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Міністерство аграрної політики та продовольства України

KSE | Center for Food and Land Use Research

OVERVIEW OF THE FRESH FRUIT AND VEGETABLES MARKET IN THE EUROPEAN UNION AND UKRAINE FOR THE SELECTED CROPS

This report was prepared by The Center for Food and Land Use Research at the Kyiv School of Economics in cooperation with the Ministry of Agrarian Policy and Food of Ukraine within the framework of a memorandum of cooperation.

The author **Olha Halytsia**
The editor **Mariia Bogonos**

2024

1. INTRODUCTION

Fruit and vegetables (F&V) are undoubtedly important for a balanced healthy diet. Additionally, they noticeably contribute to a number of Sustainable Development Goals (UN, 2015) that shape an agenda for addressing global challenges (Figure 1). Since fruit and vegetables are important sources of various nutrients and dietary fibre, increasing their production and consumption can contribute to tackling malnutrition, enhancing food security and promoting good health.

From an economic perspective, fruit and vegetable cultivation generates income, contributing to welfare improvement in rural areas. The F&V sector adds to economic growth by creating jobs in both F&V farming and the broader agricultural supply chain, which includes processing, marketing, and retail.

F&V production and consumption are also essential for mitigating the effects of climate change. Diets high in diverse plant-based foods, including vegetables and fruits, can significantly reduce environmental impacts (Willett et al., 2019). More specifically, CO2 emissions associated with most plant-based products are 10 to 50 times lower compared to emissions from most animal-based products (Ritchie, 2020).

1.1 SPECIFICS OF FRUIT AND VEGETABLE PRODUCTION

The nature of fruit and vegetable production is characterized by several distinct features, namely labour intensiveness, fragility to various environmental stressors and the more prominent issue of post-harvest losses compared to other crops. More specifically, F&V production has a much lower capital intensity compared to grain and oilseed farming (Blanco and Raurich, 2022) and is sensitive to labour availability, especially at harvest since many fruits and vegetables need to be picked manually. The primary effect that the decrease in farm labour supply has on F&V production is a reduction in harvested area, but it can also affect yield (Rutledge and Mérel, 2022).

F&V production is also substantially impacted by various environmental factors, such as deviations in temperature trends and rainfall patterns, that affect agricultural yield and nutritional quality of crops (Alae-Carew et al., 2020). Thus, adaptation strategies are essential for the optimisation of F&V productivity and safeguarding the resilience of corresponding food systems.

Concerning post-harvest losses, globally noticeable volumes (25–50%) of fruits and vegetables are lost from farm to fork, undermining food security and having substantial adverse environmental impacts (Bancal and Ray, 2022).

Figure 1. *Links between fruit and vegetable production and consumption and Sustainable Development Goals (SDGs)*

Fruit and vegetables							
Sustainable Development Goal (SDG)	***SDG2*** (Zero Hunger)	***SDG 3*** (Good Health and Well-being)	***SDG 12*** (Responsible Consumption and Production)	***SDG 1*** (No Poverty)	***SDG 8*** (Decent Work and Economic Growth)	***SDG 13*** (Climate Action)	
Impact channel	nutrient-rich foods, which address issues of malnutrition and food security	sources of essential nutrients and dietary fiber, contributing to reducion of the risk of various diseases	sustainable cultivation can enhance biodiversity and soil health, along with responsible consumption can reduce food waste	income source for many small-scale producers and rural family farms, contributing to poverty alleviation	F&V cultivation and trade creats jobs in both farming and the broader agricultural supply chain	agricultural practices associated with F&V farming can contribute to carbon sequestration	lower carbon footprint of plant-based diets

Source: Own visualisation based on RELX SDG Resource Center

1.2. EU FRESH FRUIT AND VEGETABLE MARKET: CURRENT TRENDS

Among current trends shaping the European F&V market that are of particular relevance for producers in the trading partner countries are environmental and social sustainability and health consciousness. There are several performance indicators that European fresh fruit and vegetable companies put more emphasis on in order to make their supply chain transparent and report on their environmental sustainability.[1] These indicators include water, pesticide and carbon footprints, which reflect amounts of water use and pesticide application per unit of harvested fruits and vegetables and carbon emissions associated with production and logistics. From the perspective of social sustainability, more fruit and vegetables in the European fresh F&V market come from socially and ethically certified production, such as, for instance, the GLOBALG.A.P. certification scheme with a focus on a variety of agricultural practices ranging from crop management to worker health and environmental concerns.

Sustainability considerations are not only an essential factor behind the transformation of F&V production but they also drive changes along the supply chain, making sustainability sourcing mainstream. One of the prominent examples of these developments is the Sustainability Initiative Fruits and Vegetables, which brings together leading retailers and traders throughout Europe. It focuses on cross-cutting supply chain challenges such as smallholder farmer inclusion, health and safety, food safety and the sustainable use of water resources.

1 *Which trends offer opportunities or pose threats on the European fresh fruit and vegetables market?*

One of the major factors that creates opportunities for F&V market growth is consumers' consciousness of adopting a healthy diet. Demand for plant-based foods is driven mainly by flexitarians, whose diet is centred on plant-based foods, with a focus on vegetables and fruits, with limited or occasional inclusion of meat. An EU-wide study[2] in 2021 revealed that 30% of Europe's population followed a flexitarian diet, with the figure rising to 40% when including vegetarians and pescetarians.

Box 1. *EU fresh fruit and vegetable market in 2023*

- was characterised by a rather tight supply, which resulted in higher prices at the consumer level;
- in general, developments on the cost and revenue side are likely to have largely balanced each other out in 2023;
- the issue of water (both its scarcity and excessive amount) is likely to be one of the biggest challenges for the future quantity and quality of produced F&V:
  - — lack of rainfall, drought, and water sources drying up
  - — persistent heavy rain and hail
- predominance of internal flows over extra-EU trade;
- EU was a net importer of fruits and a net exporter of vegetables.

Source: FRUIT LOGISTICA, 2024. European Statistics Handbook

1.3 DETERMINANTS OF FRESH FRUIT AND VEGETABLES EXPORT COMPETITIVENESS

The export competitiveness of a country reflects its "market development and possession ability" and "profit-making ability" in the markets of trading partners (Farinha et al., 2018). In order to assess the level of export competitiveness, the revealed comparative advantage (RCA) index can be used. This index is based on international trade data and was developed by Balassa (1977). The revealed comparative advantage index of country i c in product j p is calculated in the following way:

$$RCA_{ij} = \frac{X_{ij} \Big/ \sum_{j' \in J} X_{ij'}}{\sum_{i' \in I} X_{i'j} \Big/ \sum_{i' \in I j' \in J} X_{i'j'}} \qquad (1)$$

where $X_{ij} \Big/ \sum_{j' \in J} X_{ij'}$ is the share of the export value of product j in the total value of the country's i exports, $\sum_{i' \in I} X_{i'j} \Big/ \sum_{i' \in I j' \in J} X_{i'j'}$ is the share of the export value of product j in the total value of the world exports.

2 *What consumers want: a survey on European consumer attitudes towards plant-based foods, with a focus on flexitarians', European Union's Horizon 2020 research and innovation programme (No 862957) (2021).*

RCA values exciding 1 suggest comparative advantage, while values less than unity indicate comparative disadvantage in the particular F&V product.

Existing empirical literature suggests a number of factors that have significant effects on fresh F&V export competitiveness. Among them are such macroeconomic determinants as per capita GDP or income of major importing countries and real effective exchange rate (Bhattacharya, 2018). Empirical evidence suggests that sector-specific factors, such as investment in the agricultural sector (Bhattacharya, 2018) and the price of particular F&V in trading partner countries (Hayat et al., 2024) as well as domestic price (Bhattacharya, 2018), also have statistically significant effects on the volumes of F&V exports.

With respect to international trade-related determinants, distance to trading partners is an important factor partially due to product perishability and the presence of trade agreements (Hayat et al., 2024).

2.CROP-SPECIFIC ANALYSIS

a. PRODUCTION OF SELECTED VEGETABLES

This report provides a descriptive analysis of production and international trade for the top 5 vegetables by production volume in Ukraine[3]: cabbage, tomatoes, cucumbers, onions, and carrots. Subsequently, production and trade are analysed for the same vegetables in the EU.

I. Production in Ukraine

Over the last five years production of selected five vegetables, namely cabbage, tomatoes, cucumbers, onions, and carrots, accounted on average for more than 70% of the total vegetable production[4] and almost two-thirds of the total area under vegetables. Selected vegetables are predominantly produced by family farms, whose share in the total output ranges from 73% for tomatoes to as large as 96% for cucumbers (Table 1).

Cabbage and tomatoes are the top vegetables by production volumes with the latest being most significantly affected by Russia's full-scale invasion (Figure 2). The main region for tomato production in Ukraine – Kherson – is partially occupied, other major regions, namely Mikolayiv and Dnipropetrovsk regions, despite being close to the frontline, showed an increase in tomato production in 2023, which however didn't compensate fully for the temporary production losses in Kherson region (Appendix A, Figure A1-A2) Kherson region is also the main region for the production of cucumbers and onions along with Kharkiv region, which is being severely affected by war (Appendix A, Figure A1). Consequently, over the last 5 years, production of cucumbers and onions declined with compound annual growth rates (CAGR) of -3.3% and -2.3% respectively.

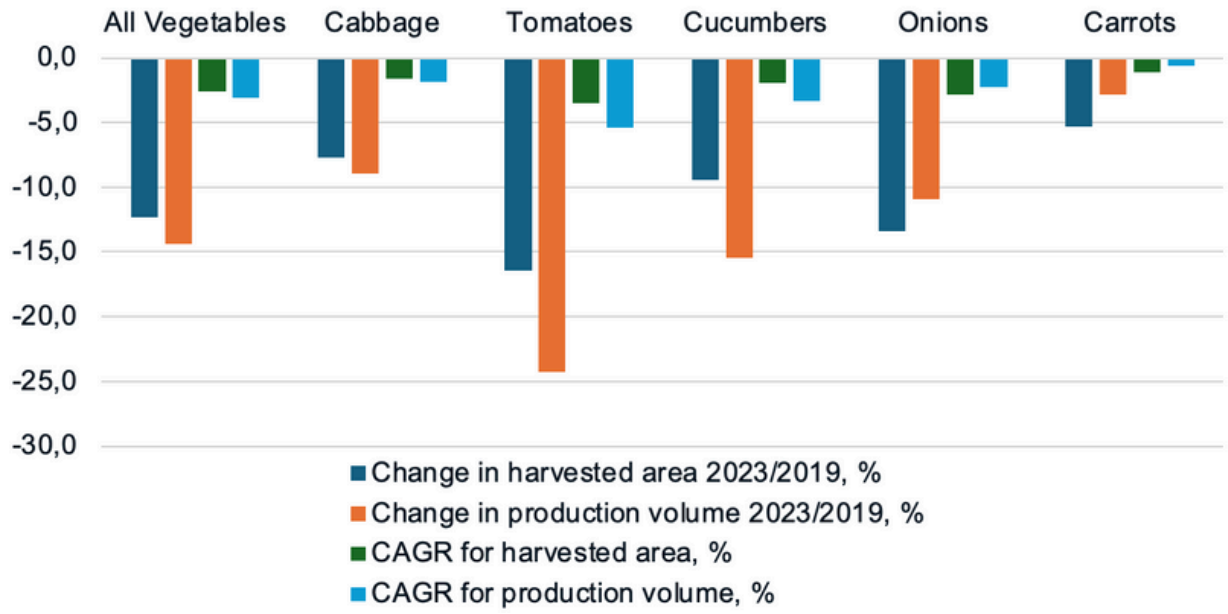
3 *Excluding table beet*
4 *Vegetable crops include cucumbers and gherkins, tomatoes, cabbage, table beet, table carrot, onion bulb, garlic, pepper sweet and bitter, squashes, eggplant, and table pumpkins.*

Table 1. *Harvested area and production volume of selected vegetables in 2019-2023 in Ukraine*

	2019		2020		2021		2022		2023		
	Area,[5] '000 ha	Volume[6], '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Share of total output produced by family farms, %
All Vegetables	**452.4**	**9687.6**	**464.9**	**9652.8**	**460.8**	**9935.2**	**374.9**	**7511.6**	**396.7**	**8297.1**	**88.5**
Cabbage	67.3	1755.5	70.6	1779.4	69.2	1740.5	60.1	1542.6	62.1	1597.9	94.1
Tomatoes	72.9	2224.4	74.9	2250.3	75.8	2444.9	51.5	1257.5	60.9	1683.6	72.5
Cucumbers	52.1	1034.2	54.1	1012.5	53.3	1080.0	45.1	825.6	47.2	874.3	96.1
Onions	53.9	998.1	55.1	1033.7	53.8	1024.4	44.2	809.8	46.7	889.0	87.1
Carrots	43.0	869.5	43.5	861.9	43.2	863.3	38.2	748.4	40.7	844.4	88.8

