CATTLE FARMING AND CLIMATE CHANGE IN THE AMERICAS:

IN SEARCH OF NET ZERO EMISSIONS

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The dilemma of cattle farming in the americas

Cattle farming in the Americas has significant global relevance, not only in terms of production, but also because of its role in international trade and global food security (Table 1).

	% PERCENTAGE OF GLOBAL PRODUCTION		% PERCENTAGE OF GLOBAL BEEF EXPORTS (AVERAGE 2017-2021)
	Beef	Cow's milk	
The Americas	31,2	24,9	25,62
North America	15,1	13,3	15,22
Latin America and the Caribbean	16,1	11,55	10,4

Table 1. Global share (%) of beef and dairy production of the Americas in terms of number of heads (left) and beef exports (right). Source FAOSTAT (2023).

In global terms, FAO statistics (FAOSTAT, 2023) show that the livestock industry in the Americas contributes to more than 30 percent of beef and almost 25 percent of dairy production.

These numbers are evenly distributed between Northern America (USA and Canada) on the one hand, and Latin America and the Caribbean on the other hand. In terms of beef exports, on average a little over 25 percent of global exports came from the Americas in the 2017-2021 period. USA and Canada provided just over 15 percent and Latin America and the Caribbean the remaining 10.4 percent.

The recognition of the region's importance as a global supplier of animal protein also comes with a dilemma and growing concern regarding the impact of cattle farming on the global climate and environment. **A recently released study by Our World in Data (Ritchie et al., 2022) focused on research from Grippa et al. (2021) that demonstrates that around 34 percent of global greenhouse gas emissions (referred to here as carbon) is produced by the global agrifood system.** A substantial part of these global emissions are attributed to livestock food systems (mainly cattle production). Land-use changes (such as deforestation), application of nitrogen fertilizers, methane released by ruminal digestion, nitrous oxide from feces and urine, pasture and rangeland management, burning of grazing lands, and on-farm fuels use, among others, are the factors that are responsible for emissions in beef and dairy production.

Well-known reports that have been disseminated worldwide, such as *Livestock's Long Shadow* (Stanfield at al., 2006) and *Tackling Climate Change through Livestock* (Gerber at al., 2013), estimate that livestock farming accounts for 14.5-18 percent of global carbon. These reports cast a shadow of suspicion on livestock farming in general, and especially on cattle farming, due to the supposed negative impact on the environment and climate. To explore this question further, an extensive study involving 37,700 farms, 40 agricultural products, and 1,600 processing, packaging and distributing industries in different countries, was published by scientists at Oxford University (Poore and Nemecek (2018). Relying on different environmental indicators, the results showed that beef production has a carbon emission cost between 50 and 100 times higher than that of cereals, oilseeds, vegetables, fruits and other plant products. More recently, based on a wide literature review, Clark et al. (2022) researched 57,000 different foods and classified them according to their negative impacts on the environment and human health. Beef and dairy products appeared to be safe for health, but were shown to have major negative impacts on the environment (e.g., through carbon emissions). On the other hand, processed beef and dairy products were shown to have the most negative impacts on human health and the environment.

These studies caught the attention of vegan and environmentalist communities, who adopted a militant strategy against beef and dairy products. They lobbied intensively on EU policies and had a major influence on public opinion through the media. They also launched a wide-reaching campaign to modify European and global consumer habits and advocated for the need to extensively replace animal foods with plant-based products.

Given that these actions directly affect the social and economic interests of livestock production in the Americas, IICA has led an agenda to clarify sensitive issues, such as the relationship between beef production and the environment. The idea is to broaden the analysis and debate about the impact of cattle farming in the Americas on global warming and climate change. Within this conceptual framework, the specific goal of this report is to provide information and data to enhance the analysis of the relationship between cattle farming in the Americas and climate change, and its potential consequences on the international beef trade.

Are cattle climate and human health villains?

One effect of campaigns against beef production is that some EU public opinion and policies have categorized beef cattle as climate and human-health villains. The consequences of this viewpoint should not be underestimated. Given the global leadership that Europe has assumed in environmental issues, an intelligent strategy needs to be agreed on in the Americas to preserve a vital resource: beef production.

