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# **Ukraine food balances in times of uncertainty**

Scenario analysis of Black Sea grain initiative abandonment and infrastructure destruction on food balances in Ukraine

September 2023

# Table of content

1. Project background and methodology
2. Scenarios and key model inputs
3. Scenario analysis: food balances
  - Commodities affected by scenario assumptions
  - Commodities unaffected by scenario assumptions
4. Conclusions
5. Additional materials



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## Section 1.

Project background and methodology

# Project background

Ukraine is a major agricultural producer and one of the world's key agricultural exporters, playing a significant role in commodities such as wheat, maize and sunflower oil. When the Russian Federation invaded Ukraine in February 2022, it created shockwaves onto both the global food markets and the domestic economy. Before the war, the agricultural sector accounted for 10.9% of gross domestic product and 15% of employment in the country.

On 17 July 2023, the Russian Federation decided not to renew the [Black Sea Grain Initiative](#), which had enabled the safe export of food stuffs from Ukrainian Black Sea ports since its signing in July 2022. This meant that the export of grains from Black Sea ports became close to impossible. Furthermore, the summer of 2023 saw a noticeable increase in [attacks on critical port infrastructures](#), creating a knock-on effect on logistics costs and damaging grain storage facilities.

The Grain Initiative has had a significant positive impact on global food prices and global food security and analysis thus far have mainly focused on the global implications of its abandonment. However, considering the importance of agricultural production in Ukraine's economy and for domestic consumption and food security, the impacts on Ukraine itself are of keen interest.

To examine the potential longer-term consequences, the World Food Programme Ukraine and the Kyiv School of Economics collaborated on an analysis with the objective to understand the national level implications on production of a range of food commodities important for the local economy and domestic consumption. Specifically, a dynamic partial-equilibrium, multi-country and -market model is employed to examine various production and consumption scenarios over an eight year period. Scenarios take into account different degrees of export access as well as different sizes of infrastructure attacks, in order to understand the dynamic effects the war may have on domestic production and food availability. This presentation shows the results of the scenario modeling. It is important to note that the analysis is not an attempt to produce production forecasts or comment on the most likely trajectory for Ukrainian agricultural production, but rather to show what outcomes could look like under different scenarios.

# AGMEMOD partial equilibrium model description

To assess the future perspectives of the Ukrainian agricultural sector and markets under different war-related scenarios, the **AGMEMOD model** is applied.

- a. **AGMEMOD** is an **econometric, dynamic, partial-equilibrium, multi-country, multi-market model**. It covers all EU Members States, some non-EU countries, such as Ukraine, Balkan countries, and Kazakhstan, and a stylized version of the rest of the world (RoW). The model provides annual projections until the year 2030 for markets of the main agricultural commodities.
- b. The markets are represented by **equations for supply and demand, stocks, international trade, and market prices**. They reflect behavioral responses of economic agents to changes in prices and exogenous variables such as agricultural policy instruments, GDP, currency exchange rate, import tariffs, etc.
- c. The equations' parameters are usually estimated as time series regressions. Following the **partial equilibrium approach**, commodity prices adjust to clear each commodity market.
- d. Lagged endogenous variables introduce (recursive) dynamic behavior when entered as determinants in the next period's equilibrium supply and/or demand.
- e. Exogenous shocks enter the models and dynamically affect future market outcomes.



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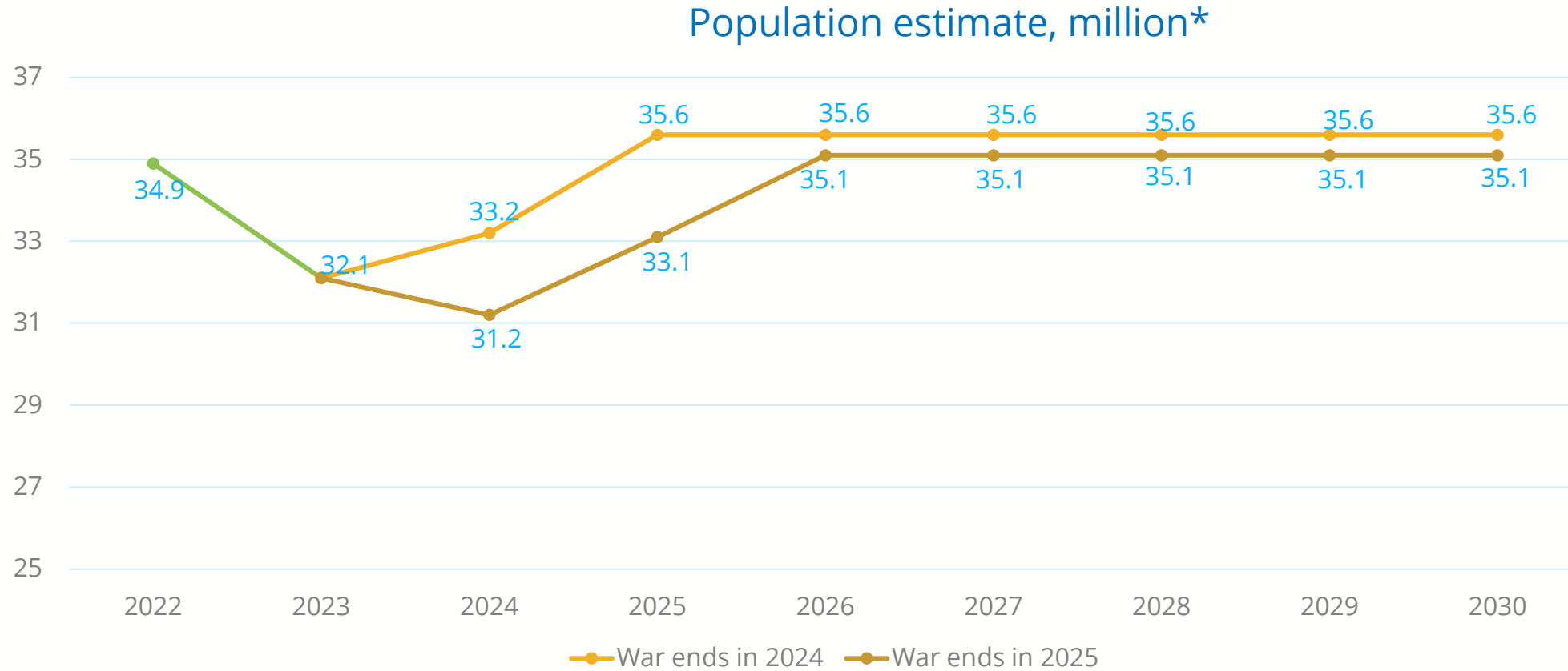
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## Section 2.

Scenarios and key model inputs

# Key model inputs - population



- Based on estimates of UNFPA backed by research of EU Joint Research Center, University of St.Andrews, KSE Institute.
- Population increase after the war takes into account regaining control of the Ukrainian territories in the borders of 1991. Population changes due to mortality and migration processes were not taken into account

# Scenarios: impact on maximum export and storage capacity

	Attacks on infrastructure <b>SMALL</b>	Attacks on infrastructure <b>MEDIUM</b>	Attacks on infrastructure <b>LARGE</b>
Export infrastructure: Odesa + Danube + land	<i>Max export capacity:</i> <b>No restriction</b> <i>Additional logistics costs:</i> <b>+0 UAH/t</b>	<i>Max export capacity:</i> <b>No restriction</b> <i>Additional logistics costs:</i> <b>+500 UAH/t</b>	<i>Max export capacity:</i> <b>No restriction</b> <i>Additional logistics costs:</i> <b>+1000 UAH/t</b>
Export infrastructure: Danube + land	<i>Max export capacity:</i> <b>40 mil t</b> <i>Additional logistics costs:</i> <b>+500 UAH/t</b>	<i>Max export capacity:</i> <b>40 mil t</b> <i>Additional logistics costs:</i> <b>+1000 UAH/t</b>	<i>Max export capacity:</i> <b>40 mil t</b> <i>Additional logistics costs:</i> <b>+1000 UAH/t</b>
Export infrastructure: land only	<i>Max export capacity:</i> <b>20 mil t</b> <i>Additional logistics costs:</i> <b>+1500 UAH/t</b>	<i>Max export capacity:</i> <b>20 mil t</b> <i>Additional logistics costs:</i> <b>+1500 UAH/t</b>	<i>Max export capacity:</i> <b>20 mil t</b> <i>Additional logistics costs:</i> <b>+2000 UAH/t</b>



# Intuition behind the scenarios

Attacks on logistics and storage infrastructure (elevators, grain terminals, etc.) lead to declined supply of the logistics services available for Ukrainian producers

The market forces lead to the price increase for the service, the supply of which gets radically decreased

Increased logistics costs may make farming of certain products unprofitable forcing farmers to switch to different crops or leaving the business

Blockades of the seaports of Ukraine not only contribute to the declining supply of agricultural logistics and its overall higher price, but also to the cap on the maximum capacity on the export volume (20 million tons in case only land infrastructure is available; 40 million tons if land and Danube infrastructure is available)

The model takes two external shock variables entering the equations:  
1) additional logistics costs per ton  
2) overall maximum export capacity



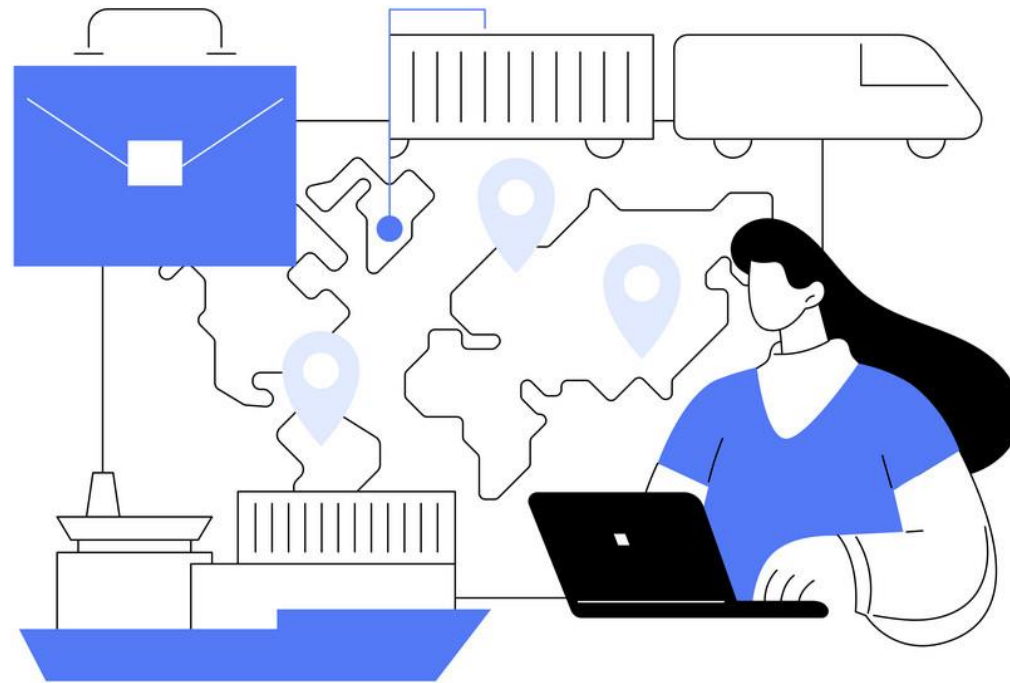
# Other assumptions used in the model

Assumptions	Values
Kachovska dam destruction	94% of agricultural land in Cherson oblast not available in 2023/2024, 40% - in Zaporizhzhya oblast and 30% - in Dnipro oblast not available in 2023/2024. 584 thsd ha of oilseeds and grains have been left without irrigation. No production on these territories until 2030. Currently occupied territories don't contribute to production until 1 year after the war
<b>Production costs</b>	
Increase in fuel expenses compared to 2021	Following annual average crude oil price change in 2023 and projection for further years based on World Energy Outlook (adjusted to inflation).
Change in fertilizer use compared to 2021	50% reduction in fertilizer use in 2023 and until the end of the war. Then the use returns to normal. The yield reduction coefficients are applied.
Decrease in labor availability, and the resulting change in labor costs, due to mobilization, migration and war-related death*	As the war goes on 30% less, after the end of the war gradual return to 2021 level*
Additional area of uncultivated arable land as an effect of increased production costs	-5%
World market prices in 2023–2030	OECD-FAO Outlook 2023
Crops storage assumption	No impact



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### Section 3.

Scenario analysis: food balances

# Food products covered by the research

- **Food products with the greatest export potential (*high impact of the scenarios*)**
  - Wheat
  - Maize
  - Sunflower oil
- **Major locally grown grains (*medium to high impact of the scenarios*)**
  - Rye
  - Oats
  - Buckwheat
- **Core products of daily consumption of Ukrainians (*low impact of scenarios*)**
  - Potatoes
  - Sugar
  - Poultry
  - Pork
  - Eggs
  - Milk and dairy

# Data sources and logic



**AGMEMOD**  
predictive model



**Normative food**  
consumption (food basket)

18 scenarios

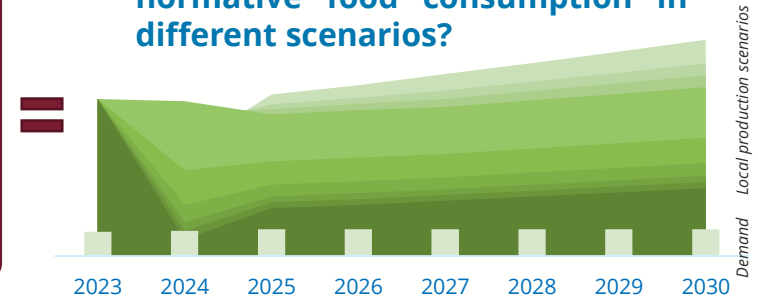
Local production estimate  
2023-2030 by commodity

2 scenarios

Normative food  
demand based on  
population  
estimate 2023-2030

## Results

Can local production cover the  
normative food consumption in  
different scenarios?



18 scenarios

Local production  
estimate 2023-  
2030 by  
commodity

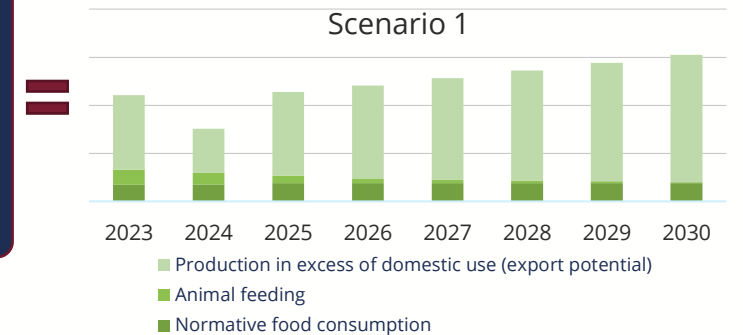
18 scenarios

Animal feeding  
estimate 2023-  
2030 by  
commodity

2 scenarios

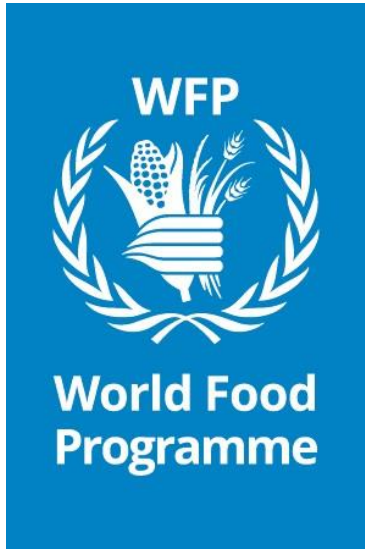
Normative food  
demand based on  
population estimate  
2023-2030

What commodity volume is available for  
export or excessive consumption in  
different scenarios?



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## **Section 3.1**

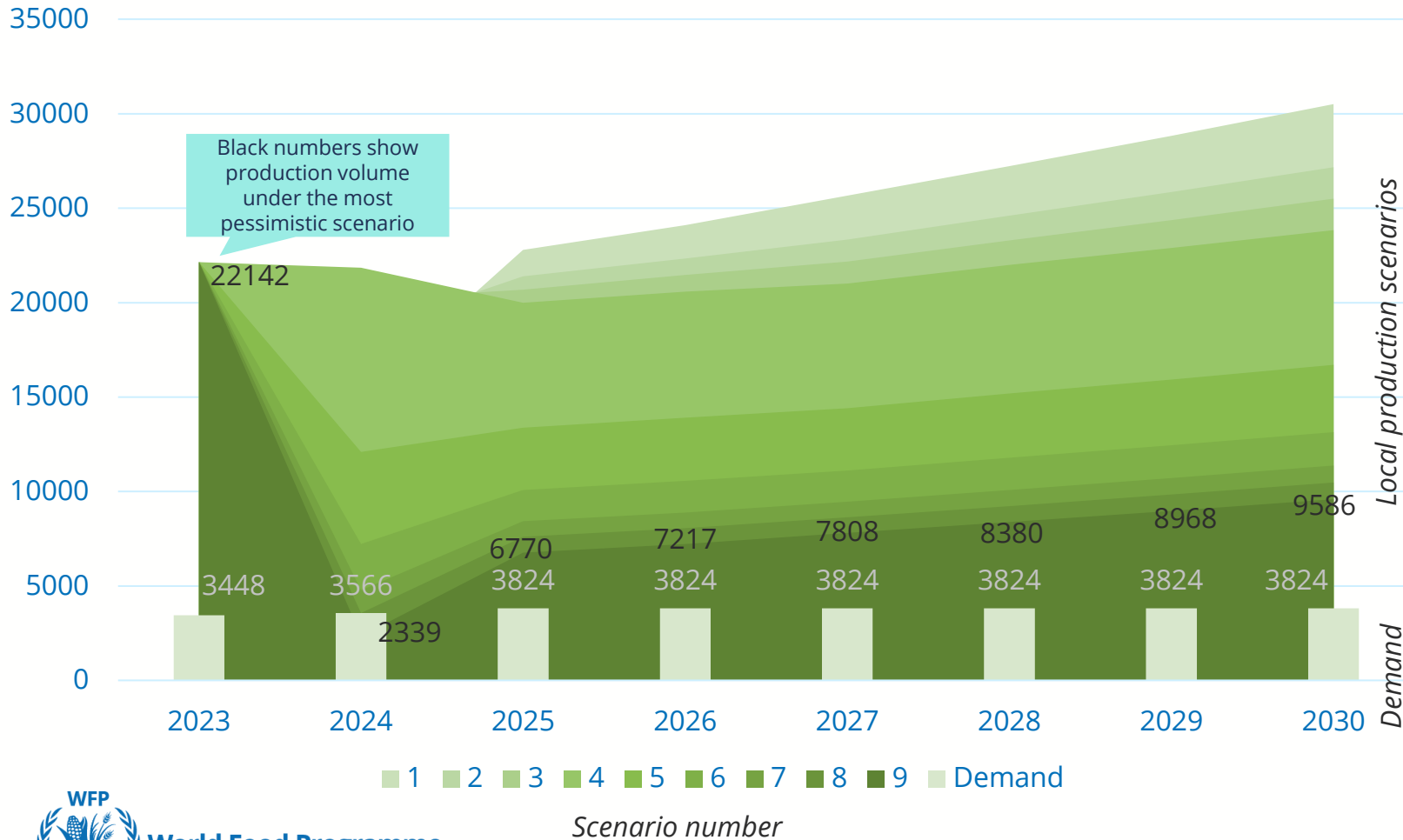
### Commodities affected by scenario assumptions

*[The commodities in this section either were actively exported through seaports of the Black Sea or use the same logistics infrastructure. Attacks on the infrastructure and port blockade have a great impact on production of these commodities]*

# Supply and demand analysis: Wheat (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

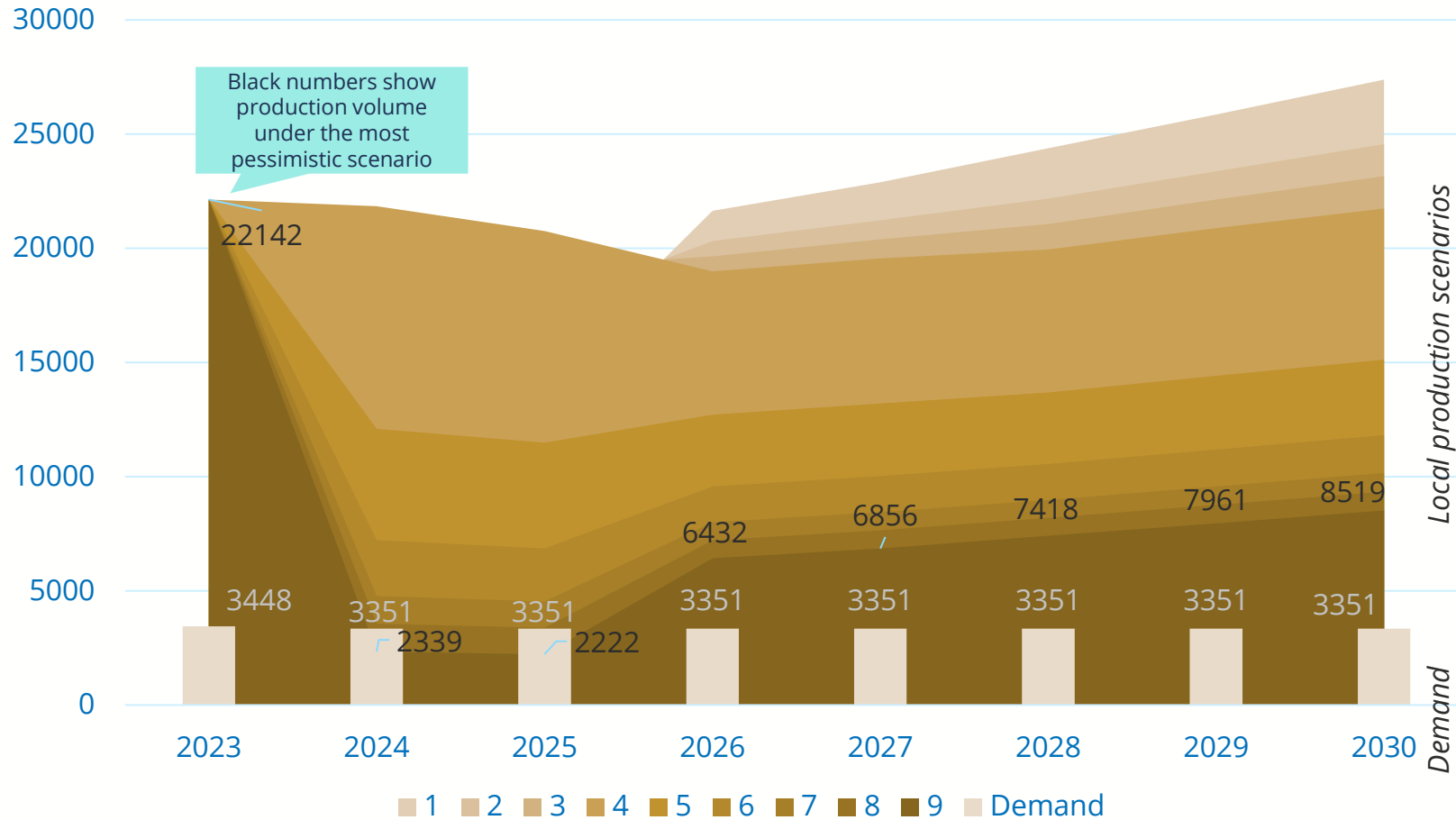
	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	<b>1</b>	<b>2</b>	<b>3</b>
Export infrastructure: Danube + land	<b>4</b>	<b>5</b>	<b>6</b>
Export infrastructure: land only	<b>7</b>	<b>8</b>	<b>9</b>

- Only the two most pessimistic scenarios (full blockade of the ports and medium or large scale attacks on the infrastructure) create the situation when local production of wheat is below local demand by about 1.1 million tons in 2024.
- Taking into account that long-time wheat stocks in Ukraine in 2022 were 5.5 million tons, it is likely that this stock compensates for the drop in 2024.

