate change on food systems and, moreover, its adverse impacts on sustainable development can be minimised. Furthermore, while it is necessary to implement AFOLU-associated countermeasures, as we think about our options we need to consider how to create co-benefits for the sustainable development of society and how to contribute to poverty alleviation [SPM D.2]. In other words, rather than only considering short-term GHG reductions—the result of climate change mitigation—we must cultivate a more long-term perspective, thinking about the co-benefits and trade-offs of climate initiatives with fields related to the SDGs[8]. Climate action, therefore, must be taken in combination with work done in poverty alleviation, food security, health, education, and other areas related to the sustainable development of civilisation.

[8] SDGs: The Sustainable Development Goals

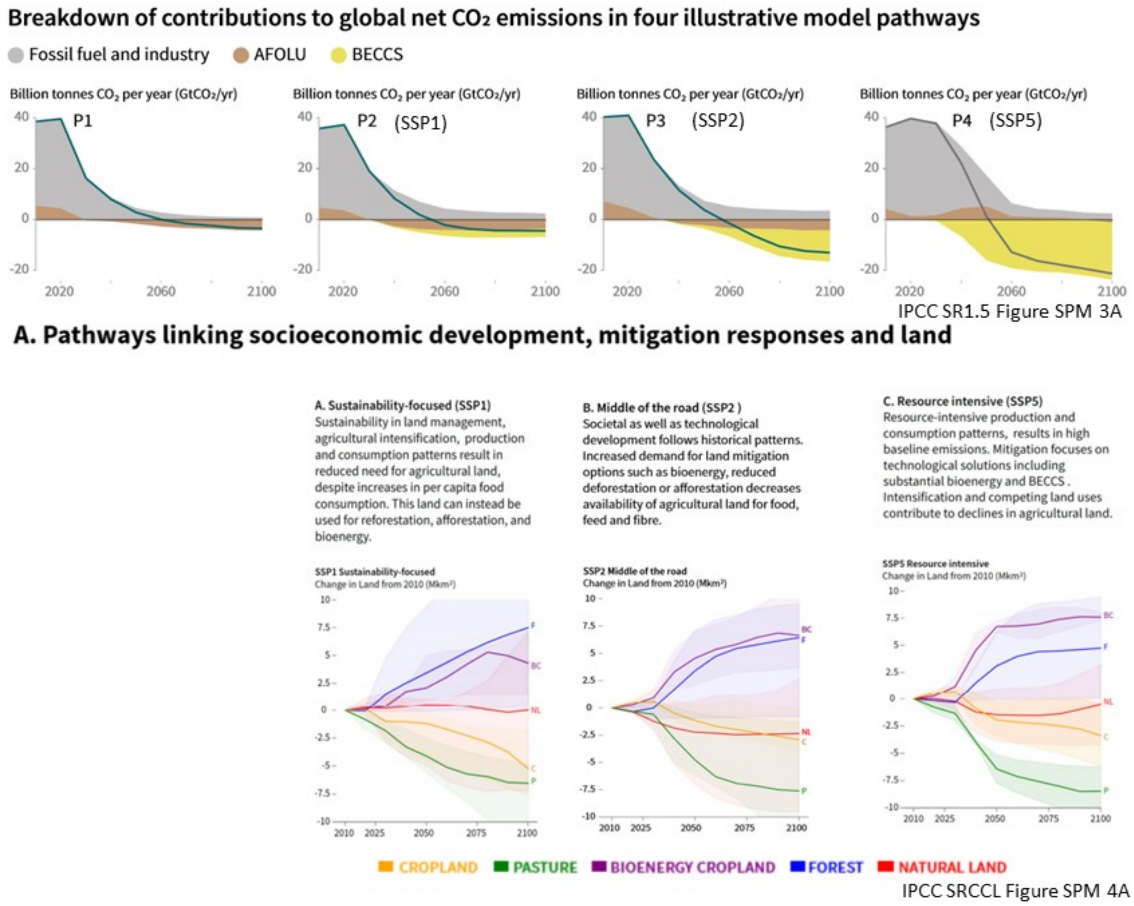

Figure 3

Top: Emission pathways to limit warming to 1.5℃

The figure shows the emission reduction pathways to limiting global warming to 1.5℃ for each shared socioeconomic pathway (SSP). It demonstrates expected emission reductions and CO2 absorption of AFOLU and BECCS. (Adapted from IPCC SR1.5℃ SPM Figure SPM 3)

Bottom: Future land use change necessary for both climate change mitigation and socioeconomic development

The figure shows future land use change after mitigation actions are taken to limit global warming to 1.5℃ (as seen in Figure 3, top) under each SSP. Land area used to absorb CO2 (Forestry and biomass energy crop cultivation) will need to be substantially expanded. (Adapted from IPCC SRCCL SPM Figure SPM 4)

Institute for Global Environmental Strategies (IGES)
Strategic Management Office (SMO)
2108-11 Kamiyamaguchi, Hayama, Kanagawa, 240-0115, Japan
Tel: 046-826-9601 Fax: 046-855-3809 E-mail: iges@iges.or.jp
www.iges.or.jp