Summary report on the SBSTA–IPCC special event: Unpacking the new scientific knowledge and key findings in the IPCC Special Report on Climate Change and Land

Madrid, Spain, 4 December 2019

Note by the Chairs of the SBSTA and the IPCC

30 April 2020

Contents

I. Introduction

A. Background

1. The Intergovernmental Panel on Climate Change (IPCC) adopted a special report on *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in c* (SRCCL) at its fiftieth Session held on 2–7 August 2019 in Geneva. The SRCCL's Summary for Policymakers (SPM) was approved by the IPCC plenary on 6 August 2019.[1]

2. The special report was prepared under the joint scientific leadership of IPCC Working Groups I, II, III and the Task Force on National Greenhouse Gas Inventories and supported by the WG III Technical Support Unit.

3. The SRCCL was prepared by 107 experts from 52 countries serving as Coordinating Lead Authors, Lead Authors and Review Editors ensured that comments by experts and governments were given appropriate consideration. For the first time, more authors (53 per cent) of an IPCC report were from developing than developed countries. 40 per cent of the coordinating lead authors were women. The SRCCL assessed over 7,000 scientific publications and received more than 28,000 comments from expert reviewers and governments.

B. General objective and approach for the special event

4. The joint SBSTA-IPCC special event on the SRCCL was organized by Mr. Paul Watkinson, the Chair of the Subsidiary Body for Scientific and Technological Advice (SBSTA), and Mr. Hoesung Lee, the Chair of the IPCC. The event was organized to present new scientific concepts and the global contribution of integrated response options to mitigation, adaptation, combating desertification and land degradation and enhancing food security, to help all participants have a better understanding of its main findings, including some of the data behind the key findings drawing on information in the report. In return, it was expected that the special event would assist the IPCC and the scientific community in identifying areas of interest to policymakers to be further developed in future IPCC products.

5. In the lead up to the special event, the Chairs of the SBSTA and the IPCC issued an information note[2] which provided background information on the SRCCL and proposed an approach for the special event, including guiding questions for participants and presenters to consider when preparing for the event.

6. The agenda of the special event was structured as follows based on the four sections of the SPM:

(a) Land, people and climate change (section A);

(b) Adaptation and mitigation response options (section B);

(c) Enabling response options (section C) *and* actions in the near-term (section D).

II. Summary of proceedings of the special event

7. The special event was held on 4 December 2019 (15:00–18:00 p.m.) at the Plenary LOA, IFEMA Conference Centre in Madrid, Spain, and was jointly chaired by the SBSTA and IPCC Chairs. It was open to all registered participants and, to increase accessibility, the event was available by webcast.[3]

8. Co-Chairs from all three IPCC Working Groups (WGs) gave presentations on the findings of the special report, informed by guiding questions. Each round of presentations was followed by question and answer discussions, which saw the participation of IPCC experts on relevant topics who complemented responses provided by the WG Co-Chairs and/or responded to specific questions posed by participants.

9. The special event opened with a video entitled "**It Is at Risk**" which underscored the importance of land to humanity, including as **a home, source of nutrition, protection and amusement**. It further emphasized the fact that land was at risk due to how humans through energy use and the ways they lived and produced food were affecting the global climate. The video stressed that the land surface was warming faster than the globe on average and further emphasized that every degree of warming mattered and that there was a need to reduce the impacts of climate change.

1 See https://www.ipcc.ch/event/50th-session-of-the-ipcc/.
2 Available at https://unfccc.int/sites/default/files/resource/SRCCL_InfoNote_SBSTA_IPCC_6Nov2019.pdf.
3 The webcast can be viewed at https://unfccc-cop25.streamworld.de/webcast/joint-sbsta-ipcc-special-event-special-report-on-c.

10. It summarized the findings of the SRCCL stating that global warming can be limited, and climate change impacts reduced and that the report explored **how the use of land was contributing to climate change and how climate change was affecting land**. Furthermore, it stated that the special report was one of the most comprehensive records on the interactions between climate change and land, noted that the use of land today will affect the Earth's climate for future generations and summarised the challenges faced, ranging from maintaining a balanced Earth climate to those related to food security.

11. Mr. Paul Watkinson welcomed all participants and, on behalf of the SBSTA, conveyed his gratitude to the IPCC and commended the Panel for having continuously served as a trusted provider of the best available science to the UNFCCC process.

12. Mr. Watkinson presented the proposed approach for the organization of work, including the order in which presentations on the various sections of the report will be given, and informed participants that each round of presentations would be followed by question and answer discussions.

13. The UNFCCC Executive Secretary, Ms. Patricia Espinosa, congratulated and thanked the IPCC, the scientists and all involved in the production of the special report. She highlighted and praised the fact that, **for the first time, more authors of an IPCC report were from developing than developed countries, and 40 per cent of the Coordinating Lead Authors were women**. She noted that the results of the SRCCL were relevant to all three Rio Conventions (UNFCCC, the Convention on Biodiversity and the Convention to Combat Desertification) and that the report was another confirmation of the importance of science in the UNFCCC process and the collective efforts to address climate change.

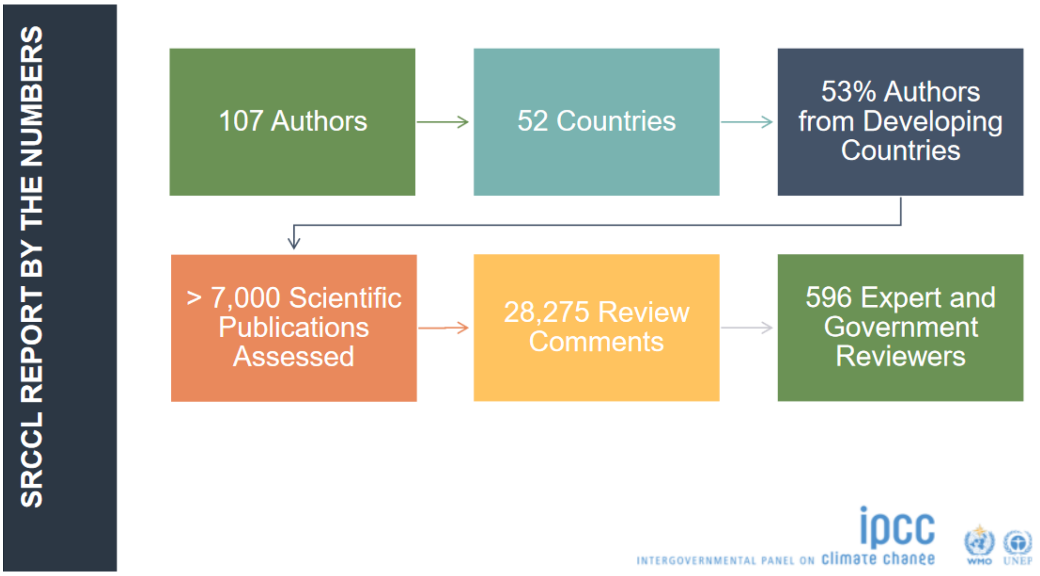
14. Ms. Espinosa emphasized that **science must remain central and paramount to the work of the UNFCCC** and that the process must continue to be guided by facts and the facts in this and previous IPCC reports have consistently showed that humans were severely impacting the very support systems that sustained life on Earth. To change this, she recommended starting by **enhancing understanding of the relationship between climate change and land**, including how climate change is increasing stress upon land and how the use of land is contributing to and can help address climate change. Furthermore, she proposed looking more closely at how fighting climate change can, at the same time, strengthen efforts to address desertification, as well as enhance biospheres. She encouraged participants to reflect on how policies, institutions and governance systems at all scales could be designed to contribute to land-related climate change adaptation and mitigation actions.

