

Uncovering trader water reliance and risks in Brazilian soy and beef supply chains



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Key messages

- Water use in supply chains is critically important to commodity traders. Soy and beef production use large quantities of water, yet there is a lack of visibility over this reliance because they are often produced in one country and consumed in another.
- Commodity supply chains face growing water-related risks. Climate change, drought and water scarcity can disrupt production and threaten food security, yet companies rarely monitor water use beyond their own operations.
- Brazil's soy and beef sectors rely on key river basins to supply water alongside other business sectors, domestic users and ecosystems, raising the prospect of increasing competition over diminishing water resources.
- Deforestation and water scarcity impacts often overlap. Addressing one without the other risks shifting environmental burdens.
- Traders, governments and financiers all have a role. From setting supply chain targets on water use and improving reporting to aligning policies and credit with sustainable water use, coordinated action can reduce risks.
- Expanding supply chain transparency beyond deforestation is essential. Incorporating water use is a crucial next step for sustainable commodity trade.

Water use in supply chains is often overlooked

The agricultural sector is the world's largest user of freshwater, accounting for 70% of the 4,000 billion cubic meters (m³) used by humanity in 2020 according to the UN World Water Development Report (UNESCO World Water Assessment Programme 2024). Water is essential for the production of commodities that are often consumed far away from where they are produced. In other words, consumers rely on distant water sources for their food and related products. This amount of 'indirect' water use is often hidden in the complexities of supply chains. High-income countries effectively outsource their water demand to low and middle-income countries that have a larger prevalence of agricultural production in their economy (UNESCO World Water Assessment Programme 2024; Vallino et al 2021), but the water used is attributed to the producer country rather than the consumer.

The dependency of agricultural production on water resources leads to risks in commodity supply chains that are exacerbated by climate change, particularly in regions where resources are already scarce (FAO 2015). The CEO Water Mandate, a business-led water stewardship initiative, defines a water-related risk as the "possibility of an entity experiencing a water-related challenge". It includes, for instance, risks of dry spells or drought¹ for agricultural commodities that are exclusively rainfed, or water scarcity risks for commodities that depend on crop irrigation for which the supply of surface and groundwater may be compromised (CEO Water Mandate 2014). For instance, recent meteorological conditions have affected coffee production in Brazil, Colombia and Vietnam with an expected decline in supply of 30,000 tonnes in 2025 (USDA-FAS 2025). Drought affected Paraguay's soy industry in 2021 when low water levels in the Paraná river, a key supply route², caused increased costs for soy processors and traders (Bolsa de Comercio de Rosario 2021).

Companies monitor their operational water use, such as volumes withdrawn, consumed or reused, as well as effluent water quality. However, this information is not usually complemented by data on the water used by suppliers and the level of water-related risks to which they may be exposed. Over the past 20 years, the emerging field of 'water footprint' assessments has delivered methods to estimate the water use for products and services, and the impacts resulting from this use (Berger et al 2025). This development led to the publication of international guidance and standards such as the Water Footprint Assessment Manual (Hoekstra et al 2011), the ISO 14046 water footprinting standard (ISO 2014) and the FAO-LEAP guidelines (FAO 2019). These assessments often remain narrowly focused on the environmental performance of an individual product or system, or lack the geographic resolution and sector-wide scale to link commodity traders and markets to specific river basin management options. This gap leads to a failure to inform collective decisions and actions on the ground.

1. A dry spell is a short period of drought over the crop development cycle typically affecting yields; a drought is a more extended dry period that could lead to complete crop failure (Rockström et al 2010)
2. For more information about Argentina's role in soy production, see the following [Trase insight](#).

This report is an analysis of water use in supply chains based on Trase's existing spatially explicit commodity supply chain maps to fill this knowledge gap. Our objectives are to (1) bring more attention to the critical reliance and water-related risks that traders can face in their supply chains, and to (2) inform specific actions and recommendations to key stakeholders.

Our analysis focuses on soy and beef traders in Brazil that export internationally using a new dataset developed by Trase (see Methods and Data box). Brazil is a leading producer and exporter of both products with its agricultural sector contributing close to 20% of the country's gross domestic product (GDP) in 2024 (CNA 2025).

Since 2015, Trase has supported the transition towards a more sustainable and just food system by providing open data on commodity supply chain maps that link deforestation in jurisdictions of production to traders and international consumer markets.

It is critical to go beyond deforestation and bring greater transparency and attention to water use in commodity supply chains to leverage the role of supply chain actors – companies, markets and financial institutions – in mitigating water scarcity impacts and risks and improving resilience in how water resources are managed. Broadening attention to multiple impacts, including deforestation, water use, biodiversity loss and greenhouse gas emissions can also help address inconsistencies and trade-offs in how different impacts are addressed by often siloed policies.



