The New Tendencies of Environmental Impact Assessment of Livestock Production: A Road Testing of LEAP/FAO Biodiversity Assessment Guidelines in Pastoral Systems in Uruguay

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The new tendencies of environmental impact assessment of livestock production: a road testing of LEAP/FAO Biodiversity Assessment Guidelines in pastoral systems in Uruguay

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Abstract

After the publication of the "long shadow of cattle" report, ruminant production systems have received great pressure for their contributions in greenhouse gases (GHG). However, the environmental effects of human activities are much broader than GHG production and in some cases, there are positive contributions. In order to broaden the environmental perspective and with the encouragement of governments, the private sector and NGOs, LEAP-FAO has developed environmental assessment guidelines for the world's livestock production systems. This paper presents a road-testing of the Biodiversity Assessment Guideline at farm scale for six case studies in pastoral livestock systems in Uruguay. The producers involved correspond to farmers with a mixed livestock system (cows and sheep) with a full cycle and areas ranging between 2000 and 5000 hectares. Three of the farms have production based 100% on natural grasslands, while the other three had 30% of their area with sown pastures. The application of the guide at local level implies the use of the system of pressure, state and response indicators (PSR). The recommendation of the guide in its public review version requires a minimum set of 24 indicators, which can also be divided into several measurable variables. The results obtained in this study showed that the complete set is a reliable tool to evaluate the functioning of the systems in terms of their contribution to biodiversity conservation. However, some are more sensitive than others to evaluate changes depending on the scale. For example, the change in land use due to planting of forage crops clearly affects birds and arthropods such as spiders; though, due to scale of habitat use is less clear the global effect in bird population. The state indicators related to richness and diversity of species from different taxonomic groups is very relevant but result the more expensive issue in the assessment. Global indicators as the Ecosystem Integrity Index (EII) show a consistent effect of intensification but the connectivity in the actual percentages of natural grassland substitution is still good.

Introduction

After the publication of the "long shadow of cattle" report, ruminant production systems have received great pressure for their contributions in greenhouse gases (GHG). However, the environmental effects of human activities are much broader than GHG production and in some cases, there are positive contributions. In order to broaden the environmental perspective and with the encouragement of governments, the private sector and NGOs, LEAP-FAO has developed environmental assessment guidelines for the world's livestock production systems. This study presents a road-testing of the Biodiversity Assessment Guideline at farm scale for six case studies in pastoral livestock systems in Uruguay

Methods and Study Site

The application of the LEAP guidelines at local level implies the use of the system of pressure, state and response indicators (PSR). The recommendation of the guide in its public review version requires a minimum set of 24 indicators, which also can be divided into several measurable variables. For doing the road-testing at farm level in Uruguay, six study cases were involved. These study cases correspond to farmers with a mixed livestock system (cows and sheep) with a full cycle and areas ranging between 2000 and 5000 hectares. Three of the farms had 100% production based on rangeland (natural grasslands with different proportion of shrubs, isolated trees and small groups of trees) while the other three had 30% of their area with sown pastures. The table 1 resumes the set of indicators evaluated, the variables recorded, and the methodology used.

