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# From trap to transition? The food-feed biomass battle under climate variability in Ethiopian enset-sheep farming systems

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**Abstract**

In mixed crop-livestock systems of sub-Saharan Africa, trade-offs typically occur between competing uses of crop biomass. In central Ethiopia's enset farming systems, farmers face a food-feed biomass battleöver enset (*Ensete ventricosum*), a drought-tolerant perennial crop. This battle reflects a tension between food security insurance and income from feeding livestock. The objectives of this study are to diagnose whether this battle constitutes a socio-ecological trap and evaluate the extent to which the Small Ruminant Value Chain Technology Pack (SmaRT Pack) intervention alters system feedback processes.

Using a mixed-methods design comprising a structured household survey (n=100), focus group discussions (n=6), and key informant interviews (n=21) in the Doyogena region of Ethiopia. Data were analysed using the binomial with effect size quantified using Cohen's d. The feed-to-food ratio (R) is calculated, where R = 1.0 indicates equal allocation between food and feed as a diagnostic threshold.

Enset biomass was allocated to food (64 %), feed (20 %), and sale (16 %). The system shows no directional shift toward equal allocation dry-to-wet (40.5 % toward vs. 55.7 % away) from R=1.0; sign test $p = 0.9$. This pattern is observed among sheep-fattening farmers, as biomass yields more income when used as feed than when sold as food. This systemic distance from R=1 shows the system is structurally trapped. The 85 % of households would increase feed if sheep prices rose 50 %, but 95 % would prioritise food during a prolonged dry season. This indicates a battle sustained by risk aversion driven by chronic climate variability. The SmaRT Pack intervention increased livestock holdings (d = 1.7, $p = 0.001$) and shifted livelihoods but did not change biomass allocation (d = 0.3, $p = 0.16$). The intervention targeted livestock productivity, while the trap functions at biophysical and behavioural feedbacks regulating biomass trade-offs. Without addressing self-reinforcing feedback, a component-based intervention alone can't break the trap.

We conclude that escaping this socio-ecological trap requires not just increasing biomass but also improving resource-use efficiency, especially livestock feed conversion efficiency. This approach reduces climate pressure on biomass while ensuring food security. The study offers insights for designing a climate-resilient, sustainable livestock transition pathway.

**Keywords:** Biomass battle, climate variability, enset (*Ensete ventricosum*), smallholder farming systems, socio-ecological traps

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