DEEP-DIVE ANALYSIS ON ARGENTINA CATTLE LEATHER PRODUCTION IMPACTS ON BIODIVERSITY, ECOSYSTEMS, AND LAND

REPORT

THE FASHION PACT

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EXECUTIVE SUMMARY

Transforming the Fashion Sector with Nature is a two-year project funded by the Global Environment Facility (GEF). Conservation International, a GEF Agency, is partnering with The Fashion Pact to work together in executing this project. By using world-class science, this project aims to better understand and mitigate the fashion industry's impact on biodiversity.

Under this project, deep-dive analyses were conducted by Conservation International, along with the International Union for Conservation of Nature (IUCN), Natural Capital Coalition, and the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), applying the current Science Based Targets for Nature (SBTN) metrics for land, ecosystem services, and biodiversity to understand the associated impacts of three key commodity supply chains: **cotton in the United States, leather in Argentina, and viscose in Austria and Indonesia.**

The deep-dive analyses included four metrics, Species Threat Abatement and Restoration (STAR), Ecosystem Integrity Index (EII), the SBTN Land Hub Impact Indicators (Land Hub Indicators), and Ecosystem Services. Each metric modeled a variety of interventions. The STAR metric quantifies the potential opportunity to reduce the risk of species extinction and identify conservation and restoration actions. STAR modeled interventions for zero-deforestation and protection of riparian areas. The EII metric measures the alignment between an area of interest and its natural ecosystem counterpart. EII modeled interventions for zero-deforestation and fire prevention. The SBTN Land Hub Impact Indicators are focused on developing targets for land systems, in both natural and working lands. Currently, there is not an impact factor for cattle under the Land Hub Indicators. Therefore, the metric analyzed the conversion of native vegetation, land productivity and soil organic carbon. The Ecosystem Services metric demonstrates the benefits to humans from nature. For this metric, the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST), measured the impact leather has on nitrogen retention, sediment retention, and carbon storage.

Based on these analyses, summary reports were produced for each commodity to support companies looking to set science-based targets for nature and to identify opportunities to strengthen actions and investments for biodiversity and nature-positive outcomes. This report focuses on the findings and recommendations for leather in Argentina; the other reports can be found here.

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KEY FINDINGS AND RECOMMENDATIONS

Findings from the analyses detail how leather production impacts biodiversity in Argentina. Results range from identifying the top threats to threatened and endangered species, the changes to ecosystem integrity if scenarios for avoided deforestation and riparian protection are put in place, the native vegetation loss due to cattle density and losses in soil organic carbon, as well as the livestock-related deforestation estimations, and other soil quality and condition metrics. These findings can help companies better understand their direct and indirect impact from sourcing locations and prioritize actions to abate or alleviate impacts to sensitive regions or species.

The **key recommendations from the deep-dive analysis** on leather production underscore the importance of:

1.) establishing supply chain traceability to the slaughterhouse, at a minimum, and additional traceability to the feedlot or farm;

2.) working with suppliers to understand and/or establish zero-deforestation[1] and traceability commitments; and

3.) aligning company commitments and targets with global standards.

For the purposes of this report, we focused on road-testing these metrics, but these are not the types of scientific steps a company must take. Companies should follow the corporate-friendly guidance from SBTN.

Although this report is specific to leather production in Argentina, this analysis can be exemplary and easily applied to other leather production in any country. For companies who do not source from Argentina, this report may still be relevant to their cattle leather supply chains given the extent of feed crops produced in Argentina that are exported to feed cattle in many other countries, including cattle raised in Europe.

[1] Zero-deforestation commitments are the actualized avoided deforestation actions taken or committed to by a party. Avoided deforestation is the outcome of actual or anticipated impacts on remaining standing forests if an activity stops or diverts. This includes conversion of natural forest to tree plantations and/or pulp plantations.

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INTRODUCTION

The Fashion Pact, a global initiative composed of companies in the fashion and textile industry, has committed to transforming the fashion sector to improve sustainability performance across the entire sector. The Fashion Pact focuses on driving change in three areas: climate, biodiversity, and oceans.

With support from the Global Environment Facility (GEF), Conservation International and The Fashion Pact Association launched Transforming the Fashion Sector with Nature, a project that focuses on using science to better understand and mitigate the fashion industry's impact on biodiversity. Through this initiative, we aim to 1) provide companies across the fashion sector with a foundational understanding of the environmental impacts of the production and extraction of raw materials through deep-dive analyses on key production areas for cotton, leather, and viscose; and 2) support companies across these supply chains to identify opportunities for further action, investment, and collaboration through a scenario analysis of potential interventions and outcomes. Together, these outputs can help fashion companies prioritize actions that can have the greatest impact for biodiversity.

This report is an adaptation of one of the primary outputs of the first objective – a deep-dive analysis of the environmental impacts of leather production in Argentina. This report uses country level data to assess biodiversity, land, and ecosystem metrics in key leather production regions. Companies sourcing from Argentina can use this study to better understand the environmental impacts of their supply chain and inform company commitments and actions to protect, restore or regenerate nature in key production regions. For companies who do not source leather or cattle products from Argentina, this report still holds value to their supply chain. Many companies that raise cattle elsewhere, for example in Europe, feed cattle crops produced in Argentina and Brazil. The findings below show the extent to which threats from annual and perennial crops, including soy and corn, are impacting this region. This report illustrates an example of how impacts can be measured across commodities and production regions, and can inform company interventions for both cattle and cattle feed.

METHODS

One of the goals of the Transforming the Fashion Sector with Nature GEF project is to align corporate actions with The Science Based Targets Network (SBTN), a collaboration of organizations developing guidance to support companies and cities in setting science-based targets for land, freshwater,

oceans and biodiversity. As the biodiversity pillar's delivery partner, Conservation International seeks to provide sector-specific guidance for how companies across the fashion and textile industry can apply the developing methods of the SBTN, how those methods can inform corporate sustainability commitments and targets, and the utility of the methods and metrics in measuring the impacts of corporate actions.

In this analysis, Conservation International along with the International Union for Conservation of Nature (IUCN), Natural Capital Coalition, and the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) conducted a series of deep-dive analyses applying the current SBTN metrics for land, ecosystem services, and biodiversity to the leather supply chain.

The study area was defined by key leather producing regions in Argentina. To spatially identify the area where cattle are raised for leather production[2] a we applied a density threshold of 200 cattle (more than 200 cattle per ~8 km^2). The map below indicates areas where cattle density is greatest (Figure 1). The analyses were conducted using four metrics: the Species Threat Abatement and Restoration Metric (STAR), the Ecosystem Integrity Index (EII), the SBTN Land Hub Impact Indicators, and Ecosystem Services. These metrics were applied to both baseline and intervention scenarios to understand the impacts of sustainability interventions companies are looking to make.

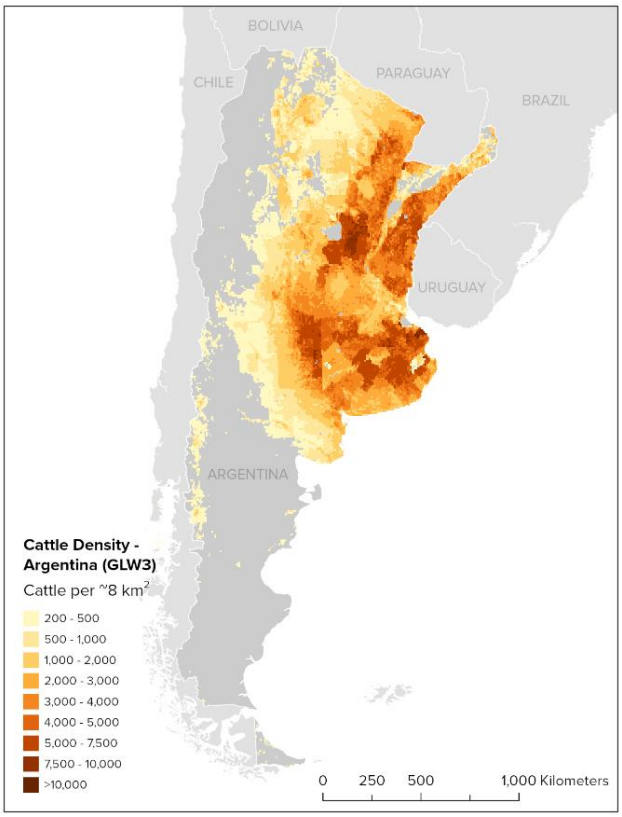

Figure 1. *This figure shows areas where cattle density is greatest. Areas in orange have higher density of cattle per unit area. The density is concentrated around Buenos Aires, which could indicate the point of export.*

[2] Gilbert, Marius; Nicolas, Gaëlle; Cinardi, Giusepina; Van Boeckel, Thomas P.; Vanwambeke, Sophie; Wint, William G. R.; Robinson, Timothy P., 2018, "Global cattle distribution in 2010 (5 minutes of arc)", https://doi.org/10.7910/DVN/GIVQ75, Harvard Dataverse, V3

STAR: Species Threat Abatement and Restoration Metric

The STAR[3] metric uses data from the IUCN Red List of Threatened Species to quantify the potential opportunity for reducing the risk of species extinction and to identify opportunities and guide conservation and restoration actions (Mair et al 2021)[4]. STAR can be used to identify areas where certain actions can abate threats to threatened species or where restoration can help reduce the risk of extinction. The metric currently covers amphibians, birds, and mammals, and is in the process of extending to marine and freshwater systems, including reptiles. The metric combines data on species' range (Area of Habitat; AOH), conservation status of species (i.e., Near Threatened, Vulnerable, Endangered and Critically Endangered), and threats from IUCN Red List threats classification scheme (e.g., wood and pulp plantations, oil and gas drilling, agricultural and forestry effluents, etc.) to produce two data layers with associated scores on the biodiversity potential for threat abatement ($STAR_T$) and restoration ($STAR_R$). High $STAR_T$ scores indicate areas where species, individuals, or ecosystems are threatened, indicating key areas for opportunities to reduce threats. High $STAR_R$ scores indicate areas where threatened species habitats have been lost or threatened and can identify key places for restoration.

