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内蒙古放牧草地土壤碳固持速率和潜力

Soil carbon sequestration rates and potential in the grazing grasslands of Inner Mongolia

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中文摘要:

放牧是典型草地最重要的利用方式,弄清放牧对草地碳固速率的影响,将为我国内蒙古地区草地碳汇管理提供重要的科学依据。通过在平坦草地和斜坡草地设置相同的放牧梯度实验(放牧强度0、1.5、3.0、4.5、6.0、7.5、9.0 羊/hm^2),探讨了放牧和地形对草地土壤碳固持速率的影响。实验结果表明:轻度放牧草地表现为碳固持,重度放草地表现为碳流失;对放牧草地而言,存在碳源/碳汇的转化阈值(或放牧强度),且坡地阈值低于平地。为了实现草地碳增汇目的,平坦草地的放牧强度应低于 4.5羊/hm^2(放牧期6-9月),斜坡草地应低于3 羊/hm^2。地形因素(平地*VS*斜坡)使准确评估放牧草地土壤的碳固持速率变得更加复杂。总之,内蒙古地区放牧草地具有较大的碳固持潜力,通过控制放牧强度是实现其碳固持潜力的重要途径之一。

English Summary:

Temperate grasslands in the northern China account for approximately 110 million hectares, and grazing is common in the grasslands of Inner Mongolia. Therefore, understanding soil carbon (C) sequestration and its mechanism in these grazing grasslands is very important for the regional carbon budget. However, how and to what extent is soil C sequestration affected by increasing grazing intensities have not been well documented. To date, it is still uncertain whether changes in topography have modified soil C sequestration in these grazing grasslands; this is a crucial issue for the decision makers of grassland management.

On the basis of previous grazing experiments with 7 stocking rates (i.e., 0 1.5, 3.0, 4.5, 6.0, 7.5, and 9.0 sheep/hm^2) in the plat and slope grasslands, respectively, and by selecting free-grazing grasslands as control (CK), we specifically investigated soil C sequestration and the effects of increasing stocking rates on this sequestration and quantified the influence of topography on soil C sequestration in temperate grasslands of northern China. The experimental results showed that C storage in the 0-30 cm and 0-100 cm soil layers increased to a certain extent when the grazing intensity was light, and increases in soils N were relatively lower. In addition, the C and N storage in soils of heavy-grazing grasslands decreased slightly. Our findings prove the existence of an underlying transformation from soil C sequestration under low-grazing pressure to soil C loss under heavy-grazing pressure, and this transforming threshold was found to be 4.5 sheep/hm^2 in flat grasslands and 3.0 sheep/hm^2 in slope grasslands. Furthermore, the effect of increasing stocking rates on soil C sequestration was modified by topography, and slope grasslands were found to be stronger than flat grasslands. Our results showed that soil C sequestration rates in the grazing grasslands of Inner Mongolia are modified by topography; therefore, we need to focus more on identifying the potential impact of topography in future studies in order to accurately evaluate soil C sequestration in these grazing grasslands. Although this topic has limited scope, we attempted to experimentally demonstrate the presence of an underlying transforming threshold of soil C sequestration that changes with increasing stocking rates and the changes in topography; this study was essential for not only assessing the regional C budget but also optimizing grassland management to improve soil organic matter. Altogether, our findings suggest that grazing grasslands in northern China have a good capacity to sequester C in soil with rational grazing and that the different effects in flat and slope grasslands due to increasing grazing intensities should be taken into account for grassland management.

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