STUDY

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European Parliament

The dependency of the EU's food system on inputs and their sources

Agriculture and Rural Development

Policy Department for Structural and Cohesion Policies
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RESEARCH FOR AGRI COMMITTEE

The dependency of the EU's food system on inputs and their sources

Abstract

This study analyses the vulnerabilities of the EU food system regarding inputs, describing the tools to secure those inputs and make the EU less dependent on foreign suppliers. It provides recommendations for appropriate measures to increase the EU food system's resilience to disruptions in trade flows and price increases of imported inputs.

This document was requested by the European Parliament's Committee on Agriculture and Rural Development.

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LIST OF ABBREVIATIONS

AECC	Agri-environment climate commitments
AGRI	Agriculture and Rural Development Committee of the European Parliament
BRG	Better Regulation Guidelines of the European Commission
CAP	Common Agricultural Policy
CBAM	Carbon Border Adjustment Mechanism
CN	Combined Nomenclature
COVID-19	Coronavirus disease of 2019
DG AGRI	Directorate-General for Agriculture and Rural Development of the European Commission
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
EFSA	European Food Safety Authority
EFSCM	European Food Security Crisis preparedness and response Mechanism
EGD	European Green Deal
EPRS	European Parliamentary Research Service
ETS	Emission Trading Scheme
EU	European Union
EUR	Euro (currency)
EUROMED	Euro-Mediterranean Partnership
F2F	European Union's Farm to Fork strategy
FAO	Food and Agriculture Organisation of the United Nations
FEFAC	European Feed Manufacturers' Federation
FIGARO	Full International and Global Accounts for Research in input-output analysis

GAEC	Good Agricultural and Environmental Conditions
GDP	Gross Domestic Product
GM	Genetically modified
GMO(s)	Genetically modified organism(s)
IO	Input-output
JRC	Joint Research Centre Directorate-General of the European Commission
K	Potassium
kg	Kilogram
MFN	Most Favoured Nation tariff arrangements
Mr	Mister
Ms	Miss/Mistress
n.	Number
N	Nitrogen
NGT(s)	New genomic technique(s)
NSP(s)	National Strategic Plan(s) (for the implementation of the Common Agricultural Policy)
OSA	European Union's Open Strategic Autonomy
P	Phosphorus
R&D	Research and development
R&I	Research and innovation
RED	Renewable Energy Directive (Directive EU/2023/2413)
RQ(s)	Research question(s)
SME(s)	Small and medium-sized enterprise(s)
SWOT	Strengths, weaknesses, opportunities and threats

TCF	Temporary Crisis Framework
TEN-T	Trans-European Transport Network
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
US	United States (of America)
USA	United States of America
USSR	Union of Soviet Socialist Republics
WTO	World Trade Organisation

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EXECUTIVE SUMMARY

While the European Union (EU) is a key global producer of agricultural commodities and has a positive agricultural trade balance, it is dependent on the import of some key commodities. However, recent shocks to the global markets following the COVID-19 pandemic and the Russian invasion of Ukraine have highlighted the risks of increasing economic efficiency at the expense of resilience and food security. They have also impacted the EU's food production sector's prices, supply chains and logistics.

The availability of food in the EU is not generally considered to be at risk but these price increases and the related market disruptions have highlighted the fact that **the EU food system is dependent on some inputs which, in some cases, originate from a limited number of third-country suppliers.**

Against this background, the European Parliament (EP), in its resolution of 24 March 2022 on 'The need for an urgent EU action plan to ensure food security inside and outside the EU in light of the Russian invasion of Ukraine' expressed its will to commission "a comprehensive study on the dependence of the EU's food system on inputs and their sources" (point 56 of the resolution). In its 2022 own initiative report on 'Ensuring food security and long-term resilience of the EU agriculture', the EP has also highlighted the need for the EU to strengthen its food security and the resilience of its agricultural sector and its entire supply chain by reducing its dependence on imports from third countries and diversifying the supply of critical imported products such as fertilisers, animal feed and raw materials.

The study relies on a **mixed approach** combining the analysis of quantitative evidence (mostly from official sources) with qualitative evidence and insights gathered through literature review and interviews with key institutional and sectoral stakeholders. The methods used in the study are theoretical, qualitative and quantitative analysis, the latter also including a quantification of the dependency of the EU food system on imported inputs.

Vulnerabilities of the EU food system regarding inputs

- **The total sector's dependency ratios for imported inputs** [*imported inputs/total sectoral output*]**, in value, are generally below 10 %** for the core components of the EU's food system (i.e., the "agriculture", "fisheries and aquaculture" and "food and beverages" sectors). In agriculture, this ratio is 7.7 %.
- However, **when expressed as a share of the total inputs used by these three core components of the food system, the value of imported inputs points to a heavy reliance on imports, with significantly higher import dependency ratios** [*value of imported input/total input value*] **for the selected inputs** (ranging for instance from 11.06 % to 66.71 % for the inputs to the agricultural sector). The same applies for the **geographical concentration of imports**, measured as the *aggregated % share of the top-4 suppliers,* **which is relatively low at aggregate level (with a combined share lower than 40 % in 2019 for the top-4 suppliers) but significantly higher for individual input groups** (e.g., for soya beans, soya bean meals, phosphates, potash, where the top two suppliers' market share reaches 50 to 85 %).
- **Dependency on imported inputs is particularly significant for animal products** (soya beans and meal are feed materials of critical importance to this subsector and to poultry and pig farming in particular, and their imports are characterised by the strongest polarisation towards few non-EU suppliers) and **cereals** (which depend on imported raw materials and energy sources needed to produce fertilisers).

- **Recent developments reflect the degree of integration of the EU food supply chain into the global supply chain and, just as for EU industry, the cross-sectoral risks associated with global supply chains**: the COVID-19 pandemic, the Russian invasion of Ukraine and disruptions in logistics (notably for maritime transportation) and the related higher price volatility recently amplified the negative implications of an high import dependency for key inputs.

Available tools to secure inputs and make the EU less dependent on foreign suppliers

- **The EU has considerable interest in supporting trade relations** to ensure that the EU's resilience in the face of trade shocks is not compromised, as EU foreign trade accounts for 30 % of EU GDP. Trade openness is key to improve resilience and avoid bottlenecks and vulnerabilities due to excessive dependence on a limited number of trade partners.
- The **EU's trade policy, free trade agreements and strategic partnerships with third countries facilitate access to a diverse range of inputs** from outside the EU, notably for key products where the EU has an input dependency. Tariffs are a key tool to facilitate smoother trade flows and improving access to inputs for EU farmers (e.g., for protein-rich feed and fertilisers).
- **Recent policies developed under the European Green Deal have raised sustainability ambitions for agriculture and food systems**. The EU's climate ambition is likely to impact in particular the EU's fertiliser sector and its imported inputs through the revised Renewable Energy Directive (RED), the Emission Trading Scheme (ETS) and the Carbon Border Adjustment Mechanism (CBAM).
- The **Farm to Fork Strategy aims to contribute to the EU's input autonomy by 2030** through a targeted 50 % reduction in nutrient losses (which should lead to a reduction of 20 % in the use of fertilisers), a target of 25 % of agricultural land under organic production, the development of alternative sources of proteins for animal feed (in the framework of the European protein strategy), the promotion of the bio-economy and shorter supply chains.
- **The Common Agricultural Policy (CAP) national strategic plans have also the potential to reduce the EU's import dependency**, notably through support to low-input practices, nutrient management, sustainable fertilisers and organic farming and the possibility for Member States to grant increased coupled support to protein crops. As highlighted by several stakeholders, there is however also a risk that the EU Green Deal and the adoption of sustainable practices under the CAP could reduce the production capacity of EU agriculture and thereby weaken the EU's self-sufficiency in food.
- **Emergency measures recently adopted at EU and Member State level** proved useful to mitigate the impact of increased inputs costs following the war in Ukraine.

Recommendations to increase the EU food sector's resilience to disruptions in trade flows and price increases of imported inputs, and to reduce the dependency of EU agriculture on imported inputs

- **There are a number of available tools to address instability in the imported inputs' markets, and diversify input sources**, including trade and strategic partnerships, a renewed enlargement agenda and the opportunities offered by Ukraine's production capacities during the transition phase, strategic stockpiling and financial instruments (derivatives) and long-term contracts.
- **Available options to increase domestic production of key inputs** include research, technological development and innovation in EU agriculture, to achieve a more efficient use of natural resources, raw materials and farming inputs, to improve crop productivity without using input-intensive techniques and to fully exploit the potential offered by bio-based, fully circular production processes.
- **Changes in consumption patterns could reduce the EU's food sector's input dependency**, notably through a reduction of animal products in people's diets to reduce third countries' feed imports, as well as consumer preferences for more sustainably produced products.
- **To improve the capacity of the EU food system to cope with structural changes and increased input dependency, the research team recommends to:**
    - *Diversify input sources and trade partners* (finalisation of new free trade agreements and strategic partnerships, use of custom tariffs and preferential conditions for imports).
    - *Address market instability* (analyse the feasibility and relevance of strategic stockpiling and financial instruments to hedge risks linked to price volatility).
    - *Avoid disruptions in logistics* (keep vital traffic lanes open, promote the completion of some of the EU's Trans-European Transport Network corridors).
    - *Reduce input dependency through domestic production, research and innovation* (increase domestic production of key inputs, support precision farming).
    - *Use the CAP toolbox to increase self-sufficiency and promote risk-management tools* (support low-input practices through the CAP's national strategic plans, reduce the need for imported feed materials and expand protein crops, promote a wider uptake and an improvement in the effectiveness of insurance, mutual funds and risk management schemes).
    - *Improve transparency and monitoring of the EU's input dependency.*

1. INTRODUCTION

1.1. Background

While the European Union (EU) is a key global producer of agricultural commodities and has a positive agricultural trade balance, it is dependent on the import of some key commodities[1]. Given that the EU is an open economy, it has historically specialised in higher value products and those where the EU has a comparative advantage, while at the same time relying on imports for other products. However, recent shocks to the global markets following the COVID-19 pandemic and the Russian invasion of Ukraine have highlighted the risks of increasing economic efficiency at the expense of resilience and food security. Their strategic importance is also compounded by climate change and the associated increasing incidence of extreme weather conditions.

In this respect, the impact of the Russian invasion of Ukraine has been particularly disruptive, given that Russia and Ukraine are typically major exporters of cereals and oilseeds (notably sunflower) and fertilisers. Belarusian exports of fertilisers have also been negatively affected, as well as the exports of agricultural products from former-USSR countries (mainly Kazakhstan) that are landlocked and that use the Russian transportation system as their main gateway to international markets. In fact, the conflict has caused an extensive rearrangement of global logistic chains[2]. Another impact of the conflict and associated counter measures has been increasing energy prices, which have impacted the EU's food production sector, from the cost of fertiliser manufacturing to the heating of glasshouses.

While the availability of food in the EU is not generally considered to be at risk, these price increases and the related market disruptions have highlighted the fact that the EU food system is dependent on some inputs which, in some cases, originate from a limited number of third-country suppliers. This dependency calls into question the long-term resilience of the EU food system in an increasingly uncertain climate and geopolitical context.

It is now generally accepted both at EU and Member State level that the balance between economic efficiency and resilience needs to be addressed by focusing on the vulnerabilities of the EU's food supply chain and on its dependency on imported inputs. This consensus was notably reflected in the Versailles declaration of the European Council on 10-11 March 2022[3], the Commission's communication on 'Safeguarding food security and reinforcing the resilience of food systems' (23 March 2022)[4] and the Commission's communication on fertilisers (9 November 2022)[5].

Against this background, the European Parliament (EP), in its resolution of 24 March 2022 on 'The need for an urgent EU action plan to ensure food security inside and outside the EU in light of the Russian invasion of Ukraine'[6] expressed its will to commission a "comprehensive study on the dependence of the EU's food system on inputs and their sources" (point 56 of the resolution) In its 2022 own initiative report on 'Ensuring food security and long-term resilience of the EU agriculture'[7], the EP has also highlighted the need for the EU to strengthen its food security and the resilience of its agricultural

[1] Some of these are products that the EU is unable to produce economically in sufficient quantity to meet demand, such as tropical fruit. Others are not produced in sufficient quantity because they are not as profitable as those produced in non-EU countries, and/or as alternative products; this applies to some organic products and to vegetable protein meals used as livestock feed.
[2] An interesting overview on the matter can be found in https://www.intellinews.com/russia-s-war-in-ukraine-has-distorted-global-trade-routes-270642/
[3] https://www.consilium.europa.eu/en/press/press-releases/2022/03/11/the-versailles-declaration-10-11-03-2022/
[4] https://agriculture.ec.europa.eu/system/files/2022-03/safeguarding-food-security-reinforcing-resilience-food-systems_0.pdf
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022DC0590(01)
[6] https://www.europarl.europa.eu/doceo/document/TA-9-2022-0099_EN.html
[7] 2022/2183 (INI) https://oeil.secure.europarl.europa.eu/oeil/popups/ficheprocedure.do?lang=en&reference=2022/2183(INI) , rapporteur Ms Marlene Mortler.

sector and its entire supply chain by reducing its dependence on imports from third countries and diversifying the supply of critical imported products such as fertilisers, animal feed and raw materials.

In this context and as a follow-up to this resolution and the related own initiative report, the EP's Committee for Agriculture and Rural Development (AGRI Committee) has decided to commission this research project on the EU food sector's input dependency.

1.2. Objectives of the study

The study aims at depicting the vulnerabilities of the EU's food system regarding imported inputs and at assessing its capacities to cope with structural changes and manage transition, along the lines of the resilience dashboards developed by the European Commission[8]. The final goal of the study is to provide **concrete policy recommendations to increase the EU food sector's resilience in terms of input supply**.

The **specific objectives** of the study are the following:

1. Exploring the vulnerabilities of the EU food system regarding inputs.
2. Providing a state of play of the available tools to secure inputs and make the EU less dependent on foreign suppliers.
3. Making recommendations for appropriate measures to increase the EU food sector's resilience to disruption in trade flows and price increases of imported inputs.

1.3. Scope of the study

The analysis is carried out at the **aggregated EU level** rather than at the level of individual Member States. The study focuses on the EU's food system, intended as the combination of primary production, food processing, storage and transport, retail distribution, and the food service sector.

The key **typologies of inputs** covered in the study include fertilisers and soil improvers, pesticides and plant protection products, feedstuffs, seeds and planting materials, and energy products and lubricants.

The in-depth analysis of EU's agriculture's dependency on imported inputs focuses on the following **agricultural sectors** (output typologies): products of arable crops (cereals, oilseeds, protein crops); meat products (cattle, pigs, poultry); milk and dairy products; products of specialised crops (fruit and vegetables, wine, olive oil).

[8] https://commission.europa.eu/system/files/2021-11/dashboard_report_20211129_en.pdf

2. APPROACH AND METHODOLOGY

KEY FINDINGS

- The study relies on a **mixed approach** combining the analysis of quantitative evidence (mostly from official sources) with qualitative evidence and insights gathered through literature review and interviews with key institutional and sectoral stakeholders.
- The reference scientific methods used in the study are **theoretical analysis**, **qualitative analysis** and **quantitative analysis**, the latter also including a quantification of the dependency of the EU food system on imported inputs through **input-output modelling** and a set of **indicators**.

2.1. Approach to the study

The three specific objectives of the study outlined in section 1.2 were achieved by answering to sets of dedicated **research questions** (RQs hereinafter). The related analysis and the key findings are presented in sections 3, 4 and 5. The study relies on a **mixed approach** that combines the analysis of **quantitative evidence** (mostly from official sources) with **qualitative insights** gathered through a review of scientific and technical publications and grey literature (e.g., documents issued by public institutions, position papers of sectoral stakeholders, etc.). Those elements were supplemented by evidence and insights collected through eleven interviews with key institutional and sectoral stakeholders.

2.2. Methods and tools

Three reference scientific methods were used in the study.

Theoretical analysis was used to define the **conceptual frameworks** to answer RQs related to specific objective n° 3, i.e., elaborating recommendations and suggesting appropriate measures to increase the EU food sector's resilience to disruption in trade flows and price increases of imported inputs. Theoretical analysis consists in a **critical review** by selected experts in the research team of elements emerging from the analysis of **scientific literature from authoritative sources** dealing with the topics of interest.

Qualitative analysis was used to process a wide range of **non-quantitative evidence** relevant to most of the RQs related to all the three specific objectives of the study. This evidence was sourced from literature review, websites, and in-depth interviews with stakeholders and experts. Qualitative analysis was also applied in the critical reflection on **inputs and insights provided by the consulted stakeholders and experts** with regard to the elaboration of recommendations (RQs related to specific objective n° 3).

Finally, **quantitative analysis** consisted in the use of **input-output modelling**[9] to measure the dependency of the EU food system on imported inputs, and of **basic descriptive statistics** to process other quantitative evidence on specific key inputs. The use of input-output modelling (IO modelling hereinafter) is explained in more detail in Annex A to this report.

[9] The input-output (IO) modelling technique was developed by Leontief in 1936 to analyse the interdependencies and linkages between different industries for both goods and services in the economy. The technique allows for the analysis of the contribution of domestic and imported inputs in each industry. Focusing on both goods and services, IO modelling can only be applied to monetary values (not to physical quantities).

3. THE VULNERABILITIES OF THE EU FOOD SYSTEM REGARDING IMPORTED INPUTS

KEY FINDINGS

- **The total sector's dependency ratios for imported inputs** [*imported inputs/total sectoral output*], **in value, are generally below 10 %** for the core components of the EU's food system (i.e., the "agriculture", "fisheries and aquaculture" and "food and beverages" sectors). In agriculture, this ratio is 7.7 %.
- However, **when expressed as a share of the total inputs used by these three core components of the food system, the value of imported inputs points to a heavy reliance on imports, with significantly higher import dependency ratios** [*value of imported input/total input value*] **for the selected inputs** (ranging for instance from 11.06 % to 66.71 % for the inputs to the agricultural sector). The same applies for the **geographical concentration of imports**, measured as the *aggregated % share of the top-4 suppliers*, **which is relatively low at aggregate level (with a combined share lower than 40 % in 2019 for the top-4 suppliers) but significantly higher for individual input groups** (e.g., for soya beans, soya bean meals, phosphates, potash, where the top two suppliers' market share reaches 50 to 85 %).
- **Dependency on imported inputs is particularly significant for animal products** (soya beans and meal are feed materials of critical importance to this subsector and to poultry and pig farming in particular, and their imports are characterised by the strongest polarisation towards few non-EU suppliers) and **cereals** (which depend on imported raw materials and energy sources needed to produce fertilisers).
- **Recent developments reflect the degree of integration of the EU food supply chain into the global supply chain and, just as for EU industry, the cross-sectoral risks associated with global supply chains**: the COVID-19 pandemic, the Russian invasion of Ukraine, policy and regulatory constraints, disruptions in logistics (notably for maritime transportation) and the related higher price volatility recently amplified the negative implications of high import dependency for key inputs.

3.1. Dependency of the EU's food system on imported agricultural inputs, raw materials and intermediate inputs, including capital goods

To the extent allowed by the availability of suitable data, the quantitative assessment of the dependency of the EU food system on imported inputs was based on the quantification of indicators fed by EU official datasets of input-output data. In addition to Eurostat standard EU-level input-output

data[10] the research team used the FIGARO (Full International and Global Accounts for Research in input-Output analysis) dataset[11] which is the result of a joint Eurostat/JRC effort. The main limitations deriving from this approach are mostly related to the sectoral detail of EU-level input-output data, which does not allow a separation of the food and non-food components in the downstream stages of the EU food system, i.e., (wholesale and retail) distribution and HoReCa (hotels, restaurants and catering). This limitation makes a quantification of the dependency on non-EU inputs for the EU's food system as a whole unfeasible. Such a quantification is instead possible for the **three core components of the system**, i.e., the "**agriculture"**[12], "**fisheries and aquaculture**" and "**food and beverages"**[13] sectors.

The **total sector dependency ratios** [*imported inputs/total sectoral output*] in value terms are reported in Table 1, which distinguishes direct imports from indirect imports. Considering the sectors as a whole, the total dependency ratios are not very high.

Table 1: Total sector dependency ratios, %*, 2019

Sectors	Direct	Indirect	Total
Products of agriculture, hunting and related services	3.19	4.51	7.70
Fish and other fishing products; aquaculture products; support services to fishing	4.64	5.81	10.45
Food, beverages and tobacco products	5.62	4.26	9.88

Source: research team elaboration on Eurostat input-output data at basic prices in 2019
Note: * value of direct / indirect / total imports of inputs as % of total output value at basic prices

The analysis of the **breakdown of the import content** for the three sectors [*value of each imported input group/total sectoral value of imported inputs*], which distinguishes direct imports from indirect imports, and ranks input groups according to their share of total imports reveals some specificities. In particular, imported inputs supplied by the "mining and quarrying" sector mostly see an indirect use, i.e., they are processed in the EU to obtain intermediate products that are used as inputs in the three core components of the EU food system. In the agricultural sector, "chemicals and chemical products" account for an important share of imports for direct use as inputs, whereas in the food and beverages sector they account for a significant share of imports for indirect use. The detailed indicators are reported in Annex B to this report.

The key set of indicators to assess the dependency of the core components of the EU food system on imported inputs is based on **import dependency ratios** for each input group supplied to each sector [*value of imported input/total input value*]. These ratios are reported for each sector in Table 2, which highlights selected input groups characterised by high (or anyway significant) dependency on imports for at least one of the three sectors, plus agricultural products used as inputs, due to their importance for the EU food system. The most noteworthy cases of import dependency concern "computer, electronic and optical products" (with the partial exception of the fisheries and aquaculture sector),

[10] https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/database
[11] FIGARO presents transactions in nominal million Euros, valued at basic prices, to capture the relationships between the EU economies, 18 main trading partners (Argentina, Australia, Brazil, Canada, China, India, Indonesia, Japan, Republic of Korea, Mexico, Norway, Russian Federation, Saudi Arabia, South Africa, Switzerland, Turkey, United Kingdom, United States of America), and a "rest of the world" aggregate, for 64 industries and 64 products, which are defined according to the "European Systems of Accounts 2010" (ESA 2010) methodology.
[12] This aggregate actually includes also hunting activities.
[13] This aggregate actually includes also the tobacco products subsector.

"basic metals" and "mining and quarrying". By contrast, the dependency on imports is rather low - at least on aggregate - for agricultural products used as inputs, but it is important to consider that within an input group characterised by limited import dependency as a whole there may be specific input typologies with a significant and even substantial import dependency, as Table 4 clearly shows.

Table 2: Import dependency ratios* for selected input groups, by sector, %, 2019**

Input groups (supplying sectors)	Agriculture	Fisheries & aquaculture	Food & beverages
Mining and quarrying	***49.83***	20.35	***57.84***
Products of agriculture, hunting and related services	11.06	8.71	11.98
Fish and other fishing products; aquaculture products; support services to fishing	***29.50***	***30.05***	***31.32***
Basic metals	***54.50***	***51.69***	***44.24***
Coke and refined petroleum products	16.98	21.16	24.40
Chemicals and chemical products	21.59	***25.73***	***28.35***
Basic pharmaceutical products and pharmaceutical preparations	***33.23***	***45.37***	***35.40***
Textiles, wearing apparel, leather and related products	***34.68***	***33.31***	***52.45***
Electrical equipment	***28.92***	15.04	***41.00***
Computer, electronic and optical products	***66.71***	***26.81***	***60.08***

Source: research team elaboration on Eurostat input-output data at basic prices in 2019
Notes: * Total imports of inputs (sum of direct and indirect imports) as % of total input use (sum of imported inputs and domestic inputs) (in value terms). Ratio > 25% ***bold italics***; ratio > 50% ***red type***. ** The selection excludes input groups that account for a negligible share (<1%) of total imported inputs.

