

To what extent are the Italian regional food  
systems vulnerable to climate shocks?  
*An assessment framework for critical products*

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# Motivations - 1

- Climate shocks are expected to dramatically affect agriculture and food production in the very next years (e.g., FAO, 2021). They are generally not predictable and geographically dispersed
- Since the 1980s onwards, global trade of food commodities increased as well as intensive methods of production, thus increasing the imports of inputs

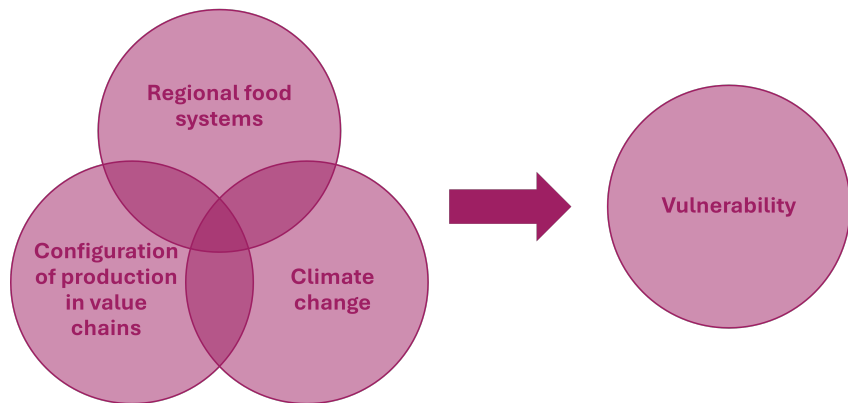
## **MAIN QUESTION OF THIS RESEARCH PROJECT**

To what extent the Italian regional food systems (RFSs) are vulnerable to climate shocks?

## Motivations - 2

- When tackling vulnerability of RFSs to climate shocks the input-output framework appears appealing: trade indeed is not purposeless but it satisfies specific (consumers', firms') needs (vertically integrated sectors; value chains)
- However, classic approaches suffer from different (sometimes overlapped) issues → level of aggregation of inter-sector/inter-territories relations, hypotheses about input substitutability, geographical lenses used to examine phenomena, lack of attention to firm heterogeneity and market structures, etc..

# Vulnerability of RFSs to climate shocks



# The (starting) conceptual framework

We first borrow from the EC assessment framework (see, e.g., Blengini et al., 2017; European Commission, 2023):

- **Economic relevance:** The importance of the critical raw material depends, on the one hand, on the (value added) importance of the end-use sector. On the other, on the technical and cost performance of the substitutes.
- **Supply risk:** It reflects the risk of a disruption in the EU supply of the material. It is function of the concentration of primary supply from raw materials producing countries, considering their governance performance and trade aspects.

# Renewed in an interregional input-output framework: why?

- Production is organized in value chains which are both regionally clustered (economies of scale; clusters, industrial districts) and globally dispersed (GVCs)
- Regions do trade goods (or tasks) for which they have a comparative advantages in exchange for purchasing power to satisfy local consumer needs (love for variety) → dependence is both forward and backward
- It is therefore important to take both a supply side (production) and a demand side perspective when looking at vulnerability

→ interregional input-output analysis allows to correctly frame the “vulnerability problem” since with it value chains can be consistently pinned down both from a production side and from a demand side perspective

# Reframing economic relevance and supply risk

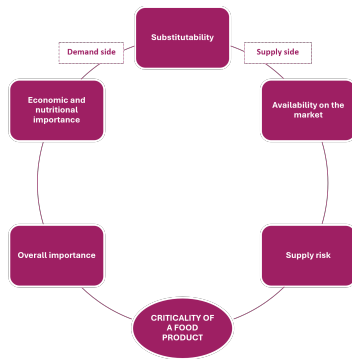
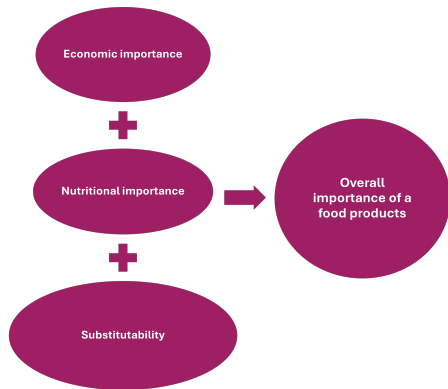
## ECONOMIC RELEVANCE

- In a production framework: the share of a given sector, or segment of value chain, in total economy in responding to a peculiar demand shock
- In a consumption framework: still a continuous measurement? what about essential items such as food products?