To estimate the contribution to global species extinction risk caused by Argentinian leather, we applied a derivative of the STAR metric. By using national commodity production values and national impacts on biodiversity caused by the production of the commodity, this data quantified potential threat reduction and restoration activities that can reduce species extinction risk.

EII: Ecosystem Integrity Index

The EII[5] measures to what degree the area of interest is aligned with characteristics of natural ecosystems using a combination of geospatial layers representing three components:

- Ecosystem Composition – The Biodiversity Intactness Index (BII) summarizes how human pressures change the ecosystem by looking at the percentage of the original species population in an area compared to populations in a natural setting. The impact of human activity on species abundance and the similarity between disturbed ecological communities and their reference sites is calculated. These results are projected onto maps of human pressures (i.e., land use change, population density) to create a map of BII for the area.
- Ecosystem Structure – The structural component of EII includes habitat area, quality, and fragmentation by using multiple input layers including population density, built-up areas, agriculture, roads, railroads, mining, oil wells, and wind turbines and electrical infrastructure.

[3] IUCN STAR Metric

[4] https://doi.org/10.1038/s41559-021-01432-0

[5] Hill, S. L. L. et al., (2022). The Ecosystem Integrity Index: a novel measure of terrestrial ecosystem integrity with global coverage. bioRxiv 2022.08.21.504707; doi: https://doi.org/10.1101/2022.08.21.504707

- Ecosystem Function – This layer includes the interactions between abiotic and biotic components, which describes the ratio between the observed and natural net primary productivity (NPP) level or the rate of production of biomass per land surface. The larger the difference between the observed productivity and natural productivity, the more degradation or loss of ecosystem function.

For this indicator, we modeled zero-deforestation interventions and riparian protection interventions. For the zero-deforestation intervention, we projected EII outcomes for two future development scenarios based on targets under SSP3 and SSP5[6] Since deforestation of natural forests would lead to a decrease in ecological integrity, it would affect three components of EII. For the riparian protection intervention, the three components were modified to create a new EII layer that would occur if riparian areas were protected across areas with cattle in Argentina.

Land Hub Indicators

The SBTN Land Hub[7] is focused on developing targets for land systems – including both natural ecosystems like forests, grasslands, and woodlands, as well as "working lands" such as pasture and agricultural and the built environment like cities and linear infrastructure. The Land Hub is therefore interested in indicators that both capture change among categories (e.g., from forest to pasture), as well as changes that might occur on land under continual use (e.g., loss of topsoil that might occur in working lands due to poor soil maintenance). To address these impacts through avoidance or reduction of impacts, regeneration, or restoration, the Land Hub identified seven indicators: 1) conversion of native vegetation (forest); 2) conversion of native vegetation (non-forest); 3) productivity; 4) soil carbon; 5) soil erosion; 6) pollution; and 7) infrastructure development. The Land Hub piloted an assessment tool (CAMEL) for an initial set of commodities.

Since the Land Hub has not yet developed impact factors for cattle ranching or for leather production, instead we used datasets on change in soil organic carbon, productivity, and loss of native vegetation (both forest and non-forest, separately).

Ecosystem Services

Ecosystem services are the benefits from nature that sustain human life. There are several methodologies to quantify ecosystem services. Here we used a spatial model that demonstrates ecosystem processes in a mechanistic way. Specifically, we used the Integrated Valuation of Ecosystem Services and Tradeoffs[8] (InVEST), a free and open-source software tool developed by the Natural Capital Project, with services including carbon storage and sequestration, crop pollination, crop production, forestry, livestock production, annual and seasonal water yield, coastal risk reduction, sediment retention, nitrogen retention, recreation, and scenic quality.

[6] https://unfccc.int/sites/default/files/part1_iiasa_rogelj_ssp_poster.pdf
[7] SBTN Land Hub
[8] InVEST

This tool uses land-use/land cover maps to show ecosystem services across a landscape and if an ecosystem is altered the reciprocal impacts it will have on nature and the people who depend on the associated benefits.

Modeled Interventions:

The interventions assessed in the analysis were

- Zero-deforestation: What forests and ecosystems would be protected if companies enact and fulfill their zero-deforestation commitments.
- Protection of riparian areas: Within cattle production regions, protection and restoration to native habitat of riparian areas around major river systems.
- Prevention/decrease of fires: Fire reduction and prevention within cattle production landscapes.
- Change in soil organic carbon (SOC): The amount of measurable carbon component in soil organic carbon plays an important role in soil retention, structure, and sequestration among others.
- Land productivity: The amount of sustainable land use and output generated
- Conversion of native vegetation (forest/non-forest): The change in land cover to another use

STAR, EII, and Ecosystem Services modeled zero-deforestation, while EII modeled protection of riparian areas, and STAR modeled fire prevention. Because the Land Hub has not yet developed a leather-specific impact factor, we applied alternative methods aligned with those used for the other Land Hub impact factors to estimate the impacts of leather production by looking at change in SOC, land productivity, and conversion of native forests (Table 1).

Table 1. Modeled interventions for leather

	STAR	EII	Land Hub Indicators	Ecosystem Services
Zero-Deforestation	x	x		x
Protection of riparian areas		x		
Fire prevention	x			
Change in SOC			x	
Land productivity			x	
Conversion of native vegetation (forest/non-forest)			x	

LIMITATIONS

The metrics used in this analysis provide valuable assessments to companies, especially when deciding where to prioritize efforts and identifying the impact to biodiversity. Across all the metrics, a major limitation is access to supply chain level data. In all cases, the more granular data the more accurate the analysis. Each metric has limitations and nuances that are important to note, though this list is not exhaustive of all known limitations. STAR values are directly dependent on the total area that is assessed (i.e., the larger the areas, the more species at threat) but do not consider other factors such as the production practices or the production yields. This metric is also just focused on terrestrial vertebrates (amphibians, birds, mammals, reptiles) and insects and aquatic species, which are not accounted for in the metric. Having access to spatially explicit data to determine the impact on biodiversity is key to STAR, and without that level of detail, the metric remains more general. The limitation for EII is poor quality and mismatched resolution of the data. Due to the movement pattern of cattle, data rescaling and pixel scores were based off the amount of potential cattle in each area. If these steps had not been taken, it could have resulted in gross homogenization of integrity across the study area. Land Hub Indicators limitations are due to the factor that an impact factor for cattle ranching or leather production has not yet been produced. Therefore, we had to supplement with other datasets to provide a complimentary approach for the metric.

FINDINGS AND RECOMMENDATIONS

STAR

Across Argentina, the total $STAR_T$ score is 1,552,821.74 centiSTARs. Findings show that the highest values for $STAR_T$, indicating the greatest areas of species threat, are found in the northwest, northeast, and southwest regions of the country (Figure 2, left). A similar pattern was observed when considering only the threat from livestock farming and ranching (Figure 2, right). It is important to note that the low scoring areas do not mean there are no threatened species present, it indicates that the threat from cattle ranching and livestock is lower to the species present.

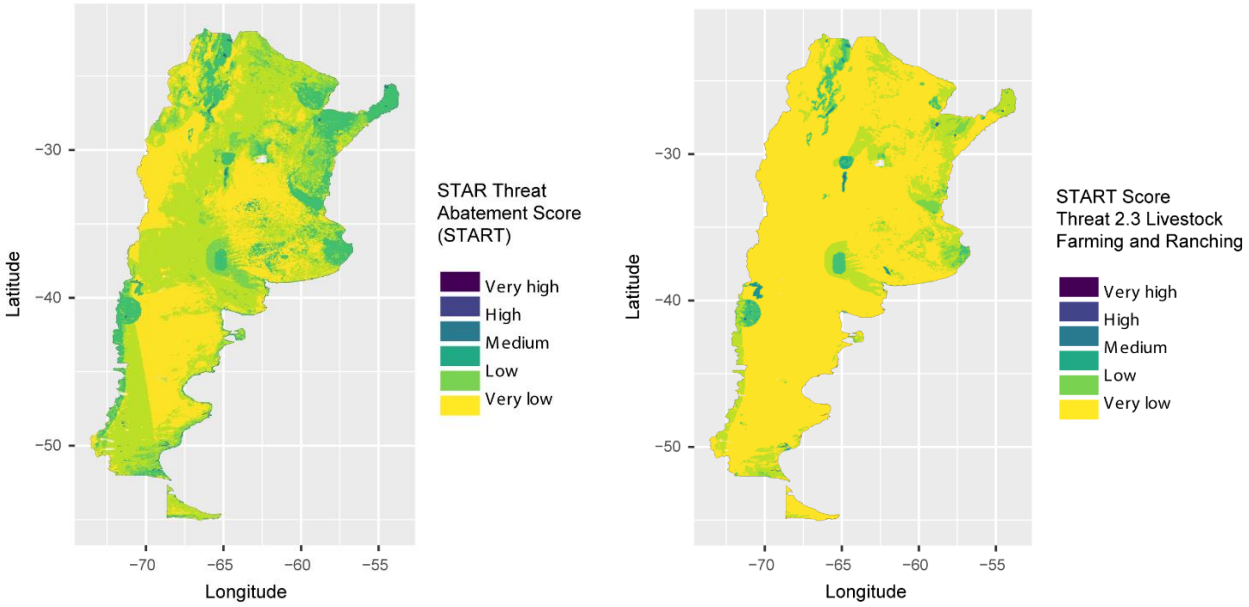

Figure 2. *(left) STAR Threat Abatement ($STAR_T$) map for Argentina for all threats. Grid cell score categories range from Very Low to Very High. Note that low scores do not mean that there are no threatened species present. Grid cells are at a 5 km resolution. (right) STAR Threat Abatement score for Threat 2.3. Livestock Farming and Ranching in Argentina (21.39% of total STAR score for Argentina). Grid cell score categories range from Very Low to Very High.*

Each threat analyzed in STAR received a score based on its contributions to the STAR Threat Abatement ($STAR_T$) score. Within the landscapes, the top threat afflicting species in Argentina is livestock farming and ranching, which is directly associated with cattle ranching and leather (Figure 3). This threat in combination with the following top contributors – annual and perennial non-timber crops, invasive non-native/alien species and diseases, and logging and wood harvesting – account for 61% of the total species extinction risk.