# Supply and demand analysis: Wheat (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- In case the war lasts till 2025 local production of wheat may fall under the level of local demand (two most pessimistic scenarios).
- However, the accumulated wheat storage would compensate for the gap even under the most pessimistic scenarios.



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Scenario number

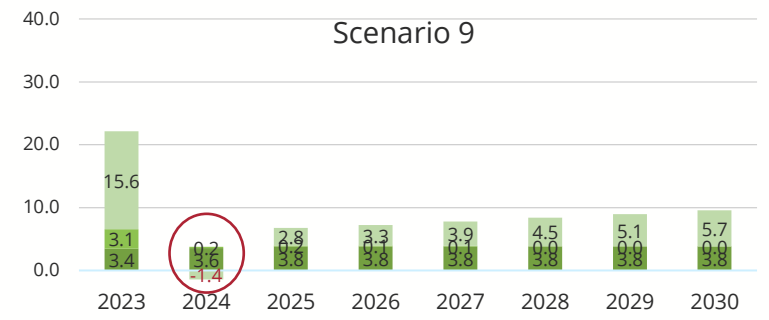
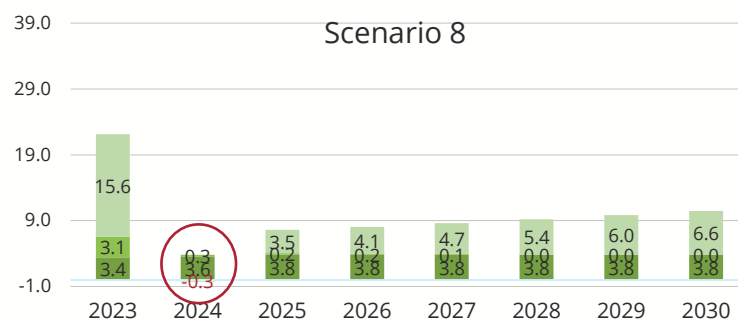
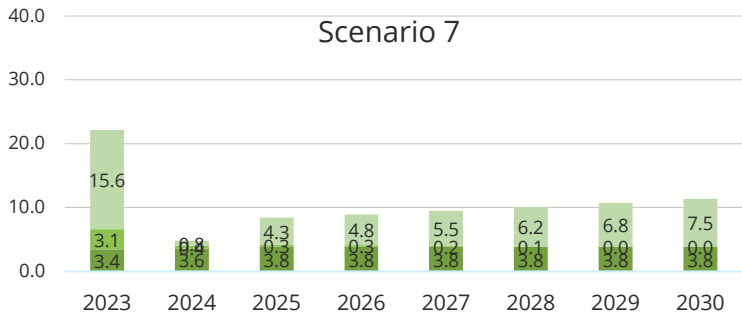
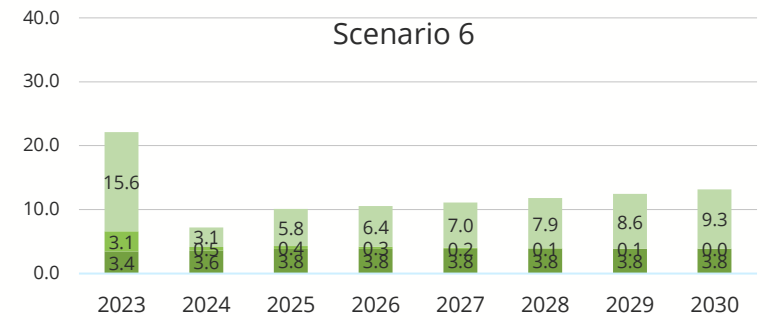
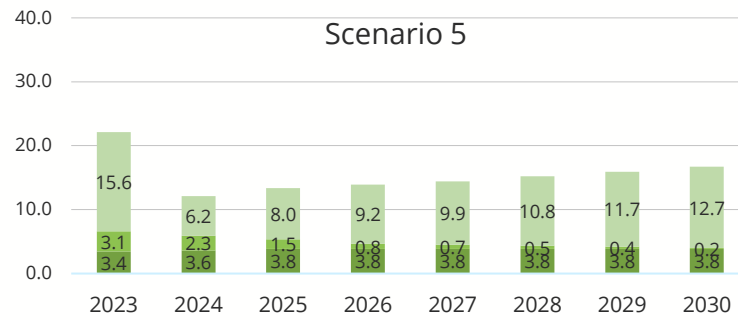
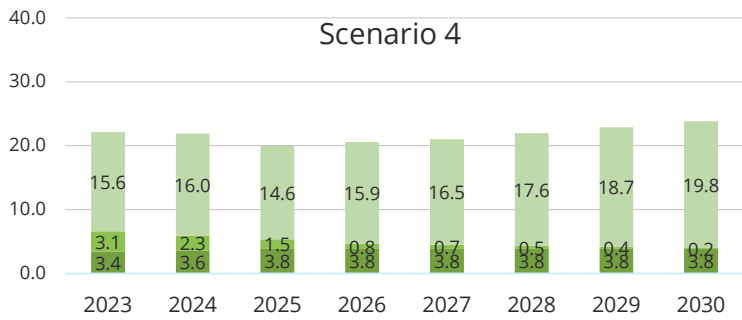
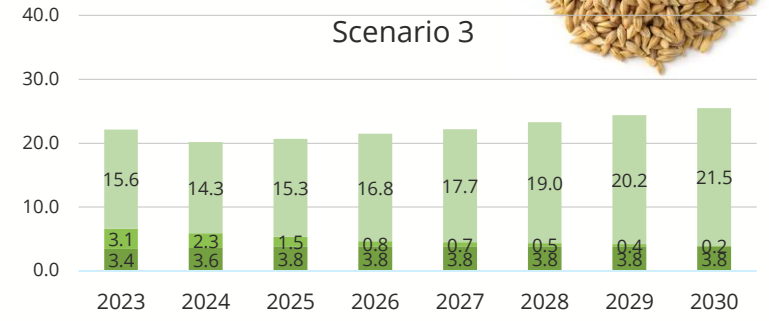
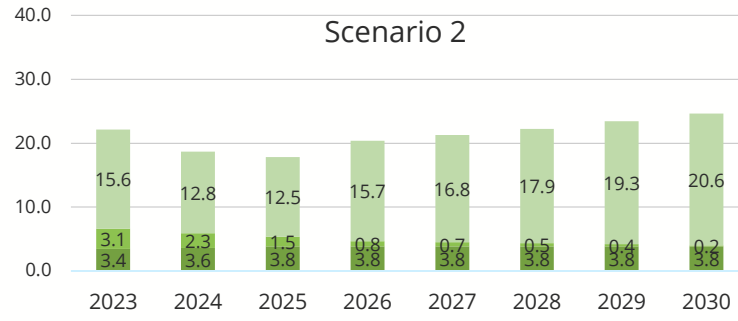
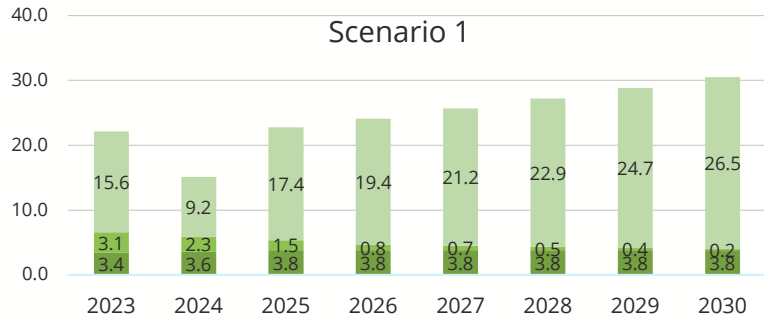
NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

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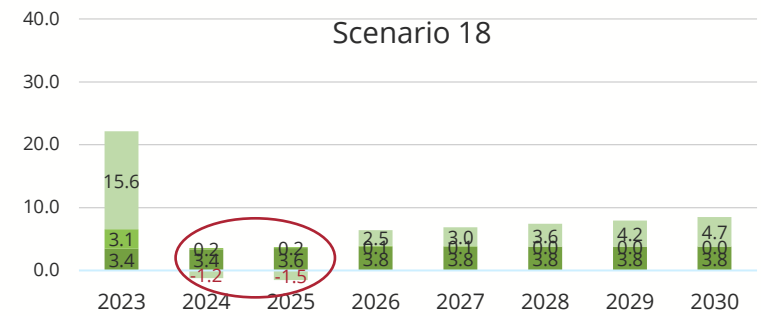
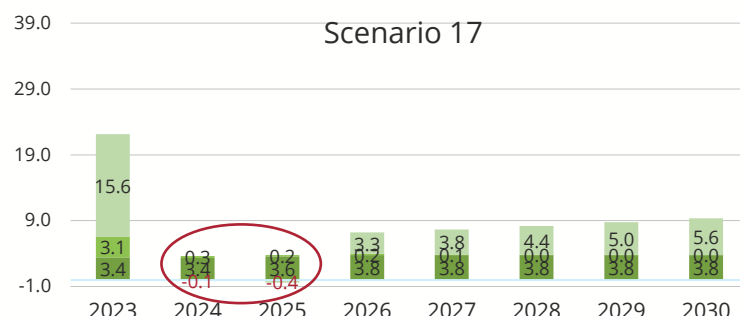
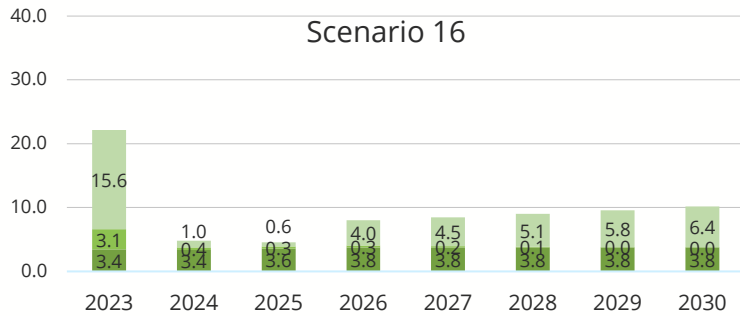
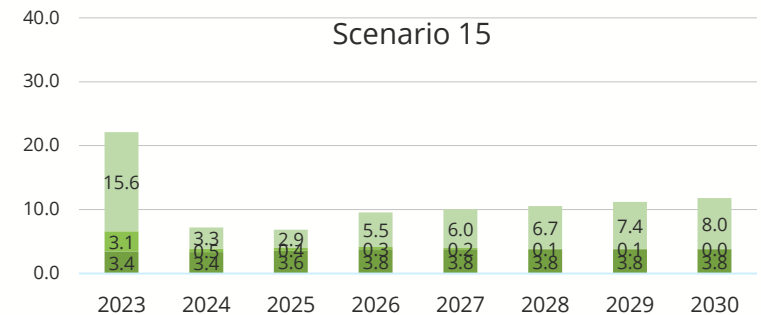
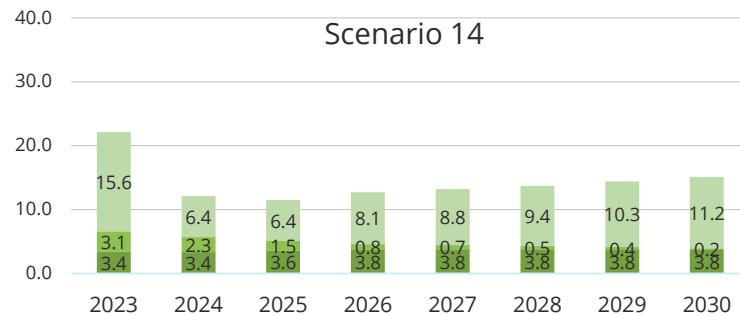
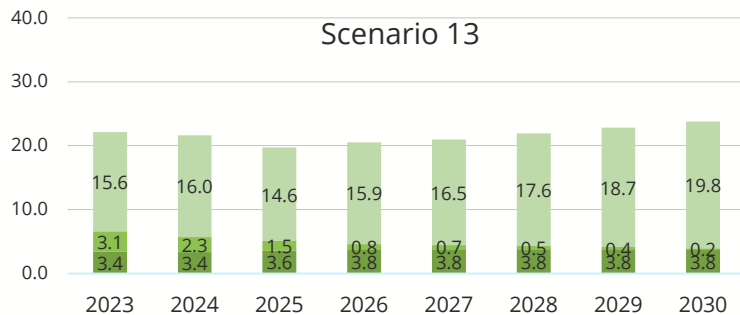
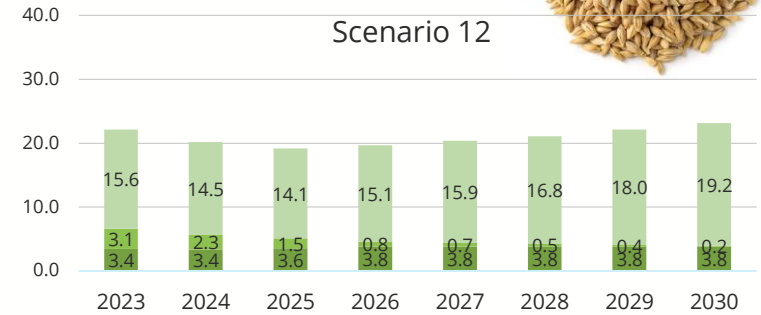
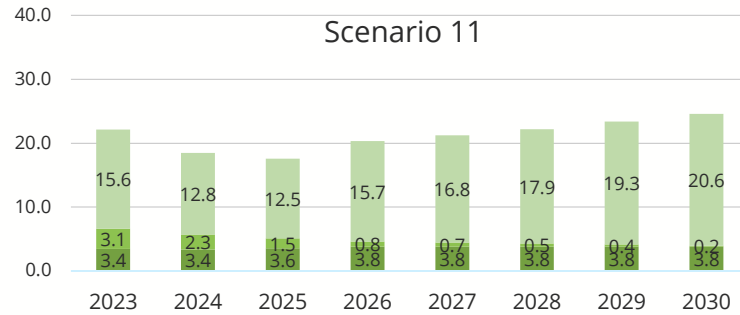
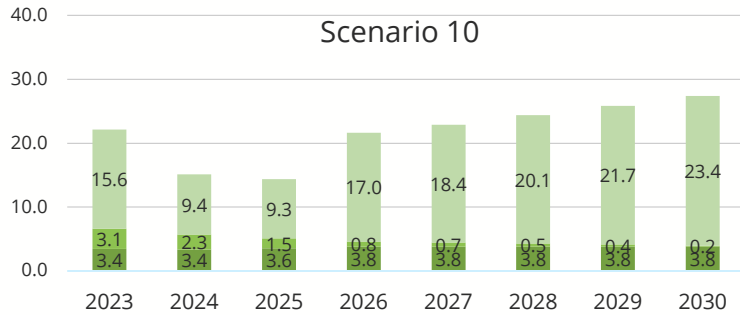
# Scenarios deep dives (end of war 2024)

19.1  
million t  
(average export per  
year in 2017-2021)



# Scenarios deep dives (end of war 2025)

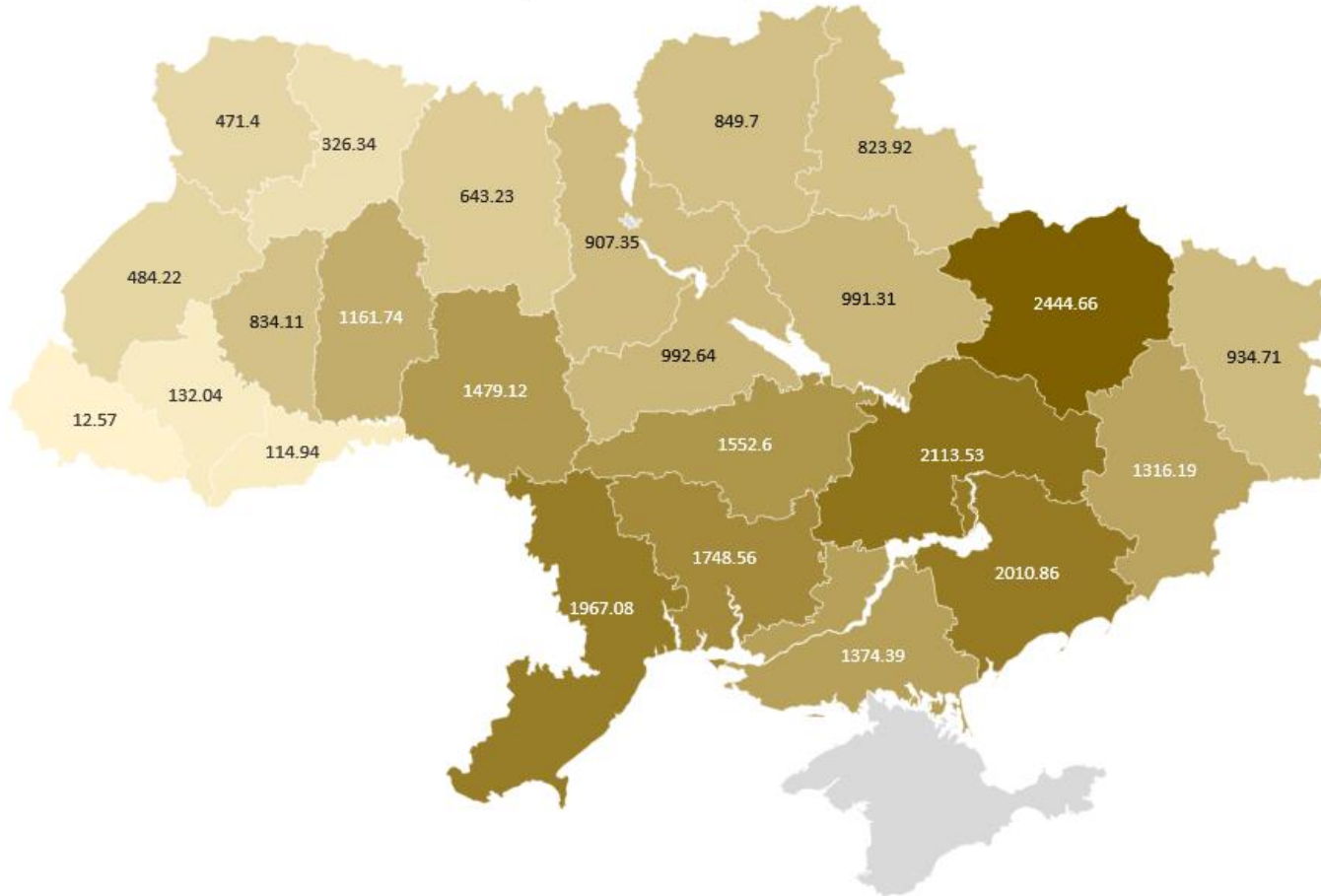
19.1 million t  
(average export per year in 2017-2021)



# Pre-war wheat production by regions



Wheat production 2021, thds tonnes



- Most of the areas with the most active wheat farming are hit by the war directly: large territories of Kherson, Zaporizhzhia, Kharkiv, Donetsk regions are occupied or located near the front line.
- Wheat production in the Western regions is relatively minor.

# Comments on scenarios and food balances: Wheat

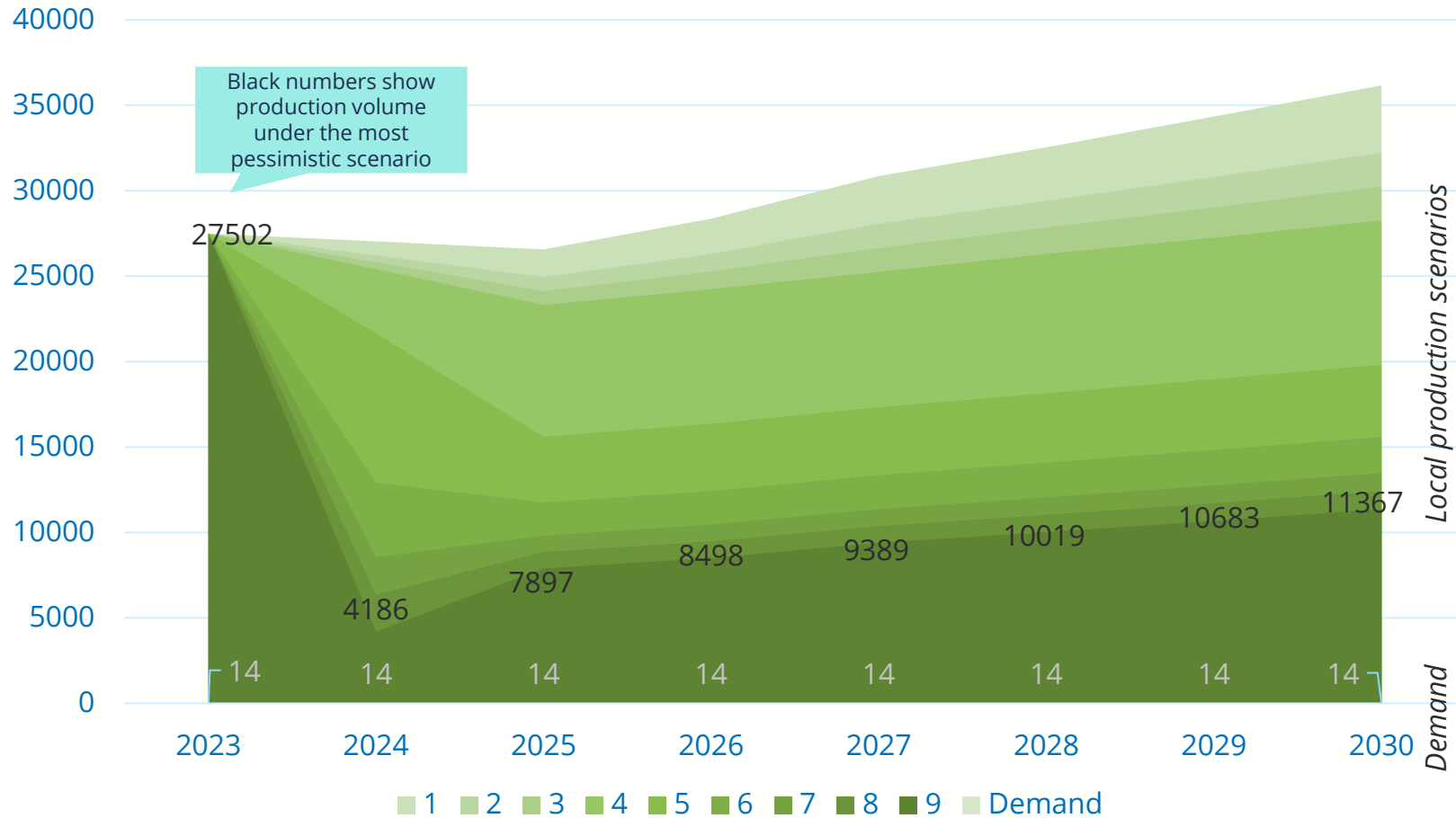


- Wheat is among Ukraine's most widely produced crops and the core of Ukrainian exports. Pre-war export volume was around 19 million tons per year, while the wheat export totaled \$5.1 billion in 2021. The wheat production and associated industries employed over 300 thousand people in 2021.
- During the war both the production and export of wheat declined sharply. In 2023, the production volume is expected to be about 22 million tons, significantly lower than pre-war figures. While wheat is the most consumed cereal in Ukraine, local demand for wheat used for food consumption is relatively low compared to production level: less than 4 million tons per year or about 15% of the current low production level.
- There are two pessimistic scenarios when the full blockade of sea and river ports and substantial damage to the logistics infrastructure contribute to production level falling below the local demand volume. However, there is a large number of decentralized wheat storage in Ukraine that was capable of keeping at least 33 million tons of wheat in the certified elevators before the war. Such storage creates a sizeable buffer that can cover the gap in wheat production over 2024-2025. At the same time, a decline in grain exports will have an evident negative effect on the Ukrainian economy.
- The quality of Ukrainian wheat is deteriorating. Export-grade wheat accounted for about 60% of production in 2019 compared to about 25% in 2023. Lack of adequate storage and logistics infrastructure can contribute to the further decline in the wheat quality making the majority of it unsuitable for export or food consumption.

