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Source: Franklin, J., Serra-Diaz, J.M., Syphard, A.D. & Regan, H.M. (2016). Global change and terrestrial plant community dynamics. *Proceedings of the National Academy of Sciences* 113(14): 3725–3734. DOI:10.1073/pnas.1519911113.

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Science for Environment Policy

How will climate change and other environmental changes affect vegetation?

Climate change and other environmental changes can have major impacts on plant communities. Researchers have assessed current methods of understanding the impact of these global changes on vegetation and outlined the implications for future research. Vegetation is highly dynamic and likely to respond in complex ways to environmental changes. Researchers should, therefore, use a variety of methods to predict vegetation change in order for findings to be useful for policymaking.

Plant communities, such as woodlands and grasslands, support economic activities including forestry and livestock grazing, and provide essential ecosystem services, such as water regulation and carbon storage. They also influence the distribution of animals, including economically important species, such as pollinators. Predicting the effects of global environmental changes on plant communities is therefore important to ensure that the benefits provided by plants are protected.

In this study, researchers explored previous research to summarise recent changes to plant communities across the globe, as well as approaches that can be used to predict the impacts of different drivers of change on vegetation. Major human causes of environmental change include land-use change, nitrogen deposition (due to fossil fuel combustion and intensive agriculture, for instance), climate change and the spread of invasive species.

The study highlights how the responses of vegetation to climate change and other environmental changes are likely to be highly dynamic and variable. For example, in certain locations land-use changes and fires started by humans are likely to combine with climate-change impacts, leading to long-lasting changes in plant communities. There may also be time lags in the way vegetation responds to change, particularly in long-lived communities, such as forests, which contain trees and other woody species that live for centuries.

Understanding the combined impacts of different drivers of change on vegetation is a particular challenge. For this reason, the research considered various methods of assessing vegetation changes. For example, national forestry inventory data have identified shifts in tree-species composition in Spain, which is related to climate change-induced drought. Remote sensing, experimental research and various modelling techniques were also considered.

A major challenge for future research is to minimise the impacts of environmental change on plant communities. Forecasting tools that incorporate global change drivers and threats are being developed to understand how this can be achieved. These tools can focus on impacts on single species as well as the interaction between many species to help researchers understand which species are most vulnerable to changes.

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There are a number of major gaps in understanding of vegetation change, such as species-specific responses to change and the existing distributions of plant communities on a landscape scale. Remote sensing and other emerging disciplines and technologies provide opportunities to fill these data gaps.

Global vegetation models are also improving in their ability to predict the impacts of disturbance and land-use changes, although more advanced models that can simulate the impact of interactions between species are needed. Climate and land-use changes are likely to alter the distribution of invasive species, pollinators, pests and other plants and animals, leading to new interactions between species. Understanding how plant communities will be influenced by these new species interactions should therefore be another focus for research.

In addition, changes in planetary processes, such as the carbon and nitrogen cycle, may lead to shifts in vegetation types and distributions. Finally, another key challenge is to consider how human decision-making and policy impacts are likely to affect future vegetation change.