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RESEARCH ARTICLE

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Sediment addition and legume cultivation result in sustainable, long-term increases in ecosystem functions of sandy grasslands

Honghui Wu[1] | Linyou Lü[2] | Yunlong Zhang[3] | Chong Xu[3,4] | Hao Yang[5] | Wei Zhou[1] | Weiqi Wang[6] | Liren Zhao[2] | Nianpeng He[5] | Melinda D. Smith[7] | Xingguo Han[8] | Iain P. Hartley[9] | Qiang Yu[3]

[1] Ministry of Agriculture Key Laboratory of Crop Nutrition and Fertilization, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China

[2] Liaoning Institute of Sandy Land Improvement and Utilization, Fuxin 123000, PR China

[3] National Hulunber Grassland Ecosystem Observation and Research Station, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China

[4] College of Pastoral Agriculture Science and Technology, Lanzhou University, Lanzhou 730020, PR China

[5] Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, PR China

[6] Institute of Geography, Fujian Normal University, Fuzhou 350007, PR China

[7] Department of Biology, Graduate Degree Program in Ecology, Colorado State University, Fort Collins, CO 80523, USA

[8] State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, Chinese Academy of Sciences, Beijing 100093, PR China

[9] Department of Geography, College of Life and Environmental Sciences, University of Exeter, Exeter EX4 4RJ, UK

Correspondence
Nianpeng He, Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, PR China.
Email: henp@igsnrr.ac.cn

Qiang Yu, National Hulunber Grassland Ecosystem Observation and Research Station, Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences, Beijing 100081, PR China.
Email: yuqiang@caas.cn

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Abstract

Desertification of sandy grasslands is an increasing problem, with serious negative impacts on ecosystem functions. Sandy grasslands are fragile with low ecosystem productivity mainly because of the sandy soil structure with low water and nutrient holding capacities and especially low levels of nitrogen. Here, we evaluate the long-term impacts of sediment addition from a local reservoir, and grass and legume cultivation (artificial grasslands) on a sandy grassland in eastern Inner Mongolia, China. The results showed that even after 32 years, sediment addition had improved soil structure significantly, that is, increasing of silt and clay contents, soil bulk density, and water holding capacity. As the result of improved soil structure, ecosystem functions, including aboveground net primary productivity (ANPP) and soil carbon, nitrogen (N), and phosphorus storage, increased significantly. Net C, N, and P sequestration increased even after accounting for the sediment addition, due, at least partially, to the greater plant biomass trapping large quantities of wind-blown dust. Plant cultivation, especially the addition of a legume, further increased ANPP significantly, that is, the cultivation of *Leymus chinensis* and the legume *Medicago sativa* increased ANPP 6.99 and 44.62 times, respectively. Our study highlights that improvements in soil structure and cultivation with legume species can increased substantially the productivity of sandy grasslands and that the initial increases in grass biomass promoted the sequestration of wind-blown dust, which helped sustain the increases in productivity.