# Supply and demand analysis: Maize (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	<b>1</b>	<b>2</b>	<b>3</b>
Export infrastructure: Danube + land	<b>4</b>	<b>5</b>	<b>6</b>
Export infrastructure: land only	<b>7</b>	<b>8</b>	<b>9</b>

- Local food consumption of maize (corn) is very low compared to production. Almost all corn produced in Ukraine is used for feeding livestock and export.
- Even under the worst scenario of the port blockades and increased cost of logistics, food demand of Ukrainians will be covered many times by the locally produced corn.



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Scenario number

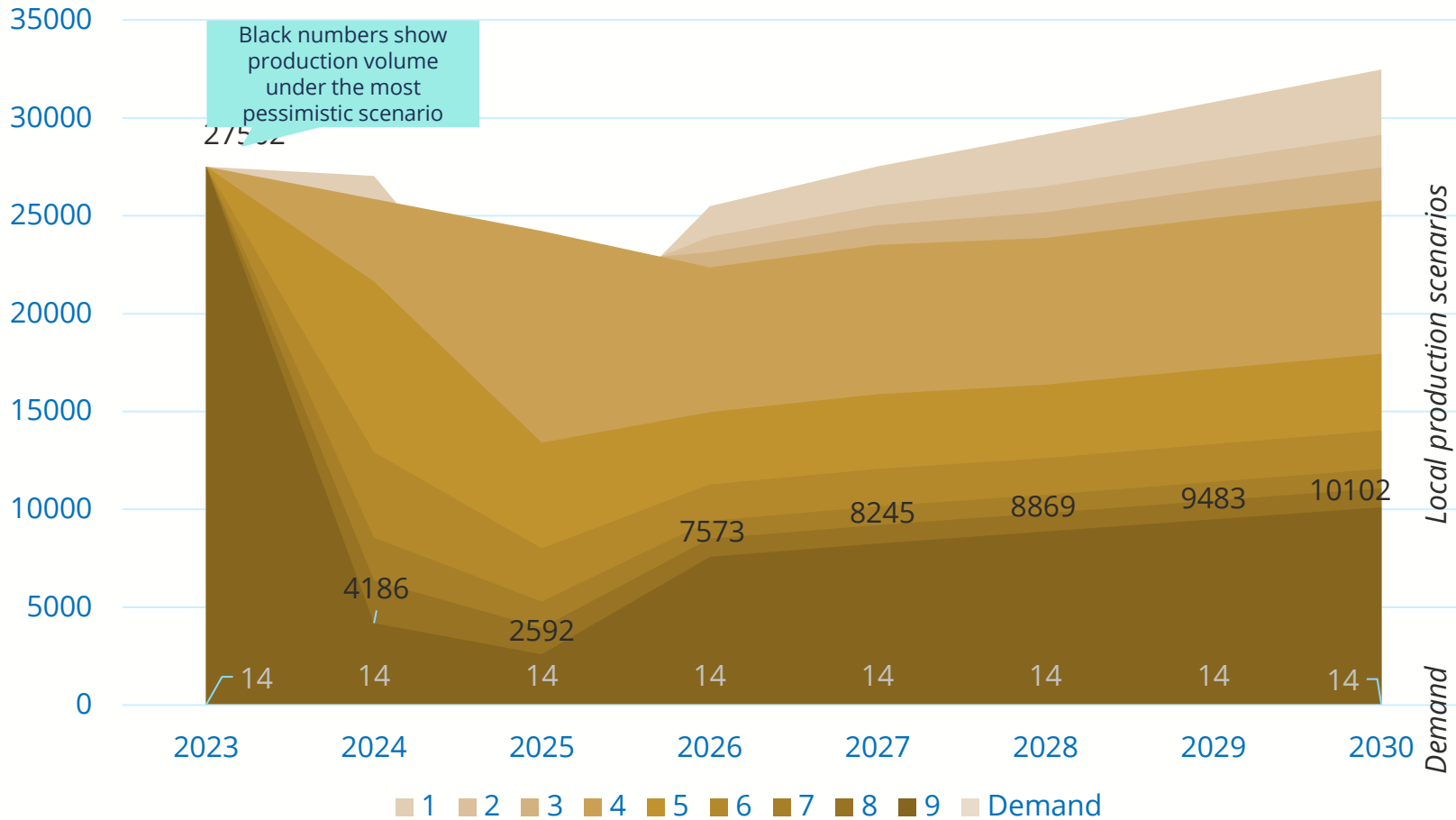
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Supply and demand analysis: Maize (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- In case the war continues in 2025 together with port blockades and attacks on the infrastructure, production of maize is likely to be very low in 2025 (10 times lower than current production level). However, it would be still more than sufficient to cover Ukrainian food demand for corn.



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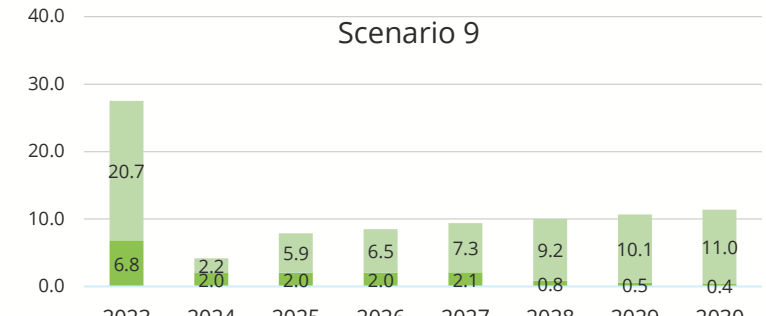
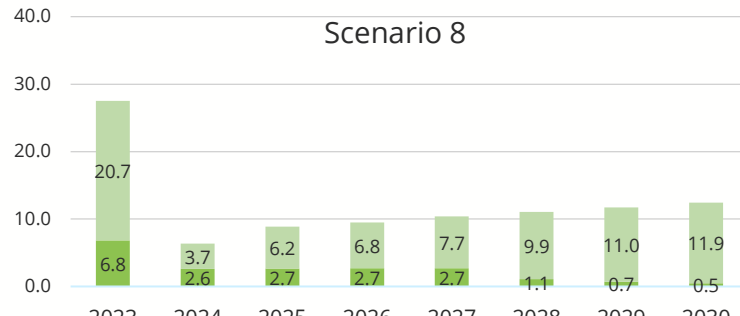
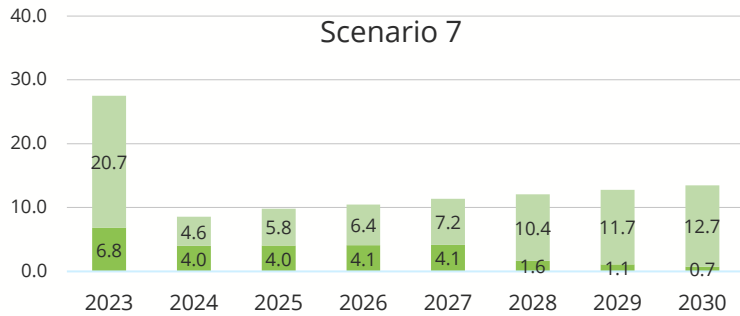
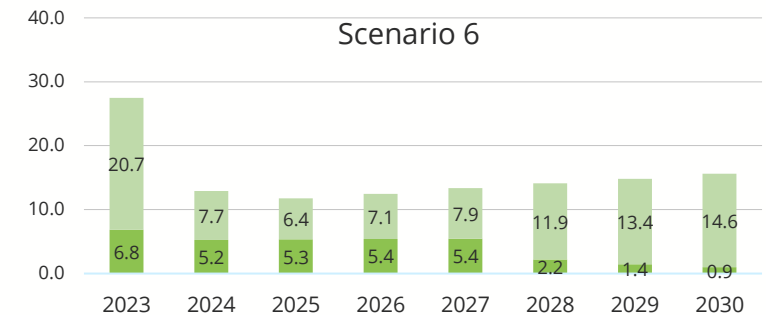
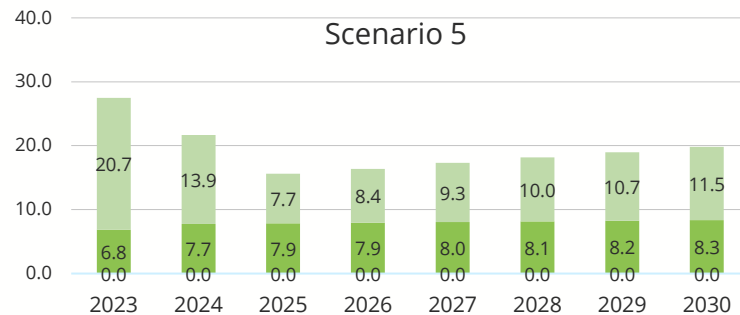
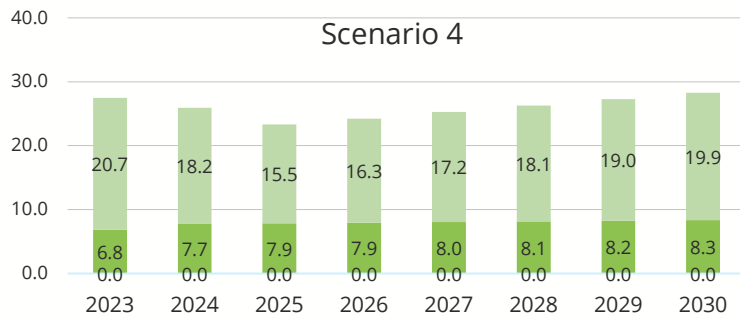
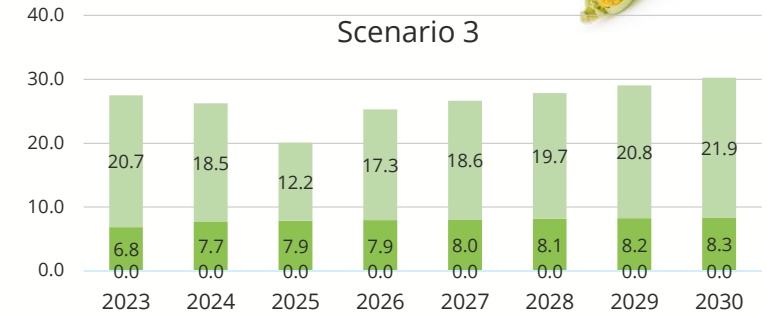
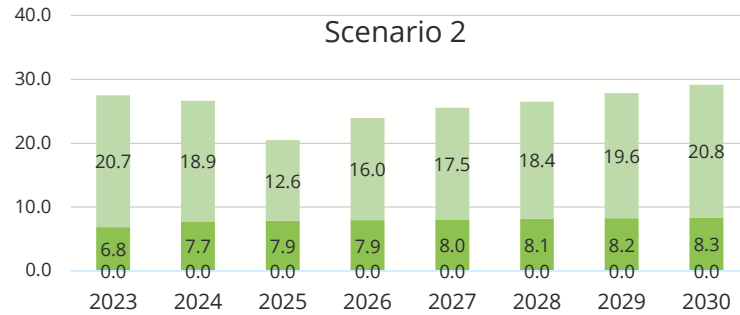
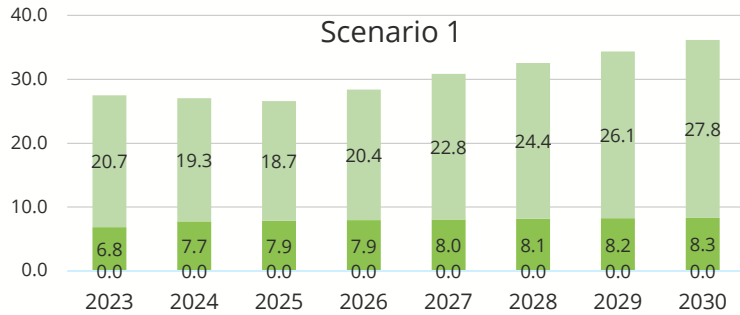
NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

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Scenario number

# Scenarios deep dives (end of war 2024)

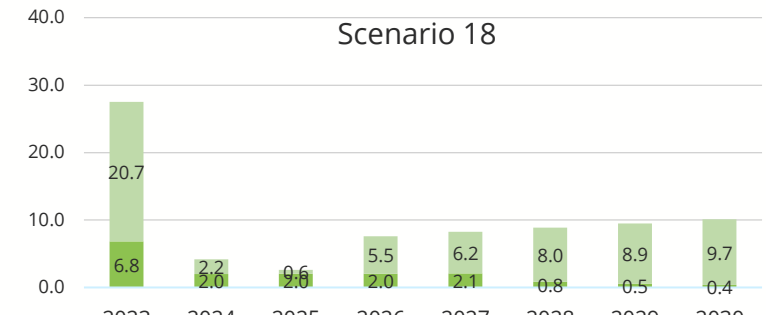
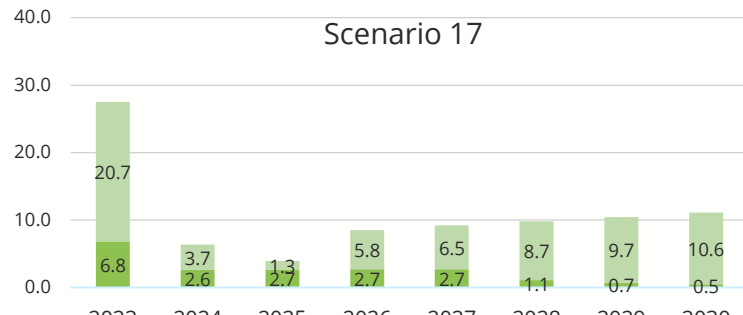
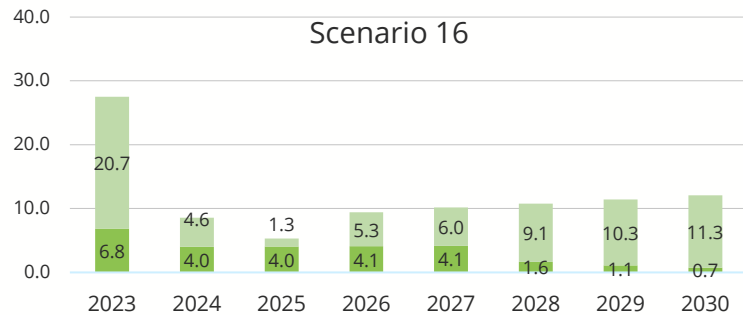
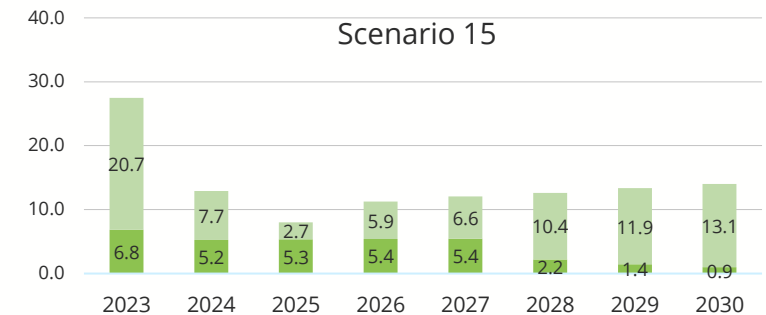
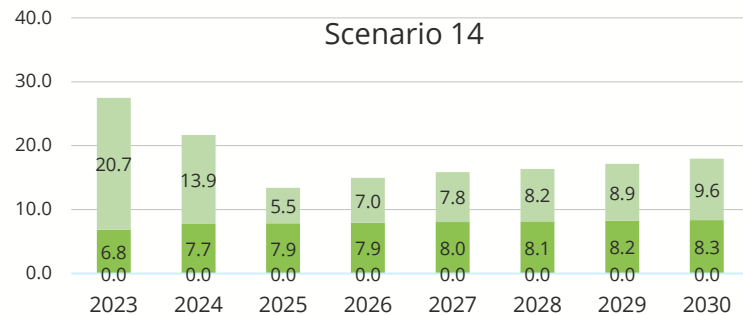
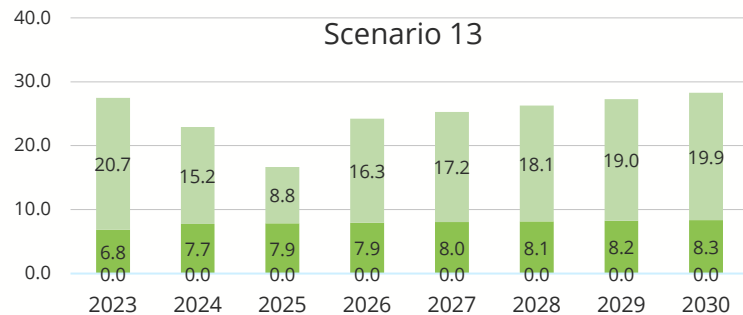
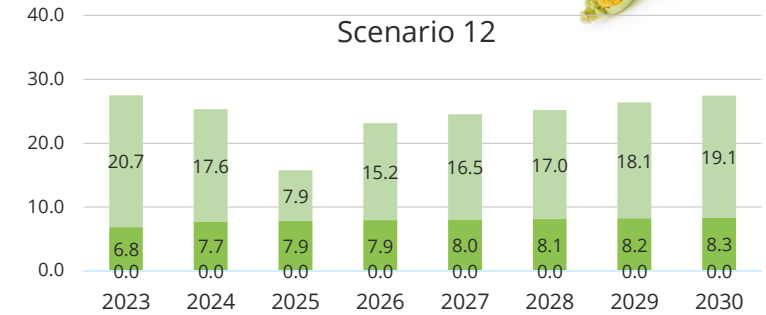
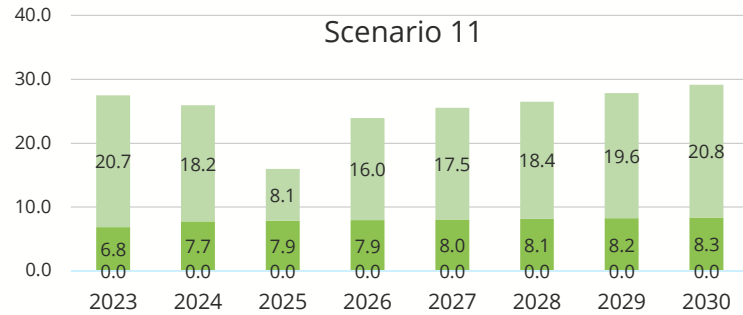
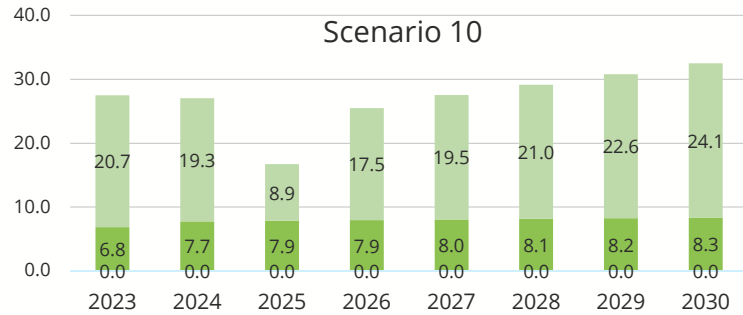
24.8  
million t  
(average export per  
year in 2017-2021)





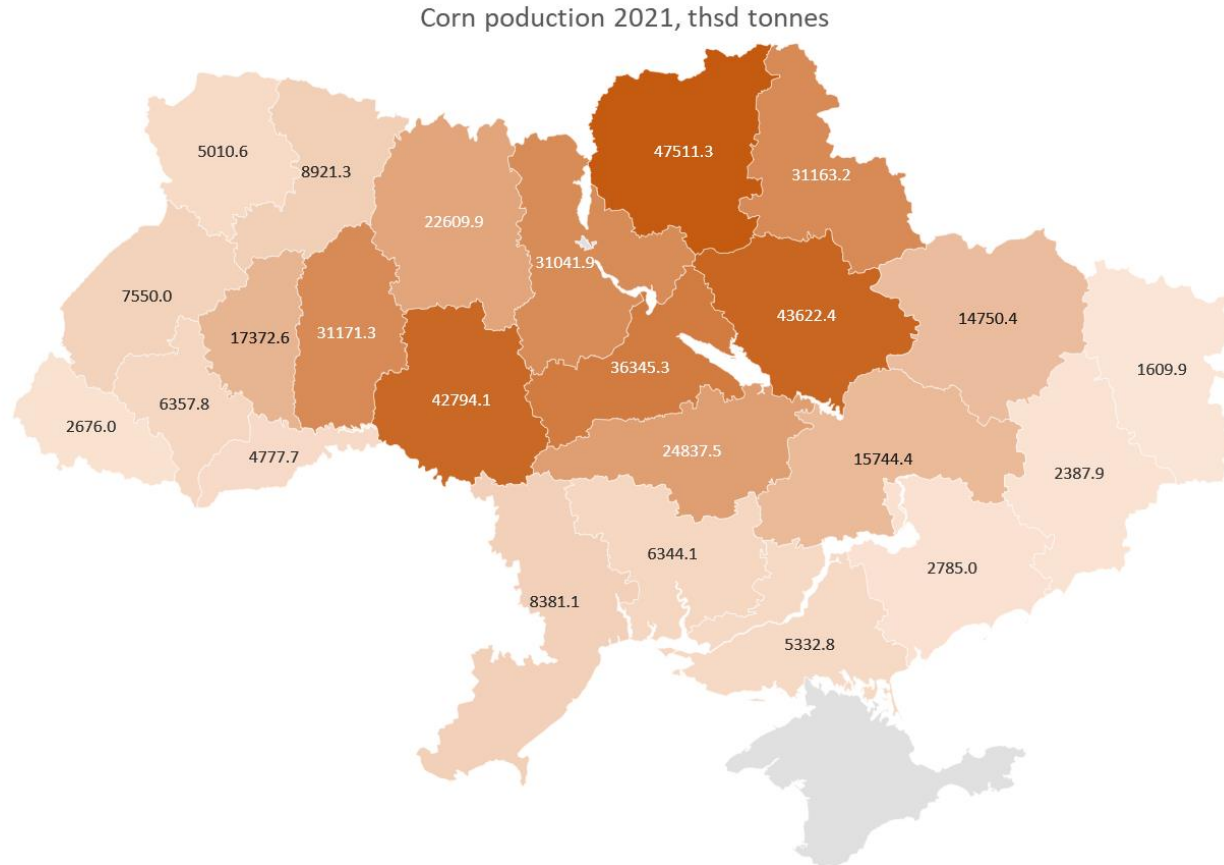
# Scenarios deep dives (end of war 2025)

24.8  
million t  
(average export per  
year in 2017-2021)





# Pre-war maize production by regions



- Maize is primarily grown in Chernihiv, Poltava, Vinnytsia and Cherkasy regions. Although the territories in the Northern part of Ukraine are re-captured, the effects of the war are noticeable.
- Easy land-based export of maize from the territories where it grows is not possible (border with Belarus).