Methods and data

The insights in this report are based on peer-reviewed research by Lathuillière et al (2025) published in *Communications Earth & Environment*. The research is based on Trase data on Brazilian soy and beef production and exports in 2015–2017³. This time period represents the best overlap of the key datasets needed to derive soy and beef water use and river basin water scarcity information, together with Trase's soy and beef supply chain maps, which have a lower uncertainty in the municipalities from which these commodities were sourced. The insights of this report should be seen as an advance in how to interpret water use through different metrics for supply chain performance that apply to other commodities and hydro-geographies.

3. The dataset is available at: <https://zenodo.org/records/14921618>

Traders critically depend on the river basins where their suppliers operate

Beyond their own operations, traders rely on Brazilian river basins that supply the water resources needed for the soy and beef that they source and process for domestic and international markets. The location of each producer and structure of the supply chain will link each trader to a different set of river basins across Brazil (figure 1).



Figure 1: Brazil's river basins.

The 12 river basins supply water for soy and beef production, as well as energy generation and other business sectors, domestic users and ecosystems.

Brazil's cattle sector required 10.1–10.4 km³ (or billion cubic metres) per year of surface and/or groundwater resources in the 2015–2017 period to sustain the living herd (excluding rainfed pasturelands). This volume exceeds the urban water use of the states of São Paulo, Rio de Janeiro, Bahia, Paraná and the Federal District combined (or 7.8 km³ per year according to the National Water and Sanitation Agency of Brazil, ANA (ANA 2021). Over the same period, soy production relied on 188–206 km³ per year of water almost entirely supplied by rainfall, which is seven times greater than the capacity of the Itaipú dam located in Southern Brazil (~29 km³). The amount of irrigation for soy was 0.96–1.7 km³ per year over the same period.

Soy production is almost entirely rainfed and therefore at risk of dry spells and drought¹, as variability in rainfall can affect yields (Rattis et al 2021). Irrigation is used as a back up, but also as a means to intensify production beyond the end of the rainy season, enabling up to three crops per year for crops such as soy, corn and irrigated beans.

Cattle typically drink from small farm reservoirs that evaporate large amounts of water, representing nearly 70% of all cattle water use (figure 2). As a result of this loss, less water is available for downstream uses such as domestic or industrial uses, energy production, aquatic life and ecosystems.



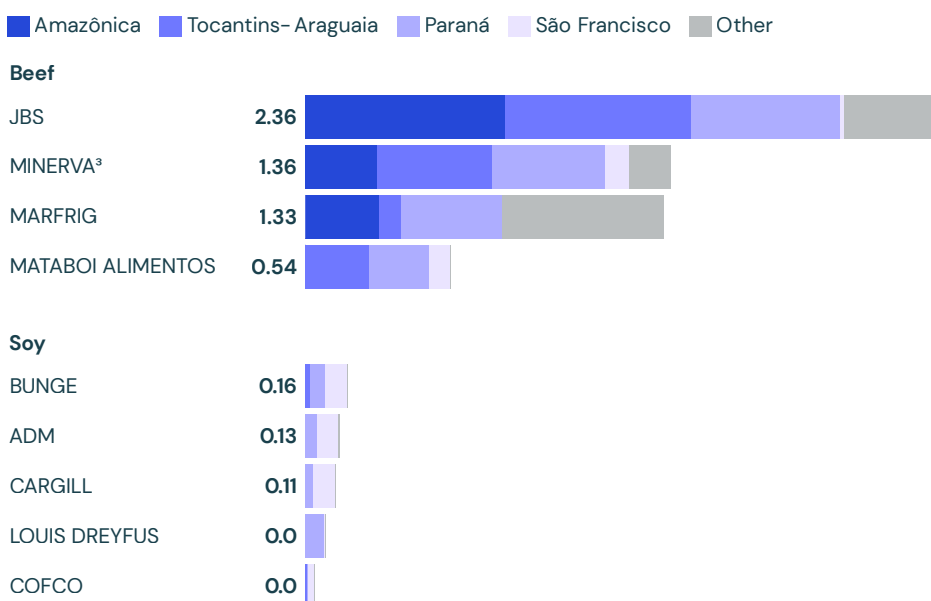
Figure 2: Soy irrigation and evaporation from farm reservoirs used for cattle drinking water are the main surface and ground water uses for these sectors in Brazil.