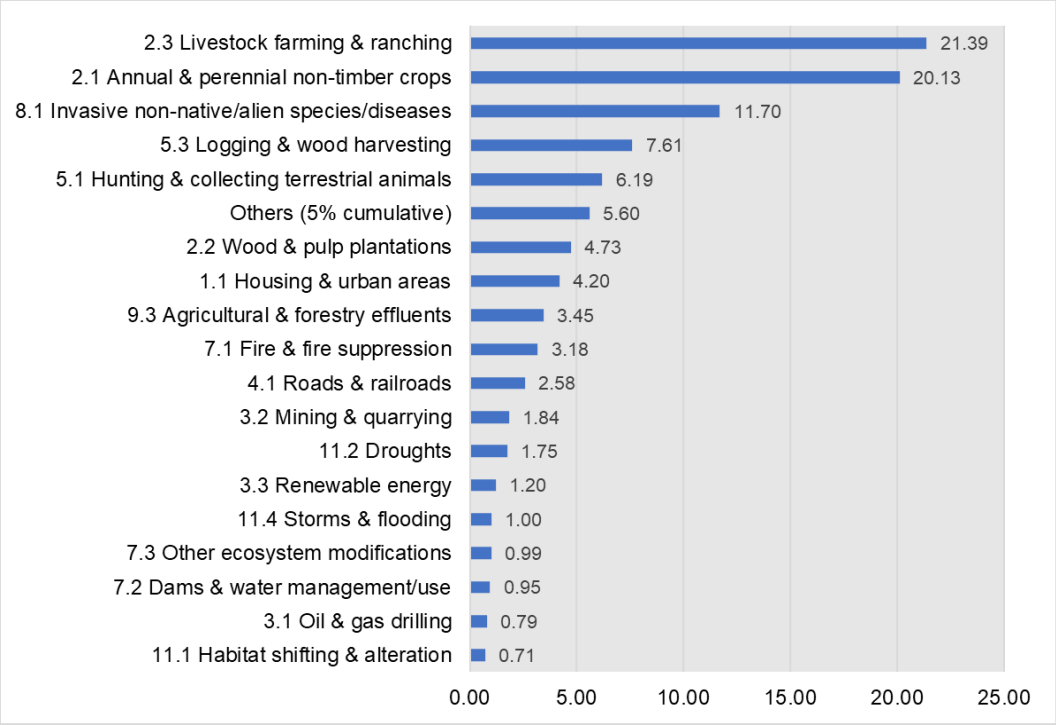

Figure 3. *Breakdown of STAR Threat Abatement score for Argentina ($STAR_T$ = 1,552,821.74 centiSTARs) by threat types and relative contributions (%) to overall score. By including other non-related threats, demonstrates the significant proportion related to livestock farming and ranching and annual and perennial non-timber crops.*

The total STAR Restoration score ($STAR_R$) for Argentina is 1,122,913 centiSTARs. The highest values are found in the northeast regions of the country. The threat whose abatement in restored habitats would greatly contribute to reducing species extinction risk are annual and perennial non-timber crops, and livestock farming and ranching. Together, these two threats account for 89.33% of the total species extinction risk (Figure 4).

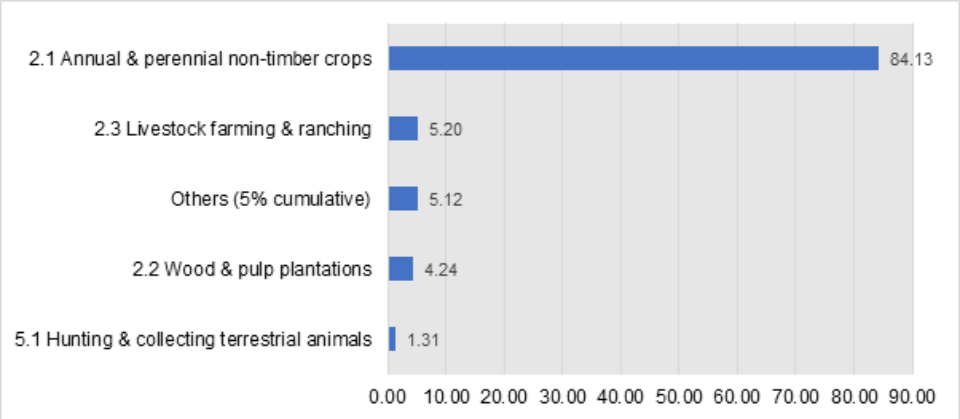

Figure 4. *Breakdown of STAR Restoration score for Argentina ($STAR_R$ = 1,122,913.00 centiSTARs) by threat types and relative contributions (%) to overall score. It is important to note the impacts of annual and perennial non-timber crops, such as soy or corn production, in the country. These crops are frequently produced in Argentina, and they are exported globally, including to Europe as feed for cattle.*

Interventions

To accurately calculate a company's impact on species extinction, it is critical to have supplier data. This could be georeferenced farm locations or even information to the slaughterhouse or feedlot. With granular data, STAR is able to depict where activities are taking place and species at risk due to production. Generally, in Argentina, restoring forests lost to cattle ranching provides the greatest benefit for reducing species extinction risks.

Through this analysis, we identified sites for further engagement by locating the areas across the country where there are currently opportunities to undertake actions on the ground to promote zero-deforestation commitments[9] and overlaid those with the Livestock Farming and Ranching data layer. It is possible that these areas, highlighted in red, could most positively impact biodiversity by working with the local ranchers to commit to zero-deforestation (Figure 5).

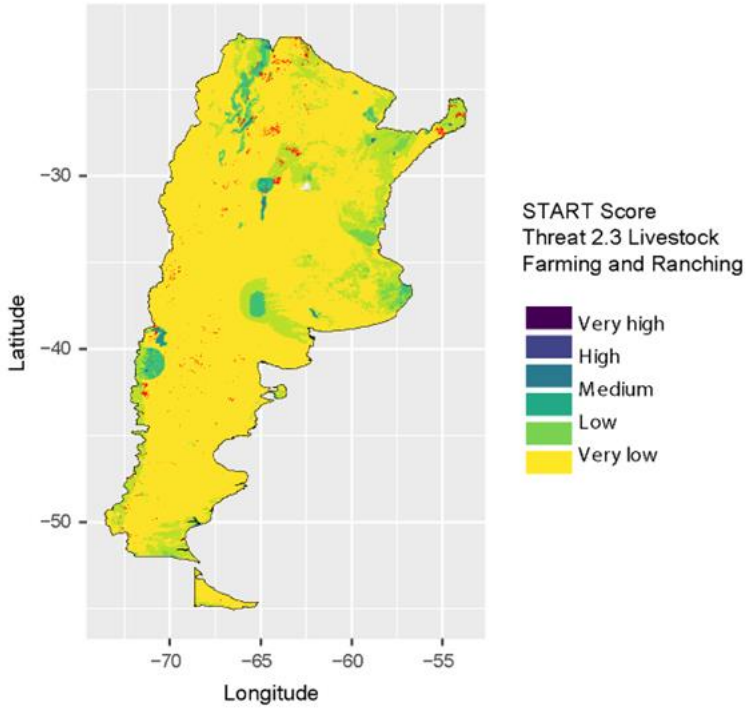

***Figure 5**. Zero-deforestation/conversion areas in Argentina (red points) overlapping with STAR Threat Abatement opportunity layer for Livestock Farming and Ranching Threat in Argentina. We used the 2050 SSP5 RCP 8.5 Land Use Dataset (GLOBIO - Global biodiversity model for policy support) to obtain the zero-deforestation/conversion areas in Argentina. The red points represent areas where there is an opportunity for no deforestation/conversion commitments, and there are currently no commitments. The obtained raster layer was converted to polygon data to perform STAR$_T$ analysis. Note that low STAR$_T$ scores do not mean that there are no threatened species present. STAR$_T$ grid cells are at a 5 km resolution.*

[9] GLOBIO https://www.globio.info/globio-data-downloads

A similar analysis was conducted on the second intervention of fire and fire suppression. By combining the fire threat with the fire density distribution across the country, we identified four areas with the highest STAR$_T$ scores which indicate priority areas for fire abatement actions (Figures 6 and 7).