## SUPPLY RISK

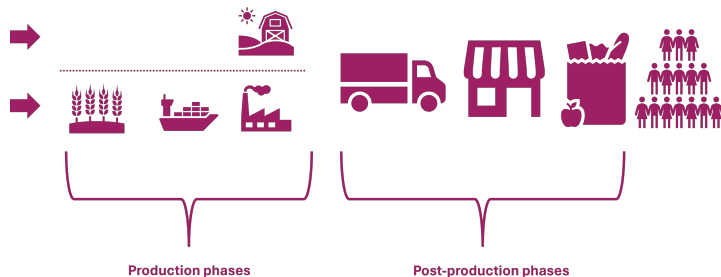
- Risk can be tackled now both in terms of inputs serving the same value chains (e.g., US automotive industry vis-à-vis EU automotive industry)..
- .. or in terms of materials serving competing value chains (e.g., car industry vis-à-vis computer industry)

# Evaluating the criticality of a food product





# The configuration of food systems and value chains



- Production is (often) spatially dispersed
- Industries (more precisely, firms) are in charge of production within the network
- Products are the items which are traded and some of them are critical

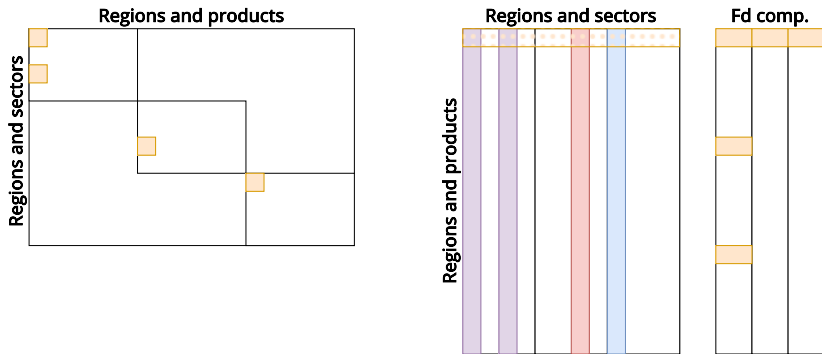
## Via a multi-layer approach



1. An inter-country interregional framework based on trade data and SUTs
2. An interregional framework based on disaggregated SUTs
3. A spatial disaggregation of production
4. Firm level data on productions and balance sheets

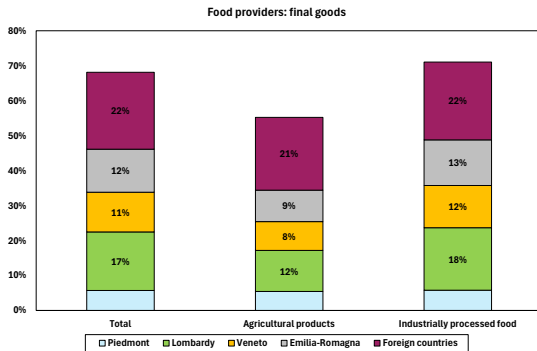
The (disaggregated) interregional framework (2) is integrated in the inter-country interregional framework (1)

# Our starting point: the interregional SUT



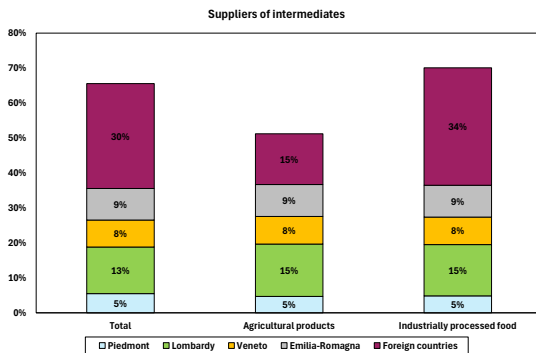
Our starting point is an interregional-international SUT with 43 sectors, 54 products, 66 geographical areas (21 Italian regions, 44 countries, Rest of the World)

# RFSs in the international-interregional SUT framework - 1



Almost 70% of final food products is provided to Italian regions by 4 Italian regions (Piedmont, Lombardy, Veneto, Emilia-Romagna) and foreign countries

