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Trase 'SEI-PCS Argentina soy v1.0.1' supply chain map: Data sources and methods

Trase maps supply chains for agricultural commodities, making it possible to link products and supply chain actors with specific areas of production, and associated sustainability risks and opportunities. It uses an approach called Spatially Explicit Information on Production to Consumption Systems (SEI-PCS) as the basis for this work (see this webpage or our manual for more detail). This document describes the data and methods that Trase used to map the subnational supply chain for Argentinean exports of soy, using a model called **'SEI-PCS Argentina soy v1.0.1'**.

For all soy exports, this model determined the likely department in which the soy was produced. It used trade and production data, as well as information on company-specific assets. The model used a decision tree to allocate exports to departments of soy silos and crushing facilities. It used linear programming to redistribute exports among departments of production, by minimising the overall transport distance, and taking into account local demand for soy. Table 1 provides an overview of key statistics.

Table 1. Summary statistics

	2016	**2017**	**2018**
Soy exports (million tonnes*, soy equivalent)	51.3	38.5	27.6
Exporting companies	117	94	97
Domestic market (% share of production)	5.6	5.6	7.4
Exports with unknown source of origin (%)	14	11	3

*= metric tons

Data and sources

Trade data

The model used per-shipment data (such as customs data, bills of lading or cargo manifests) for 2016-2018, covering all exports of the soy products classified under the 'HS' customs codes in Table 2. These products include all soybean, oil and cake commodities. We used a commodity-equivalence factor (see Table 2) to convert different products to a standard commodity equivalent, in this case soybeans. We confirmed the quality of the data by comparing it with other data sources and with data in different aggregated forms (such as COMTRADE, as illustrated in Table 3).

Table 2: Soy product HS codes and commodity-equivalence factors (to soy equivalent)

Product	**HS code**	**Commodity-equivalence factor**
Soya beans, whether or not broken	120110	1.000
Soya beans, other than seed, whether or not broken	120190	1.000
Flours and meals; of soya beans	120810	1.031
Vegetable oils; soya bean oil and its fractions, crude whether or not degummed, not chemically modified	150710	1.031
Vegetable oils; soya-bean oil and its fractions, other than crude, whether or not refined, but not chemically modified	150790	1.031
Oil cake and other solid residues; whether or not ground or in the form of pellets, resulting from the extraction of soya bean oil	230400	1.031

Table 3: Comparison of results from customs data and COMTRADE data (2016-2018)

	Volume of exports (tonnes)		**Value of exports (Freight on Board; US$)**	
	Customs	**COMTRADE**	**Customs**	**COMTRADE**
2016	50,186,240	43,796,286	19,810,882,129	17,316,220,439
2017	37,551,794	40,636,046	14,354,106,206	15,542,925,114
2018	26,931,700	31,019,401	11,233,658,425	13,097,119,198

Internal trading of soybean is available by SIOGRANOS on an annual basis and includes information on the volumes of flows of soybeans between large regions that contain several departments. We used SIOGRANOS information to derive special rules about links between regions and ports of export.

Domestic demand

We calculated domestic demand for soy as a function of livestock population, livestock products (eggs) and the quantity of seed farmers saved. We determined demand for livestock and livestock products by estimating the total live weight (kg) of cattle, chickens and pigs per department, as well as eggs, using the data sources listed in Table 4.

We then applied a conversion factor to transform these live weight (or egg) values into tonnes of soy cake and then soybean equivalent. For this, we relied on feed information from Brazil's National Union of the Animal Feed Industry that shows how much soy is required in feed to produce a given amount of livestock.

We based farmers' demand for seed on a fixed quantity of 73 kg per hectare that we applied to all soybean-producing departments of Argentina. Table 5 compares our estimates of domestic soy demand to total soy production for 2016-2018 — it shows how domestic demand, as a proportion of total production, has varied over that period.

Table 4: Data used to estimate domestic soy demand, including data used to derive total live weight of livestock for each department in Argentina

Demand	Data source	Transformation, processing	Comment
Cattle	SENASA	We converted numbers of animals to live weight using annual live weight for each cattle sub-category from Datos Abiertos.	No data for 2017, so we used average population for 2016 and 2018.
Pigs	SENASA	We converted number of animals to live weight using annual live weight for each pig sub-category from the Ministry of Agriculture's annual reports.	No data for 2018, which we assumed to be equal to 2017.
Chicken	Combination of sources	The number of slaughtered animals was obtained from CAPIA and crossed with slaughterhouse information from SENASA to derive the department of chicken production.	No data for 2016, which we assumed to be equal to 2017
Eggs	Combination of sources	The number of slaughtered animals was obtained from CAPIA and crossed with facility information from SENASA to derive the department of egg production.	No data for 2016, which we assumed to be equal to 2017
Seed	Under-secretariat of Agricultural Markets Report	73 kg of seed saved per hectare of soybean	Fixed ratio for 2017-2018 in all departments

