Climate change in drylands

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Credit: Dr. Anja Linstädter

Approximately 40 percent of the earth's surface is covered by drylands in which average annual precipitation is lower than evaporation. The changes projected to unfold in these areas in the course of climate change are alarming. Greater variations in annual and seasonal precipitation will lead to more frequent droughts and, presumably, longer drought periods. This means that drylands are among those areas most severely affected by climate change.

Research has thus far not adequately addressed the question of how strongly annual plant growth in pasture landscapes - hence the available food for livestock - is affected by droughts. Also, how predictable is the correlation? Yet this knowledge about vegetation stability would be

essential for more accurate predictions of the effects of climate change in these areas. Over the past years, Dr. Jan Ruppert, an ecologist from the University of Cologne, has compiled hundreds of long-term studies on annual plant growth in drylands. Together with Dr. Anja Linstädter, the head of his working group at the University of Cologne, he has now completed his analysis of these data. The researchers are looking for an answer to the question of how droughts of varying intensity affect plant production - during and after the event. They are particularly interested in whether or not certain characteristics of the vegetation or the grazing regime affect the outcome. In this context, the scientists differentiate between two aspects of stability: on the one hand, the vegetation's durability to droughts of varying intensity (resistance), and on the other hand its ability to regenerate after a drought (recovery).

Credit: Dr. Jan C. Ruppert

"We were surprised to see that the type of ecosystem (biome) is a rather poor indicator of vegetation stability in the face of drought. It does not make a large difference whether a drought occurs in a savanna, grassland or shrubland. The decisive factor is the dominant herbaceous life history - that is, whether we are dealing with annual or perennial plants", Ruppert explains. Drylands that are dominated by annual plants are more severely affected during droughts, but recover more quickly afterwards.

Areas in which perennial plants dominate exhibit the opposite trend. The effect of the grazing regime on vegetation stability in the face of drought is also highly dependent on whether one is dealing with annual or perennial plants. Enduring communities of plants will react to grazing with a lower drought resistance. Grazing does not, however, have a significant effect on resistance in areas where annual plants dominate. "Our results indicate that the vegetation of drylands is not capable of optimizing its resistance and recovery potential at the same time," Linstädter concludes.

Besides this comprehensive analysis, the researchers are also hazarding a prognosis for the future. On the basis of 500 analyzed droughts, they can fairly accurately predict the reduction in plant production caused by droughts. A centennial-scale drought would reduce the production of plant biomass by about 45 or 72 percent - depending on whether the dominant plant life is perennial or annual. "This is an alarming finding, particularly if we consider that 'centennial-scale droughts' by today's standards will occur much more frequently in the future," Linstädter cautions.

"The good news is that drylands have a relatively good pre-adaption to droughts. The bad news is that the combined effects of climate change and overgrazing could have detrimental effects on the capability of drylands to resist droughts and recover from them," Ruppert sums up. "The progressing loss of perennial grasses and decreasing vegetation cover in drylands can serve as important warning signs."

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Provided by University of Cologne

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