RESEARCH PROGRAM ON Livestock and Fish

Brief 20

More meat, milk and fish by and for the poor *December 2016*

Using the CLEANED approach to assess environmental impacts in the dual-purpose cattle value chain in Nicaragua

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Key messages

- The CLEANED approach was used to carry out a rapid, ex-ante assessment of assessment of different potential interventions to enhance Nicaragua's dual-purpose cattle value chains.
- Nicaragua's livestock sector is characterized by low productivity (700 kg of milk/animal/year), low reproduction rates (age at first calving 3-4 years) and low stocking rates (< 1 animal/ha). Few farmers use external inputs for livestock production (fertilizer for forages or concentrate feeds). The sector's extensive character, combined with inadequate pasture management and husbandry practices, causes feed deficiencies and pasture and soil degradation. Its contribution to agricultural greenhouse gas (GHG) emissions in Nicaragua is almost 50%, with an intensity of 10 kg of CO^2 equivalent per kg of milk.
- Improved technologies and practices to reverse this situation have been developed and validated. The CLEANED assessment indicates that implementing improved grasses and forages, combined with improved pasture management, silvo-pastoral components and improved breeds can improve productivity by up to 400% in terms of kg of milk /ha while reducing GHG emission intensity by 50%.
- The CLEANED methodology allows for rapid feedback to farmers and other value chain actors on interventions and encourages value chain actors to apply alternative and inclusive development pathways. It is a powerful tool to give rapid insight into the impact of sustainable livestock interventions and best-bets.

The challenge

Nicaragua's livestock sector is the largest in Central America, with 200,000 smallholder farmers generating 75% of their income from dual-purpose (milk and meat) cattle farming. The sector is a major pillar of the economy: Improved dairy and beef production, processing and marketing are important opportunities to improve farmer livelihoods and the nutrition of poor consumers, including vulnerable groups like children and pregnant women.

The productivity and product quality of Nicaraguan smallholder cattle farmers are negatively affected by a lack of adequate infrastructure, combined with often sub-optimal production practices. Inadequate pasture management causes soil degradation and feed deficiencies, issues which are exacerbated by climate change.

Addressing these challenges requires more efficient and productive smallholder cattle farming systems, improved natural resource integrity, increased added value to animal-source products, and strengthened links between the value chain components.

The overall goal of the Livestock and Fish CGIAR Research Program work on the dual-purpose cattle value chain in Nicaragua is to improve the competitiveness and income of small cattle farmers by creating and strengthening sustainable dairy and beef value chains, increasing access to high-quality products for poor consumers, diversifying products for national and regional markets and reducing the environmental footprint.

The environment agenda

Interventions on forages, breeding and husbandry have a great potential to increase cattle productivity and carbon accumulation, reduce GHG emission intensity and recuperate degraded soils.

Best practices for sustainable intensification of livestock production such as soil protection, more efficient nutrient use, and restoring degraded lands while storing carbon have been identified, developed and are being implemented. They are strongly connected to research on incentive mechanisms for sustainable livestock production, like generating carbon credits. Related socio-economic aspects at farm level have been researched, such as the trade-offs between use of biomass as animal feed versus for carbon accumulation, market perspectives and willingness to pay by the private sector.

The assessment process

In 2016, the CLEANED^{X} tool was used to compare and assess the environmental impacts of traditional extensive systems with two intervention strategies. Based on local data and expert opinion, three scenarios were defined and entered in the tool (see Table 1). The three interventions tested were:

- a traditional extensive system: as practiced by most livestock farmers and characterized by low stocking rates, low productivity, and very low external inputs.
- a silvo-pastoral system: scenario (i) plus a silvo-pastoral component (3 ha) and improved pasture management practices (increased stocking rates, increased production per animal).
- a semi-intensive system: based on scenario (ii) with improved pastures and improved cattle breeds.

The differences between these systems were assessed in terms of soil and greenhouse gas (GHG) emissions.