The EU today threatens to restrict and penalize trade of products from countries with a lax attitude toward carbon emissions. The European Green Deal sanctioned by the European Parliament (European Commission, 2019) includes the decision to trade only with exporting countries that can demonstrate, with verifiable evidence, that their products have a carbon load tolerable according to European standards.

The Americas comprise a variety of countries that have adopted a wide diversity of beef production systems. For this reason, there are extreme variations in terms of intensification, ranging from very extensive pastoral systems with low carbon emissions per hectare, to very intensive systems (feedlots) with a dense concentration of confined animals, fed in pens that release high carbon emissions per hectare. Recent studies of these livestock variants (Viglizzo and Ricard, 2023) show that their carbon balance (difference between emission and uptake by photosynthesis) differs substantially (Figure 1).

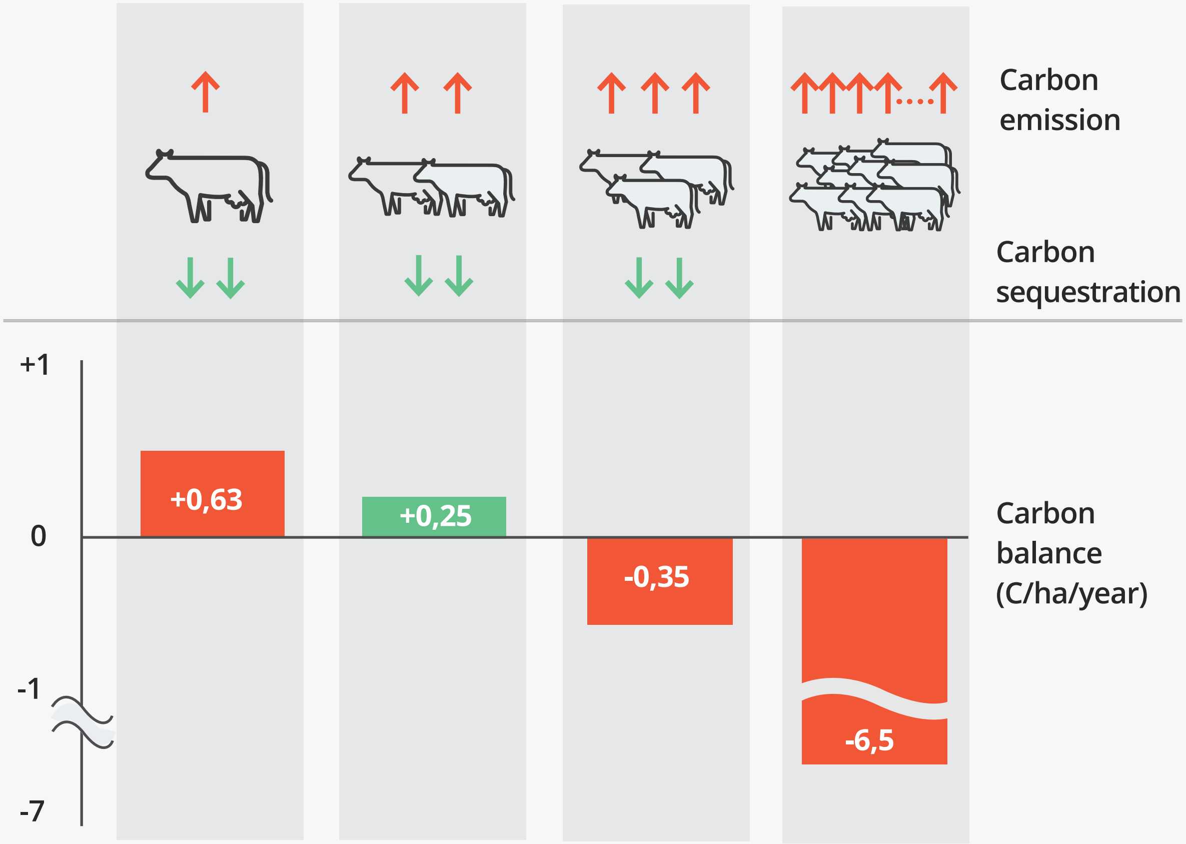

Figure 1. Relationship between the level of intensification (more extensive to the left and more intensive to the right) and the carbon balance of the livestock system. Note that intensive confined systems generate more emissions and do not sequester carbon. As a result, they record a greater negative balance (Source: Viglizzo & Ricard, 2023).