Source: SSSU data

Figure 2. *Growth rates for the total harvested area and production volumes of vegetables and for selected vegetables over the last 5-year period in Ukraine*



Source: Own calculations and illustration based on the SSSU data

II. **Production in the EU**

Analysed vegetables account on average for 54% of the EU's total vegetable output and slightly more than 30% of the total area under vegetables with tomatoes having the biggest share in the total vegetable output (Table 2). Over the last 5 years, selected vegetables' production declined in the EU with compound annual growth rates ranging from -0.2% for cucumbers to -4.2% for carrots (Figure 3). Among the main reasons for this decline were two major shocks hitting production during these 5 years: the COVID pandemic, affecting labour

5 *Harvested area*
6 *Production volume*

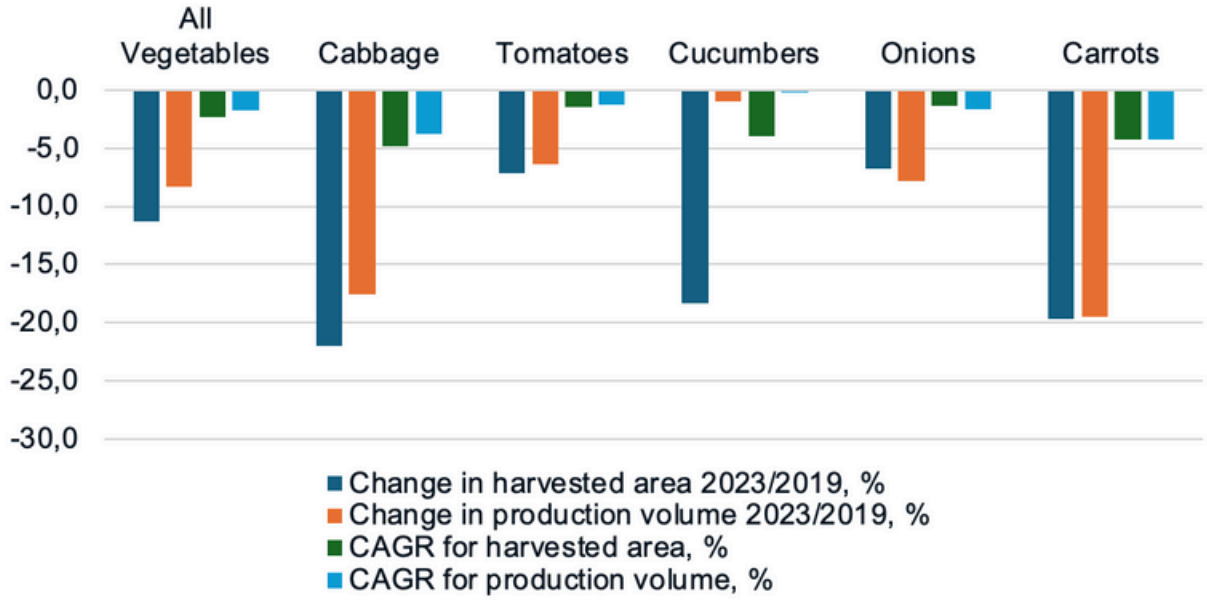
production input among others, and Russia's full-scale invasion of Ukraine[7] resulting in a sharp rise in energy costs, affecting F&V cultivation in greenhouses particularly hard, as well as the increase in prices of fertilizers and crop protection products.

Table 2. *Area and production volume of selected vegetables in 2019-2023 in the European Union*

	2019		2020		2021		2022		2023	
	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne
All Vegetables	**2143.2**	**64,470.2**	**2004.2**	**62,653.0**	**2051.3**	**66,099.9**	**1891.2**	**58,779.6**	**1900.5**	**59,119.0**
Cabbage [8]	95.9	3272.8	76.67	3054.5	77.29	3024.8	74.96	2694.2	74.77	2697.7
Tomatoes	242.7	17,100.5	227.89	16,666.6	231.25	17,929.9	208.43	15,551.8	225.35	16,015.0
Cucumbers	33.8	2439.4	29.33	2599.2	29.94	2532.6	26.36	2412.2	27.61	2415.7
Onions	187.1	6921.6	174.41	6656.6	185	7205.1	170.12	6183.9	174.38	6380.3
Carrots	119.9	5494.7	106.25	4819.1	108.41	5246.2	96.75	4412.4	96.28	4423.3

Source: Eurostat data

Figure 3. *Growth rates for the total harvested area and production volumes of vegetables and for selected vegetables over the last 5-year period in EU-27*

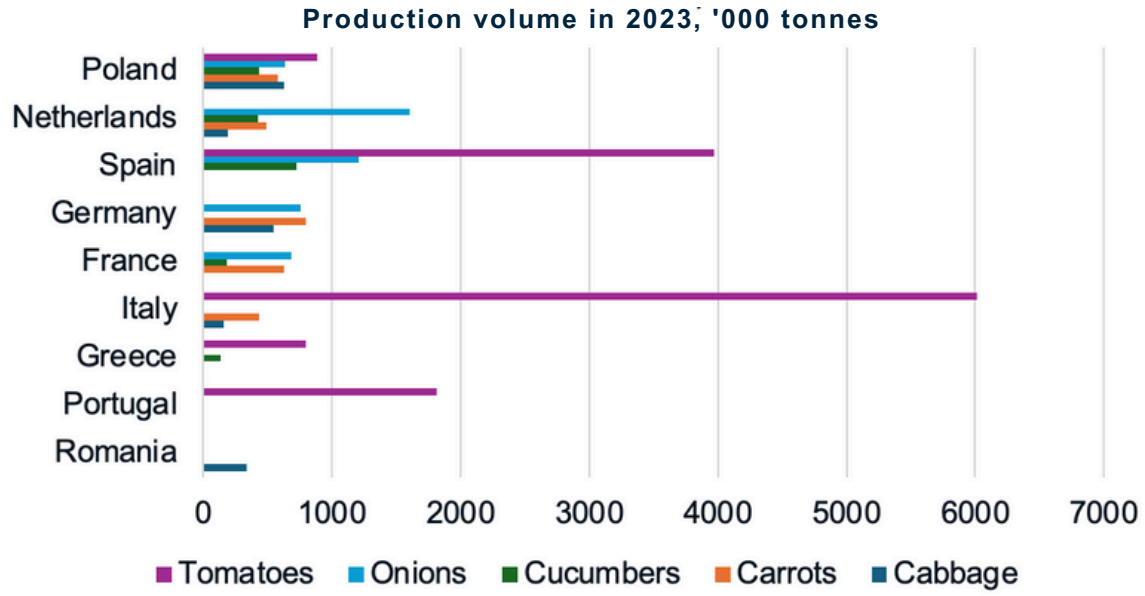


Source: Own calculations and illustration based on the Eurostat data

7 *FRUIT LOGISTICA, 2023. European Statistics Handbook*
8 *Not including data for Estonia due to data confidentiality*

From a geographical perspective, we looked at the top 5 EU countries by their total production volume of the analysed vegetables. The top 5 producers of tomatoes account for 84% of total EU production, for cabbage, cucumbers, onions and carrots these shares are 69%, 78%, 77% and 66% respectively. Figure 4 displays the countries that were the EU's top producers of selected vegetables in 2023. Noticeably, Poland is among the top five EU countries by production volume for all 5 analysed vegetables.

Figure 4. *Production volumes in top EU countries-producers of the selected vegetables*



Source: Own illustration based on the Eurostat data

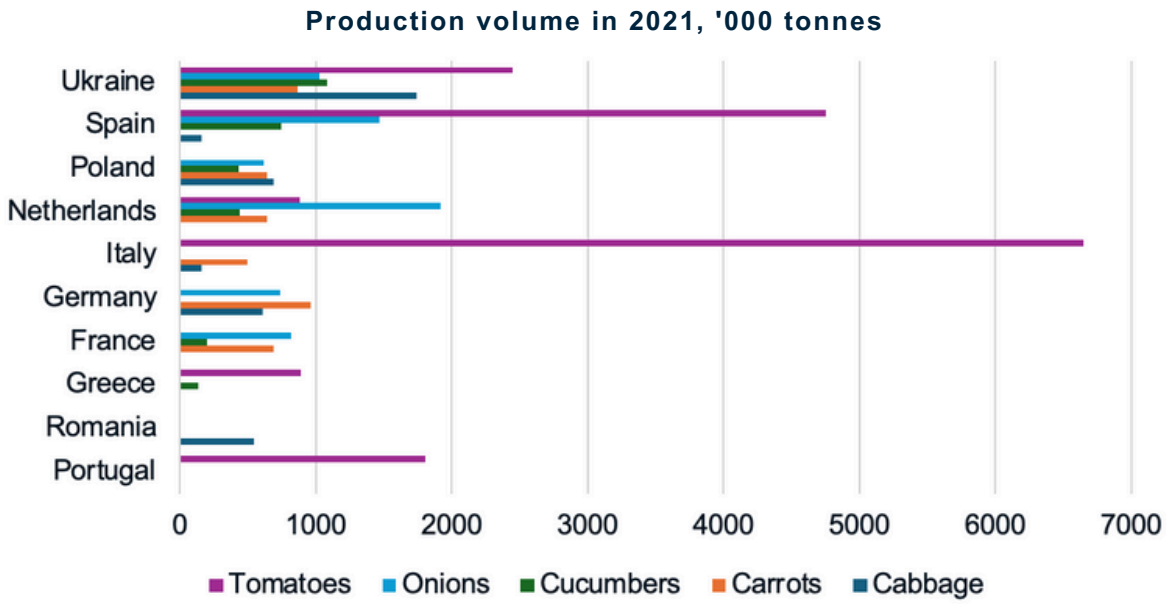
III. **Comparison of selected vegetables' production in the EU and Ukraine**

Among selected vegetables, tomatoes are the main crop by production volume for both Ukraine and the EU, having an especially noticeable share of total production in the EU while in Ukraine tomatoes and cabbage account for roughly the same share of the total vegetable output. Production volumes and harvested area for all selected vegetables decreased over the last 5 years both in Ukraine and the EU, with tomatoes in Ukraine and carrots along with cabbage in the EU showing the largest decline among considered crops.

When comparing production volumes of selected vegetables in Ukraine and top EU producers[9] in the pre-full-scale invasion year, in absolute terms, the Ukrainian output of cabbage and cucumbers was the largest among the countries considered (Figure 5). For other crops (tomatoes, onions and carrots) Ukrainian production volumes are above the median values of the top EU producer countries.

9 *Comparison is done using 2021 data and the top 5 EU producers for this year (top producers in EU by production volume vary across years)*

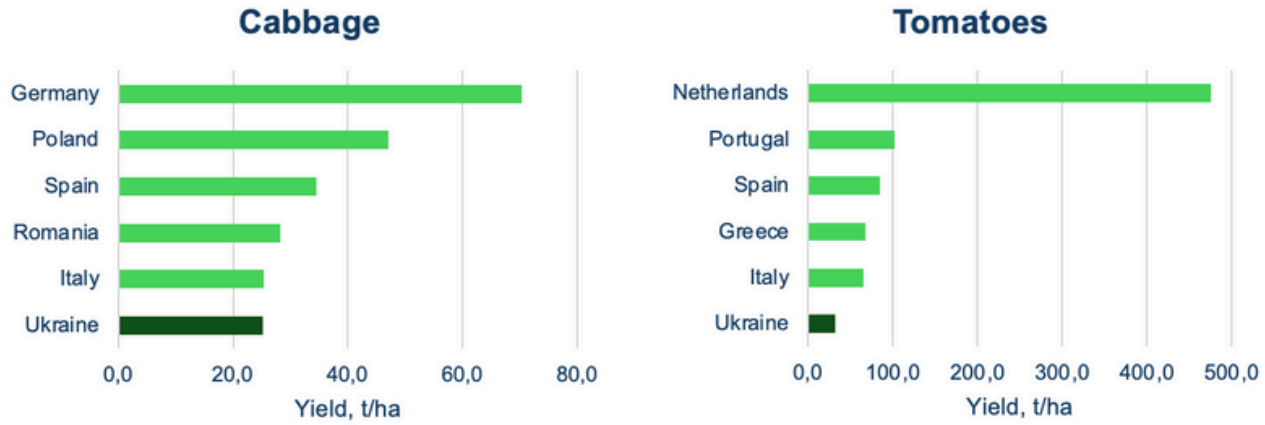
Figure 5. *Production volumes of selected vegetables by country in 2021*