15. Ms. Espinosa further stated that the SRCCL provided the best available scientific basis for relevant work under the UNFCCC process, for which land is a vital sector as demonstrated by Parties through the **inclusion of land-based solutions for addressing climate change in most Nationally Determined Contributions (NDCs) under the Paris Agreement.** In conclusion, she stated that the SRCCL was timely and its content would allow Parties to draw from it with respect to updating and communicating their NDCs for the 2020 deadline and urged Parties to take adequate and timely actions based on the findings of the report as there was no time to waste.

16. Mr. Hoesung Lee indicated that the SRCCL was the result of two years of intensive work that explored how using land contributed to climate change and how climate change affected land.

17. Using the visual in Figure 1 below, Mr. Lee shared with participants the number of actors who contributed to the preparation of the SRCCL, as well as the number of publications assessed, and comments received during its preparation (also see paragraph 3 above).

Figure 1
Number of actors who contributed to the preparation of the report, number of publications assessed, and the number of comments considered

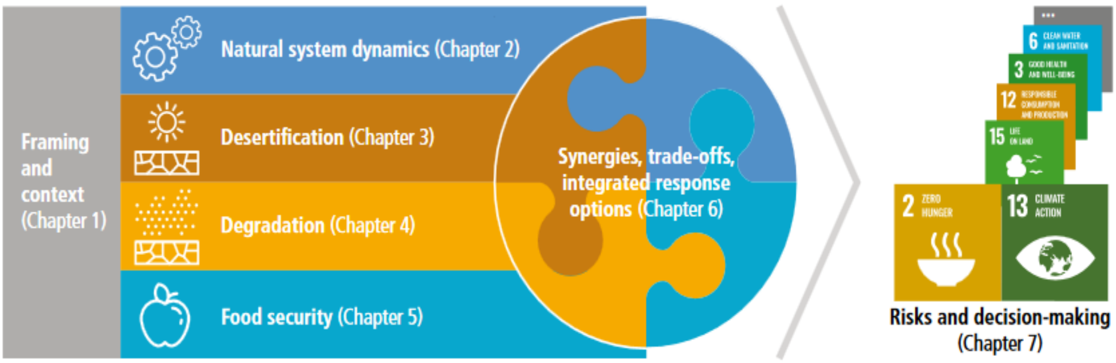


Source: Presented by Mr. Hoesung Lee at the SBSTA-IPCC special event on unpacking the new scientific knowledge and key findings in the IPCC Special Report on Climate Change and Land in the presentation "Remarks by the IPCC Chair".[4]

18. Mr. Lee stated that, consistent with all IPCC products, the preparation of the SRCCL was rigorous, open and a multi-step process. To determine what the SRCCL should address, the Panel began with the consolidation of six land-related proposals from member states and observer organizations that were made at the start of the 6th Assessment Cycle. To avoid duplication of work with other intergovernmental bodies, the IPCC held three web-based consultations with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Food and Agriculture Organization (FAO) and UNCCD prior to the scoping meeting of the SRCCL and decided to focus the SRCCL on the land and climate change nexus.

19. The IPCC Chair introduced the structure of the SRCCL (Figure 2), as well as that of its SPM (see paragraph 6 above).

Figure 2
Overview of the SRCCL



Source: IPCC, 2019: IPCC Special Report on Climate Change and Land, Chapter 1, Figure 1.2.

[4] Available at: https://unfccc.int/sites/default/files/resource/1.%20COP25_Special%20Event%20for%20the%20Special%20Report%20on%20Climate%20Change%20and%20Land%20Introduction.pdf.

20. Mr. Lee summarized the key findings of the SRCCL using the following words: "**land is under growing human pressure**;" "**land is part of the solution**;" and "**land cannot do it all.**" He recalled that, consistent with previous IPCC reports, this report confirmed the need for immediate reduction of GHG emissions and that failing to do so would mean a further degradation of land resulting in increased threat to food security, biodiversity and ecosystem services. He emphasized that a lack of success in the immediate reduction of GHG emissions would leave very little room for ecosystem-based adaptation and sustainable land management as relevant adaptation options were only effective under low emission pathways.

III. Summary of the presentations and discussion

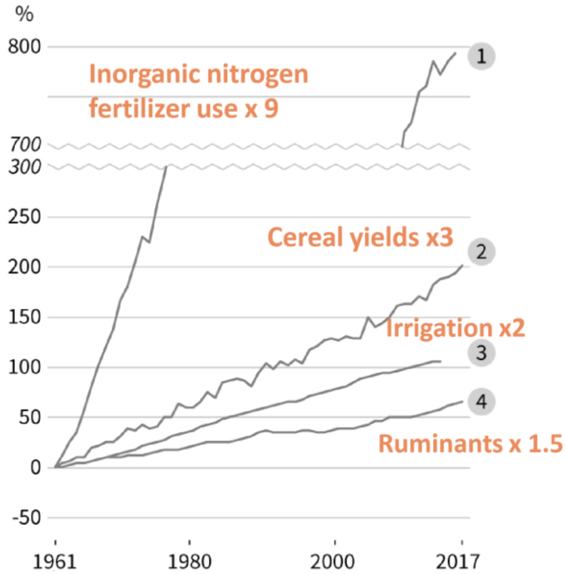
A. Presentations by experts to unpack the new scientific knowledge and key findings

1. Land, people and climate change

21. Ms. Valérie Masson-Delmotte, the IPCC Co-Chair of WG I, began by stating that **land in the SRCCL refers to soil, vegetation and other living organisms, water, as well as our settlements and infrastructures**. She stressed that land was under growing human pressure with unprecedented rates of land, and freshwater use and that climate change was adding to these pressures. Human use had directly affected more than 70% of the global ice-free land surface. People currently used one quarter to one third of ice-free land's potential net primary production[5] for food, feed, fibre, timber and energy. These uses have resulted in a loss of natural ecosystems (e.g. forests, savannahs, natural grasslands and wetlands) and declining biodiversity.

22. **About a quarter of the Earth's ice-free land area is subjected to human-induced degradation**. Soil erosion from agricultural fields is estimated to be one or two orders of magnitude higher than the soil formation rate. Ms. Masson-Delmotte stated that since 1961 global population growth and changes in per capita consumption of food, feed, fibre, timber and energy have caused unprecedented rates of land and freshwater use. Since 1961, the total number of ruminant livestock has increased by more than 50%. Cereal yields have doubled, the use of inorganic nitrogen fertilizer has increased by nearly nine-fold and the use of irrigation water has doubled (figure 3).

Figure 3
Percentage change relative to 1961 for inorganic nitrogen fertilizer use, cereal yields, irrigation water volume and total number of ruminant livestock

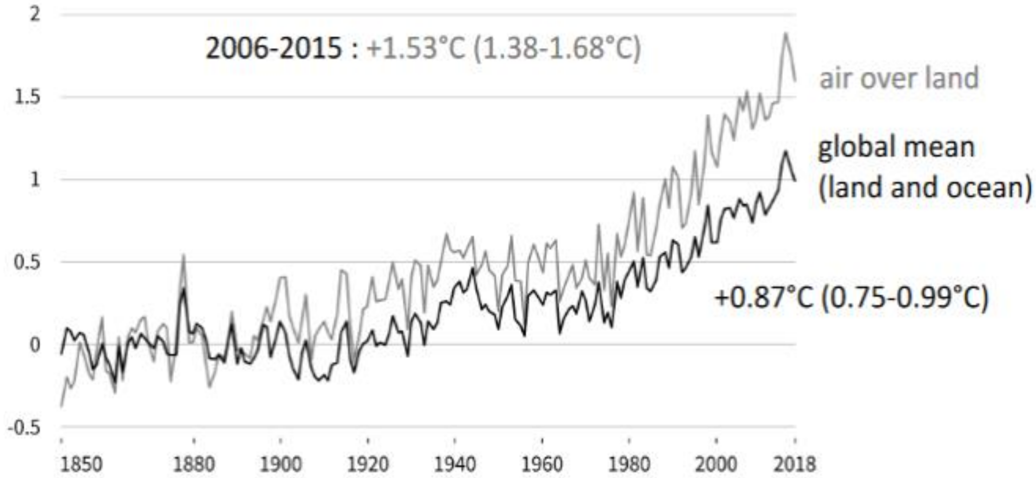


Source: Modified from IPCC, 2019: IPCC Special Report on Climate Change and Land, Chapter 1, Figure 1.1 D. Land use change and rapid land use intensification have supported the increasing production of food, feed and fibre. Since 1961, the total production of food (cereal crops) has increased by 240% (until 2017) because of land area expansion and increasing yields. Fibre production (cotton) increased by 162% (until 2013).