(Image credit: Alfribeiro / iStock / Getty Images Plus via Getty Images and Cacio Murilo via Shutterstock)

We derived the level of reliance of soy and beef traders and their exports of these commodities on Brazil's 12 river basins (figure 1) by quantifying the total volume of freshwater linked to these basins through company supply chains, or the 'indirect' water use of those companies. The four largest soy traders in Brazil⁴ relied mostly on the São Francisco river basin for their supply of irrigated soy. The five largest beef traders in Brazil⁵ relied on the Paraná (28%), Tocantins-Araguaia (26%), Amazônica (23%), and other river basins (23%) (figure 3). As a result, the international markets importing Brazilian soy and beef also depend on these sources to supply the water needed for the products they consume.

4. The four companies that exported >50% of soy products in 2017.

5. The five companies that exported >70% of beef products in 2017.



Footnotes: ¹ As animal drinking and reservoir evaporation; ² Irrigated soy only;

³ Minerva purchased Marfrig's slaughterhouses in 2018.

Source: Lathuillière et al. (2025)

Figure 3: The largest beef and soy traders and their reliance on surface and groundwater resources in Brazilian river basins.

Amount of water use for exports in 2017 (km³) for beef¹ and soy² by river basin.

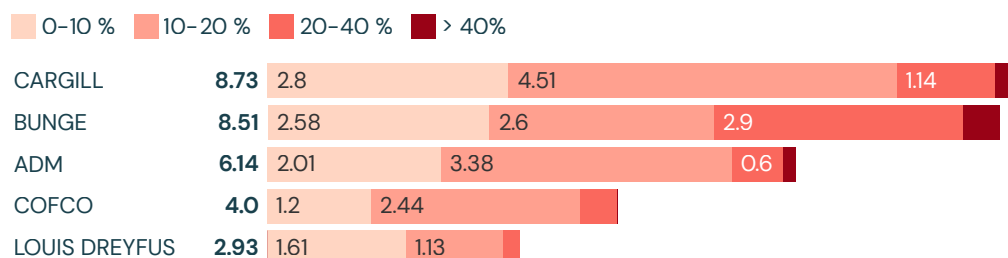
Traders face water-related risks in their supply chains

The critical reliance of soy and beef sectors on water resources means that traders are vulnerable to disruptions in their commodity supplies which can affect food prices and security. This process can be exacerbated by deforestation and climate change which affect regional temperatures and rainfall patterns (Leite-Filho et al 2021; Flach et al 2021).

Water-related risks are caused by changes in water availability in the production system and regions that supply traders. We explore these risks by considering soy and beef production systems that rely on (1) rainfall and are at risk of drought, and (2) surface and groundwater and are at risk of water scarcity.

For the rainfed soy supply chain, we characterise the drought risk to soy traders by linking the total volume of rainfed soy in company supply chains with a drought probability metric obtained for each Brazilian municipality for the 1958–2018 period (Petrillo et al 2023). Regions with a higher drought probability (>20%) are located in Brazil's north-eastern, south and south-eastern regions with some regions in Maranhão and Bahia states having a drought probability exceeding 40%. The state of Rio Grande do Sul, in particular, has been known to experience large variability in soybean yields (Ferreira et al 2024).

These geographical differences present a variability of risk among traders and companies in their supply chains through soy exports. Soy traders such as Cargill and Bunge source more soybeans from regions with more frequent droughts (>20% drought probability) (figure 4). However, these risks generally remain concentrated in a handful of soy-producing municipalities. For instance, trader supply chains are linked to a range of two (COFCO) to eight (Bunge) municipalities when considering a drought probability >40%. These numbers increase to 15 (Louis Dreyfus) and 127 (Bunge) when considering the range of municipalities with a drought probability >20%.



Source: Lathuillière et al. (2025)

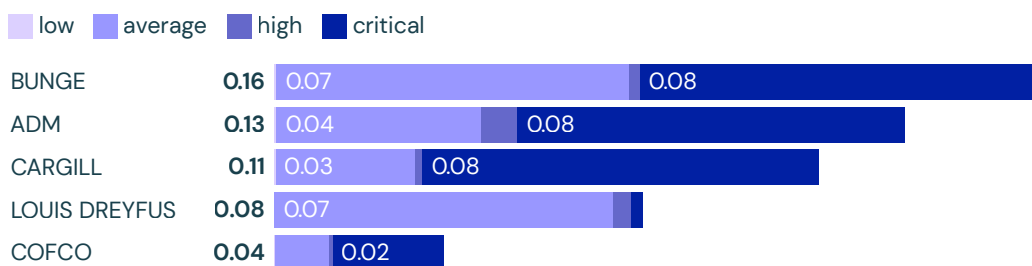
Figure 4: Trader water-related risk in the rainfed soy supply chain.

Trader exports of rainfed soy (million tonnes) in 2017 according to drought probability (%).