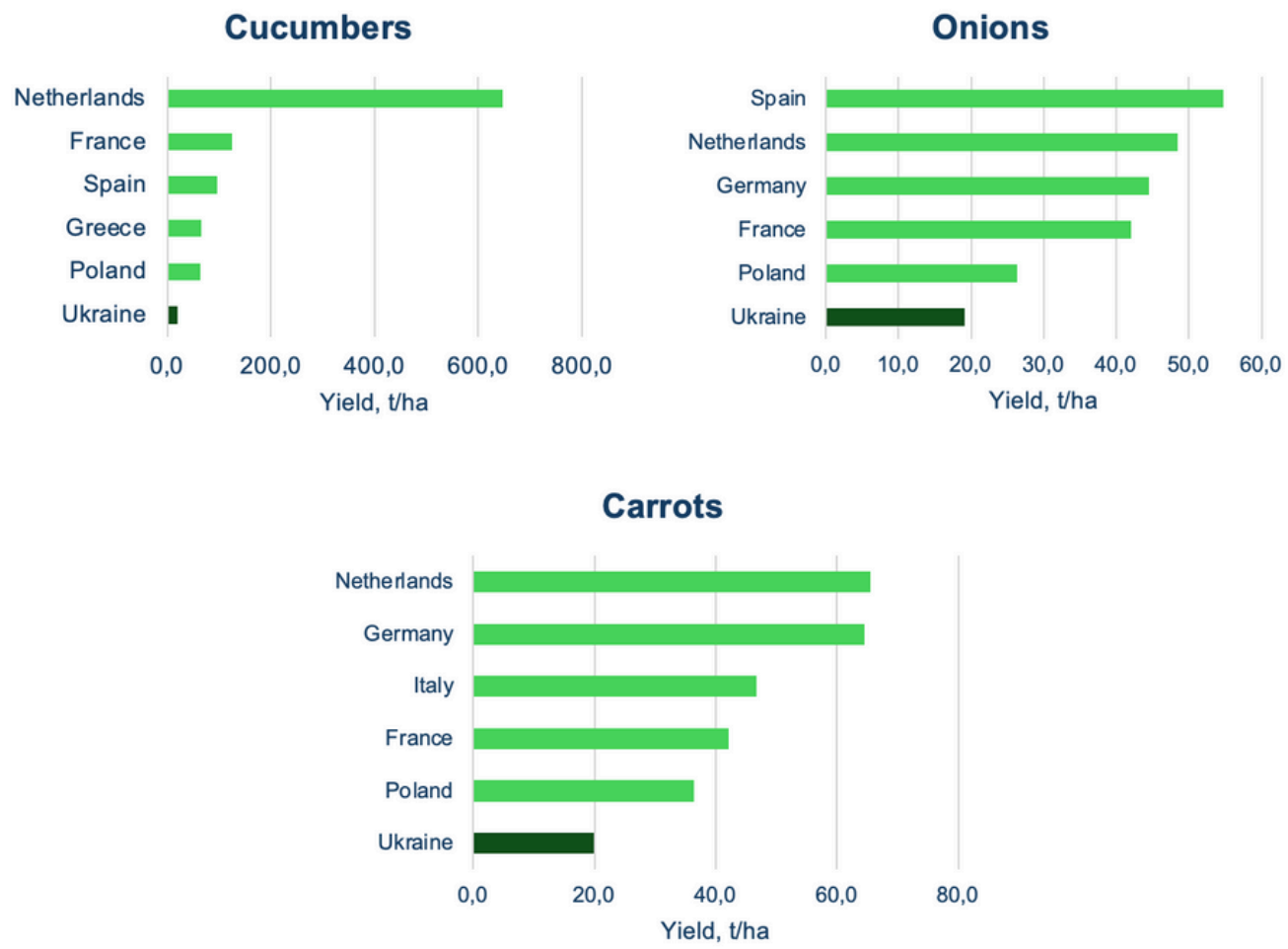
Own calculations and illustration based on the Eurostat and SSSU data

However, when analysing in relative terms and looking at yields per hectare as a partial measure of productivity, for all vegetables, except cabbage (Ukrainian yields per hectare are very close to Italian), analysed EU's top producers have higher land productivity compared to Ukraine. Among the factors that explain this difference is the level of mechanisation processes in vegetable production, which is lower in Ukraine compared with the EU.[10] The gap in yields per hectare is the most notable for tomatoes and cucumbers (Figure 6). This might be partially due to the fact that the share of tomatoes and cucumbers grown in open fields is much higher in Ukraine compared to the EU's top producers, such as the Netherlands, with production being predominantly under glass or highly accessible cover.

Figure 6. *Yield of selected vegetables by country in 2021*



10 *CBI, 2015. Value Chain Analysis for fresh and processed fruits and vegetables in Ukraine.*



Own calculations and illustration based on the Eurostat and SSSU data

b. PRODUCTION OF SELECTED FRUITS

This report outlines an analysis of production and international trade for the top 5 fruits, berries and nuts (hereafter fruits) by production volume in Ukraine: apples, sour cherries, plums, pears, and walnuts. Subsequently, descriptive analysis is provided for the production and trade of the same fruits in the EU.

I. Production in Ukraine

Average shares of selected five fruits - apples, sour cherries, plums, pears, and walnuts – in the total fruits and berries production and in the total area of the plantations in bearing age are 86% and 76% respectively over the last five years. The major producers of selected fruits are family farms, with the share in the total output ranging from 70% for apples to as large as 98% for plums (Table 3).

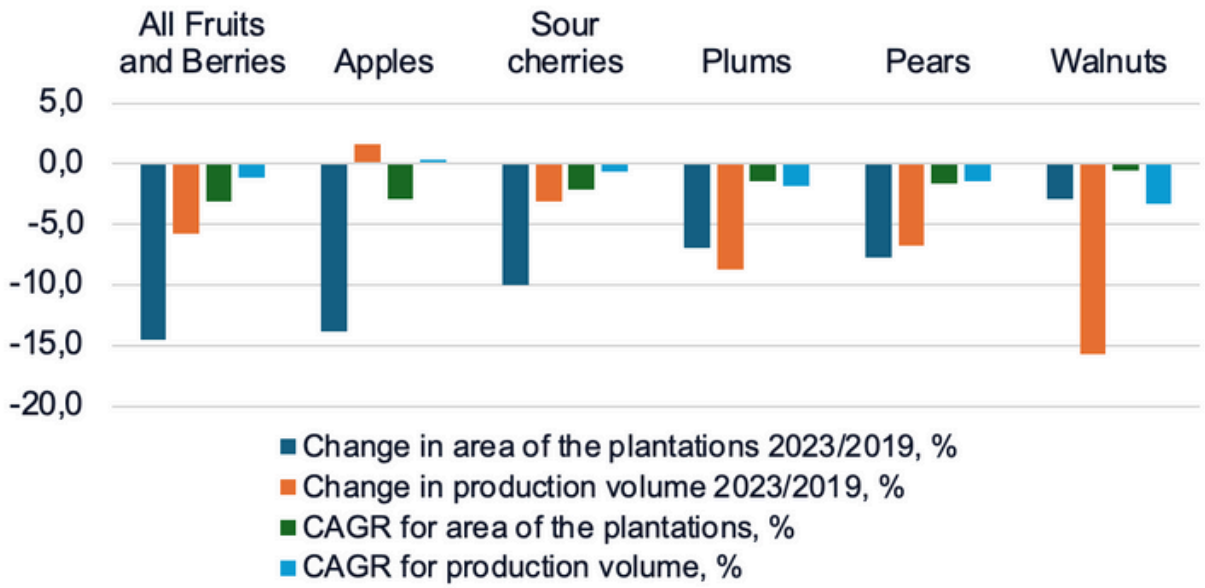
Ukrainian fruit output is dominated by apples (accounting for almost 60% of the total fruits and berries output in 2023), with a noticeable share of production concentrated in west-central (Vinnytsya, Khmelnytskiy, and Ternopil regions) and western parts of Ukraine (Chernivtsi, Lviv, and Zakarpattya regions) (Appendix A, Figure A3). The second major Ukrainian fruit by production volumes is sour cherries. Before the start of Russia's full-scale invasion, Ukraine was the second-largest world producer of sour cherries (FAOSTAT, 2021), shifting to third place in 2022. Overall, the effects of Russia's full-scale invasion are displayed in the noticeable reduction of plantations area (Figure 7) in the south-east part of Ukraine, namely Kherson, Zaporizhzhya, Donetsk, Luhansk and Mikolayiv regions.

Table 3. *Area of plantations in bearing age and production volume of selected fruits in 2019-2023 in Ukraine*

	2019		2020		2021		2022		2023		
	Area,[11] '000 ha	Volume[12], '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Share of total output produced by family farms, %
Fruits, berries and nuts	**195.5**	**2118.9**	**191.0**	**2023.9**	**190.5**	**2235.1**	**171.2**	**1994.8**	**167.0**	**1995.9**	**80.2**
Apples	87.7	1154.0	85.0	1114.6	84.4	1278.9	76.9	1129.1	75.6	1172.8	69.6
Sour cherries	20.0	167.5	19.9	174.6	20.2	193.7	18.7	180.2	18.0	162.2	96.7
Plums	17.3	181.1	17.6	173.2	17.9	188.3	16.7	168.6	16.1	165.3	97.7
Pears	11.7	155.3	11.7	152.3	12.0	163.3	11.1	146.1	10.8	144.8	94.4
Walnuts	13.9	125.9	13.4	113.3	13.8	115.4	13.4	107.7	13.5	106.1	97.1

Source: SSSU data

Figure 7. *Growth rates for the total area and production volumes of fruits and for selected fruits over the last 5-year period in Ukraine*



Source: Own calculations and illustration based on the SSSU data

11 *Area of the plantations in bearing age*
12 *Production volume*

II. **Production in the EU**

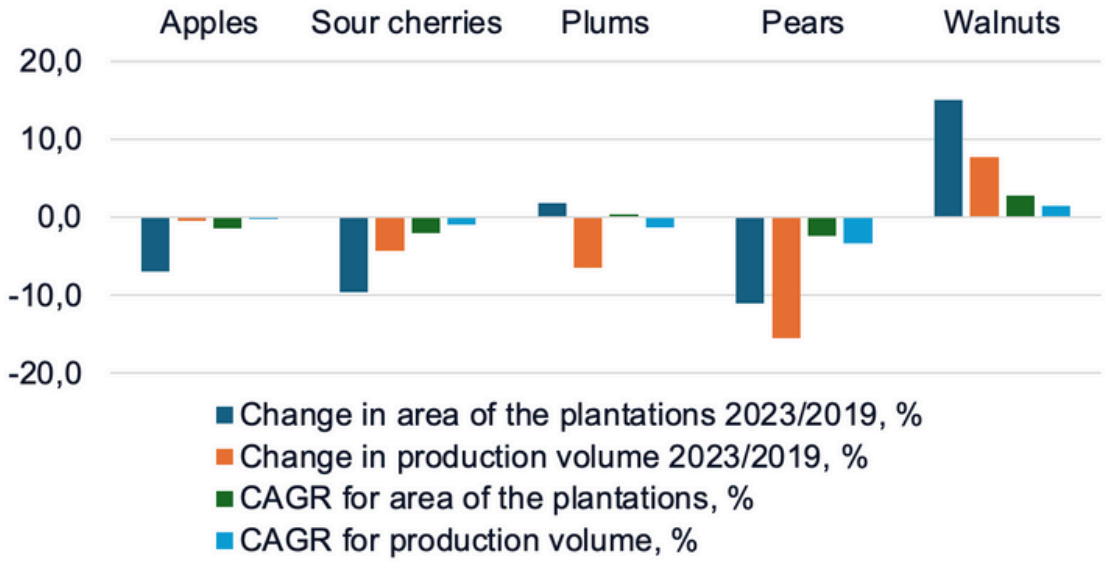
Fruits under consideration form on average almost two-thirds of the EU's total fruits, berries and nuts output and 30% of the total area under fruits with apples being the major crop, which accounts for almost 50% of total fruit production volume (Table 4). The same as for vegetables analysed, all selected fruits, except walnuts, experienced a decline in production volumes over the last 5 years (Figure 8). The major reasons are the same as for vegetable production, namely the pandemic, with potentially even stronger effects due to the higher labour-intensiveness of fruit production, and higher production costs after the launch of Russia's full-scale invasion of Ukraine.

Table 4. *Area and production volume of selected fruits in 2019-2023 in the European Union*

	2019		2020		2021		2022		2023	
	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne	Area, '000 ha	Volume, '000 tonne
Fruits, berries and nuts [13]	**2855.9**	**25,912.1**	**2947.7**	**25,684.7**	**2973.2**	**24,933.7**	**2997.0**	**25,432.5**	**2981.6**	[14]
Apples	507.0	12,093.0	489.2	11,957.2	492.6	12,405.5	478.0	12,559.4	472.0	12,038.4
Sour cherries	53.9	295.2	50.3	293.2	50.8	296.4	50.3	318.2	48.8	282.4
Plums	155.1	1632.4	160.4	1639.7	157.7	1571.8	156.6	1472.5	158.1	1526.4
Pears	112.2	2125.4	108.3	2368.2	107.0	1904.8	103.1	2063.4	99.7	1797.5
Walnuts	87.6	171.1	99.2	182.4	97.0	220.5	102.4	239.3	100.8	184.3

Source: Eurostat data.

