UN environment programme

FINANCING SUSTAINABLE LAND USE

Assessing low-carbon livestock technologies in Costa Rica:

Business case analysis of low-carbon livestock production

Summary

UN-REDD PROGRAMME

Food and Agriculture Organization of the United Nations

UNDP Empowered lives. Resilient nations.

UN environment programme

Lead author
César Solano Patiño

The following individuals contributed to the business case report:
Jacinto Coello, Felipe Guntin, and George Scott.

The authors and contributors would like to thank Francois Gigante and Jonathan Gheyssens for the comments and suggestions provided for improving the report.

Disclaimer

Executive Summary

This summary presents the results of an analysis undertaken to model and assess the viability of sustainable practices for the livestock sector outlined in Costa Rica's Low Carbon Livestock Strategy and NAMA.

Background – addressing the climate performance while increasing the productivity of the livestock sector in Costa Rica

Livestock is one of the traditional productive activities of Costa Rica. The sector is the third-largest source of GHG emissions in the country, making up around 10.3% of total emissions. Despite this, productivity is relatively low (average animal density of 1.2 AU/ha).

To address this, the government has adopted policy instruments (a Low Carbon Livestock Strategy and a NAMA) that aim to promote a more sustainable climate-smart sector. These instruments foster the adoption of practices and technologies that increase farmer productivity, reduce carbon emissions, and increase their resilience to climate change. A key subset of these practices includes: rational grazing, hedgerows, improved pastures and set-asides for increasing forest cover.

Modelling the performance of sustainable practices

The analysis carried out modelled the potential outcomes from the adoption of these practices on four farms in the country. The four farms selected for this analysis had different levels of management practices and were at different stages of the transition to a climate-smart system. The farms cannot be consired representative of all the farms in the country, but are located in the country's main producing regions, therefore can provide an important opportunity to explore the scope and potential impacts of the proposed technologies in various scenarios.

For the development of the analysis, business as usual and improved/climate smart scenarios for each of the four farms were developed using a stochastic model, with the aim of assessing the costs and benefits accrued to producers from the implementation of climate-smart technology adoption in different contexts. The improved secenario was built based on the technology that best matched the baseline situation and production system on each of the farms and the plausibility of the technologies being adopted by the producers.

The successful implementation of these strategies is assessed by whether they increase farmer productivity and income, reduce the GHG emissions intensity per unit produced, and increase captures of GHG emissions at the farm level, relative to the baseline.

Resutls from the analysis

A summary table with the results is included below. The results show that by adopting technologies and practices outlined in the NAMA, the farms could both increase their financial and climate performance. However, the impact of the adoption of these technologies was highly sensitive to the baseline characteristics of the farm. For instance, the results from the analysis show that impacts may be greater for dual-purpose farms as there are faster returns given the increase in dairy production.

Farm	Results
Dual-purpose farm in Puerto Viejo de Sara-piqui	The results show that for the dual-purpose farm, increasing the use of improved pastures by 10% per year over a 3-year period, and the release of 10% of pastures for the regeneration of secondary forest resulted in benefits in all variables measured. Emission intensity rates were significantly reduced, and producer cash flows were shown to improve.
Dual-purpose farm in Cañas, Guanacaste	The results show that increasing the area dedicated to fodder raises the productivity of the herd and improves the emission intensity per unit produced. This in turn increases profitability and cash flow for the producer.
Cow-calf farm - Las Juntas de Abangares, Guanacaste	The results show that introducing rational grazing and expanding the availability of fodder banks contributed to improvements in productivity, reductions in the emissions intensity per unit produced, and profitability.
Cow-calf farm in Cría de La Virgen de Sa-rapiquí, Heredia	The results show that by increasing the area under rotational grazing by 10 hec-tares and releasing 10% of pasture lands as set-asides for natural regeneration of forests, the farm sees an improvement in its carbon balance, cash-flows, and profitability.

The simulations carried out as part of this analysis also show that some technical parameters such as the calving rate, mortality rate (young and adult), daily weight gain for male and females, the Kg/milk/day, and the age at first birth – have a significant impact on the outcome associated with the adoption of a sustainability strategy. It is important that these parameters are identified when assessing the feasibility of implementing the technologies outlined in the NAMA.

