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Effects of tree lucerne adoption on livestock endowment in South Wollo, Ethiopia

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Abstract

Livestock production plays a crucial role in smallholder livelihoods in Ethiopia, yet its potential is constrained by persistent feed shortages and low productivity. Perennial forage technologies, such as tree lucerne, have been promoted as a promising climate-resilient livestock feed option to address livestock feed insecurity; however, evidence on tree lucerne adoption and its welfare effects remains limited. This study examines the factors influencing tree lucerne adoption and estimates its effect on livestock endowment. We analysed survey data from 400 smallholder farmers and used an Endogenous Switching Regression (ESR) model to address endogeneity arising from nonrandom adoption choices, complemented by a Double Machine Learning (DML) estimator. Results show that adopters experience a 24.8% increase in livestock endowment. Conversely, the ATU indicates that non-adopters would have gained even more, about 50.1%, had they adopted, highlighting positive transitional heterogeneity.

The DML results support the ESR findings, showing a consistently positive, statistically significant effect of tree lucerne adoption on livestock endowment. Moreover, both the ESR counterfactual estimates and the DML results suggest that non-adopting households could achieve substantial gains in livestock assets if they began planting tree lucerne. This implies that low adoption is more likely driven by constraints such as limited access to information, weak extension support, small landholdings, and low peer influence than by low economic returns. The study underscores the need to strengthen extension service delivery, reduce information asymmetries, and enhance farmers' participation in field demonstrations to enhance the uptake of tree lucerne and increase livestock endowment. As a result, policy efforts should therefore focus on strengthening extension services, expanding farmer training, improving access to information, and promoting local demonstration and peer-learning platforms that support the establishment, management, and integration of perennial fodder technologies into existing crop-livestock systems for promoting sustainable livestock development and climate-resilient livelihoods in Ethiopia's highland farming systems and similar contexts.

Keywords: Adoption, DML, ESR, livestock endowment, tree lucerne