As systems intensify and livestock density per hectare increases, emissions outweigh carbon sequestration. Therefore, carbon balances tend to become increasingly negative as intensification increases. Only grazing systems have the capacity to compensate, totally or partially, for cattle emissions through plant photosynthesis. Carbon sequestration does not occur in the more intensive confined cattle systems, given the absence of grazing lands.

These differing characteristics of the predominant systems in each country also call for a differentiated analysis. It is clear that views that unify all livestock systems under a common framework to analyze their carbon economy are not appropriate. Their functional differences demand specific consideration before penalties or trade restrictions are imposed on beef products from third exporting countries.

In the case of livestock farming in the Americas, two programs from the EU Green Deal must be cause for future concern: one that seeks to penalize countries for deforestation in native forests (Due Diligence), and another that imposes penalties for the carbon load of cattle products (Border Carbon Adjustment Mechanism). Although neither of them is fully in effect, they will be in the near future.

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Science, academia and selective omissions

In the last twenty years, many of the world's academic and scientific media have embraced the assumption that cattle farming has a negative impact on the environment, climate and human health. This vision selectively ignores other essential roles and functions that cattle production systems play in ecosystems and the environment.

It is common to blame cattle farming for the deforestation of native forests, but while there has been a correlation between livestock farming and deforestation in Brazil, Paraguay and Colombia, in Argentina and Bolivia deforestation is mainly explained by the production of soybeans and other crops (Ricard et al., 2021).

Different cattle production systems, from the most extensive to the most intensive, are present in the Americas. As mentioned above, the greater the intensification, the greater the carbon emissions and the greater environmental impact (Viglizzo and

Ricard, 2023). However, those impacts must be regarded as the inevitable cost of producing essential food nutrients and contributing to food security. This is not to absolve cattle farming of all blame for its negative impact, but rather to recognize that many other social and even economic sectors generate negative impacts of a considerable magnitude without providing any benefit such as food production. In economic terms, beef and dairy products contribute to farmers' income in developing countries and are a source of foreign currency that boosts their economy as well.

Many grazing lands in the Americas are located in semi-arid and arid regions. Due to water shortages and soil conditions, these lands are unable to produce cereals, vegetables, fruits and other primary products there. Nor is it possible to raise domestic animals such as pigs and poultry that demand concentrated feed that these regions do not produce. Only fibrous forages of very low nutritional value survive in these areas, and only the ruminants living there can convert this resource into proteins of high biological value and essential nutrients (Stritzler and Rabotnikof, 2019). Furthermore, grazing lands are potentially an important, and still undervalued, carbon sink in the Americas (Viglizzo et al., 2019).

In poor regions where humans must overcome extreme conditions, ruminants offer life insurance. They not only contribute food (meat and milk), but also reduce the biological and economic risk of surviving there. In fact, bovines provide traction, feces and urine, which are used as fertilizer, bioenergy source and construction material. Urine is also used as a disinfectant and repellent for animal-borne pests (Ørskov and Viglizzo, 1994). Animals represent a kind of "savings account" that can be used if necessary and in practice are a survival factor whose value goes far beyond the food they provide. However, many prestigious academic and scientific centers in industrialized countries tend to selectively omit the great social relevance of cattle in marginal lands.

The metrics: carbon footprint (CF) and carbon balance (CB)

The Carbon Footprint of beef production

The two above-mentioned publications (Stanfield et al., 2006 and Gerber at al., 2013) calculate the carbon emissions of livestock farming at the global level and estimate that they represent 14.5 to 18 percent of total world emissions. These results are in line with a generalized approach known as the Life Cycle Assessment (LCA) of a product, which in the case of beef involves calculating the emissions that occur throughout a sequence of stages ("from cradle to grave") within the beef food chain.