[5] The difference between the amount of carbon accumulated through photosynthesis and lost by plant respiration, in the absence of land use.

23. Ms. Masson-Delmotte underscored that since the pre-industrial period (1850–1900), the observed **mean land surface air temperature has risen considerably (1.53°C) more than the global mean surface (land and ocean) temperature (0.87°C) (**figure 4). She noted that warming has resulted in increased frequency, intensity and duration of heat related events, including heat waves in most land regions. The frequency and intensity of droughts has increased in some regions, including the Mediterranean, West Asia, many parts of South America, much of Africa, and North-Eastern Asia, and there has been an increase in the intensity of heavy precipitation events at a global scale.

Figure 4
Temperature change at the Earth's surface since 1850 to 1900



Source: Modified from IPCC, 2019: IPCC Special Report on Climate Change and Land, Chapter 2, Figure 2.2, Evolution of land surface air temperature (LSAT) and global mean surface temperature (GMST) over the period of instrumental observations. The grey line shows annual mean LSAT in the BEST, CRUTEM4.6, GHCNmv4 and GISTEMP datasets, expressed as departures from global average LSAT in 1850–1900. The black line shows annual mean GMST in the HadCRUT4, NOAA Global Temp, GISTEMP and Cowtan&Way datasets. (monthly values of which were reported in the Special Report on Global Warming of 1.5°C; Allen et al. 2018).

24. Furthermore, global warming has led to shifts of climate zones in many world regions, including expansion of arid climate zones and contraction of polar climate zones resulting in **many plant and animal species experiencing changes in their ranges, abundances, and shifts in their seasonal activities**. **Vegetation greening** is observed by satellites over the last three decades in parts of Asia, Europe, South America, central North America, and South East Australia caused by a combination of an extended growing season, nitrogen deposition, CO_2 fertilization, and land management. On the other hand, **vegetation browning** has been observed in some regions including Northern Eurasia, parts of North America, Central Asia and the Congo Basin, largely as a result of water stress. She concluded that, globally, **vegetation greening has occurred over a larger area than vegetation browning**.

25. In some dryland areas, increased land surface air temperature and evapotranspiration, and decreased precipitation amount, in interaction with climate variability and human activities, has contributed to **desertification**, including in sub-Saharan Africa, parts of East and Central Asia, and Australia. Since 1961, the annual area of drylands in drought has increased, on average, by slightly more than 1% per year, with large inter-annual variability. About **500 million people are living within areas which experienced desertification between the 1980s and 2000s** with the highest numbers of people affected in South and East Asia, around the Sahara, including North Africa and the Middle East (including the Arabian Peninsula).

26. Ms. Masson-Delmotte further stated that the frequency and intensity of **dust storms** has increased over the last few decades due to land use and land cover changes and climate-related factors in many dryland areas resulting in increasing negative impacts on human health in regions such as the Arabian Peninsula and broader Middle East, as well as Central Asia. Climate change has exacerbated **land degradation**, particularly in low-lying coastal areas, river deltas, drylands and in permafrost areas due to changes in rainfall intensity, heat and water stress, permafrost thaw, coastal erosion and sea level rise.

27. The **food system** is under pressure due to population growth, changes in consumption patterns and its vulnerability to climate change. Data since 1961 shows that **per capita supply of vegetable oils and meat has more than doubled** and the **supply of food calories per capita has increased by about a third**. While about **821 million people are still undernourished**, **25–30% of total food produced is lost or wasted**. Also, changes in consumption patterns have contributed to about two billion adults being overweight or obese.

28. **Climate change has already affected food security** due to warming, changes in precipitation patterns, and greater frequency of some extreme events. While the yields of some crops (e.g., maize and wheat) in many lower-latitude regions have declined over recent decades, they have increased in many higher-latitude regions. Climate change has resulted in lower **animal growth rates and productivity** in pastoral systems in Africa. There is evidence that **agricultural pests and diseases have already responded to climate change**. Based on indigenous and local knowledge, climate change is affecting food security in drylands, particularly those in Africa, and high mountain regions of Asia and South America.

29. Land plays a key role in the global climate system and changes in land conditions affect global and regional climate through sources and sinks of GHGs, energy, water and aerosols between the land surface and atmosphere. Data shows that **Agriculture, Forestry and Other Land Use (AFOLU) activities account for around 23% of total net anthropogenic GHGs** or 12 +/– 3 $GtCO_2e$ per year during 2007–2016.

30. If emissions associated with pre- and post-production activities in the global food system are included, they would be estimated to be 21–37% of total net anthropogenic GHG emissions. A breakdown by annual GHGs per year from 2007–2016 shows that:

(a) **13% of global net CO_2 emissions** (5.2 ± 2.6 $GtCO_2$) were from land use and land-use change, which were mostly due to deforestation and these were partly offset by afforestation/reforestation. There was no clear trend in annual emissions since 1990;
(b) **CH_4 emissions constituted 44%** with ruminants and the expansion of rice cultivation being important contributors;
(c) N_2O emissions from the sector were rising and represented **82% of total N_2O emissions**. Anthropogenic N_2O emissions from soils are primarily due to nitrogen application, with some over-application or poorly synchronized with crop demand timings. There was growth in emissions from managed pastures due to increased manure deposition, and, in 2014, livestock on managed pastures and rangelands accounted for more than half of total anthropogenic N_2O emissions.

31. Furthermore, emissions from agricultural production are projected to increase, driven by population and income growth, and changes in consumption patterns. The natural response of land to human-induced environmental changes result in changes of global net removals of CO_2. Data shows that increasing atmospheric CO_2 concentration, nitrogen deposition, and climate change, account for 29% of total CO_2 emissions (global net removals of 11.2 +/– 2.6 Gt CO_2 per year) during 2007–2016. The sum of net removals resulting from the response and AFOLU net emissions account for a total net land-atmosphere flux removal of 6.0 +/– 2.6 $GtCO_2$ per year during this period.

32. Ms. Masson-Delmotte concluded that **land is simultaneously a source and a sink of CO_2** due to both anthropogenic and natural drivers, which have made it difficult to separate anthropogenic from natural fluxes. **Global models and national GHG inventories use different methods** to estimate anthropogenic CO_2 emissions and removals for the land sector and both produce estimates that are in close agreement for land-use change involving forest (e.g., deforestation, afforestation), but differ for managed forest. She explained that, for example, global models consider as managed forest those lands that are subjected to harvest whereas national inventories define managed forest more broadly.