## RFSs in the international-interregional SUT framework - 2

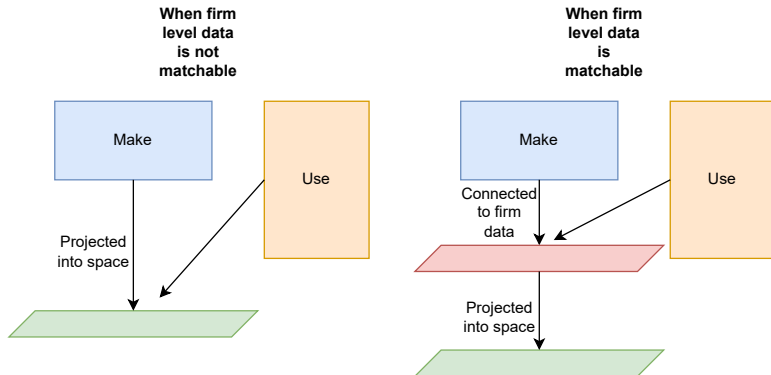


Foreign countries are also relevant providers of intermediate inputs to Italian regions serving final demand for food. Backward foreign dependence (final + intermediates) of RFSs accounts for 45%.

# Further steps to evaluate impact of climate shocks on RFSs

- The final aim of the project is to construct a **food satellite account** with a satisfactory level of disaggregation of products and sectors to track regional heterogeneity in the participation to food value chains
- ... and an adequate spatial representation of production so as to match the spatial granularity of climate shocks → **Geolocalization of cultivations**
- ... and firm heterogeneity to account for criticalities stemming from the impact of climate shocks on firm balance sheets → **A data-driven ABM for food production**

# Three connected layers



# Food satellite account - Data & Methods

## Production side:

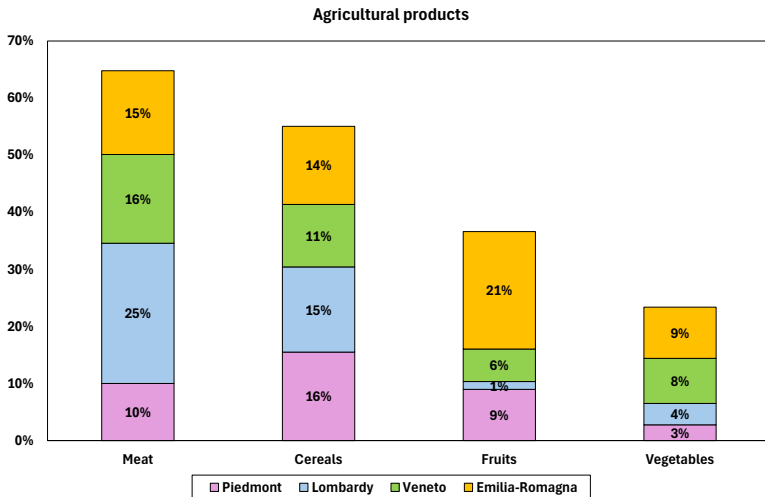
- For agriculture the starting point is represented by Istat agricultural accounts (disaggregated products, aggregated sector with production, value added, intermediate inputs) combined with FADN accounts (much more aggregated products, disaggregated sectors) and COEWEB data
- For the food & beverages industry we use PRODCOM (5 digits sectors, 8 digits products) combined with SCI, SCI pmi (5 digits sectors), ASIA microdata and COEWEB data to disaggregate sectoral regional accounts

## Consumption side:

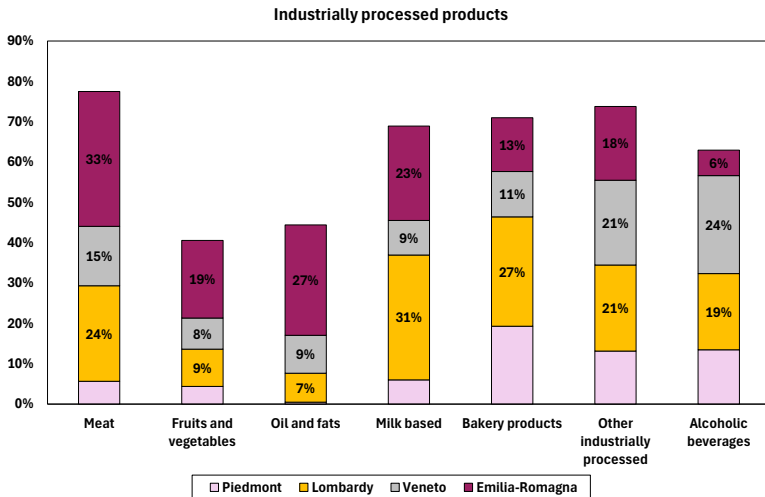
- Consumption survey (up to 100 items in the food basket)