Surface and groundwater scarcity can affect both cattle and irrigated soy due to hydrological conditions such as reduced river flows or aquifer levels, but also competition over water resources shared among users that require freshwater from the same sources.

We link beef and soy trader supply chains to river basin water scarcity levels as defined by ANA as ‘low’, ‘average’, ‘high’, ‘very high’ or ‘critical’⁶ to assess the exposure of supplies to water scarcity (figures 5 and 6). Trader exposure to water scarcity remains concentrated in a subset of municipalities and river basins. All but one trader (Marfrig) is exposed to critical water scarcity in the São Francisco basin, while one third of Marfrig’s beef exports is exposed to high water scarcity through its link to the Atlântico Sul and Uruguai river basins of Southern Brazil.

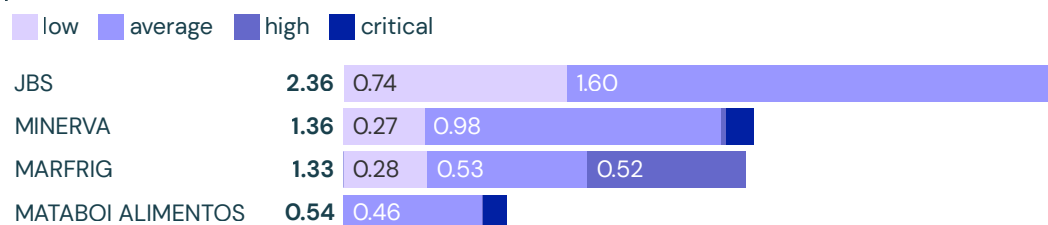
6. Water scarcity is defined as the ratio of water demand to water availability categorized into low (< 5%), average (5–30%), high (30–70%), very high (70–100%), critical (>100%), and periodic (null) (ANA 2016).



Source: Lathuillière et al. (2025)

Figure 5: Soy traders exposed to water scarcity in Brazil’s river basins.

Volume of freshwater (km³) used in soy trader supply chains in 2017 linked to levels of water scarcity as assigned by the National Water and Sanitation Agency of Brazil (ANA).



Source: Lathuillière et al. (2025)

Figure 6: Beef traders exposed to water scarcity in Brazil’s river basins.

Volume of freshwater (km³) used in beef trader supply chains in 2017 linked to levels of water scarcity as assigned by the National Water and Sanitation Agency of Brazil (ANA).

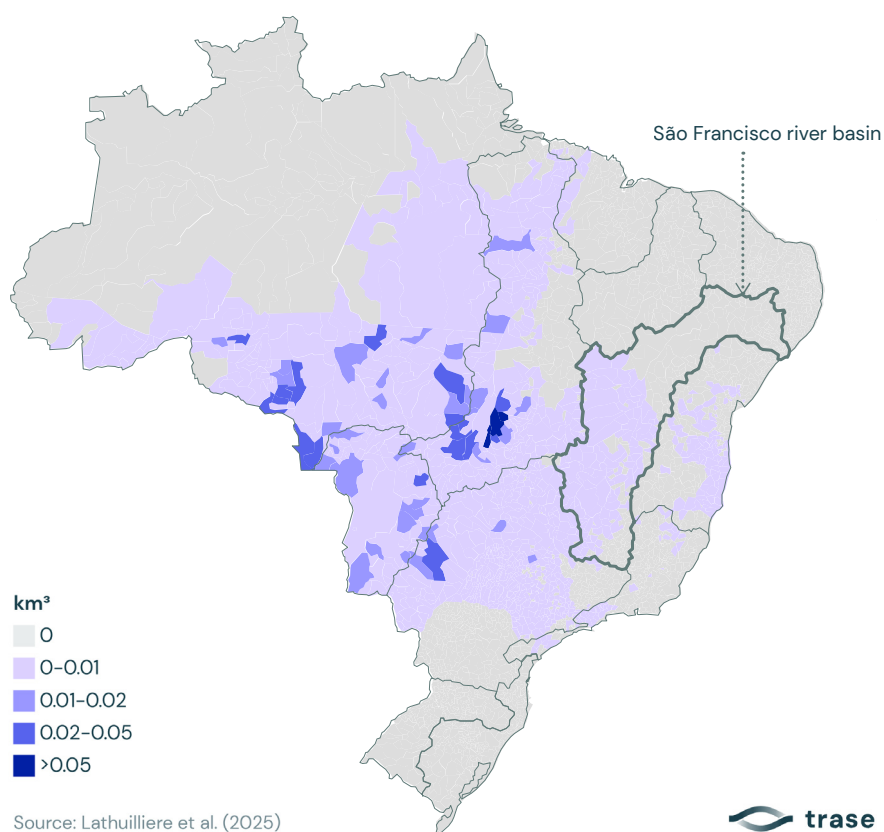


Figure 7: JBS's reliance on water for beef exports at municipality level in Brazil.
JBS was supplied from a set of municipalities across Brazil with a subset located in the São Francisco river basin which experienced 'critical' water scarcity in 2017.