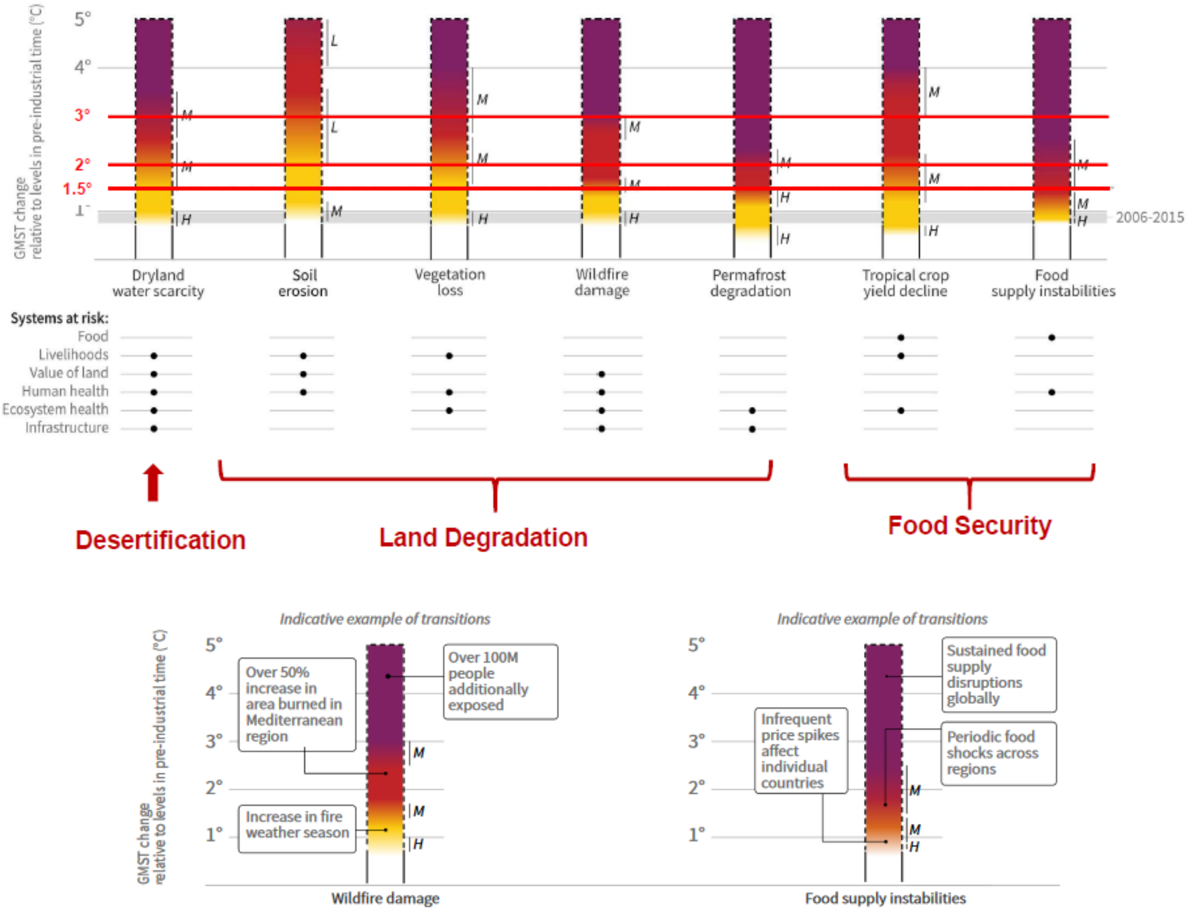
33. Future net increases in CO_2 emissions from vegetation and soils due to climate change are projected to counteract increased removals from CO_2 fertilization and longer growing seasons. The balance between these processes is a key source of uncertainty for determining the future of the land carbon sink. Projected **thawing of permafrost** is expected to increase the loss of soil carbon and, during the 21st century, vegetation growth in those areas may compensate in part for this loss.

34. Mr. Hans-Otto Pörtner, the IPCC Co-Chair of WG II, then presented on risk assessments in the SRCCL examining a range of sectors in terms of how they are changing with global mean surface temperature. As shown in figure 5.a below, at around:

(a) 1.5 °C of global warming, the risks from dryland water scarcity, wildfire damage, permafrost degradation and food supply instabilities were projected to be high;
(b) 2 °C of global warming, the risk from permafrost degradation and food supply instabilities were projected to be very high;
(c) 3 °C of global warming, risk from vegetation loss, wildfire damage, and dryland water scarcity were also projected to be very high.

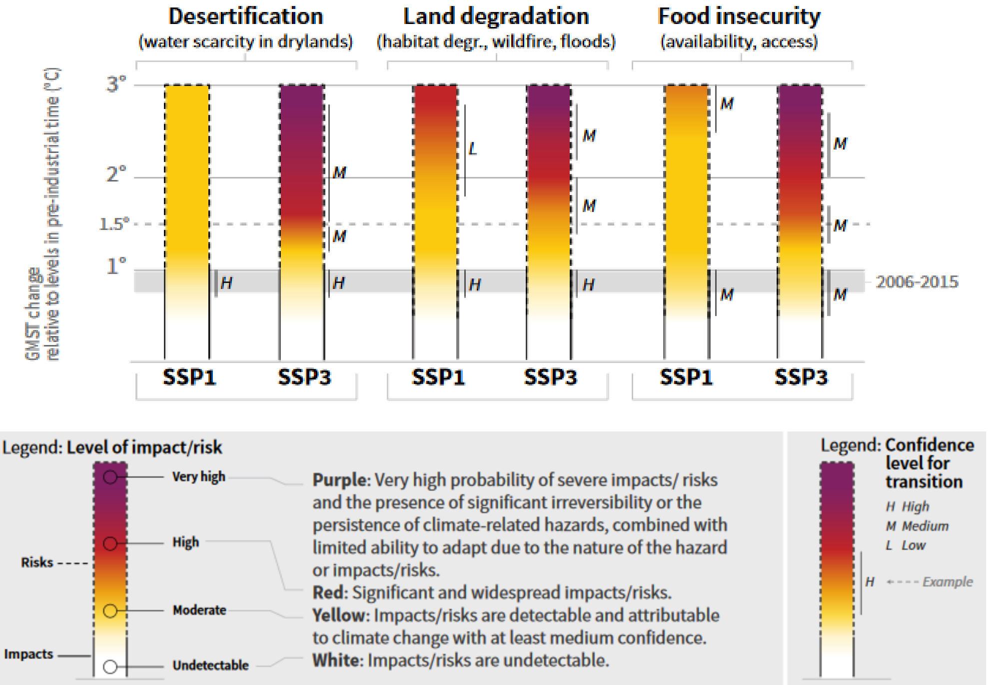
35. Furthermore, risks associated to drought, water stress, heat related events, such as heat waves and habitat degradation simultaneously increased between 1.5 °C and 3 °C of global warming. Under the second shared socio-economic pathway (SSP2), dryland population vulnerable to water stress, drought intensity and habitat degradation is projected to reach 178 million at 1.5 °C, 220 million at 2 °C and 277 million at 3 °C of global warming by 2050.

Figure 5.a
Risks to humans and ecosystems from changes in land-based processes as a result of climate change



Source: IPCC, 2019: Summary for Policymakers, IPCC Special Report on Climate Change and Land, Figure SPM. 2.

Figure 5.b
Different shared socio-economic pathways affect levels of climate related risks



Source: IPCC, 2019: Summary for Policymakers, IPCC Special Report on Climate Change and Land, Figure SPM 2.

36. At the same temperature, the **level of risk is determined by the developmental path chosen**. Mr. Pörtner explained that for SSP1, there is low population growth, reduced inequalities, low emission production systems, efficient use of land, increased capacity for adaptation. In the case of SSP3, there is a scenario with high population growth, increased demand and inequality, multiple pressures on land, low capacity of adaptation (figure 5.b).

37. The **stability of food supply** is projected to decrease as the magnitude and frequency of extreme weather events that disrupt food chains increase. The most vulnerable people will be more severely affected, and, in drylands, climate change and desertification are projected to cause reductions in crop and livestock productivity, modify the plant species mix and reduce biodiversity.

38. The level of risk posed by climate change depends on the level of warming and on how population, consumption, production, technological development, and land management production patterns evolve. SSPs with increases in population and income will result in increased demand for food, feed, and water by 2050 in all SSPs. Together with resource-intensive consumption and production, and limited technological improvements in agriculture yields result in higher risks from water scarcity and food insecurity. These changes, combined with land management practices, have implications for terrestrial GHG emissions, carbon sequestration potential and biodiversity.

39. Furthermore, risks related to climate change driven **land degradation** are higher in SSPs with low adaptive capacity and other barriers to adaptation and those related to food security are greater in pathways with lower income, increased food demand and prices resulting from e.g., competition for land and limited trade.