As for the **geographical origin of imported inputs** for each sector, its concentration is relatively low at aggregate level: the combined share of the top-4 non-EU suppliers was always lower than 40 % in 2019 (with the leading supplier's share always lower than 15 %)[14]. However, the **geographical concentration for individual input groups** can be significantly higher. Table 3 reports the shares of the top-4 non-EU suppliers for a selection of key input groups that combine a high share of the total value of imported inputs (Tables 8 to 10 in Annex B to this report) with a high/significant import dependency ratio (Table 2). For two groups, the leading non-EU supplier (China) holds a share that is close to, or higher than, 25 % of total imports. Section 3.3 considers in detail how the concentration of

[14] Source: research team elaborations on JRC-Eurostat FIGARO input-output data (https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/database).

a high share of imports in the hands of few non-EU suppliers may constitute a risk in terms of supply security for key inputs.

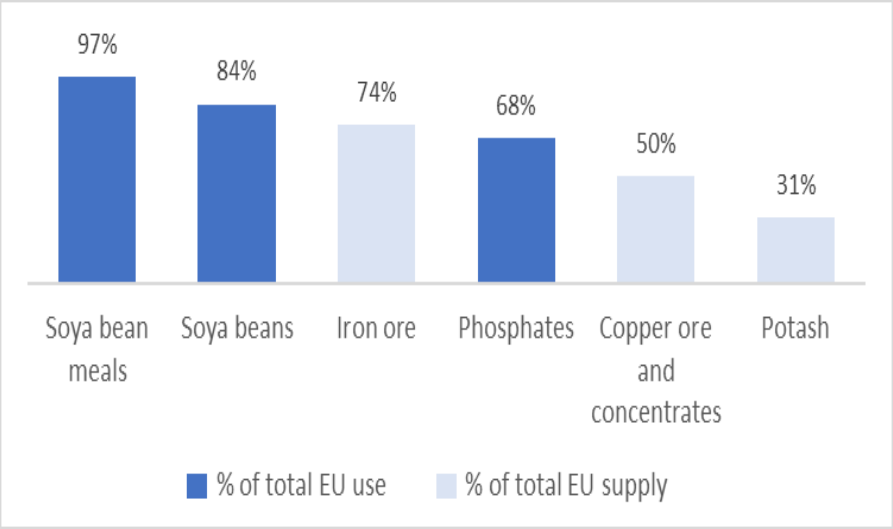
Table 3: Geographical concentration of imports for selected input groups, %*, 2019

Input groups (supplying sectors)	1st country	2nd country	3rd country	4th country	Top-4
Computer, electronic and optical products	China 24.65	USA 15.80	Switzerland 6.76	UK 6.61	53.83
Textiles, wearing apparel, leather and related products	China 30.78	India 7.40	Turkey 6.18	USA 5.85	50.22
Chemicals and chemical products	USA 16.87	Russia 11.30	UK 8.63	China 7.89	44.69
Mining and quarrying	USA 11.14	UK 10.71	China 10.49	Russia 9.68	42.02
Basic metals	Russia 16.03	USA 8.44	China 8.29	UK 6.53	39.29

Source: research team elaboration on JRC-Eurostat FIGARO input-output data (https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/database) in 2019.
Note: * % shares of each country on total (= sum of direct and indirect) imports (in value terms)

As already explained, the sectoral detail of EU-level input-output data does not allow the quantification of the previous sets of indicators for specific typologies of inputs. However, updated official datasets and the review of recent authoritative literature allowed for a quali-quantitative appraisal of **notable cases of import dependency for specific inputs** that are important to the EU food system. The key findings from this appraisal are presented in Figures 1 and 2 and in Table 4.

Figure 1: Import dependency ratios for selected inputs



Source: elaboration on data and publications from the European Commission (see Table 4 for the complete detail)

As previously highlighted, outstanding cases of import dependency can also concern specific inputs within input groups that are not characterised, on aggregate, by a high import dependency ratio: particularly striking examples (besides the obvious cases of inputs that are not produced in the EU, like cocoa or coffee) are soya beans within the "products of agriculture, hunting and related services" group, and honey within the "food, beverages and tobacco products" group. Some of the notable cases concern basic raw materials (iron ore, copper ore and concentrates) that are used to produce inputs for a wide range of sectors; some other cases concern instead basic raw materials (phosphates, potash) that are mostly used to produce specialist inputs for the agricultural sector (i.e., fertilisers). Finally, those for soya beans, soya bean meal and honey are notable cases of import dependency that are specific to the EU food system. For several of these inputs, high import dependency is combined with geographical concentration of non-EU supply (Figure 2).

Figure 2: Geographical concentration of EU imports* for selected inputs

Source: elaboration on data and publications from the European Commission (see Table 4 for the complete detail)
Note: * % shares of leading non-EU suppliers on total imports

Table 4: Notable cases of import dependency and geographical concentration of imports for specific inputs: key findings

Inputs	Main uses as inputs in the EU food system	Import dependency	Geographical concentration of imports
Soya beans	Direct use as feed Production of soya oil Production of soya meal ➔ manufactured feed Ingredient in food products	Imported soya beans = 84 % of total EU use (2022/23 marketing year – in volume) (a)	% shares of leading suppliers (2022 - in volume) (b) Brazil 50 % USA 35 %
Soya bean meal	Production of manufactured feed	Direct plus indirect imports (meal obtained in the EU from imported soya beans) = 97 % of total EU use (2022/23 marketing year – in volume) (a)	% shares of leading suppliers (2022 - in volume) (b) Brazil 46 % Argentina 39 %
Honey	As ingredient in a wide range of food products	Around 37 % of total EU use (c)	% shares of leading suppliers (2022 - in volume) (c) Ukraine 24 % China 21 %
Phosphates	Production of fertilisers	68 % of EU consumption in 2021*(d)	% shares of leading suppliers (2021 – in volume) (d) Morocco 28 % Russia 23 %
Potash	Production of fertilisers	31 % of EU available supply (2019 – in volume) (e)	% shares of leading suppliers (2019 – in volume) (e) Russia 34 % Belarus 30 %
Copper ore and concentrates	Machinery parts Digital appliances	50 % of EU available supply of copper ore (2012-16 average – in volume) (e)	% shares of leading suppliers (2012-16 average – in volume) (e) Chile 27 % Peru 19 %
Iron ore	Steel production ➔ machinery & equipment	74 % of EU available supply of iron ore (2012-16 average – in volume) (e)	% shares of leading suppliers (2012-16 average – in volume) (e) Brazil 33 % Ukraine 11 % Canada 11 %

Source: Areté elaboration on: (a) DG Agriculture Balance Sheet for Oilseeds and EU Feed Protein Balance Sheet (downloaded in January 2024); (b) European Commission (2023a); (c) European Commission (2023b); (d) European Commission (2022); (e) European Commission (2020a).
Note: * The dependency ratio is referred to total consumption of phosphate nutrients in EU agriculture.

3.2. Dependency of the key EU agricultural products on imported inputs

The limitations in terms of data availability explained in section 3.1 prevented the assessment of the dependency of key EU agricultural products on imported inputs on a purely quantitative basis. Nevertheless, literature review and stakeholder consultation allowed to collect sufficient quantitative and qualitative evidence from official and/or authoritative sources for an adequate assessment, whose findings are reported for each key agricultural product in the following sections.

The blueprint *Resilient EU2030* (Spain's National Office of Foresight and Strategy, 2023) tackles, among others, the issue of import dependency for key inputs. It reveals that the EU has a high dependency on third countries for more than 300 products, including raw materials, energy inputs, manufactured goods and technological components that are critical for the EU economy and that have a limited potential for diversification and substitution, since their production is highly concentrated in few non-EU countries. Around a third (37 %) of these products are agricultural, fish and food products.

The main **arable crops** (cereals, oilseeds, protein crops) have a number of specificities in terms of input use. According to scientific literature[15] the productivity (yield per hectare) and the quality of **cereals** (protein content in particular) tend to be tightly linked to the level of nitrogen fertilisation. As underlined in European Commission (2022), nitrogen (N) fertilisation needs to be applied regularly in cereal farming, whereas the application of phosphorus (P) and potassium (K) can be foregone for a certain period without a negative impact on yields. The production of synthetic nitrogen fertilisers is an energy-intensive process. In the EU, natural gas is normally used as an energy source in the process (see also European Commission, 2020a), and also serves as feedstock for producing the hydrogen needed for the synthesis, whereas nitrogen is obtained from the atmosphere. This implies that EU import dependency for natural gas severely affects the production of synthetic nitrogen fertilisers in the EU. According to Eurostat (2023a), EU import dependency for natural gas[16] is severe: it amounted to 97 % in 2022, up from 83 % in 2021. Natural gas import dependency was higher than 90 % in 20 Member States in 2022, up from 15 Member States in 2021. Norway was the source of 24.4 % of EU imports of natural gas in 2022, followed by Russia (15.3 %), the United States (9.8 %) and Algeria (8.3 %).

Unlike cereals, **leguminous crops** like soya and other protein crops (peas, beans, lupins, etc.) have the capacity of fixing nitrogen. This implies that these crops do not need nitrogen fertilisation, but their productivity benefits from the application of fertilisers containing phosphorus (P) and potassium (K). As highlighted in section 3.1, Table 4, the EU is affected by significant import dependency for potash (used to produce fertilisers rich in potassium) and by serious import dependency for phosphates (used in the production of phosphatic fertilisers). Overall, the main arable crops in the EU are all affected by significant to severe import dependency for key raw materials used in fertiliser production.

As for **animal products** (beef, pig meat and poultry meat; milk and dairy products), import dependency for protein-rich feed materials, soya beans and soya bean meal in particular, is particularly severe (amounting to 84 % and 97 %, respectively, as highlighted in section 3.1, Table 4). The different species of farmed animals are not exposed to the same extent to EU import dependency for protein-rich feed materials (EPRS, 2023a). Whereas protein needs in the diet of ruminants (bovines, sheep and goat) are covered to a variable extent also by the forage component (especially if it includes leguminous crops, which are rather rich in proteins), monogastric animals (pigs and poultry) mostly rely on manufactured feed to meet protein needs; protein-rich feed materials (soya beans and soya bean meal in particular)

[15] See for instance the contributions by Tudor *et al*. (2023), Lungarska *et al*. (2022), Ahvo *et al*. (2022), Redlich *et al*. (2021).
[16] Computed as: *[(imports)-(exports)]/(gross inland consumption)*.

are an important component of manufactured feed. Table 5 presents an overview of EU self-sufficiency in protein crops for animal feed.

Table 5: EU self-sufficiency in protein crops for animal feed

Product	Protein content (%)	Feed use 2020/2021 (million tonnes)	Feed use with EU origin (million tonnes)	EU self-sufficiency (%)
Soybean meal	45.5 %	27.1	0.9	3 %
Rapeseed meal	33 %	12	8.3	69 %
Common wheat	11 %	38.2	36.2	95 %
Barley	10 %	35.6	35.6	100 %
Maize	8 %	63.5	50.4	79 %
Fodder legumes	7.2 %	84	84	100 %
Silage maize	2.9 %	244	244	100 %
Grass	2.6 %	629	629	100 %

Source: EPRS (2023b) / European Commission, EU feed protein balance sheet

The high importance of soya products in the diets of farmed animals is mainly related to their high protein content and to their optimal composition in terms of amino acids (the so-called "aminoacidic profile"). The possibility to substitute soya products in the diets of farmed animals also varies according to the species, with ruminants generally more flexible than monogastric animals[17].

Exposure to import dependency in the animal products subsector can also vary according to the **specific nutrition requirements that apply in particular segments**, for example, "GM-free" and organic. The challenges posed by quality standards and product specifications in terms of security of supply for key production inputs are discussed in more detail in section 3.3; here we present some quantitative evidence on import dependency in these segments of the animal products subsector.

With regard to the "**GM-free**" segment, according to a study by Tillie and Rodríguez-Cerezo (2015) for the Joint Research Centre (JRC) of the European Commission, based on a selection of 14 Member States[18] the countries covered imported from non-EU suppliers a total of 2.71 million tonnes of non-GM soya bean meal equivalent in 2012. According to DG AGRI data[19] EU soya bean production (entirely non-GM) in the 2012/13 marketing year amounted to one million tonnes. The cited study for JRC estimated that up to 11 % of total manufactured feed in the EU-28 in 2012 was marketed as "non-GM"; according to FEFAC (2021), based on an internal survey among its members, that share had risen to 15 % in 2020. Over the same period, according to DG AGRI data[20] EU production of non-GM soya bean had risen to 2.6 million tonnes in the 2020/21 marketing year, a 160 % increase. These figures suggest that EU import dependency for non-GM soya products has tended to decrease: FEFAC (2021) reports

[17] Amino acids (including synthetic ones) can be included in the diets of farmed animals to address the sub-optimal aminoacidic profile of certain substitutes for soya products. However, according to Sturm *et al.* (2022) and to some of the consulted stakeholders, the EU is heavily dependent on imports from China and other Asian countries for such feed grade amino acids as Lysine and Threonine, whose production in the EU is unprofitable.

[18] Austria, Belgium, Denmark, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Spain, Sweden, United Kingdom.

[19] https://agridata.ec.europa.eu/extensions/DashboardSTO/STO_Oilseeds.html

[20] https://agridata.ec.europa.eu/extensions/DashboardSTO/STO_Oilseeds.html

that during the COVID-19 pandemic it was very difficult to source "non-GM" protein sources outside the EU.

As for the **organic** segment, according to European Commission (2023c), EU imports of organic soya beans[21] in 2022 amounted to nearly 192 000 tonnes (up 51 % from 2021, when imports amounted to nearly 127 000 tonnes). Togo was by far the leading non-EU supplier of organic soya beans in 2022, accounting for a 63 % share of imports, followed by Ukraine (16 %). According to Eurostat data[22] EU production of organic soya beans in 2021 amounted to over 135 000 tonnes; this is likely to be an underestimation since no production data for Italy have been available since 2017 (when it ranked second after France with 19 700 tonnes).

These figures suggest that imports account for an important share of the available supply of organic soya beans in the EU, and are extremely concentrated in terms of origins. According to European Commission (2023c), EU imports of organic oil cakes (entirely used for feed manufacturing) in 2022 amounted to around 223 000 tonnes (up 6.8 % from 2021). China was the leading non-EU supplier of organic oil cakes, with a 53.9 % share of imports, followed by India with a 31.1 % share. According to FEFAC (2022), the EU feed manufacturing industry is highly dependent on imports of organic feed materials. The Russian invasion of Ukraine has made it difficult to access the Ukrainian production of organic sunflower "expellers"[23] and also the production of soya bean "expellers" of Kazakhstan. China and India are by far the leading suppliers of organic soya bean "expellers" for feed use to the EU.

Specialised crops (fruit and vegetables, wine, olive oil) have some specificities in terms of import dependency for key inputs. **Production of fruit and vegetables in heated greenhouses** was indicated by the consulted stakeholders as a subsector that is particularly affected by the EU's high dependency on imports of energy sources (natural gas and crude oil in particular). The EU's import dependency for natural gas has been discussed above; as for EU import dependency for crude oil[24], an essential raw material for the petrochemical industry and fuel production, according to Eurostat (2023b) it decreased from its all-time high (96.8 %), recorded in 2019, to 95.1 % in 2021. The main non-EU suppliers of crude oil in 2021 were Russia (25.2 %), Norway (9.8 %), the United States (8.4 %), Kazakhstan (8.0 %), Libya (8.0 %) and Iraq (7.3 %). The consulted stakeholders indicated **no notable import dependency cases** that affect the key inputs used in **wine or olive oil** production. According to European Commission (2020a), some of the raw materials used in glassmaking, and hence in the production of **bottles**, are affected by non-negligible or significant import dependency (e.g., arsenic, feldspar, kaolin, potash, selenium, silver, tellurium, tin metal), whereas other key raw materials (e.g., limestone, silica sands, magnesite) are not.

3.3. Main risks and vulnerabilities of the EU food supply chain in terms of dependency on imported inputs

3.3.1. Risks and vulnerabilities deriving from import dependency

Recent literature reveals that the EU food system is relatively less affected by serious strategic dependencies on imported inputs than other sectors. The work by Vicard and Wibaux (2023), focusing on seven sectors (agri-food, chemicals, health, steel, defence and aerospace, transport and electronics),

21 It has to be underlined that the figures presented here for soya beans do not distinguish feed use from food use.
22 https://ec.europa.eu/eurostat/databrowser/view/org_croppro/default/table?lang=en
23 Organic "expellers" are the protein-rich cakes obtained from the sole mechanical crushing of organic oilseeds, without the customary use of chemical solvents (which makes oilseed meals obtained in the standard process non-eligible as "organic" feed materials).
24 Computed as: *[(imports)-(exports)]/(gross available energy)*.

reveals that out of 134 products affected by strategic dependencies[25] in 2019, only four concerned the agri-food sector, compared to 77 in the chemicals sector, 22 in the electronics sector, 17 in the steel sector, and 11 in the health sector. However, the assessment in sections 3.1 and 3.2 revealed that part of the strategic dependencies for inputs in other sectors has significant implications for the EU food system, due to indirect imports.

Furthermore, a recent study by Bertolozzi-Caredio *et al*. (2023) for JRC, based on a survey of business operators, reveals that sectoral actors consider high dependency on certain import (or export) markets as an important vulnerability factor for the EU food supply chain. This is especially true for operators that are strongly linked to specific non-EU markets (e.g., a single country) for buying key inputs (and/or selling their products). Lacking a diversified portfolio of markets to rely on, these operators could be strongly affected by (and are hence vulnerable to) changes in the access to their reference markets. The consulted operators also indicated low diversity of input suppliers and a high concentration of input supply as another major cause of vulnerability (even though these conditions can also be related to EU suppliers).

The evidence presented in sections 3.1 and 3.2 allows the identification of a number of situations where high import dependency for key inputs can translate into serious risks and vulnerabilities for the EU food supply chain.

Some of the related **risks and vulnerabilities** are **cross-sectoral**, since the concerned inputs are widely used in multiple sectors within the EU food system. High dependency on imports for raw materials supplied by the "mining and quarrying" sector (with particular regard to *iron ore* and to *copper ore and concentrates*) affect the production of capital goods (machinery and equipment, electrical and digital appliances, etc.) that are widely used in the EU food system. Import dependency for *crude oil* and *natural gas* also has cross-sectoral relevance, both directly (use of natural gas as an energy source in the farming and processing stages) and indirectly, through its effects on fuel and fertiliser production. Other notable cases of import dependencies with cross-sectoral relevance concern intermediate products like *basic metals* (used to produce a wide range of capital goods of common use in the EU food system), and capital goods like *computer, electronic and optical products*, and *electrical equipment*. The severity of the system-wide risks and vulnerabilities deriving from cases of high import dependency with cross-sectoral relevance can be further aggravated by: i) the polarisation of imports on few leading non-EU suppliers accounting for a substantial aggregated share of imports; ii) the prevalence of imports from non-EU suppliers whose flows to the EU are most (likely to be) affected by a number of "compounding factors" that will be analysed in section 3.3.2. As seen in sections 3.1 and 3.2, such conditions apply in particular for natural gas[26] and iron ore[27], but also for computer, electronic and optical products[28].

Other situations of high import dependency for inputs can determine **sector-specific risks and vulnerabilities**, since the concerned inputs are mostly used in a specific sector or subsector within the EU food system. The most notable cases in this regard were found to derive from high dependency on imports of specific raw materials or intermediate products, often further aggravated by polarisation on

[25] These are defined according to the same criteria adopted in European Commission (2021a), i.e.: geographical concentration of imports; importance of imports in demand; substitutability of imports by EU production.

[26] According to Eurostat (2023a), Norway was the source of 24.4% of EU imports of natural gas in 2022, followed by Russia (15.3%), the United States (9.8%) and Algeria (8.3 %).

[27] According to European Commission (2020a), the shares of the leading non-EU suppliers (2012-16 average – in volume) were as follows: Brazil 33%; Ukraine 11%; Canada 11%.

[28] According to a research team's elaboration on JRC-Eurostat FIGARO input-output data (https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/database), the shares of the leading non-EU suppliers in 2019 were as follows: China 24.65%; USA 15.80%.

few non-EU suppliers and/or prevalence of supply from non-EU countries that are particularly exposed to the effects of "compounding factors".

Import dependency for *phosphates* and *potash*[29], raw materials supplied by the "mining and quarrying" sector, seriously affects the production of fertilisers, which are widely used especially in **arable crop farming**. The already underlined high dependency on imports of *natural gas* also has an indirect effect in terms of risks and vulnerabilities for arable crop farming, since natural gas is a critical raw material for producing nitrogen fertilisers.

EU's fertiliser dependency

The EU depends on imports for 45 %, 46 % and 58 % of its consumption of inorganic nitrogen, phosphates and potash nutrients respectively[30].

EU imports of nitrate-based fertilisers originate mainly from Russia, Egypt and Algeria. Phosphate-based products are mainly sourced from Morocco and Russia, while Potassium chloride imports are mainly coming from Russia and Belarus.

At the peaks of gas prices during the summer of 2022 (following the war in Ukraine), gas had come to account for up to 90 % of the variable production cost of nitrogen fertilisers. This has resulted in a 149 % increase in the price of these products for EU farmers (September 2022 compared to September 2021). Fertiliser prices are decreasing since October 2022, but remain higher in comparison to previous years.

A temporary crisis framework allowed for State aid measures, to offset rising fertiliser prices. Moreover, in November 2022 the European Commission put forward a communication[31] on ensuring available and affordable fertilisers, outlining a series of domestic and international actions to guarantee the global supply of this critical agricultural input, maintain a sustainable EU fertilisers' production and reduce dependencies.

However, according to Eurostat data, total nitrogen imports into the EU were up 34 % in the 2022-23 fertilisers marketing campaign (July-June) compared to the previous period, with Russia accounting for around a third of the total.

Urea (the most used fertiliser expressed in terms of nutrient, followed by nitrates) imports were up 53 %, doubling the volumes recorded in 2020-2021. Of this, 40 % came from Russia. The trend has slowed in the current season, but Russian urea still accounts for almost a third of the total imports.

The most striking case of sector-specific risks and vulnerabilities caused by high import dependency for certain inputs affects **animal farming**, and has been widely discussed in section 3.2. In this case, high import dependency concerns *soya beans* and *soya bean meals*, feed materials of critical importance to this subsector (and to *poultry* and *pig* farming in particular), whose imports are

[29] EU imports of phosphates and potash are polarised towards few leading suppliers. According to European Commission (2022), the leading non-EU suppliers of phosphates to the EU in 2021 were Morocco (28%) and Russia (23%). According to European Commission (2020a), the leading non-EU suppliers of potash to the EU in 2019 were Russia (34%) and Belarus (30%).