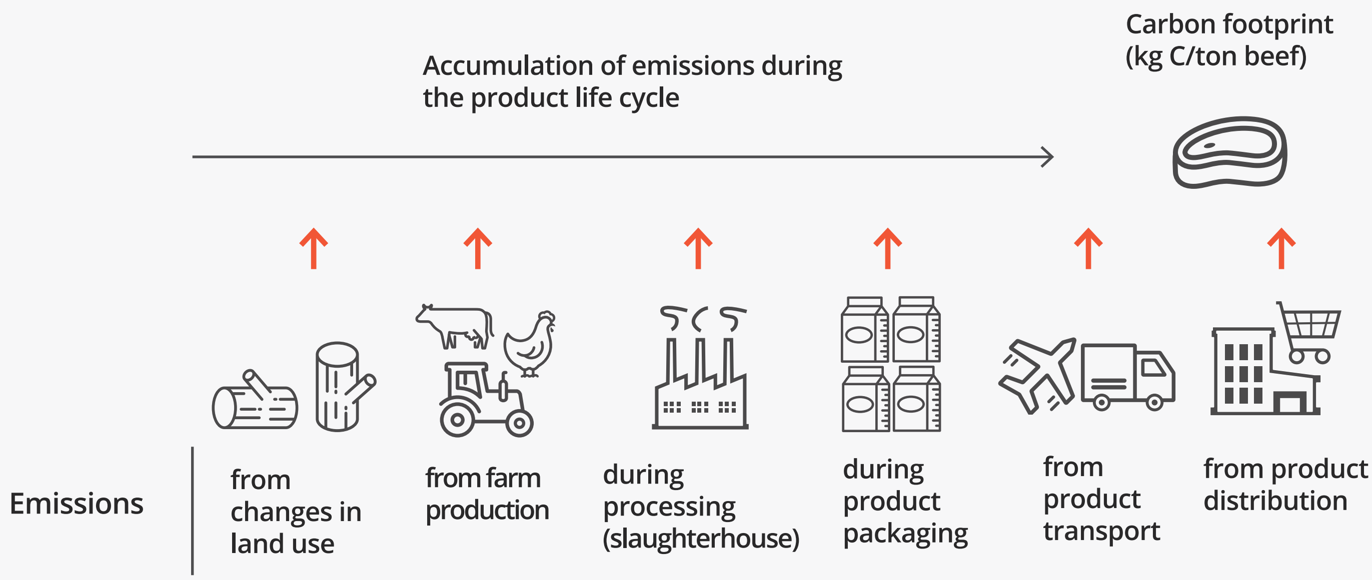

Figure 2. Accumulation of carbon emitted in different links of the entire beef chain (Source: Adapted from Our World in Data, 2023).

Carbon emitted in each stage adds up and progressively accumulates and the product reaches the supermarket shelf with a high carbon load (Figure 2). This generates a very high carbon footprint that far exceeds emissions computed at the farm gate. In practice, this means that the relative contribution of the primary livestock producer to the carbon footprint is indistinguishable amidst the majority of emissions attributed to the final product, which are delocalized or off-farm emissions from other economic sectors that intervene in the food chain, such as those of the slaughterhouse, transportation, wholesale, retail distribution, etc.

Thus, the emissions attributed to cattle farming within the LCA framework are inevitably high. However, if only biogenic emissions are attributed to cattle (that is, the methane and nitrous oxide produced by enteric fermentation), it can easily be shown that their impact on global climate is much lower than that estimated through the LCA. That figure amounts to no more than 5 % of total global emissions and tends to decrease when compared to all sectors that rely on fossil fuel combustion (Figure 3 left). Fossil fuel burning has grown at a greater rate than biogenic emissions from beef cattle. Since emissions are even lower in the case of cattle farming in the Americas, the figure does not exceed 3% of global emissions. (Figure 3 right). Given that this continues to be an unresolved matter, another issue will demand future consideration in calculations: methane remain in the atmosphere 11.8 years on average, much less than carbon dioxide, which remains for about one thousand years (Lesschen, 2021).