# Comments on scenarios and food balances: Maize

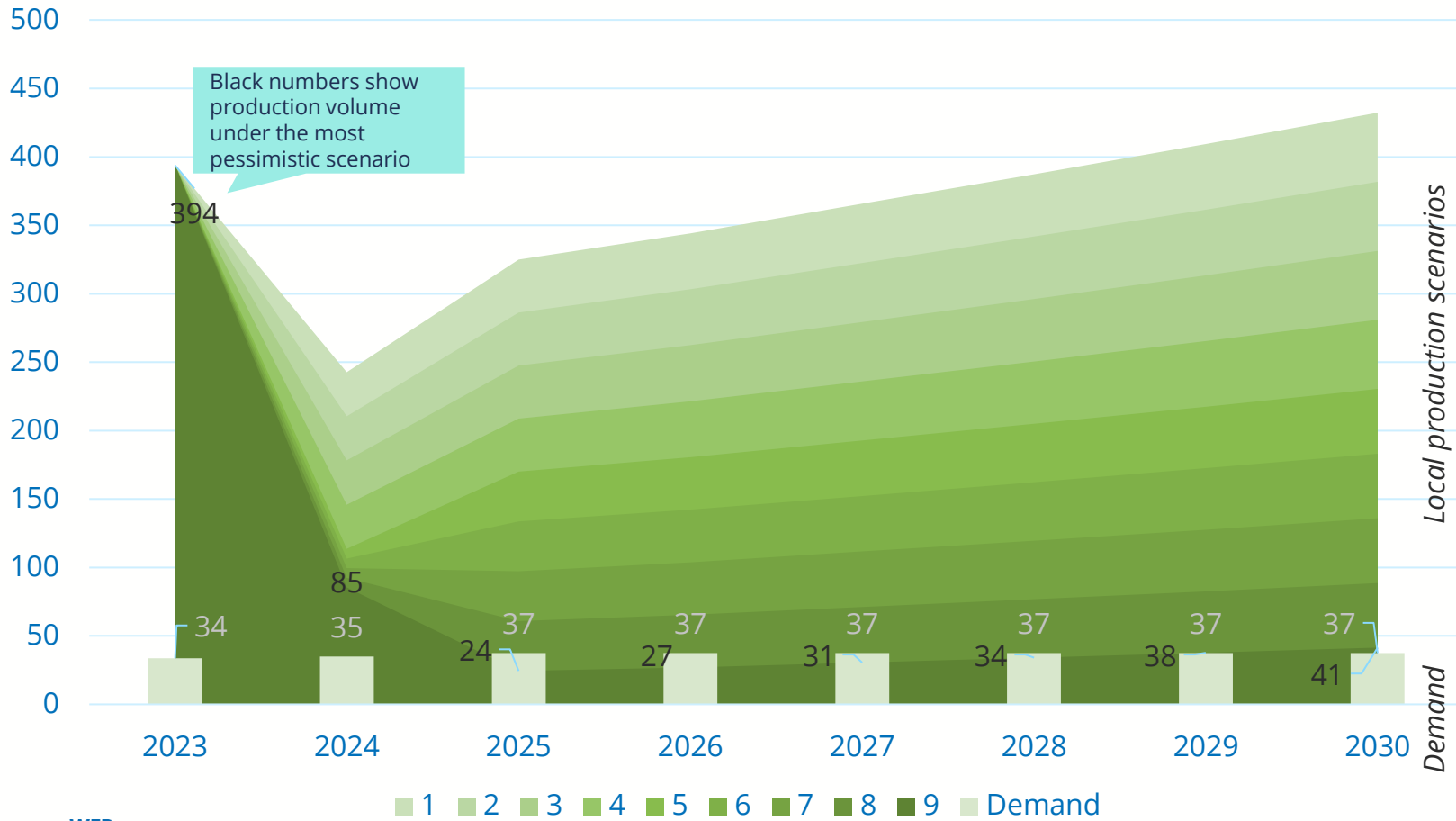


- Along with wheat maize is one of the agricultural cultures that has the largest export volume. Its export in the pre-war 2021 was about 25 million tons.
- Unlike wheat, maize is not a common food product for the Ukrainians: share of corn used for internal food consumption is minor – only about 1% of total production.
- Under no realistic scenario corn production in Ukraine falls below the level of local demand. Still, the sharp decline in export volume will lead to substantial harmful economic effect on Ukrainian farming and the economy in general.
- Large share of corn is used for livestock feeding. Transportation costs for this type of corn are substantially lower, which makes it more attractive for the farmers.

# Supply and demand analysis: Oats (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Oats are not among the most consumed cereals in Ukraine with current food consumption accounting for less than 10% of local food production.
- Increased logistics costs and attacks on infrastructure may bring the production of oats as low as the quantity of local oats demand as farmers will be switching to more profitable and demanded cultures.



World Food Programme

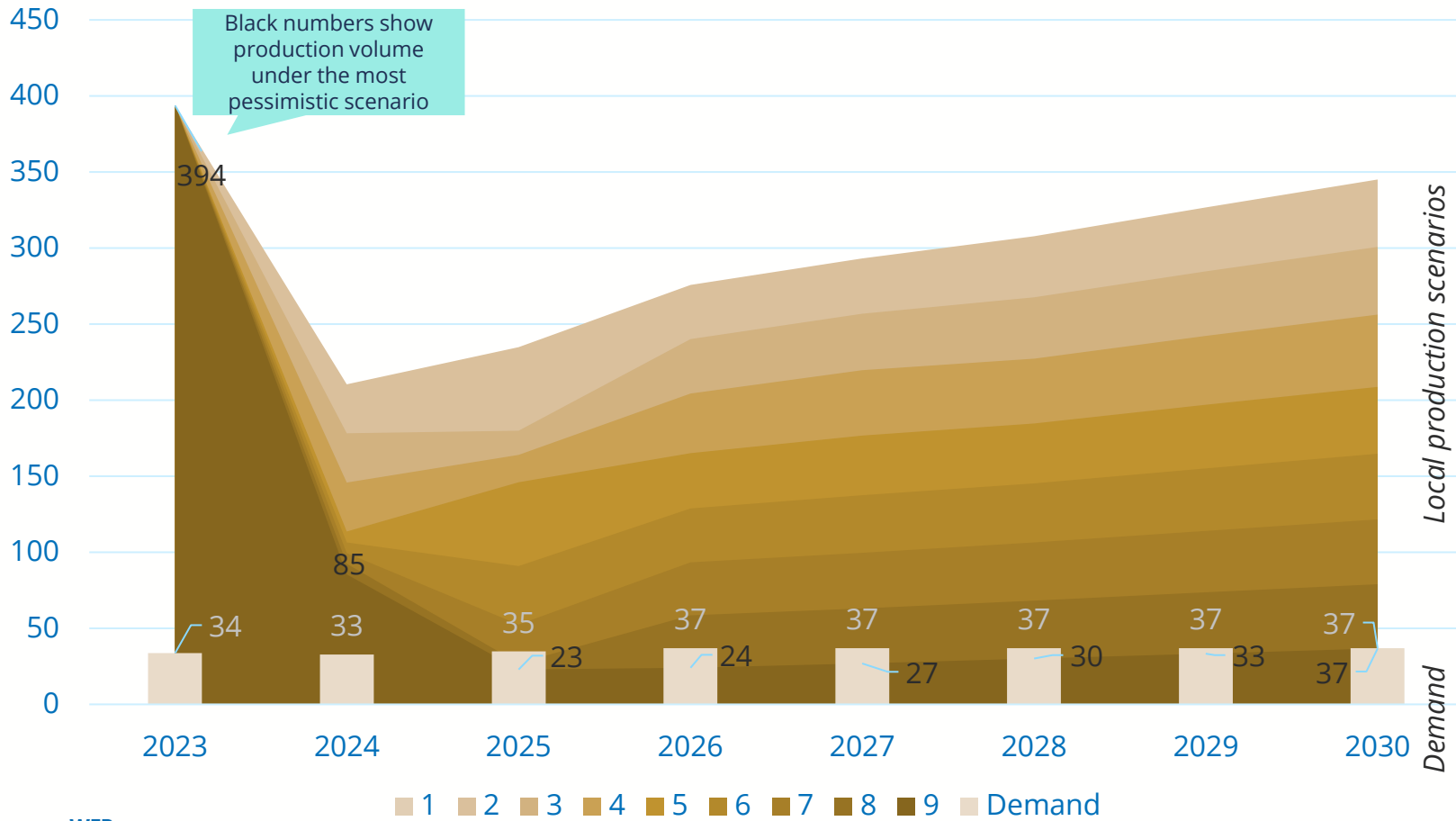
Scenario number

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# Supply and demand analysis: Oats (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- In case the war continues in 2025 together with port blockades and attacks on the infrastructure, production of oats is likely to continue falling in 2025 reaching a level lower than food demand. In the most pessimistic scenario, the production volume will keep at the such level till 2030.



World Food Programme

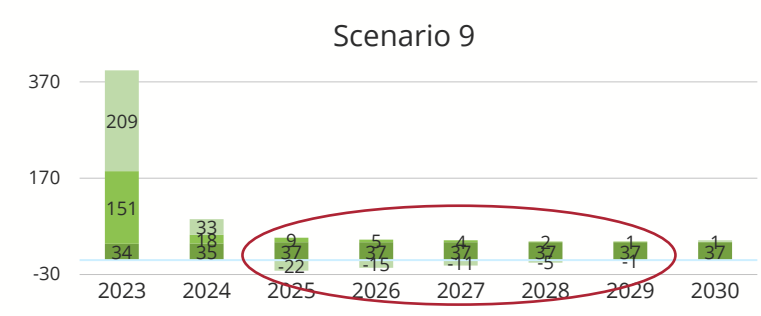
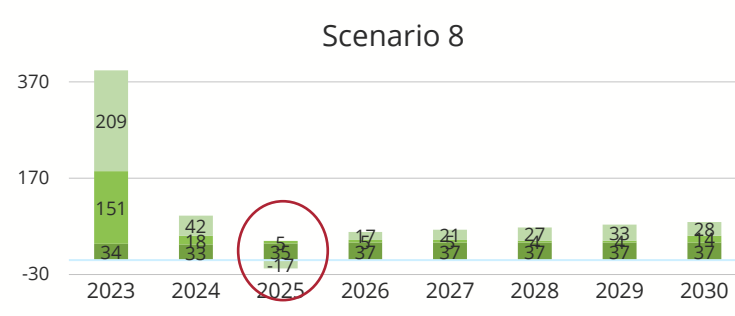
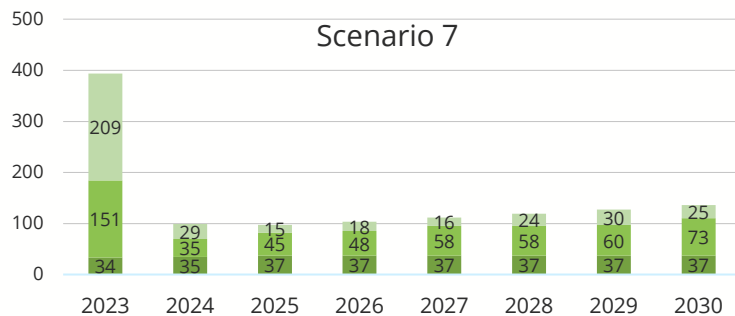
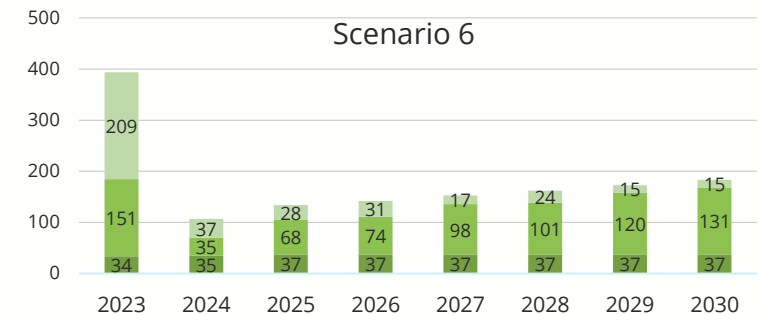
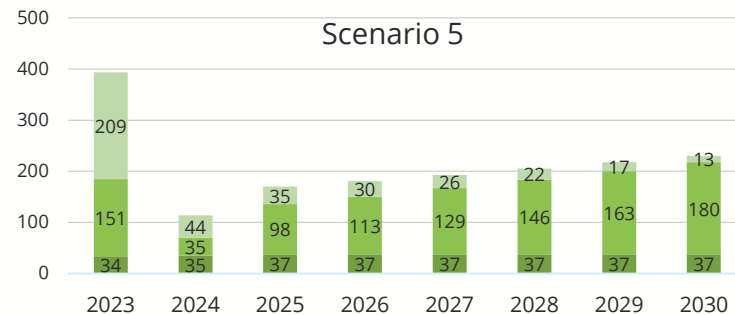
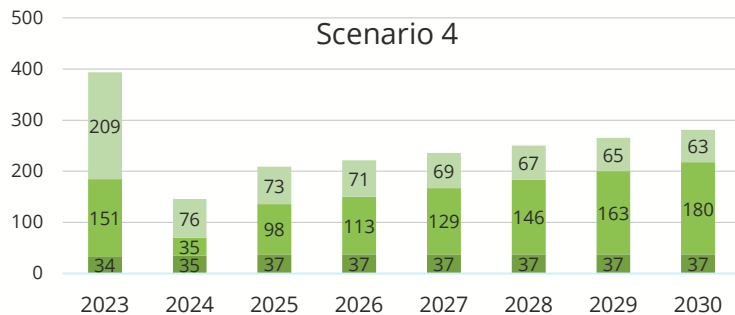
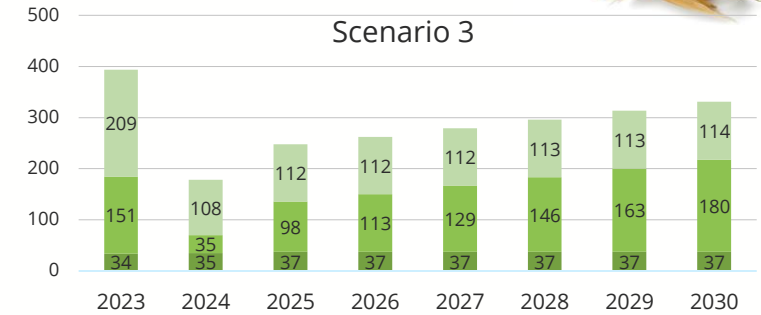
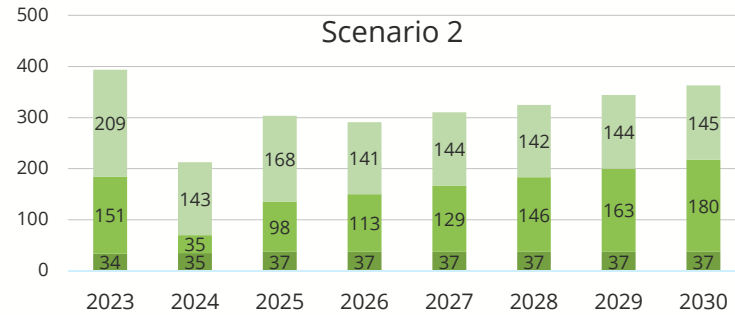
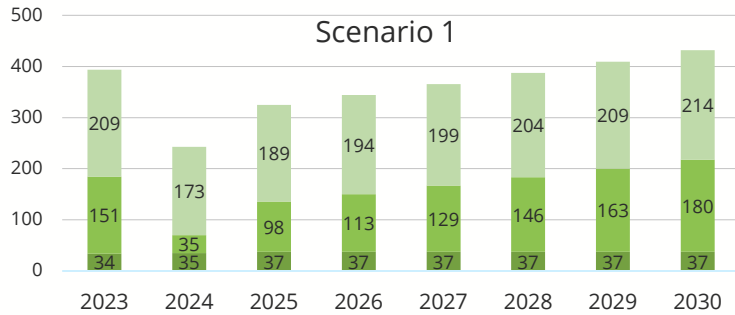
Scenario number

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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

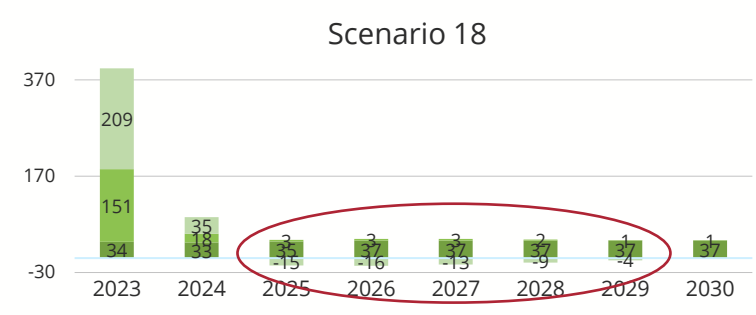
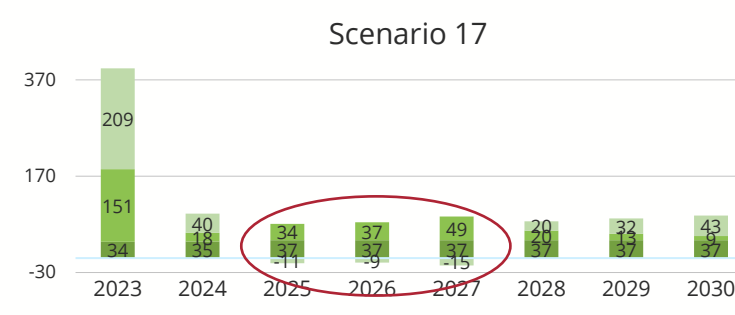
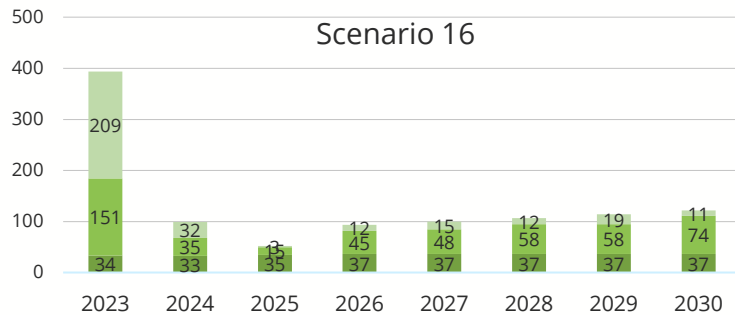
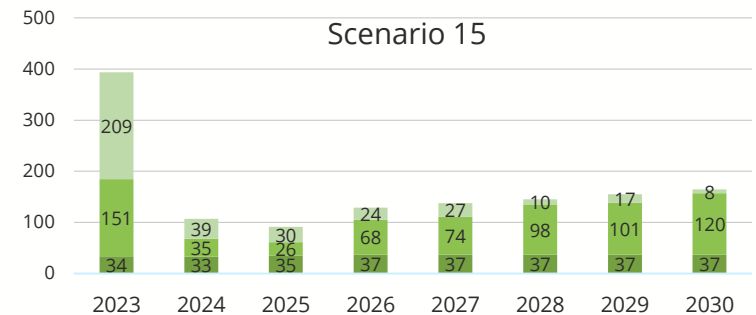
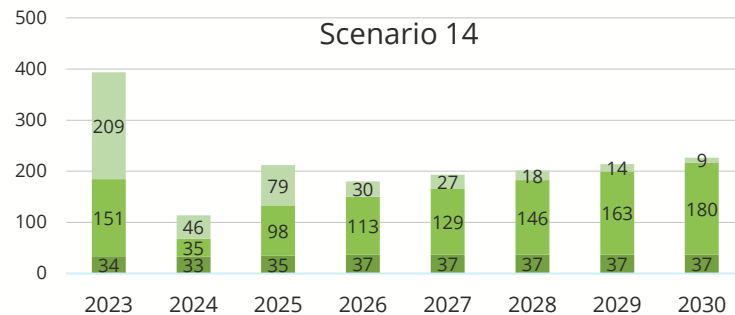
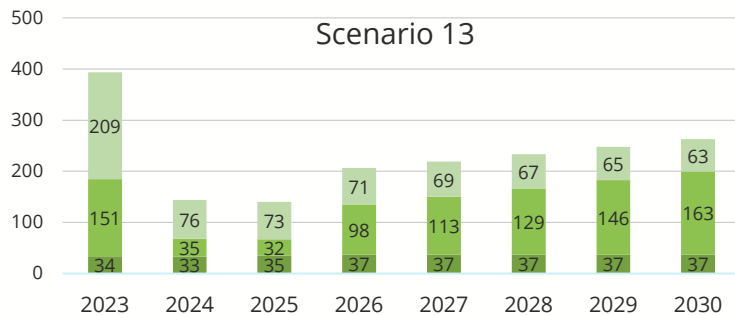
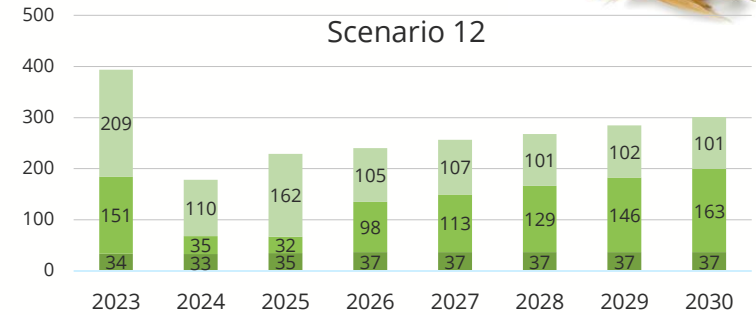
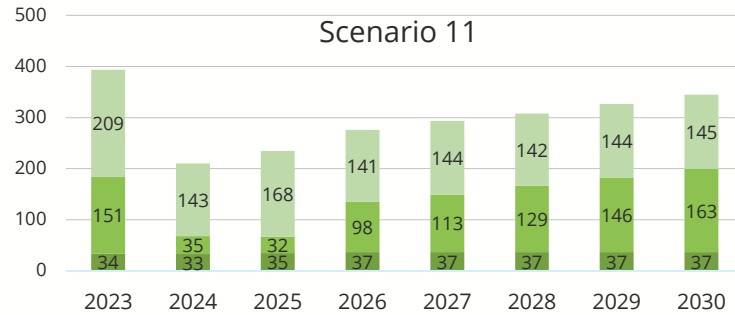
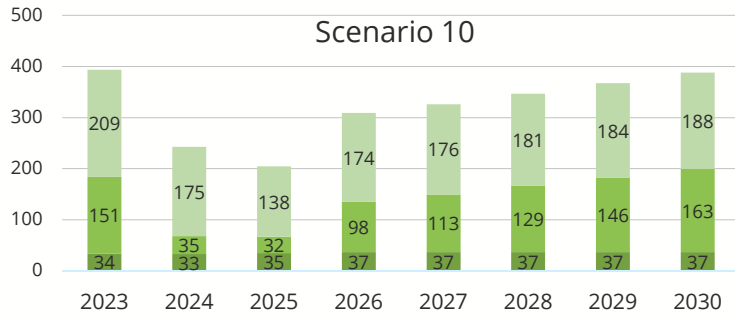
# Scenarios deep dives (end of war 2024)