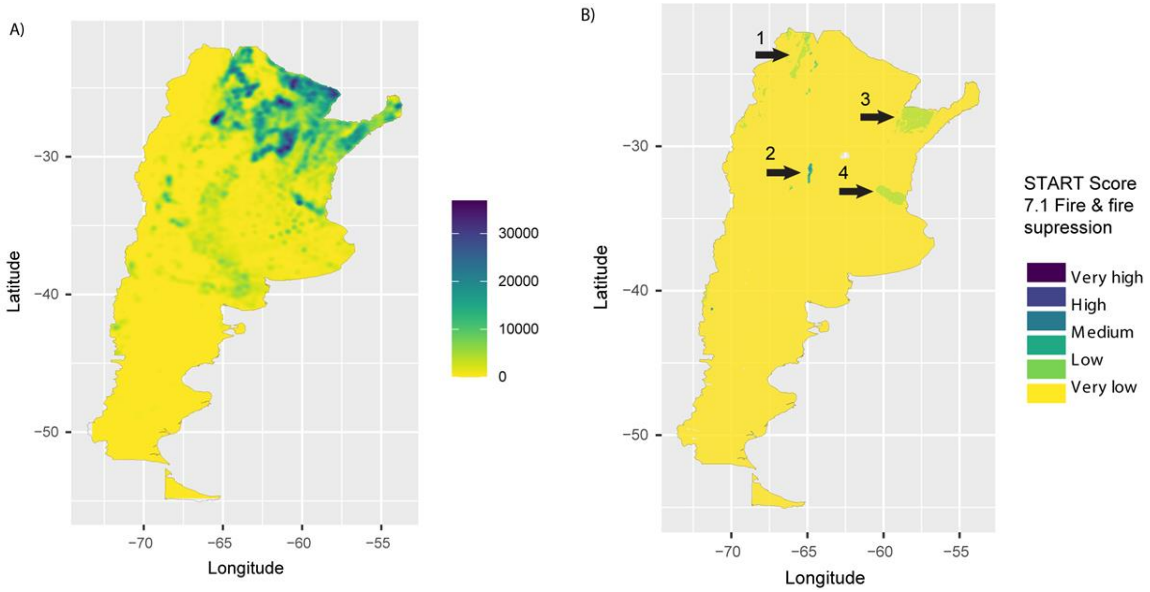

Figure 6 and 7. *Fire density in Argentina* ***(A)*** *and STAR Threat Abatement score for Threat 7.1. Fire & Fire Suppression for Argentina* ***(B)****. Note that low scores in STAR Threat map do not mean that there are no threatened species present. Grid cells for both maps are at a 5 km resolution. A bilinear interpolation method was performed to the Fire density map to change original resolution (~90 m) to 5 km resolution for cross comparison with STAR$_T$ layer.*

From these two interventions, we identified 145 species of amphibians, birds, mammals, and reptiles threatened by Livestock Farming and Ranching (Figure 8).

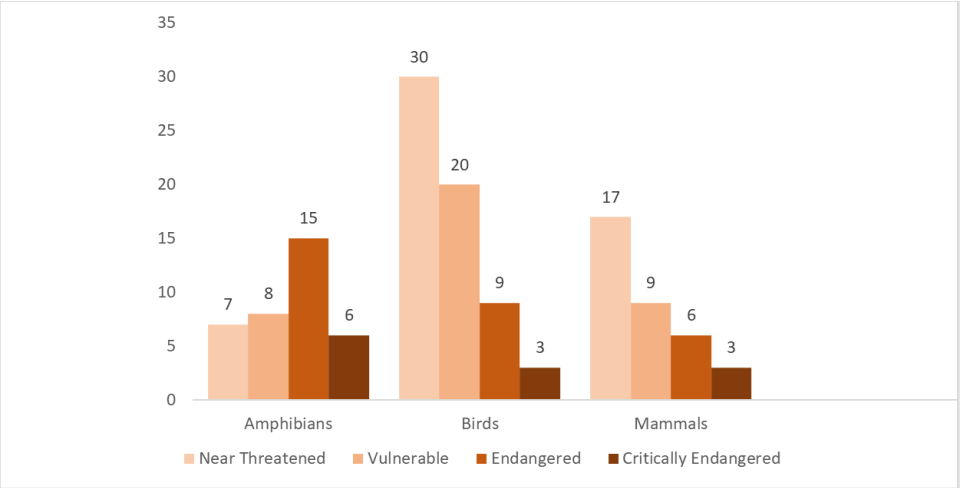

Figure 8. *Cattle leather production in Argentina presents threats to the following species categories (see appendix for full species list for Argentina cattle) from the STAR metric.*

EII

Ecological integrity in Argentina varies across cattle production areas (Figure 9). Cattle-producing regions encompass areas with a wide variety of ecosystem integrity conditions, which is reflected in EII and in the histogram of values. It includes areas that range from high integrity ecosystems, such as inland areas with EII over 0.7 where the number of cattle heads is typically low, to low and very low integrity regions (EII < 0.4) in parts of the country with a higher population and cattle production, like the Rio de la Plata delta. On average the baseline EII value is 0.583.

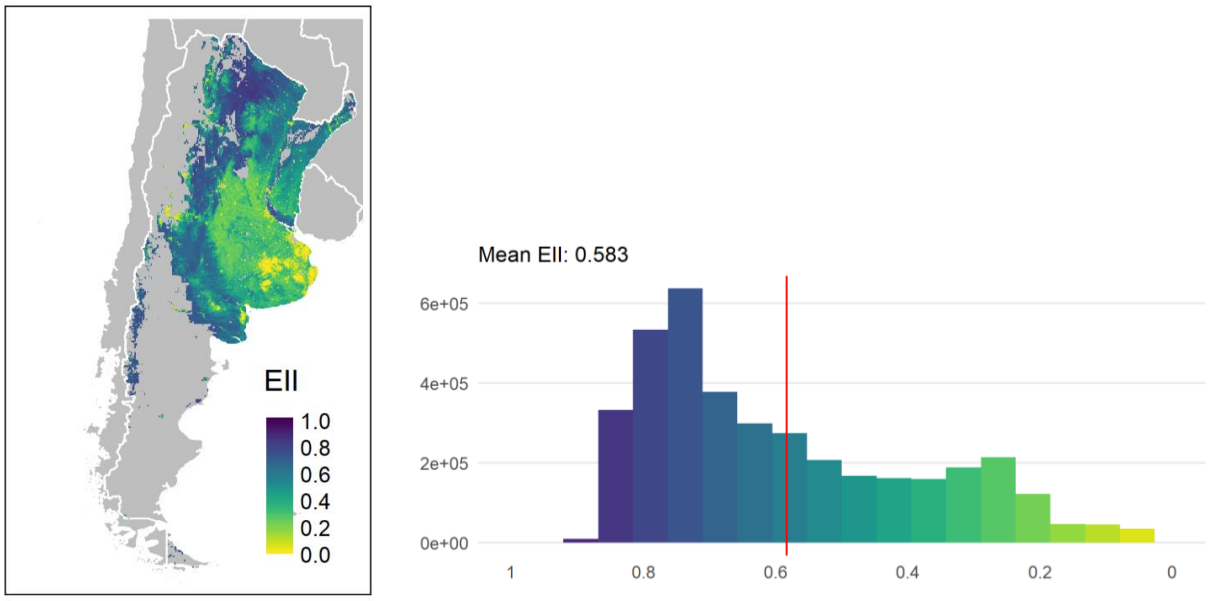

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Figure 9. *Baseline EII for cattle fields in Argentina. The map on the left panel shows the spatial pattern of EII in the study area. The figure on the right shows a histogram of EII values, and the average EII value.*

Interventions

The first modeled intervention is avoided deforestation in two scenarios, under SSP3 and SSP_5 for 2050. The findings show these scenarios only have a small decline at the national level. This is because compared to the country-wide spatial data for cattle pastures, the potential areas impacted by zero-deforestation interventions are minute. However, our analysis demonstrates the impacts of such interventions can be meaningful at the local level, where there is the potential for avoiding losses of EII of around 0.4 (avoiding the loss of >50% of the baseline) (Figure 10).

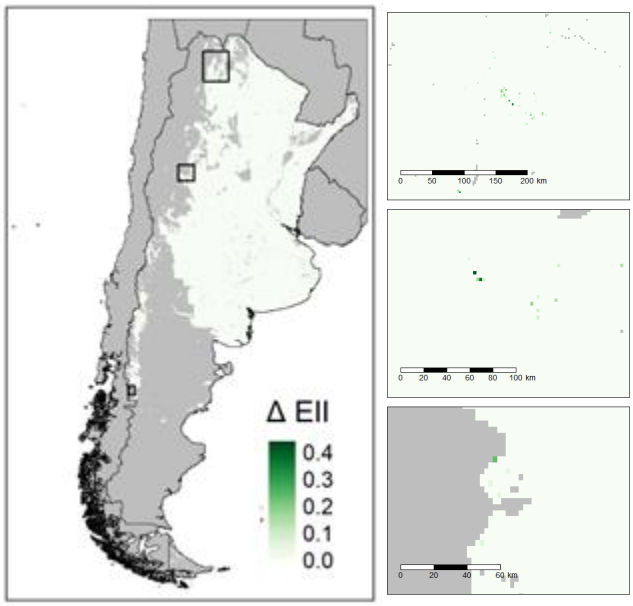

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Figure 10. *Change in EII between the baseline and the zero-deforestation intervention SSP3 scenario (SSP_5 had similar results, so we are only showing SSP3 visualizations). The left map shows differences in EII resulting from the intervention for all cattle area in Argentina (SSP3 scenario), with black rectangular boxes indicating areas expanded in close-up maps. Right maps zoom into specific areas and serve as examples of EII change locally according to the intervention, for both SSP scenarios.*

Second, we modeled interventions for the protection of riparian zones, which resulted in a 0.5% increase in ecosystem integrity. Again, with this intervention, we see greater increases locally in areas in the North, East and South Coast, where there is a high concentration of river systems, while at the regional level, this intervention is not noticeably impactful given the large areas under cattle grazing nationally (Figure 11).