Figure 8. *Growth rates for the total area and production volumes of fruits and for selected fruits over the last 5-year period in EU-27*

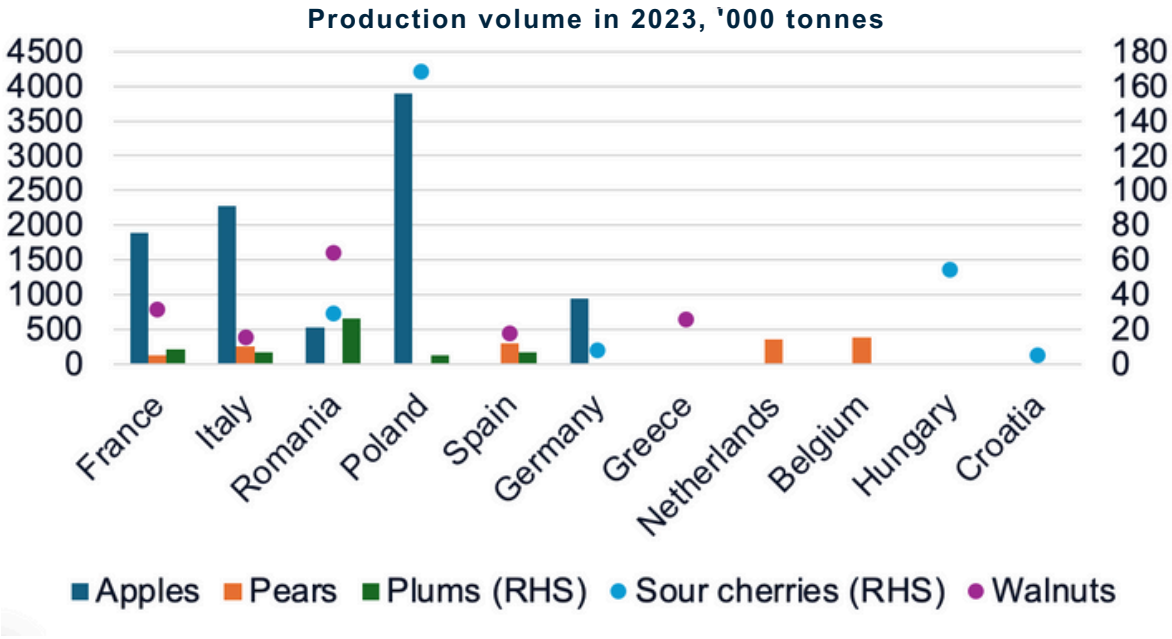


Source: Own calculations and illustration based on the Eurostat data

13 *Excluding citrus fruits, grapes and strawberries*
14 *Data is not available because of missing value for Italy*

Concerning the top countries-producers of the analysed fruits, levels of production concentration are even higher than for vegetable production: the top 5 producers of apples account for 79% of total EU production, for sour cherries, plums, pears and walnuts these shares are 94%, 86%, 78% and 83% respectively. The countries that were the EU's top producers of selected fruits in 2023 are displayed in Figure 9.

Figure 9. *Production volumes in top EU countries-producers of the selected fruits*



Source: Own illustration based on the Eurostat data

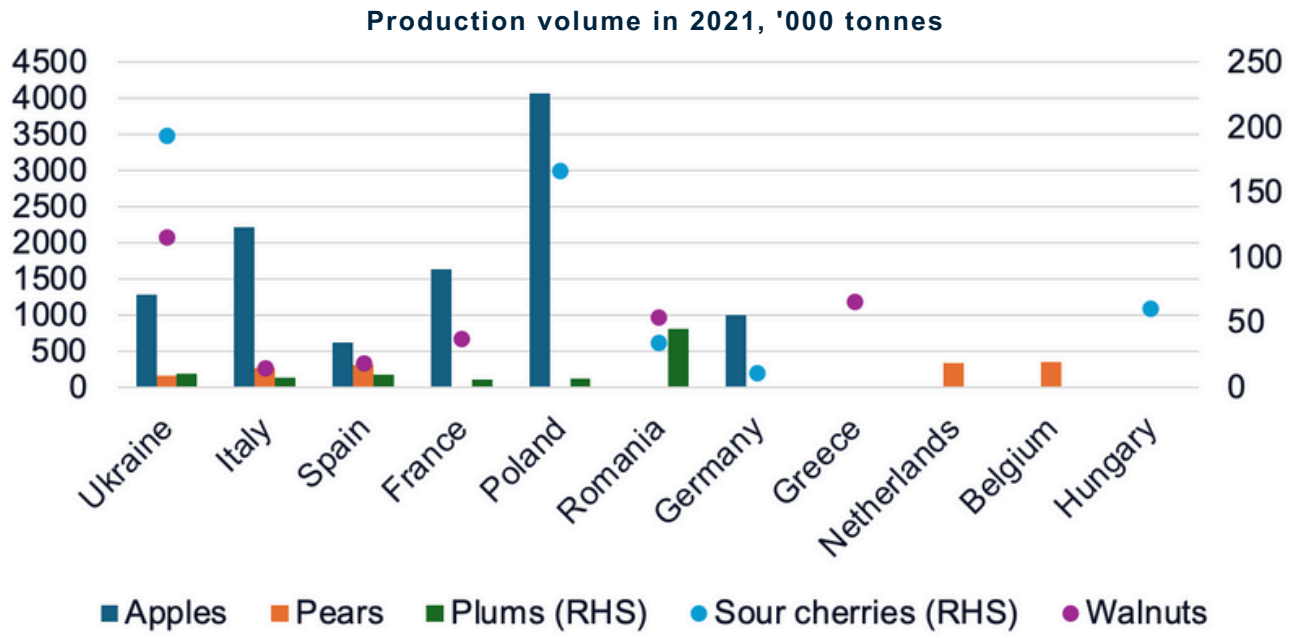
III. **Comparison of selected fruits' production in the EU and Ukraine**

Apples are the top crop, among the considered fruits, berries and nuts, by production volume for both Ukraine and the EU, accounting for more than half of total production volumes. For all selected fruits, outputs and harvested areas experienced a decrease over the last 5 years in Ukraine with walnuts showing the largest decline. While in the EU, among selected fruits, berries and nuts, only walnuts had a positive growth rate between 2019 and 2023.

With respect to production volumes of selected fruits in Ukraine and top EU producers[15] in the pre-full-scale invasion year, in absolute terms, Ukraine was the largest producer of walnuts and sour cherries among the countries considered (Figure 10). For all other fruits (apples, pears and plums) Ukrainian output was below average production volumes of the top EU producer countries.

15 *Comparison is done using 2021 data and the top 5 EU producers for this year (top producers in EU by production volume vary across years)*

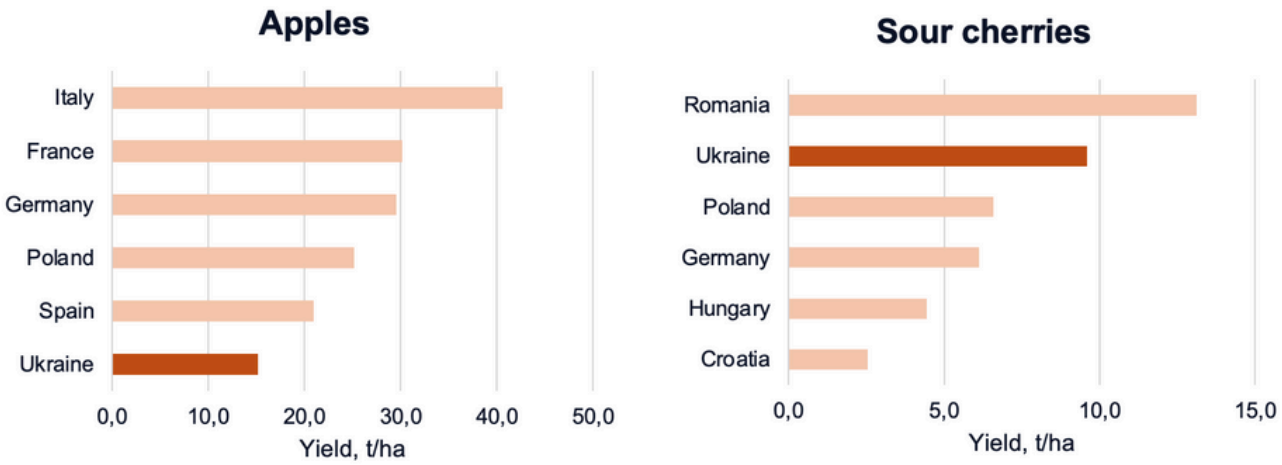
Figure 10. *Production volumes of selected fruits by country in 2021*



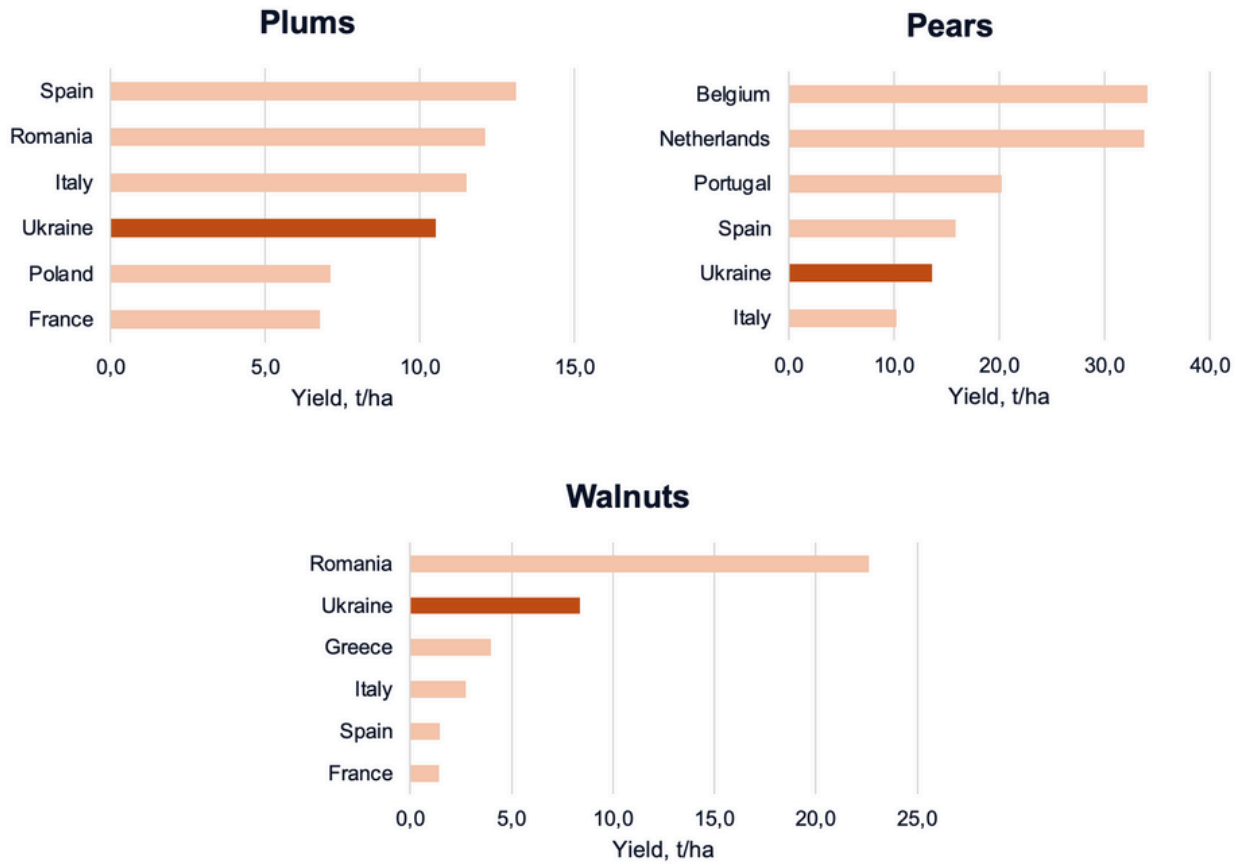
Source: Own illustration based on the Eurostat and SSSU data

With respect to the yields per hectare,[16] unlike for vegetables, Ukrainian partial productivity is in line with the top EU producer countries for all considered fruits, except for apples (Figure 11). Noticeably, when comparing with the top five EU producers of sour cherries and walnuts, Ukraine has the second highest yields per hectare. This can be one of the indications of the selected Ukrainian fruits' potential competitiveness in the EU market.

Figure 11. *Yield of selected fruits by country in 2021*



16 *Comparison is done using 2021 data and top 5 EU producers for this year*



Source: Own calculations and illustrations based on the Eurostat and SSSU data

c. INTERNATIONAL TRADE: UKRAINIAN RCA FOR SELECTED F&V

From an international trade perspective, in 2023 Ukraine was a net importer of all selected vegetables (Figure 12). EU countries are among the major trading partners for Ukraine, accounting for a noticeable share of imports, especially of onions, carrots and cabbage (Figure 12), and being among the top export destinations of the selected crops (Appendix B, Table B4).