40. In concluding, Mr. Pörtner stressed that urban expansion is projected to lead to conversion of cropland resulting in losses in food production and that this can create additional risks to the food system.

2. Summary of discussions on land, people and climate change

41. A participant sought to know what the **effects of climate change on biodiversity and related ecosystem services** were, given that geographic shifts of flora and fauna were being observed. An expert responded that there were very singular reports and evidences that species will go extinct under climate change, but climate change is affecting the abundance and the productivity of species.

42. In responding to a question about which **regions would be most vulnerable to sustained food supply disruptions**, and which would be most limited in their ability to adapt, an expert identified Asia and Africa as projected to have the highest number of people exposed to increased desertification. The expert further stated that the sub-tropics are projected to be the most vulnerable to crop yield decline, and wildfires are projected to occur in higher frequency in food producing areas in South America.

43. When asked whether the report addressed the **consequences of delayed climate actions to land**, an expert stated that the report flagged implications and response options associated with enhancing soil carbon storage, challenges associated with the sustainability of land carbon sinks, both in agricultural soils and in other ecosystems, including permafrost areas.

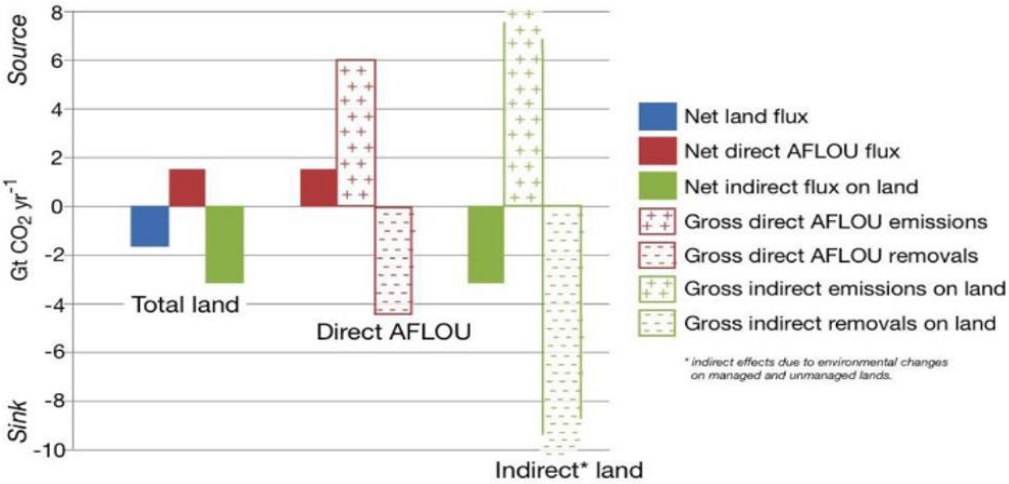
44. A participant sought to know if there was evidence showing that **loss and damage** was already occurring and an expert identified the challenge of expanding desertification and loss of land available for agriculture, including salinization effects in the small island States. The expert further stated that Table SM 5.3 in the supplementary material of Chapter 5 lists observed climate change impacts on crop productions fully traceable to data source publications and detection and attribution methods.

3. Adaptation and mitigation response options

45. Mr. Panmao Zhai, the IPCC Co-Chair of WG I, also noted that land can be simultaneously a source of GHG emissions and a sink for CO_2 and illustrated scenarios in which land can be a net sink or a net source (figure 6). The land and emissions relationship can be used to find mitigation adaptation and land degradation solutions. Degraded land reduces its soil's ability to take up CO_2 and exacerbates climate change and, in return, climate change has the potential to exacerbate land degradation.

46. Deforestation and destruction of peatland directly contribute to 10–15% of anthropogenic CO_2 emissions. Choices made about sustainable land management can help reduce and, in some cases, reverse adverse impacts of climate change.

Figure 6
Land is simultaneously a source and a sink of CO_2



Source: Presented by Mr. Panmao Zhai on the SBSTA-IPCC special event on unpacking the new scientific knowledge and key findings in the IPCC Special Report on Climate Change and Land in the presentation "Land, people and climate change".[6]

47. **Reducing food losses and wastes** would translate to a reduction in GHG emissions and improved food security. For example, about 41% of human-caused methane emissions come from ruminant livestock and from paddy fields, which implies dietary changes can both reduce pressure on land and reduce emissions.

48. Citing the examples of China and Africa, Mr. Zhai stated that **many land-based responses can contribute to climate change adaptation and mitigation, help combat desertification and land degradation, as well as enhance food security**.

49. The SRCCL identifies **40 response options** for the land sector with most having multiple consequences for adaptation, mitigation, desertification, land degradation or food security. Three types of classifications were used:

(a) Whether the response options involve the management of land directly, management of the value chain that brings land-based products to consumers, or management of the wider risks faced by farmers and others;
(b) Based on the magnitude of their technical mitigation potential at the global level;
(c) According to their impact on competition for land.

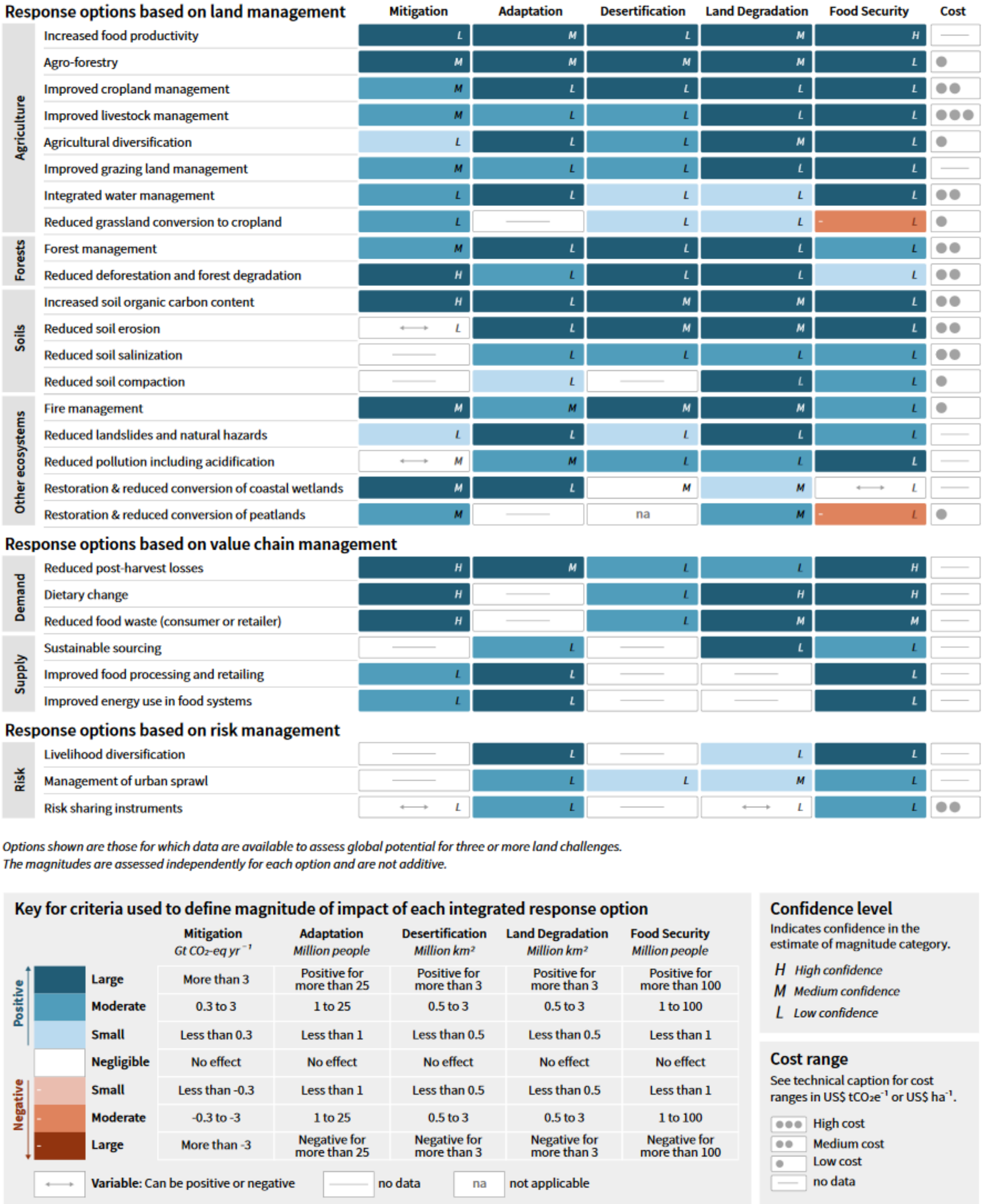
50. Mr. Zhai provided the following takeaway messages based on figure 7.a below:

(a) Twenty-eight different response options can be implemented with limited or no competition for land;
(b) Almost all response options have a positive effect on mitigation, adaptation, desertification, land degradation and food security;
(c) The potentials for land-related responses and relative emphasis on adaptation and mitigation is context specific, including the adaptive capacity of communities and regions. While some response options had immediate impact, others took decades to deliver measurable results;
(d) The successful implementation of response options depends on consideration of local environment and socio-economic conditions;
(e) Eight response options are from an agriculture perspective and eleven from a forest, soils and other ecosystems perspective. Most above land-related options have a positive effect and co-benefits, except food security under the option of restoration & reduced conversion of peatlands;
(f) Nine response options are based on value chain and risk management. All of these have a positive impact and many co-benefits for mitigation and adaptation for climate change, combating desertification and land degradation and enhancing food security.

[6] Available at: https://unfccc.int/sites/default/files/resource/3.%20COP25_Special%20Event%20for%20the%20Special%20Report%20on%20Climate%20Change%20and%20Land-%20Adaptation%20and%20mitigation%20response%20options.pdf.

Figure 7.a

Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and enhancing food security



Source: IPCC, 2019: Summary for Policymakers, IPCC Special Report on Climate Change and Land, figure SPM.3 Panel A.

51. Mr. Jim Skea, IPCC Co-Chair of Working Group III, focused his presentation on four land-based mitigation and adaptation response options with high mitigation potential, that involve land use change, including **bioenergy and bioenergy with carbon capture and storage (BECCS), reforestation and forest restoration, afforestation, and biochar addition to soil**. For each of these options, the impacts are evaluated at two different levels of deployments: a high level of deployment consistent with the higher ranges coming out of many of the global models and a more modest level of deployment, including the assumption that land was managed sustainably (figure 7.b). For the:

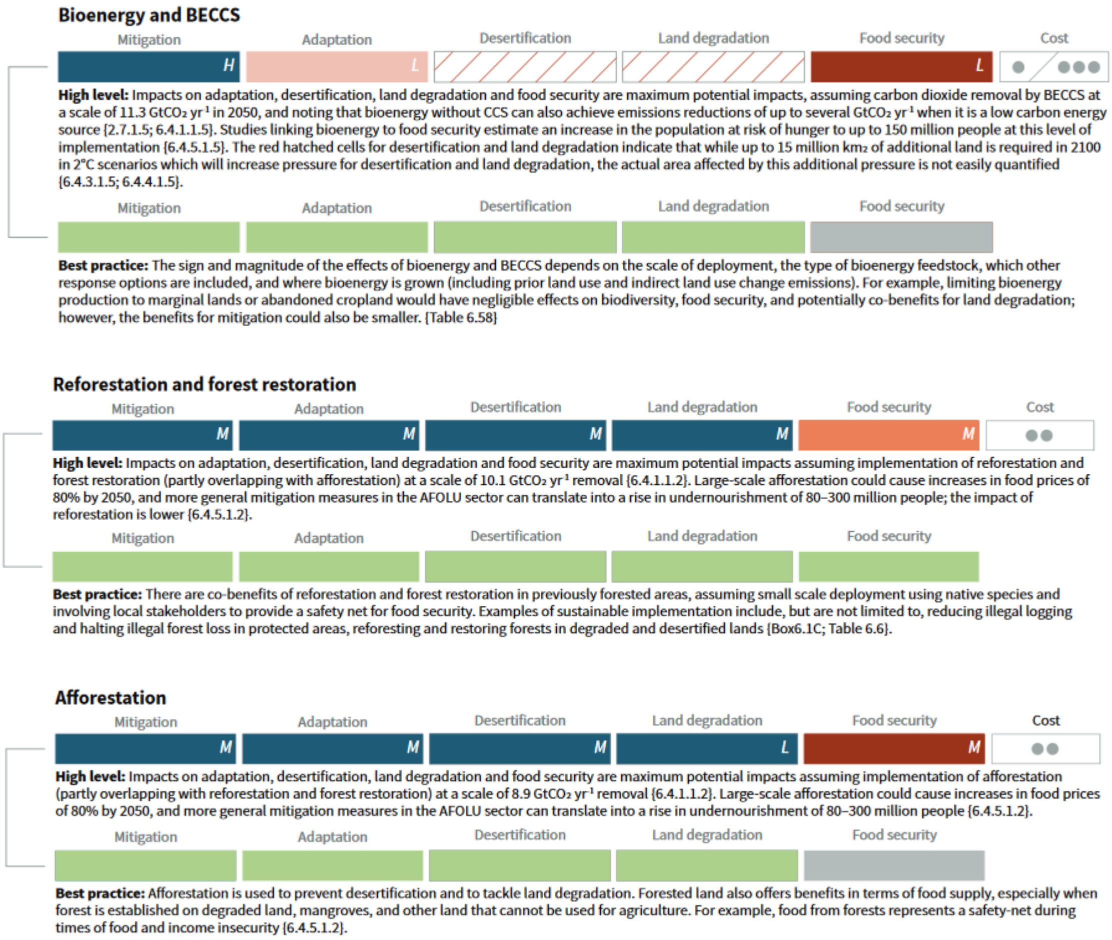
(a) **bioenergy and bioenergy with carbon capture and storage option**, food security have a big negative impact at high levels of deployment. Some of the modelling numbers indicate that there could be 150 million more people at risk of hunger under this option. However, restricting the use of bioenergy to marginal lands and abandoned cropland would have negligible effects on biodiversity and food security, as well as have potential benefits in terms of combating desertification;

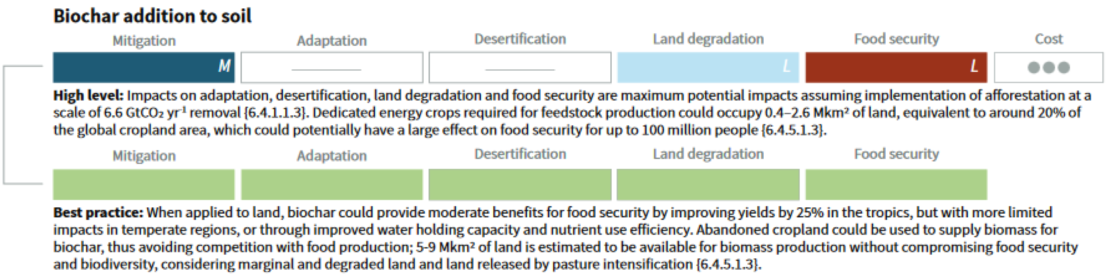
(b) **reforestation and forest restoration option**, there are positive impacts on mitigation, adaptation, desertification and land degradation, but a negative impact at high level of deployment on food security is a risk of causing undernourishment for 1–100 million people depending on the scenario;

(c) **afforestation option**, a high level of deployment could result in about 9 $GtCO_2e$ reduction and have very big impacts on food security resulting in the undernourishment of 80–300 million more people. It could also lead to food prices rising by up to 80% by 2050. A small-scale well-managed deployment could prevent desertification and land degradation, as well as enhance food security if it was deployed on degraded land, mangrove or other lands not suitable for agriculture;

(d) **biochar addition to soil option**, it is assumed to be deployed at a level that would give about 6.5 $GtCO_2e$ reduction, and crops for biomass could use from 0.4–2.6 million km^2 of land, which is approximately 20% of the global cropland area. There is a negative impact at this high level of deployment that affects food security for up to 100 million people. A best practice could result in moderate benefits for food security, including improving crop yields by up to 25% in the tropics.