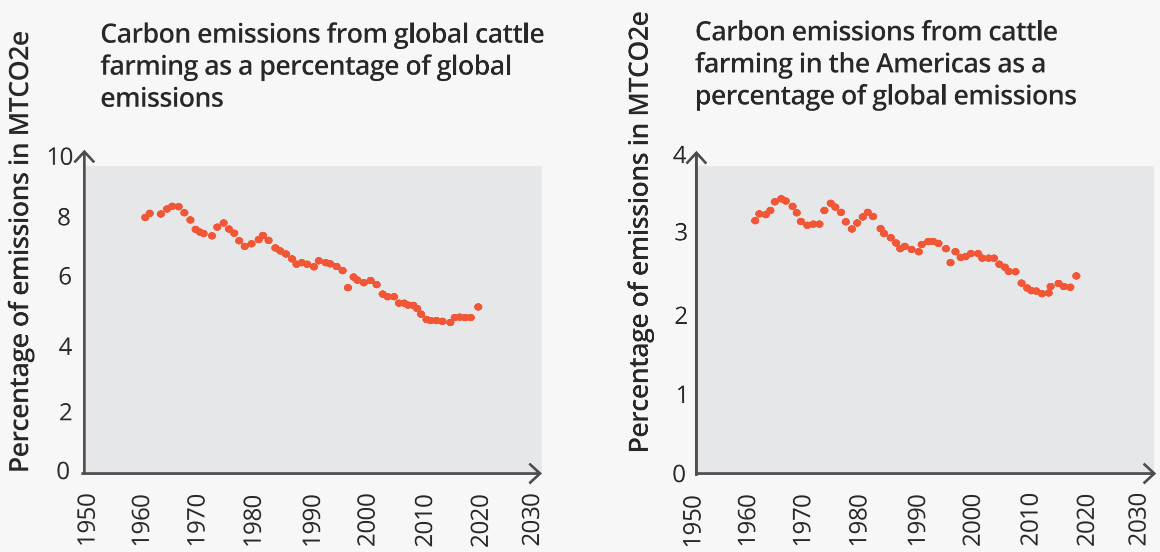

Figure 3. Impact of beef cattle farming in the world and the Americas on global carbon emissions. Sources: FAOSTAT (2023); Our World in Data (2023).

On the other hand, the carbon that is part of the methane molecule is the product of natural recycling. Plants capture atmospheric carbon through photosynthesis, which in turn returns to the atmosphere as methane released through the process of rumi-nal fermentation. Given that no fossil carbon intervenes in this process, the net carbon balance is zero.

The Carbon Balance of the livestock system

Compared to the carbon footprint calculated using the LCA approach, the carbon bal-ance seems better able to account for carbon in extensive pastoral and grazing-based cattle production systems. On an annual basis, it estimates not only emissions, but also carbon captured by plants and in turn accumulated in biomass and soil.