Table 1: Intervention scenarios

Herd composition and level of production						
	i. Traditional scenario		ii. silvo-pastoral scenario		iii. Semi-intensive scenario	
Livestock category	N	Annual milk production (kg/animal/yr)	N	Annual milk production (kg/animal/yr)	N	Annual milk production (kg/animal/yr)
Traditional cattle	8	700	12	1000		-
Improved cattle	-	-		-	15	1400
Other adult cattle	14	-	8	-	10	-
Calves	8	-	9	-	10	-
Feed basket						
	i.Traditional scenario		ii. Silvo-pastoral scenario		iii. Semi-intensive scenario	
	Wet season	Dry season	Wet season	Dry season	Wet season	Dry season
Traditional pastures	100%	40%	90%	35%	40%	10%
Improved (*Brachiaria*) pastures					50%	25%
Maize - crop residues		10%		10%		10%
Napier grass (*Pennisetum purpureum*)		50%		35%		35%
Leucaena leucocephala (tree legume)			10%	20%	10%	20%

Results of the assessment

The CLEANED assessment showed that the semi-intensive scenario 3 with improved pastures and cattle and including a silvo-pastoral component leads to a milk productivity increase by 300% (from 370 to 1300 kg/ha/year). The required area for feed production remains constant.

For the silvo-pastoral scenario 2 comprising better pasture management and a silvo-pastoral component, the assessment exercise assumed an increase in stocking rates of 100%, which doubles the productivity of the land.

Figure 1. Livestock and Fish critical success factors for genetic product development and delivery.

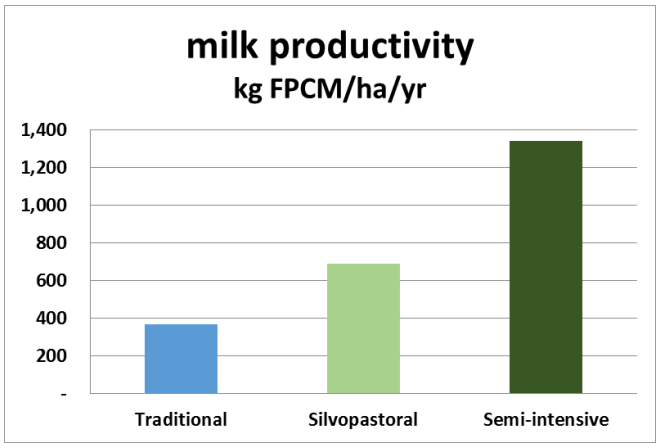
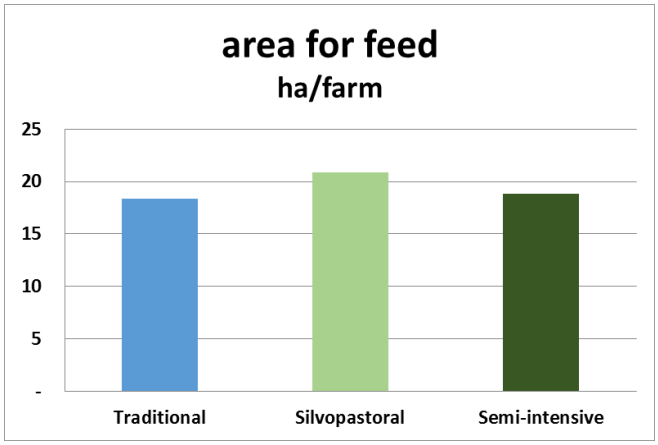


Figure 2: Feed requirements for the three scenarios



Both intervention strategies are projected to reduce the GHG emission intensity. The introduction of trees results in carbon accumulation. This carbon accumulation is highest in the semi-intensive scenario (2 t CO_2 eq./ha/year).

The major source of GHG emissions in all scenarios is methane from enteric fermentation (accounting for 76% in the traditional to 66% in the semi-intensive scenario), followed by nitrous oxide from manure (11% in the semi-intensive to 16% in the traditional scenario).

The transition from traditional to silvo-pastoral systems results in a decrease of GHG emission intensity from 10.7 to 6.7 kg CO_2 eq. per kg of fat-protein converted milk. In the semi-intensive systems this is projected to further decrease to 5.1 kg (Tier 2, IPCC).

Overall N balances are projected to be negative in all systems: 5 kg/ha for the traditional system, for silvo-pastoral and semi-intensive 10 and 22 kg/ha respectively (Figure 4).

