Remote Sensing for pasture monitoring in Integrated Crop-Livestock Systems

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Integrated Crop-Livestock Systems (ICLS) integrate plant and animal production activities to leverage synergies and beneficial interactions among system components. Effective management of the pasture phase is critical for achieving improvements in soil quality and nutrient cycling, and both primary and secondary production outcomes. However, pasture monitoring remains a challenge for large properties, prompting increased interest in remote sensing technologies. The objective of the study was to evaluate the accuracy of vegetation indices in estimating herbage mass and sward height at different grazing intensities. The experiment was conducted at Espinilho Farm, located in the municipality of São Miguel das Missões, Rio Grande do Sul, Brazil, during the 2023 pasture phase. This local hosts a long-term experimental protocol involving an ICLS featuring soybean (*Glycine max*) in the crop phase and ryegrass (*Lolium multiflorum* Lam.) in the pasture phase. The experimental design employed randomized blocks - with three replications and included five treatments. These treatments comprised various grazing intensities: high (G10), moderate (G20), moderate-light (G30), and light (G40), alongside an ungrazed area (UG). The animals used were crossbreeds Angus x Hereford x Nelore, averaging 217 ± 13 kg liveweight and aging twelve months. The study correlated actual measurements of herbage mass and sward height with the NDVI (Normalized Difference Vegetation Index) and NDRE (Normalized Difference Red-Edge) indices derived from *PlanetScope* satellite images. - Measurements were conducted over an annual ryegrass growth cycle. Herbage mass was determined by cutting plants at ground level in five randomly located 0.25 m² quadrants, per paddock. Sward height was measured using a sward stick with five readings per quadrant. These measurements were repeated every 28 days throughout the 100-days stocking period. The findings reveal that treatments G10, G20, and G30 showed stronger correlations between herbage mass and NDRE (R=0.704, R=0.867, and R=0.748, respectively). Conversely, the highest correlation between sward height and NDRE was observed in treatments G40 and UG (R=0.822 and R=0.869, respectively). These results suggest that vegetation indices derived from remote sensing efficiently estimate both sward height and herbage mass. Therefore, remote sensing emerges as a valuable tool for enhancing pasture management within ICLS.

Keywords: forage mass; mixed crop-livestock; ryegrass; sward height; vegetation indices

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