12.5  
thsd t  
(average export per  
year in 2017-2021)

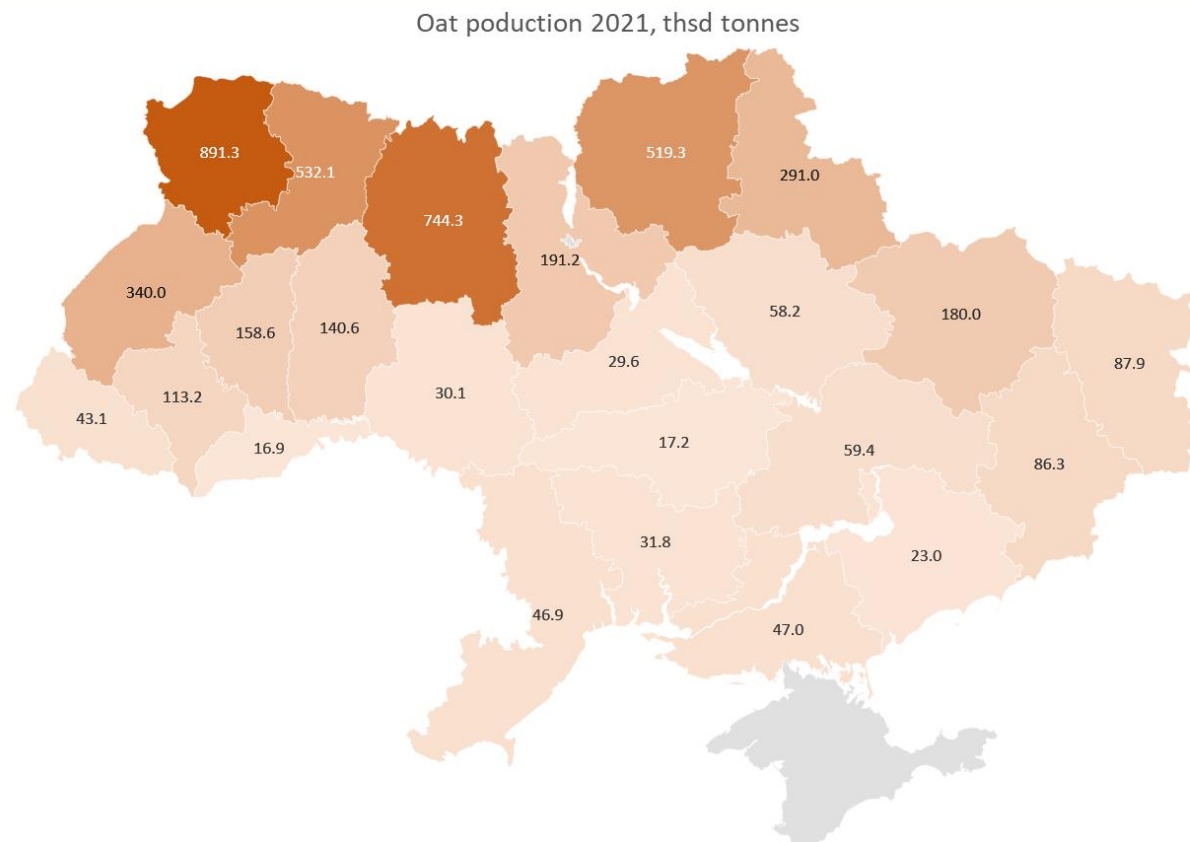


# Scenarios deep dives (end of war 2025)

12.5  
thsd t  
(average export per  
year in 2017-2021)



# Pre-war oats production by regions



- Oat is primarily grown in the Northern-Western region of the country where the effect of the war is minimal.

# Comments on scenarios and food balances: Oats



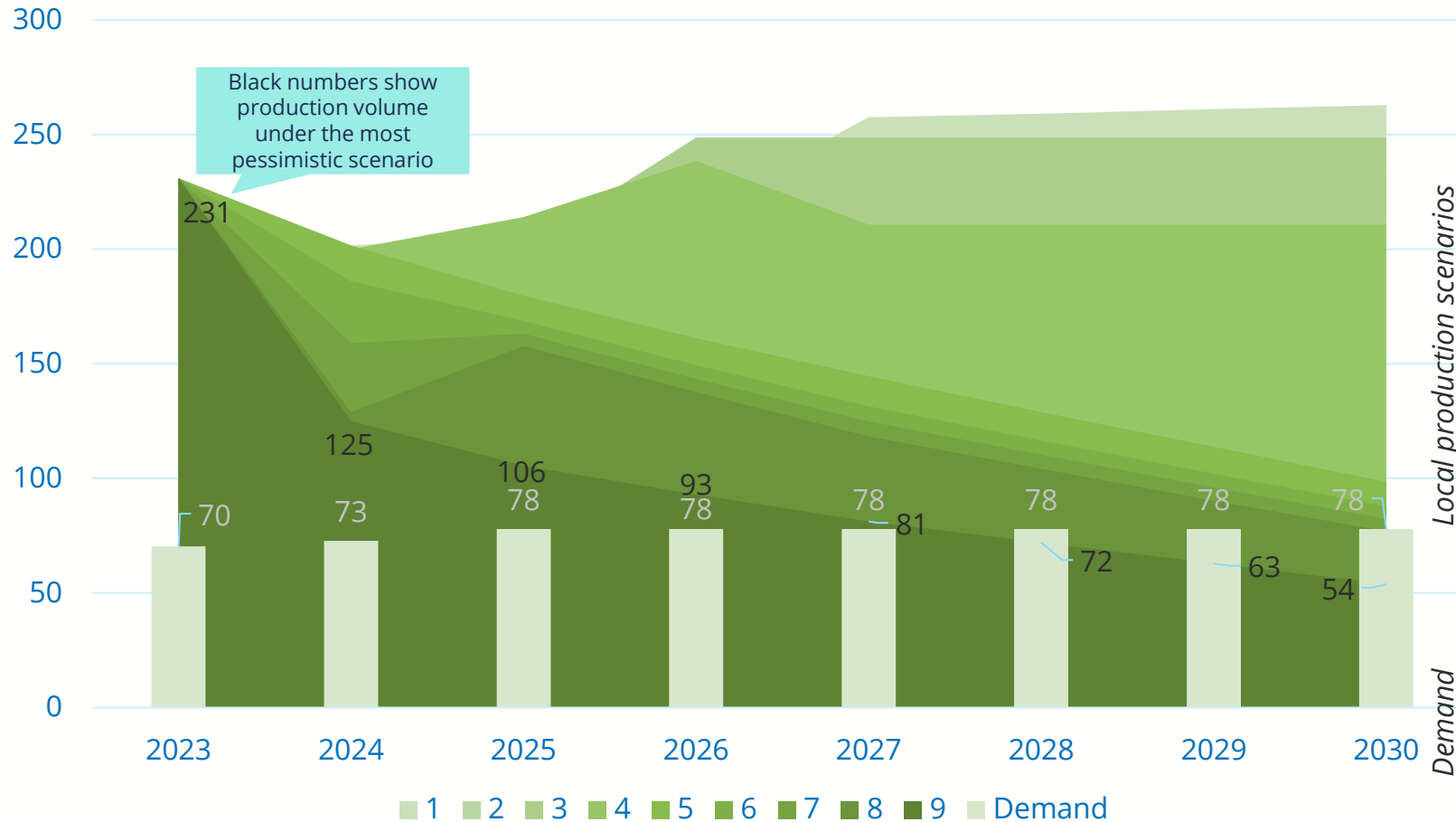
- Oats are primarily used for livestock feeding, not for food consumption.
- Food consumption accounts for about 10-15% of total production.
- Oats are not commonly exported from Ukraine or imported to Ukraine.
- The scenarios of heavy attacks on the Ukrainian infrastructure may lead to decline of oats production to the level close to the volume of the normative food demand, as the profitability of oats production may not be too low for the farmers compared to other crops .



# Supply and demand analysis: Buckwheat (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Production of buckwheat is closely linked to local consumption. Export and import of buckwheat are minimal. Production of buckwheat is cyclical as well as prices on the domestic market
- In case logistics costs are increased substantially, production of buckwheat may fall to the minimal level of local demand.
- Production of buckwheat depends a lot on domestic prices for buckwheat and prices for alternative crops.



World Food Programme

Scenario number

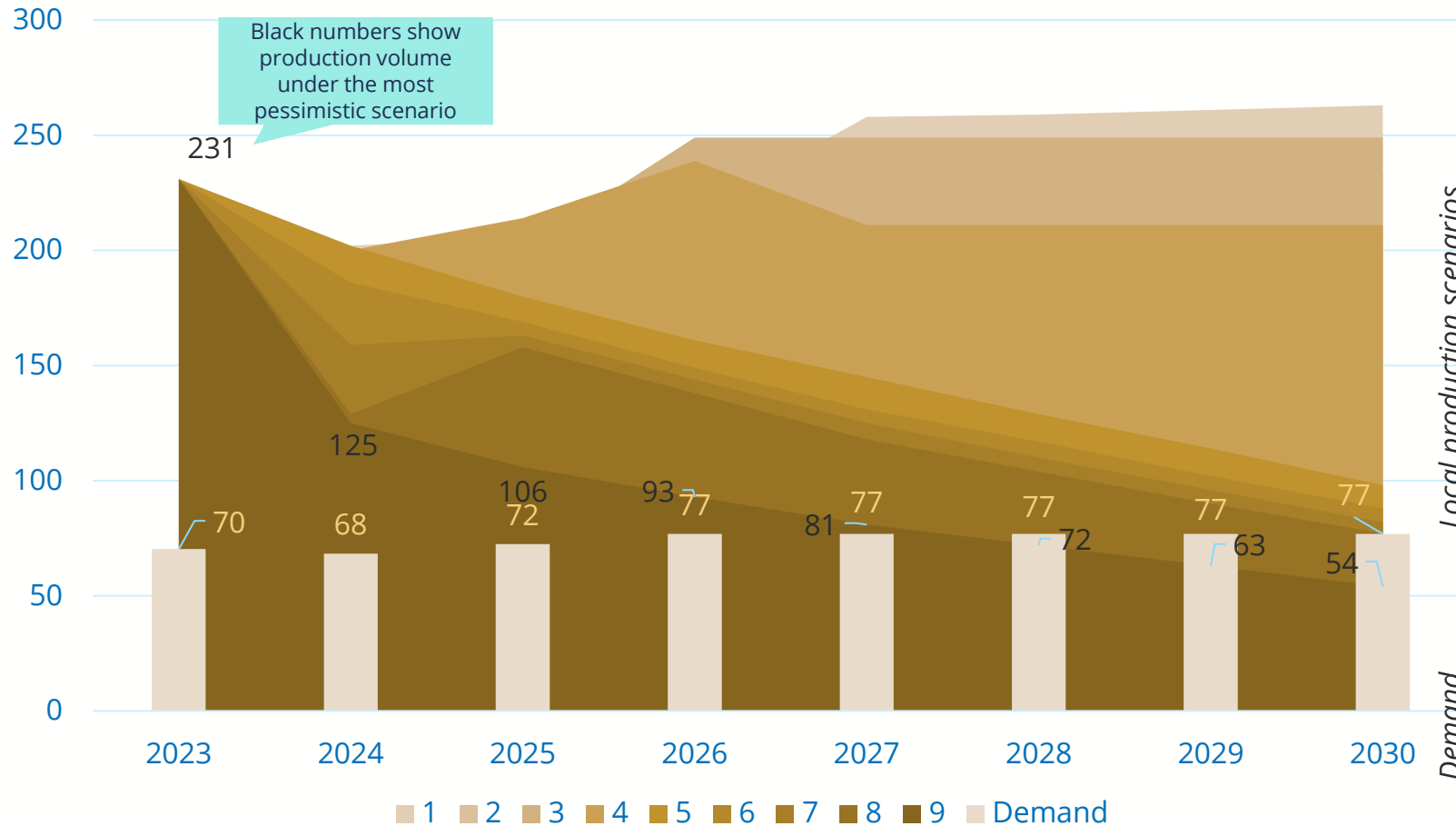
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Supply and demand analysis: Buckwheat (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Change in war duration has little impact on expected buckwheat production, as its production is located far from the war zone and demand for buckwheat is fairly stable.
- But even in the most pessimistic scenario the production level will keep near the level of minimal consumption.



World Food Programme

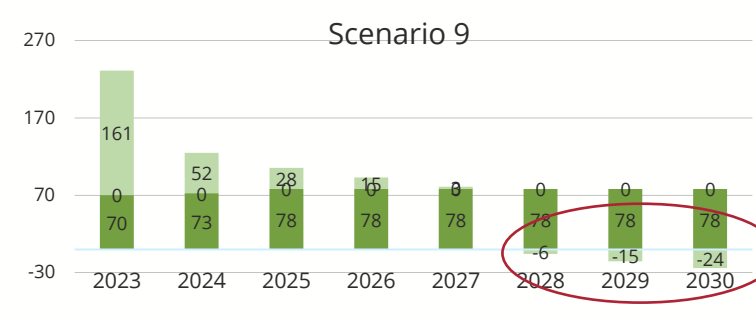
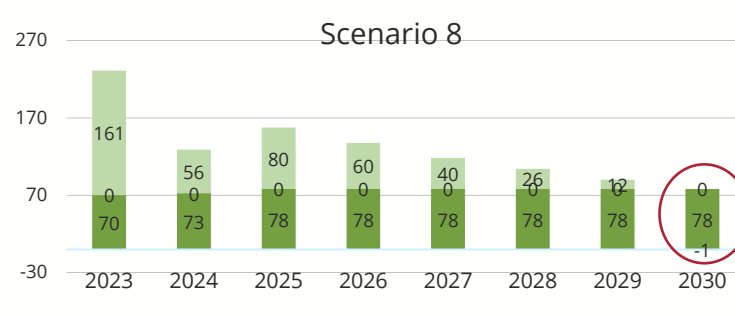
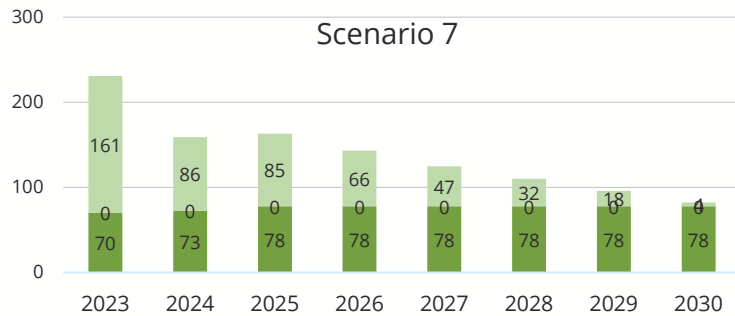
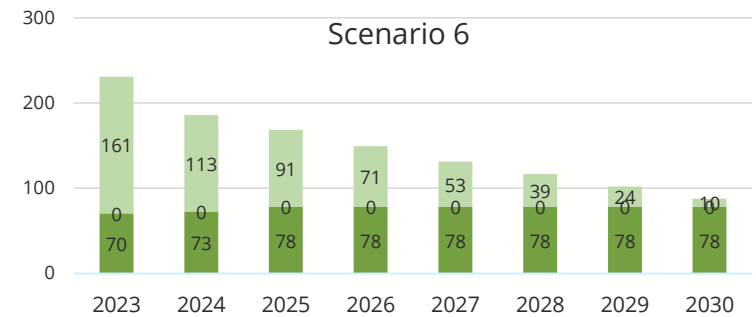
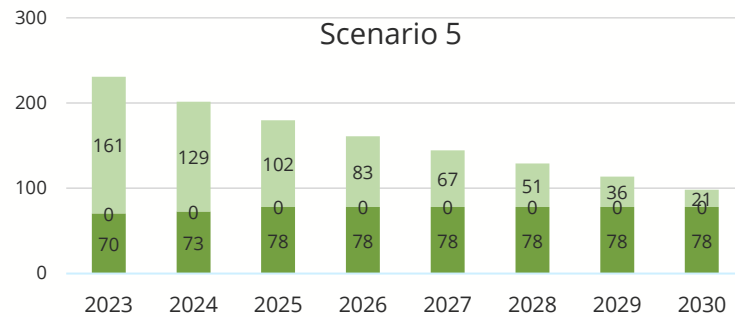
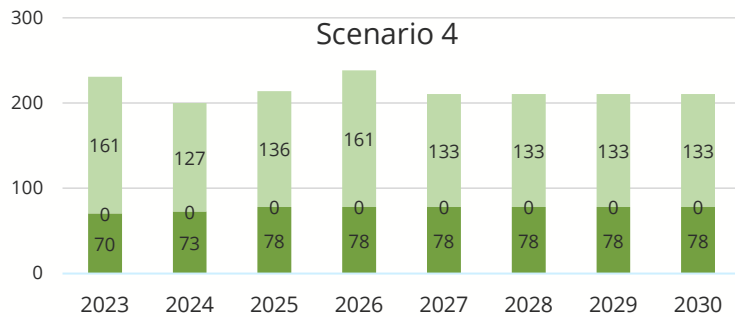
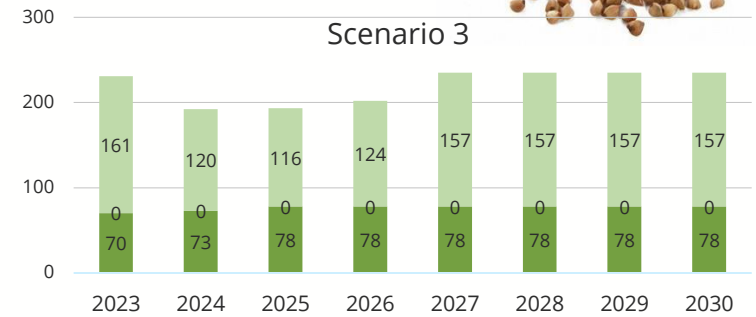
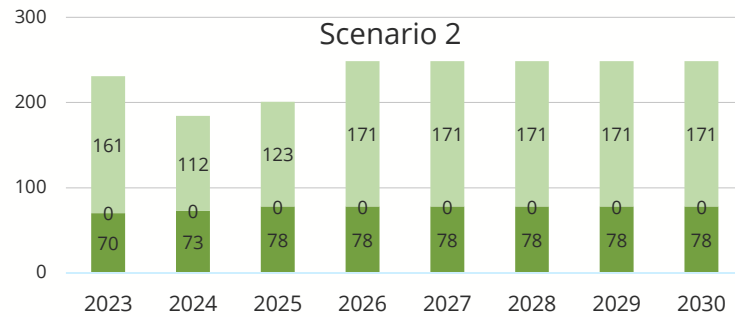
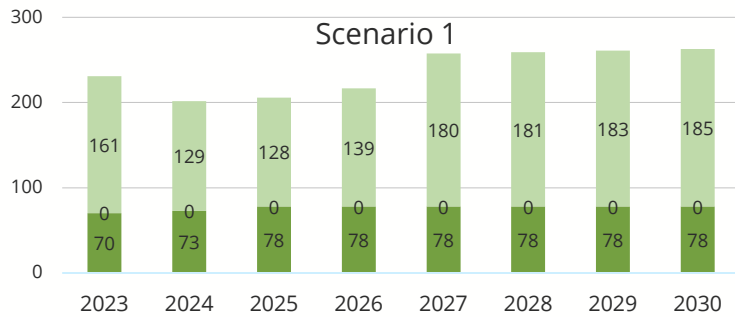
Scenario number

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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

