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同位素示踪·资源环境·动植物生理

基于FRN技术的我国不同地区典型土壤保持措施的有效性评价

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摘要：

选择中国西南-东北样带4个典型土壤侵蚀区,包括位于长江上游的西昌,黄土高原延安,北方风蚀区的丰宁和东北黑土区的拜泉,应用环境放射性核素(FRN)技术研究了不同土壤保持措施在减少土壤侵蚀、改善土壤质量方面的作用。在西昌,^{137}Cs和^{210}Pbex的测定结果表明,不同植被覆盖结构减少土壤侵蚀的作用为:灌木 > 有地被物的乔木 > 草类 > 无地被物的乔木;在延安,利用^{137}Cs示踪技术对坡地景观的产沙量估算结果表明,梯田和林草地相对于坡耕地产沙量分别减少了49%和80%,林草地的土壤有机质、碱解氮和速效磷含量相对于坡耕地分别增加了255%、198%和18%,梯田土壤有机质、碱解氮和速效磷含量分别增加了121%、103%和162%,而土壤容重分别降低了1.6%和6.4%;在丰宁,对^{7}Be的测定结果表明,与传统耕作方式相比,4年免耕+作物高留茬(50～56cm)和免耕+作物低留茬(25cm)分别使土壤侵蚀速率下降44%和33%;在拜泉,通过^{137}Cs测定结果发现,坡改梯使土壤流侵蚀降低14%,等高耕作使土壤侵蚀量减少了34%。研究结果说明,灌木林覆盖、林草复合结构是控制西南侵蚀山地土壤侵蚀的优选生物配置措施,梯田和林草复合结构在控制黄土高原土壤侵蚀和改善土壤质量方面有重要作用,免耕+高留茬措施是我国北方风蚀区防治土壤侵蚀退化的有效措施,等高耕作应当成为防治东北黑土区土壤侵蚀的关键措施。

关键词： 环境放射性核素 土壤保持措施 土壤侵蚀 土壤质量 区域评价

FALLOUT RADIONUCLIDE BASED TECHNIQUES FOR ASSESSING THE EFFECTIVENESS OF SOIL CONSERVATION MEASURES IN DIFFERENT ERODED REGIONS OF CHINA

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Abstract:

Using fallout radionuclide techniques (FRN), we investigated the extent of soil erosion and to quantify the beneficial effects of soil conservation measures at four sites (Xichang city in the Yangtze upriver, Yan'an in the Loess Plateau, Fengning in the wind erosion region of northern China, and Baiquan in black soil region of north-eastern China) extending from South West (SW) to North East (NE) China. At the Xichang site of SW-China, the combined use of FRN ^{137}Cs and ^{210}Pbex measurements demonstrated that the effectiveness of vegetation species in reducing soil erosion decreased in the following order: shrubs > trees with litter layer > grasses > trees without litter layer. At the Yan'an site of Loess Plateau, sediment production estimated by^{137}Cs declined by 49% due to terracing and by 80% due to vegetated (with grass and forest) compared to the cultivated hillslopes. Vegetated hillslope with grasses and forest increased soil organic matter (SOM) by 255%, soil available N (AN) by 198%, and soil available P (AP) by 18% while terracing increased SOM by 121%, soil AN by 103%, and soil AP by 162% compared with the entire cultivated hillslope. Both terracing and vegetating hillslopes were found to enhance soil porosity as shown by a decrease in soil bulk density (1.6% and 6.4%, respectively). At the Fengning site, data from^{7}Be measurements indicated that four years of no tillage with high crop residues (50～56cm depth) reduced soil erosion by 44% and no tillage with low residues (25cm depth) reduced soil erosion rates by 33% when compared with conventional tillage practices. At the Baiquan site in NE-China, soil loss as measured by ^{137}Cs tracer, decreased by 14% due to terracing and by 34% due to contoured tillage. Our results suggested that shrub cover and composite structure of forest and grass are the effective practices to control hillslope erosion in SW-China, while terracing and forest-grass structure can greatly reduce soil erosion and improve soil quality on steep hillslopes of the Chinese Loess Plateau. No-tillage plus high crop residues is an effective measure to control land degradation in

wind erosion region of northern China while contour tillage practice is more effective in soil erosion control as compared with the terracing in black soil region of NE-China.

Keywords: fallout radionuclide (FRN) soil conservation measures soil erosion soil quality regional assessment

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