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Climate Smart Livestock: The interaction between mitigation, adaptation and efficient management practices in Ecuador

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Abstract

Identifying and implementing management practices that promote sustainable production in a climate change context, becomes a challenge. In Ecuador, the Climate Smart Livestock Project (CSLP) identifies practices to be implemented at farm level under a climate-smart perspective by considering three objectives: 1. sustainably increasing productivity; 2. adapting to climate change; and 3. reducing GHG emissions whenever possible. A quantification of GHG emissions from beef and dairy cattle at national level was carried out using local information with an IPCC 2006 tier 2 methodology to derive the estimates. For 2012, preliminary results show a value of 15465.70 Gg CO_2 eq from direct emissions, being 77.14% CH_4 from enteric fermentation, 17.93% N_2O from manure in pastures, 2.63% CH_4 and 2.31% N_2O from manure management. Adaptive capacity was quantified as part of climate risk, by analyzing the interactions between climate threats in three dimensions: environmental, socioeconomic and governance. A total of 14 categories of good livestock practices that contribute to a climate-smart management at farm level were identified. The impact of implementing the practices in 165 pilot farms is monitored through two web apps to estimate emissions and climate risk using herd management (number of animals, production, reproduction, weights, etc.) and farm data (area, conservation area, pastures, infrastructure, etc.).

Keywords: Climate change, livestock, greenhouse gases, climate risk, mitigation, adaptation, Ecuador.
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Introduction

According to the Intergovernmental Panel on Climate Change (IPCC, 2014), the increase of GHG has a direct influence on the occurrence of extreme climatic events, making productive systems more vulnerable. Livestock supply chain emissions account for 7.1 million Gg CO_2 eq, representing 14.5 % of anthropogenic gases worldwide (Gerber et al., 2013). At the same time, livestock activity represents almost 40% of the global agricultural value chain, providing employment for nearly 1300 million people (Mehta-Bhatt & Ficarelli, 2014). In Ecuador, for 2015, livestock industry participation in the Gross Domestic Product (GDP) accounted for 1.6% (BCE, 2016), occupying nearly 5 million hectares with 4.1 million animals. Despite of its contribution to the GDP and employment generation in rural areas, livestock production lacks practices aimed to increase their efficiency, thus reporting low yields (INEC, 2015) (MAE & MAGAP, 2016). According to the GHG National Inventory, in 2012, almost 46% of the emissions from the agriculture sector are associated with livestock, being enteric fermentation one of the main emission sources (MAE, 2017). Since 2016, the country is implementing the Climate Smart Livestock (CSL) Project in seven provinces of the country in order to: 1. sustainably increase productivity; 2. adapt to climate change; and 3. reduce GHG emissions whenever possible. At farm level, the objectives are pursued by properly identifying and implementing good livestock practices; and evaluating their impacts on mitigation and adaptation. The field intervention strategy as well as the GHG and adaptive capacity monitoring activities are presented in the following sections.

Methodology

Good livestock practices: a participatory approach to strengthen capacities

The identification and prioritization of productive problems, climatic threats and gender relationships in the livestock systems was carried out by implementing participatory techniques in order to promote local empowerment (Grundmann & Stahl, 2002). A total of 29 rural participatory workshops, 28 local vulnerability analyses and 7 gender analysis focus groups were implemented. Besides identifying the main problems in the productive system, the applied techniques propose suitable solutions to the local problems. A multidisciplinary technical team identified and prioritized good livestock practices, and 165 pilot farms were established to strengthen the capacities of producers and evaluate the impacts on productivity, mitigation and adaptation.

Quantification and monitoring of GHG direct emissions and climate risk

Direct emissions were calculated by applying the IPCC 2006 tier 2 methodology, through the application of the Global Livestock Environmental Assessment Model (GLEAM) developed by FAO (FAO, 2017). GHG emissions were estimated at national and farm level. In the first case; direct emissions were calculated for the 2010-2025 period by collecting data regarding productive and reproductive parameters, feed basket and manure management systems through 419 nationwide field surveys. Total animal number was projected from the historical data 1960-2009 published by FAOSTAT. At farm level, input data was collected in the pilot farms prior intervention of the CSL project (2017) and after implementing the good livestock practices (2018).

Climate risk was assessed in the seven intervention provinces based on the definition of climate risk presented on IPCC 5th Assessment Report: an interaction between climate threats, exposure and vulnerability of the system (IPCC, 2014). Due to information availability, the parish was defined as the analysis unit. The assessment was carried out on three dimensions: environmental, socioeconomic and governance by considering an exposed element for each one: pasture, animal tenure and associative level, respectively. Droughts, heavy rains, frosts and heat waves were analyzed considering the increase on extreme events during the last 30 years; 31 indicators were used to estimate sensitivity and adaptive capacity. Data sets per province were normalized assigning a value of 1 and 0 to the parishes with the highest and lowest indicator respectively, and were used as boundaries to normalize the other parishes. In order to estimate climate risk at farm level, 11 indicators for sensitivity and adaptive capacity were homologated, the rest of indicators as well as climate threats were maintained according to the parish the farm is located on.

In order to monitor the impact of implementing good livestock practices on mitigation and adaptation, two web tools were developed: An R programing module of GLEAM and an automated version of the excel tool, respectively. Both have a user-friendly interface that requests farm information, carries out the calculations and provides the results.

Results and discussion

Good livestock practices

As a result of the participatory process, 1017 livestock producers (32% women) have been linked with the project. The capacities of the producers have been strengthened through 37 farmer field schools (588 training workshops) influencing 33401 hectares. Additionally, 348 producers receive financial technical assistance and 1823 hectares implemented conservation practices due to the sustainable intensification of the system. A total of 88 good livestock practices grouped in 14 categories (Figure 1) were identified to integrate the climate smart approach, methodological guidelines and step by step infographics for each practice were developed. The impact of the good livestock practices on climate risk and emissions is evaluated with the two web apps developed by the project.