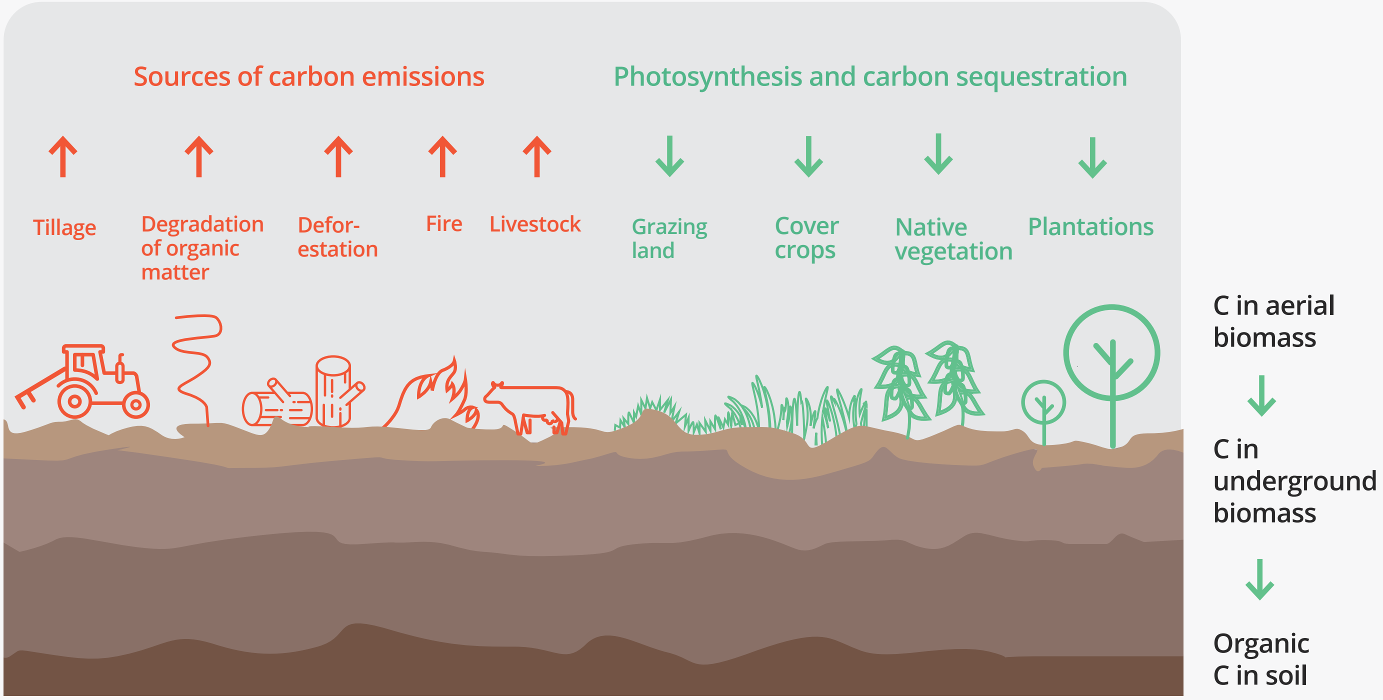

Figure 4. Carbon Balance on a farm involves counting the sources of carbon emission (red arrows) and carbon sink and sequestration (green arrows) from plant photosynthesis.

In this case, the reference unit to assess carbon is not the kilogram or ton of beef as the LCA proposes, but the hectare of land. To estimate the national carbon balance, a large number of developing countries apply the simplest method (Tier 1) that the IPCC (1996/2006/2019) recommends. It applies default carbon sequestration values for forest biomes, but calculations do not include grazing areas such as grasslands, savannas, cultivate pastures, bushlands, semi-desert regions, etc. Considering that most of the productive lands in the Americas are grazing lands, it is necessary to assess their potential for carbon capture and storage (Viglizzo et al., 2019).

At the farm level, the Carbon Balance approach is able to determine the individual contribution of beef farmers to positive balances, that is, to get carbon credits. This allows for the identification of farmers who can receive awards or penalties based on their individual capacity to manage on-farm carbon balances.

Based on a relatively simple method, Figure 5 shows results from a recent unpublished analysis of 40 real cattle farms in Argentina. A third of the producers were credited with a positive balance (green bars on the left), another third an almost neutral balance, and the final third (red bars on the right) showed a negative or very negative balance (due to deforestation or the burning of vegetation).