Table 1 – Set of basic indicators recommended by guidelines, variables recorded, and methodology used in this study			
Thematic issues Indicators	Category P, S, R	**Variables recorded**	**Methodology**
Procedural checks			
A scoping analysis was conducted	R	Scope of study is decided	Analysis of limits of the system studied
Regulatory constraints and extrinsic value are considered.	R	IUCN red listed species and national regulations such as protected areas and species	Consultation of national and international regulation
Progress is monitored	R	Measures are repeated every certain time	Compare results every time
Stakeholder engagement	R	Perspective/stakeholder analysis Iterative stakeholder engagement	Stakeholders inquiry
Habitat protection			
Wildlife habitats under the farm influence are inventoried (mapped) and protected	R	Different habitats are inventoried and mapped	Satellite images analysis and field validation
Semi-natural habitats in the landscape	P	Area or proportion (relative to the area controlled by the user)	Mapping
Grassland restoration	R	Area of degraded grassland restored through improved grazing management	Inventory of restoration initiatives
Habitat change			
Soil erosion and soil erosion risk are mapped and a management plan is Implemented	R	Soil erosion and soil erosion risk are mapped and a management plan is implemented	Evaluated throw EII (Blumetto et al, 2019)
Degraded soil	P	Area or proportion (relative to the area controlled by the user) of degraded soil	Evaluated throw EII (Blumetto et al, 2019)
Livestock density	P	Livestock density in number of animals or other livestock units	Stock registration of farmers
Habitat conversion	P	Area or rate of conversion of natural and semi-natural habitats	Mapping of environments and lands uses
Wildlife conservation			
Priority actions promoting species with high conservation value are listed and implemented	R	High conservation value includes national and international designations	Actions in management if exist
Particular species (with high conservation value)	S	Presence of priority conservation species	Species in Uruguayan priority conservation lists
Species richness or diversity	S	Number of species (S) and Shannon diversity index (H) of herbaceous plants, trees, birds and spiders	Botanic census, MacKinnon lists, pitfall traps and grasses and bushes aspirations
Invasive exotic species			
A management plan is in place for the control of invasive species	R	Existence of control	Farmer's control plan
Invasive exotic species	P	Presence/absence, abundance and/or distribution	Registration of alien plants and animals
Pollution & aquatic biodiversity			
A management plan is in place for the application of ecotoxic agrochemicals	R	Pesticides, veterinary products application	Records of farmers

A nutrient management plan is in place to rationalize fertilizer application	R	Fertilizer application	Records of farmers
Protected waterways	R	Length or proportion (relative to length controlled by the user, or to the length in need of protection)	Mapping
Biological indicators of water quality	S	Fish richness and diversity	Electro-fishing in two reference streams
Off-farm feed			
An inventory of the off-farm feed being used is established	R	Categorizing and countifying off farm feed	food purchase record
Traceability systems for feedstuff is implemented	R	Tracking of off farm feed	Investigating feedstuff supply chain
Share of imported feed	P	Share of imported feed from areas that are certified/deforested/ of high conservation value	Registering origin of imported feed if correspond
Landscape scale conservation			
Measures to promote connectivity	R	Habitat mapping and assessment of connection between habitat patches and between water bodies	Assessment of measures adopted if necessary

Results

The study has two main groups of results, the own biodiversity indicators results and the analysis of the applicability of guidelines, on which we will focus the discussion.

Indicators results (selection)

The application of ecosystem integrity index (EII) gives a general view of ecosystem state and show global values ranging from 3.1 to 4.0 as displayed in figure 1. There are variations between paddocks within each farm, and is a beat lower in farms with 30 % of pastures (B, E and F). Nevertheless, the connectivity of different ecosystems is still good for all the farms.