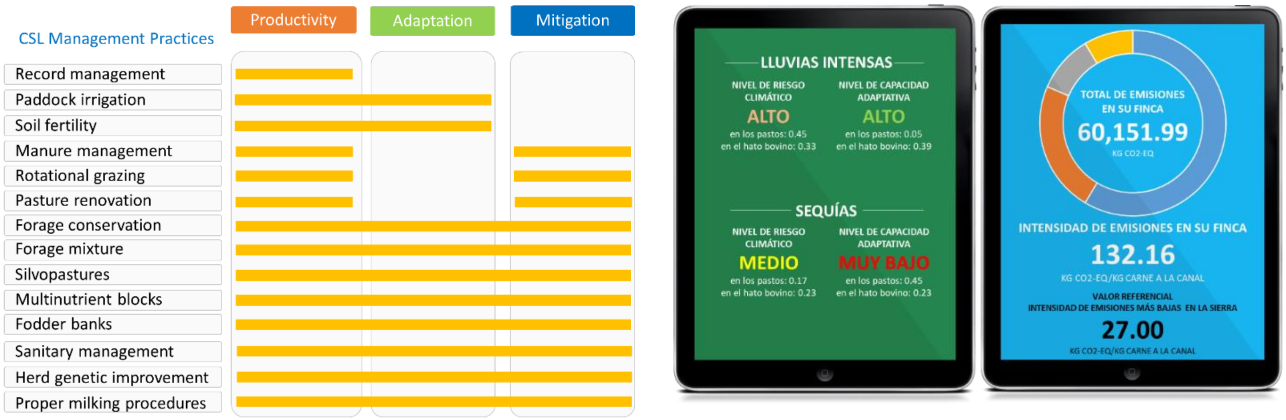

Figure 1. Good livestock practices and monitoring tools (web apps)

The participatory techniques used to identify and prioritize the needs and potential solutions seem to have empowered and involved local producers, since they directly contribute with almost 38% of the financing needed to implement the practices.

Quantification and monitoring of GHG direct emissions and climate risk

The quantification of GHG direct emissions at national level were calculated yearly for the 2010-2025 period. For 2012, the values obtained by the CSL project are much higher than the ones presented in the Third National Communication (Table 1).

Table 1. Livestock related GHG direct emissions at national level

Livestock related GHG direct emissions: 2012					
	Gg CO_2 eq				
Source	Enteric fermentation	Manure management	Manure management	Manure left on pastures	Total
	CH_4	CH_4	N_2O	N_2O	
CSL Project estimates	11930.19	406.12	356.84	2772.55	**15465.70**
Third National Communication	6361.04	190.38	151.72	--	**6703.14**

There are important differences between the estimates; however, no direct comparison may be done at this point since there are methodological differences on the calculations. Estimations for the Third National Communication apply the IPCC 1996 tier 1 methodology, while the CSL project applies the IPCC 2006 tier 2 version. Since the tier 2 methodology uses national data instead of default parameters, the information generated by the project is used to compute and update the National GHG Inventory. At farm level, the results on the 165 pilot farms are shown in Table 2.

Table 2. Monitoring results: GHG emissions and production

Variable	Year		Variation
	2017	2018	%
Direct emissions (t CO_2 eq)	19.583,02	15.595,17	-20,36
Milk production (l/year)	2'901.307,01	3'188.590,34	9,9
EI milk (kg CO_2 eq/l)	6,75	4,89	-27,54
Meat production (kg/year)	186.823,82	156.231,53	-16,37
EI meat (kg CO_2 eq/kg)	104,82	99,82	-4,77

GLEAM also allows to calculate total milk and meat production from the herd, as well as emission intensity (amount of emissions per unit of product), which can be used to evaluate the efficiency of the system since direct GHG emissions are considered as loss of energy (methane and nitrogen).

The reductions in meat and milk intensity, demonstrate that the implementation of the identified good livestock practices has increased the efficiency of the pilot farms. Most of the practices focus on improving the feed basket, which has an impact on reducing the GHG from enteric fermentation. Total direct emissions have also decreased after one year of implementing the practices. However, a long term monitoring is necessary to evaluate if the sustainable intensification will substantially increase the amount of animals per producer and thus, will have an impact on total emissions.

The first monitoring shows a climate risk reduction and an increase on adaptive capacity in the 165 pilot farms due to the impact of the implementation of good livestock practices (Table 3).

Table 3. Monitoring results: Adaptive capacity and climate risk

Variable	2017		2018		Variation
	Value	*Category	Value	*Category	%
Adaptive capacity	0.3468	4	0.4188	4	7.21
Climate risk	0.4544	3	0.4192	3	-3.52

*5-Very high; 4-High; 3-Moderate; 2-Low; 1-Very low

Conclusions

The CSL project identified good livestock practices that improve productive efficiency, reduce GHG emissions and adapt livestock systems to climate change. The implementation of 165 pilot farms distributed in 3 different regions of Ecuador gives the opportunity to collect data and monitor the impacts. The mitigation results show that enteric fermentation is the main source of direct emissions, thus it is recommended to continue implementing practices aimed to improve the feed basket.

Despite direct emissions have been quantified, it is advised to account for carbon sequestration activities that take place at farm level in order to better understand the mitigation potential of the livestock sector. Collecting and processing information regarding livestock management and farm data remains a challenge to evaluate mitigation and adaptation practices in Ecuador.

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