Background

Livestock is one of the traditional productive activities of Costa Rica. Pastures for livestock production account for over 20% of the national territory. Livestock production, for either beef or dairy, generates employment or income opportunities for over 35,000 farmers in the country. The national cattle stock is estimated at 1.5 million head of cattle.[1] More than half of this cattle stock is dedicated to beef production, around one third to dual-purpose[2] systems and one sixth to milk production systems.[3] Farms tend to be relatively small; over half of the farms in the country are smaller than 10 hectares (ha) and almost 90% are smaller than 50 ha. The productivity of the sector is relatively low, as reflected by the calving rate, which averages circa 55%, and the relatively low animal density, which averages around 1.2 animal units per hectare.

While primary production is typically fragmented, processing is concentrated in a handful of companies and distributed mainly through retailers and small butcher shops. Most of the value is captured downstream in the value chain (retailers and feedlots), with less than a quarter remaining for primary producers.[4] The market for dairy products is even more concentrated, with just a few cooperatives controlling nearly 90% of the entire market.

In the last few decades, Costa Rica has implemented numerous policies which favour the conservation and protection of natural resources, with particular emphasis on forests, and has adopted a national decarbonisation plan. Despite preserving a vast amount of forested land within farms, livestock farms cover around 38% of the territory when forest land is considered, and the sector generates more than 10% of the country's total greenhouse gas emissions and over 97% of the total emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sectors. Low levels of productivity in the sector, coupled with the country's efforts to promote conservation, have made salient the need for transition towards a more sustainable climate-smart sector.

Costa Rica has taken steps to support this transition and improve climate performance in the livestock sector. The country developed a National Low Carbon Livestock Strategy and a Nationally Appropriate Mitigation Action (NAMA[5]) Livestock proposal that outlines an action plan for decarbonizing the sector while increasing its resilience to the impacts of climate change. These policy instruments promote the adoption of practices that increase farmer productivity, reduce carbon emissions, and increase their resilience to climate change. In order to achieve this, the NAMA aims to introduce several technologies and practices, such as rational grazing, hedgerows, improved pastures, and areas set-aside for increasing forest cover. The country has already implemented pilot projects[6] in specialized beef, dairy, and dual-purpose farms, which have started to build evidence of the impact of the Low-Carbon Livestock Strategy technologies.

Problem statement

Low productivity of livestock producers with low climate performance

Beef and dual-purpose farms in Costa Rica gravitate towards low productivity. Typically, animal density per farm is close to 1.2 animal units per hectare and the calving rate is estimated at 55% (compared to normative benchmarks of over 2 AU/ha; and 65% respectively).

Typically, pastures are overgrazed, which reduces the nutritional value of the grasses that the cattle feed on. This leads to a reduction in live weight gain and an increase in methane produced by enteric fermentation by cattle during digestion. The reduced weight gain also leads to lower revenues for the farmers. Typically, farmers compensate for the lower quality pastures by increasing the application of fertilizers, however, as the land degrades, the soil structure breaks down and the soil's water-retaining capital decreases, thus requiring more fertilizer, at greater cost to the farmer, to compensate for lost runoff.

Accordingly, Costa Rica's livestock sector is a large source of greenhouse gas (GHG) emissions: the sector is the third largest source of GHG emissions in the country, making up around 10.3% of total emissions. As outlined above, the main source within cattle ranching is enteric fermentation (CH_4), a potent GHG. Fertilizers for pastures, excreta in pastures, feed supplementation, in-farm fuel consumption and electricity play a lesser role in the emission of GHGs in the form of nitrous oxide (N_2O) and carbon dioxide (CO_2).

Producers in the sector are also vulnerable to the impacts of climate change: the sector is affected by an increasing number of droughts and floods. Droughts can exacerbate animal morbidity and mortality by decreasing the grazing quality of pasture and hampering animal productivity. Equally, floods have also caused direct animal losses and reduced productivity through pasture loss. It is estimated that between 2009 and 2018, producers faced losses of both pastures and animals from extreme weather events worth close to USD 45 million.[7]

There is consequently a strong need to improve the economic and climate performance of the sector through the widespread adoption of climate-smart practices.