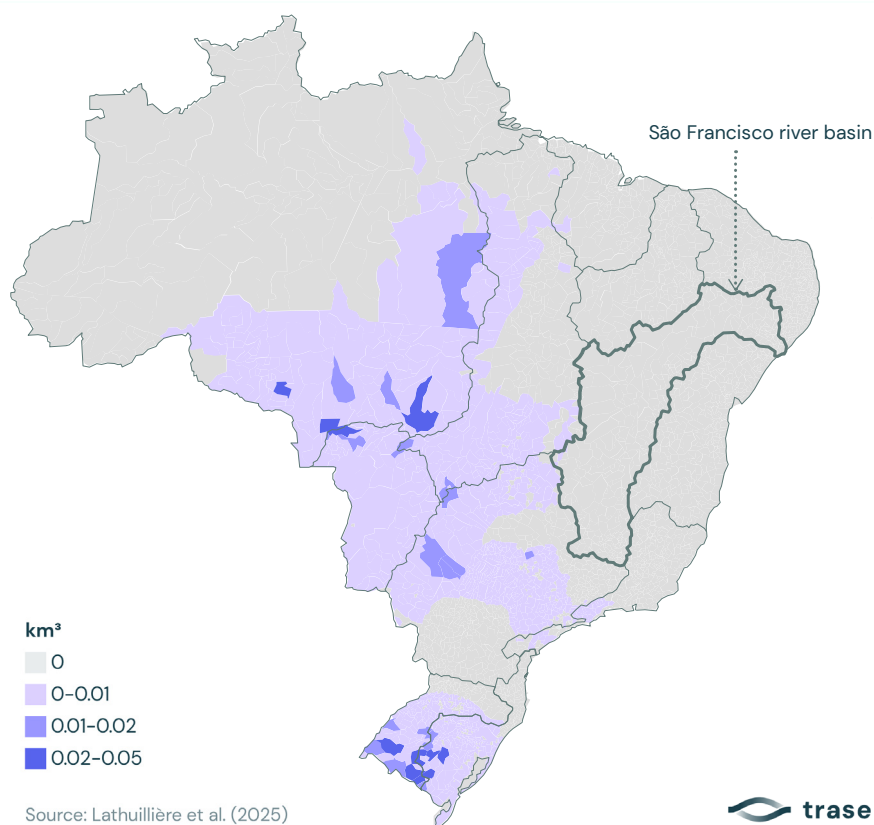


Figure 8: Marfrig's reliance on water for beef exports at municipality level in Brazil.
Marfrig was supplied from a set of municipalities across Brazil with a subset located outside the São Francisco river basin which experienced 'critical' water scarcity in 2017.

Deforestation and water scarcity impacts can overlap

Through commodity supply chains, traders and markets are linked to both deforestation impacts⁷ and water-related risks. To illustrate this link, we quantify municipality-level soy and beef deforestation and water scarcity footprints⁸ before comparing how, in a given trader's supply chain, the municipalities with the greatest impacts in one category (e.g. deforestation) overlap with the other (e.g. water scarcity impacts)⁹.

As most soy is rainfed, only a small portion of production carries a water scarcity impact due to irrigation. Traders, such as Bunge, face an overlap of impacts which mostly occur in the municipalities of the Matopiba region (São Francisco basin) where deforestation has taken place and where there is a practice of irrigation (figure 9). Results are drastically different for beef traders given the dependency of the beef sector on surface and groundwater. As a result, the overlap of impacts is more spread out across the country. For instance, JBS's supply chain shows an overlap of impacts in Matopiba that extend to a wider set of municipalities in the São Francisco and Tocantins-Araguaia basins (figure 10). The same analysis could be done for other traders.

Combined information on deforestation and water scarcity impacts not only allows for more targeted sustainability reporting, but also helps to set regional targets and focus mitigation actions and investments in places where the most significant impacts can be reduced first. Decisions based on a narrow focus on a single metric can also risk shifting the environmental burden from one impact (e.g. deforestation) to another (water scarcity) as a result of changing the supply from one region to another (Lathuillière et al 2022).

A multi-metric analysis to assess the sustainability of supply chains shows how a large country, such as Brazil, may require different types of interventions based on whether a given region has a large deforestation footprint, a large water scarcity footprint, or both. Companies currently face the challenge of identifying where these impacts may overlap so that they can take action to meet their own zero-deforestation commitments and/or reduce their impacts from water use.