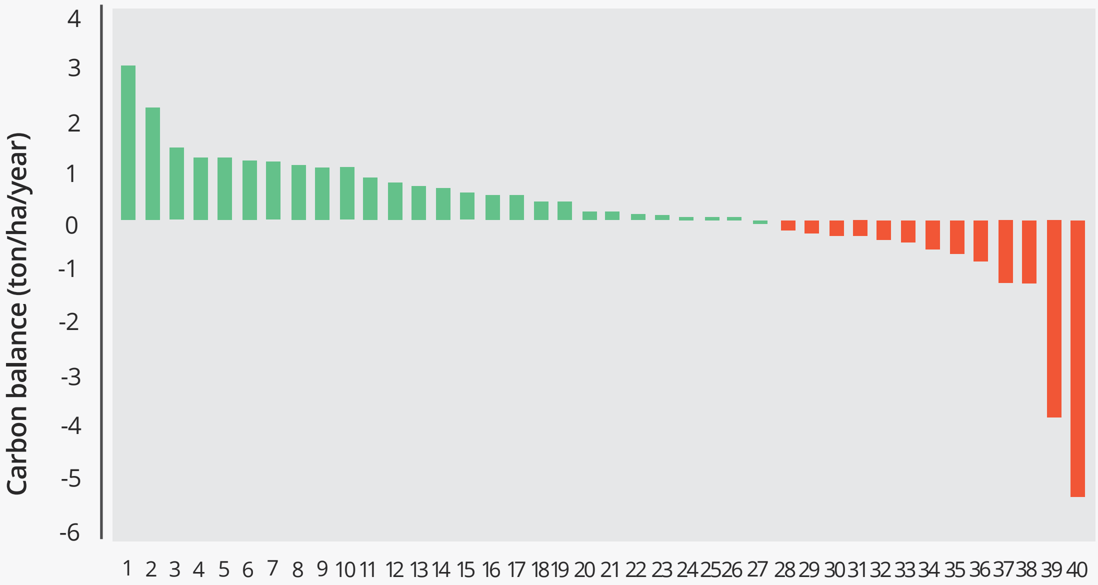

Figure 5. Carbon balance estimate by hectare (ton/ha/year) determined by the difference between annual carbon emission and sequestration on 40 farms in Argentina. This type of analysis makes it possible to distinguish individual farms and farmers (Source: Viglizzo & Ricard, 2023).

From Carbon Footprint to Carbon Balance: Comparing accounts

A recent research study in Argentina (Viglizzo and Ricard, 2023) shows that the results can be very different depending on whether Carbon Footprint of Carbon Balance is used. Carbon Footprint is rather a rigid method that does not detect variations between highly different production systems, such as the extensive and intensive ones. The rigidity of the Carbon Footprint approach tends to produce relatively homogeneous results when comparing different products such as beef, maize, wheat or soy (Figure 6). Per ton of product, beef will always show much higher carbon emission levels than grains, and that difference invariably persists in both extensive and intensive farming. Therefore, the method make it impossible to discriminate between farmers based on their capacity to manage carbon.

In contrast, the Carbon Balance method facilitates differentiation. Depending on the production system configuration, beef can record annual emissions per hectare that may be lower than those of annual crops in mixed-production areas. Figure 6 assigns a value of 100 to beef to facilitate the comparison, with the Carbon Footprint of beef being extremely high in relation to the compared grain crops. In contrast, beyond farming activities, the method of Carbon Balance seems to be highly sensitive to the configuration of the production system. As an example, in a mixed system in which the soybean crop accounts for a significant share of the total land area, the per hectare emissions of soybean clearly exceed the per hectare emissions of beef cattle. Thus, one can distinguish between the performance of individual cattle production farmers with different methods.

	Emissions by product (kg C/kg beef)	Emissions by hectare (kg C/ha/year)
Beef	100	100
Corn	0,69	26,7
Soybeans	0,23	130,8
Wheat	0,93	82,4

Figure 6. Carbon emission estimates for four activities measured per ton of product according to the LCA approach, or per hectare of land (hectare) according to the IPPC approach. The values presented correspond to compared averages from 70 farms (Source: Viglizzo & Ricard, 2023).

Conclusions

There are fundamental ethical reasons why countries and sectors must assume commitments and sign agreements to reduce carbon emissions and combat global warming. Our life systems face an emergency due to the global climate crisis, which transcends countries' national or economic interests. Achieving "climate neutrality" is the most important goal of the 2015 Paris Agreement (COP21) to limit global warming to well below 2º C in comparison to pre-industrial levels (United Nations Climate Change, 2022). To date, only a few countries respect the signed agreement, and consequently the practical outcome in terms of climate change mitigation tends to be poor.