Table 5: Soy production and estimated domestic demand for soy in Argentina (2016-2018)

Year	Soy production (tonnes)	Estimated domestic soy demand (tonnes)	Proportion of soy production used domestically (%)
2016	57,221.982	3,189,806	5.6
2017	54,838,945	3,087,535	5.6
2018	34,712,148	2,574,541	7.4

Production data

Soybean production data is available from the Ministry of Agroindustry (Agricultura—Estimaciones agrícolas), but this data is currently missing departments in key provinces such as Formosa and Corrientes. We therefore used remote sensing images of soy crop area, together with soybean production yields reported by the Ministry of Agroindustry, to derive volumes of soy production per department. For this we used 30 m resolution Landsat images (Global Land Analysis and Discovery, University of Maryland). See Table 6.

Table 6. Differences in soybean production estimates (2016-2018) derived from official statistics (Ministry of Agroindustry) and remote sensing

Year	Ministry of Agroindustry (tonnes)	Remote sensing (tonnes)	Percentage difference of remote sensing estimate
2016	58,799,259	57,221,982	-3%
2017	54,972,546	54,838,945	0%
2018	37,787,927	34,712,148	-8%

Supply chain data

Asset data

Soy silos, crushing facilities and ports

We obtained information on silos, crushing facilities and ports from different official sources (see Table 7).

Table 7: List of datasets used for assets (silos, crushing facilities and ports)

Data	Data source	Link to datasets	Comment
Assets	RUCA	https://ruca.agroindustria.gob.ar/	Official list of assets based on resolution 21-E/2017
Assets	ONCCA	Link to ONCCA	List of operators from 2008-2012
Assets	Railway	Link 1 Link 2	List of silos that are linked to railway
Assets	Various	Company websites	

Transportation data

Road network

We sourced road network data from Open Street Map.

Boundaries

We mapped the supply chain information at the department level in Argentina using the BAHRA, the official database of human settlements in Argentina. We used the BAHRA's unique location codes to identify departments and localities within departments. Some BAHRA codes also identify specific buildings or assets and this enabled us to allocate assets to specific locations.

SEI-PCS implementation

We used a logic-based decision tree (see Annex 1) to link exports back to departments of soy storage facilities (silos and crushing facilities) that serve as logistics hubs. The decision tree allocated exports to logistics hubs based on a series of conditional rules. It triangulated information on the per-shipment export data (including province of origin where available); company ownership of and locations of soy silos and crushing facilities; and the SIOGRANOS data on internal trading. We labelled exports as having an 'unknown source of origin' if we could not link them to a silo in a department.

The decision tree took account of the fact that traders can source from beyond their own silo network. In using the information on internal trade from SIOGRANOS, the model effectively shared exports among departments within the same SIOGRANOS zone (which encompasses multiple departments).

For oil and cake products, the model assumed that crushing facilities are mainly located at ports. There are some exceptions where a company has a crushing facility outside of the province identified as the province of origin in the trade data.

The results of the decision tree are expressed in terms of the amounts of soybeans (tonnes) sourced from the department of the logistic hubs (soy silos). The model converts soy oil and cake quantities to their soybean equivalents using a commodity-equivalence factor of 1.031 kg soybean per kg of oil/cake.

We used a simple linear program to make the final link between exports from departments that the decision tree (Annex 1) identified as logistics hubs and nearby departments of soy production. The linear program minimised the overall distance soy could have travelled from supply nodes (departments of production) to demand nodes (logistic hubs). This linear program used a distance matrix, based on the road network data, to calculate distances between geometric centres of departments of production (supply nodes) and logistic hub departments (demand nodes). Supply nodes are constrained by production and demand nodes are constrained by exports and domestic demand.

Subnational and company sustainability indicators

The Trase indicator manual for Argentina describes the connection of these supply chain data to department level sustainability indicators including soy deforestation risk. These indicators cover agriculture, environment, territorial governance, actor commitments, socio-economic and contextual (e.g. ecoregions).