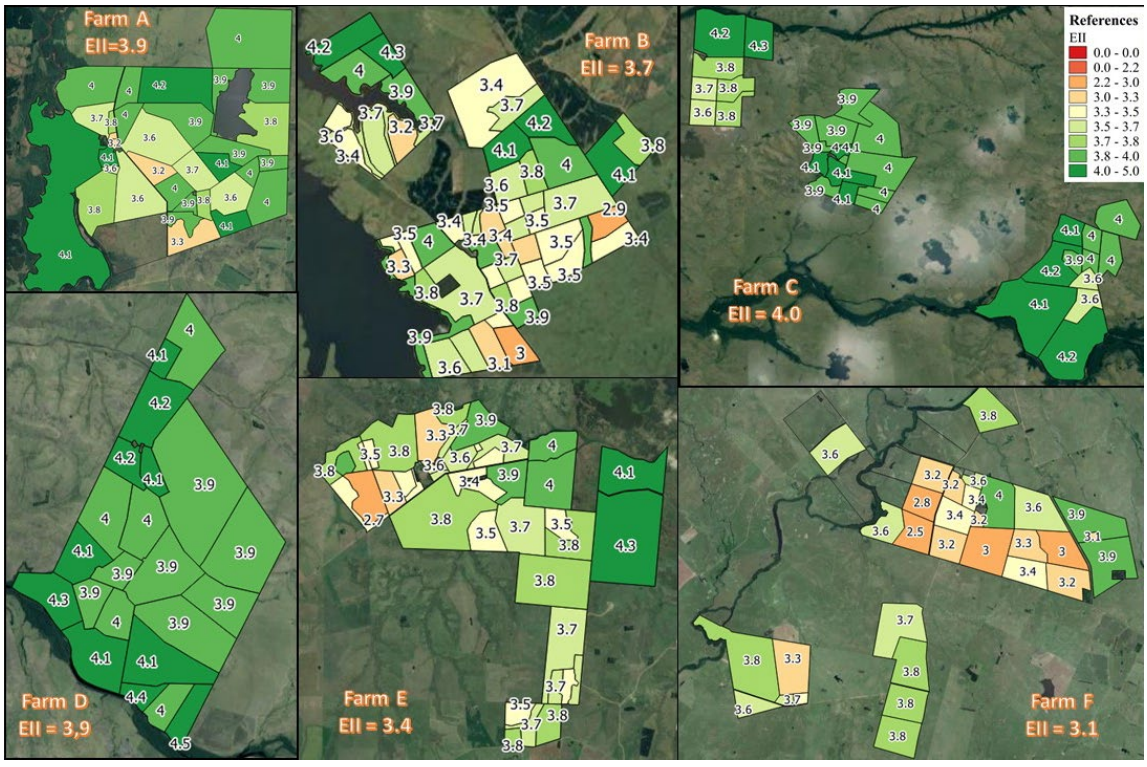

Fig 1 – Graphical representation of values obtained for EII for each paddock and whole farms

Regarding to wildlife communities, 196 species of birds were recorded considering all farms, 26 of these species are included in priority conservation list (Soutullo *et al,* 2013).We recorded 162 species for natural

grasslands, 89 species in sown pastures and 90 species in natural forests, 16 of which are exclusive from this environment.

Spiders were represented by 79 species in all farms, and two of them are considered of conservation priority according to the Uruguayan priority species list for spider conservation importance (Ghione et al. 2017). The species richness and diversity of spiders was clearly higher in natural grasslands (S: 74; H´ diversity index: 2.97) comparing to sown pastures (S: 45; H´ diversity index: 2.75).

A total of 35 species of fish were collected, with 20 species in the most diverse stream and 4 species in the least diverse. Ten of the recorded species are considered priority for conservation (Soutullo *et al*, 2013)

Analysis of Guidelines applicability

The application of the different indicators had three main sources of information: (1) satellite images and pre-existing mapping, (2) productive records of the farmers and (3) field work to survey the different wildlife groups. The information required was adequately available and had high quality levels. The evaluation of state indicators required a significant investment of time of several specialists and varied operational resources (as travelling costs and laboratory analysis).

Discussion and Implications

This work is the first road testing of this guide in local level analysis (farm or landscape). The set of recommended indicators published in the public review version, was applied without technical problems. Both general information and farmer individual data were adequately accessible and then, the obtention of pressure or response indicators was completely possible. However, these indicators have relative low value if we do not have adequate state indicators to measure the consequences of management measures taken (response) or land uses and management of productive systems (pressures). The state indicators are only three: species richness or diversity, particular species (with high conservation value) and biological indicators of water quality (see table1). These indicators have really a wide spectrum of possibilities related to variables or taxonomic groups to study, but then, their value depends strongly on how comprehensive the study is done. In our case the inclusion of flora (herbaceous and woody), birds, fishes and spiders, bring a wide panorama including plants, vertebrates and invertebrates. However, these kinds of studies are very expensive, in time and money, to carry out. In addition, each group requires a certain number of specialists. Some can be recorded in a single time, but most of them need more instances, often seasonal assessments. The EII is a more economic tool for a state indicator at ecosystem level, including the possibility of adapting life cycle thinking by application in off farm feed production. Nevertheless, persist the necessity of obtaining some information at species or community level.

Finally, we consider that the LEAP´s biodiversity assessment guidelines is a useful tool for evaluate the interaction of productive system with the environment and planning management in consequence. It is necessary to find the adequate amount of resources for make the studies such comprehensive and deep as possible. In studied cases, a high richness and diversity have been recorded in these systems, which demonstrate the importance of it for maintaining habitat for wildlife species. The results obtained in communities such as birds or spiders also showed that substitution of natural grasslands by pastures could reduce species richness and diversity, so this way of production intensification has to be carefully studied for not to compromise the sustainability of the ecosystems involved.

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