Figure 7.b
Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and enhancing food security





Source: IPCC, 2019: Summary for Policymakers, IPCC Special Report on Climate Change and Land, figure SPM.3 Panel B. (For each option, the first row (high level implementation) shows a quantitative assessment (as in Panel A) of implications for global implementation at scales delivering CO2 removals of more than 3 GtCO2 yr-1 using the magnitude thresholds shown in Panel A. The red hatched cells indicate an increasing pressure but unquantified impact. For each option, the second row (best practice implementation) shows qualitative estimates of impact if implemented using best practices in appropriately managed landscape systems that allow for efficient and sustainable resource use and supported by appropriate governance mechanisms. In these qualitative assessments, green indicates a positive impact, grey indicates a neutral interaction).

52. Mr. Skea concluded that **response options were site and regionally specific, with no one-size-fits-all solution**. Activities to combat desertification can contribute to adaptation and mitigation co-benefits and halt biodiversity loss. Some solutions could support both climate change adaptation and mitigation, as well as combat desertification, including water harvesting and micro-irrigation, using drought-resilient ecologically appropriate plants, and agroforestry. Avoiding, reducing and reversing land degradation in rangelands, croplands and forests could help to eradicate poverty and ensure food security.

53. Reducing deforestation and forest degradation could lower GHG emissions and contribute to adaptation goals. Sustainable land management could prevent, reduce and, in some cases, reverse land degradation. Technological solutions exist to avoid, reduce and reserve desertification while also contributing to climate change action. Investment in sustainable land management and land restoration in dry land had positive economic returns. Mr. Skea emphasized that the benefits of preventing desertification far outweighed those associated with restoring degraded land.

54. Response options throughout the food system could be deployed and scaled up to advance adaptation and mitigation. Dietary choices and balanced diets with plant-based foods produced in resilient-sustainable, lower GHG emission systems, present major opportunities for adaptation and mitigation with significant co-benefits, including to human health.

4. Summary of discussions on adaptation and mitigation response options

55. An IPCC expert responded to a question on the **role that reducing deforestation and forest degradation could play in achieving the goal of the Paris agreement** by clarifying that forests are a huge carbon store of peatland, providing natural sink service which takes up about a third of anthropogenic emission.

56. In responding to a question on the **contribution land-based response options could make to the 1.5 or 2 °C target**, an IPCC expert stated that the level of contribution depends on what is done in the energy sector. The less the reductions in the energy sector would translate to more reliance on land which is also related to the SSP chosen.

57. Recalling that based on the SR1.5 report the world needs to be carbon neutral by 2050, a participant asked whether the **concept of carbon neutrality referred only to anthropogenic GHG emissions and removals or also the natural GHG emissions and removals**. An expert responded that in the SSPs, neutrality is related to anthropogenic emissions and removals on the land, energy and other sectors only.

58. In responding to a question about the **limitations of top-down modelling**, an expert stated that scientists are working hard to improve the models, therefore the interpretation of their outputs should be handled carefully at this stage.

59. A participant sought to know if it was possible to **suggest an overall most efficient pathway** noting that regional differences exist. An expert responded that the context specificity of each region should be considered rather than an overall option/pathway. It is important for local and regional stakeholders to be engaged to enhance understanding at the local and regional levels.

60. In responding to a question about the **timeframe that was used in measuring CO_2 mitigation**, an expert stated that they were based on mitigation to be achieved by 2050.

61. An expert responding to a question on what the **main drivers of food losses and wastes** are given how important the issue is to achieving the second sustainable development goal (zero hunger) by stating that developing countries mostly face food losses which is mostly due to food rotting on the way to the market because

of lack of adequate food storage facilities and refrigeration while developed countries face food wastes resulting mainly from food leftovers.

62. A participant asked whether the **impacts of the response options on biodiversity were considered**. An expert responded that not many messages regarding biodiversity were raised in the SPM as it was not a main focus of the SRCCL, but some related issues can be found in the underlying chapters of the report, including in chapter 6, and the issue would be further addressed in the upcoming AR6.

5. Enabling response options and actions in the near-term

63. Ms. Debra Roberts, IPCC Co-Chair of Working Group II, explained that an appropriate design of **policies, institutions and governance systems at all scales could contribute to land-related adaptation and mitigation** while facilitating the pursuit of **climate-adaptive development pathways**. Mutually supportive climate and land policies have the potential to save resources, amplify social resilience, support ecological restoration, and foster engagement and collaboration between multiple stakeholders.

64. Policies that operate across the food system, including those that **reduce food losses and wastes**, and influence **dietary choices** enable more sustainable land-use management, enhance food security and follow low emissions trajectories. Such policies can contribute to climate change adaptation and mitigation, reduce land degradation, desertification and poverty, as well as improve public health.

65. The adoption of sustainable land management and poverty eradication can be enabled by: improving access to markets; securing land tenure; factoring environmental costs into food; making payments for ecosystem services; and enhancing local and community collective actions.

66. Policy features are heavily integrated in the SPM. Acknowledging **co-benefits and trade-offs** when designing land and food policies could overcome barriers to implementation and strengthen multilevel, hybrid and cross-sectoral governance. Also, policies developed and adopted in an iterative, coherent, adaptive and flexible manner could maximise co-benefits and minimise trade-offs. She explained that this was because land management decisions are made from farm level to national scales, and both climate and land policies often go across multiple sectors, departments and agencies.

67. Furthermore, when those most vulnerable to climate change, including indigenous peoples and local communities, women, and the poor and marginalized, are involved in the selection, evaluation, implementation and monitoring of policy instruments for land-based climate change adaptation and mitigation, the effectiveness of decision-making and governance is enhanced.

68. Ms. Roberts explained that changes to land cover due to different land-management approaches over time for SSP1, SSP2 and SSP5, are all compatible to global warming of 1.5 °C (figure 8).

69. In the case of the SSP1, a **sustainability-focused pathway**, sustainability in land management, agricultural intensification, production and consumption patterns lead to reduced need for agricultural land, despite increases in per capita food consumption. In this SPP, a 3 million km^2 increase in forest land and a 1.2 million km^2 reduction in cropland by 2050 is observed growing to a 7.5 million km^2 increase in forest land, a 5million km^2 reduction in cropland and an increase of 4 million km^2 in bioenergy cropland in 2100 compared to 2010.