Proposed sustainability strategies and climate mitigation and adaptation benefits

The National Low Carbon Livestock Strategy and NAMA Livestock promote a series of climate-smart technologies[8] which should bring benefits for cattle ranchers in the following ways: improved productivity/income, a reduction of emissions, an increase in carbon sequestration, and an increase in resilience to climate change. These technologies or practices are summarized below.

Rotational grazing[9,10,11]

A rotational grazing system involves dividing paddocks (sub-pastures) into smaller sections of equal size and periodically rotating the cattle between sections, allowing fallow periods for regeneration and occupation of the pastures/forages.

Rotational grazing maximizes beef and milk production per unit area by allowing pastures to recover and maintaining forages at a relatively earlier growth stage. In turn, animals can select the most nutritious forage thereby increasing the productivity of the system. More nutritious forage is thus more digestible and reduces methane (CH_4) production per unit of weight gain, as well reducing the production of nitrous oxide (N_2O) and ammonia (NH_3) from urine and faeces in pasture.[12]

Healthier pastures and more trees also increase the sequestration of carbon dioxide (CO_2) in the soil and biomass by stopping land degradation and allowing the land to recover. Well-managed pastures can lead to an improvement of the soil structure which increases water retention, leading to a reduction in soil erosion and requiring less pesticides and fertilizers.

Live Fences (hedgerows)[13,14]

This practice is associated with rational grazing, as it favours the division of paddocks into smaller areas by planting trees and shrubs. Live fences can provide habitat for biodiversity, and are a source of shade, which can reduce animal heat stress. This can lead to an increase in weight gain, milk production, and rates of reproduction. The establishment of trees and shrubs for fencing also contributes to carbon (CO_2) sequestration in biomass and soil.

Improved pastures[15]

Improved pasture management measures involve the sowing of better-quality varieties, typically higher yielding and more digestible forages. Similarly, the benefits accrued by rotational grazing mean that improved pastures can increase productivity through their benefit to animal digestion and methane (CH_4) production by enteric fermentation, as well as the reduction of nitrous oxide (N_2O) emissions from urine and faeces in pastures. Improved pastures have also been shown to increase soil quality and support water retention.

Set asides - regeneration of forest coverage[16]

The NAMA proposes that an average of 10% of pasture area per farm be transformed into forest through natural regeneration processes. This should involve the less productive areas within the farm. When planted on degraded pasture lands, trees sequester significant amounts of carbon (CO_2) in the soil and biomass.

Methodology of the analysis

An analysis was undertaken to model and assess the An analysis was undertaken to model and assess the viability of the practices outlined above, using the baseline information of four real farms. The analysis comprised two stages. The first stage was the collection of primary data from four farms; two in the Huetar Norte region, one dual-purpose and one cow-calf system farm; and two in the Chorotega region, one dual-purpose and one cow-calf system farm. The second stage consisted of modelling a business-as-usual scenario and an improved scenario for each of the four farms, to assess the costs and benefits that would accrue to producers from the implementation of climate-smart technology adoption in different contexts.

Collection of primary information

Primary information was gathered to develop case studies for two farms in the Dry Pacific or Chorotega Region, and two in the Humid Tropics or Northern Huetar Region. In both cases, information was collected from a dual-purpose[17] farm and a cow-calf system farm. A static survey was carried out with the help of a pre-established form that allowed information to be gathered to characterize the farm in terms of its structure and function, as well as to gather information on the technical indicators of the performance of the farm. Information was also collected on socioeconomic aspects of the cattle ranchers. The information on the farm characteristics and the baseline indicators are presented in Tables 1 and 2, respectively.

Farm description

The four farms analysed are in the main producing regions in the country. The farms show different levels of management practices and are at different stages of the transition to a climate-smart system. While the farms selected are not representative of all the farms in the country, they provide an important opportunity to explore the scope and potential impacts of the proposed technologies in various scenarios. These frameworks include different types of production systems, at different scales and under different agroecological conditions and socio-economic environments, in order to understand the feasibility of scaling up their implementation.

Table 1. Case studies – The four farms characterized in terms of their productive orientation, grazing systems, farming area and number of animals.

Type of production	Region	Existing System	Total area (ha)	Pastures Area (ha)	# Animals
Dual-purpose (DP1)	Huetar Norte	Non-intensive rotational grazing year-round	25	17	65