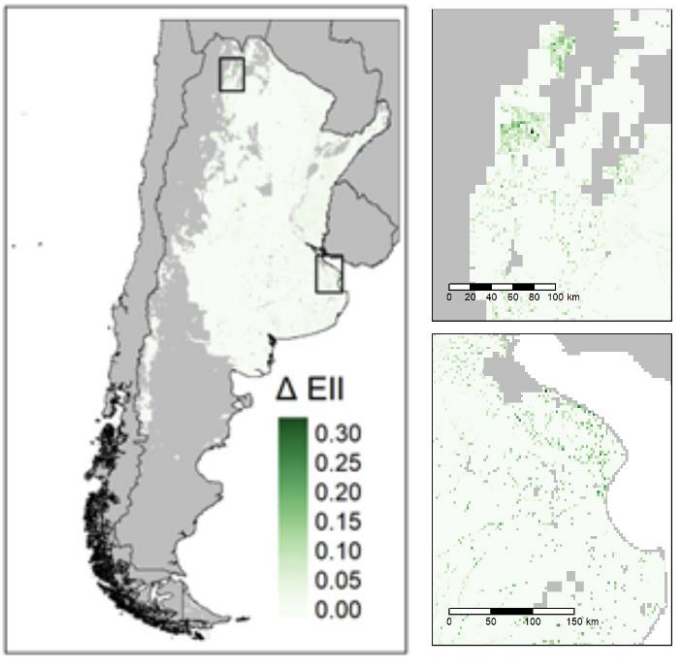

Figure 11. *Map of change in EII between the baseline and the riparian protection intervention, across cattle field area in Argentina.*

The minor changes across EII for both interventions are likely due to the small expanse of areas relevant to the modeled interventions relative to the large expanse of cattle fields included in the spatial data. Although the findings may not be regionally significant, they can be useful at the local and subregional level.

Land Hub Indicators

As the Land Hub has not yet developed impact factors specific to leather, we used methods aligned with those used for the other Land Hub impact factors to estimate the impacts of leather production in terms of conversion of native vegetation (forest and non-forest), land productivity, and soil organic carbon. As the cattle density layer was derived for 2010, the base layers were used to assess coincidence of land impacts with cattle production.

There is greater loss of forest than non-forest vegetation associated with cattle production as shown below (Figure 12). With the cattle density thresholds, we see a loss of 180,000 hectares of native non-forest vegetation and over 4.1 million hectares of forest from 2005 to 2015, with Santiago del Estero, Salta, and Chaco provinces experiencing the highest forest loss amounts. Interestingly, these areas do not have the highest concentration of cattle. This is often seen when data on cattle density lags behind land clearing data. We used data from 2005 to 2015, meaning if the land was cleared prior to 2005, it would not have been captured in the analysis.

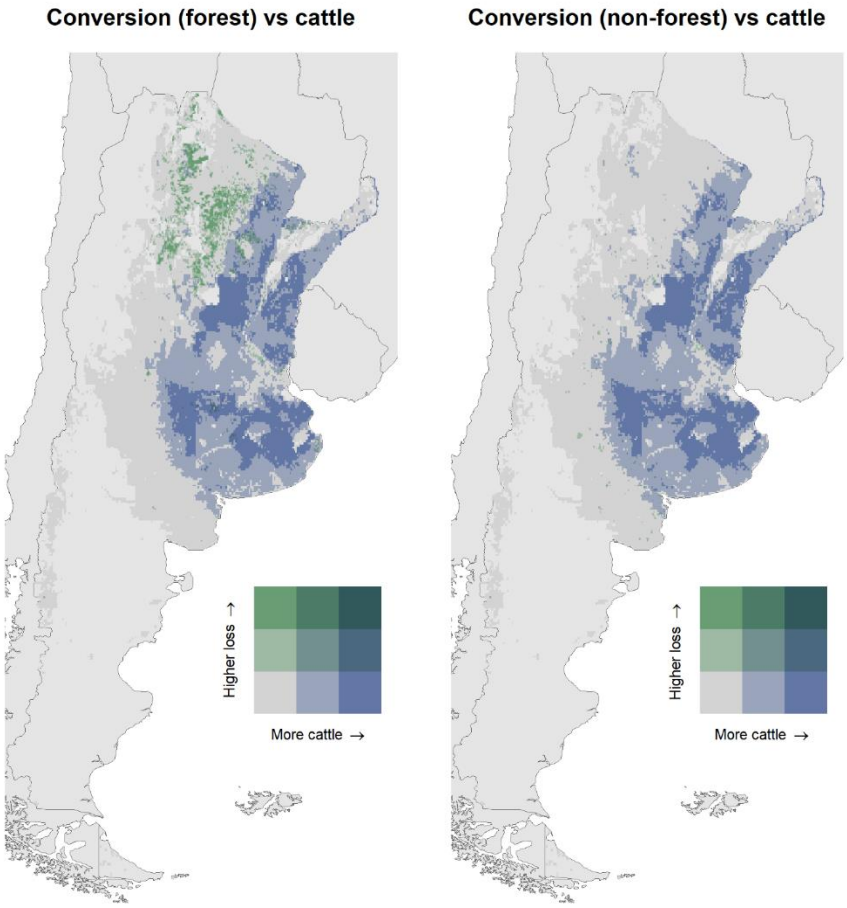

Figure 12. *Coincidence of loss of forest with cattle production (left) and coincidence of loss of native vegetation (including grasslands) with cattle production (right, with higher forest and non-forest loss in green and cattle density shown in blue. The more darkly shaded an area is, the higher the co-occurrence of those two factors).*

The second impact factor was soil organic carbon (SOC) and productivity. Using Trend.Earth, we assessed the change in soil organic carbon and productivity from 2005 to 2015 compared to cattle production in 2010. SOC losses were higher in the northern cattle producing regions and productivity losses were higher in the southern regions of Argentina, represented in yellow (Figure 13).

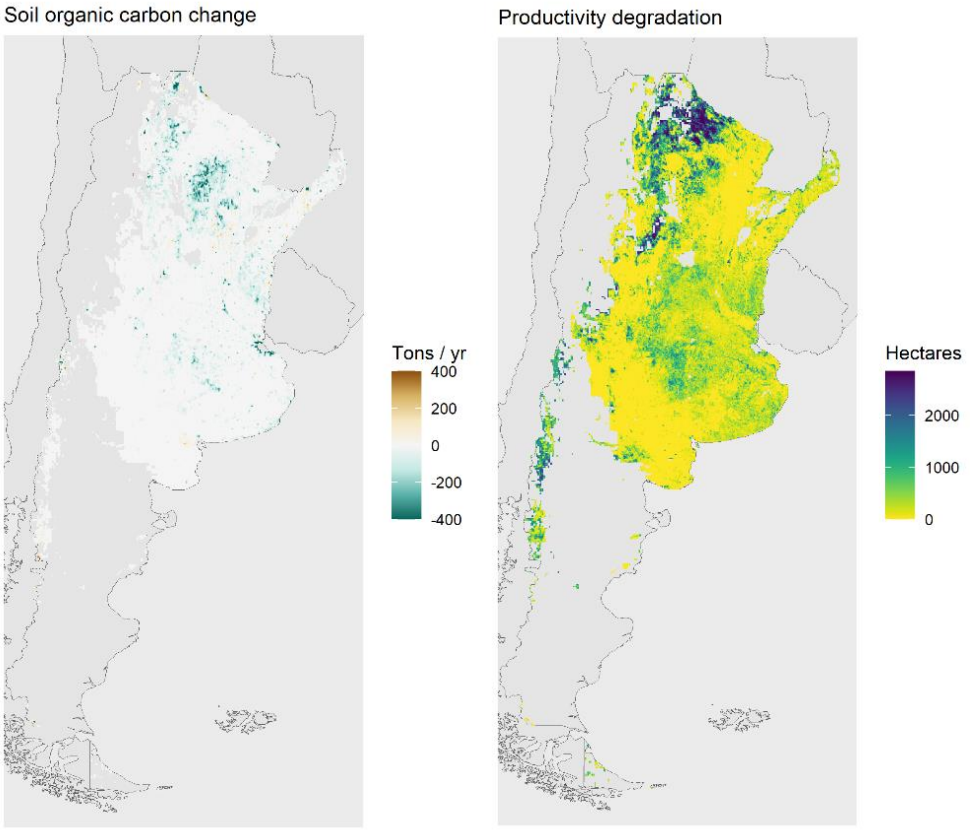

Figure 13. *Change in soil organic carbon in tons C per year and productivity for areas with cattle production.*

Ecosystem Services

The InVEST mapping tool gives several outcomes on current and possible expanded production of leather and the impacts on ecosystem services. For this indicator, we assessed the impact leather production has on nitrogen retention, sediment retention, and carbon storage. Currently, livestock-related deforestation is estimated to occur on 3% of the total land area in Argentina, but future livestock production in the currently forested areas could expand to 4-5% of the total land area. The current livestock footprint impact (relative to the natural vegetation potential) results in a 15% -per-area loss of nitrogen retention and a 17%-per-area loss of sediment retention. Meaning leather production has a significant impact on the soil quality and condition. The current livestock footprint estimates an 18% loss of carbon storage from the natural vegetation potential (Figure 14).