Figure 3: Greenhouse Gas emissions for the three scenarios

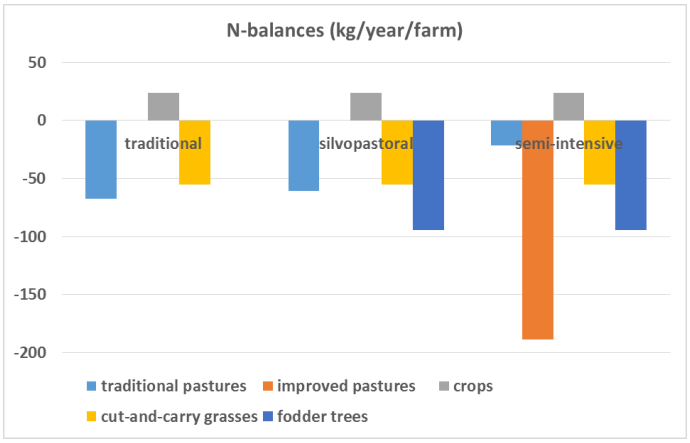
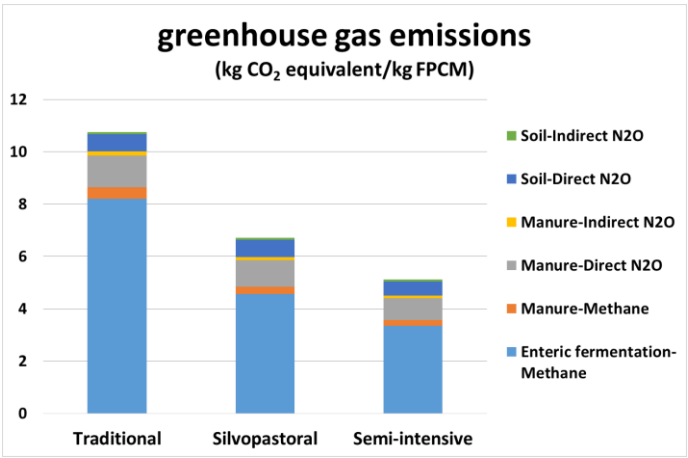


Figure 4: N-balances for the three scenarios



Discussion and significance

So far, adoption rates of the practices and technologies in scenarios (ii) and (iii) have been low, mainly due to a lack of incentives (markets) and (enforcement of) policies.

The results of this assessment and the recent increased emphasis on these practices in the Livestock and Fish country program (and others such as equity and establishment of stakeholder platforms) is leading to a shift towards sustainable intensification interventions. These could have significant impacts driven by lower GHG emission intensities and increased carbon accumulation through trees in silvo-pastoral systems, and improved forages producing more biomass throughout the year.

Two additional intervention, not included in the assessment, but likely to positively contribute to these challenges include manure use and payment for environmental services.

Manure is the second largest contributor to GHG emissions in such systems. The traditional management system, scenario 1, under-utilizes manure by stocking it with no end use. This means that pasture systems are being undermined, as nutrients are removed from the system, and pasture productivity will decrease over time. Applying manure back to pastures would close the nutrient cycle. Although GHG emissions would rise from the surface spreading of manure, pasture productivity would increase and ultimately further livestock productivity increases can be expected. Overall a decrease in GHG emission intensity is expected.

An important potential incentive in this area is payments for ecosystem services mechanisms explicitly designed to generate 'win-win' (environmental and productivity) benefits for buyers and providers. Actors in the Nicaragua milk value chain have a comparative advantage in terms of production costs and are competitive in export markets. Such schemes are however contingent on buyers' willingness to pay, as well as the strengths of underpinning motives to realize social, economic, and environmental and productivity gains through investment in ecosystem service provision.

Credits and more information

This brief was produced as part of a synthesis activity of the CGIAR Research Program on Livestock and Fish. It focuses on ex-ante environment impact assessment work carried out between 2012 and 2016 and supported by the Program and other investors. Development and testing of the CLEANED framework was led by the International Livestock Research Institute, with Stockholm Environment Institute, International Center for Tropical Agriculture and the Commonwealth Scientific and Industrial Research Organisation.

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