[30] https://www.fertilizerseurope.com/wp-content/uploads/2023/07/Industry-Facts-and-figures-2023.pdf

[31] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_6564

characterised by the strongest polarisation towards few non-EU suppliers[32] among all the key inputs analysed for this study.

3.3.2. Effects of compounding factors

This section analyses the **main factors** that can **amplify** (hence the term "compounding factors") the **negative implications for the EU food system** deriving from **high import dependency for key inputs**. The analysis focuses on the most recent developments, i.e., those that have occurred since the start of the COVID-19 pandemic in 2020 and combines the findings of authoritative literature with insights from the consulted stakeholders and experts. Generally speaking, all the factors that restrict the access of EU operators to the main sources of key inputs in non-EU countries act as "**compounding factors**" of high import dependency for those inputs.

The **COVID-19 pandemic** had significant effects on the availability of key inputs for the EU food system. A JRC study authored by Di Marcantonio *et al*. (2022), based on a survey of business operators, reports that 10 % of respondents highlighted problems in receiving raw materials (with increased delivery times) and shortages of inputs (including imported ones) during the lockdown phase. A significantly higher share of respondents (19 %) reported disruptions of logistical chains, which could result in input sourcing issues, or could aggravate their effects. The study by Bertolozzi-Caredio *et al*. (2023) for JRC reveals that a significant share of operators in the EU food system considers "upstream supply disruptions or unavailability" and "lack or failure of transport, infrastructure and logistics" as important risk factors and sources of vulnerability for the system. The majority of operators attributed a global or non-EU origin to those factors: this reflects the degree of integration of the EU food supply chain into the global supply chain, and the many risks associated with each step in the logistical process. The sectoral stakeholders and experts consulted for the present study also agreed unanimously on the essential role of logistics as enabling or limiting factors in achieving supply security for key inputs. On these grounds, the role of logistical aspects as compounding factors deserves a more detailed discussion at the end of this section.

The impacts of the **Russian invasion of Ukraine** on the global and EU food systems have been studied by the scientific community[33] and, especially, by international and EU institutions[34]. The impacts of this conflict in terms of supply of inputs used in the EU food system derive from the combined effect of:

- Reduced capacity of Ukraine to produce and export raw materials (the analysis made in sections 3.1 and 3.2 highlighted in particular its role as supplier of iron ore to the EU), agricultural commodities and intermediate products (Ukraine used to be a leading global exporter of sunflower cake and sunflower oil)[35].
- Drastically reduced EU imports of key inputs from Russia, initially as a consequence of restrictions and bans imposed by the EU on the country as sanctions for its unprovoked aggression of Ukraine, and then also as a form of retaliation by the Russian government due to EU support to Ukraine. The evidence presented in sections 3.1 and 3.2 highlighted the importance of Russia as supplier of potash, phosphates, crude oil, natural gas, basic metals,

[32] According to European Commission (2023a), the shares of the leading non-EU suppliers for these commodities in 2022 were as follows: for soya beans, Brazil 50% and USA 35%; for soya bean meal, Brazil 46% and Argentina 39%.

[33] Recent references include Fazle Rabbi *et al*. (2023), Taran (2023), Zachmann *et al*. (2022) and Hellegers (2022).

[34] A non-exhaustive selection of noteworthy recent publications and online resources includes: FAO (2022); EPRS (2022); DG AGRI's dedicated data portal *Impact of Russia's invasion of Ukraine on selected agricultural sectors*.

[35] According to EPRS (2022), Ukraine accounted for 61% of global exports of sunflower cake (used as feed material) and for 31% of global exports of sunflower oil in 2021.

chemicals and chemical products to the EU. Russia is also an important global exporter of sunflower cake and sunflower oil[36].

The disruption of the global markets for raw materials, agricultural commodities and intermediate products characterised by a high share of global supply originating in Ukraine and/or Russia resulted in **remarkable price increases** and in **higher price volatility**, which further aggravated the negative implications of the high import dependency of the EU food system for the affected inputs (natural gas, crude oil and derivatives, mineral fertilisers, sunflower cake and sunflower oil in particular)[37].

Bertolozzi-Caredio *et al*. (2023) revealed that operators in the EU food system perceive **policy and regulatory constraints** applying in the EU as a "compounding factor" of some of the vulnerabilities deriving from high import dependency for key inputs. This finding is supported also by the views of most sectoral stakeholders consulted for this study. It applies in particular to all the cases where compliance with particularly strict/demanding EU mandatory requirements concerning inputs, production processes and/or final products can pose further restrictions to already limited input sourcing options, since some (or most) of the few non-EU suppliers may be unable/unwilling to provide compliant inputs. The consulted stakeholders highlighted as noteworthy examples of such constraints: i) EU requirements on maximum residue levels for pesticides in agricultural commodities and processed products used as food ingredients and feed materials; and, ii) the obligations established by Regulation (EU) 2023/1115 on certain commodities and products associated with deforestation and forest degradation, which may impact the sourcing of soya beans and of agricultural commodities and products that are mostly or exclusively produced in non-EU countries (palm oil, coffee, cocoa, tea, tropical fruits, etc.)[38]. Particularly strict/demanding requirements in **quality standards**[39] that have direct or indirect implications on the characteristics and origin of production inputs affected by high import dependency can also act as "compounding factors".

As previously explained, particularly important "compounding factors" are finally related to **logistics**, with particular regard to **maritime transportation**[40]. Bailey and Wellesley (2017) identify a number of **chokepoints** along the core ocean shipping routes of relevance to global agri-food trade. Among those chokepoints, some particularly critical ones are located along routes of particular interest for input supplies to the EU food system, and specifically:

- With regard to *inputs from Asian and Eastern African countries*, the most critical chokepoints are the *Suez Canal* in Egypt, linking the Mediterranean Sea and the Red Sea, and the *Bab al-Mandab strait* between the Red Sea and the Indian Ocean.

[36] According to EPRS (2022), Russia accounted for 20% of global exports of sunflower cake and for 24% of global exports of sunflower oil in 2021.

[37] The related price dynamics can be observed through Eurostat's dedicated overview on Ukraine, through the already mentioned DG AGRI's dedicated data portal *Impact of Russia's invasion of Ukraine on selected agricultural sectors*, through DG AGRI's market observatories and through the European Food Security Crisis preparedness and response mechanism (EFSCM) Food alert system.

[38] A more or less important share of the global exports of these commodities and products actually comes from countries like Brazil, Indonesia, and other Asian and Sub-Saharan African countries where deforestation related to agricultural uses of land is a significant or serious issue. IDH *et al*. (2023) reports a great amount of data and information on deforestation and supply of certified deforestation-free soya beans to the EU.

[39] Established by EU legislation, like in the case of organic production or products with geographical indications, established by national legislation (like the *Label Rouge* family of standards in France), or voluntary standards established by producer groups, retail chains, etc.

[40] Rail and road transportation are only available for imports from Russia, Belarus and Ukraine, from non-EU countries in the Balkans, and from Norway, Switzerland and Turkey (Areté, 2017). In the case of former USSR countries, the difference in rail gauges ("large" gauge of 1,520 mm inherited from the Soviet Union vs. the standard gauge of 1,435 mm used in most EU Member States – with the notable exception of the Baltic states - as well as in Turkey, Iran and China) creates major bottlenecks and limits the development of international rail shipments involving former USSR countries (UNECE, 2017).

- With regard to *inputs from the regions and countries located along the Western coast of the Americas*, the most critical chokepoint is the *Panama Canal*, linking the Pacific Ocean with the Atlantic Ocean[41].

UNCTAD (2020 to 2023), Özkanlisoy and Akkartal (2022), and Miller (2023) report extensively on the most significant **trends and events concerning maritime transportation** that since the outbreak of the COVID-19 pandemic in 2020 acted as "compounding factors" of the EU food system's high import dependency for specific inputs, with particular regard to the core traffic routes highlighted above. This period, and in particular the second half of 2021 and the first half of 2022, has been characterised by dramatic increases of dry bulk freight rates (relevant for ores and grains), tanker rates (relevant for crude oil and seed oils), and above all of containerised freight rates (relevant for perishable products and a wide range of components and manufactured products used as inputs, from machinery to computers). The resulting inflation of transportation costs was often combined with a serious deterioration of the quality and reliability of service, in particular for containerised transportation (which is mostly based on scheduled services). Ocean shipping was severely affected by systemwide disruptions stemming from "domino effects" caused by widespread port congestion (with delays in cargo handling and cancellation of sailings), by a blockage of the Suez Canal between late March and early April 2021[42] and by a serious reduction of the traffic handling capacity of the Panama Canal over most of 2023, due to low waters. Another major disturbance of freight traffic across the Suez Canal and Bab al-Mandab strait has emerged since late November 2023, due to more and more frequent attacks on cargo vessels by the Houthi militia of Yemen. Similar to the 2021 blockage, several operators have opted to reroute Suez traffic via the much longer and circuitous route around the Cape of Good Hope in South Africa. Analysts predict that massive and prolonged detours of Suez traffic are most likely to result in another period of extremely high ocean freight rates (which have actually spiked since the end of 2023, especially for containerised cargo) and widespread service disruptions, which will especially affect the routes linking Europe with Asia and Eastern Africa.

[41] Due to limitations in the length of its locks, the Panama Canal cannot handle ships exceeding a maximum overall length of 370.33 metres. Since 2021 the maximum vessel draft allowed on the canal is 15.24 metres, but this limit can be lowered according to actual water levels (source: Port Technology International, 2021).

[42] Due to an accident occurred to the *Ever Given* container ship on March 23, 2021 (Özkanlisoy and Akkartal, 2022).

4. AVAILABLE TOOLS TO SECURE INPUTS AND MAKE THE EU LESS DEPENDENT ON FOREIGN SUPPLIERS

KEY FINDINGS

- **EU has considerable interest in supporting trade relations** to ensure that the EU's resilience in the face of trade shocks is not compromised, as EU foreign trade accounts for 30 % of EU GDP. Trade openness is key to improve resilience and avoid bottlenecks and vulnerabilities due to excessive dependence on a limited number of trade partners.
- **EU's trade policy, free trade agreements and strategic partnerships with third countries facilitate access to a diverse range of inputs** from outside the EU, notably for key products where the EU has an input dependency. Tariffs are a key tool to facilitate smoother trade flows and improving access to inputs for EU farmers (e.g., for protein-rich feed and fertilisers).
- **Recent policies developed under the European Green Deal have raised sustainability ambitions for agriculture and food systems**. The EU's climate ambition is likely to impact in particular the EU's fertiliser sector and its imported inputs through the revised Renewable Energy Directive (RED), the Emission Trading Scheme (ETS) and the Carbon Border Adjustment Mechanism (CBAM).
- **The Farm to Fork Strategy aims to contribute to EU's input autonomy by 2030** through a targeted 50 % reduction in nutrient losses (which should lead to a reduction of 20 % in the use of fertilisers), a target of 25 % of agricultural land under organic production, the development of alternative sources of proteins for animal feed (in the framework of the European protein strategy), the promotion of the bio-economy and shorter supply chains.
- **The Common Agricultural Policy national strategic plans** have also the potential to reduce the EU's import dependency, notably through support to low-input practices, nutrient management and fertiliser optimisation, sustainable use of fertilisers, organic farming and the possibility for Member States to grant increased coupled support to protein crops. As highlighted by several stakeholders, there is however also a risk that the EU Green Deal and the adoption of sustainable practices under the CAP could reduce the production capacity of EU agriculture and thereby weaken the EU's self-sufficiency in food.
- **Emergency measures recently adopted at EU and Member State level** proved useful to mitigate the impact of increased inputs costs following the war in Ukraine.

4.1. Main EU trade policy tools to increase the EU food system's input autonomy

4.1.1. Overview of trade policy tools

The EU is the world's largest single market area and is one of the most outward-oriented global economies[43]. A recent study (Amighini *et al*., 2023)[44] commissioned by the EP's committee on international trade (INTA Committee) explains that EU foreign trade accounts for 30 % of EU GDP and the Euro area specifically is more interlinked with global industrial chains than the USA or China. This high degree of global interconnectedness brings risks in the form of potential trade disruptions and explains why the EU therefore has considerable interest in supporting a co-operative trade system to ensure that the EU's resilience in the face of trade shocks is not compromised. EU trade policy is hence vital for achieving diversification and guaranteeing unimpeded access to raw materials (for this reason, since 2015, the Commission is proposing a dedicated Energy and Raw Commodities chapter in bilateral trade agreements, which includes key raw materials).

In order to maximise its advantages of scale, the EU takes responsibility for trade policy on behalf of the Member States and negotiates trade agreements for the bloc as a whole.

The EU's trade policy is set within the context of its membership of the World Trade Organisation (WTO). The EU's membership of the WTO places trade with other WTO members within a rules-based system. The EU has suggested some ideas to modernise the WTO and to adapt its rules to address the emerging challenges of the global economy[45]. Put forward in 2018, these suggestions were made against the background of increasing threats of unilateral trade measures and countermeasures being taken. The EU's reform agenda highlights the need to secure predictable, rules-based international trade flows for both imports and exports.

In addition to WTO membership, the EU negotiates bilateral and regional trade agreements with specific trade partners and blocks. These agreements grant mutually beneficial access to the EU market for the partner countries/blocs, and to the partner countries/blocs' market for the EU. Each of these agreements is unique and the access granted to each other's markets reflects the export focus of both partners and their import needs. The EU has ratified trade agreements of one form or another with 78 countries, either individually or within regional agreements. Agreements are in the process of being adopted or ratified with a further 25 countries, and agreements are currently being negotiated with seven countries. Finally, negotiations on agreements are on hold with 22 countries[46].

[43] https://european-union.europa.eu/priorities-and-actions/actions-topic/trade_en
[44] https://www.europarl.europa.eu/RegData/etudes/STUD/2023/702582/EXPO_STU(2023)702582_EN.pdf
[45] https://circabc.europa.eu/ui/group/7fc51410-46a1-4871-8979-20cce8df0896/library/42115f40-e2ba-4a49-9162-de92098f15bd/details
[46] https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/negotiations-and-agreements_en

How trade policy contributes to supplying inputs to EU agriculture

1. **Access to Inputs:** Trade policy governs the importation of various inputs such as fertilisers, pesticides, seeds, machinery, and equipment that are essential for agriculture. The EU relies on imports for many of these inputs, and trade agreements facilitate access to a diverse range of products from both within and outside the EU.

2. **Diversification of Supply:** Trade agreements allow the EU to diversify its sources of agricultural inputs. By negotiating trade deals with different countries and regions, the EU can secure a stable and varied supply of inputs, reducing dependency on any single supplier or market.

3. **Cost and Availability:** Trade policy influences the cost and availability of inputs for EU agriculture. Access to competitive international markets can help lower input costs for farmers, making agricultural production more efficient and cost-effective.

4. **Quality and Standards:** Trade policy also addresses quality standards and regulations for agricultural inputs imported into the EU. Strict regulations ensure that imported inputs meet EU standards for safety, quality, and environmental sustainability, protecting consumers and the environment.

5. **Tariffs and Trade Barriers:** Tariffs and trade barriers imposed by the EU or its trading partners can impact the cost and availability of agricultural inputs. Trade negotiations aim to reduce or eliminate tariffs and non-tariff barriers, facilitating smoother trade flows and improving access to inputs for EU farmers.

7. **Trade Facilitation:** Trade policy measures include efforts to streamline customs procedures, reduce bureaucratic barriers, and enhance trade facilitation mechanisms. These measures help expedite the importation of agricultural inputs, ensuring timely delivery to farmers and minimising disruptions to agricultural production.

The EU's latest overarching strategy on trade is set out in the Commission's 2021 *Trade Policy Review - An Open, Sustainable and Assertive Trade Policy* (European Commission, 2021b). The policy is designed to address the economic transformation and geopolitical instability present at the time and to prepare for the world of 2030. The Trade Policy Review makes clear that the EU needs a new trade policy strategy to support its domestic and external policy objectives against the background of a more sustainable growth model as defined by the Green Deal and the European Digital Strategy. It is also made clear that trade policy should play a role in the recovery from the COVID-19 pandemic. Russia's subsequent invasion of Ukraine, and the resulting impacts on trade, make the Review even more pertinent. The Review sets out the need for a trade policy that supports the EU's open strategic autonomy (OSA). This concept stresses the EU's ability to reflect its strategic interests and values while assertively defending its interests, protecting its economy from unfair trade practices and ensuring a level trading playing field. The Review explains that OSA means building on the importance of trade openness, but also strengthening the EU's economy through enhanced resilience and competitiveness while encapsulating sustainability and fairness. Finally, the concept points to the EU's preference for rules-based cooperation, but states that assertiveness is required to combat unfair practices; autonomous tools can also be used to pursue the EU's interests where necessary. The Review stresses

the importance of enhancing the resilience and sustainability of value chains. In line with the above, the Review sets out **three core trade policy objectives** for the medium-term:

- Support the recovery and fundamental transformation of the EU economy in line with its green and digital objectives.
- Shape global rules for a more sustainable and fairer globalisation.
- Increase the EU's capacity and autonomy to pursue its interests and enforce its rights.

4.1.2. Mapping of trade deals concerning the main products on which the EU food system has an import dependency

Section 3.1 identified seven key inputs to the EU food system on which the EU has an import dependency. The mapping in Table 6 shows the Most Favoured Nation (MFN) tariff arrangements for these products as well as preferential access provided via the EU's network of trade deals for substantial sources of these imports. It should be noted that, reflecting the importance of these imports, in many cases the EU does not impose tariffs on any supplier with the MFN set to 0 %.

Table 6: Mapping of EU trade deals for key imports to the EU food system

	Main third country exporters to the EU (2022, % volume)	**Main exporters combined (2022, % volume)**	**Tariff rate**
Soya beans	1. Brazil 50 % 2. USA 35 % (a)	85 %	***MFN tariff on imports: 0 %***
Soya bean meal	1. Brazil 46 % 2. Argentina 39 % (a)	85 %	***MFN tariff on imports: 4.5 %*** • Brazil (MFN) • Argentina (MFN) • Serbia (0 %, tariff preference Stabilisation and Association Agreement) • UK (0 % tariff preference – EU- UK Trade and Co-operation Agreement) • India (0 %) Tariff preference under the General System of Preference (GSP) for lower or lower-middle income countries
Honey	1. Ukraine 24 % 2. China 21 % (b)	45 %	***MFN tariff on imports: 17.3 %*** • Ukraine (0 %) Full trade liberalisation for agricultural goods • China (MFN) • Mexico (8.6 %) Tariff preferential rate, EU – Mexico trade agreement) • New Zealand (MFN, tariff free access expected on implementation of the

	Main third country exporters to the EU (2022, % volume)	Main exporters combined (2022, % volume)	Tariff rate
			EU-New Zealand Free Trade Agreement)
Phosphates	1. Morocco 28 % 2. Russia 23 % (c)	51 %	***MFN tariff on imports: 0 %***
Potash	1. Russia 34 % 2. Belarus 30 % (d)	64 %	***MFN tariff on imports: 0 %***
Copper ore and concentrates.	1. Chile 27 % 2. Peru 19 % (d)	46 %	***MFN tariff on imports: 0 %***
Iron ore and concentrates.	1. Brazil 33 % 2. Ukraine 11 % (d) 3. Canada 11 %	55 %	***MFN tariff on imports: 0 %***

Source: Areté elaboration on: (a) European Commission (2023a); (b) European Commission (2023b); (c) European Commission (2022); (d) European Commission (2020a).

4.2. Contribution of the EU's Green Deal, Farm to Fork strategy and the Common Agricultural Policy (CAP) toolbox to promoting input autonomy for the EU food system and for the agricultural sector

It should be noted that **reducing EU dependency on imported inputs** and **increasing resilience** are **not explicit aims of the European Green Deal**, which pre-dates both the COVID-19 crisis and the crisis caused by Russia's invasion of Ukraine. These have increased political awareness of the importance of resilience and reducing dependencies on imported inputs. That said, the Green Deal was later presented as a lifeline out of the COVID-19 pandemic with one-third of the EUR 1.8 trillion investments from the *NextGenerationEU* Recovery Plan, providing the financing, together with the EU's seven-year budget[47]. The Green Deal Communication itself contains a rather vague reference to access to resources as a strategic security issue. It only mentions imports twice in the context of the EU food system, stating that: imported food must comply with relevant EU environmental standards (*Farm to Fork Strategy*, see below) and that EU imports shall not involve deforestation and forest degradation. Despite this lack of focus on reducing import dependency, there are aspects of the Green Deal that could nonetheless have an impact in this area.

4.2.1. The European Green Deal

The European Green Deal Communication was published on 11 December 2019 and is designed to transform the EU into a modern, resource-efficient and competitive economy, ensuring: i) no net emissions of greenhouse gases by 2050; ii) economic growth decoupled from resource use; and, iii) no person and no place left behind. The Green Deal is a blueprint or roadmap and is delivered through a

[47] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

package of measures/legislation, although all EU actions and policies will have to contribute to its objectives. The primary focus of the Green Deal is to reset the commitment to tackling climate and environmental-related challenges. However, the Communication makes clear that the policy response must seek to maximise benefits for health, quality of life, resilience and competitiveness. The focus on resilience and competitiveness is relevant to reducing the EU's dependency on imports in general terms.

The centrepiece of the Green Deal is the European Climate Law. This commits the EU to becoming climate neutral by 2050 and to reduce net greenhouse gas emissions by at least 55 % by 2030 compared to 1990 levels. To meet these obligations, EU Member States will have to cut emissions, invest in green technologies and protect the natural environment. The EU's climate ambition is likely to impact on the EU's fertiliser sector through the revised Renewable Energy Directive (RED), the Emission Trading Scheme (ETS) and the Carbon Border Adjustment Mechanism (CBAM).

The revised ***Renewable Energy Directive*** (Directive EU/2023/2413) sets an overall binding renewable energy target of at least 42.5 % at the EU level, with the intention that 45 % is achieved. This has relevance for the EU fertiliser sector because ammonia, the basic ingredient of mineral fertilisers, is produced from hydrogen which in turn is usually produced from fossil fuels. The revised RED creates secure demand for renewable energy and therefore investment certainty to aid the development of renewable supply.

The ***Emission Trading Scheme*** is the main mechanism by which the EU intends to reduce carbon emissions. The ETS sets limits on the total amount of greenhouse gases that can be emitted by installations and reduces this annually in line with climate targets so that emissions decrease over time[48]. By forcing EU fertiliser manufacturers to reduce their emissions over time, the ETS is imposing costs on the domestic production of fertilisers. According to European Commission figures presented by Fertilizers Europe, the annual cost of ETS to the European fertiliser industry is just over EUR 500 million[49]. Third country producers of fertilisers may not be subject to comparable costs and therefore have a competitive advantage on EU markets. Unaddressed, this would lead to carbon leakage as imported products would gain market share on the EU market at the expense of domestic production.

The Green Deal recognises the risk of carbon leakage if international partners do not share the same ambitions as the EU. This could be caused by either the transfer of production from the EU to other countries or because EU products are replaced by more carbon-intensive imports. To this end, a ***Carbon Border Adjustment Mechanism*** (CBAM) has been introduced to ensure that the price of imports of cement, iron and steel, aluminium, electricity, hydrogen and fertilisers more accurately reflects their carbon content. In essence, CBAM aims to rewrite supply networks by tackling climate leakage (Amighini *et al.*, 2023).

