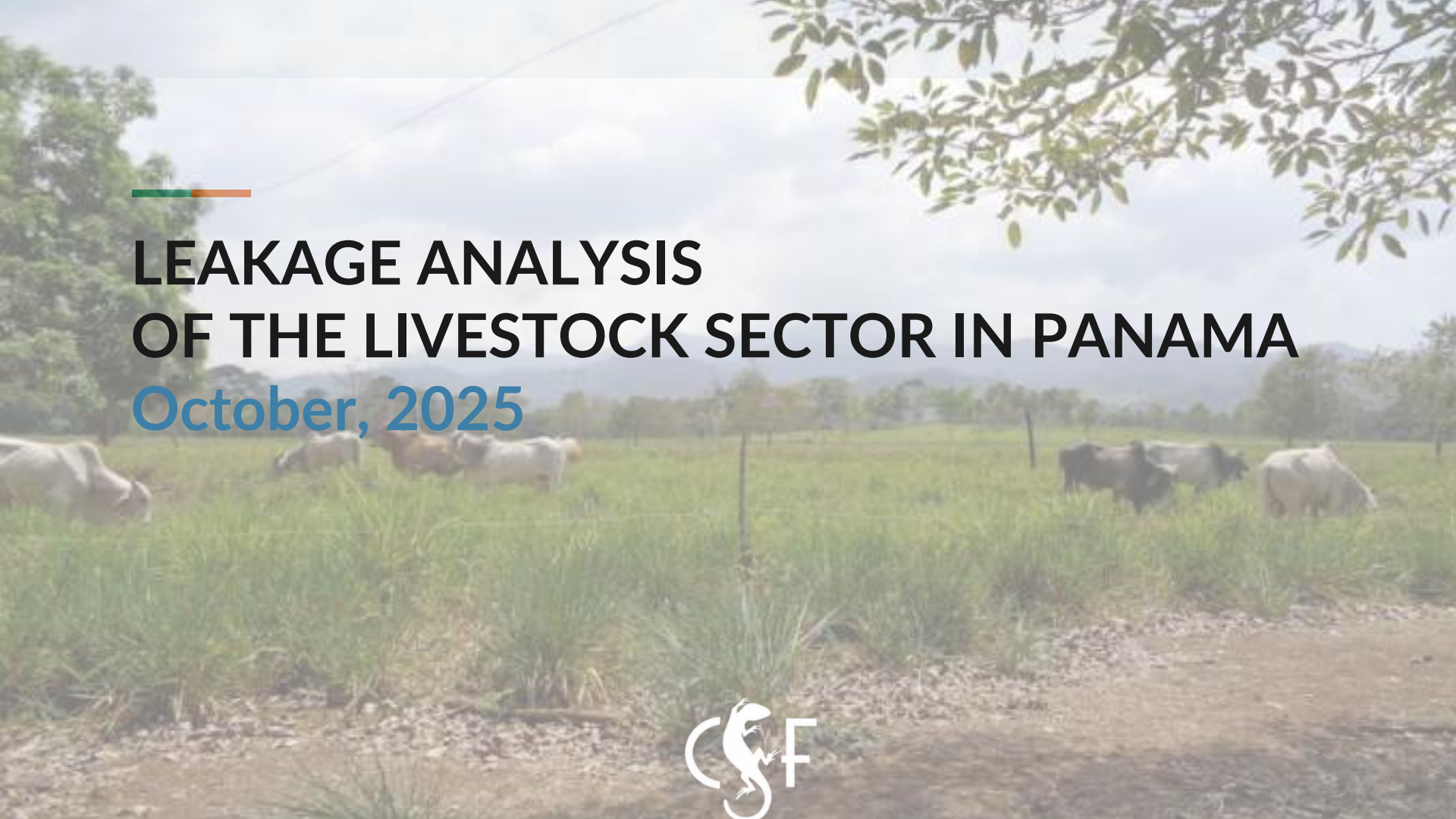

LEAKAGE ANALYSIS OF THE LIVESTOCK SECTOR IN PANAMA

October, 2025

Objective

To analyze the risk of carbon leakage associated with the ARC Restaura Azuero project in Panama through an economic assessment of the livestock sector and an empirical analysis of the regional context, in order to demonstrate that the restoration activities implemented under the ARR framework present a limited risk of emission displacement.