# Food satellite account: Evidence - 1



# Food satellite account: Evidence - 2



## A couple of research questions

⇒ **What has been the impact on food production and imports of the flood which hit Emilia-Romagna in May 2023?**

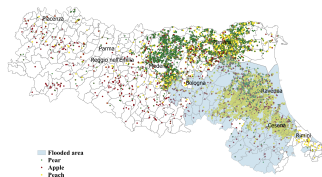
⇒ **What has been the impact of the drought of 2023 on the balance sheets of Tuscan farmers specialized in wine production?**

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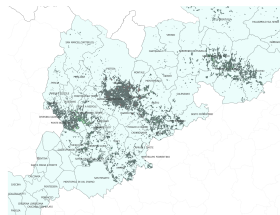
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# Climate shocks and spatial heterogeneity



Emilia-Romagna: May 2023



Tuscany: November 2023

For Emilia Romagna we estimated that:

- in the second half of 2023 the Italian imports of pome and stone fruits more than doubled because of the flood
- the exports of fruits of the hit provinces dropped by 60% in 2023Q3 → moreover: capital (trees) destruction

# Climate shocks and firm heterogeneity - 1

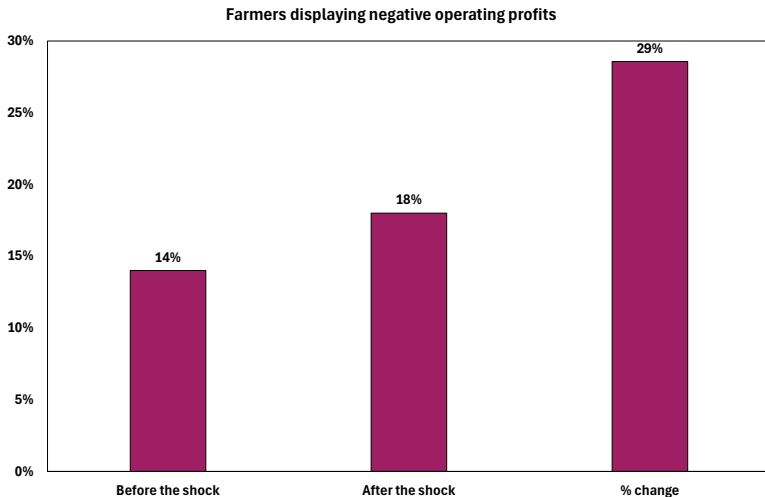
- Heterogeneity is not only product- and space- based, but also related to firms
- Active farmers: data from Piani Colturali Grafici, Tax Declarations, Registro delle Imprese, Asia Agricoltura, Aida, Sistema Informativo Lavoro (CO)
- Active firms in the food processing industry: Asia UL, Asia Frame Imprese, Asia Frame Territoriale, Aida, Sistema Informativo Lavoro (CO)
- A simplified balance sheet is attributed to all firms in the population (via imputation for missing data) → production, labor cost, intermediate inputs
- Impacts of adverse climate shocks on firm balance sheets computed starting from production via simulation of effects on input use (both labor and intermediates) and finally on gross operating margins

## Climate shocks and firm heterogeneity - 2



- We simulated the impact on farmer balance sheets of the negative shock on wine production in Tuscany in 2023
- Wine production in the agricultural sector dropped by 25% at the regional level with a certain degree of territorial heterogeneity
- Input usage, however, did not drop by the same amount: e.g., labor -7% (indeed: harvested grapes dropped by less than 10%)

# Climate shocks and firm heterogeneity - 3





# Discussion

- The approach of criticality is very useful for assessing the impact of climate shocks on production, but still limited for essential goods like food
- From this perspective, we need to assess to what extent the damages have a direct impact on our food security
- Evaluating the impact of climate shocks on RFSs through the integration a plurality of layers provides a promising toolkit for addressing this crucial challenge