With respect to comparative advantage, calculated values of the revealed comparative advantage index (Appendix B, Table B3) suggest a comparative disadvantage for Ukraine compared with the EU in all selected vegetables (Figure 12).

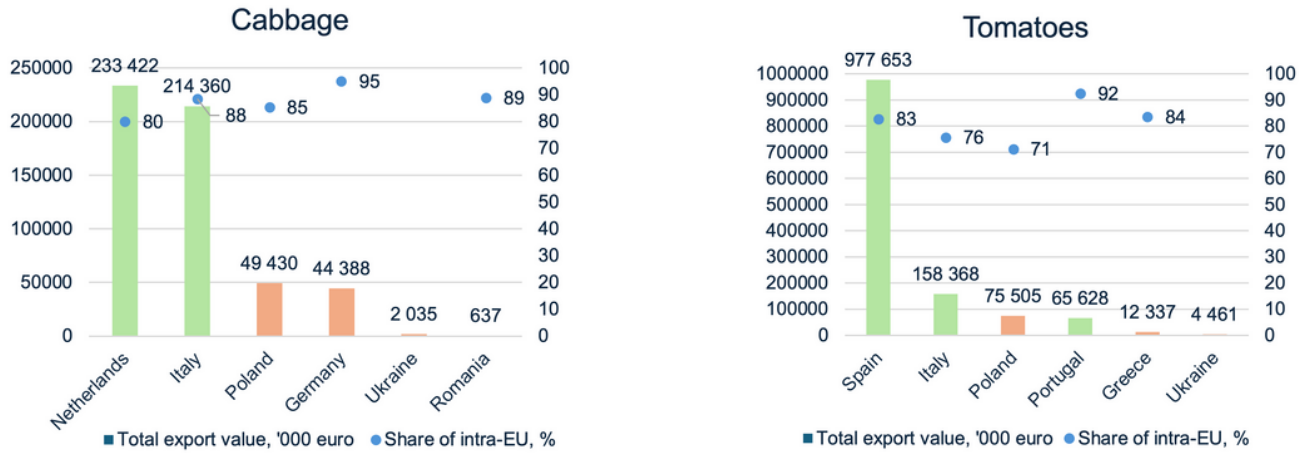
Figure 12. *International trade of selected vegetables produced in Ukraine*

Selected vegetable	Cabbage	Tomatoes	Cucumbers	Onion	Carrots
Trade status of Ukraine in 2023	Net importer	Net importer	Net importer	Net importer	Net importer
Share of import from EU in 2023, %	43.9	19.3	15.2	66.3	52.9
RCA index (average 2019 — 2021)	0.26	0.29	0.74	0.28	0.82
RCA index (average 2022 — 2023)	0.07	0.12	0.39	0.03	0.02

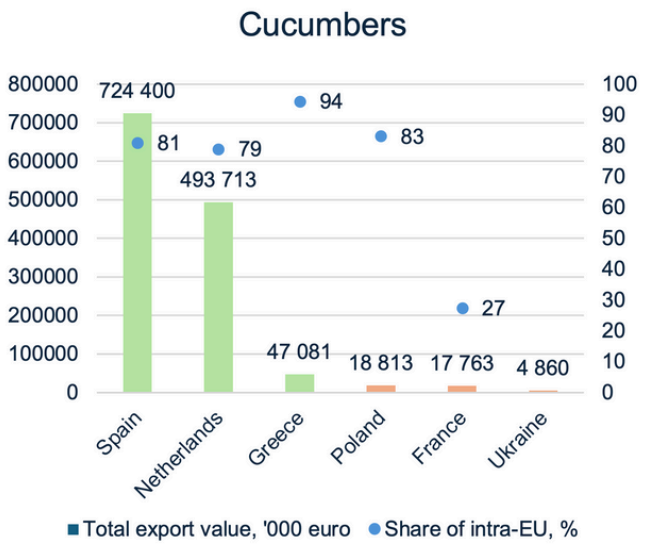
Source: Own calculations and illustration based on the State Customs Service of Ukraine and Eurostat data

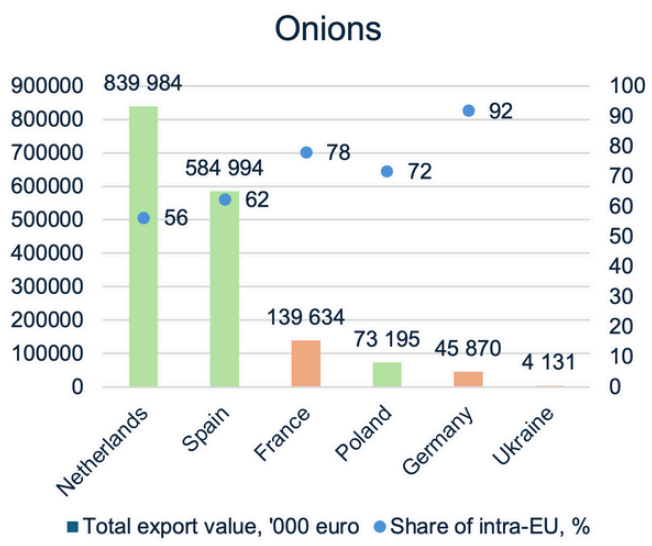
Concerning export values of selected vegetables in Ukraine and top EU producers[17] in the pre-full-scale invasion year, in absolute terms, Ukraine had the lowest export values of tomatoes, cucumbers, onions and carrots, and the second-lowest of cabbage (Figure 13). Netherlands, Spain, and Italy were the top countries in terms of export values and are net exporters of the selected vegetables. Noticeably, for the majority of top EU producers of the selected vegetables the share of intra-EU export was very significant (Figure 13).

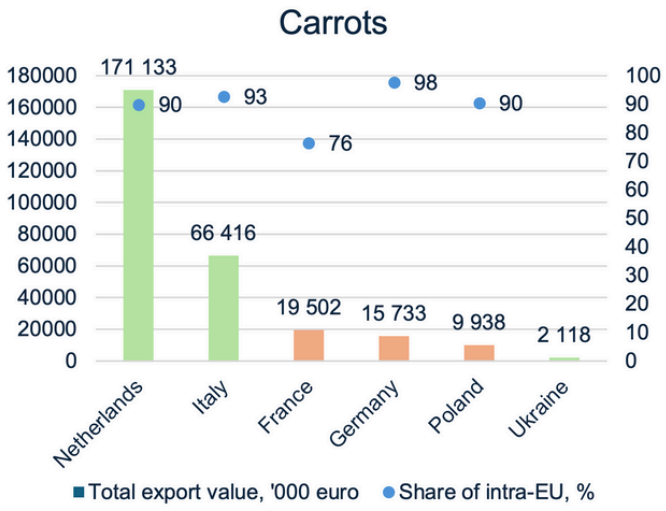
Figure 13. *International trade of selected vegetables produced in Ukraine and top EU producers in 2021*



17 *Comparison is done using 2021 data and the top 5 EU producers for this year (top producers in EU by production volume vary across years)*







Note: *net exporter* *net importer*

Source: Own calculations and illustration based on the State Customs Service of Ukraine and Eurostat data

When it comes to selected fruits, in 2023 Ukraine was a net importer of all considered fruits, except apples and walnuts (Figure 14). For the latest, Ukraine is among the top 6 exporters in the world after the United States, Mexico, Chile, China and Germany.[18] A noticeable share of EU countries in total imports of selected fruits (Figure 14), as well as in Ukrainian exports of them (Appendix B, Table B4) reflects the importance of EU countries as trading partners for Ukraine. Calculated values of the revealed comparative advantage (RCA) index suggest that compared with the EU, Ukraine has a comparative advantage for apples, sour cherries and walnuts: RCA values for these fruits are larger than unity and especially significant for walnuts.

18 *Walnuts without shells, fresh or dried exports by country in 2021*

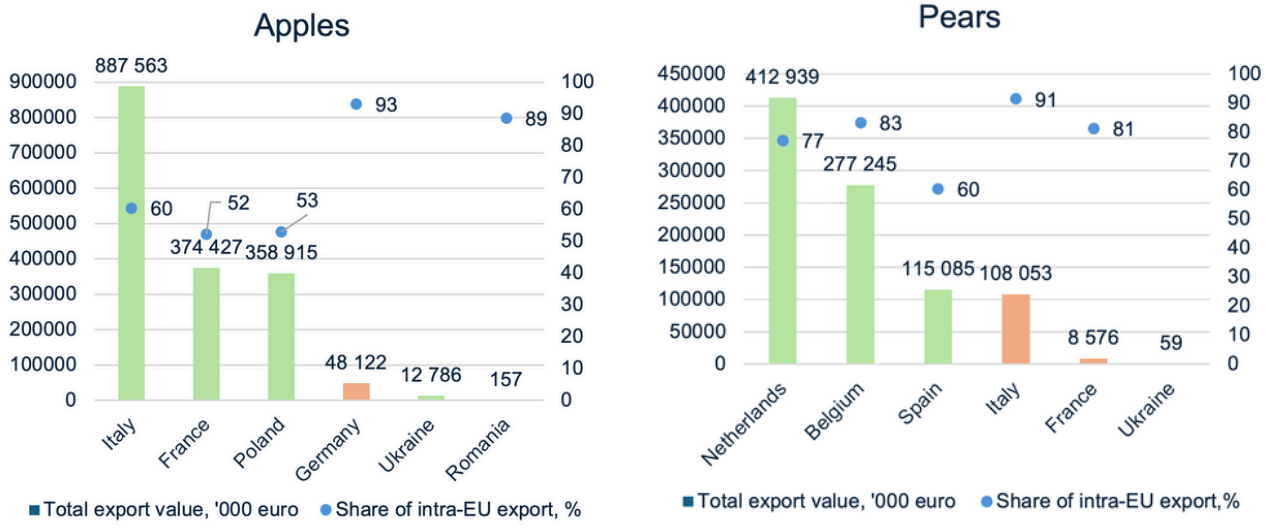
Figure 14. *International trade of selected fruits produced in Ukraine*

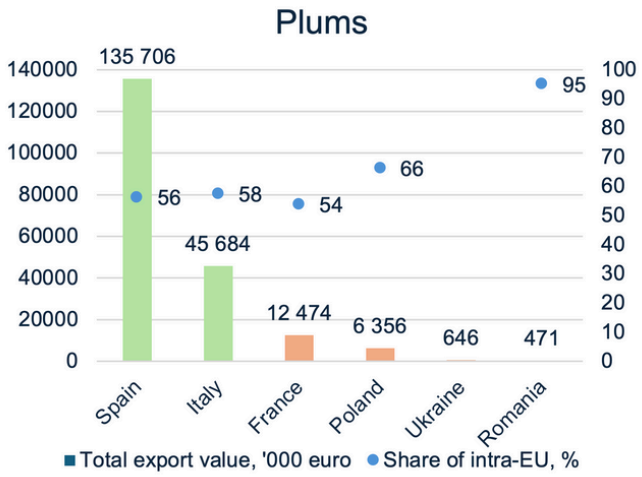
Selected fruits	Apples	Pears	Sour cherries	Plums	Walnuts
Trade status of Ukraine in 2023	Net exporter	Net importer	Net importer	Net importer	Net exporter
Share of import from EU in 2023, %	98.7	71.3	91.5	57.4	18.9
RCA index (average 2019 — 2021)	0.67	0.01	0.25	0.17	94.26
RCA index (average 2022 — 2023)	1.10	0.04	1.06	0.10	88.98

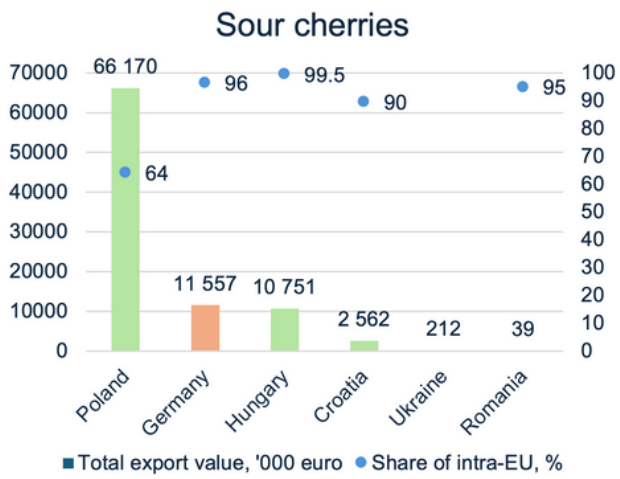
Source: Own calculations and illustration based on the State Customs Service of Ukraine and Eurostat data

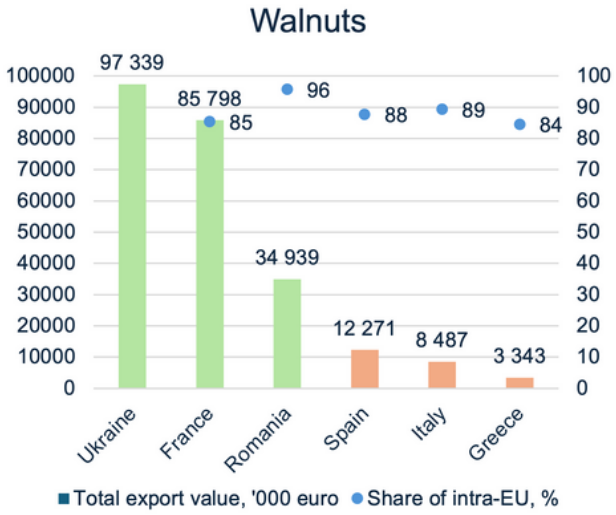
When comparing export values of selected fruits in Ukraine and top EU producers in the pre-full-scale invasion year, in absolute terms, Ukraine was the largest exporter of walnuts among the countries considered. With respect to all other analysed fruits, in 2021 Ukraine had the second-lowest (after Romania) export value of apples, sour cherries and plums and the lowest export value of pears compared to the top EU producers (Figure 15).