Well-known reports hold the livestock industry chain and primarily beef cattle farming responsible for between 14.5 - 18 % of global anthropogenic emissions. However, this interpretation seems to be a distraction as it deviates the focus from the energy sector, which is the predominant emitter and cause of global warming. Cattle farming suffers, on the contrary, from delocalized emissions attributable to other sectors that strongly depend on fossil fuels, such as the manufacturing industries, transportation, food distribution, supermarkets, domestic consumption and so on.

As a result of such misinterpretation, various developed countries are implementing a strategy that aims to penalize cattle farming as a primary cause of global warming. Concrete actions proposed include a policy to drastically reduce meat consumption (especially beef), and a "kind suggestion" to reduce the cattle stock in producing countries. Given the contribution of cattle production to national economies, both options put at risk one of the more dynamic sectors in the Americas.

One critical issue for the cattle industry in the Americas is the need to focus on the metrics to assess emissions, that is Carbon Footprint or Carbon Balance. In intensive livestock production, with animals confined in reduced spaces, the Carbon Footprint is a useful metric to assess the carbon load per ton of beef. Inputs whose manufacture demands high use of fossil fuels have a major impact on the results when this metric is applied. On the other hand, in extensive cattle production systems, land becomes the critical input. Therefore, the Carbon Balance appears to be the most appropriate metric to assess emissions, with the hectare being the key reference unit. Unlike the Carbon Footprint, this metric accounts for both carbon emission and carbon sequestration and produces a net result that may be positive, negative or neutral. This approach is useful at the farm level to differentiate farmers that successfully manage carbon within their farms from those who do not. Given that different metrics adapt better to different farming systems, both the Carbon Footprint and the Carbon Balance deserve consideration in international negotiations. None of them should predominate to the detriment of the other.

We must not divert the focus from the main problem. Extensive cattle production is not one of the major causes of global warming, as some distractive communication strategies suggest. The main problem is that economic sectors that consume massive amounts of fossil fuels are the source of 90 % of global emissions today.

Beyond these confounding strategies, cattle farming in the Americas faces the double challenge of harmonizing global food security and global climate security. The double challenge is to absorb carbon from the atmosphere on the one hand, and to reduce emissions on the other hand. Both processes satisfactorily adapt to the notion of Carbon Balance, and certainly both require double accreditation.

The accreditation of carbon credits suggests that carbon may become a tradeable commodity, like beef, milk, grains and other agricultural products (Australian Beef, 2022). Likewise, on the mitigation side, the region needs to implement the certification of "credits from reduction of carbon emission". Both mechanisms allow for joint implementation.

A recent study by Almaraz et al. (2023) shows that current technology enables tens of billions of tons of carbon to be captured annually, which can render positive balances. On the carbon-gain side, climate-smart approaches include the design of silvo-pastoral systems that maximize carbon absorption, reafforestation, preservation of native woody vegetation, application of organic amendments, use of cover crops, rock weathering to capture atmospheric carbon and the incorporation of vegetable carbon (biochar). On the other hand, mitigation requires the use of forage legumes to replace nitrogen fertilizers, no-till operations to minimize fossil-fuel consumption, production of bio-fertilizers and biogas from feces and urine, the manufacture of fertilizers with renewable energies, the use of genetic selection in cattle and food additives to reduce methane emissions, and a drastic reduction of food losses and waste.

Although advancements in the application of these approaches and technologies is not homogeneous in the Americas, it is clear that a promising process has begun that will not be deterred whenever global conditions favor it and do not impose barriers to its implementation. Free trade is a complementary tool to accompany and strengthen the process. In an article by Janssens et al. (2020), the authors estimate that in the event that there is a global average temperature increase of 4° C by 2050, over 50 million people would suffer from severe undernutrition. The solution will inevitably rely on free trade, and not on ideal but utopian models targeting local production schemes.

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