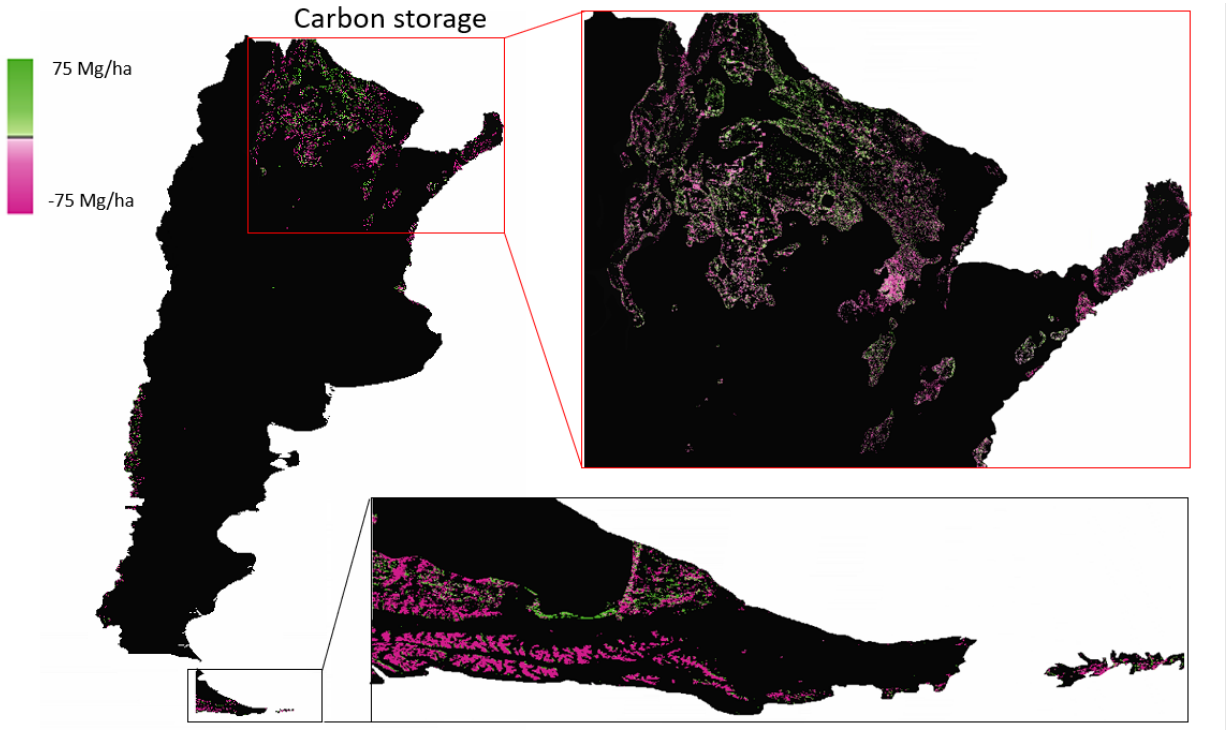

Figure 14. *Impact of current livestock footprint (relative to potential natural vegetation): 78 million Mg carbon (an 18% loss from potential). Additional indicator maps can be found in the appendix.*

Interventions

We modeled the zero-deforestation intervention and found a 24-41%-per-area improvement for sediment retention and a 40-49%-per-area improvement for nitrogen retention. Additionally, this intervention could lead to 340-480 million Mg of carbon storage (100-150% of current livestock footprint) by avoiding deforestation.

CONCLUSION AND NEXT STEPS

Although this deep-dive analysis was conducted on leather producing regions in Argentina, it is important to remember that this type of impact assessment can be done for any leather sourcing country. It may also have applications for leather production beyond the animals themselves. For those companies not sourcing leather from Argentina, the company's footprint might still interact with Argentina or other South American countries due to the large amounts of livestock feed crop produced in these countries and linked to forest loss and ecosystem conversion.[10]

This analysis gives a high-level overview of leather production impacts in the region using country-level data. With this scale we can see areas that are more impacted by production and should be considered higher priority because of the species and biodiversity present or because of their susceptibility to deforestation or other damaging ecosystem impacts from livestock.

We recognize the complexities associated with traceability and transparency in leather and cattle supply chains in many regions of the world. It will be important to work with suppliers and other stakeholders in key production regions to better understand efforts underway and identify opportunities for companies to support. In the meantime, there are opportunities to target sourcing to existing leather supplies that do not contribute to deforestation or ecosystem conversion to relieve pressure from new production on forests and grasslands. A significant amount of leather is destroyed or sent to landfill due to high current levels of beef production and consumption[11]. Acknowledging that quality specifications for leather are important and may thus present some initial barriers, efforts should be made to utilize material that is already available, not linked to deforestation and conversion, and would otherwise go to waste.

The risk cattle leather supply chains pose to forests and natural ecosystems are prevalent, not only though direct deforestation and conversion, but also through cattle feed such as soy and corn, and forest fragmentation created by road building, with road incursions leading to major forest degradation and habitat loss. To avoid these risks, it is important to establish whether existing suppliers have signed up to zero-deforestation/conversion commitments. If they have, it will be important to understand what interventions are being implemented, as well as their overall progress toward these commitments. If current suppliers have not yet established zero-deforestation/conversion commitments, we recommend companies engage directly with them to underscore the importance of zero-deforestation/conversion actions and assurances, including traceability and transparency. With resources such as the Accountability Framework Initiative[12] (AFi), suppliers have clear and accessible guidelines of best practices to follow when making a zero-deforestation/conversion commitment. In some cases, companies may seek to further incentivize

[10] Trase.earth

[11] Leather and Hide Council of America - https://www.leathernaturally.org/getattachment/d1387bd4-32b7-4754-8c66-ca986e4a50a9/LHCA-Infographic.pdf.aspx?lang=en-US

[12] https://accountability-framework.org/

action with key suppliers by negotiating improved offtake agreements, such as longer-term contracts or performance-based incentives, in exchange for demonstrated actions toward zero-deforestation/conversion. Given the sensitivity of deforestation in many leather producing regions, such as the Amazon, and despite all efforts to avoid these areas, it is crucial to establish confidence in suppliers to ensure sourcing is not negatively impacting highly sensitive ecosystems.

As a company considers its commitments and interventions in its leather supply chain, it will be important to align with recognized best practices, such as SBTN and global avoided deforestation commitments. This will ensure not only the credibility and ambition of commitments, but also allows the sector as a whole to work toward common targets and streamlining engagement with producers and suppliers on traceability data needs. As SBTN launches their version 1.0, we recommend reviewing the guidance and recommended metrics and indicators, and to apply a Science-Based Targets process to any nature and biodiversity commitments in the future.

APPENDIX

Table a1. *List of threatened species from Argentina (Red List Category: Near Threatened, Vulnerable, Endangered and Critically Endangered) coded by IUCN threat 2.3 Livestock Farming and Ranching. The species of Class Reptilia are not included in the STAR analysis, but will likely benefit from the other class groups included in the STAR metric.*

Class	Order	Family	Scientific Name	Red List Category
AMPHIBIA	ANURA	ALSODIDAE	*Alsodes neuquensis*	Endangered
			Alsodes pehuenche	Critically Endangered
		BATRACHYLIDAE	*Atelognathus reverberii*	Vulnerable
			Atelognathus praebasalticus	Endangered
			Atelognathus nitoi	Vulnerable
			Atelognathus patagonicus	Critically Endangered
		BUFONIDAE	*Rhinella rubropunctata*	Vulnerable
			Rhinella achalensis	Endangered
			Rhinella rumbolli	Near Threatened
		CERATOPHRYIDAE	*Ceratophrys ornata*	Near Threatened
			Lepidobatrachus asper	Near Threatened
		CRAUGASTORIDAE	*Oreobates barituensis*	Near Threatened
			Oreobates berdemenos	Vulnerable
		HEMIPHRACTIDAE	*Gastrotheca christiani*	Critically Endangered
			Gastrotheca gracilis	Endangered
			Gastrotheca chrysosticta	Endangered
		HYLIDAE	*Argenteohyla siemersi*	Endangered
		LEPTODACTYLIDAE	*Pleurodema somuncurense*	Critically Endangered
			Leptodactylus laticeps	Near Threatened
			Pleurodema kriegi	Near Threatened
			Pleurodema marmoratum	Vulnerable
		ODONTOPHRYNIDAE	*Odontophrynus achalensis*	Vulnerable
			Proceratophrys bigibbosa	Near Threatened
		RHINODERMATIDAE	*Rhinoderma darwinii*	Endangered
		TELMATOBIIDAE	*Telmatobius laticeps*	Critically Endangered
			Telmatobius scrocchii	Critically Endangered
			Telmatobius pisanoi	Endangered
			Telmatobius contrerasi	Endangered
			Telmatobius hauthali	Endangered
			Telmatobius hypselocephalus	Endangered
			Telmatobius pinguiculus	Endangered
			Telmatobius platycephalus	Endangered
			Telmatobius schreiteri	Endangered
			Telmatobius stephani	Endangered
			Telmatobius rubigo	Vulnerable
			Telmatobius huayra	Vulnerable
AVES	ACCIPITRIFORMES	ACCIPITRIDAE	*Buteogallus coronatus*	Endangered
			Spizaetus isidori	Endangered