7. See the Trase explainers on deforestation in the Brazilian soy and beef supply chains: [Brazilian soy exports and deforestation](#) and [Brazilian beef exports and deforestation](#)

8. Following the [ISO 14046](#) standard, a water scarcity footprint is a metric that quantifies the potential environmental impact of water scarcity in a life cycle assessment. The method from Boulay et al (2018) was used in this research to estimate the water scarcity footprint by multiplying soy and beef blue water footprints by a characterisation factor specific to each river basin.

9. Using an 80th percentile cutoff to assign municipalities in a trader's supply chain as having a large footprint. For more details see Lathuillière et al (2025).

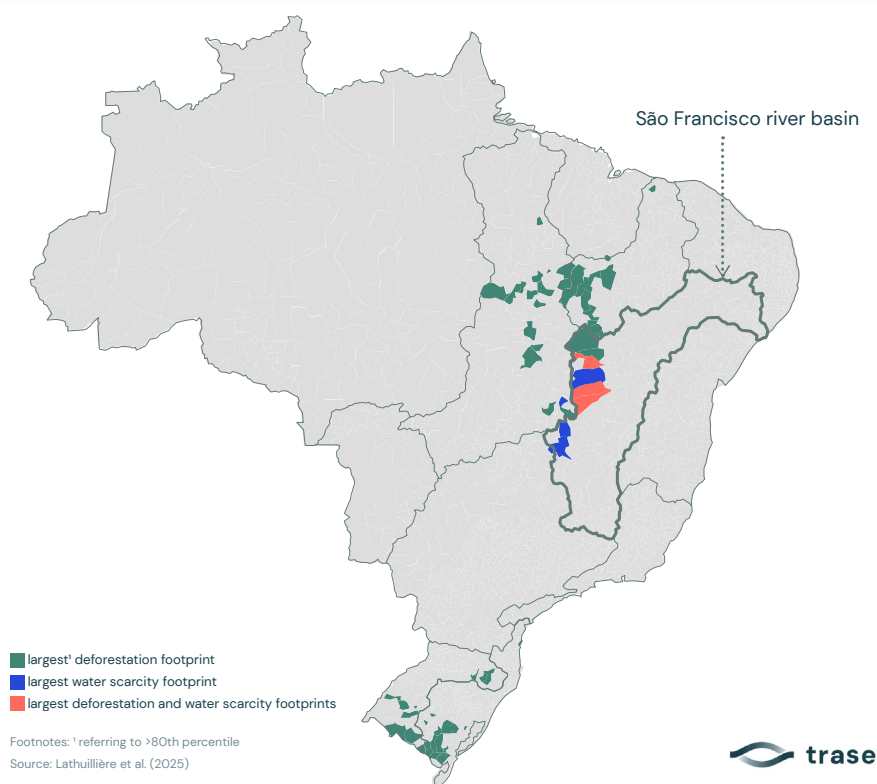


Figure 9: Deforestation and water scarcity impacts in soy trader supply chains can overlap in a small set of municipalities. Bunge showed overlapping impacts from its soy supply chain in the Matopiba region in 2017, especially in the São Francisco river basin.

