Info Note

Climate change affects rainfall patterns in crop-producing regions

Findings from the study "Emergence of robust precipitation changes across crop production areas in the 21st century"

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Key messages

- Unless emissions are curbed soon, by 2040, the rainfall patterns in many major wheat, soybean, rice and maize regions will have changed outside their natural boundaries.
- Emissions reductions in accordance with the Paris Agreement would result in far less crop-producing areas experiencing novel rainfall patterns.
- Targeting adaptation efforts remains a major challenge, but region specific results can now enable investment and action.

Rain-fed agriculture currently constitutes 60–95% of farmed land across the developing world. Changing rainfall patterns could have a large impact on agriculture in developing countries. Using over 20 different climate models, researchers have projected how precipitation could be affected by climate change. Model simulations for the four main emission scenarios were used identify the timeline when climate change causes rainfall to deviate significantly from the past, more than it would naturally. This is also called the time of emergence (TOE). This was done for the crop-growing regions of four major crops: wheat, rice, soybean and maize.

Precipitation changes cross natural boundaries

Changes in precipitation are already exceeding their natural variability globally. Under a high emission scenario, up to 36% of all land area will be wetter or drier. In areas where there is already a lot of rainfall, precipitation is likely to increase. The tropics and the North—Canada, Russia, India and the eastern United States—will get wetter, in some cases as soon as 2020. Drier regions, mainly in the Southern Hemisphere, including southwestern Australia, Southern Africa, southwestern and South America, and the Mediterranean, are expected to experience a decrease in precipitation. Fourteen percent of land dedicated to the four crops could have less rainfall, while up to 20–30% may see increases in rainfall. This would start early this century, and would increase rapidly after 2040.

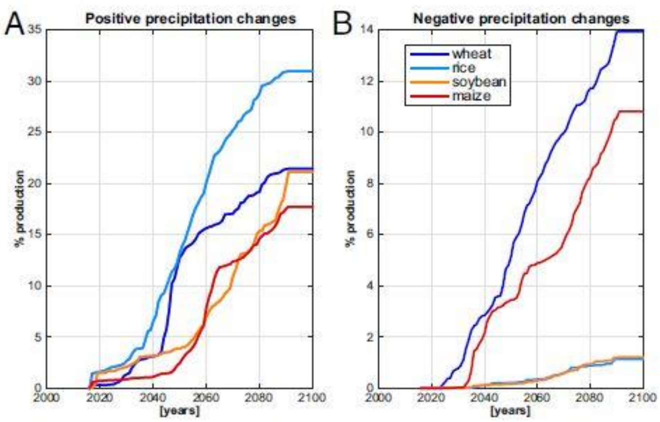

Figure 2. Cumulative percentage of global production of four major crops affected by positive (A) and negative (B) precipitation changes under RCP8.5. Derived from Rojas et al. (2019).

Global food security could be affected

Wheat, soybean, rice and maize constitute around 40% of the global calorie intake globally. Currently, rainfall changes have not exceeded natural variability in most

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crop-growing regions. This does not mean that there are no trends in rainfall, but rather that these trends have not changed more than natural variability.

Nevertheless, a globally significant percentage of current production will in the future be affected by a TOE of precipitation changes. Many of the major wheat producers are expected to face drier conditions. The higher the emissions, the sooner this happens. Algeria, Morocco, South Africa, Mexico, Spain, Chile, Turkey, Italy and Egypt are some of the wheat producers affected already under a low emission scenario. Wheat fields in Northern Europe, the United States, Canada and Russia will have higher precipitation.

The differences across emission scenarios are striking. Ninety-nine percent of the crop-growing regions in South Africa would be affected in a high emissions scenario, versus 27% in a low emissions scenario. The same goes for Australia, where 28% of cropped land is affected versus 4% under a low-emission scenario.

Big rice producers in Asia—including the world's most populous countries China and India—will have TOEs for increased rainfall, even in a low-emission scenario.

It has been suggested that more precipitation may mean higher crop production in some areas, e.g. Argentina, which is the world's largest soybean producer. However, rising sea levels, temperatures and increased potential for flooding, could mean otherwise. The benefits of enhanced precipitation may be negated by more flood events, unless adaptation infrastructure is invested in. Similarly, in southern India and eastern Africa, which are currently dry and low-yielding regions, may experience wetter conditions in the future. The low water holding capacity of the soil in these areas means higher flood risks as well.

Science can enable targeted actions to contain precipitation changes

In the past, rainfall patterns have been difficult to predict. It was therefore hard to give policy advice on growing conditions. The timelines of precipitation changes in this study help to identify regions where precipitation changes are expected to cross their 'natural' average into a new rainfall regime within the 21st century. By pointing to where changes can be expected, this study can help to focus timely policies and actions.

Regional investment and more detailed analyses of productivity and cropped area change at the TOE could guide adaptation investment. Farmers could shift to growing more drought-tolerant crops, and governments could consider investing in infrastructure for floods and different irrigation policies in drier regions.

Furthermore, this study shows that lower-level emission scenarios would reduce the TOE globally to a major extent. Hence, mitigation strategies to lower emissions have major implications for agricultural production and food security. Governments should pursue emission cuts that are consistent with the 2015 Paris Agreement and be pressured to follow and update their Nationally Determined Contributions (NDCs). This helps to reduce the risk of droughts and floods and stabilize food security.

This Info Note summarizes information from the journal article "Emergence of robust precipitation changes across crop production areas in the 21st century". The data reported in this paper have been deposited in the Earth SystemGrid Federation database.

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