			Accipiter poliogaster	Near Threatened
			Spizaetus ornatus	Near Threatened
			Buteogallus solitarius	Near Threatened
			Pseudastur polionotus	Near Threatened
			Buteo ventralis	Vulnerable
			Harpia harpyja	Vulnerable
	CAPRIMULGIFORMES	CAPRIMULGIDAE	*Eleothreptus anomalus*	Vulnerable
		TROCHILIDAE	*Lophornis chalybeus*	Near Threatened
	CHARADRIIFORMES	CHARADRIIDAE	*Phegornis mitchellii*	Near Threatened
		PLUVIANELLIDAE	*Pluvianellus socialis*	Near Threatened
		SCOLOPACIDAE	*Gallinago stricklandii*	Near Threatened
			Numenius borealis	Critically Endangered
	FALCONIFORMES	FALCONIDAE	*Falco deiroleucus*	Near Threatened
	GALLIFORMES	CRACIDAE	*Crax fasciolata*	Vulnerable
			Penelope superciliaris	Near Threatened
	GRUIFORMES	RALLIDAE	*Fulica cornuta*	Near Threatened
			Laterallus jamaicensis	Endangered
			Laterallus spilopterus	Vulnerable
			Rallus antarcticus	Vulnerable
	PASSERIFORMES	CINCLIDAE	*Cinclus schulzii*	Vulnerable
		COTINGIDAE	*Phibalura flavirostris*	Near Threatened
		FURNARIIDAE	*Asthenes hudsoni*	Near Threatened
			Leptasthenura setaria	Near Threatened
			Limnoctites rectirostris	Near Threatened
			Sylviorthorhynchus yanacensis	Near Threatened
		ICTERIDAE	*Leistes defilippii*	Vulnerable
			Xanthopsar flavus	Endangered
		MOTACILLIDAE	*Anthus nattereri*	Vulnerable
		THRAUPIDAE	*Charitospiza eucosma*	Near Threatened
			Conirostrum binghami	Near Threatened
			Coryphaspiza melanotis	Vulnerable
			Gubernatrix cristata	Endangered
			Poospiza baeri	Vulnerable
			Sporophila cinnamomea	Vulnerable
			Sporophila hypochroma	Near Threatened
			Sporophila iberaensis	Endangered
			Sporophila palustris	Endangered
		TYRANNIDAE	*Piprites pileata*	Near Threatened
			Polystictus pectoralis	Near Threatened
			Pseudocolopteryx dinelliana	Near Threatened
			Alectrurus risora	Vulnerable
			Culicivora caudacuta	Vulnerable
			Alectrurus tricolor	Vulnerable
			Xolmis dominicanus	Vulnerable

			Platyrinchus leucoryphus	Vulnerable
			Agriornis albicauda	Vulnerable
	PICIFORMES	PICIDAE	*Celeus galeatus*	Vulnerable
			Hylatomus schulzii	Near Threatened
			Piculus aurulentus	Near Threatened
		RAMPHASTIDAE	*Pteroglossus bailloni*	Near Threatened
	PODICIPEDIFORMES	PODICIPEDIDAE	*Podiceps gallardoi*	Critically Endangered
	PROCELLARIIFORMES	PROCELLARIIDAE	*Procellaria westlandica*	Endangered
	PSITTACIFORMES	PSITTACIDAE	*Amazona aestiva*	Near Threatened
			Amazona pretrei	Vulnerable
			Anodorhynchus glaucus	Critically Endangered
	STRIGIFORMES	STRIGIDAE	*Strix hylophila*	Near Threatened
			Strix chacoensis	Near Threatened
	STRUTHIONIFORMES	RHEIDAE	*Rhea americana*	Near Threatened
			Rhea tarapacensis	Near Threatened
		TINAMIDAE	*Taoniscus nanus*	Endangered
MAMMALIA	CARNIVORA	CANIDAE	*Speothos venaticus*	Near Threatened
	CETARTIODACTYLA	BOVIDAE	*Hemitragus jemlahicus*	Near Threatened
			Blastocerus dichotomus	Vulnerable
			Hippocamelus antisensis	Vulnerable
			Hippocamelus bisulcus	Endangered
			Mazama nana	Vulnerable
			Ozotoceros bezoarticus	Near Threatened
			Pudu puda	Near Threatened
	DIDELPHIMORPHIA	DIDELPHIDAE	*Chacodelphys formosa*	Near Threatened
			Thylamys fenestrae	Near Threatened
	RODENTIA	CAVIIDAE	*Dolichotis patagonum*	Near Threatened
		CRICETIDAE	*Phyllotis bonariensis*	Near Threatened
		CTENOMYIDAE	*Ctenomys azarae*	Endangered
			Ctenomys bergi	Endangered
			Ctenomys osvaldoreigi	Critically Endangered
			Ctenomys roigi	Critically Endangered
			Ctenomys sociabilis	Critically Endangered
	CETARTIODACTYLA	TAYASSUIDAE	*Tayassu pecari*	Vulnerable
	PERISSODACTYLA	TAPIRIDAE	*Tapirus terrestris*	Vulnerable
	CINGULATA	CHLAMYPHORIDAE	*Cabassous chacoensis*	Near Threatened
	CINGULATA	CHLAMYPHORIDAE	*Priodontes maximus*	Vulnerable
	CINGULATA	CHLAMYPHORIDAE	*Zaedyus pichiy*	Near Threatened
	CARNIVORA	CANIDAE	*Chrysocyon brachyurus*	Near Threatened
		FELIDAE	*Leopardus colocolo*	Near Threatened
			Leopardus guigna	Vulnerable
			Leopardus guttulus	Vulnerable
			Leopardus jacobita	Endangered
			Leopardus wiedii	Near Threatened
			Panthera onca	Near Threatened

		MUSTELIDAE	*Lontra longicaudis*	Near Threatened
			Lontra provocax	Endangered
			Pteronura brasiliensis	Endangered
		URSIDAE	*Tremarctos ornatus*	Vulnerable
	CETARTIODACTYLA	TAYASSUIDAE	*Catagonus wagneri*	Endangered
	PRIMATES	ATELIDAE	*Alouatta caraya*	Near Threatened
			Alouatta guariba	Vulnerable
		CEBIDAE	*Sapajus nigritus*	Near Threatened
REPTILIA	TESTUDINES	CHELIDAE	*Acanthochelys pallidipectoris*	Endangered
	SQUAMATA	BOIDAE	*Epicrates alvarezi*	Near Threatened
		DIPSADIDAE	*Lygophis elegantissimus*	Vulnerable
			Lygophis vanzolinii	Near Threatened
		ELAPIDAE	*Micrurus silviae*	Vulnerable
		LIOLAEMIDAE	*Liolaemus tandiliensis*	Vulnerable
			Phymaturus tenebrosus	Endangered
		TROPIDURIDAE	*Stenocercus doellojuradoi*	Near Threatened

Table a2. *List of threatened species from Argentina (Red List Category: Near Threatened, Vulnerable, Endangered and Critically Endangered) coded by IUCN Threat 7.1. Fire & Fire Suppression. The species of Class Reptilia are not included in the STAR analysis, but will likely benefit from the other class groups included in the STAR metric.*

Class	**Order**	**Family**	**Scientific Name**	**Red List Category**
AMPHIBIA	ANURA	BATRACHYLIDAE	*Atelognathus nitoi*	Vulnerable
			Batrachyla fitzroya	Vulnerable
		BUFONIDAE	*Rhinella achalensis*	Endangered
		CERATOPHRYIDAE	*Lepidobatrachus asper*	Near Threatened
		HYLIDAE	*Argenteohyla siemersi*	Endangered
		LEPTODACTYLIDAE	*Leptodactylus laticeps*	Near Threatened
			Pleurodema marmoratum	Vulnerable
		ODONTOPHRYNIDAE	*Odontophrynus achalensis*	Vulnerable
		RHINODERMATIDAE	*Rhinoderma darwinii*	Endangered
		TELMATOBIIDAE	*Telmatobius pisanoi*	Endangered
			Telmatobius contrerasi	Endangered
AVES	ACCIPITRIFORMES	ACCIPITRIDAE	*Harpia harpyja*	Vulnerable
	CAPRIMULGIFORMES	CAPRIMULGIDAE	*Eleothreptus anomalus*	Vulnerable
	GRUIFORMES	RALLIDAE	*Rallus antarcticus*	Vulnerable

	PASSERIFORMES	COTINGIDAE	*Phibalura flavirostris*	Near Threatened
		FURNARIIDAE	*Sylviorthorhynchus yanacensis*	Near Threatened
		ICTERIDAE	*Xanthopsar flavus*	Endangered
		MOTACILLIDAE	*Anthus nattereri*	Vulnerable
		THRAUPIDAE	*Sporophila ruficollis*	Near Threatened
			Conirostrum binghami	Near Threatened
			Coryphaspiza melanotis	Vulnerable
		TYRANNIDAE	*Piprites pileata*	Near Threatened
			Polystictus pectoralis	Near Threatened
			Alectrurus risora	Vulnerable
			Culicivora caudacuta	Vulnerable
			Alectrurus tricolor	Vulnerable
	PICIFORMES	RAMPHASTIDAE	*Pteroglossus bailloni*	Near Threatened
		PICIDAE	*Piculus aurulentus*	Near Threatened
	PSITTACIFORMES	PSITTACIDAE	*Amazona tucumana*	Vulnerable
			Amazona aestiva	Near Threatened
	STRUTHIONIFORMES	TINAMIDAE	*Taoniscus nanus*	Endangered
MAMMALIA	CETARTIODACTYLA	BOVIDAE	*Hemitragus jemlahicus*	Near Threatened
		CERVIDAE	*Mazama nana*	Vulnerable
			Hippocamelus antisensis	Vulnerable
			Hippocamelus bisulcus	Endangered
			Blastocerus dichotomus	Vulnerable
			Pudu puda	Near Threatened
	RODENTIA	CHINCHILLIDAE	*Chinchilla chinchilla*	Endangered
		CTENOMYIDAE	*Ctenomys osvaldoreigi*	Critically Endangered
	PILOSA	MYRMECOPHAGIDAE	*Myrmecophaga tridactyla*	Vulnerable
	CARNIVORA	FELIDAE	*Leopardus wiedii*	Near Threatened
			Leopardus guttulus	Vulnerable
			Panthera onca	Near Threatened