Of direct relevance here, ***CBAM*** will place a price on the carbon emitted during the production of fertilisers that are then imported into the EU[50]. Operationally, EU importers of fertilisers will have to buy CBAM certificates from their national authority with prices set by weekly Emissions Trading Scheme allowances. The importer then surrenders the number of certificates required to cover the emissions embedded in its imports. However, if the importer can prove that a carbon price has already been paid during the production process, this can be deducted from the amount required to be covered by certificates.

[48] https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en
[49] https://www.fertilizerseurope.com/AnnualOverview/images/climate.pdf
[50] https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

4.2.2. The Farm to Fork Strategy

Published on 20 May 2020, the ***Farm to Fork Strategy*** has the objective to make food systems fair, healthy and environmentally friendly. The strategy includes targets to reduce the use and risk of chemical pesticides and the use and risk of more hazardous pesticides by 50 % by 2030; reduce nutrient losses by at least 50 % and thereby the use of fertilisers by at least 20 % by 2030; reduce by 50 % the sales of antimicrobials for farmed animals and in aquaculture by 2030; and, increase the area of EU farmland under organic production to 25 % by 2030. The ***Biodiversity Strategy*** supports the Farm to Fork Strategy in its aim to reduce the use of fertilisers by setting a target that 30 % of land in Europe will be legally protected (an increase from the 26 % of land under protection at the time), of which a third (10 % of total EU land) will be strictly protected. Although the way in which this land must be managed is not specified in the Strategy, it is likely that there will be limits or prohibitions on the use of fertiliser.

The Strategy is explicit in its call to examine EU rules to reduce the dependency on critical feed materials by fostering EU-grown plant proteins, as well as alternative feed materials such as insects, marine feed stocks (e.g., algae) and by-products from the bio-economy (e.g., fish waste). Measures here clearly imply a reduction in imported inputs. However, the importance of food security should not be ignored in addressing agricultural, environmental or climate issues, as noted by Commissioner Wojciechowski in a 13 June 2023 statement in response to the European Parliament report Ensuring food security and long-term resilience of EU agriculture.

The most obvious way in which the Farm to Fork Strategy will contribute to EU input autonomy is in its target to reduce nutrient losses by 50 % and thereby lead to a reduction of 20 % in the use of fertilisers, as long as this can be accomplished without reducing EU food production to the point that food imports are required to meet demand (this is a concern for some authors: see for example, Wesseler (2022)). This will be accomplished by implementing and enforcing the relevant environmental and climate legislation in full. With relevance to demand for fertilisers, and therefore demand for imported fertilisers, the Strategy notes that the Commission will work with Member States to extend the application of precise fertilisation techniques and the recycling of organic waste into renewable fertilisers. The Strategy notes that this will be done through the CAP Strategic Plans (see below). The intention to reduce fertiliser use will also be served by the target to increase the area under organic production to 25 % from the 9.9 % in 2021[51] and by the promotion of the circular bio-based economy which includes advanced bio-refineries that produce bio-fertilisers. Several measures under the 2023-2027 CAP will also help to achieve the targeted reduction in fertiliser use (see section 4.2.4). Again, it will be important that the increase in organic area does not result in reductions in food production to the point that imports become required.

In addition to the above, the Farm to Fork Strategy contains a number of statements and planned initiatives that imply a reduced reliance on imports. Some of these have relevance to the more explicit intentions set out above. A general decreased reliance on imports is implied by:

- The Strategy's call for shorter supply chains and more sustainable food which implies favouring local domestic production over imports as this is likely to have lower food miles and therefore a reduced carbon footprint.

[51] https://www.eea.europa.eu/en/analysis/indicators/agricultural-area-used-for-organic#:~:text=The%20share%20of%20the%20EU's,remaining%20years%20up%20to%202030

- The statement that, "the transition to sustainability presents a 'first mover' opportunity for all actors in the EU food chain", again implying an advantage for EU production over imported production.

Measures to reduce overall food demand will decrease demand for imported foodstuffs and inputs such as fertilisers proportionally. For example, by highlighting food waste and obesity, and proposing measures to address this, such as the revision of rules on date marking on food and setting a baseline and legally binding targets to reduce food waste, the Strategy implies a reduction in necessary supply. In a similar vein, a review of the EU promotion programme for agricultural products, with a view to enhancing its contribution to sustainable production and consumption and in line with the evolving diets, could alter the overall demand profile with implications for the use of imported inputs. For example, meat is specifically mentioned in this context in terms of considering how the EU can use its promotion programme to support the most sustainable, carbon-efficient methods of livestock production. These methods are likely to include systems with lower demand for imported feedstuffs.

Two measures related to research and knowledge dissemination could have an impact on the demand for imported inputs such as fertilisers:

- Funding of around EUR 1 billion under Horizon 2020 for research and innovation (R&I) under Green Deal priorities in 2020, and a further EUR 10 billion under Horizon Europe on R&I. A key area of research will include increasing the availability and source of alternative proteins such as plant, microbial, marine and insect-based proteins and meat substitutes. This should help to reduce the EU's reliance on imports in this area.
- A mission in the area of soil health and food which will help develop solutions for restoring soil health and functions. This will include new knowledge and innovations to scale up agro-ecological approaches in primary production through a dedicated partnership on agro-ecology living laboratories. The intention is to contribute to reducing the use of fertilisers (as well as pesticides and antimicrobials).

Demand for fertilisers could also be reduced as a consequence of the initiative to improve access to fast broadband internet, which will allow precision farming and artificial intelligence to be used more widely.

Highlighting the need to foster the competitiveness of the EU supply sector may indirectly imply a refocusing on domestic production. Several initiatives are likely to have a marginal impact on the demand for imported food products and agri-inputs by increasing, also marginally, the competitive position of EU producers:

- The Strategy notes that the Commission will present a legislative proposal and other measures to avoid or minimise the placing of products associated with deforestation or forest degradation on the EU market. This was subsequently done in Regulation (EU) 2023/1115.
- The Strategy makes clear that imported food must continue to comply with relevant EU regulations and standards. For example, environmental aspects will be taken into account when assessing requests for import tolerances for pesticide substances which are no longer approved in the EU. Products of animal origin imported into the EU will have to comply with strict requirements on the use of antibiotics to reduce the risk of antimicrobial resistance. The creation of a level playing field will help to maintain the competitive position of EU production.

Where farms are heavy users of energy, for example in the dairy sector, encouragement of the production of biogas from agricultural wastes and residues and investment in the use of solar panels will reduce demand from the grid and hence increase resilience. The Strategy makes the point that

while the Commission will take action to speed-up market adoption of these and other energy efficiency solutions in the agriculture and food sectors, this must not compromise food security.

4.2.3. The European protein strategy

Plant-based proteins, rich in amino acids, represent a crucial element in animal nutrition, since meat and bone meals are limited in EU livestock feed (EPRS (2023b)). Of all crops used in compound feed, soya bean has the highest protein content with over 40 %. While other products such as legumes and oilseeds are also important sources of plant-based protein, they lack the nutrition profile that makes soya bean so important for the feed industry. The EU's self-sufficiency does not extend to proteins of vegetable origin, to which Member States devote only 3 % of their agricultural land. This is due to several factors, including lower production costs in third countries, sometimes at the environment's expense. Because of this deficit, in 2018, more than 75 % of the EU's plant-based proteins had to be imported from third countries, particularly Argentina, Brazil and the US.

To address the EU's deficit in plant-based proteins, the European Parliament adopted a resolution on the EU protein deficit: what solution for a long-standing problem? in March 2011. This was followed by the European Soya Declaration in July 2017, which called for an increase in domestic production of legume crops for food and feed. The Commission duly set out a European strategy for the promotion of protein crops. This encouraged the production of domestic protein and leguminous plants and specifically reflected debates on the need for EU critical dependencies and strategic autonomy. The strategy was followed by a report in November 2018 that sets out policy recommendations, but which fell short of setting out a strategy as such. The report did though anticipate that incentives to grow more protein crops would be part of the post-2020 CAP. The report also identified the importance of EU R&D programmes to improve the competitive position of EU protein crops. The Commission also committed to promoting protein crops as both food and feed in terms of health and environmental benefits. Finally, in December 2021, the Austrian and French agricultural ministers signed a joint declaration calling on the Commission to follow up on its 2018 report to devise a protein strategy for the EU.

The Versailles Declaration, issued following Russia's invasion of Ukraine on 11 March 2022,contains a commitment to reducing strategic dependency, including on key imported agricultural products and inputs, in particular by increasing the EU production of plant-based proteins.

On 24 March 2022, the European Parliament adopted a resolution calling on the Commission 'to propose a comprehensive European protein strategy in order to increase European protein production and reduce the EU's dependency on third countries'. The day before, the Commission announced in its food security communication that it would review protein policy in the first quarter of 2024; an external study is ongoing to help inform this review. Finally, the Parliament's Committee on Agriculture and Rural Development (AGRI) has produced an own-initiative report on a European protein strategy which was adopted by the Parliament on 19 October 2023.

4.2.4. The 2023-2027 Common Agricultural Policy

The ***Common Agricultural Policy*** (CAP) is the main mechanism through which the objectives of the Farm to Fork Strategy will be met. It is also relevant to the implementation of the Biodiversity Strategy and the objectives of the Versailles Declaration. Under the 2023-2027 CAP, Member States are obliged to produce a National Strategic Plan (NSP), based on a SWOT analysis, which justifies their selection of measures from the CAP toolbox. NSPs must also indicate how the measures selected will contribute to meeting the EU-level targets set out in the Farm to Fork and Biodiversity Strategies, including the expected reduction in fertiliser use. The requirement that Member States develop NSPs is the main

innovation of the 2023-2027 CAP (Rac *et al*., 2020). NSPs combine what were previously the two pillars of the CAP, and being based on a SWOT analysis, they should allow Member States to tailor the support offered to meet their local needs and circumstances. A key element is the requirement that the Commission will assess the consistency and contribution of Member States' proposed NSPs to the EU 2030 objectives under the Farm to Fork and Biodiversity strategies (Bradley and Christodoulou, 2022). National implementation of the CAP through the NSPs is analysed in more detail in section 4.3, with specific regard to the possibility of improving the input autonomy of the Member States' agricultural sectors through low-input practices.

While **promoting the EU's input autonomy** for the EU food system as a whole, and for the agricultural sector in particular, **is not an explicit objective of the CAP**, there are elements of the policy that will work in this direction. The 2023-2027 CAP is one of the key pieces of legislation that will implement the Farm to Fork Strategy and in doing this, it will help to deliver on the targets and ambitions that it sets out. European Commission (2020b) sets out the links between CAP reform and the Green Deal and makes clear that the specific objectives of the CAP are in line with the focus of the Green Deal in relation to food systems. This is considered to be especially the case in terms of:

- increased contribution of EU agriculture to climate change mitigation and adaptation;
- improved management of natural resources used by agriculture, such as water, soil and air;
- reinforced protection of biodiversity and ecosystem services within agrarian and forest systems;
- effective sustainability of food systems in accordance with societal concerns regarding food and health on, e.g., animal welfare, use of pesticides and antimicrobial resistance; and,
- ensuring a fair economic return and improving the position of farmers in the food supply chain.

The first three of these objectives pick up on the areas of the Farm to Fork Strategy that are likely to influence demand for fertilisers, and which therefore work towards increasing the EU's input autonomy in this area. Some 40 % of the CAP budget is environment/climate-relevant[52] and the so-called green architecture encompasses:

- ***Eco-schemes.*** These will provide funding and additional incentives for climate and environment-friendly farming practices.
- ***Agri-environment-climate measures and investments.*** Rural development support will enhance ecosystems, promote resource efficiency and help move the EU agricultural sector towards a low-carbon, climate-resilient economy.
- ***Enhanced conditionality.*** Conditionality links income support to environment and climate-friendly farming practices and standards.
- ***Farm Advisory Service.*** This will draw on economic and environmental data to deliver up-to-date technological and scientific information to advise farmers.

[52] https://ec.europa.eu/commission/presscorner/detail/en/fs_20_910

4.3. Use of the CAP toolbox by Member States (CAP national strategic plans) to improve the input autonomy of their agricultural sectors through low-input practices

This section presents the main findings of an analysis of CAP NSPs aimed at identifying and briefly describing the CAP measures implemented at national level that can contribute to the improvement of the input autonomy of the agricultural sector by promoting the adoption of low-input practices. The analysis relied on three recent reports by the European Commission (2023d), by Munch *et al*. (2023)[53] and by Folkeson Lillo and Chartier (2023)[54]. The analysis focused in particular on support schemes aimed at reducing or substituting the use of mineral fertilisers (including by promoting the cultivation of nitrogen-fixing crops), pesticides and fossil energies, promoting organic farming and precision farming, and providing advice and training schemes on nutrient management and recycling. The results of the analysis are presented in a general EU-level overview; a synoptic table at the end of the section (Table 7) provides an overview on the use of the CAP toolbox in selected Member States[55] to improve the input autonomy of their agricultural sectors through the adoption of low-input practices.

Generally speaking, there is a substantial effort by several Member States to reduce the EU's import dependency for **protein crops and legumes**, which have the additional merit of being nitrogen-fixing crops that do not require N-fertilisers: this is pursued through increased financial contribution to *coupled support*[56] to these crops, or introduction of that measure. The related provisions are set out in Article 32 of Regulation (EU) 2021/2115. It is important to underline that whereas Member States must demonstrate the difficulties encountered in the sectors to which they wish to apply coupled support, this is not necessary in the case of protein crops. Member States may allocate up to a maximum of 13 % of their direct payment envelopes to coupled support payments, but an additional 2 % may be allocated specifically to protein crops.

Reductions in the use of mineral fertilisers, pesticides and fossil energies in national CAP strategic plans are also pursued through a wide range of measures, including:

- more demanding requirements for specific *GAEC*[57] *standards* and/or the activation of *Natura 2000* or *Water Framework Directive payments* conditional on non-use of pesticides and/or mineral fertilisers, limited use of these inputs, compliance with requirements for their application, or on the application of nutrient management approaches;
- the introduction of *additional GAEC standards focusing on nutrient management*;
- the promotion of *precision farming*;
- the promotion of the *use of organic fertilisers* such as manure, slurry or compost;
- the implementation of *fertilisation plans* to improve efficiency;
- promotion of *integrated pest management* through *eco-schemes* and *agri-environment climate commitments* (AECC) in the framework of Rural Development interventions (Article 70 of Regulation (EU) 2021/2115); and, last but not least,

[53] For the European Parliament's Committee on Agriculture and Rural Development.
[54] For the European Commission, Directorate-General for Agriculture and Rural Development.
[55] The selection includes six Member States contributing a substantial part of the EU agricultural sector's overall output value: France, Germany, Italy, Poland, Romania, Spain.
[56] Coupled support takes the form of an annual payment per hectare (or per farmed animal) to help producers address the difficulties encountered in their sector by improving competitiveness, sustainability or quality.
[57] GAEC: requirement related to ensuring Good Agricultural and Environmental Conditions.

- promotion of *organic farming* through *eco-schemes* and *AECC*. Additional support to organic farming can be provided via *sectoral interventions* (support to Producer Organisations, including for Operational Programmes, Article 47 and Article 50 of Regulation (EU) 2021/2115).

According to the **EU-level overview of the NSPs carried out by the** European Commission (2023d), 24 % of the budget for CAP direct payments is dedicated to *eco-schemes* (EUR 44.7 billion), and 48 % of the rural development spending (EUR 31.6 billion) is earmarked for *environment and climate-related measures*. Some 20 CAP Strategic Plans (out of a total of 28) include *coupled support for legumes/protein crops, including soya beans*, for food and/or feed use, with a budget share of about 13 % of the overall financial allocation. As for requirements concerning a minimum share of arable area devoted to non-productive features or areas (GAEC 8), 12 Member States/13 plans offer an alternative option, whereby a farmer commits to devote at least 7 % of arable land to non-productive areas and features, including land lying fallow, under an "enhanced" eco-scheme.

With regard to the *thematic objectives pursued by eco-schemes* in the national CAP strategic plans, the situation is as follows:

- 47 eco-schemes are related to soil management[58], and are based on – among others – the cultivation of leguminous crops;
- 30 eco-schemes are related to landscape and biodiversity, and are based on low-input practices[59];
- 23 eco-schemes are focused on grasslands management and grazing, and may include a ban of fertilisation;
- 12 eco-schemes deal with integrated pest management and pesticide management and are based on bans/limitations in the application of plant protection products, promotion of biological control, mechanical weeding, use of resistant and local species and varieties;
- nine eco-schemes support the conversion to organic farming, and four support the adoption of integrated production schemes;
- eight eco-schemes focus on nutrient management[60]; and,
- six eco-schemes support the adoption of precision farming techniques.

Münch *et al*. (2023) reports that, on the advice of the Commission, **adaptations to the drafted CAP Strategic Plans** were made in the light of changes to food security and resilience of the agricultural sector **following Russia's invasion of Ukraine**. The Commission also postponed the mandatory implementation of GAEC 8 (requiring a minimum share of arable area devoted to non-productive features or areas) by one year. In practice, however, Münch *et al*. (2023) conclude that the changes made were quite limited. In most cases Member States simply referred to the invasion as an extra justification (alongside other external shocks such as COVID-19) for interventions already selected. For example, nine Member States used the invasion to justify sectoral coupled support, usually targeted at multiple sectors, including livestock farming. Only four Member States cited the invasion as justification for the use of risk management tools.

[58] Improvement of soil structure and increase in the soils' ability to store organic matter, the so-called "carbon sequestration".
[59] Ecological management of farmland, maintenance and creation of landscape features and non-productive areas, and extensive management of biodiversity-rich farming systems.
[60] In terms of banning the use of mineral fertilisers, limiting the use of fertilisers or setting requirements on their application to the soil, promoting the use of organic fertilisers such as manure, slurry or compost, carrying out fertilisation plans to improve efficiency.

An overview of the **main CAP implementation choices of selected Member States** that are relevant for improving the input autonomy of their agricultural sectors through low-input practices is provided in Table 7.

Table 7: Use of the CAP toolbox in selected Member States to improve the input autonomy of their agricultural sectors through low-input practices

Member States	Main measures adopted at national level	
	Support to nitrogen-fixing crops	***Main measures to promote reductions in the use of mineral fertilisers, pesticides and fossil energies***
France	Via coupled support Food & feed legumes	Promotion of organic farming (via eco-schemes and rural development interventions) Interventions focusing on fertilisation, soil amendment and soil management
Germany	Via eco-schemes Inclusion of legumes in the rotations	Promotion of organic farming (via rural development interventions) Interventions focusing on fertilisation, soil amendment and soil management Promotion of precision farming
Italy	Via coupled support Food & feed legumes	Promotion of organic farming (via rural development interventions) Interventions focusing on fertilisation, soil amendment and soil management AECC banning chemical control of pests and application of fertilisers along water courses Promotion of integrated pest management Promotion of precision farming
Poland	Via coupled support Feed legumes	Promotion of organic farming (via rural development interventions) Interventions focusing on fertilisation, soil amendment and soil management Promotion of integrated pest management
Romania	Via coupled support Food & feed legumes	Promotion of organic farming (via rural development interventions) Interventions focusing on fertilisation, soil amendment and soil management
Spain	Via coupled support Food & feed legumes	Promotion of organic farming (via rural development interventions) Interventions focusing on fertilisation, soil amendment and soil management Additional GAEC focusing on sustainable fertilisation Promotion of integrated pest management Promotion of precision farming

Source: Areté elaboration on European Commission (2023d), Munch *et al.* (2023), Folkeson Lillo and Chartier (2023).

4.4. Main EU and national measures recently adopted to mitigate the impact of increased input costs

4.4.1. EU measures

In March 2022 the Commission announced a range of short-term and medium-term actions to support farmers and consumers in the EU against the background of rising food prices and input costs, including energy and fertilisers. Food availability within the EU was not at risk. However, it was noted that the EU agricultural sector is a net importer of certain products, including feed proteins. This, coupled with high input costs, including for fertilisers and fossil fuel energy, created challenges for farmers and risked higher food prices for consumers. In addition to a range of measures to support food security in Ukraine, the Commission announced a package of support for EU farmers and consumers as follows.

Support package of EUR 500 million for the agricultural sector. The EU allocated this emergency fund, which included making use of the crisis reserve, to help farmers most affected by rising input costs. It was also designed to help farmers that were particularly impacted by the closure of the Belarussian and Russian markets following EU sanctions that followed the Russian invasion of Ukraine. Funds could be used to support:

- the circular economy;
- nutrient management;
- the efficient use of resources;
- environmental and climate friendly production methods.

National top-ups to this support were allowed up to 200 % of the EU contribution. The allocation of EU funds and national top-ups by Member State is set out in section 4.4.2 on national measures below. A further ***EUR 430 million to support the agricultural sector*** was made available in June 2023. The justification for this support was the impact of adverse climatic effects, high input costs, and diverse market and trade related issues (this includes EUR 100 million made available in May 2023 for farmers in Bulgaria, Hungary, Poland, Romania and Slovakia). Again, Member States were able to supplement the support with national funds up to 200 % of the allocated EU support.

Market safety net measures for the pig sector. The EU pig sector faced particular difficulties in terms of rising input costs and falling producer prices, which exacerbated the impact of outbreaks of African Swine Fever in some Member States. Market safety net measures were introduced to support the pig market, including financial support to cover the costs of storing pig meat that has been withdrawn from the market for a period of between two and five months.

Exceptional and temporary derogation to allow the production of any crops for food and feed purposes on fallow land. Measures relating to environmental requirements outlined in the CAP were relaxed, with no reduction to the Greening payment. This allowed an increase in the EU's production capacity to meet higher demand and thereby hold consumer prices down. The derogation allowed for the temporary relaxation of rules regarding crop rotation, the use of fallow land and the maintenance of farmland set aside for biodiversity and improving soil health.

Temporary flexibilities regarding the importation of animal feed. Greater flexibility was permitted regarding the importation of animal feed products into the EU to help alleviate supply issues facing EU

farmers. This allowed EU Member States to source cheaper feed inputs from alternative markets, with one notable example being Spain importing maize from Argentina[61].

Temporary Crisis Framework (TCF). This covers farmers, fertiliser producers and the fisheries sector. It permitted state aid to be provided to farmers affected by significant increases in input costs up to a maximum of EUR 35 000. The Framework was amended in July 2022 when the amount of aid permitted in the agricultural sector was increased to EUR 75 000. A further amendment was adopted in October 2022 which increased the maximum support to EUR 250 000 in the agricultural sector and extended the implementation period to 31 December 2023. In November 2023 the Framework was extended yet again for a further (and final) six months with another increase in the maximum aid in the agricultural sector to EUR 280 000.

The European Food Security Crisis preparedness and response Mechanism (EFSCM). The EFSCM was created to map out issues in the European food supply chain and to improve cooperation between the public and private sectors. The EFSCM focuses on a range of activities and actions including:

- foresight, risk assessment and monitoring;
- coordination, cooperation and communication;
- developing recommendations to address crises; and,
- coordinating and cooperating with the international community.