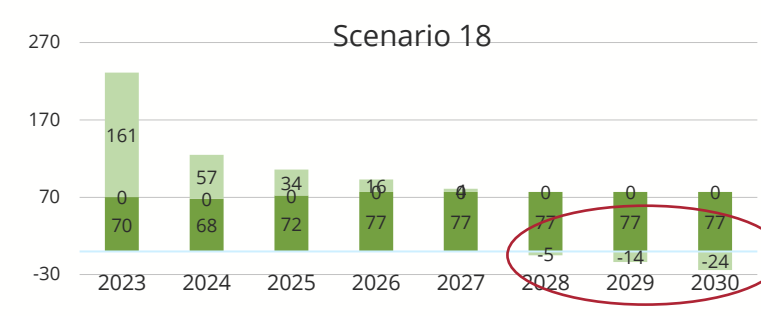
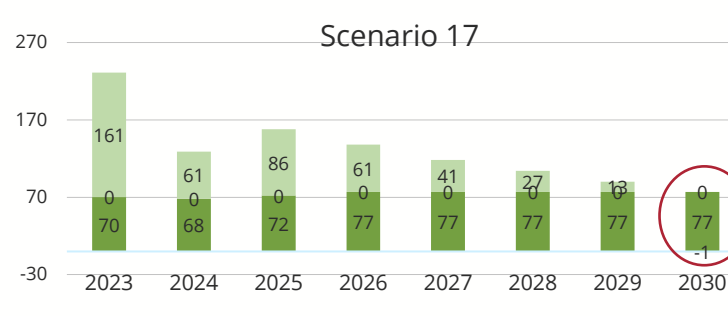
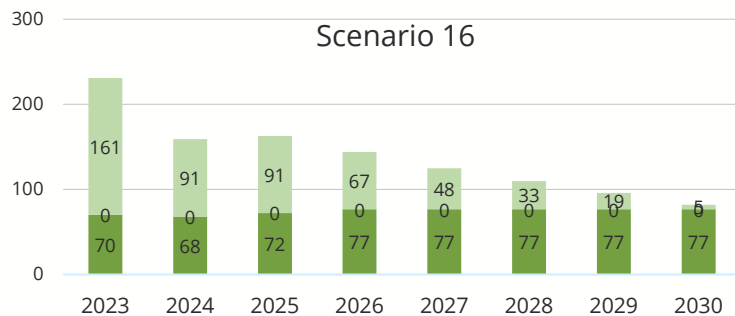
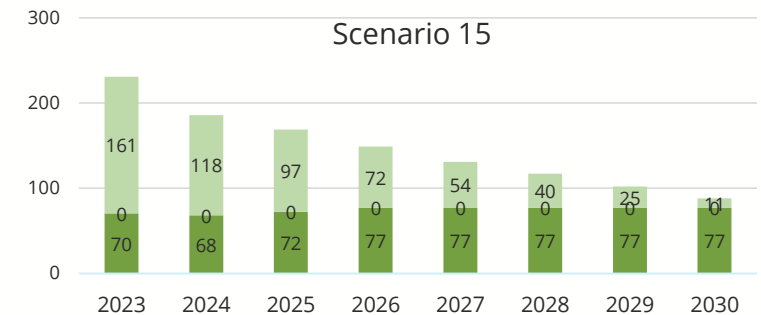
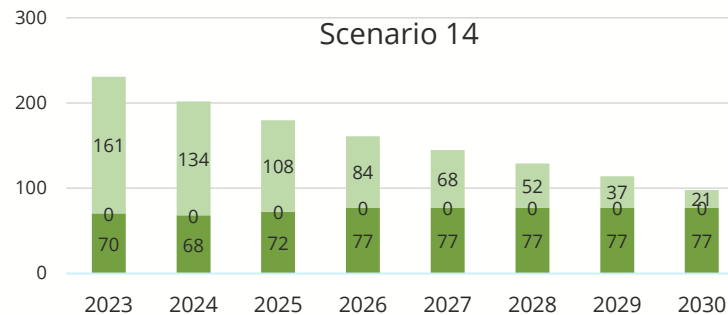
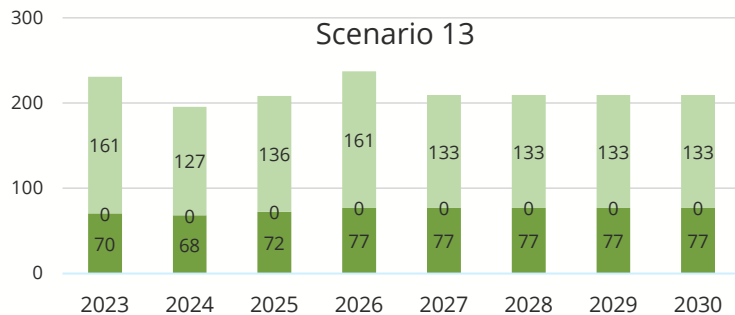
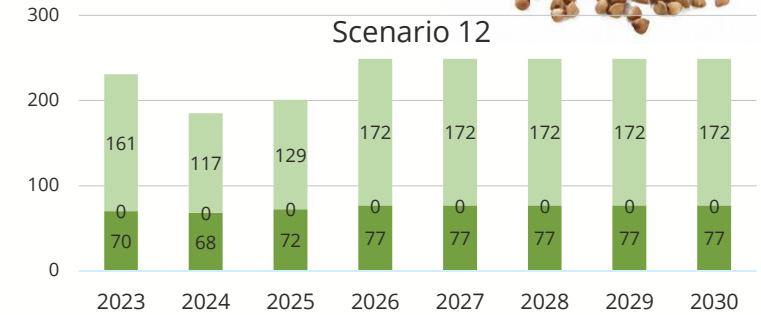
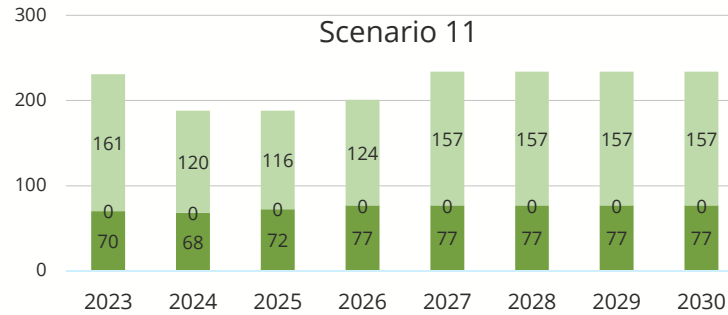
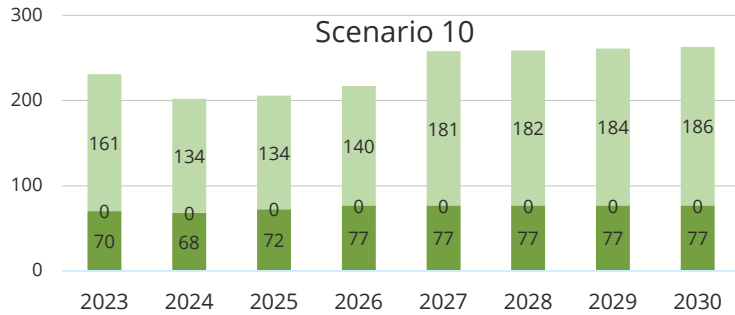
# Scenarios deep dives (end of war 2024)

~1  
thsd t  
(average export per  
year in 2017-2021)



# Scenarios deep dives (end of war 2025)

~1  
thsd t  
(average export per  
year in 2017-2021)





# Comments on scenarios and food balances: Buckwheat

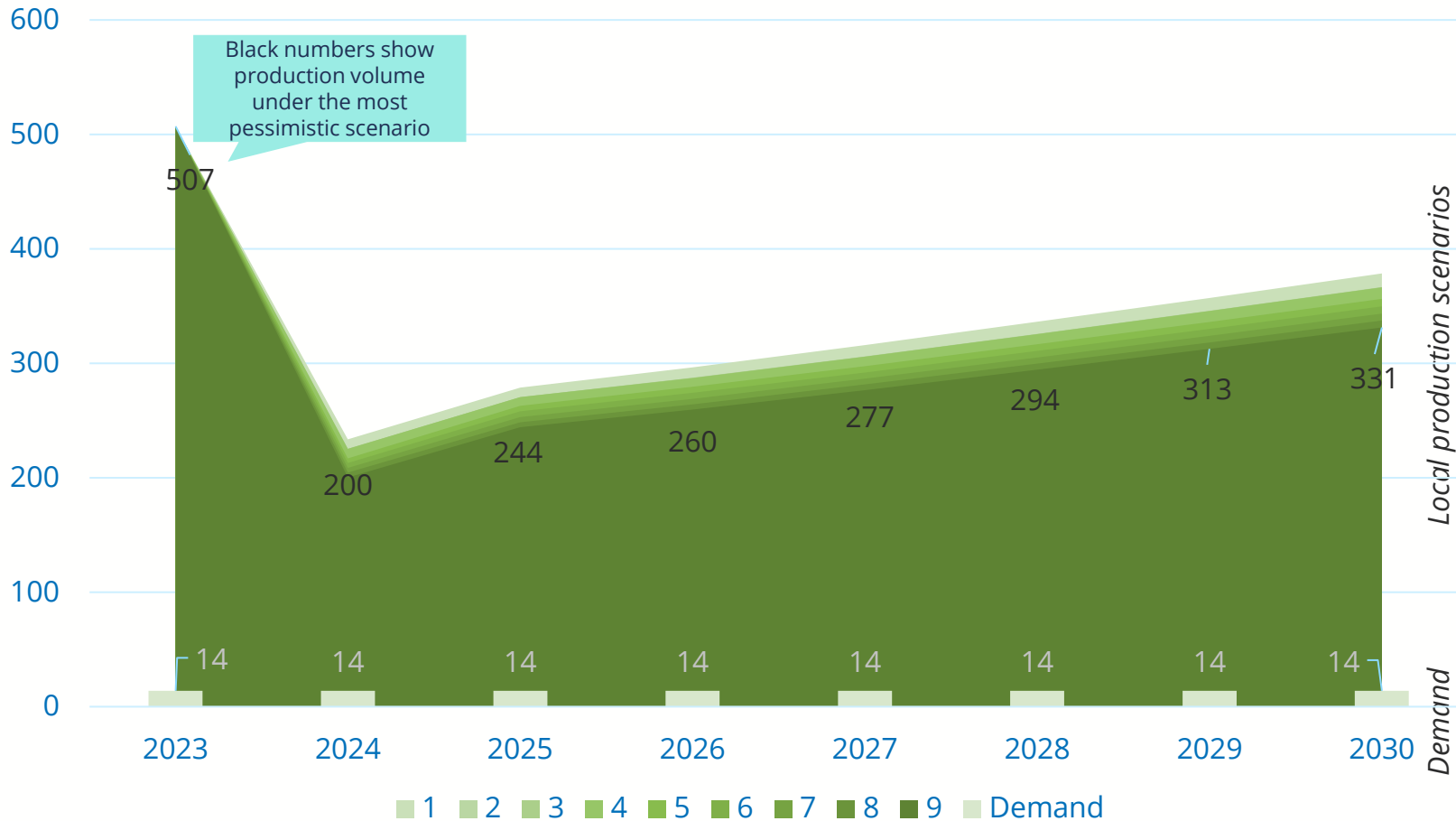


- Buckwheat is one of the main cereals consumed by Ukrainians. In 2023 all internal food demand for buckwheat was satisfied by local production.
- Import and export of buckwheat is minor.
- It is expected that local production will satisfy the demand for buckwheat in the foreseeable future even though some scenarios may be associated with temporary (up to 2 years) shortages of locally produced buckwheat.

# Supply and demand analysis: Rye (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

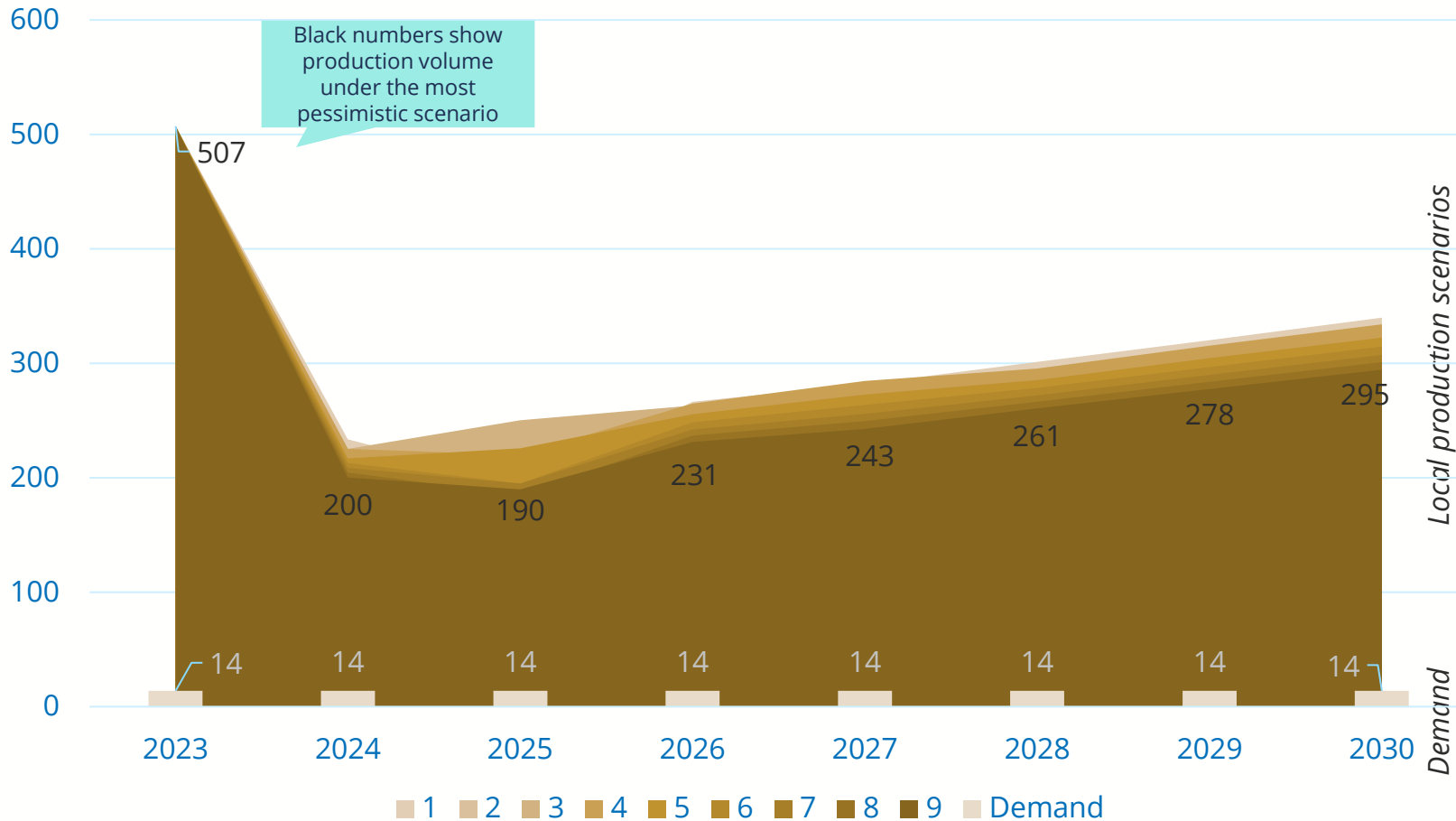
- Production of rye is not that dependent on logistics, so deviation of scenarios is relatively small.
- Rye is not commonly used as a food source in Ukraine, but under all scenarios the local production will satisfy the local demand.



# Supply and demand analysis: Rye (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

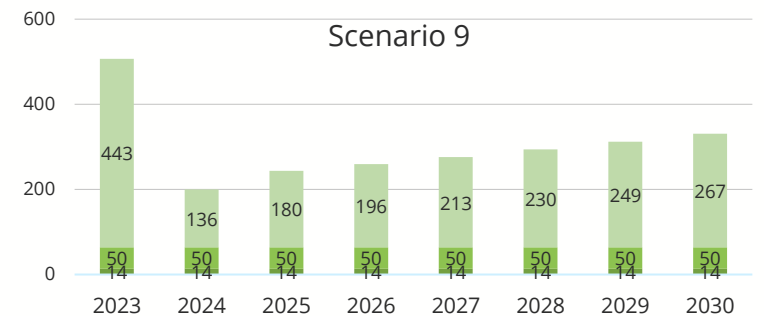
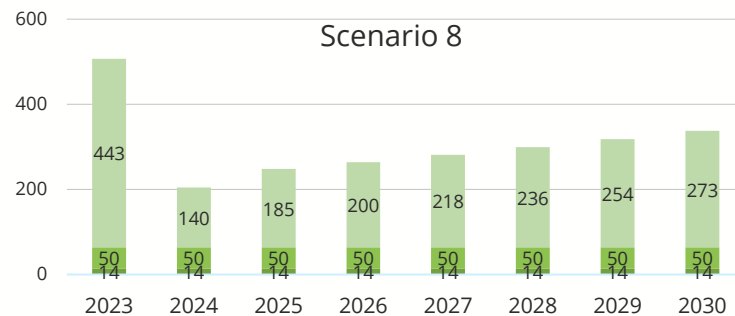
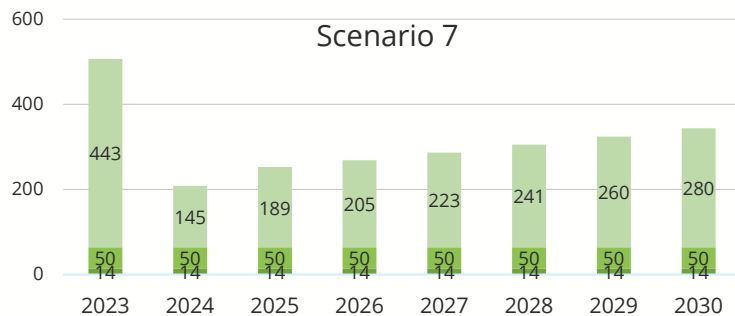
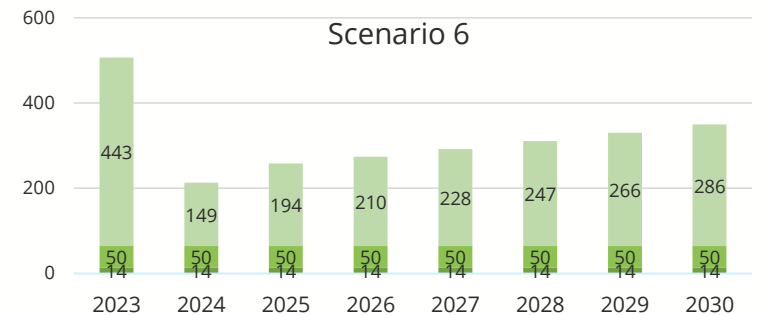
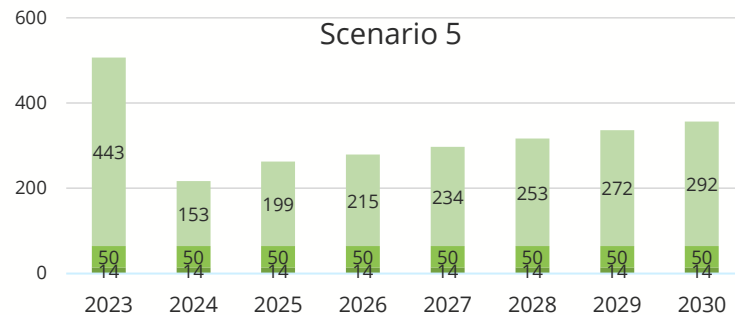
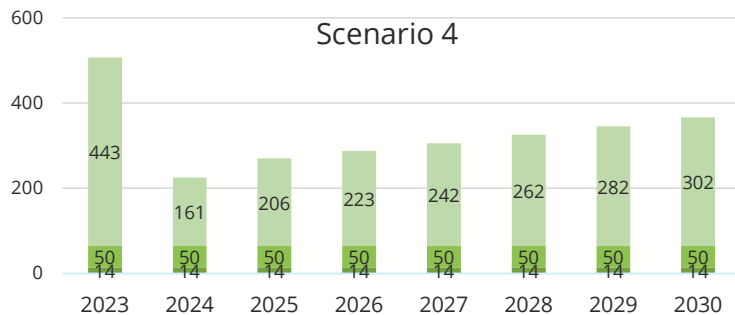
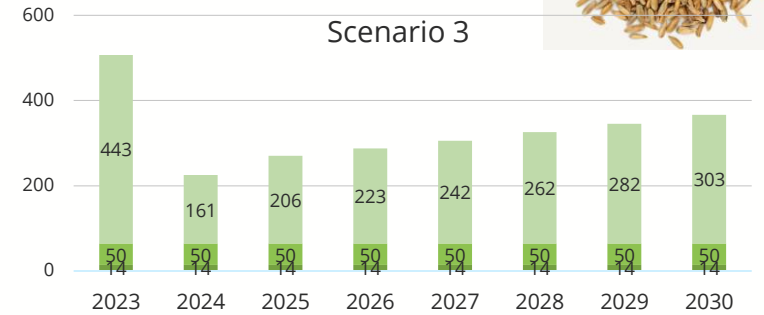
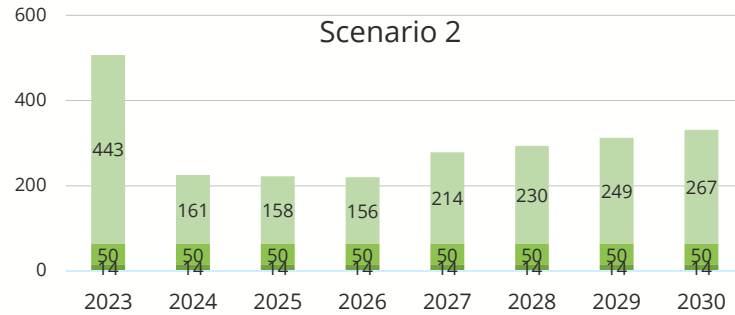
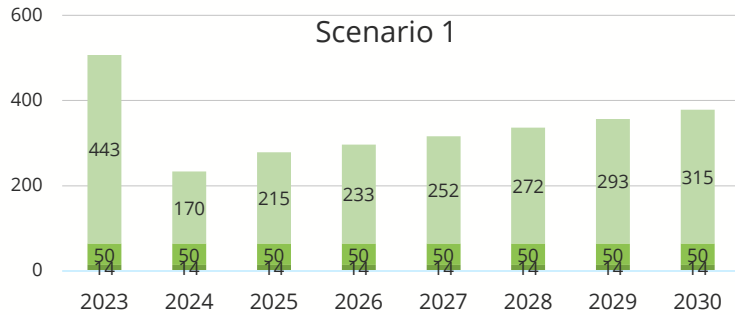
	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	<b>1</b>	<b>2</b>	<b>3</b>
Export infrastructure: Danube + land	<b>4</b>	<b>5</b>	<b>6</b>
Export infrastructure: land only	<b>7</b>	<b>8</b>	<b>9</b>

- Production of rye is not that dependent on logistics, so deviation of scenarios is relatively small.
- In case the war lasts longer, recovery of rye production is likely to take longer.