Figure 15. *International trade of selected fruits produced in Ukraine and top EU producers in 2021*









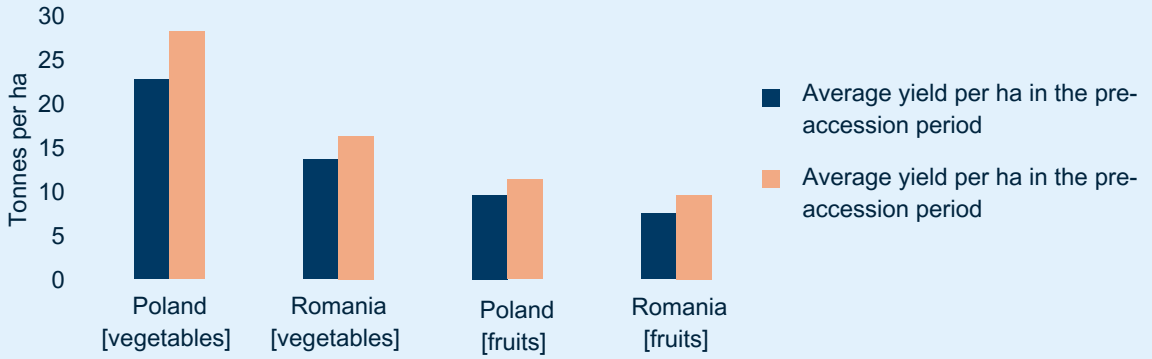
Note: *net exporter* *net importer*

Source: Own calculations and illustration based on the State Customs Service of Ukraine and Eurostat data

Box 2. *Developments in the F&V sector in Poland and Romania following Accession to the EU*

In the post-accession periods, the production of fruits and vegetables in Poland and Romania exhibited an increase in productivity with on average around 20% higher yields per hectare compared to pre-accession periods (Figure B1). Notably, growth rates of intra-EU import values are much higher than values for extra-EU import of fruits and vegetables, suggesting a widening of opportunities for intra-EU trade after the accession of Eastern European countries (Figure B1). It is also noteworthy to highlight considerably higher growth rates of Polish fruits and Romanian vegetables extra-EU export values compared to corresponding intra-EU values.

Figure B1. *Yields per hectare and international trade of F&V in Poland and Romania in pre- and post-accession period*



Source: Own calculation and illustration based on Eurostat data

Post-accession average / Pre-accession average, growth rate	Poland		Romania	
	Vegetables	Fruits	Vegetables	Fruits
Extra-EU export value	1.12	2.56	2.38	-0.08
ntra-EU export value	2.51	1.38	1.33	2.16
Extra-EU import value	0.96	0.26	2.13	0.47
Intra-EU import value	4.79	2.79	9.55	8.97

Note: Pre-accession period: 2000-2004 for Poland, 2000-2007 for Romania
Post-accession period: 2005-2023 for Poland, 2008-2023 for Romania

Among important developments in the Polish F&V markets in the post-accession period (Czyżewski and Czakowski, 2016) were:

- significant increase in the average annual volume of F&V wholesale purchases due to, among other factors, the dynamically growing export and investments in the processing industry, promoting the development of warehousing and processing infrastructure;
- a positive development of procurement prices for producers, which had an impact on export growth;
- increase in income of farms growing fruit trees, which was to a considerable degree a consequence of direct payments.

3. UKRAINIAN FRESH F&V SECTOR: STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS

This section provides a general overview of the Ukrainian fresh fruit and vegetables sector, highlighting its strengths, areas for improvement, opportunities and threats. The Ukrainian fresh fruit and vegetables sector is characterised by a number of strengths, which are summarised in Figure 16. Among the natural endowment-related ones are favourable climatic conditions for horticultural production as well as good availability and quality of natural resources such as soil and water. More specifically, Ukraine is among the countries with the most fertile soils in the world and is characterized by low to medium water stress levels (Kuzma et al., 2023). Ukraine produces a wide range of horticulture crops, with cabbage, tomatoes, cucumbers, onions and carrots being the top ones by production volumes among vegetables,[19] and apples, sour cherries, plums, pears, and walnuts among fruits, berries and nuts. Since many fresh fruits and vegetables are perishable, an important advantage for the Ukrainian F&V sector is geographical proximity to the EU market, suggesting shorter transport time and lower carbon footprint associated with logistics.

At the same time, there are several important areas that need improvement for Ukrainian fresh F&V production to be competitive (Figure 16). Concerning production, levels of mechanisation processes in agricultural production, especially vegetable and fruit production,[20] [21] are much lower compared with the EU, affecting productivity levels. More specifically, the mechanisation level, proxied by farm machinery per unit of agricultural land, was 0.43 units of horsepower per 1000 hectares of agricultural land in Ukraine in 2021 (USDA, 2021). Meanwhile, the average corresponding value for the EU was 2.87 units of horsepower per 1000 hectares (USDA, 2021). Another important weak area is the high rates of post-harvest loss of F&V (40-60% of post-harvest waste) due to a lack of properly equipped storage facilities, which can be addressed by promoting cold chain logistics as post-harvest handling capacity.[22] As for selling produced fruits and vegetables, small and medium farms (SMFs) often lack the necessary certifications for exporting to EU countries as well as consistent access to the market, namely linkages to multiple market channels that allow moving from local open-air markets to working with traders who can connect producers with higher-value markets.[23]

With respect to opportunities, the F&V sector is one of the main agricultural sectors with respect to the creation of employment and income generation opportunities for small and medium farms. Similar to EU countries, horticultural production in Ukraine is dominated by small farms: 94% of the vegetable volume and 82% of the fruit volume were produced in 2022 by family farms (SSSU,[24] 2022). In Ukraine, small scale family farms include i) individual farmers - legal entities (ua: fermerski hospodarstva), ii) family farmers – physical persons entrepreneurs (ua: simeyni fermerski hospodarstva), iii) individual rural farms physical persons (ua: osobysti selianskihospodarstva/odnoosibnyky); iv) other commercial farms that effectively fall into the category of small farmers (so called physical persons entrepreneurs or other types of legal entities operating on relatively small scale) (Nivievskyi, Iavorskyi, and Donchenko, 2023).

19 *Excluding potatoes and beetroot*
20 *Calculated ratio between depreciation cost and F&V revenue (based on State Statistics Service data for Ukraine and Farm accountancy network data (FADN) for EU) suggests that the capital intensity of F&V production was 14%higher in EU compared with Ukraine in 2019.*
21 *CBI, 2015. Value Chain Analysis for fresh and processed fruits and vegetables in Ukraine.*
22 *Horticulture Opportunities in Ukraine. UHBDP*
23 *Horticulture Opportunities in Ukraine. UHBDP*
24 *State Statistics Service of Ukraine*

A distinct feature of F&V production is its labour-intensiveness, e.g. average share of labour cost in total production cost is around 20% for F&V compared with 6% for cereals and pulses.[25] Lower labour costs compared to the EU contribute to the competitiveness of F&V production, especially when it comes to the development of organic production in Ukraine. In Ukraine, the average monthly wage of employees was 455 euros[26](in agriculture - 381 euros) in 2021 while in the European Union, the average monthly wage value was 2792 euros[27] in 2021.

An important opportunity for the development of EU export markets for Ukrainian fruits and vegetables is the Deep and Comprehensive Free Trade Area (DCFTA), the implementation of which is ongoing. For better integration with the EU market, Ukraine is aligning its legislation to the EU's norms and standards for industrial and agri-food products as well as to the EU's legislation in trade-related areas (competition, technical barriers to trade, sanitary and phytosanitary, customs and trade facilitation, protection of intellectual property rights, and public procurement). Priority Action Plan for 2023-2024 contains a set of actions aimed to accelerate the implementation process of the DCFTA.

Among the major threats to the Ukrainian F&V sector, the most acute ones are vast landmine contamination of farmland and undermined water security caused by Russia's full-scale invasion. A substantial share of vegetable production is located in regions (Figure 17, 18) severely affected by war and having confirmed and suspected explosive ordnance contamination.[28] The south and east of Ukraine are also affected severely by cut supplies of potable, industrial and irrigation water: since the beginning of the unprovoked full-scale invasion, Russian forces have destroyed one-third of Ukraine's freshwater storage, causing major ecological and economic consequences for water bodies and infrastructure (Hapich et al., 2024).

Another potential constraint for Ukrainian F&V producers might be limited access to long-term loans for SMFs, which can negatively affect the speed of new technology uptake and productivity, and insufficient internal financial resources during the post-war recovery period. The agricultural sector alone has suffered more than $80 billion in direct losses and damages as a result of the full-scale invasion (Neyter, Zorya and Muliar, 2024), while the average Ukrainian GDP over the ten years before the full-scale invasion was $102 billion.[29]

25 *Calculation based on data from the State Statistics Service of Ukraine 'Report on the main economic indicators of agricultural enterprises' in 2019*
26 *State Statistics Service of Ukraine data*
27 *Eurostat data*
28 From the Ground Up: Demining Farmland and Improving Access to Fertilizer to Restore Ukraine's Agricultural Production
29 Source: World Bank national accounts data

Figure 16. *SWOT analysis for the Ukrainian fresh F&V sector*

Strengths

- Favourable climatic conditions;
-Fertile soil and good water resource endowments;
- Proximity to the European market;
- Diversity of produced horticulture crops

Weaknesses (Areas for improvement)

- SMFs lack consistent access to the market;
- High rates of post-harvest waste;
- Lack of necessary certifications;
- Levels of mechanization processes in vegetable production need improvement;
- Lack of properly equipped storage facilities

F&V sector in Ukraine

Opportunities

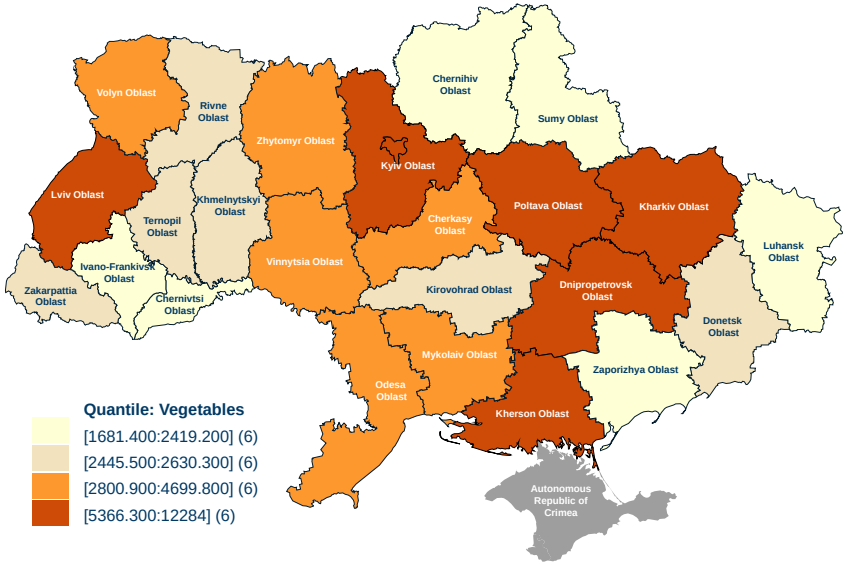
-Horticulture: Opportunity for SMFs;
- Opportunities for the production of organic F&V;
- Potential for competitive advantages in the most labour-intensive sector products;
- Potential for rapid development of EU export market after the full completion of DCFTA with EU implementation process