4.4.2. National measures

National measures include those taken in the context of options made available at the EU level under the EUR 500 million agricultural sector support package, the TCF and the CAP. This section focuses on the agricultural sector support package and the TCF.

Table 8 shows the support provided to producers in the Member States which together account for 75 % of total EU agricultural output under the ***agricultural sector support package***[62].

[61] https://www.feednavigator.com/Article/2022/07/26/EU-Commission-extends-contingency-measures-for-feed-imports
[62] Details for all Member States are available at https://agriculture.ec.europa.eu/system/files/2023-07/ms-distribution-exceptional-package-500mil_en_0.pdf

Table 8: Exceptional adjustment aid to producers in selected Member States

	EU support (EUR millions)	National top-up (EUR millions)	Sectors	Number of beneficiaries	Activities*
France	89.3	143.2	Livestock	251	a, b, c, d
Germany	59.0	73.5	Fruit and vegetables, hops, wine, poultry meat, pig meat	40 965	d
Italy	47.8	85.2	Pig meat, fruit and vegetables	77.3	d (animal welfare)
Netherlands	7.9	0	Pig meat, poultry meat	2 941	d
Poland	43.9	0	Fruit and vegetables, pig meat	20 441	a, b, c, d
Spain	63.3	126.5	Beef and veal, sheep and goat, poultry meat, rabbit meat, fruit and vegetables (citrus fruit)	116 414	a, b, c, d

Source: European Commission
Note: * (a) circular economy; (b) nutrient management; (c) efficient use of resources; (d) environmental and climate friendly production methods.

A wide range of State Aid measures were introduced by Member States under the ***Temporary Crisis Framework*** and subject to its conditions. These are set out in a Commission press release. A comprehensive overview of the agricultural support measures implemented by the above-mentioned EU Member States is detailed in Annex C to this report (there were no specific measures in the German agricultural sector).

Member States chose to support the agricultural sector in a variety of ways from ***direct grants*** to cover, or partially cover, increases in the costs of specific inputs including feed (EUR 400 million in France for companies in the agricultural and aquaculture sector), fertilisers (EUR 836 million for farmers in Poland) and fuel (EUR 25 million for fishing companies in France); ***loan guarantees*** to support liquidity in the face of price increases (for example, EUR 180 million in Italy for companies in the agricultural, forestry, fishery and aquaculture sectors faced by increases in energy and other costs, EUR 70 million to support SMEs in the greenhouse horticulture in the Netherlands); support to cover ***social security contributions*** (for example, EUR 152.5 million in France for companies in the agriculture, forestry and aquaculture sectors, EUR 34.4 million in Italy for businesses active in the agribusiness (and others) sector if activities had been suspended in early 2022). Finally, some very ***specific measures*** were

introduced including support for corn traders active in the trading or purchasing of corn and for SME pig producers (EUR 53.6 million and EUR 113 million respectively in Poland); support for milk producers in Spain (EUR 169 million); and, organic farmers and lavender producers to reduce dependency on fuel in France (EUR 60 million and EUR 9 million respectively).

4.5. Relevance of the analysed measures for securing inputs and making the EU less dependent on foreign suppliers

According to the EU Better Regulation Guidelines (BRG), the **relevance** of a policy measure should be assessed by looking at the **objectives** of the intervention, and evaluating how well they reflected and, most importantly, they still reflect, the current and future **needs** ("continuing relevance") of the **stakeholders**. The assessment presented here was carried out by following the methodological indications of the BRG. It is based on the findings of the analysis of the relevant policy measures developed in sections 4.1 to 4.4 (with particular regard to the definition of the objectives of those measures), and on inputs from the consultation of key stakeholders in the EU food system (with regard to the definition of their needs and to the identification and characterisation of gaps, shortcomings (if any) and areas for improvement in the assessed measures). The assessment covers a selection of specific measures/groups of similar measures that, in the light of their specific objectives, are more closely related to the overall objective of securing inputs and making the EU less dependent on foreign suppliers. The findings of the assessment are presented in the following sections.

As far as **EU trade policy** is concerned, the Commission's 2021 *Trade Policy Review - An Open, Sustainable and Assertive Trade Policy* (European Commission, 2021b) underlines the need for a new trade policy strategy to support the EU's domestic and external policy objectives against the background of a more sustainable growth model (as defined by the Green Deal and the European Digital Strategy), and to support the EU's open strategic autonomy (OSA)[63]; it also stresses the importance of enhancing the resilience and sustainability of value chains. In line with the above, the Review sets out three core trade policy objectives for the medium-term:

- supporting the recovery and fundamental transformation of the EU economy in line with its green and digital objectives;
- shaping global rules for a more sustainable and fairer globalisation;
- increasing the EU's capacity to pursue its interests and enforce its rights, including autonomously where needed.

The majority of the consulted business stakeholders acknowledged, at least in general terms, the importance of EU trade policy and of free trade agreements between the EU and individual third countries/blocs of third countries for maintaining or improving the security of supply for key inputs used in the EU food system. They also underlined the importance of ***strategic partnerships*** between the EU or individual Member States and specific third countries/blocs of third countries, which may allow a closer focus on securing adequate supply of specific key inputs. Some of the consulted business stakeholders, however, expressed concern about the potential negative implications in terms of supply security for key inputs that can derive from establishing ***more and more demanding requirements for accessing the EU market***[64]: they observed that some of the leading non-EU suppliers for those inputs

[63] This concept stresses the EU's ability to reflect its strategic interests and values while assertively defending its interests, protecting its economy from unfair trade practices and ensuring a level trading playing field.
[64] Some of those stakeholders mentioned the obligations established by Regulation (EU) 2023/1115 on certain commodities and products associated with deforestation and forest degradation, and EU requirements on maximum residue levels for pesticides in agricultural commodities and processed products used as food ingredients and feed materials, as concrete examples in that regard.

may be unable/unwilling to comply with EU requirements, especially if their core export markets are non-EU countries with less demanding requirements.

As for the **European Green Deal (EGD)**, the analysis in section 4.2.1 revealed that some of the objectives of the policies that were elaborated within its framework, and in particular the ***Renewable Energy Directive (RED)***, the ***Emission Trading Scheme (ETS)***, and the ***Carbon Border Adjustment Mechanism (CBAM)***, are relevant to, or at least have implications for, the production in the EU and/or the security of supply for key inputs, with particular regard to ***fertilisers*** (due to the energy-intensive nature of the related production processes). With specific regard to the ***Renewable Energy Directive***, some of the consulted business stakeholders observed that it may constrain/disincentivise EU production of certain renewable energy sources that have a significant potential in terms of:

- use of agricultural biomass (including biomass that would be unsuitable for food or feed use) as feedstock;
- side streams of co-products that can be used as alternative inputs in the EU food system (e.g., as feed materials, fertilisers, etc.);
- inclusion in fully circular agro-industrial systems, where the products and co-products obtained by each component are used as inputs by other components, minimising or eliminating the need for inputs that are external to the system.

The analysis presented in section 4.2.2 revealed that within the framework of the EGD the **Farm to Fork Strategy** (F2F hereinafter) includes a number of aspirational objectives that can have implications in terms of EU production/security of supply for some key inputs used in the EU food system. This concerns more explicitly pesticides and fertilisers (the F2F sets targets for reduced use of pesticides and for reduced nutrient loss by 2030; the latter will lead to a reduction of 20 % in use of fertilisers) and critical feed materials (for which the dependency on imports should be reduced by fostering EU-grown plant proteins, as well as alternative feed materials)[65] but the implications of the F2F in terms of EU production of agricultural products that are used as inputs in the EU food system are equally important.

Several of the consulted stakeholders elaborated rather extensively on the implications of the F2F in terms of supply of key inputs to the EU food system, sometimes focusing on the combined effect of the F2F and the **Biodiversity Strategy**, which supports the F2F in its aim to reduce the use of fertilisers by setting a target that 30 % of land in Europe will be legally protected[66] A reflection shared by several business stakeholders is that whereas a reduced use of fertilisers and pesticides in EU agriculture may make it less dependent on imports of these inputs as such and/or of the raw materials and energy sources used to produce them, a number of impact studies from authoritative institutions and from sectoral organisations[67] suggest that this is likely to result in reduced agricultural production in the EU. This would have negative implications in terms of reduced self-sufficiency/increased import dependency of the EU food system for a wide range of agricultural and agri-food products used as inputs (cereals, oilseeds, fodder crops, fruits and vegetables, meat, raw milk and dairy products, etc.).

Some business stakeholders also observed that the options to offset (at least in part) the likely decline in crop yields due to reduced use of pesticides and fertilisers are seriously limited, in the EU, by the barriers to the use of such technological innovations as genetically modified (GM) crops or genetically improved crops through the use of new genomic techniques. Several stakeholders also observed that

[65] Such as insects, marine feed stocks (e.g., algae) and by-products from the bio-economy (e.g., fish waste).
[66] Of which a third (10% of total EU land) will be strictly protected.
[67] Widely cited references include: Beckman *et al.* (2020); Barreiro Hurle *et al.* (2021); Bremmer *et al.* (2021); Henning and Witzke (2021); COCERAL and UniStock Europe (2021).

the constraints (including those deriving from the Biodiversity Strategy) to a significant increase in the availability of agricultural land in the EU imply that any expansion of a specific crop (e.g., in the F2F framework, of protein crops) mostly occurs at the expense of other crops used as inputs in the EU food system: the resulting decreases in EU production for the latter translate into reduced self-sufficiency/increased import dependency.

As for the **Common Agricultural Policy (CAP)** for the 2023-2027 programming period (discussed in section 4.2.4), and the related implementation at national level (discussed in section 4.3), it is important to recall that whereas promoting the EU's input autonomy for the EU food system as a whole, and for the agricultural sector in particular, is not an explicit objective of the CAP, there are elements of the policy that should work in this direction. In particular, the 2023-2027 CAP establishes - consistently with the aspirational targets of the F2F strategy discussed above - more stringent requirements in terms of climate-friendly farming practices and standards, and incentivises the adoption of low-input practices by farmers: these should translate into a reduced demand for fertilisers, pesticides and energy sources by EU farmers, with potential implications in terms of reduced import dependency. However, as already observed for the F2F strategy, there is a significant risk that these changes in farming techniques could also cause a reduction of agricultural production in the EU. The considerations made by several consulted business stakeholders were hence similar to those reported above for the F2F strategy: there is a rather widespread concern that a "greener" CAP might translate into reduced self-sufficiency/increased import dependency of the EU food system for a wide range of agricultural and agri-food products used as inputs.

Finally, with regard to the main ***EU and national measures*** recently adopted to ***mitigate the impact of increased input costs*** (presented in section 4.4), their closely targeted focus on well-defined objectives should ensure, in theory at least, their capacity to address the specific needs of the stakeholders for which they were designed.

5. RECOMMENDATIONS: APPROPRIATE MEASURES TO INCREASE THE EU FOOD SECTOR'S RESILIENCE TO DISRUPTIONS IN TRADE FLOWS AND PRICE INCREASES OF IMPORTED INPUTS

KEY FINDINGS

- **There are a number of available tools to address instability in the imported inputs' markets, and diversify input sources**, including trade and strategic partnerships, a renewed enlargement agenda and the opportunities offered by Ukraine's production capacities during the transition phase, strategic stockpiling and financial instruments (derivatives) and long-term contracts.
- **Available options to increase domestic production of key inputs** include research, technological development and innovation in EU agriculture, to achieve a more efficient use of natural resources, raw materials and farming inputs, to improve crop productivity without using input-intensive techniques and to fully exploit the potential offered by bio-based, fully circular production processes.
- **Changes in consumption patterns could reduce the EU's food sector's input dependency**, notably through a reduction of animal products in people's diets to reduce third countries' feed imports, as well as consumer preferences for more sustainably produced products.
- **To improve the capacity of the EU food system to cope with structural changes and increased input dependency**, the research team recommends to:
  - Diversify input sources and trade partners (finalisation of new free trade agreements and strategic partnerships, use of Custom tariffs and preferential conditions for imports).
  - Address market instability (analyse the feasibility and relevance of strategic stockpiling and financial instruments to hedge risks linked to price volatility).
  - Avoid disruptions in logistics (keep vital traffic lanes open, promote the completion of some of the EU's Trans-European Transport Network corridors).
  - Reduce input dependency through domestic production, research and innovation (increase domestic production of key inputs, support precision farming).
  - Use the CAP toolbox to increase self-sufficiency and promote risk-management tools (support low-input practices through the CAP's national strategic plans, reduce the need for imported feed materials and expand protein crops, promote a wider uptake and an improvement in the effectiveness of insurance, mutual funds and risk management schemes).
  - Improve transparency and monitoring of the EU's input dependency.

5.1. Available tools to address instability in the imported inputs' markets

Recent reflections by the European Commission (2021a; 2023f) identify the **root causes of instability** in the markets for (imported) key inputs used in the EU food system in the **wide array of risks of different nature** that may affect their availability and trade. Recent research by Bertolozzi-Caredio *et al*. (2023) for JRC provides a comprehensive conceptual framework for the understanding of those risks, which can be classified as follows:

- ***Biophysical and Environmental risks***, which derive from the inherent biological and physical characteristics of the natural environment in which production systems operate. These risks are related to changing climate and weather patterns, natural disasters, extreme weather events, land-related issues, natural resources and biodiversity loss, pollution and nuclear contamination.
- ***Economic and Market*** risks, which are caused by disturbances or disruptions in the market, as well as unfavourable (macro)economic and financial circumstances threatening the economic viability of operators.
- ***Socio-cultural and Demographic risks***, which arise from changes in the structure, culture and behaviours of the society (e.g., risks related to pandemic and human health, or social unrest).
- ***(Geo)Political and institutional risks***, which are related to changes in the political framework: these risks derive from (geo)political instability, conflicts and terrorism, trade barriers and trade flows distortion, and policy changes and regulatory requirements.
- ***Risks related to supply chain performance.*** These risks arise from the incorrect functioning of supply chains, deriving in particular from disruptions in transport, infrastructure or logistics, and from disruptions in upstream supply. As already observed, they are of particular relevance to the study, given the high degree of interdependencies among the different stages of the food supply chain, and the high reliance on foreign suppliers that determines import dependency for some key inputs to the EU food system.
- ***Information and technology risks***, which originate from lack of information and from technical, technological or digital disruptions.

The **availability of tools** to address the risks identified above **varies significantly**. It is essential to bear in mind that some preventive measures and/or risk management solutions can only be applied by institutions and/or operators in the third countries supplying inputs to the EU food system. This implies that the tools available to EU institutions and/or operators are rather few. It is also important to analyse the **actual uptake** of relevant preventive measures and risk management tools **within the EU food system**. The analysis that follows focuses on the sole tools available to EU institutions and/or operators.

Generally speaking, the tools for addressing the risks affecting the exploitation of natural resources and the production of inputs are only available to non-EU entities. The main tools available to EU institutions and operators can deal with the **trade** of those inputs and with **price volatility** in the related markets.

As discussed in section 4.1, **trade policies and free trade agreements** can help in addressing issues stemming from variable availability and/or price of key imported inputs for the EU food system by removing or relaxing barriers to access to the EU market. Indeed, preferential conditions (mainly in the form of zero- or reduced-tariff access to the EU market, which may be limited to specific countries of origin and/or to pre-defined import quantities) are granted for a number of critical raw materials and key inputs for the EU food system (e.g., soya beans, soya bean meal, phosphates, potash, iron ore,

copper ore and concentrates, etc.). These tools are available to, and managed by, the European Commission. They can have both a preventive and a corrective action (in the latter case, they usually take the form of temporary tariff reductions or exemptions and/or opening of emergency import quotas at preferential conditions).

Strategic partnerships between the EU and/or individual Member States and specific non-EU countries/blocs of countries supplying key inputs to the EU food system have gained importance as a way to ensure a more stable supply of those inputs. These tools are available to the relevant EU and national institutions, but can also be established between EU and non-EU operators, individually or in aggregated form. They mainly have a preventive action, and can contribute to address several of the risks identified above, with particular regard to the geopolitical and economic ones. Noteworthy examples of concrete application are the strategic partnerships and policy dialogues that the EU established with a number of non-EU countries[68] to secure access to raw materials. These initiatives have been developed in the framework of the so-called raw materials diplomacy, which since 2011 is an important component in the implementation of the EU *Raw Materials Strategy*[69].

Strategic stockpiling is aimed at addressing temporary shortages of critical inputs. It has historically been an important component of the US policy, aimed at preventing shortages of energy products and critical raw materials, and at responding to emergency and crisis situations (Siripurapu and Berman, 2023; Berman, 2023). The *Strategic Petroleum Reserve*[70], worth hundreds of millions of barrels of crude oil, is the most widely known component of the US strategic stockpiling system, but the US government also maintains strategic stocks of, among others, diesel fuel, rare earths, lithium, and metals. It also maintains a vault that houses thousands of plant species and genetic material of livestock in the event of a disaster. Strategic stocks for critical raw materials and inputs have also been established (Bourgery-Gonse, 2023; Burton *et al*., 2023; IRIS-OFSME, 2023; Rietveld *et al.*, 2022) by - among others - China, Japan, South Korea, Switzerland and some EU Member States, as well as, during the COVID-19 pandemic, by 42 % of the operators surveyed for a JRC study (Di Marcantonio *et al.*, 2022).

In contrast, no EU-level initiative in this regard has been taken so far, including in the framework of the European Commission's proposal for a Regulation on critical raw materials (March 2023)[71]. There is an ongoing debate on whether EU-level initiatives to establish strategic stocks of critical raw materials and inputs should be taken. A study by Rietveld *et al*. (2022) for the European Parliament concludes that "stockpiling action in the EU would mitigate supply shocks for nascent and strong manufacturing industries which are vital for the green and digital transition", albeit observing that "if stockpiling is encouraged by public policy, the question of its effective public-private management arises".

A recent study by IRIS-OSFME (2023) provides a comprehensive international overview of strategic stockpiling for critical metals and suggests that increasingly widespread use of raw materials as a diplomatic and strategic weapon in the current geopolitical context should lead governments to reconsider the question of building strategic stocks. However, the study also observes that strategic stockpiling is not free from risks and drawbacks, including inflation of prices of raw materials on international markets, increased price volatility, market distortions and substantial maintenance costs

[68] Including Argentina, Canada, Chile, the Democratic Republic of the Congo, Greenland, Kazakhstan, Namibia, Ukraine and Zambia. The EU also has additional relations in this regard with, Brazil, China, Colombia, Japan, Mexico, Peru, the United States, Uruguay, the EUROMED countries and the African Union. Details on individual initiatives are available at https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/raw-materials-diplomacy_en

[69] *Tackling the challenges in commodity markets and on raw materials*. COM(2011) 25 final.

[70] For a comprehensive overview on the Strategic Petroleum Reserve, see US Congressional Research Service (2020).

[71] Which anyway foresees critical raw materials supply chain monitoring and stress-testing, coordination of strategic stockpiling by Member States, and a risk preparedness obligation on large companies producing strategic technologies.

for governments: these potential shortcomings were also underlined by the Commission services consulted for this study.

Hedging of price risks through the use of the so-called market derivatives, i.e., futures and options, is a technique used by operators to limit or offset the probability of losses from fluctuations in raw material and input prices and, therefore, provides a theoretically sound risk management method for farmers, processors, traders/wholesalers and their customers (Ecorys and Wageningen Economic Research, 2017).

Futures are standardised contracts, usually traded in exchanges, in which the buyer agrees to take delivery, from the seller, of a specific quantity of a certain product at a predetermined price on a future delivery date. Futures exchanges are organised marketplaces that: i) provide and operate facilities for trading; ii) establish, monitor and enforce rules for trading; and, iii) keep and disseminate trading data. Hedging through futures and options allows operators to lock in a specific price or establish minimum/maximum prices for upcoming purchases or sales of the commodities for which futures and options are available.

Futures and options are available for a wide range of commodities, including energy products (crude oil, natural gas, coal), raw materials (e.g., ores), farming inputs (e.g., fertilisers), and a range of agricultural commodities (cereals, oilseeds, sugar, cocoa, coffee, dairy products, etc.). There are important conditions attached to a well-functioning futures market, such as ensuring participants' trust through the convergence of spot and futures prices, which in turn allows sufficient participation and liquidity (Penone *et al*., 2022). Given these conditions, in practice, failure of futures markets is not uncommon.

The European Commission's Agricultural Markets Task Force notes that futures markets for several imported commodities in the EU have not reached full maturity. This is due to lack of liquidity and other constraints such as barriers for smaller operators to engage due to high transaction costs and the need to have large transaction volumes (Agricultural Markets Task Force, 2019). Ecorys and Wageningen Economic Research (2017) also observe that the application of price hedging techniques requires rather advanced know-how, and that this is a major limitation to their application in the farming stage of supply chains.

The availability of data on the uptake of input price hedging techniques based on futures and options in the EU food system is extremely scarce. Ecorys and Wageningen Economic Research (2017) report that the use of such techniques by EU farmers was limited and mostly concerned sales of agricultural products. The use of these techniques in input purchases (mainly feed) was even more limited (less than 5 % of surveyed farmers in France, where the highest uptake was recorded). Information in annual reports to shareholders of EU-based agrifood companies suggests that the use of these techniques is relatively common among EU processors purchasing commodities for which futures and options are widely traded in EU and/or international exchanges (wheat, maize, soya beans, rapeseed, sugar, cocoa, coffee, milk powder). A study by Areté and IHS Markit (2022) for DG AGRI reveals that EU-based sugar refiners extensively apply these techniques to manage price risks in the sourcing of their most critical raw material, i.e., raw cane sugar, which is mostly imported from non-EU countries.

Annual and multi-annual fixed-price supply contracts are another available solution to address market instability in input prices. These contracts are used along the agri-food supply chain to reduce uncertainty and establish a longer-term basis for standard repeated transactions. When correctly applied, these provide important benefits, including lower transaction costs, improved planning, reducing market volatility, and creating stable relationships. These contracts can take many forms, but

in their optimal expression they may be seen as providing a "flexible vertical integration that preserves the independence of the parties" (Agricultural Markets Task Force, 2016).

These arrangements generally fall under contract law, which is not an EU competence, but is regulated under national rules. Evidence in Ecorys and Wageningen Economic Research (2017) and Areté and IHS Markit (2022) suggests that these contracts tend to be adopted where the lack of futures markets does not allow the application of price hedging techniques and/or where operators are unable or reluctant to apply them. The main advantage of these contracts is straightforward, i.e., price stability; the main drawback is that they limit the possibility for purchasers to reap the benefits brought by declining input prices, especially when most/all of their supply needs are covered through these contracts.

5.2. Available options to diversify input sources and trade flows and increase domestic production of key inputs

5.2.1. Available options to diversify input sources and trade flows

The finalisation of **new free trade agreements** and **strategic partnerships** with third countries/blocs of third countries that are significant producers and exporters of raw materials and key inputs to the EU food system (see section 4.1) is by far the most important option available to EU and national policymakers to diversify input sources and trade flows. However, the consultation of sectoral stakeholders revealed a significant challenge to address. The demanding requirements that non-EU operators often have to meet to access the EU market may entail significant adjustments and compliance costs for them. These costs may reduce or eliminate the economic incentive for those operators to supply the EU market, in particular where the extent of the price premium on the EU market vis-à-vis other destination markets is not sufficient to ensure an attractive margin over compliance costs. Further to that, from the consultation of the Commission services it emerged that the complex structure of free trade agreements, and the careful balance that needs to be reached to ensure mutual benefits to both parties (i.e., the key incentive to the finalisation of a free trade agreement) and to protect sensitive products and sectors, may suggest to focus on strategic partnerships as a more straightforward and targeted solution to find alternative suppliers of raw materials and key inputs for the EU food system.