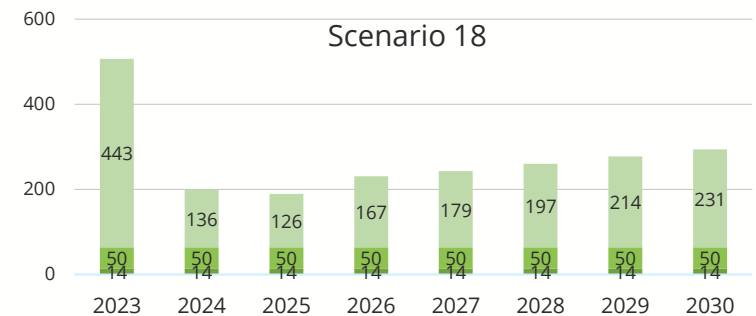
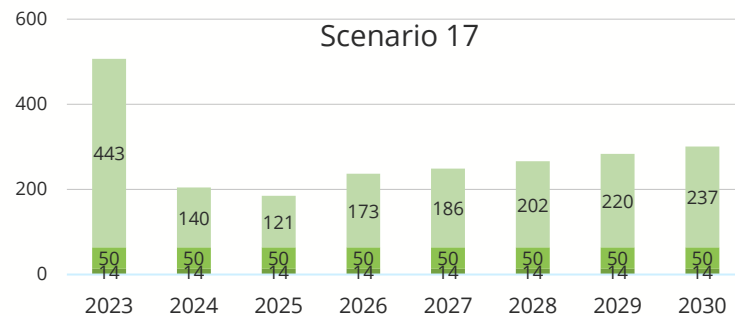
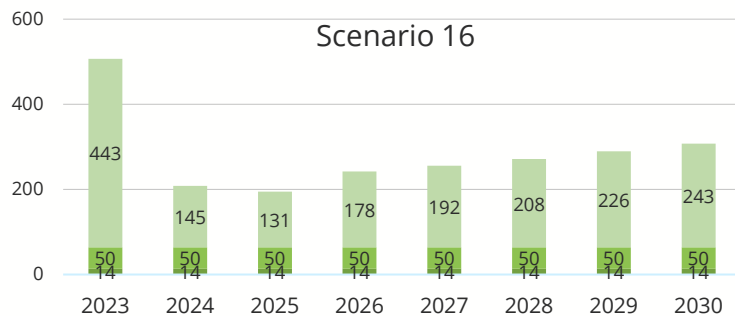
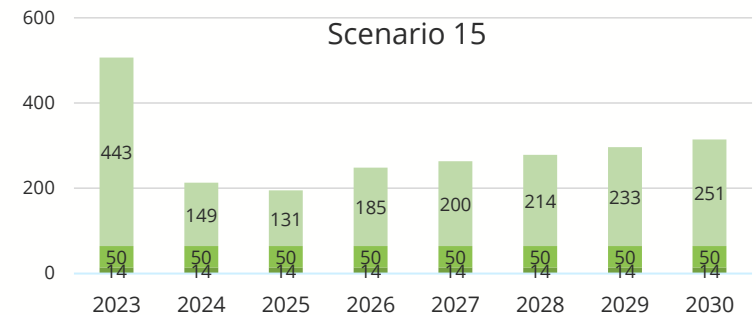
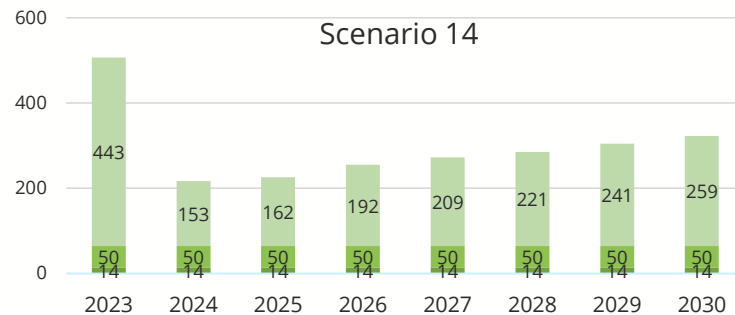
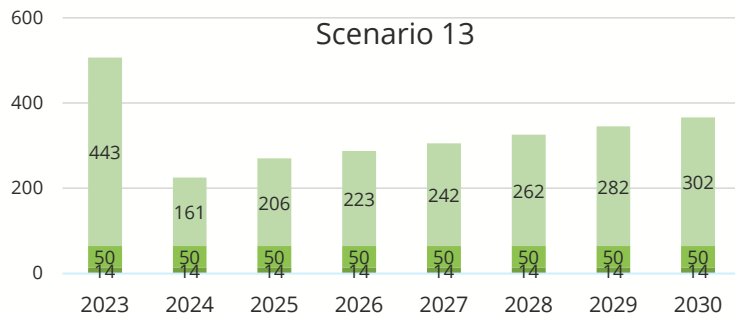
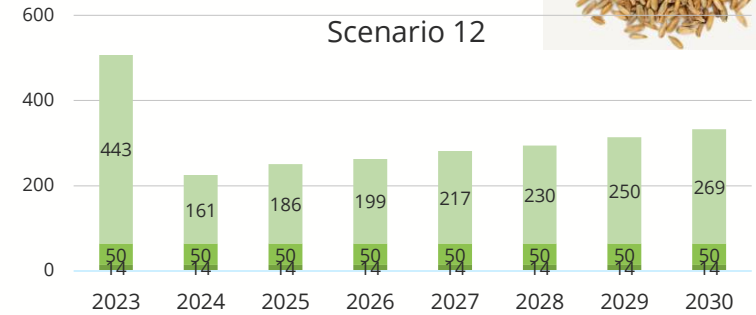
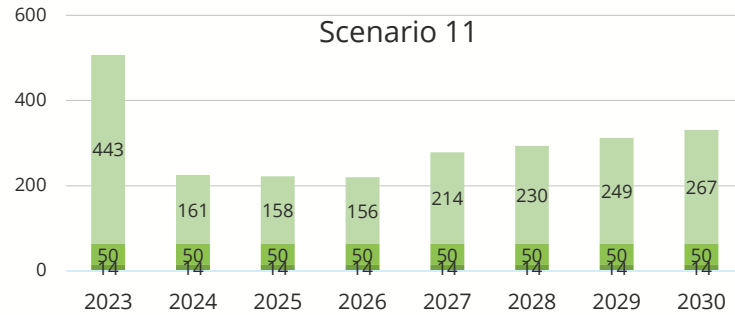
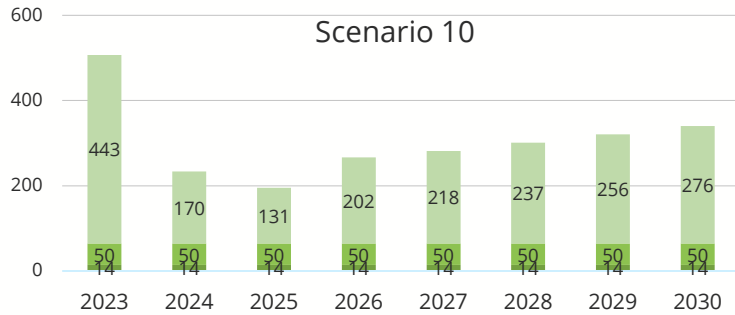
# Scenarios deep dives (end of war 2024)

162  
thsd t  
(average export per  
year in 2017-2021)



# Scenarios deep dives (end of war 2025)

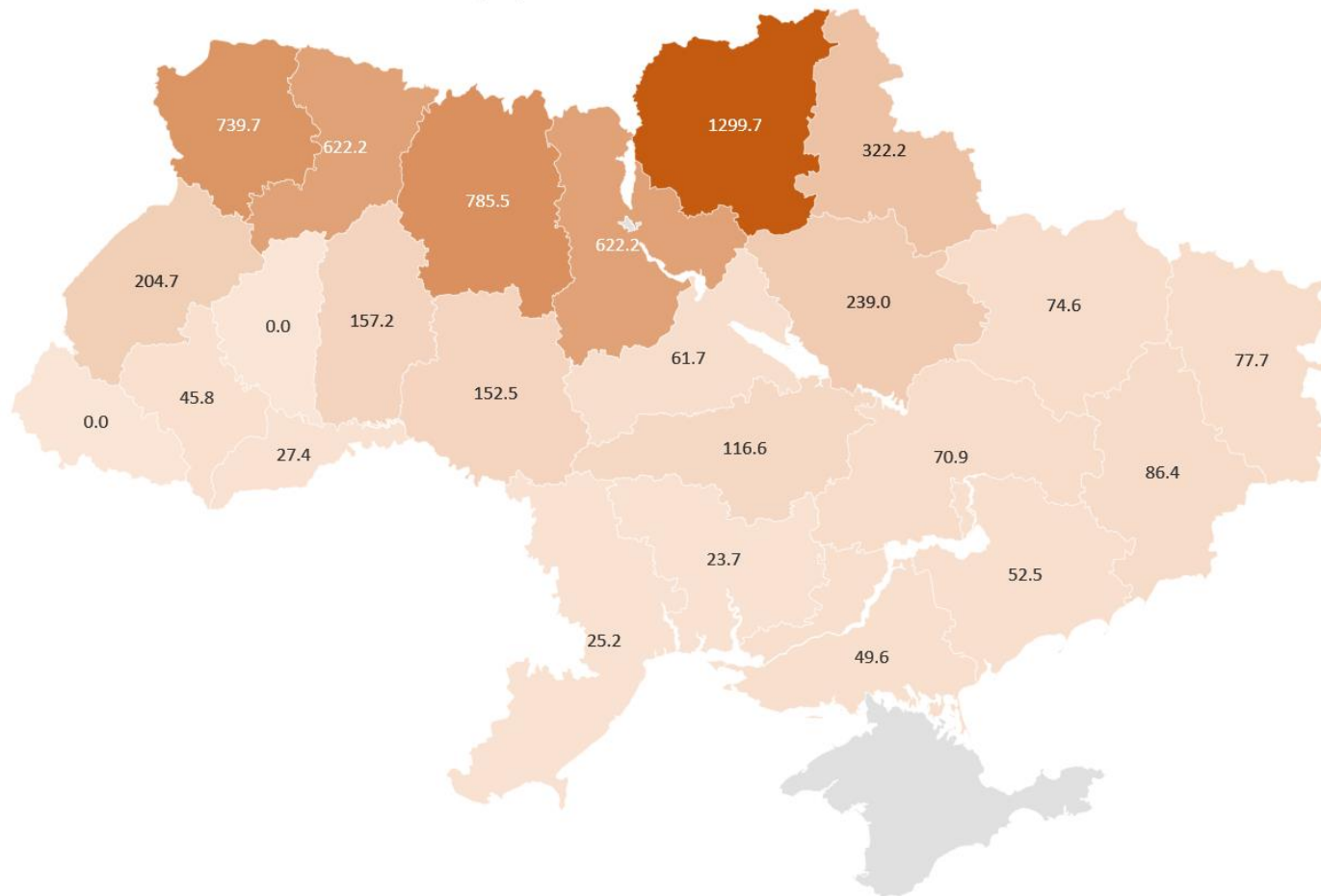
162  
thsd t  
(average export per  
year in 2017-2021)



# Pre-war rye production by regions



Rye production 2021, thsd tonnes



- Rye is grown mostly in the Northern and Western parts of Ukraine.

# Comments on scenarios and food balances: Rye

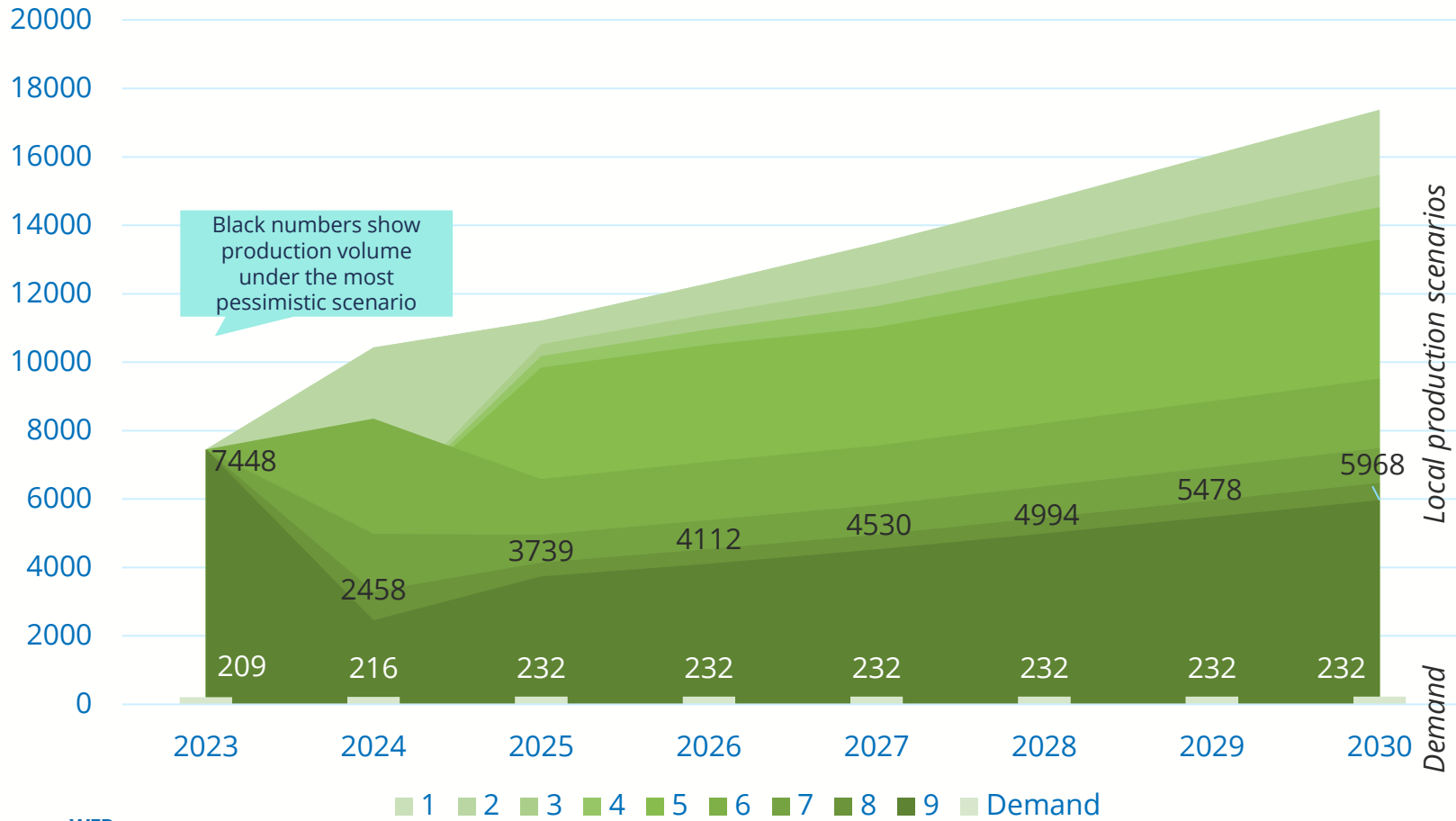


- Rye is not included in food basket in Ukraine, but it is still consumed fairly widely, even though in substantially lower quantities compared to buckwheat or rice.
- Local production covers local food consumption multiple times. No substantial export or import volume is expected, which makes rye less susceptible to attacks on Ukrainian logistics infrastructure.
- The export of rye was not done through the Grain Initiative, and it was primarily land-based. Rye is primarily grown in the regions of Ukraine which are not directly affected by hostilities and are located near the Western border of the country. Thus, attacks on grain infrastructure would not cause substantial impact on rye production and export.

# Supply and demand analysis: Sunflower oil (end of war 2024)



Local production and demand by scenario, thsd. tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Sunflower oil is one of the major export commodities in Ukraine. Production of sunflower oil exceeds local consumption by a factor of over 20X.
- Under the optimistic scenario farmers shift to sunflower seed and expand production of seeds in foreseeable future.



World Food Programme

Scenario number

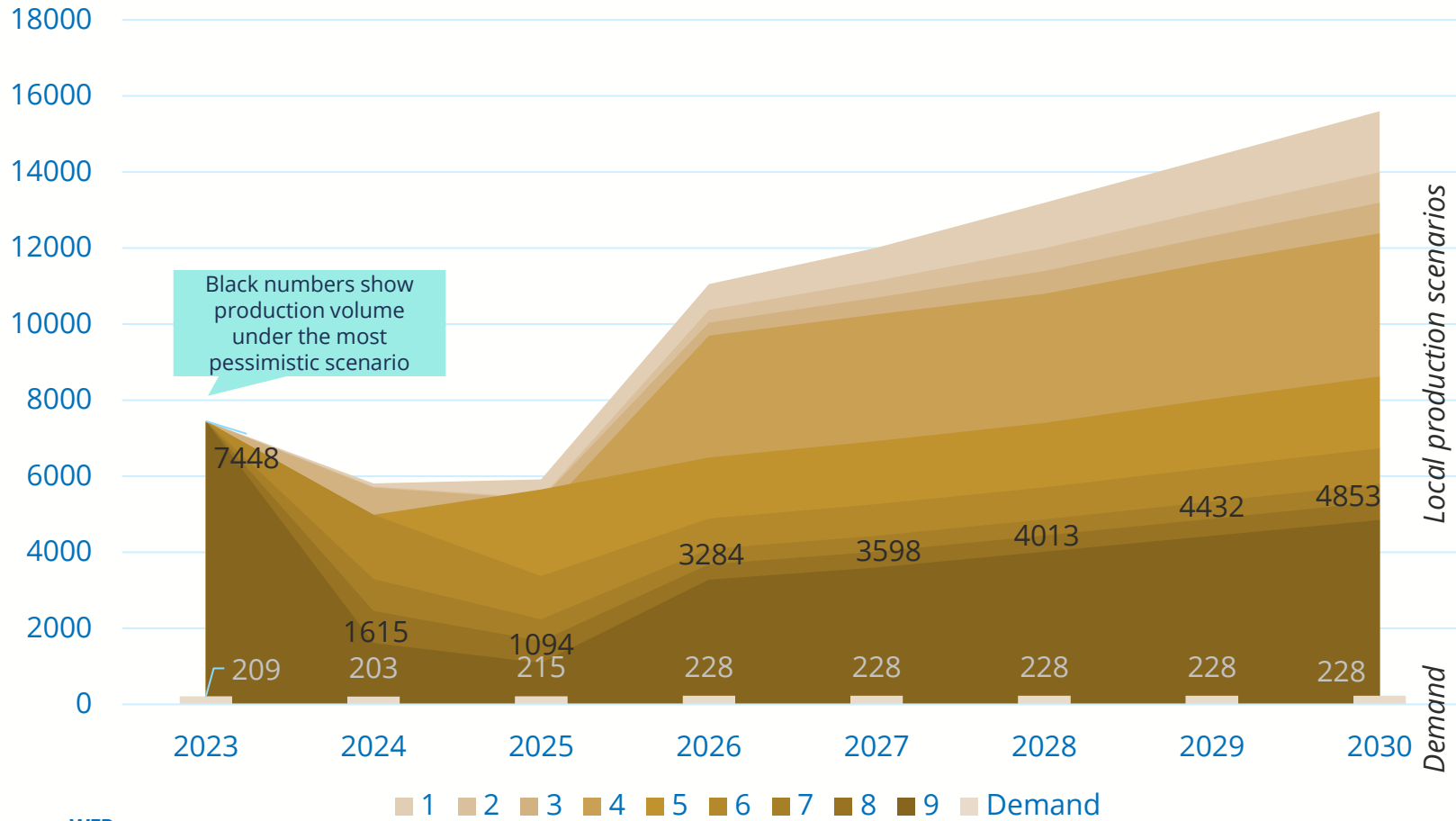
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Supply and demand analysis: Sunflower oil (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	<b>1</b>	<b>2</b>	<b>3</b>
Export infrastructure: Danube + land	<b>4</b>	<b>5</b>	<b>6</b>
Export infrastructure: land only	<b>7</b>	<b>8</b>	<b>9</b>

- In case the war lasts longer the period of decline lasts longer and the recovery phase takes longer.
- Even under the most pessimistic scenario production of sunflower oil substantially extends the local consumption.



World Food Programme

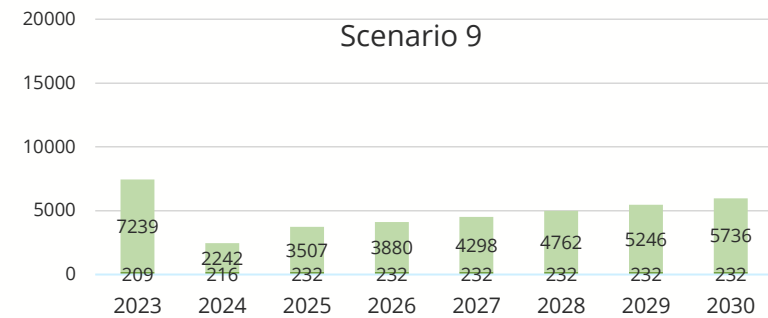
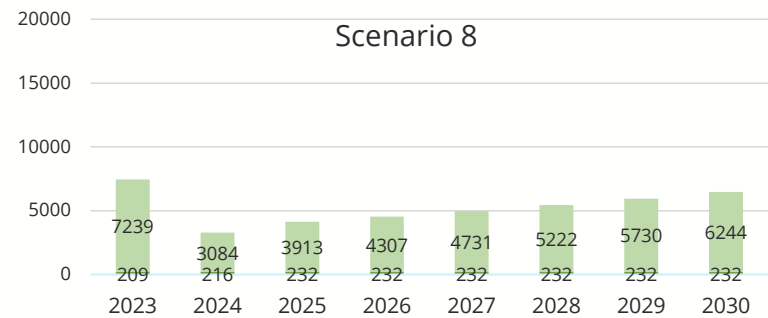
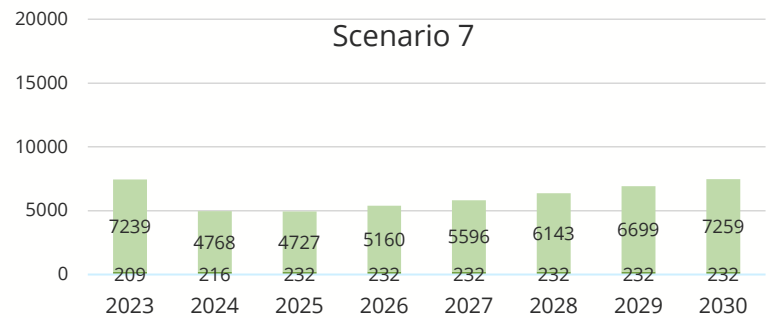
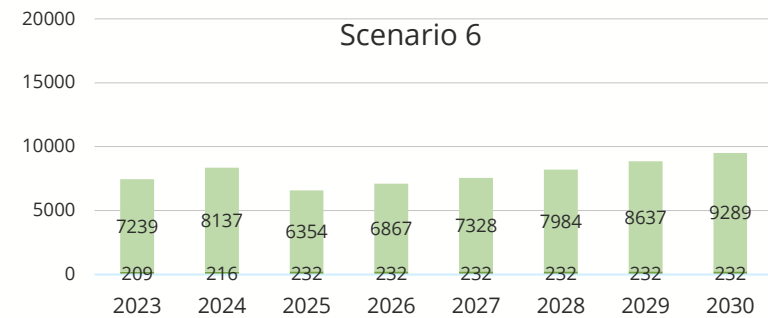
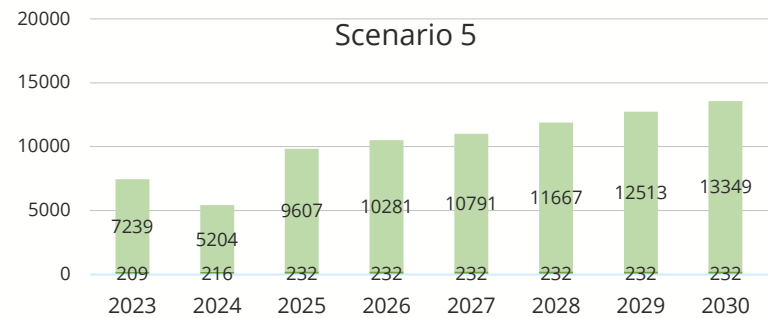
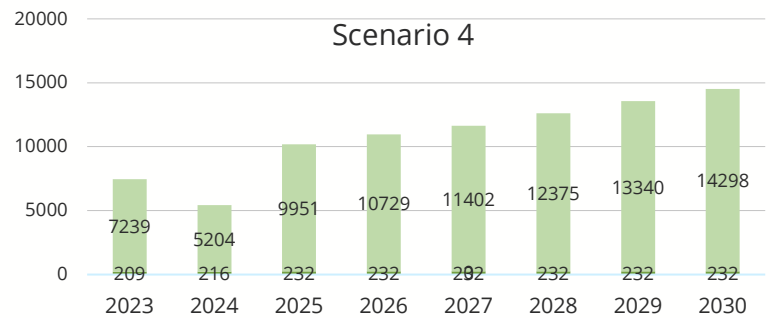
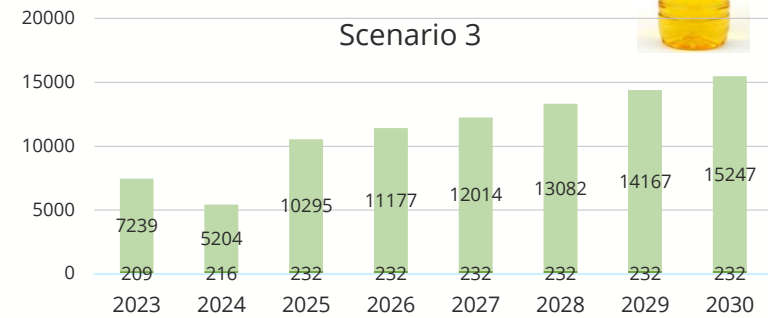
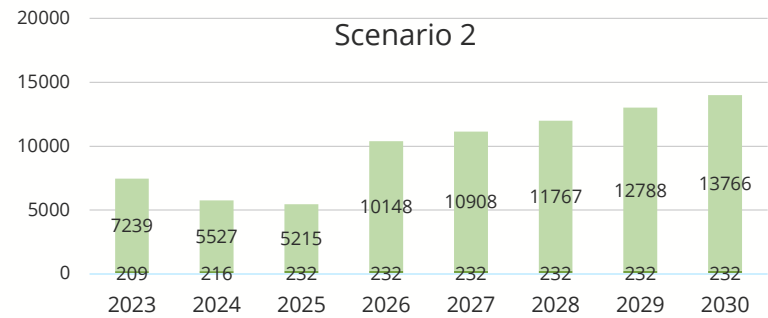
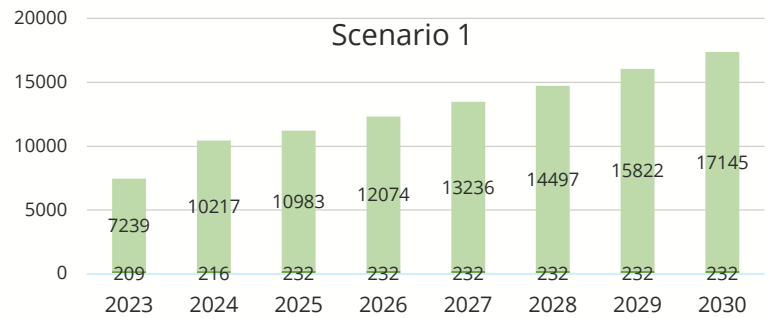
Scenario number

