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Biomass production and nutritional value of natural rangelands under two management systems in northern Benin

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Abstract

In Benin, grazing management of communal rangelands is undergoing changes linked to the sedentarisation policy towards livestock keepers. This study, conducted within the DeLaRe project (<https://www.uni-kassel.de/forschung/declare/home>), aimed to evaluate how two contrasting rangeland management systems (innovative versus traditional) affect herbaceous biomass production and nutritional quality of rangelands in northern Benin. While the innovative management includes soil fertility management, tree-integration, and supplementary livestock feeding practices, supported by local institutions, research, and co-operatives, the traditional management has fewer or no of these elements. From July 2023 to April 2025, 20 actively grazed rangelands were monitored across four villages that represented the two management types. Data were collected every other month and included vegetation height, species richness, the percentage of bare ground, and aboveground biomass. A total of 180 vegetation samples were collected and analysed for dry matter, ash, carbon, nitrogen, phosphorus, calcium, and fiber fractions. Differences in species composition were assessed using PERMANOVA. Differences in aboveground biomass production were evaluated using a linear mixed model, and forage quality was assessed using MANOVA. All analyses were conducted using RStudio version 4.5.1.

Eighty-one herbaceous plant species were recorded, mainly belonging to the families Poaceae (26 %), Fabaceae (20 %), and Cyperaceae (18 %). Species composition differed significantly among management systems ($p = 0.001$). The mean biomass production exhibited clear system-dependent patterns. Across all measurements, the traditional management yielded significantly ($p = 0.004$) more biomass (725 ± 492 kg DM/ha) than the innovative one (606 ± 519 kg DM/ha). However, for the proximate components (g/kg DM), the innovative system yielded significantly higher concentrations of N (12.9 ± 2.91 ; $p < 0.001$), P (1.46 ± 0.702 ; $p < 0.05$), and Ca (9.33 ± 3.65 ; $p > 0.05$) than the traditional system that yielded 11.6 ± 2.92 , 1.35 ± 0.630 , and 9.1 ± 3.12 respectively for N, P, and Ca. Although forage yield was lower, the higher share of nutrient-rich functional groups suggests that under the innovative system, grazing livestock may ingest more nutrients than under the traditional system. This highlights the importance of species diversity for forage quality.

Keywords: Forage quality, Grazing systems, Herbaceous biomass, Seasonal dynamics, Species composition

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