The **accession of new countries to the EU** in the framework of the enlargement process can also provide important opportunities in this regard. In particular, the opening of accession negotiations with **Ukraine**, decided by the European Council on 14 December 2023, marks the start of a process that could bring inside the Union an important producer and exporter of raw materials[72], agricultural commodities and inputs (notably protein crops, which would reduce the dependency of the EU on a limited number of exporters).

5.2.2. Available options to increase domestic production of key inputs

In a recent communication that accompanies its proposal for a Regulation on **critical raw materials** (March 2023), the European Commission (2023g) underlines that "the **EU should make the most of its reserves** and **develop exploration, extraction, refining, processing and recycling activities** at home", in full respect of its environmental ecosystems and of its high social standards. The communication underlines the critical role that would be played in that regard by **research and innovation**. However, the communication also acknowledges that the EU "will never be self-sufficient"

[72] Even though an important share of the country's deposits of raw materials (ores, coal, etc.) is concentrated in the Donbass region, which is currently controlled for the most part by the Russian forces of invasion.

in the supply of critical raw materials, and will continue to rely on imports for a majority of its consumption, which reinforces the importance of establishing strategic partnerships with resource-rich countries, also through innovative approaches (e.g., the formation of a *Critical Raw Materials Club* bringing together consuming and resource-rich countries to promote the secure and sustainable supply of such materials).

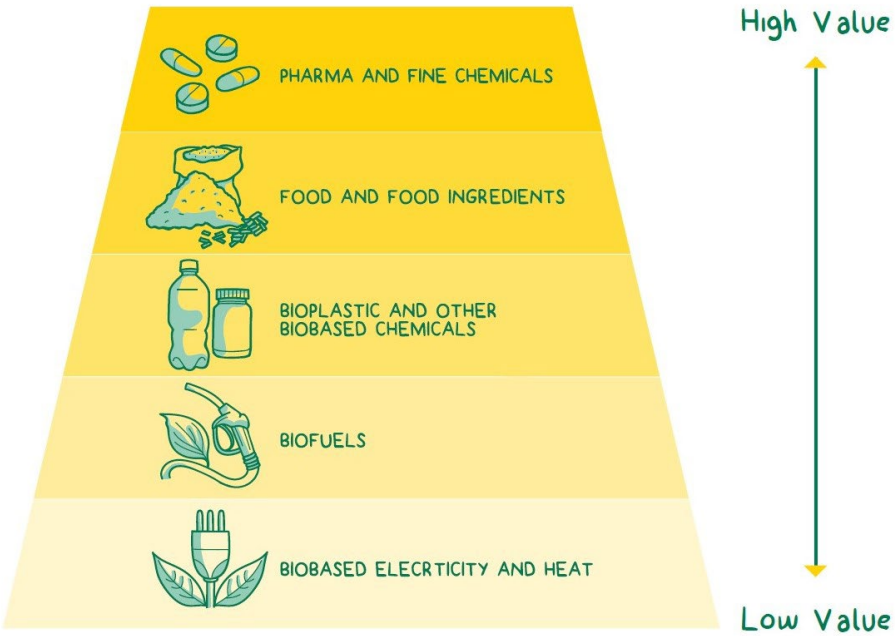
As for **increasing EU production of agricultural products** that are **used as inputs** within the sector (mainly in animal farming) and in the downstream stages of the EU food system, with a view to addressing the most serious cases of import dependency identified in section 3, a recent analysis by the European Commission (2023f) identifies a number of relevant solutions and – similar to what previously stressed for raw materials – underlines the **critical role of research and development and of innovation** as key enablers for their implementation. These solutions include:

- Promoting increases in production within the constraints posed by limited availability of agricultural land and agroclimatic conditions, to be pursued through **improvements in crop productivity**[73] not deriving from the application of more input-intensive techniques[74]. The document underlines the great potential that **new genomic techniques (NGTs)** present in this regard, which is mainly related to the possibility of developing genetically improved crop varieties that are better adapted to the agronomic and climate conditions that can be found across the EU, and/or that can better cope with climate change, extreme weather conditions (heat, drought, etc.), and new pests. A study on NGTs by the European Commission (2021c) demonstrated that NGT plant applications cover a broader range of plants (e.g., vegetables, tubers, fruits and legumes) with respect to other (transgenic) Genetically Modified Organisms (GMOs). It identified examples of NGT plants with traits that could contribute to various aspects related to food security (e.g., yield increase, reduced input use, and stress tolerance). On this basis, the European Commission adopted, in July 2023, a proposal for a Regulation on plants produced by certain new genomic techniques, aimed at: i) maintaining a high level of protection of health and the environment; ii) steering developments towards the contribution to sustainability goals in a wide range of plant species, especially for the agri-food system; and, iii) creating an enabling environment for research and innovation, especially for SMEs.
- Promoting **increased supply and use of alternative and innovative inputs** in crop farming, animal farming, feed and food production, exploiting the remarkable opportunities offered by the development of **bio-based products**[75] and **circular production processes**[76]. A noteworthy initiative in this regard is the ***Circular Bio-based Europe Joint Undertaking*** (CBE-JU), a partnership between the European Union and the Bio-based Industries Consortium (BIC) that funds projects advancing competitive circular bio-based industries under ***Horizon Europe*** (the EU's research and innovation programme), in order to achieve the following objectives: i) accelerating the innovation process and development of bio-based innovative solutions; ii) accelerating market deployment of the existing mature and innovative bio-based solutions; iii) ensuring a high level of environmental performance of bio-based industrial systems.

[73] Some of the consulted stakeholders observed that there is a significant potential for productivity increases also in the EU animal farming sector, to be pursued through genetic improvement, optimisation of diets, switch to more productive races, etc.
[74] Some of the consulted stakeholders observed that improvements in nutrient efficiency, to be pursued through optimised fertilisation (e.g., as a result of more widespread application of precision farming techniques), will play an important role in this regard.
[75] Bio-based products are derived from biological resources (urban bio-waste, organic residues or wastes from primary production and industrial processes, dedicated crops, etc.) and cover a variety of sectors and uses, such as textiles, home and personal care, furniture and construction, chemicals, plastics, fertilisers, etc. For additional information, see the European Commission dedicated web portal.
[76] The current "take-make-use-dispose" linear economy continually increases its demands of scarce natural resources. In a circular economy, the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimised. For additional information, see the European Commission dedicated web portal.

Given the already underlined constraints in terms of availability of agricultural land in the EU, the most interesting bio-based processes for the EU food system seem to be those that **exploit side streams and residues that are unsuitable for food and feed use**, and that apply the principle of **cascading use of biomass**, according to "**value pyramid**" concept (Essel and Carus, 2014; Areté, 2019; Stegmann *et al.*, 2020). The cascading principle involves obtaining the most valuable products in the first stages of biomass processing, and lower-value products only in successive stages; only the residues from biomass processing into bio-based products are finally used to generate energy (Figure 3). The economic value of biomass is given by the value added that it can generate[77]: biomaterials (e.g., polymers) are in general the bio-based products with the highest value added, followed by bio-chemicals (e.g., flavours, proteins, fine chemicals), biofuels (e.g., bioethanol, biodiesel, biogas) and bio-energy (e.g., use of wood pellets for direct combustion in combined heat and power generation). Generally speaking, products with a relatively high market value are often associated with high production costs, and *vice versa*; products with a high market value also tend to have a relatively small market (e.g., specialty chemicals), and *vice versa* (e.g., biofuels), hence the "value pyramid" concept (higher value products with smaller markets towards the narrower top of the pyramid, lower value products with larger markets towards the wider bottom of the pyramid). It is also important to consider that **increased EU production of renewable energy** would play an important role in reducing EU import dependency for fossil energy sources (natural gas and crude oil in particular), with positive implications for EU production of energy-intensive farming inputs, such as mineral fertilisers (Guidehouse, 2023).

Figure 3: Cascading use of biomass and the "value pyramid" concept



Source: adapted from Areté (2019); originally featured in Lange, L., & Lindedam, J. (2016). *The Fundamentals Of Bioeconomy - The Biobased Society*. United Federation of Danish Workers 3F.

With regard to an **economically viable implementation of the solutions** identified above, the research team – also based on insights provided by the consulted business stakeholders - recommends

[77] Intended as the difference between the revenue from the various products marketed and the production costs (sum of capital costs and operational costs) of those products.

not to overlook the **significant challenges** that may be posed by the **high EU standards** in terms of human rights, working conditions, environment conservation, food safety, preservation of landscape and cultural heritage, which are rightly valued by EU citizens. Meeting those standards may actually entail significant **additional costs**, which might **reduce or eliminate the economic incentive** for EU operators to adopt the aforementioned solutions instead of relying on imported raw materials and inputs. Furthermore, the **acceptance of innovative solutions** by national governments, the general public and consumers should not be taken for granted, as demonstrated by the significant concern that still surrounds the use of genetically modified organisms (GMOs) in the EU food system[78] and, more recently, the debate on the so-called "cultivated meat" (i.e., cell culture-derived food)[79].

5.3. How could a general change in food consumption patterns reduce the EU food system's input dependency?

As established in section 3, the two key imported input dependencies are soya bean/soya bean meal for livestock feed and fertilisers/fertiliser raw materials. The role of changes in food consumption patterns in relation to these two key inputs is considered below.

5.3.1. Reducing the consumption of livestock products to reduce demand for soya bean/soya bean meal

Román (2023) sets out the measures in place which may help to reduce the consumption of livestock products. These include promoting healthier nutrition through the Europe's beating cancer plan and the Farm to Fork Strategy. The latter specifically plans to review legislation on food information for consumers to include nutritional, climate, environmental and social aspects of food products.

In its EU agricultural outlook 2023-2035, European Commission (2023e) expects these initiatives to play a role in decreasing the consumption of beef, pig meat and dairy products by 5.0 %, 2.1 % and 7.2 % respectively between 2023 and 2035. However, poultry meat consumption is expected to increase by 2.1 % and eggs by 3.3 % over the same period.

As alluded to above, European Commission (2023e) anticipates shifts in the protein composition of the average EU diet away from beef and pig meat and towards poultry. While protein derived from livestock products is expected to remain around 60 % of total protein consumption, beef is expected to account for 8 % of total protein intake by 2035, down from 10 % in the 2021-2023 period; pig meat is expected to account for 16 % (down from 19 %). Poultry is expected to account for 16 % (compared to 14 %) and dairy products for 37 % (compared to 34 %). In aggregate, per capita consumption of meat is expected to decline by 1.6 kg (approximately 1 %) between 2023 and 2035.

In this context, it should be noted that while pig meat requires the highest amount of soya bean per kg of edible product, chicken has the second highest requirement, ahead of beef (Karlsson, et. al, 2020). It is not possible to quantify the net impact of the expected changes above in terms of their aggregate impact on demand for imported soya beans as livestock feed.[80] However, it can be noted that the

[78] A survey carried out in 2019 by Eurobarometer for the European Food Safety Authority (EFSA) revealed that "genetically modified ingredients in food or drinks" represented the main cause of concern in terms of food safety for 27% of the respondents at EU-28 level, with such prevalence rising above 40% in Bulgaria, Greece, Latvia and Lithuania.

[79] In May 2023 the European Food Safety Authority (EFSA) reported that the times were mature for the scientific evaluation of the safety of cell culture-derived food. However, the limited empirical research carried out in the EU (e.g., a 2023 study on the perception of cultured "meat" by Italian, Portuguese and Spanish consumers) suggests that the degree of consumer acceptance for these products is still unclear, and the Italian government has recently (December 2023) approved national legislation prohibiting the production and marketing of food and feed obtained from cell cultures.

[80] Some of the consulted stakeholders observed that the possible downsizing of the EU livestock sector as a consequence of reduced consumption of its products would result in reduced availability of manure, with potentially negative implications in terms of reducing EU import dependency for fertilisers and for some key raw materials and energy sources needed for their production.

expected reduction in consumption of pig meat in favour of poultry meat will reduce overall demand for imported soya beans, whereas the shift away from beef in favour of poultry meat will increase it.

Against this background, European Commission (2023e) expects the EU to remain a net importer of oilseeds and protein crops to 2035. However, net imports of oilseeds are expected to decline over this period from an average of 22.0 million tonnes in the 2021-2023 period to 18.3 million tonnes by 2035. This decrease is expected to be driven by lower domestic demand, as well as increased domestic production. It should though be noted that the base period represents a peak in imports and that net imports in 2035 are in fact expected to be similar to levels seen in the 2013-2017 period. Specific data for soya beans are not broken out, but Graph 2.9 (p 28) suggests that while net imports will retreat from the 2021-2023 peak, they will in fact be comparable to the level of imports seen previously.

Karlsson *et al.* (2020) concluded that a human dietary reduction of between 18 % and 25 % in livestock protein consumption would be necessary to completely eliminate the EU's requirement for imported soya bean as livestock feed. Even if this loss in protein was replaced directly with soya products, only between 17 % and 22 % of current soya bean imports would be required to make up this shortfall; domestically produced plant protein could also contribute in such a scenario. Earlier work by Westhoek *et al.* (2014) suggested that halving consumption of meat, dairy products and eggs in the EU would result in a reduction in soya bean demand of 75 %. Debaeke *et al.* (2022) found that due to expected climate change increasing the ability of the EU to grow soya bean and following existing dietary trends, the EU dependency ratio for imported soya bean could reduce to 46 % (down from 84 % in 2022/2023, in volume) and, with a shift to healthier diets incorporating less livestock protein, to 38 %. The Commission's review of EU protein policy due in early 2024 could also result in measures which might increase domestic production of plant protein (see section 4.2.3).

Although it is highly unlikely that EU consumers will stop eating livestock protein, Román (2023) explains that consumer preferences are moving towards a more plant-based diet as awareness of the environmental impact of the EU agri-food system increases. Health considerations are also a factor as awareness of the link between high levels of meat consumption (especially red and processed meat) and the risk of developing certain diseases also becomes more widely known.

These concerns have led to an increase in the proportion of EU consumers that follow diets which involve lower consumption of livestock products, whether this is vegetarian, vegan or 'flexitarian', which involves a preference for plant-based products, while not entirely precluding livestock products. In 2021, some 30 % of consumers across nine Member States said they were flexitarian with a further 7 % claiming to be vegetarian or vegan (https://smartproteinproject.eu/plant-based-food-sector-report/ cited in European Commission, 2023e).

There are regional differences in consumer attitudes. Boer and Aiking (2022) found that consumers in the Northwest linked reducing meat consumption more to environmental than health concerns whereas the opposite was found in the East and South. Boer and Aiking also found that a large minority of consumers in Northwest Europe saw meat reduction as part of a healthy and sustainable diet, but that this view was much less common in the East and South. For policy makers it is therefore crucial that both nutrition and environment can be motivating factors for consumers to consider meat reduction, albeit to different degrees.

European Commission (2023e) explains that EU consumers have increased their consumption of plant-based products substantially since 2011 while consumption of processed meat and cow's milk has decreased. However, the increase in the consumption of plant-based products is from a very low base, and the decrease in consumption of livestock products is very marginal. While these trends are expected to continue, in line with the analysis above, **animal protein is expected to remain the**

dominant source of protein consumed in the EU. It is clear that to substantially impact the demand for imported soya bean/soya bean meal, further encouragement will be needed.

5.3.2. Increasing consumption of sustainably produced products to reduce demand for fertiliser

The EU's key approach to reduce demand for fertiliser, albeit primarily for environmental reasons rather than reduced import dependency, is the Farm to Fork Strategy (see section 4.2.2). The principal mechanism is the target to reduce nutrient losses by 50 % by 2030, which is expected to reduce fertiliser use by 20 % (this is not a target in and of itself). This section will focus on the various measures which could help to facilitate this by increasing consumer demand for, and supply of, sustainably produced food products. The assumption is that these products will require lower applications of fertiliser.

One of the flagship initiatives of the Farm to Fork Strategy is the proposal for a legislative framework for sustainable food systems (SFS) which will be adopted by the Commission following a consultation and impact assessment[81]. The goal of this strategy is to accelerate and make the transition to sustainable food systems easier. It will also have as its core objective the promotion of policy coherence at EU level and national level, mainstream sustainability in all food-related policies and strengthen the resilience of food systems. The proposal was originally scheduled for the third quarter of 2023 but has now been removed from the Commission agenda and instead of the SFS, the Commission is now pushing for a strategic dialogue on the future of agriculture (launched in January 2024). This new framework for sustainable food systems will therefore not be presented during the present legislature.

The Farm to Fork Strategy also included a revision of Regulation (EU) No 1169/2011 on the provision of food information to consumers to ensure that labelling allows consumers to make healthier and more sustainable food choices and tackle food waste. The Strategy also announced a proposal for a sustainability labelling framework to help consumers make informed and sustainable food purchases.

The Commission will also determine the best way of setting minimum mandatory criteria for sustainable food procurement with the intention of improving the availability and price of sustainable food and to promote healthy and sustainable diets in institutional catering. Helping cities, regions and public authorities to source sustainable food for schools, hospitals and public institutions will also boost sustainable farming systems. At the same time the Commission will review the EU school scheme[82] to enhance its contribution to sustainable food consumption and to strengthen educational messages on the importance of healthy nutrition, sustainable food production and reducing food waste.

In line with Amighini *et al*. (2023), tackling food waste is also relevant in the context of increasing the overall sustainability of food consumed by reducing raw material demand. The Commission intends to build on previous work in this area by halving per capita food waste at retail and consumer levels by 2030 through legally binding targets. Other initiatives will assist, for example, a revision of EU rules on date marking ('use by' and 'best before' dates).

The proposed 'green claims' Directive[83] is not part of the Farm to Fork Strategy or the Green Deal, although it refers to both. The proposal has the objectives to: (i) make green claims reliable, comparable and verifiable across the EU; (ii) protect consumers from greenwashing; (iii) contribute to creating a

[81] https://food.ec.europa.eu/system/files/2022-02/f2f_legis_iia_fsfs_5902055.pdf
[82] https://agriculture.ec.europa.eu/common-agricultural-policy/market-measures/school-fruit-vegetables-and-milk-scheme_en
[83] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023PC0166

circular and green EU economy by enabling consumers to make informed purchasing decisions; and, (iv) help establish a level playing field when it comes to environmental performance of products.

Other specific initiatives include, for example, the Action Plan on Organic Farming which is designed to stimulate both supply and demand for organic products and will aim to boost consumer trust and demand through promotion campaigns and green public procurement. The Action Plan builds on the 2014-2020 action plan and consists of three inter-related axes, supported by 23 actions, some of which continue successful previous actions, as well as putting forward an array of new actions and mobilising different sources of funding. The Action Plan will also be supported through the 2023-27 CAP (see section 4.2.4) in the form of continued financial support through rural development commitments, as well as new support through eco-schemes, technical assistance, the exchange of best practices and innovations and knowledge exchange through the Agricultural Knowledge and Innovation Systems (AKIS). Finally, at least 30 % of the budget for research and innovation actions in the fields of agriculture, forestry and rural areas will be dedicated to topics specific to or relevant for the organic sector. This includes a focus on issues such as increased yields, genetic biodiversity and alternatives to contentious products.

Although it is not possible to quantify the impact of these initiatives on reducing the use of fertiliser, taken together, they will provide consumers with better information to make informed choices in favour of more sustainable food consumption. This, in conjunction with the other measures set out above will **drive demand for more sustainable food production**. A key consequence of this will be to support the Farm to Fork Strategy's intention to **reduce the use of fertilisers**. This in turn will **reduce the EU's reliance on imported fertilisers and fertiliser raw materials**.

5.4. Recommendations for improving the capacity of the EU food system to cope with structural changes and manage the transition towards an increased input dependency, and for reducing the dependency of EU agriculture on imported inputs

Recent studies (Bertolozzi-Caredio *et al*., 2023; European Commission, 2023f) demonstrated that multiple drivers determine EU food security, and that a complex interaction of internal and external factors determines the risks and vulnerabilities of the EU food system. This suggests the importance of a **holistic view** in the elaboration of recommendations for improving the capacity of the EU food system to cope with structural changes and manage the transition towards an increased input dependency.

To tackle the multiple challenges determined by global shocks like the COVID-19 pandemic and the Russian invasion of Ukraine, the Commission has resolved to embed **Strategic foresight** into its work and endorsed the concept of **Open Strategic Autonomy (OSA)** as an interpretive key to address those risks. For the EU, OSA means cooperating multilaterally wherever possible, and acting autonomously wherever needed. The OSA concept has been embraced by the **Spanish Presidency of the European Union** in 2023, and is developed in the blueprint *Resilient EU2030* (Spain's National Office of Foresight and Strategy, 2023). It has also been embraced by the **Belgian Presidency of the European Union** in its programme *Protect, Strengthen, Prepare*.

Taking into account the policy framework outlined above, and moving from a critical review of the findings of the analyses developed in the previous sections, and of insights and suggestions by the consulted stakeholders, the research team has elaborated a number of **recommendations** for improving the capacity of the EU food system to cope with structural changes and manage the transition towards an increased input dependency, and for reducing the dependency of EU agriculture on imported inputs.

Figure 4 provides a graphical overview of the recommendations, which are presented in detail in the following sections.

Figure 4: Overview of the recommendations

Source: project team

• Diversify input sources and trade partners

- The EU should strive for the **finalisation of new free trade agreements and strategic partnerships**, which are the most effective solutions to strengthen the security of supply for raw materials and key inputs whose production would be impossible or economically unviable in the EU, or for which the achievement of self-sufficiency through increased domestic production does not seem a realistic proposition. This is one of the priorities of the Belgian Presidency[84], which intends to secure access to critical raw materials and innovative technologies, which are crucial for our open strategic autonomy.

- **Custom tariffs and preferential conditions**[85] for imports can contribute to an improved input autonomy of the EU food system.

- **Trade agreements with Ukraine (and possibly Moldova) should favour products where the EU has an input dependency (e.g., protein crops)**. With this end in view, the Belgian presidency intends to deal with the impacts of Russia's war of aggression against Ukraine by striving for better connectivity of Ukraine and Moldova with the EU.

- EU and national policymakers should reflect on the **opportunity for the EU to assume a more proactive role** in terms of elaborating and implementing a **multi-faceted international cooperation strategy** capable of contributing to improve the EU food system's capacity to cope with structural changes and manage the transition towards an increased input dependency.

• Address market instability

- **Analyse the relevance and feasibility of strategic stockpiling**: while no EU-level initiative in this regard has been taken so far, including in the framework of the European Commission's proposal for a Regulation on critical raw materials (March 2023)[86], there is an ongoing debate on whether EU-level initiatives to establish strategic stocks of critical raw materials and inputs should be taken.

- **Support the possibility to hedge risks** linked to price volatility through derivatives (futures and options) and fixed-price supply contracts.