Changes from previous version(s)

Version	Publication date	Changes

1.0.1	June 2020	• Soybean production has been updated with revised soy production maps which have also been used to determine both soy deforestation and soy deforestation risk in the Chaco
1.0.0	December 2019	• First release

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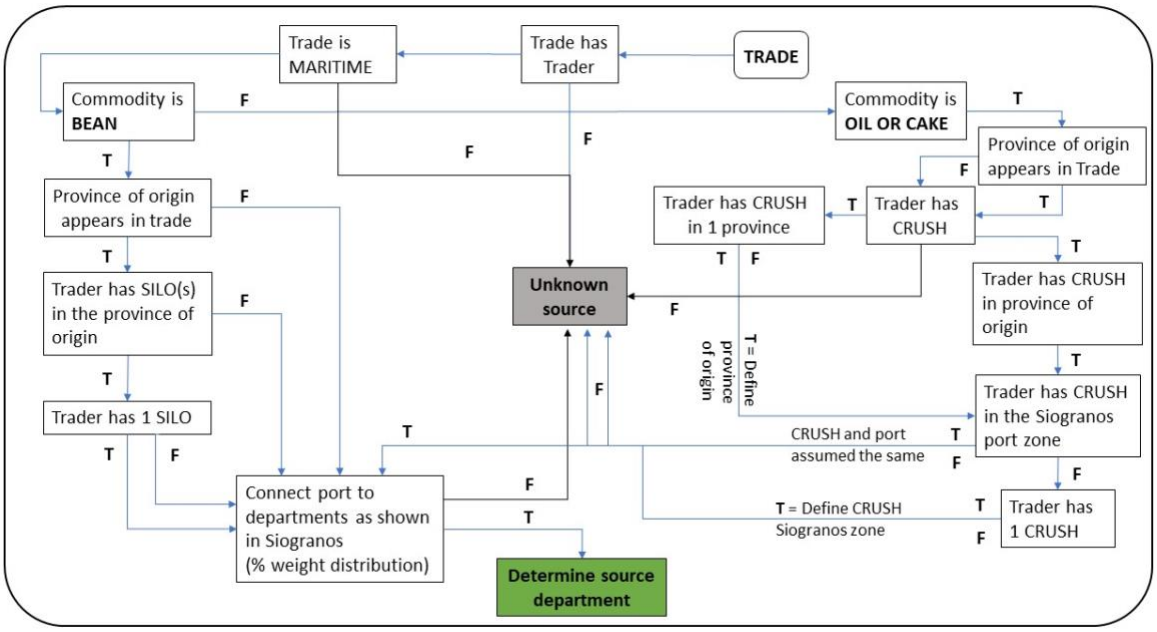
Annex 1: Decision tree for the 'SEI-PCS Argentina soy v1.0' supply chain model



T = true; and F = false. SILO = soy silo. CRUSH = soy crushing facility.

Annex 2: Glossary

Term	Definition	Example
Asset	In the context of Trase, a physical or material resource owned by a business or an economic entity that relates to the	Soy silo, slaughterhouse, refinery, mill, farm.

	production, storage or processing of a commodity.	
Commodity equivalent	Measure used to relate the trade flows of different products to a commodity equivalent. This is obtained by using the commodity equivalence factor.	Soy oil and cake products are converted into soybean equivalents.
Commodity-equivalence factor	Factor used to convert the amount of a product into a commodity equivalent.	1 kg of soy meal and oil are equivalent to 1.031 kg of soybeans (3 g are waste).
Decision tree	Outlines the conditional filtering of trade data in order to link commodity exports to a logistic hub.	Each supply chain map manual contains a figure of their respective decision trees.
Distance matrix	The distances between different demand and supply nodes. This is used in the linear programming step to solve the problem of minimising the total distance incurred in meeting all of the demand.	Supply nodes are jurisdictions of production. Demand nodes include exports from ports and domestic demand nodes such as chicken farms for Brazil soy. Distances are based on the available road networks.
HS code	Unique code from the Harmonized System (HS) which describes the nature of the products being traded internationally.	1201: Soya beans, whether or not broken 120110: Soya beans, seed; whether or not broken
Jurisdiction	The territorial administrative units into which a country is divided.	Municipality in Brazil, kabupaten (district) in Indonesia, department in Argentina, department in Paraguay (lower resolution, with departments comprised of districts).
Linear programming	Linear programming (LP, also called linear optimisation) is a method to achieve the best outcome (such as maximum profit or lowest cost) in a mathematical model whose requirements are represented by linear relationships.	Use linear program to minimise the distance between logistic hubs and production municipalities.
Logistics	Activities related to the production, storage, processing, transport, trade, etc., of commodities in supply chains.	Chicken rearing, cattle slaughtering, soybean crushing, palm oil bulking, shipping.
Logistics hub	Jurisdiction containing one or more assets that are nodes in the commodity supply chain.	Municipality, department of silo location, slaughterhouse, palm oil mills.

Node	Jurisdiction, asset, trader or country representing a point of aggregation or transfer of a commodity through its supply chain.	
Supply chain	Sequence of nodes linking a jurisdiction of production to a country of import.	