

Cattle Reduce Nitrous Oxide Emissions

Climate Researchers Correct the Relationship between the Formation of the Greenhouse Gas and Livestock Breeding on Free Grassland – Publication in Renowned “Nature” Journal



Long-term study in Mongolia: For one year, KIT scientists studied the impacts of grazing on the formation of nitrous oxide in the soil. (Photo: KIT)

Nitrous oxide emissions, mainly from agriculture, contribute considerably to the anthropogenic greenhouse effect. Contrary to previous assumptions, however, livestock breeding in steppe and prairie areas does not increase nitrous oxide emissions, but reduces them. This was found by scientists from the Atmospheric Environmental Research Division of the KIT Institute of Meteorology and Climate Research (IMK-IFU) during studies in China. The results of the project funded by the German Research Foundation (DFG) have now been published in the journal “Nature”.

After carbon dioxide (CO₂) and methane, nitrous oxide (N₂O) is the third most important greenhouse gas in the atmosphere. The greenhouse effect of a kilogram of N₂O exceeds that of the same amount of CO₂ by a factor of about 300. About 60% of the anthropogenic emissions of this trace gas are due to agriculture activities, e.g. following the microbial decomposition of nitrogen-containing excrement of grazing sheep or cattle in the soil. Therefore, it was assumed by scientists that increased livestock breeding in steppe and prairie areas has contributed to the constantly growing nitrous oxide concentration in the atmosphere. Such calculations were also reported by the Intergovernmental Panel on Climate Change (IPCC) known as World Climate Council.

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“This was a big error,” says Professor Klaus Butterbach-Bahl from the Atmospheric Environmental Research Division of the KIT Institute of Meteorology and Climate Research (IMK-IFU) in Garmisch-Partenkirchen. “In fact, areas not used for livestock breeding emit much larger amounts of nitrous oxide over the year than steppe areas on which animals are grazing.” This was found by scientists during a project in Inner Mongolia, China, funded by the German Research Foundation (DFG). For a complete year, they installed and operated several measurement stations in the steppe where temperatures may drop down to -40°C cold in winter. The German scientists were supported by scientists from the Chinese Academy of Sciences and the Scottish Centre for Ecology and Hydrology in Midlothian.

“Previous short-term studies ignored the fact that the emission of significant nitrous oxide amounts from steppe soils into the atmosphere is a natural process and most of the natural nitrous oxide emissions take place during the thawing period in spring,” explains Butterbach-Bahl the new results. Livestock breeding significantly reduces exactly these emissions. As the grass height is reduced by grazing, snow is transported by the wind more easily and, thus, the snow pack at grazed areas is smaller than in areas not used for grazing. Consequently, areas used for livestock grazing are less insulated during the long and cold winter and, hence, soil temperatures colder by up to 10 degrees. On the other hand, these areas are much dryer during the thawing period in March due to the reduced snow cover. Both factors, i.e. colder temperatures and reduced soil moisture inhibit microbial activities during thawing. As a result, the soil emits far less nitrous oxide.

Emissions Overestimated by 72%

These reductions by far exceed the “normal” stimulation of nitrous oxide emissions following faeces excretion and manure management, with considerable impacts. Scientists assume that previous calculations overestimate the nitrous oxide emissions due to livestock breeding of large areas of semi-arid, cool temperate grassland in Eurasia and North America, by about 72%.

Still, these results are no positive signals for climate change. The constantly growing nitrous oxide concentration in the atmosphere is a fact. “Our work just shows that much research remains to be done to really understand the sources of atmospheric nitrous oxide,” says Butterbach-Bahl. Also extensive grazing must not be reasonable. Ruminants are emitting large quantities of climate-active methane, which was not considered by this study. Nevertheless, the KIT study shows a way to improve the greenhouse balance of grass steppes: Haying in autumn may reduce the grass height and, hence, the snow height during winter as well as nitrous oxide emissions during thawing.

Literature:

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Zhisheng Yao, Klaus Butterbach-Bahl: "Grazing-induced reduction of natural nitrous oxide release from continental steppe" (Nature Issue No. 7290, Vol. 464, page 881-884).

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