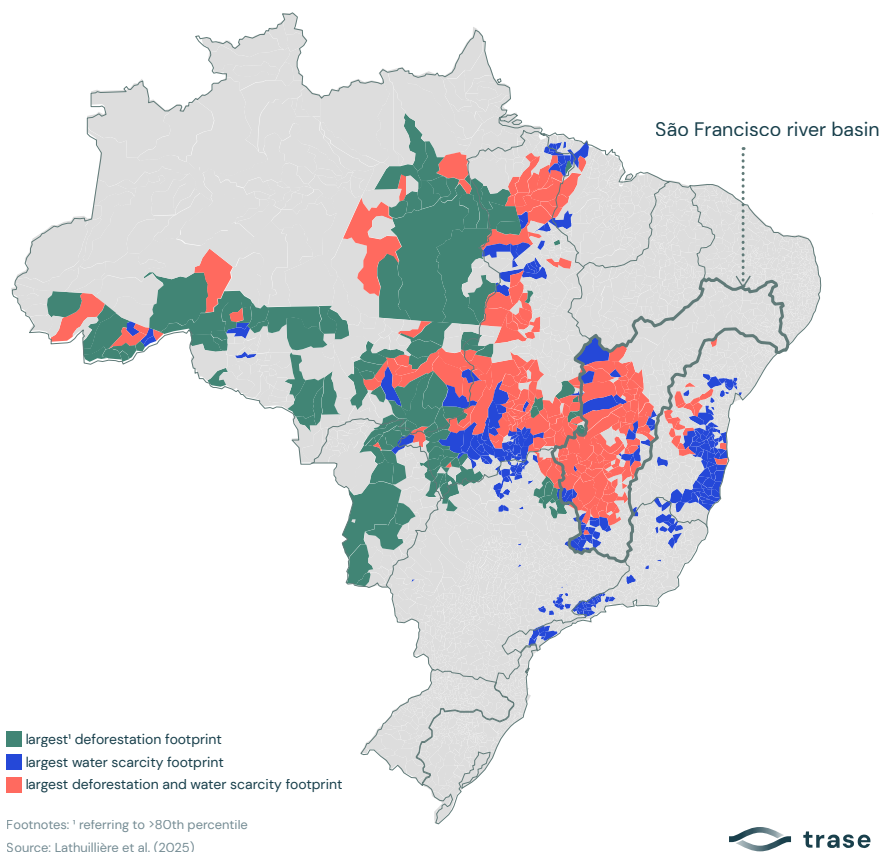


Figure 10: Deforestation and water scarcity impacts in beef trader supply chains can overlap in a small set of municipalities. JBS showed overlapping impacts from its beef supply chain in the Matopiba region in 2017, especially in the São Francisco river basin.

Opportunities for action

What traders can do

1. Set targets for supply chain water use

Traders have better information and control on their own operational water use, particularly companies that own slaughterhouses, soy-crushing facilities or refineries. While these operations can also experience water-related risks, this report has shown that traders also face risks in their supply chains and therefore should consider setting targets to also reduce water use, related risks and environmental impacts.

Some companies are advancing efforts to map their ‘scope 3’ water use, meaning water use in their supply chain, as a key step in their overall water strategy. For instance, Cargill has developed a targeting approach with the World Resources Institute (2022) for water use in their value chain with a specific supply chain water use target to “enable restoration of 600 billion liters of water and reduction of 5,000 metric tons of water pollutants in water-stressed regions”. Other companies such as Bunge (2024) and Louis Dreyfus (2024) have also carried out studies on water risks in their value chain, while Marfrig (2023) has looked at both animal and feed supply chains.

Further monitoring of water use in supply chains together with deforestation can help traders target investments in producing regions and incentivise producers to improve their production practices. For instance, traders should focus on river basins experiencing critical water scarcity such as the São Francisco, especially in municipalities where there is an overlap of high exposure to deforestation and impact to water scarcity.

2. Support farmers to reduce their water footprint of production

Traders are in a unique position to guide and support farmers in improving agricultural production practices in ways that can increase productivity while reducing their product water footprint, especially in basins of high or critical water scarcity. For soy traders, this means monitoring the expansion and use of irrigation in regions of greater drought probability to understand how irrigation, as a means to reduce the effects of drought on soy production, can also expose their supply chains to water scarcity. For beef traders, this means accounting for and monitoring cattle water use, particularly the magnitude of small reservoir evaporation and the potential impacts and risks of such reservoirs on their supply chain.

3. Improve water-use monitoring and share the findings

Traders can also play a critical role in improving monitoring of on-farm water use in their supply chains and share the findings to support best practice across the sector. This will allow multiple actors operating in, or being supplied from, the same river basins to better understand the role they can play in reducing their product water footprint. This could lead to downstream benefits for other business sectors, domestic users, as well as aquatic life and ecosystems.

Such transparency enables traders to recognise their co-dependencies within their supply chains. Using water for the supply chain of one trader can affect the amount

of water available for the supply chain of another trader, and vice-versa, such that individual efforts and investments to improve production practices overall will benefit supply chains and reduce water-related risks to international and domestic markets. This information is also key for river basin boards overlooking the allocation of freshwater resources to be able to better gauge the implications of their water resources and their link to the international demand of commodities (see next section).

What governments can do

1. Support monitoring of water use in supply chains

ANA should continue to update and make publicly available key input data for estimating water use in supply chains such as crop water use and river basin water scarcity (see next section), as well as information on water allocation permits (*outorga de água* in Portuguese). This data is crucial for river basin boards to be able to better gauge the allocation of water resources across different business sectors, domestic users and to support ecosystems. The extent to which a commodity sector is more domestically oriented, such as beef, or export oriented, such as soy, has implications on which consumers ultimately benefit, which actors may be competing over the same resources, and which river basins are more at risk to supply disruptions across the country.