Threats

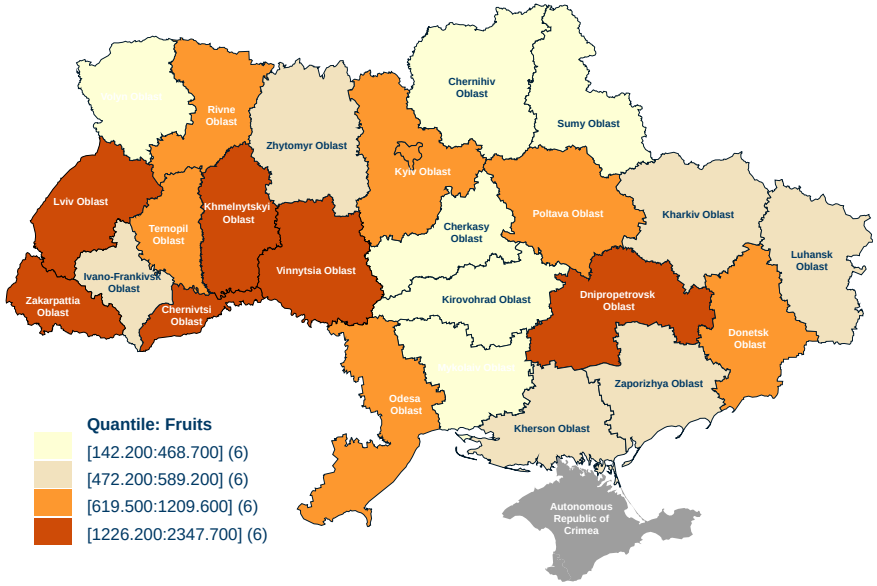
- Noticeable share of vegetable production located in regions severely affected by war:
mined land;
- Undermined water security;
-Lack of internal financial resources and limited access to long-term loans

Figure 17. *Location of vegetables, fruits and berries production in Ukraine in 2019* **30**

Fresh vegetable open field production, '00 tonnes

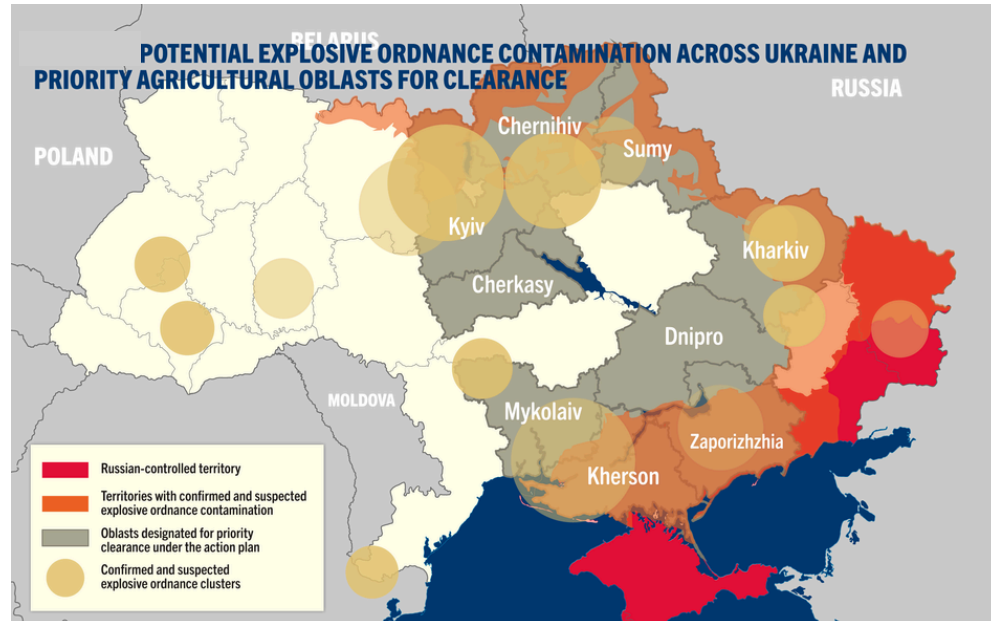


Fresh fruits and berries production, '00 tonnes



Source: Own visualisation based on State Statistics Service of Ukraine data

Figure 18. *Potential explosive ordnance contamination across Ukraine*

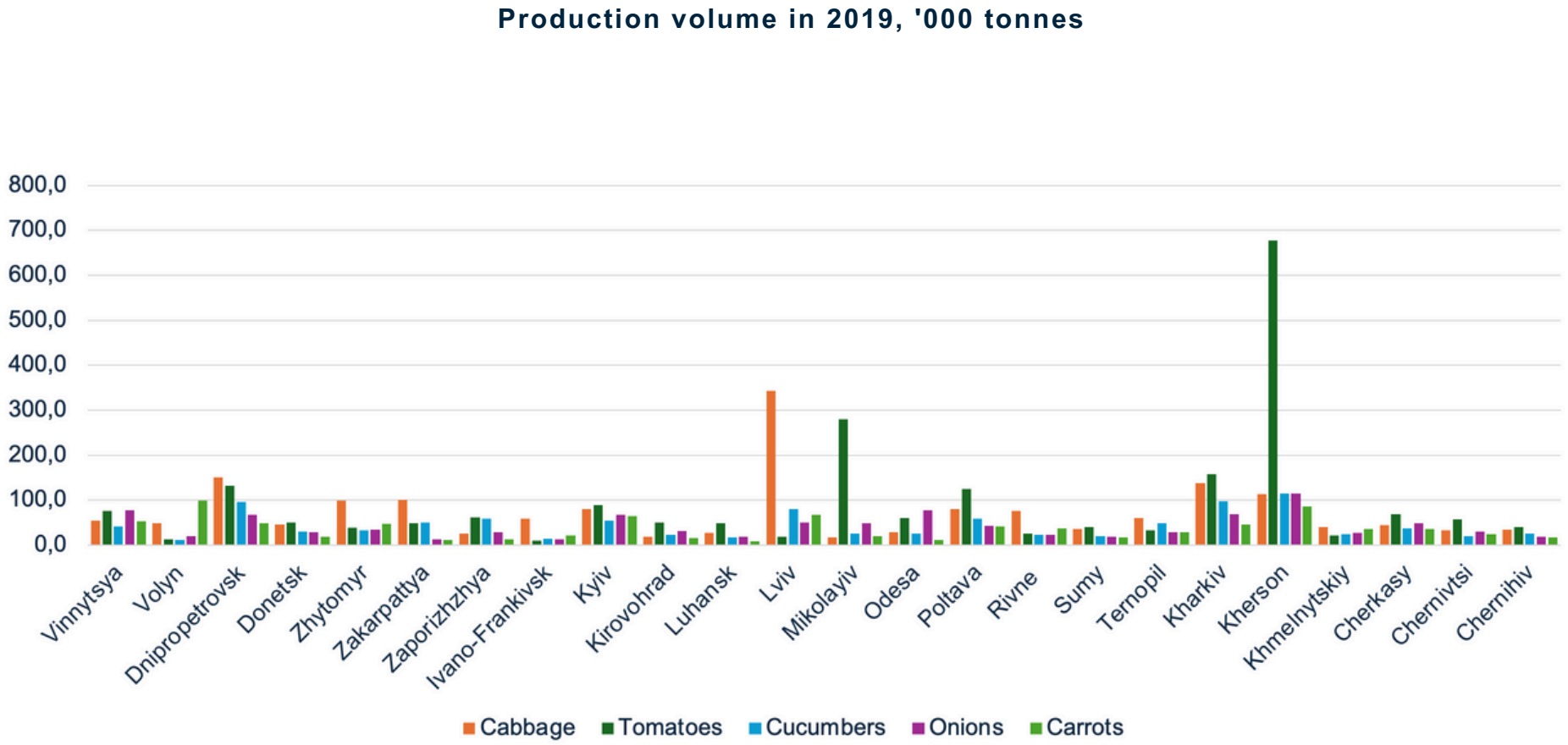


Source: CSIS, 2023. From the Ground Up: Demining Farmland and Improving Access to Fertilizer to Restore Ukraine's Agricultural Production Report Launch.
Based on:
"Interactive map of areas that could potentially be contaminated by explosive objects," State Emergency Service of Ukraine, 2023;
"Interactive Map: Russia's Invasion of Ukraine," Institute for the Study of War, December 6, 2023;
"Oleksii Reznikov: Action plan for demining agricultural land for sowing campaign approved," Ukrainian Ministry of Defence, March 20, 2023.

30 *Maps display location by production volumes for the last pre-pandemic and pre-full-scale invasion year.*

APPENDIX A.

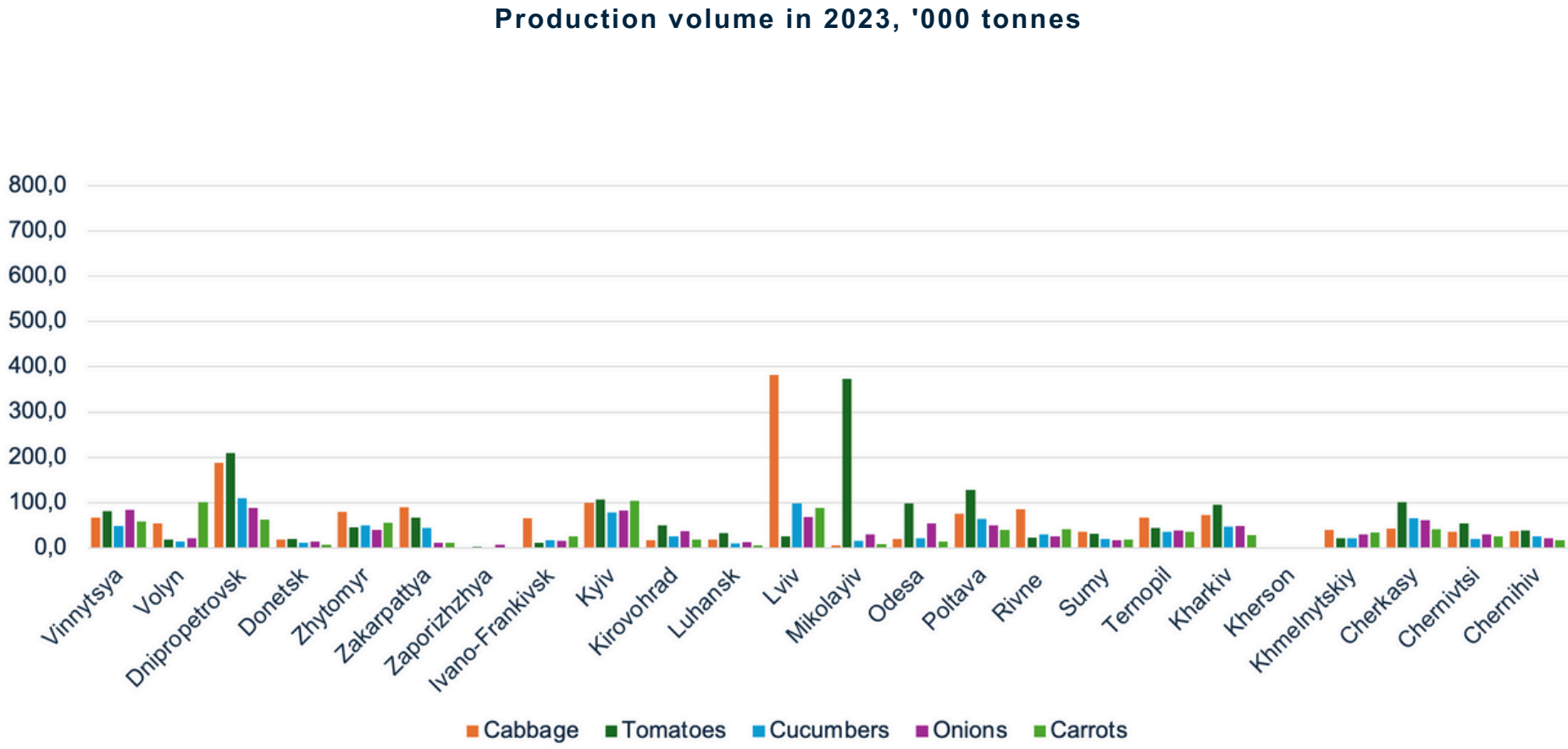
Figure A1. *Production volumes of selected 5 vegetables by region in 2019* [31]