Methodology

1 The analysis of Panama's livestock sector was conducted using secondary statistical information mainly from national sources and complemented with international data when needed.

2 Model the relationship between the growth of pasture area (the dependent variable) and a set of explanatory variables linked to livestock dynamics, trade, and relative prices.

3 Primary data was gathered through a structured survey conducted with landholders involved in the ARC Restaura Azuero project in Panama.

Main findings

1 Livestock sector overview

- Although livestock remains an important land-use activity in Panama—occupying around 20% of the national territory and contributing 2.8% to GDP (2010–2019)—the sector has shown signs of stagnation or slight contraction since 2013. Moreover, the predominance of small-scale farms and the presence of a considerable share of inactive pasturelands suggest that potential increases in livestock production could be absorbed within existing lands rather than through new deforestation.

- Beef consumption has slightly decreased in recent years, reducing pressure for pasture expansion. Although dairy supply has grown steadily, available data do not clarify whether this increase results from domestic production or imports, highlighting the need for further analysis. Additionally, Panama's positive but declining livestock trade balance reflects weakening export competitiveness, reinforcing the notion that livestock expansion pressures are limited.

Main findings

1 Econometric approach

- The econometric analysis shows a clear and positive relationship between cattle herd growth and pasture expansion. This means that when livestock numbers increase, new pasture areas are likely to be cleared, revealing a direct mechanism of potential carbon leakage if herd growth is not controlled.

- Although Panama's cattle herd has declined by about 11% between 2010 and 2021—reducing current leakage risks—the model indicates that any future rise in herd size could quickly reactivate pasture expansion and, therefore, leakage pressures.

- Since prices, trade, and policy changes have little effect on pasture growth, the main way to prevent leakage is by addressing the structural link between herd size and land demand—through productivity improvements, sustainable livestock incentives, and stronger land-use governance.

Main findings

1 Cualitative analysis

- Most of the land that was used for cattle grazing is now being restored, and native forests have remained stable. This shows that livestock was not moved to other places, meaning the project has a very low risk of internal leakage.

- Most farmers focus on fattening cattle, a stage that ends with slaughter instead of moving animals to new areas. This reduces the chance that livestock activities are displaced, so the risk of indirect leakage is low.

- The land around the project keeps showing stable or slightly better pasture conditions, with no signs of extra pressure from livestock. This suggests that the project has not caused emissions or land-use changes outside its boundaries.

Recommendations

1. **Focus on herd management to prevent future leakage.**
   Because herd size is the main factor influencing pasture expansion, ARR projects should integrate livestock management into their conservation strategies. Monitoring herd numbers, improving productivity, and promoting rotational or silvopastoral systems can reduce land-use pressure and limit future leakage risks.
2. **Use underutilized land to balance production and restoration.**
   Since a large share of ranches (around 83%) currently have no active livestock, future interventions can redirect livestock activities to these areas. This would allow restoration and production to coexist within existing land boundaries, avoiding deforestation and displacement of emissions.
3. **Improve data availability and conduct further empirical studies.**
   Data limitations constrain current leakage assessments. Future research should collect primary data on herd dynamics, land-use decisions, and farmer behavior through field surveys and monitoring systems. Expanding the dataset and using models that capture non-linear effects or external shocks would help refine leakage estimates and improve project design.
4. **Strengthen verification and adaptive monitoring.**
   Implementers should verify whether livestock was sold, relocated, or slaughtered using multiple data sources—such as field visits, producer records, and interviews. Continuous monitoring of herd and pasture trends will support adaptive management and ensure that ARR interventions maintain low leakage over time.

Thank you