2. Closing gaps on land and water use policy

Closer integration between environmental, agricultural and water agencies is essential to ensure that policy interventions reinforce rather than undermine each other. Natural ecosystems maintain rainfall and regulate temperatures in Brazil (Leite-Filho et al 2021; Flach et al 2021), meaning that conservation and restoration initiatives, and strong zero-deforestation commitments by traders and countries such as through the EU deforestation regulation (European Parliament and the Council 2023) can have positive effects on agricultural systems (Leite-Filho et al 2024). These ecosystem services should be explicitly recognised by the federal government by better communicating that reducing deforestation within its borders can also provide insurance to its agricultural production.

ANA can play an active role in supporting the mapping and monitoring of soy irrigation and cattle water use for both domestic and international food security. By better understanding the dual role of farm reservoirs in allowing cattle to live through the dry season while affecting headwaters and fragmenting streams, river basin committees and state governments could better weigh trade-offs among users up and downstream. At present, cattle reservoirs are still mainly built without a permit and represent a major oversight in the water balance of the country.

What financial institutions can do

Datasets such as the Rural Environmental Registry ([SICAR](#)), ANA's consumptive water use information (ANA 2021), water allocation permits (*outorga de água*), deforestation data ([Prodes](#)), deforestation alerts ([MapBiomas](#)) and licences ([Sinaflor](#)) provide valuable information and highlight synergies across stakeholders (subsection 1 above). This

information could be used in environmental due diligence, helping banks screen for credit applications or monitor credit users currently involved in illegal deforestation or unpermitted water withdrawals. Already, the Zoning of Agricultural Climate Risk (ZARC), which maps crop suitability by region and season, has now become a mandatory reference for access to subsidised rural credit under Plano Safra (Agência Gov 2025).

This shift creates a strategic opening to better align rural finance with climate adaptation goals. By integrating all above systems, banks can improve credit risk management while supporting more sustainable land and water outcomes in production areas, which in turn will benefit traders and downstream consumers.

Requirements for monitoring water use in supply chains

The crop water balance provided by ANA (2020) is the basis for determining whether soy requires irrigation in the fields that are now mapped annually by MapBiomas. A Brazil-wide and annual meteorological dataset, which includes surface temperature, relative humidity and reference evapotranspiration, is currently only updated by researchers (Xavier et al 2022). This information is key to estimating not only cattle water use, but also evaporation from reservoirs which are also derived from MapBiomas' surface water product (MapBiomas 2025).

Having these datasets updated annually and made available publicly would allow for annual updates of water use for soy and beef production to help farmers and traders monitor their water-related risks. This information should be complemented by field measurements of crop water use and reservoir evaporation to better predict the water use and impacts of such reservoirs across the country.

Table 1: Summary of datasets currently used to estimate water use in Brazilian soy and beef supply chains and needed frequency to reduce data gaps.

Data	Update frequency needed	Objective and additional options	References
Crop water balance	Annual	To determine the water footprint of specific crops and their irrigation requirements May also include remote sensing such OpenET Brazil	ANA (2020) Ruhoff et al (2024)
Irrigated cropland	Annual	To determine the irrigated cropland area and crop type	Based on MapBiomas (2025)
Gridded meteorological data	Annual	To determine cattle water use and reference evapotranspiration	Xavier et al (2022)
Cattle population breakdown by category	At next agricultural census	To predict the make up of the cattle herd (age, sex) at the municipality level	SIDRA-IBGE (2025)
Cattle reservoir area	Annual	To estimate the small farm reservoir evaporation that can be allocated to the cattle sector Could be based on higher resolution remote sensing	Based on MapBiomas (2025)



What's next for Trase with water?

Trase will focus on providing revised water use metrics for global agricultural commodity trade through the Global Environmental Impacts of Consumption (GEIC) indicator¹⁰. This will allow for more up-to-date global assessments of water use in global consumption activities and associated supply chains. We will continue to support users and partners with the datasets behind this report¹¹, particularly for pilots that can advance initiatives focused on water use in supply chains. We are also exploring how our water data – along with broader climate-linked information – can be used to support discussions linked to food security and supply chain resilience.

10. Available at <https://commodityfootprints.earth>
11. The dataset is available at: <https://zenodo.org/records/14921618>

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Data availability

The open data used for this analysis is available at <https://zenodo.org/records/14921618> with methodological details described in Lathuillière et al (2025).

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About Trase

Trase is a data-driven transparency initiative that revolutionises our understanding of the international trade and financing of agricultural commodities which drive tropical deforestation. Its unique supply chain mapping capabilities bring together disparate, publicly available data to connect consumer markets to deforestation and other impacts in producer countries. Trase’s free online tools and actionable intelligence enable governments, companies, financial institutions and civil society organisations to take practical steps to address deforestation. Trase is a global not-for-profit partnership co-founded in 2015 by the Stockholm Environment Institute and Global Canopy.

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