REPTILIA	SQUAMATA	DIPSADIDAE	*Tomodon orestes*	Near Threatened
			Lygophis elegantissimus	Vulnerable
		LEIOSAURIDAE	*Pristidactylus casuhatiensis*	Critically Endangered
		LIOLAEMIDAE	*Liolaemus azarai*	Critically Endangered
			Phymaturus tenebrosus	Endangered
		TROPIDURIDAE	*Stenocercus doellojuradoi*	Near Threatened

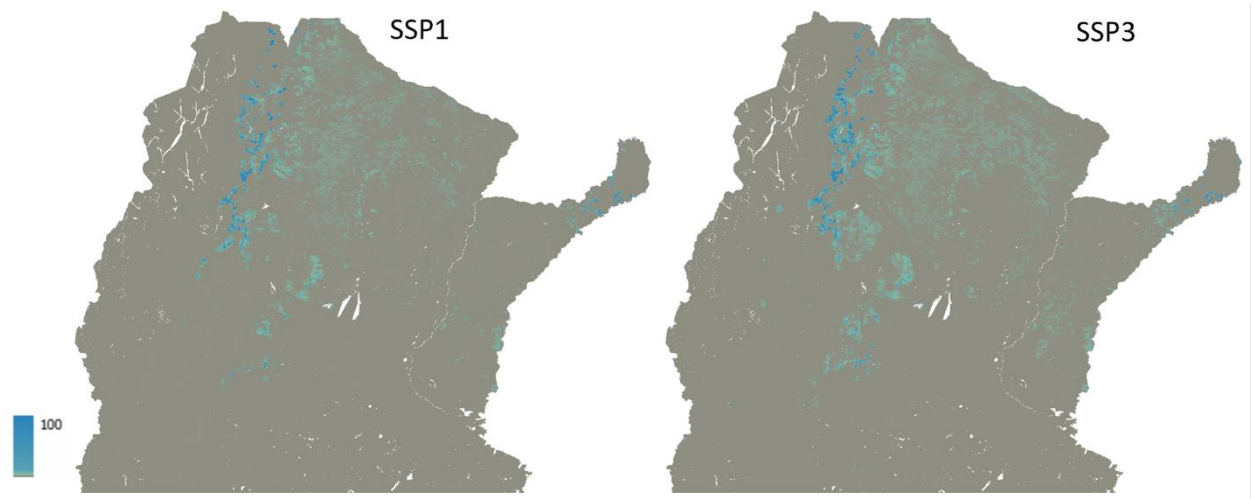

Figure a2. *Sediment retention: 1.3-1.6% improvement (24-41% per area) with avoided deforestation*

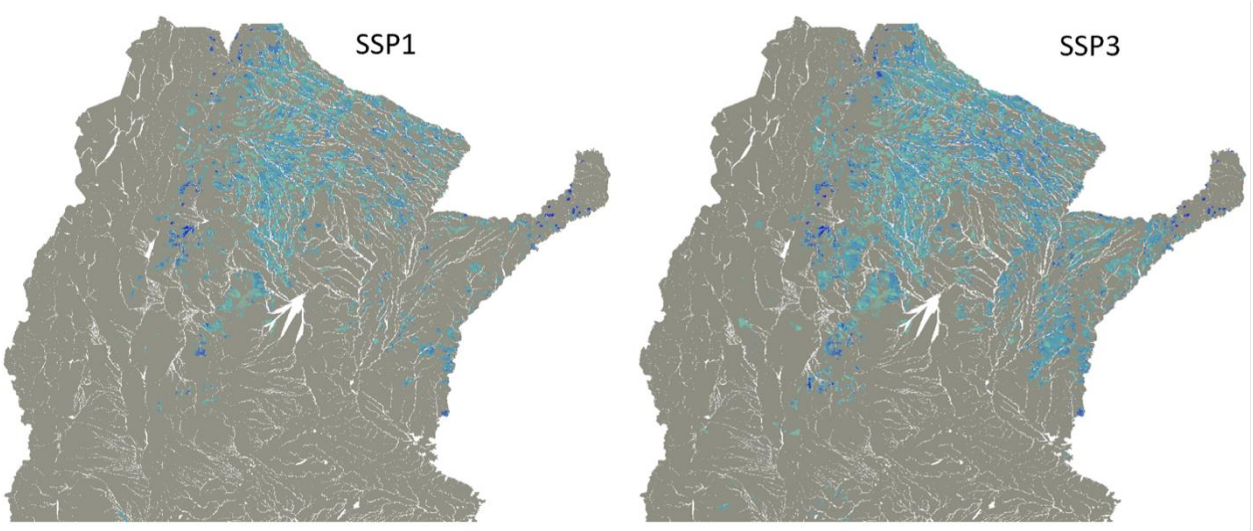

Figure a3. *Nitrogen retention: 1.5-2.5% improvement (40-49% per area) with avoided deforestation*

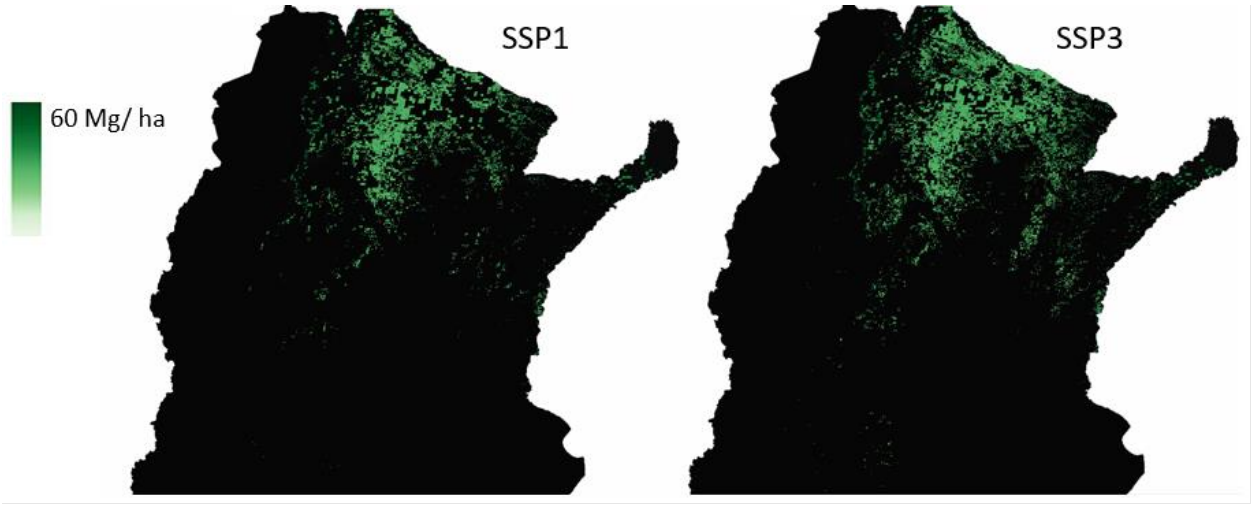

Figure a4. *Carbon storage: 340-480 million Mg saved (100-150% of current livestock footprint) with avoided deforestation*

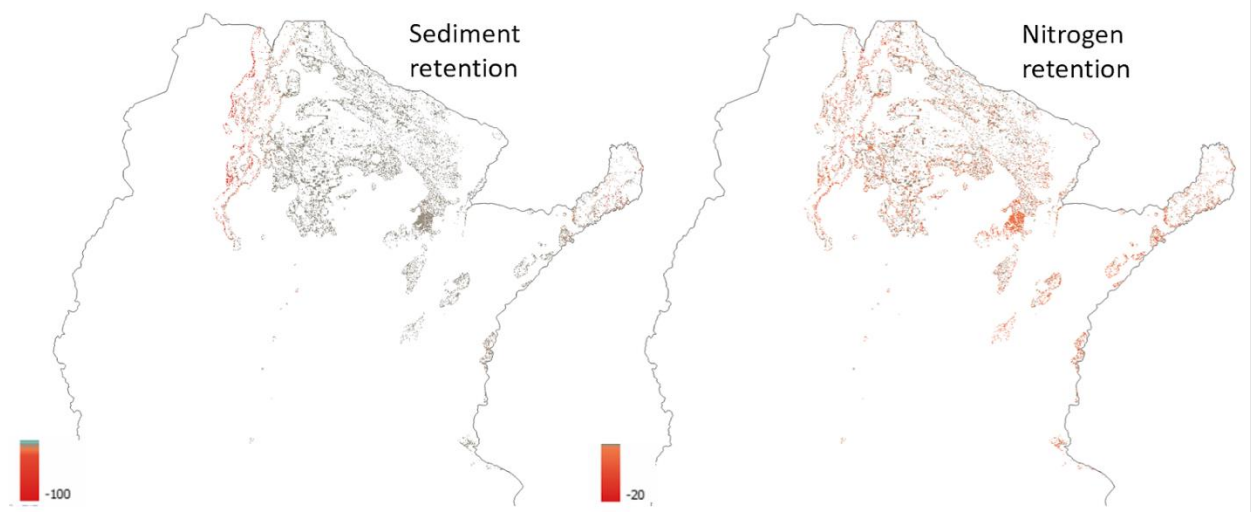

Figure a5. *Impact of current livestock footprint (relative to potential natural vegetation): 15%-per-area loss of nitrogen retention, 17%-per-area loss of sediment retention.*

The authors would like to thank the members of the Transforming the Fashion Sector with Nature project's Technical Advisory Group, in particular the SBTN and Oscar Sabag (Science Translation Lead), for lending time and expertise in reviewing this material.