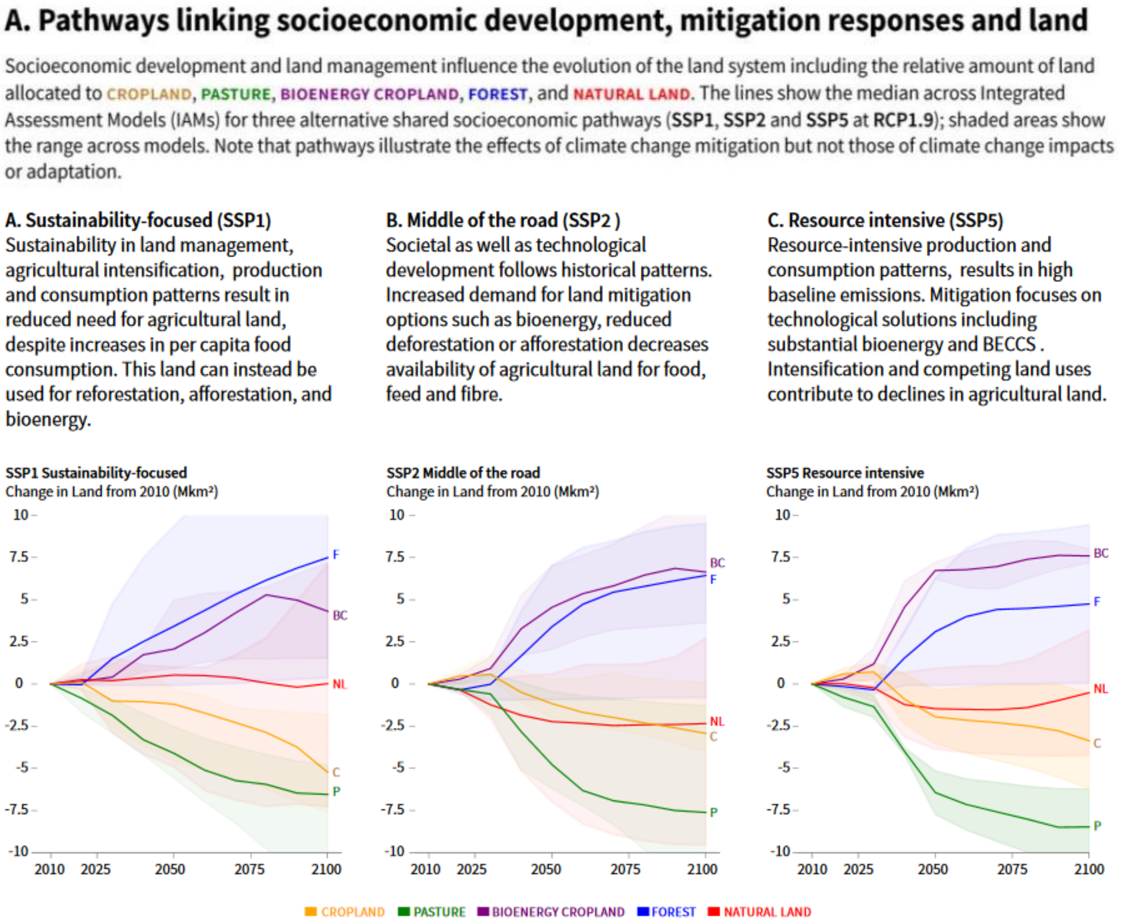
70. Regarding SSP2, a **middle of the road pathway**, societal and technological development follow historical patterns. There is an increased demand for land mitigation options, such as bioenergy, reduced deforestation, or afforestation, decreased availability of agricultural land for food, feed and fibre. By 2100, bioenergy cropland is expected to have increased by 6.3 million km^2 compared to the 4 million km^2 in SSP1.

71. In SSP5, a **resource intensive pathway**, resource-intensive production and consumption patterns, result in high baseline emissions. Mitigation focused on technological solutions, including substantial bioenergy and BECCS. Intensification and competing land uses contribute to declines in agricultural land and by 2100, bioenergy cropland is projected to have increased by 7.5 million km^2 compared to the 6.3 million km^2 in SSP2.

72. Ms. Roberts further explained that **actions can be taken in the near-term**, based on existing knowledge, to address desertification, land degradation and food security while supporting longer-term responses that enable adaptation and mitigation to climate change. These actions included: building on individual and institutional capacity; accelerating knowledge transfer; enhance technology transfer and deployment; enabling financial mechanisms; implementing early warning systems; undertaking risk management; and addressing gaps in implementation and upscaling.

73. Near-term actions to address adaptation and mitigation, desertification, land degradation and food security could bring social, ecological, economic and development co-benefits. The co-benefits could contribute to poverty eradication and more resilient livelihoods for the vulnerable.

Figure 8
Pathways linking socio-economic development, mitigation responses and land



Source: IPCC, 2019: Summary for Policymakers, IPCC Special Report on Climate Change and Land, Figure SPM.4-A. (The shaded areas show the range across all integrated assessment model; the line indicates the median across models).

74. In summary, Ms. Roberts stated that:

(a) **Rapid reductions in anthropogenic GHG emissions across all sectors following ambitious mitigation pathways reduced the negative impacts of climate change on land ecosystems and food systems**;

(b) **Delaying climate mitigation and adaptation responses across sectors would lead to increasingly negative impacts on land and reduce the prospect of sustainable development**.

75. The SRCCL showed that there were actions that could be taken to jointly tackle land degradation and prevent or adapt to further climate change. She emphasized the role of land in feeding the world and providing biomass for renewable energy but underlined that it could not achieve this without early, far-reaching actions across several fronts.

6. Summary of discussions on enabling response options and actions in the near-term

76. In responding to a question on the **potential for soil-related near-term actions**, an expert clarified that many details on soils are included in the report. For example, the SRCCL addresses emission reductions from soil sequestration in crop lands, grasslands and peatland, which each represent about 2.5–7 $GtCO_2e$ per year. Improved soil carbon can also lead to improved nutrient and water retention.

77. A participant sought clarification on **how land use profiles differ at higher temperatures** and an expert responded that mitigating to stay below any temperature relies on land and that reliance becomes greater with higher mitigation scenarios.

78. In responding to a question on what the **drivers of wildfire** are and what its **relationship to climate change** is, an expert stated that a table on wildfires was included in chapter 2 of the SRCCL and that there is a strong link between land clearing and fires, making it difficult to tease out the reason for increased wildfire – whether it was due to climate change or due to land clearing.

79. A participant sought to know what the **socio-economic perspectives for bioenergy** existed and an expert referencing chapter 7 of the SRCCL as one that discusses the issue stated that it is important to consider impacts at the local scale, and that all choices need to always be on the table and be filtered through sustainable development, equity and justice lenses.

80. In responding to a question about the **high costs and risks associated with delaying the reduction of GHG emissions,** an expert stated that a delay will result compromise the ability of land to provide services, resulting in an increase in the chances of floods, negative impacts on health and food security. As temperatures increase, there is less predictability.

81. An expert responded to a question on whether the **economic co-benefits on the health system from land restoration** were considered in the SRCC by clarifying that co-benefits and trade-offs across the Sustainable Development Goals were discussed in Chapter 6 of the SRCCL, including benefits to health from land restoration and nature-based solutions.

82. A request was made to consider the **special circumstances of countries**, especially those in Africa. An expert assured the participant that the request was noted and AR6 would pick this up more clearly.

83. Stating that some parts of the world are experiencing unexpected drought and flooding events, with terrorist acts adding to already existing desertification challenges, a participant requested to lay more emphasis on the relationship between peace and GHG emissions in future IPCC products. The IPCC Chair thanked the participant for highlighting the importance of stability and peace as part of the response options and shared that relevant issues have been identified by governments and AR6 will, to the extent possible, shed more light on them.

B. Closing remarks

84. In his closing remarks, Mr. Hoesung Lee, thanked his SBSTA counterpart, the Co-Chairs of the three IPCC Working Groups, the experts and participants. He indicated that this special event was a very productive session for IPCC. He described the special event as a very good example for the science and policy interface.

85. Mr. Lee restated that land was under growing pressure, and land was part of the solution, but could not do it all. The world must to find ways to maximize the utilization of adaptation and mitigation options that would have least adverse impacts on ecosystems. The world needs appropriate governance systems and institutions and other societal arrangements to achieve such goals.

86. Furthermore, Mr. Lee emphasized that the special event has raised many productive and insightful questions and comments that would be important inputs to the AR6. He thanked observer organisations for their interventions and suggestions and stated that such contributions would make IPCC "healthier than ever."

87. On his part, Mr. Paul Watkinson, thanked his IPCC counterpart, the speakers and all other members of the IPCC, all participants and the secretariats of the UNFCCC and IPCC for their contributions to the success of the special event.

88. Mr. Watkinson stated that the exchange has more clearly underlined the importance of science to the work of the SBSTA and the entire UNFCCC process, particularly when in its assessed form as provided by the IPCC.

89. The event co-chairs then informed the participants that all presentations, would be published on the SRCCL Special Event page of the UNFCCC and that they intend to prepare an informal summary report of the event and to make it available on the event page prior to SBSTA 52 (June 2020).