Source: Own illustration based on the SSSU data

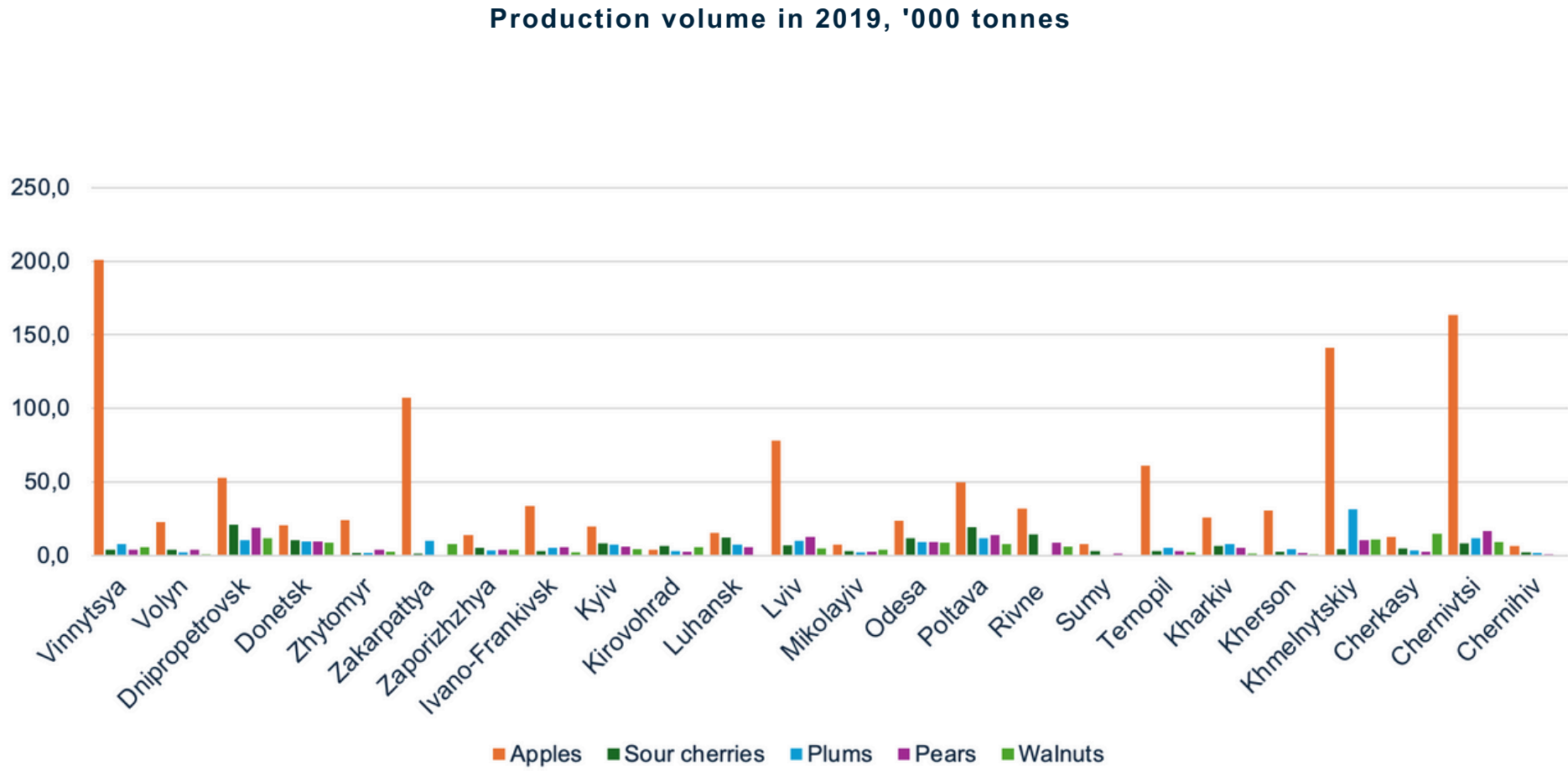
31 *Maps display location by production volumes for the last pre-pandemic and pre-full-scale invasion year.*

Figure A2. *Production volumes of selected 5 vegetables by region in 2023*



Source: Own illustration based on the SSSU data

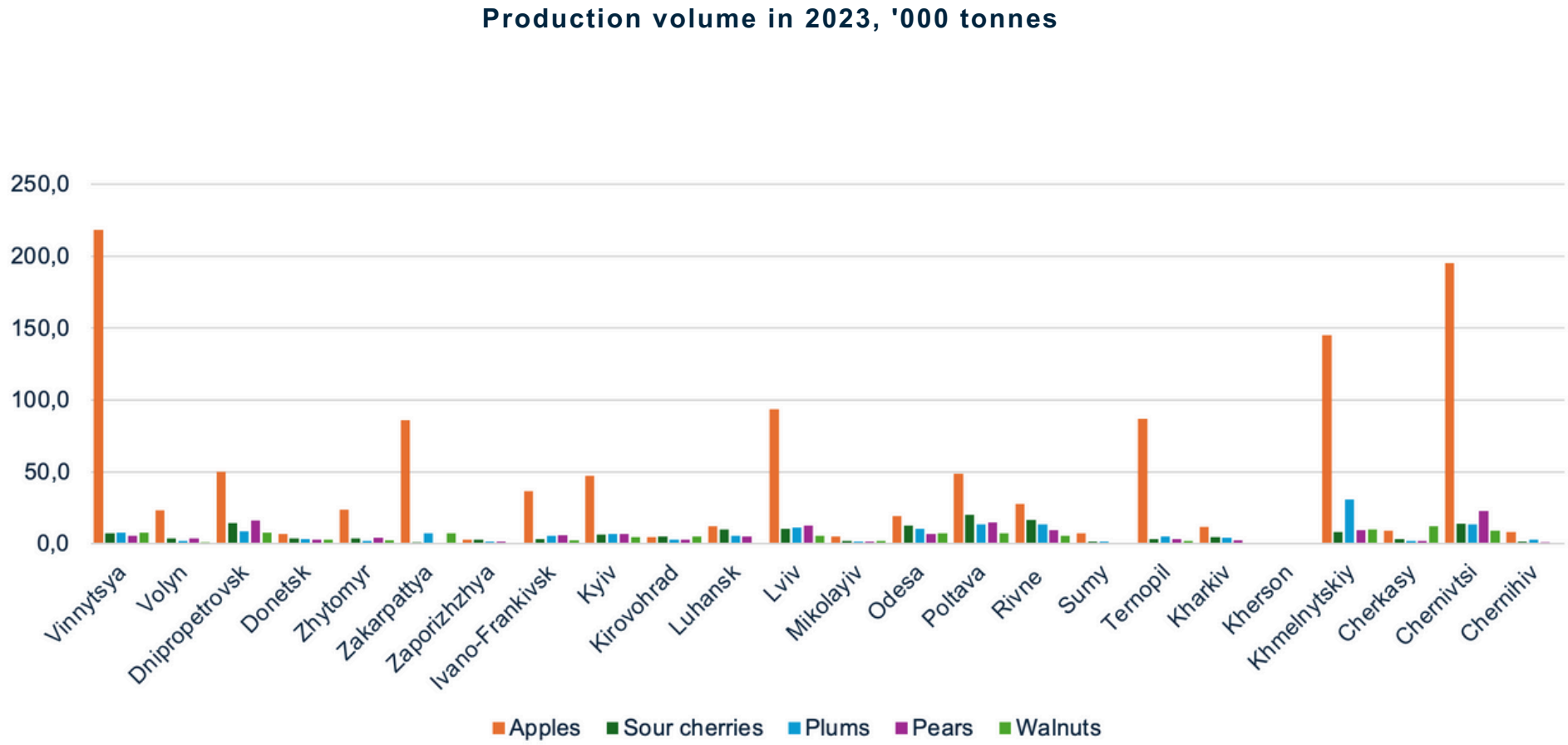
Figure A3. *Production volumes of selected 5 fruits by region in 2019* [32]



Source: Own illustration based on the SSSU data

32 *Maps display location by production volumes for the last pre-pandemic and pre-full-scale invasion year.*

***Figure A4**. Production volumes of selected 5 fruits by region in 2023*



Source: Own illustration based on the SSSU data

APPENDIX B.

Table B1. *Ukrainian annual export values for selected fruits and vegetables in 2019-2023 (based on HS2-4-6 and CN8)*

Code	Export, '000 euro	2019	2020	2021	2022	2023	International trade status in 2023
704	Cabbage	2,747	1,234	2,035	834	43	Net importer
702	Tomatoes	4,739	4,234	4,461	792	1,581	Net importer
707	Cucumbers	3,434	3,989	4,860	1,534	2,294	Net importer
703	Onions	4,202	5,068	4,131	274	589	Net importer
70610	Carrots	109	628	2,118	10	20	Net importer
80810	Apples	15,389	8,479	12,786	18,123	16,450	Net exporter
80830	Pears	24	13	59	391	13	Net importer
80921; 8119075	Sour cherries	138	80	212	734	403	Net importer
8094005	Plums	182	153	646	67	315	Net importer
80231; 80232	Walnuts	123,644	85,377	97,339	75,863	69,804	Net exporter
	Total export	**44,704,524**	**43,143,614**	**57,602,161**	**42,008,404**	**33,435,700**	

Source: State Customs Service of Ukraine data

Table B2. *EU annual export values for selected fruits and vegetables in 2019-2023 (based on HS2-4-6 and CN8)*

Code	Export, '000 euro	2019	2020	2021	2022	2023	International trade status in 2023
704	Cabbage	317,090	326,892	363,574	362,091	434,079	Net exporter
702	Tomatoes	678,634	659,996	682,122	693,962	746,892	Net importer
707	Cucumbers	222,290	225,433	264,781	340,153	348,515	Net exporter
703	Onions	658,543	754,187	662,800	846,370	937,214	Net exporter
70610	Carrots	40,441	45,443	46,417	46,751	57,043	Net importer
80810	Apples	896,621	815,256	854,502	891,330	910,245	Net exporter
80830	Pears	294,029	294,599	281,317	304,847	302,523	Net exporter
80921; 8119075	Sour cherries	25,466	27,579	28,481	29,487	33,858	Net importer
8094005	Plums	90,291	71,834	101,942	111,640	112,252	Net importer
80231; 80232	Walnuts	56,626	56,082	42,079	49,814	44,121	Net importer
	Total export	**2,132,048,081**	**1,932,076,544**	**2,180,663,787**	**2,570,178,181**	**2,554,517,679**	

Source: Eurostat data

Table B3. *Ukrainian annual RCA index for selected fruits and vegetables in 2019-2023 (based on HS2-4-6 and CN8)*

Code	Product	2019	2020	2021	2022	2023
704	Cabbage	0.41	0.17	0.21	0.14	0.01
702	Tomatoes	0.33	0.29	0.25	0.07	0.16
707	Cucumbers	0.74	0.79	0.69	0.28	0.50
703	Onions	0.30	0.30	0.24	0.02	0.05
70610	Carrots	0.13	0.62	1.73	0.01	0.03
80810	Apples	0.82	0.45	0.73	1.17	1.03
80830	Pears	0.00	0.00	0.01	0.07	0.00
80921; 8119075	Sour cherries	0.26	0.13	0.36	1.43	0.68
8094005	Plums	0.10	0.09	0.31	0.03	0.16
80231; 80232	Walnuts	104.14	65.79	112.84	87.56	90.40

Source: State Customs Service of Ukraine data

Table B4. *The main destinations for Ukrainian export of selected fruits and vegetables before and during Russia's full-scale invasion (i.e., 2021 and 2023)*

Code	Product	2021		2023	
		Country	Export share, %	Country	Export share, %
704	Cabbage	Belarus	69.96	Moldova	64.44
		Romania	11.97	Latvia	17.78
		Moldova	11.30	Turkey	2.22
		Others	6.77	Others	15.56
702	Tomatoes	Poland	41.65	Poland	56.07
		Belarus	38.62	Moldova	26.64
		Estonia	6.13	Netherlands	6.19
		Others	13.60	Others	11.10
707	Cucumbers	Poland	50.57	Poland	84.22
		Estonia	34.18	Estonia	8.13
		Moldova	5.53	Hungary	5.72
		Others	9.71	Others	1.93
703	Onions	Romania	43.16	Romania	42.86
		Belarus	12.76	Poland	19.31
		Poland	11.59	Greece	10.52
		Others	32.49	Others	27.32

70610	Carrots	Belarus	71.51	Moldova	76.97
		Romania	19.74	Turkey	2.58
		Moldova	6.26	Marshall Islands	2.46
		Others	2.48	Others	18.00
80810	Apples	United Arab Emirates	21.18	United Arab Emirates	31.74
		Belarus	19.02	Saudi Arabia	11.91
		Saudi Arabia	11.76	Uzbekistan	7.65
		Others	48.05	Others	48.69
80830	Pears	Belarus	65.11	Croatia	48.09
		Romania	20.71	Georgia	14.94
		Georgia	3.67	Panama	3.97
		Others	10.51	Others	33.00
80921; 8119075	Sour cherries	Armenia	25.77	Moldova	27.14
		Poland	23.28	Poland	22.60
		Moldova	19.58	Czech Republic	16.74
		Others	31.37	Others	33.52
8094005	Plums	Romania	46.40	Poland	63.12
		Poland	32.45	Latvia	22.24
		Belarus	14.89	Iraq	6.89
		Others	6.26	Others	7.75
80231; 80232	Walnuts	France	15.49	Azerbaijan	11.07
		Greece	10.13	Greece	10.40
		Netherlands	8.01	France	9.80
		Others	66.37	Others	68.73

Source: State Customs Service of Ukraine data

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