• Avoid disruptions in logistics

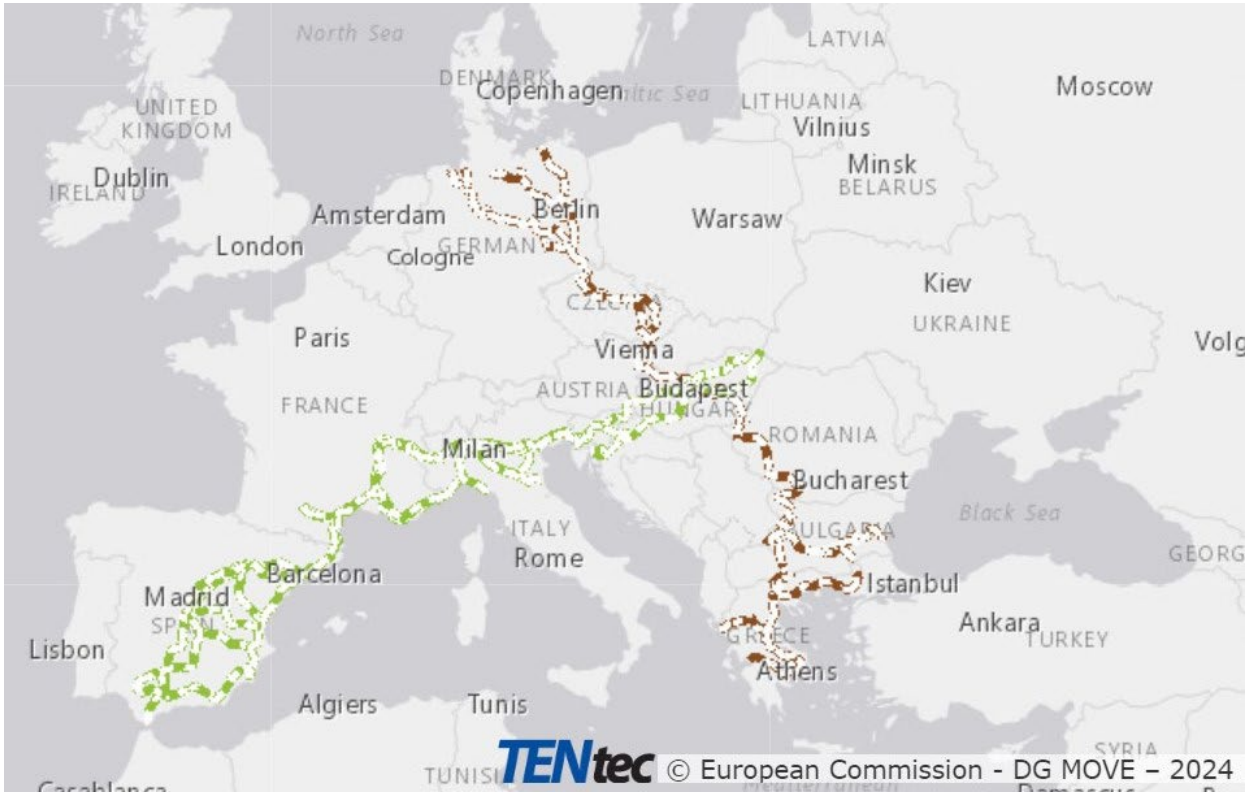
- Given the important influence of logistical aspects as compounding factors of high import dependency, the research team considers highly advisable **the support of EU institutions to all the international initiatives aimed at keeping vital traffic lanes open**, also in times of crisis, and at ensuring their smooth functioning. The Black Sea Grain Initiative, promoted by the United Nations, is a noteworthy example in this regard and played a critical role in ensuring the supply of cereals and oilseeds from Ukraine via maritime transportation also to a number of EU Member States (UNCTAD, 2022 and 2023); EU-Ukraine Solidarity Lanes, promoted by the European Commission, are an equally notable example in this regard.

- Always with regard to addressing the compounding effect on import dependency stemming from disruptions in the logistic system, the research team finds that the **completion of some of the** EU's **Trans-European** Transport **Network** (TEN-T) corridors should be seen as a priority by EU and national

[84] More specifically, the Belgian presidency intends to actively support further initiatives and negotiations aimed at enhancing trade relations with transatlantic partners, the Indo-Pacific region, Africa, and Latin America.
[85] often negotiated in the framework of bilateral trade agreements. It should be considered that in some cases the economic advantage of foreign suppliers of inputs may actually derive from trade-distorting subsidies, and/or from production conditions that are not in line with the values and strategic priorities of the EU, in terms of, e.g., environmental and/or social sustainability, respect of fundamental rights, etc.
[86] Which anyway foresees critical raw materials supply chain monitoring and stress-testing, coordination of strategic stockpiling by Member States, and a risk preparedness obligation on large companies producing strategic technologies.

policymakers (it is worth underlining that this view is consistent with the priorities of the Belgian presidency on the matter). In fact, the completion would ensure seamless and high-capacity surface connections with non-EU countries that are important suppliers of inputs to the EU food system, like Ukraine and Turkey. The **Mediterranean Corridor**, linking the south-western Mediterranean region of Spain with the Ukrainian border of Hungary, through the coastlines of Spain and France and across Northern Italy, Slovenia and Croatia, and the **Orient/East-Med Corridor**, connecting large parts of Central Europe and the Balkans with – among others – the Turkish transportation system, are corridors of critical importance in this regard (Figure 5).

Figure 5: Map of the Mediterranean and Orient/East-Med TEN-T Corridors*



Source: adapted from the European Commission – DG MOVE TEN-T Interactive Map Viewer
Note: * **Mediterranean Corridor** in **green**; **Orient/East-Med Corridor** in **brown**

China's Belt and Road Initiative constitutes a noteworthy example of multi-faceted international cooperation strategy focusing - among others - on infrastructural projects ensuring physical connectivity between the Chinese economic system and the economic systems of the other countries of interest. The **infrastructural component of the initiative** has regained **critical importance in the geopolitical context determined by the Russian invasion of Ukraine**. In particular, China and other countries involved in the Belt and Road initiative (especially Kazakhstan, Azerbaijan and Turkey) are promoting the development of surface transportation gateways that can provide an alternative route towards Europe, bypassing the Russian transportation system (and the Trans-Siberian railway in particular)[87]. The so-called "*Middle Corridor*", linking China and Eastern Asia with Turkey and Europe

[87] In this context, it is also important to consider that the Russian Federation is striving to complete transportation gateways that can provide alternative connections to international markets that can completely bypass the Black Sea, the Mediterranean Sea and Suez Canal. The "*International North-South Transport Corridor*", which Russia is trying to complete with the cooperation of Azerbaijan and Iran, would link the Russian transportation system with the Persian Gulf ports of Bandar Abbas and Chabahar, allowing access to the Indian Ocean (Avdaliani, 2023).

through the Central Asian steppe, the Caspian Sea, and the Caucasus mountains, is one of the key infrastructural projects awaiting completion in the framework of the initiative (Chang, 2023).

- **Reduce input dependency through domestic production, research and innovation**

Along the lines of the analysis of the drivers of EU food security developed by the European Commission (2023f), the research team has identified **domestic production of inputs, research, technological development and innovation as key factors to reduce the EU's input dependency**. In this regard, it would be advisable to:

- Increase domestic production of key inputs through:

i) the development of exploration, extraction, refining, processing and recycling activities in the EU;

ii) the improvement of crop productivity, including through the use of new genomic techniques (NGTs),

iii) promotion of increased supply and use of alternative and innovative inputs, and exploitation of the opportunities offered by the development of bio-based products and fully circular processes, in the framework of the Green Transition.

- **Support a more efficient use of natural resources, raw materials and farming inputs**, **including through the adoption of precision farming**. In this regard, it is however worth observing that a more widespread adoption of advanced production techniques relying on foreign technology and imported components (this is especially the case of solutions based on information and communication technologies, computers and other electronic devices) is likely to aggravate the already remarkable import dependency of the EU food system for this category of key inputs (see section 3.1).

- **Use the CAP toolbox to increase self-sufficiency and promote risk-management tools**

To that purpose, it would be advisable to:

- Monitor and adapt the Member States' CAP strategic plans to **support low-input practices and nutrient management (in line with the Farm to Fork strategy) while preserving the EU's production capacities and food security.**

- In the case of animal products, promote a **reduction in the need for feed materials**, with positive effects in terms of addressing import dependency for specific ones (soya beans and soya bean meal in particular).

- **"Free" agricultural land for an expanded cultivation of protein crops** (including soya beans). The availability of arable land in the EU cannot be increased significantly, so the expansion of protein crops would have to occur for the most part at the expense of other crops. The EU has ample self-sufficiency for soft wheat[88], which translates into substantial exports: it could hence be considered[89] to use the CAP to promote the partial substitution of soft wheat with protein crops, without endangering the EU self-sufficiency for soft wheat. A reduction of the production of animal products with the highest self-

[88] According to EFSCM (2023), average EU self-sufficiency ratios (referred to the 2020-2022 period) reached 130% for soft wheat, 112% for apples, 112% for poultry meat, 124% for pig meat, 111% for butter, 112% for cheese, and 207% for skimmed milk powder.
[89] A scientifically robust assessment of the net economic and environmental benefits (if any) that might derive from such a rearrangement would be advisable in order to make an informed policy decision in that regard.

sufficiency ratios (e.g., pig meat) would also decrease the need for feed proteins, thus contributing to reduce the related import dependency.

- **Promote a wider uptake and an improvement in the effectiveness** of **insurance, mutual funds and risk management schemes in agriculture**, in order to improve the capacity of EU farmers to cope with the increased price volatility of farming inputs. The CAP toolbox for the 2023-2027 programming period already offers to Member States a number of options in this regard. The new delivery model via the Member States' CAP Strategic Plans can play an important role in adapting risk management to national specificities, by providing more flexibility to target support to the needs of the sectors as these emerge in the national/regional context. In particular, the higher flexibility granted to Member States to design the desired distribution of subsidies could improve the targeting of support provided to risk management under the CAP second pillar (Article 76, Regulation (EU) 2021/2115). As part of the objective to support farm competitiveness and strengthen the position of farmers in the value chain, Member States have been encouraged to plan risk management schemes with ambitious targets for farmers' participation.

Altogether at EU level, the Strategic Plans that devote funding for risk management aim to reach more than 14 % of EU farms, with EUR 4.6 billion of financial support from the EAFRD, or 18 % of total public expenditure (EAGF and EAFRD). Risk management tools have been proposed by 14 Member States; these include 25 interventions in total, as follows: i) 15 insurance premia schemes; ii) seven mutual funds support schemes; iii) two other risk management schemes; iv) one scheme covering insurance premia as well as support for mutual funds. While seven Member States plan to provide support for insurance premia only, seven Member States plan a combination of risk management interventions. Three Member States assign funds from their direct payments envelope to risk management (European Commission (2023d); Munch *et al*. (2023)[90]; Folkeson Lillo and Chartier (2023)[91]).

- Consider the possibility to use, whenever relevant, **EU and national measures aimed at mitigating the impact of increased input costs** (which were presented in section 4.4), since they provide temporary but effective solutions for addressing emergency situations.

• Improve transparency and monitoring of the EU's input dependency

The most effective actions to this end are:

- Public provision of information to policymakers and operators, aimed at improving their understanding of the root causes and of the implications of import dependency, at improving their decision-making processes and at strengthening their resilience. In this regard, the European Commission has already undertaken a number of initiatives that, according to the research team, should be continued and strengthened. These include: i) the European Food Security Crisis preparedness and response Mechanism (EFSCM), with particular regard to its assessments of food supply and food security in the EU[92] and to its *food alert system*, a dashboard featuring a combination of indicators of particular relevance in times of crisis[93]; ii) the agrifood data portal and the market observatories managed by DG AGRI, which provide data on agricultural markets. The research team also values positively the initiatives of DG AGRI aimed at further improvement of the EU agrifood market information system, including the launch of the *Study on the role of information and communication technologies to improve market transparency*.

[90] Study for the European Parliament's Committee on Agriculture and Rural Development.
[91] Study for the European Commission, Directorate-General for Agriculture and Rural Development.
[92] The first of such assessment was published in the autumn of 2023 (EFSCM, 2023).
[93] The dashboard monitors, among others, indicators related to climate, energy sources, and freight costs.

- Improving the operators' know-how through education and training, to allow more widespread uptake of the relevant solutions discussed under sections 5.1 and 5.2. In this regard, it is worth noting that the CAP toolbox for the 2023-2027 programming period offers to Member States a number of options in this regard (see also: European Commission (2023d); Munch *et al*. (2023)[94]; Folkeson Lillo and Chartier (2023)[95]).

[94] Study for the European Parliament's Committee on Agriculture and Rural Development.
[95] Study for the European Commission, Directorate-General for Agriculture and Rural Development.

REFERENCES

- Agricultural Markets Task Force (2016). *Issue Paper: contractualisation*. https://agriculture.ec.europa.eu/system/files/2019-06/amtf-paper-contractualisation-20160524_en_0.pdf
- Agricultural Markets Task Force (2019). *Issue Paper: Futures markets*. https://agriculture.ec.europa.eu/system/files/2019-06/amtf-paper-futures-20160412_en_0.pdf
- Ahvo, A., Heino, M., Sandström, V., Chrisendo, D., Jalava, M., and Kummu, M. (2022). *Agricultural input shocks decrease crop yields globally*. https://assets.researchsquare.com/files/rs-2204819/v1/243ac4ca-e857-4e64-86dc-a8e800b2b354.pdf?c=1699603570
- Amighini, A. A., Maurer, A., Garnizova, E., Hagemejer, J., Stoll, P-T., Dietrich, M., Roy, R., Skowronek, A. and Tentori, D. (2023). *Global value chains: Potential synergies between external trade policy and internal economic initiatives to address the strategic dependencies of the EU*. European parliament, Directorate-General for External Policies. PE 702.582 – March 2023. https://www.europarl.europa.eu/RegData/etudes/STUD/2023/702582/EXPO_STU(2023)702582_EN.pdf
- Areté (2017). *Study on storage capacities and logistical infrastructure for EU agricultural commodities trade (with a special focus on cereals, the oilseed complex and protein crops (COP))*. Final report. European Commission, Directorate-General for Agriculture and Rural Development. Publications Office of the European Union. https://op.europa.eu/en/publication-detail/-/publication/b102ecaa-2cbd-11e8-b5fe-01aa75ed71a1
- Areté (2019). *The bioeconomy and a future biobased food industry and agriculture sector: how can workers' organisations shape the changes?* Full report for the European Federation of food, agriculture and tourism trade unions (EFFAT). https://effat.org/wp-content/uploads/2019/10/Bioeconomy_fullreport_web.pdf
- Areté and IHS Markit (2022). *Study on the adaptation strategies of the sugar supply chain after the end of the sugar quotas*. Final Report. European Commission, Directorate-General for Agriculture and Rural Development. Publications Office of the European Union. https://op.europa.eu/en/publication-detail/-/publication/c8a80147-7f1f-11ec-8c40-01aa75ed71a1
- Avdaliani, E. (2023). *The Expansion of the International North-South Transport Corridor: Geopolitical Updates*. Silk Road Briefing – Dezan Shira & Associates. http://silkroad2021.org/index-2439.html
- Bailey, R., and Wellesley, L. (2017). *Chokepoints and Vulnerabilities in Global Food Trade*. Chatham House, the Royal Institute of International Affairs. Energy, Environment and Resources Department. June 2017. https://www.chathamhouse.org/sites/default/files/publications/research/2017-06-27-chokepoints-vulnerabilities-global-food-trade-bailey-wellesley-final.pdf
- Barreiro Hurle, J., Bogonos, M., Himics, M., Hristov, J., Perez Dominguez, I., Sahoo, A., Salputra, G., Weiss, F., Baldoni, E. and Elleby, C. (2021). *Modelling environmental and climate ambition in the agricultural sector with the CAPRI model*. EUR 30317 EN, Publications Office of the European Union, Luxembourg. https://publications.jrc.ec.europa.eu/repository/handle/JRC121368
- Beckman, J., Ivanic, M., Jelliffe, J.L., Baquedano, F.G, and Scott, S.G. (2020). *Economic and Food Security Impacts of Agricultural Input Reduction Under the European Union Green Deal's Farm to Fork*

and Biodiversity Strategies. November 2020. EB-30, U.S. Department of Agriculture, Economic Research Service. https://www.ers.usda.gov/webdocs/publications/99741/eb-30.pdf?v=842.1

- Berman, N. (2023). *How Does the U.S. Government Use the Strategic Petroleum Reserve?* Council on Foreign Relations. https://www.cfr.org/backgrounder/how-does-us-government-use-strategic-petroleum-reserve
- Bertolozzi-Caredio, D., Severini, S., Pierre, G., Zinnanti, C., Rustom, R., Santoni, E. and Bubbico, A., (2023). *Risks and vulnerabilities in the EU food supply chain*. Publications Office of the European Union, Luxembourg. https://publications.jrc.ec.europa.eu/repository/handle/JRC135290
- Boer, J. de, and Aiking, H. (2022). *Do EU consumers think about meat reduction when considering to eat a healthy, sustainable diet and to have a role in food system change?* Appetite. Volume 170, 1 March 2022. https://doi.org/10.1016/j.appet.2021.105880
- Bourgery-Gonse, T. (2023). *Experts: Stockpiling may be EU's blind spot in critical raw materials debate*. Euractiv. 20 October 2023. https://www.euractiv.com/section/circular-economy/news/stockpiling-may-be-eus-blind-spot-in-critical-raw-materials-debate-experts-say/
- Bradley, D., and Christodoulou, M. (2022). *The Common Agricultural Policy at 60: A growing role and influence for the European Parliament*. Study for the European Parliamentary Research Service ex-post evaluation unit. PE 734.678 – October 2022. https://www.europarl.europa.eu/thinktank/en/document/EPRS_STU(2022)734678
- Bremmer, J., Gonzalez Martinez, A. R., Jongeneel, R. A., Huiting, H. F., and Stokkers, R. (2021). *Impact Assessment Study on EC 2030 Green Deal Targets for Sustainable Food Production: Effects of Farm to Fork and Biodiversity Strategy 2030 at farm, national and EU level*. Wageningen University & Research. https://edepot.wur.nl/555349
- Burton, M., Nardelli, A., and Krukowska, E. (2023). *Europe Balks at Strategic Stockpile for Critical Green Metals*. Bloomberg. 13 March 2023. https://www.bloomberg.com/news/articles/2023-03-13/europe-balks-at-strategic-stockpile-for-critical-green-metals
- Chang, F.K. (2023). *The Middle Corridor through Central Asia: Trade and Influence Ambitions*. Foreign Policy Research Institute. https://www.fpri.org/article/2023/02/the-middle-corridor-through-central-asia-trade-and-influence-ambitions/
- COCERAL and UniStock Europe (2021). *Impact of the Farm to Fork targets on the Cereals and Oilseeds markets*. 21st May 2021. https://nofota.com/wp-content/uploads/20210525_COCERAL-UNISTOCK_Impact_of_the_Farm_to_Fork_final_210521-1.pdf
- Debaeke, P., Forslund, A., Guyomard, H., Schmitt, B. and Tibi, A. (2022). *Could domestic soybean production avoid Europe's protein imports in 2050?* OCL. Volume 29, 2022. https://doi.org/10.1051/ocl/2022031
- Di Marcantonio, F., Solano Hermosilla, G., Ciaian, P. (2022). *The COVID-19 pandemic in the agri-food supply chain: Impacts and responses: Evidence from an EU survey*. Publications Office of the European Union, Luxembourg. https://publications.jrc.ec.europa.eu/repository/handle/JRC128581
- Ecorys and Wageningen Economic Research (2017). *Study on risk management in EU agriculture*. Final Report, October 2017. European Commission, Directorate-General for Agriculture and Rural Development. https://op.europa.eu/en/publication-detail/-/publication/5a935010-af78-11e8-99ee-01aa75ed71a1

- EFSCM (2023). *State of Food Security in the EU*. Autumn 2023 – Nr 1. European Food Security Crisis preparedness and response mechanism. DG Agriculture and Rural Development. https://agriculture.ec.europa.eu/system/files/2023-11/efscm-assessment-autumn-2023_en.pdf
- EPRS (2022). *Russia's war on Ukraine: Impact on food security and EU response*. Briefing. European Parliamentary Research Service. April 2022. https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/729367/EPRS_ATA(2022)729367_EN.pdf
- EPRS (2023a). *EU feed autonomy. Closing the gaps in European food security*. Briefing. European Parliamentary Research Service. February 2023. https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/739328/EPRS_BRI(2023)739328_EN.pdf
- EPRS (2023b). *EU protein strategy*. European Parliament Briefing. EPRS - European Parliamentary Research Service. Members' Research Service. PE 751.426 – July 2023. https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/751426/EPRS_BRI(2023)751426_EN.pdf
- Essel, R., and Carus, M. (2014). *Increasing resource efficiency by cascading use of biomass*. Rural 21 – The International Journal for Rural Development. 08.09.2014. https://www.rural21.com/english/a-closer-look-at/detail/article/increasing-resource-efficiency-by-cascading-use-of-biomass.html
- European Commission (2020a). *Study on the EU's list of Critical Raw Materials. Factsheets on Non-critical Raw Materials*. European Commission, Brussels. https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en
- European Commission (2020b). *Commission Staff Working Document Analysis of links between CAP Reform and Green Deal*. SWD(2020) 93 final. Brussels, 20.5.2020. https://agriculture.ec.europa.eu/system/files/2020-05/analysis-of-links-between-cap-and-green-deal_en_0.pdf
- European Commission (2021a). *Strategic dependencies and capacities*. Commission staff working document, SWD (2021) 352. https://commission.europa.eu/system/files/2021-05/swd-strategic-dependencies-capacities_en.pdf
- European Commission (2021b). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Trade Policy Review - An Open, Sustainable and Assertive Trade Policy*. COM(2021) 66 final. Brussels, 18.2.2021. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52021DC0066
- European Commission (2021c). *Study on the status of new genomic techniques under Union law and in light of the Court of Justice ruling in Case C-528/16*. Commission Staff Working Document. SWD(2021) 92 final. Brussels, 29.4.2021. https://food.ec.europa.eu/system/files/2021-04/gmo_mod-bio_ngt_eu-study.pdf
- European Commission (2022). *Ensuring availability and affordability of fertilisers*. Communication from the Commission and related annexes. COM(2022) 590 final/2, Brussels, 9.11.2022. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52022DC0590(01)
- European Commission (2023a). *Monitoring agri trade policy. Thematic analysis: Diversification of EU agri-food trade*. European Commission, DG Agriculture and Rural Development, Brussels. https://agriculture.ec.europa.eu/system/files/2023-10/monitoring-agri-food-trade-diversification-2012-22_en.pdf

- European Commission (2023b). *Honey Market Presentation*. Expert Group for Agricultural Markets. 23 November 2023. https://agriculture.ec.europa.eu/system/files/2023-12/market-presentation-honey_autumn2023_en.pdf
- European Commission (2023c). *EU imports of organic agri-food products. Key developments in 2022*. European Commission, DG Agriculture and Rural Development, Brussels. https://agriculture.ec.europa.eu/system/files/2023-07/analytical-brief-2-eu-organic-imports-2022_en.pdf
- European Commission (2023d). *Approved 28 CAP Strategic Plans (2023-2027). Summary overview for 27 Member States. Facts and figures*. European Commission, DG Agriculture and Rural Development, Brussels. https://agriculture.ec.europa.eu/system/files/2023-06/approved-28-cap-strategic-plans-2023-27.pdf
- European Commission (2023e). *EU Agricultural Outlook 2023-2035*. European Commission, DG Agriculture and Rural Development, Brussels. https://agriculture.ec.europa.eu/data-and-analysis/markets/outlook/medium-term_en
- European Commission (2023f). *Drivers of food security*. Commission Staff Working Document. SWD(2023) 4 final. Brussels, 4.1.2023. https://commission.europa.eu/system/files/2023-01/SWD_2023_4_1_EN_document_travail_service_part1_v2.pdf
- European Commission (2023g). *A secure and sustainable supply of critical raw materials in support of the twin transition*. Communication from the Commission. COM(2023) 165 final. Brussels, 16.3.2023. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2023%3A165%3AFIN
- Eurostat (2023a). *Natural gas supply statistics*. Data from April 2023. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Natural_gas_supply_statistics#:~:text=Highlights&text=In%202022%2C%20inland%20demand%20of,import%20dependency%20rate%20was%2097%20%25.
- Eurostat (2023b). *Oil and petroleum products - a statistical overview*. Data from March 2023. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Oil_and_petroleum_products_-_a_statistical_overview&oldid=315177
- FAO (2022). *The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the current conflict*. Information note. 10 June 2022 Update. https://www.fao.org/3/cb9013en/cb9013en.pdf
- Fazle Rabbi, M., Ben Hassen, T., El Bilali, H., Raheem, D., and Raposo, A. (2023). *Food Security Challenges in Europe in the Context of the Prolonged Russian–Ukrainian Conflict*. Sustainability, 15(6), 4745. https://www.mdpi.com/2071-1050/15/6/4745
- FEFAC (2021). *Feed & food 2021*. https://fefac.eu/wp-content/uploads/2021/12/FF_2021_final.pdf
- FEFAC (2022). *Request for special measures to facilitate supply of feed for use in organic farming*. Communication of FEFAC Secretary General to Mr. Michael Scannell, Deputy Director General, DG AGRI, European Commission, 7.03.2022. https://fefac.eu/wp-content/uploads/2022/03/22_INST_16_Organic_feed-protein.pdf
- Folkeson Lillo, C., and Chartier, O. (editors) (2023). *Mapping and analysis of CAP strategic plans – Assessment of joint efforts for 2023-2027*. European Commission, Directorate-General for Agriculture and Rural Development. Publications Office of the European Union.

https://op.europa.eu/en/publication-detail/-/publication/80d12120-89bc-11ee-99ba-01aa75ed71a1/language-en

- Hellegers, P. (2022). *Food security vulnerability due to trade dependencies on Russia and Ukraine*. Food Security: 2022(14),1503–1510. https://link.springer.com/article/10.1007/s12571-022-01306-8
- Henning, C., and Witzke, P. (2021). *Economic and Environmental impacts of the Green Deal on the Agricultural Economy: A Simulation Study of the Impact of the F2F-Strategy on Production, Trade, Welfare and the Environment based on the CAPRI-Model*. Christian-Albrechts-Universität, Kiel, and EuroCARE, Bonn. Executive summary in English: https://www.bio-pop.agrarpol.uni-kiel.de/de/f2f-studie/executive-summary-en Full report (available in German only): https://www.bio-pop.agrarpol.uni-kiel.de/de/f2f-studie/vollversion-der-studie-deutsch
- Huan-Niemi, E., Knuuttila, M., Vatanen, E., and Niemi, J. (2021). *Dependency of domestic food sectors on imported inputs with Finland as a case study*. Agricultural and Food Science: 30(3), 119–130. https://doi.org/10.23986/afsci.107580
- IDH, RTRS, ProTerra Foundation, Donau Soja, IUCN NL, FEFAC and FEDIOL (2023). *European Soy Monitor; Insights on European uptake of certified, responsible, deforestation, and conversion-free soy in 2021*. September 2023. Prepared by Schuttelaar & Partners: the Hague, the Netherlands. https://www.idhsustainabletrade.com/uploaded/2023/09/IDH-Soy-Monitor-2021-Final.pdf
- IFOAM (2022) *Evaluation of support for organic farming in draft CAP Strategic Plans (2023-2027)*. https://www.organicseurope.bio/content/uploads/2022/03/IFOAMEU_CAP_SP_feedback_20220303_final.pdf?dd
- IRIS-OSFME (2023). *Les stocks stratégiques de métaux critiques*. Institut de Relations Internationales et Stratégiques - Observatoire de la sécurité des flux et des matières énergétiques. Rapport. Octobre 2023. https://www.iris-france.org/notes/les-stocks-strategiques-de-metaux-critiques/
- Karlsson, J.O., Parodi, A., van Zanten, H.H.E., Hansson, P-A., Röös, E. (2020). *Halting European Union soybean feed imports favours ruminants over pigs and poultry*. Nature Food. https://doi.org/10.1038/s43016-020-00203-7
- Lungarska, A., Brunelle, T., Chakir, R., Jayet, P., Prudhomme, R., De Cara, S., and Bureau, J. (2022). *Halving mineral nitrogen use in European agriculture: insights from multi-scale land-use models*. https://hal-emse.ccsd.cnrs.fr/PREPRINT/hal-03761774v1
- Miller, G. (2023). *Top ocean shipping stories of 2023: War, drought and detours*. Freight Waves. Tuesday, December 26, 2023. https://www.freightwaves.com/news/top-ocean-shipping-stories-of-2023-war-drought-and-detours
- Münch, A., *et al*. (2023). *Research for AGRI Committee – Comparative analysis of the CAP Strategic Plans and their effective contribution to the achievement of the EU objectives*. European Parliament, Policy Department for Structural and Cohesion Policies, Brussels. https://www.europarl.europa.eu/RegData/etudes/STUD/2023/747255/IPOL_STU(2023)747255_EN.pdf
- Özkanlisoy, Ö., and Akkartal, E. (2022). *The effect of Suez Canal blockage on supply chains*. Dokuz Eylül University - Maritime Faculty Journal, Vol:14 Issue:1 Year:2022, 51-79. https://mfjournal.deu.edu.tr/wp-content/uploads/2022/06/141-3-ozkanlisoy-akkartal.pdf

- Penone, C., Giampietri, E., and Trestini, S. (2022). *Futures–spot price transmission in EU corn markets*. Agribusiness, Volume38, Issue3, Summer 2022: 679-709. https://onlinelibrary.wiley.com/doi/full/10.1002/agr.21735
- Rac, I., Erjavec, K., and Erjavec, E. (2020). *Does the proposed CAP reform allow for a paradigm shift towards a greener policy?* Spanish Journal of Agricultural Research, Volume 18 (3), e0111, 14 pages, 2020. https://www.researchgate.net/publication/343998595_Does_the_proposed_CAP_reform_allow_for_a_paradigm_shift_towards_a_greener_policy
- Redlich, S., Martin, E.A, and Steffan-Dewenter, I. (2021). *Sustainable landscape, soil and crop management practices enhance biodiversity and yield in conventional cereal systems*. Journal of Applied Ecology: 2021(58), 507–517. https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/1365-2664.13821
- Rietveld, E., Bastein, T., van Leeuwen, T., Wieclawska, S., Bonenkamp, N., Peck, D., Klebba, M., Le Mouel, M., and Poitiers, N. (2022). *Strengthening the security of supply of products containing Critical Raw Materials for the green transition and decarbonisation*. Publication for the committee on Industry, Research and Energy (ITRE), Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg. https://www.europarl.europa.eu/RegData/etudes/STUD/2022/740058/IPOL_STU(2022)740058_EN.pdf
- Román, A. A. (2023). *EU protein strategy*. European Parliament Briefing. EPRS | European Parliamentary Research Service. Members' Research Service. PE 751.426 – July 2023. https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/751426/EPRS_BRI(2023)751426_EN.pdf
- Siripurapu, A., and Berman, N. (2023). *The State of U.S. Strategic Stockpiles*. Council on Foreign Relations. https://www.cfr.org/backgrounder/state-us-strategic-stockpiles
- Spain's National Office of Foresight and Strategy (2023). *Resilient EU2030. A future-oriented approach to reinforce the EU's Open Strategic Autonomy and Global Leadership*. https://futuros.gob.es/sites/default/files/2023-09/RESILIENTEU2030.pdf
- Stegmann, P., Londo, M., and Junginger, M. (2020). *The circular bioeconomy: Its elements and role in European bioeconomy clusters*. Resources, Conservation & Recycling: X. Volume 6, 2020, 100029. https://www.sciencedirect.com/science/article/pii/S2590289X1930026X?via%3Dihub
- Taran, S. (2023). *EU-Ukraine wartime trade: Overcoming difficulties, forging a European path*. European Policy Centre. Discussion Paper, 21 August 2023. https://www.epc.eu/content/PDF/2023/EU-Ukraine_wartime_trade_DP.pdf
- Tillie, P. and Rodríguez-Cerezo, E. (2015). *Markets for non-genetically modified, identity-preserved soybean in the EU*. Joint Research Centre - Institute for Prospective Technological Studies (IPTS). Publications Office of the European Union, Luxembourg. https://publications.jrc.ec.europa.eu/repository/handle/JRC95457
- Tudor, V.C., Stoicea, P., Chiurciu, I.-A., Soare, E., Iorga, A.M., Dinu, T.A., David, L., Micu, M.M., Smedescu, D.I., and Dumitru, E.A. (2023). *The Use of Fertilizers and Pesticides in Wheat Production in the Main European Countries*. Sustainability: 2023(15), 3038. https://www.mdpi.com/2071-1050/15/4/3038

- UNCTAD (2020 to 2023). *Review of maritime transport*. Editions from 2020 to 2023. United Nations Conference on Trade and Development (UNCTAD). Geneva, Switzerland. https://unctad.org/topic/transport-and-trade-logistics/review-of-maritime-transport
- UNCTAD (2022). *A trade hope. The role of the Black Sea Grain Initiative in bringing Ukrainian grain to the world*. 20 October 2022. United Nations Conference on Trade and Development (UNCTAD). Geneva, Switzerland. https://unctad.org/system/files/official-document/osginf2022d6_en.pdf
- UNCTAD (2023). *A trade hope. The impact of the Black Sea Grain Initiative*. March 2023. United Nations Conference on Trade and Development (UNCTAD). Geneva, Switzerland. https://unctad.org/system/files/official-document/osginf2023d3_en.pdf
- UNECE (2017). *Draft report of the phase III of the Euro-Asian Transport Links project*. Scientific and Research Institute of Motor Transport (NIIAT) for United Nations Economic Commission for Europe (UNECE) - Inland Transport Committee. https://unece.org/DAM/trans/doc/2017/wp5-eatl/eatl_id17-01e.pdf
- US Congressional Research Service (2020). *The Strategic Petroleum Reserve: Background, Authorities, and Considerations*. May 13, 2020. https://crsreports.congress.gov/product/pdf/R/R46355
- Vicard, V., and Wibaux, P. (2023). *EU Strategic Dependencies: A Long View*. Centre d'études prospectives et d'informations internationals – CEPII. Policy Brief No 41 – June 2023. http://www.cepii.fr/PDF_PUB/pb/2023/pb2023-41.pdf
- Wesseler J. (2022) *The EU's farm-to-fork strategy: An assessment from the perspective of agricultural economics*. Applied Economic Perspectives and Policy, Volume 44, Issue 4, December 2022, pages 1826-1843. https://onlinelibrary.wiley.com/doi/full/10.1002/aepp.13239
- Westhoek, H., Lesschen, J. P., Rood, T., Wagner, S., De Marco, A., Murphy-Bokern, D., Leip, A., Grinsven, H. van, Sutton, M. A. and Oenema, O. (2014). *Food choices, health and environment: Effects of cutting Europe's meat and dairy intake*. Global Environmental Change. Volume 26, May 2014, Pages 196-205. https://doi.org/10.1016/j.gloenvcha.2014.02.004
- Zachmann, G., Weil, P., and von Cramon-Taubadel, S. (2022). *A European policy mix to address food insecurity linked to Russia's war*. Policy Contribution 23/2022, Bruegel. https://www.bruegel.org/policy-brief/european-policy-mix-address-food-insecurity-linked-russias-war#:~:text=increase%20migration%20pressure.-,3%20Possible%20European%20responses,4)%20improve%20global%20food%20allocation.

ANNEX A: MEASURING THE DEPENDENCY OF THE FOOD SYSTEM ON IMPORTED INPUTS THROUGH INPUT-OUTPUT MODELLING

The Input-Output (IO hereinafter) modelling technique was developed by Leontief in 1936 to analyse the **interdependencies and linkages between different industries for both goods and services** in the economy. The technique allows for the analysis of the contribution of domestic and imported inputs in each industry. Focusing on both goods and services, IO modelling can only be applied to monetary values (not to physical quantities).

As observed in Huan-Niemi *et al*. (2021), even though IO modelling has widely been used to analyse import dependency, empirical applications of the method that focus on the food system have been extremely few. The article by Huan-Niemi *et al*. reports the results of an empirical application of the method to analyse the import dependency of domestic food and service sectors in Finland, based on the quantification of a set of indicators to measure: i) the import content of the output of the relevant sectors; ii) the import dependency of the inputs supplied to these sectors (i.e., the imported vs. domestic share in input supply). To that end, the study considers imported agricultural inputs, intermediate inputs, raw materials and services, and utilises the so-called "output-driven" approach, rather than the traditional "demand-driven" approach.

In the output-driven approach, the outputs of domestic "industries" (in the case of interest for this study, the "industries" are the sectors that form the EU food system, as identified in section 1.3) are dependent on the outputs of other industries, which may be based domestically (i.e., in the EU) or abroad (i.e., in third countries): the latter supply inputs to the domestic industries via imports. The value of imported goods and services used as inputs by an industry vs. the output value of that industry is the direct rate of import of that industry. The industry's output contains also indirect imports, which are included in the domestic intermediate products bought by the industry from other industries for use as inputs in its own production processes.

In the case of interest for this study, **direct imports** concern goods (e.g., tomato paste) and services supplied by non-EU operators that are directly used as inputs in the production of food in the EU (e.g., to produce frozen pizzas); **indirect imports** concern goods (e.g., soya bean meal) and services supplied by non-EU operators that are used to produce in the EU intermediate products (e.g., manufactured feed) that are then used as inputs in the EU food system (e.g., to feed beef and/or dairy cattle). When considering an aggregate of multiple and partly interlinked sectors, like the EU food system, the quantification of the import dependency of the system as a whole requires the removal of duplicate imports, which are related to indirect imports (to the extent that they are direct imports of some sectors of the EU food system, part of the indirect imports of other sectors are duplicative).

ANNEX B: BREAKDOWN OF THE IMPORT CONTENT FOR THE THREE SECTORS OF INTEREST

The analysis of the **breakdown of the import content** for the three sectors of interest [*value of each imported input group/total sectoral value of imported inputs*] distinguishes direct imports from indirect imports, and ranks input groups according to their share of total imports. The detailed results are reported in Tables 9 to 11.

Table 9: Agriculture: breakdown of the import content, %*, 2019

Input groups (supplying sectors)	Direct	Indirect	Total
Mining and quarrying	4.44	29.35	19.03
Chemicals and chemical products	25.90	8.88	15.93
Products of agriculture, hunting and related services	23.50	6.59	13.60
Food, beverages and tobacco products	12.77	4.20	7.75
Top-4 input groups – aggregated share	***66.61***	***49.03***	***56.32***
Other input groups – aggregated share	*33.39*	*50.97*	*43.68*

Source: research team elaboration on Eurostat input-output data at basic prices in 2019
Note: * % shares of each input group on direct / indirect / total imports of inputs (in value terms) – column total = 100 %

Table 10: Fisheries & aquaculture: breakdown of the import content, %*, 2019

Input groups (supplying sectors)	Direct	Indirect	Total
Mining and quarrying	1.76	38.62	22.25
Coke and refined petroleum products	22.15	4.84	12.53
Chemicals and chemical products	9.39	5.79	7.39
Fish and other fishing products; aquaculture products; support services to fishing	15.60	0.15	7.01
Top-4 input groups – aggregated share	***48.90***	***49.39***	***49.18***
Other input groups – aggregated share	*51.10*	*50.61*	*50.82*

Source: research team elaboration on Eurostat input-output data at basic prices in 2019
Note: * % shares of each input group on direct / indirect / total imports of inputs (in value terms) - – column total = 100 %

Table 11: Food & beverages: breakdown of the import content, %*, 2019

Input groups (supplying sectors)	Direct	Indirect	Total
Products of agriculture, hunting and related services	41.69	4.06	25.46
Food, beverages and tobacco products	24.25	2.63	14.93
Mining and quarrying	2.78	21.29	10.76

Chemicals and chemical products	3.66	11.07	6.86
Top-4 input groups – aggregated share	***72.38***	***39.06***	***58.01***
Other input groups – aggregated share	*27.62*	*60.94*	*41.99*

Source: research team elaboration on Eurostat input-output data at basic prices in 2019
Note: * % shares of each input group on direct / indirect / total imports of inputs (in value terms) – column total = 100 %

ANNEX C: SUMMARY OF STATE AID GRANTED IN THE CONTEXT OF THE TEMPORARY CRISIS FRAMEWORK

A summary of the measures targeted specifically on the agricultural sector by selected Member States is set out below. Other measures which applied more widely, including support to energy intensive operators within Annex I of the Temporary Crisis Framework, as well as more general and unspecified support across a range of economic sectors, are not covered. However, operators in the agri-food chain are likely to have also benefited from these. There were ***no specific measures*** in the agricultural sector in ***Germany***.

France:

- 3 August 2023: EUR 60 million to support organic farmers via a direct grant to assist with reducing dependence on fuels.
- 22 May 2023: EUR 9 million to support lavender producers via direct grants to reduce dependency on fuels.
- 9 January 2023: EUR 215 million to support the cessation of use of glyphosate in the agricultural sector.
- 19 December 2022: Modification of scheme to support fishing companies to extend the scheme and increase the budget.
- 25 August 2022: Modification of scheme to support fishing companies to extend the scheme and increase the budget.
- 16 June 2022: EUR 6.7 million to support agricultural and aquaculture in the overseas departments and Corsica via the provision of direct grants to cover part of the increased cost of feed.
- 17 May 2022: EUR 25 million to support fishing companies via direct grants to partially offset increased fuel costs. EUR 0.35 per litre of fuel was granted for the period 17 to 31 March and EUR 0.15 per litre for the period 1 April to 31 July 2022.
- 16 May 2022: EUR 152.5 million to support businesses in the agriculture, forestry and aquaculture sectors. The support covered social security contributions up to EUR 5,000 per company to partially compensate for increased costs.
- 6 May 2022: EUR 400 million to support companies in the agriculture and aquaculture sectors via direct aid to partially compensate for higher feed costs.

Italy:

- 28 July 2023: EUR 30 million to support companies active in the agricultural, forestry, fishery and aquaculture sectors via loan guarantees to support liquidity.
- 23 November 2022: EUR 34.4 million to exempt payment of social security contributions for businesses active in the iron, steel, wood, ceramics, automotive and agribusiness sectors if activities were suspended between 22 March and 31 May 2022.
- 21 June 2022: EUR 180 million to support companies active in the agricultural, forestry, fishery and aquaculture sectors via loan guarantees to support liquidity in the face of increases in energy and other input costs.
- 18 May 2022: EUR 1.2 billion to support the agricultural, forestry, fishery and aquaculture sectors. Eligible beneficiaries could receive limited amounts of aid in the form of: (i) direct grants; (ii) tax or payment advantages; (iii) repayable advances; and (iv) reduction or exemption from the payment of social security and welfare contributions. All sizes of company were eligible if affected by the price increase of electricity, animal feed or fuel.
- 22 April 2022: EUR 50 million to support the agricultural (including primary production, processing and marketing of agricultural products), forestry, fisheries and aquaculture sectors in the autonomous region of Friuli Venezia Giulia. The support consisted of direct grants and loans to provide liquidity. A budget increase of EUR 50 million was allocated on 24 November 2022.

Netherlands:

- 5 April 2023: EUR 70 million to support SMEs in the greenhouse horticulture sector via guarantees covering 70% of loans over a four-year duration (with the possibility to extend to six years in certain situations).

Poland:

- 12 October 2023: EUR 53.6 million to support corn traders via direct grants to SMEs active in the trading or purchasing of corn.
- 6 October 2023: EUR 132.3 million to support the cereals and oilseeds production sectors via direct grants to producers that fulfil the criteria established under the emergency measures Poland implemented to support these sectors in accordance with the provisions of EU Regulations 2023/739 and 2023/1343, but which could not be supported due to oversubscription.
- 4 August 2023: EUR 176 million to support SMEs active in the trading or purchasing of cereals, trading of agricultural plant seeds, or the purchasing or freezing of soft fruit via subsidies on loan interest rates to assist liquidity.
- 26 July 2023: EUR 113 million to support SME pig producers via direct grants to support liquidity in the face of increases in the costs of energy, fuel and other raw materials.
- 20 July 2023: EUR 47 million to support the primary agricultural production sector via direct grants to support liquidity in the face of increases in the cost of seeds.
- 18 July 2023: Modification to existing scheme approved on 5 June 2022 to increase the budget by EUR 266 million.

- 8 June 2023: EUR 11 million to support agricultural producers via direct grants to compensate agricultural producers affected by the insolvency of a purchasing entity.
- 5 June 2023: EUR 346 million to support agricultural producers via subsidised interest rates on loans to support liquidity needs.
- 23 May 2023: EUR 1 billion to support agricultural producers via direct grants in the face of liquidity shortages due to increases in the cost of mineral fertilisers and a lack of stability on the agricultural market.
- 12 May 2023: EUR 122.6 million to support the primary agricultural production sector via direct grants to mitigate the impact of rising fuel costs.
- 4 May 2023: EUR 435.4 million to support the wheat production sector via direct grants to support liquidity needs.
- 24 March 2023: EUR 126 million to support the wheat and maize production sectors via direct grants to support liquidity needs.
- 19 April 2022: EUR 836 million to support the agricultural sector in the form of direct grants to farmers affected by the increase in the cost of fertiliser. Beneficiaries could receive up to EUR 107 per hectare of arable land and up to EUR 53.50 per hectare of grassland and pasture, capped at 50 hectares.

Spain:

- 2 May 2022: EUR 18 million to support fishing vessels in the form of direct grants to support liquidity.
- 28 April 2022: EUR 169 million to support milk producers via direct grants in the face of increases in the cost of electricity, animal feed and fuel. Support for eligible beneficiaries in the cow milk sector amounted to (i) EUR 210 per cow for the first 40 animals; (ii) EUR 140 per cow for any additional animal up to 180 animals; and (iii) EUR 100 per cow beyond 180 animals. In the sheep milk sector payments were EUR 15 per sheep with EUR 10 per goat for producers of goat's milk.

This study analyses the vulnerabilities of the EU food system regarding inputs, describing the tools to secure those inputs and make the EU less dependent on foreign suppliers. It provides recommendations for appropriate measures to increase the EU food system's resilience to disruptions in trade flows and price increases of imported inputs.

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