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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Scenarios deep dives (end of war 2024)

~5500  
thsd t  
(average export per  
year in 2017-2021)



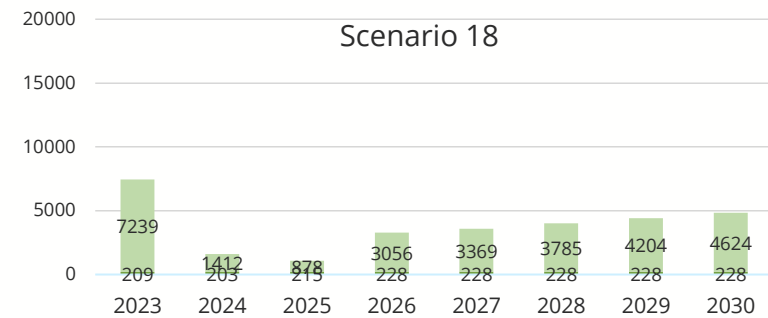
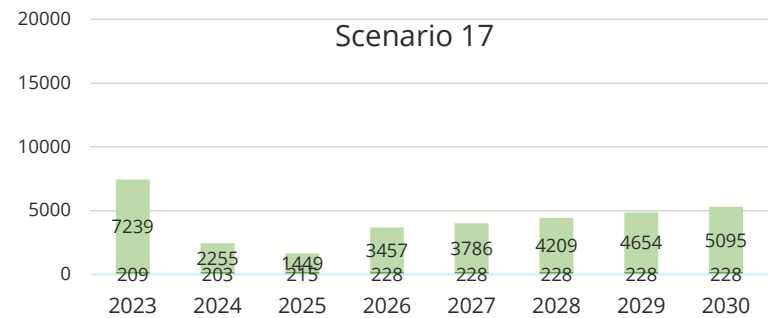
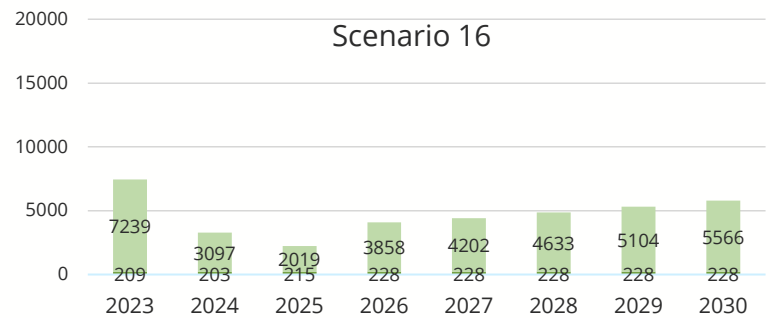
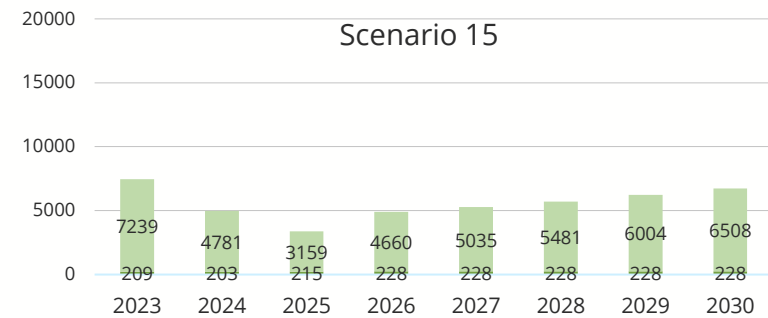
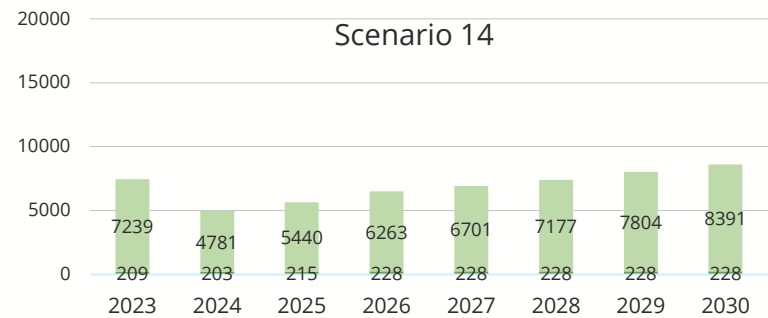
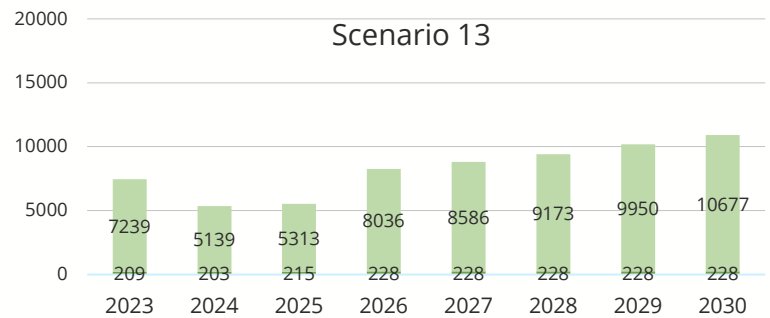
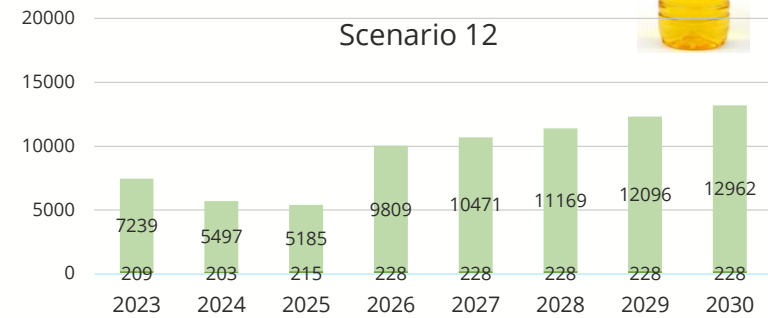
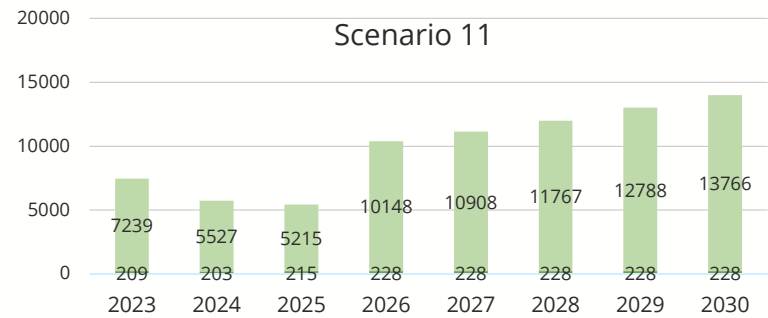
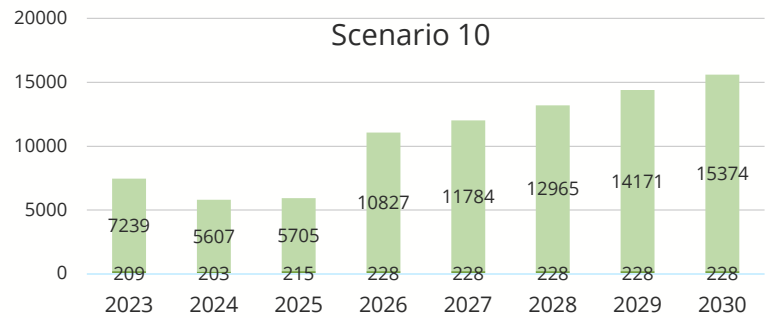
■ Normative food consumption   ■ Animal feeding   ■ Production in excess of domestic use (export potential)

Thousand tons



# Scenarios deep dives (end of war 2025)

~5500  
thsd t  
(average export per  
year in 2017-2021)

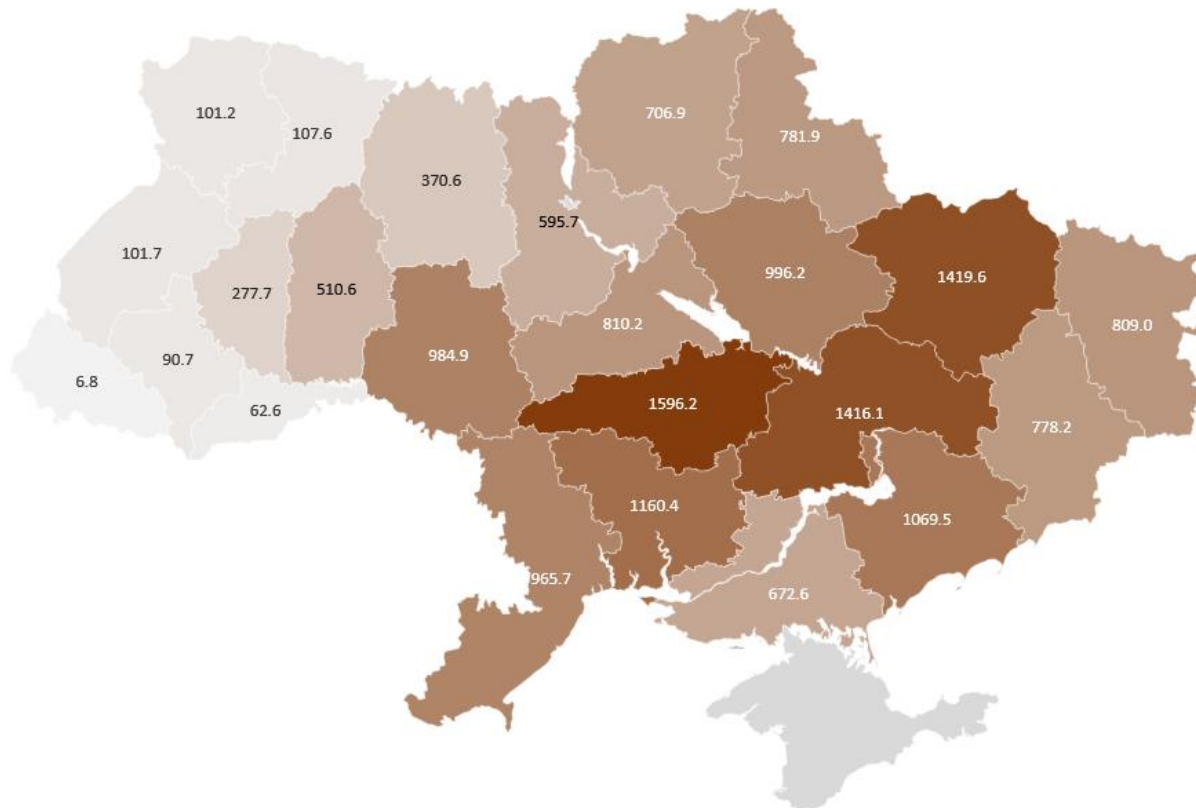




# Pre-war sunflower oil production by regions



Sunflower seed production 2021, thsd tonnes



- Sunflower seeds are mainly grown in the central regions of Ukraine. These territories are in proximity to the front, but in most cases they are not directly affected by the hostilities.

# Comments on scenarios and food balances: Sunflower oil



- Sunflower oil is widely exported from Ukraine and the export value is likely to grow in the future. The price per tonne of sunflower oil is substantially higher than the price of grain. Thus, higher logistics costs have smaller marginal effect on sunflower oil compared to grains.
- If the substantial share of logistics capacities are not operational (e.g. seaports are unavailable), there is increased demand for the constrained land export corridors. Increased demand naturally leads to elevated logistics costs. Price per ton of wheat is around \$250, while price per ton of sunflower oil is about \$1000. Thus, a fifty-dollar increase in logistics costs for grain is 20% of the total price and is likely to be above the farmer's profit margin. The same increase for sunflower oil is only 5% of the price and is likely to be below the profit margin. Thus, a farmer may find that growing wheat has become unprofitable, while growing sunflower seed is still profitable. As a result, under conditions of increased logistics costs, farmers are likely to shift to export products with higher added value.
- Even under the most pessimistic scenario sunflower oil production in Ukraine will substantially exceed domestic consumption and some opportunity for export will remain.



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## **Section 3.2**

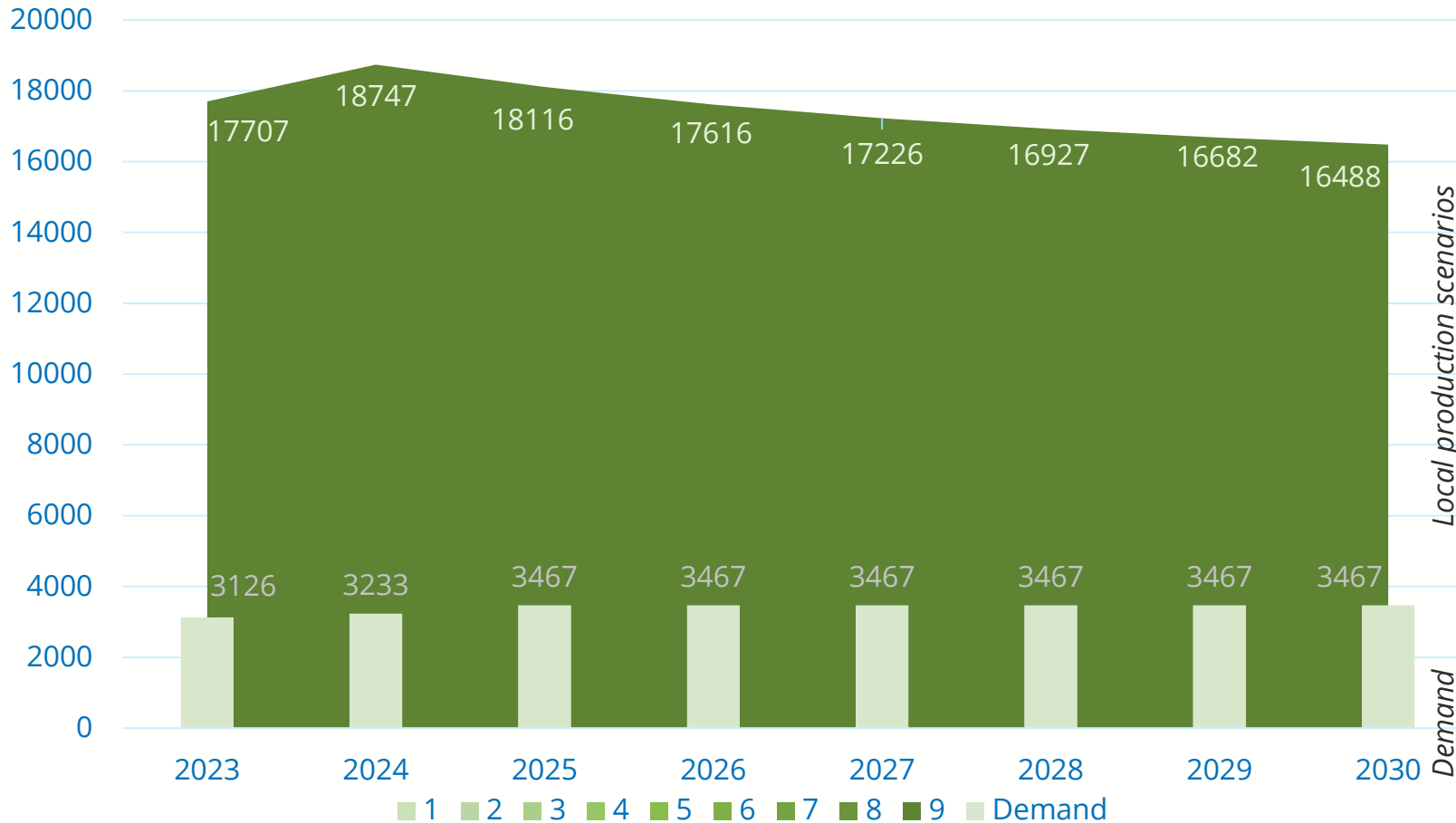
# Commodities unaffected by scenario assumptions

*[The commodities in this section were not actively exported through seaports of the Black Sea. Attacks on the grain infrastructure and port blockade will have limited effect on their supply chains and thus production levels]*

# Supply and demand analysis: Potato (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

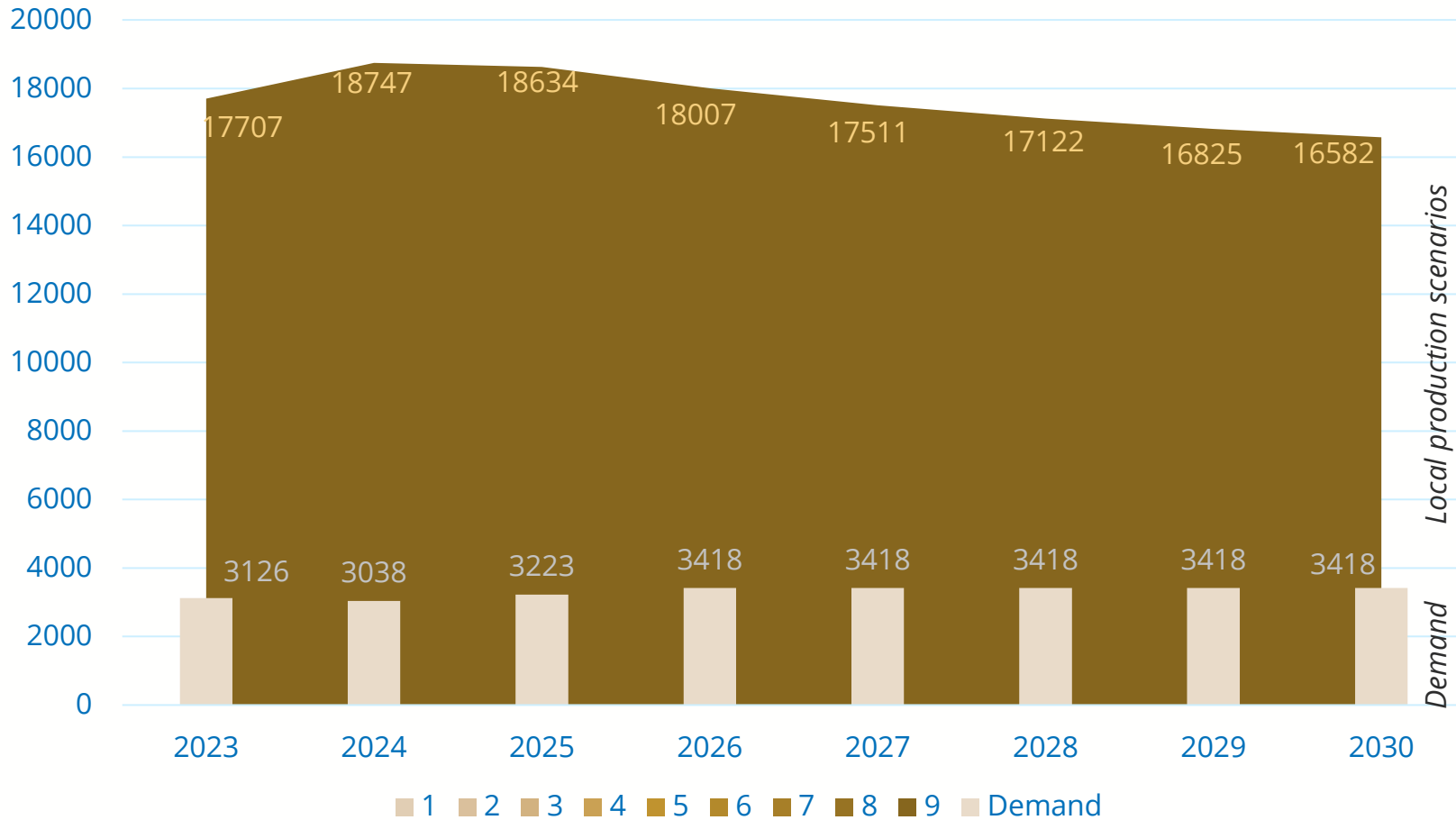
	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- The vast majority of potatoes is produced locally, so attacks on logistics infrastructure would not affect the supply of potatoes.
- Consumption of potatoes is likely to decline after the war, as people will shift to other products for more diverse food ration.

# Supply and demand analysis: Potato (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- If the war continues for longer, consumption of potatoes is likely to be higher during the war period, as potato is the product that replaces other basic food products during hardships.



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Scenario number

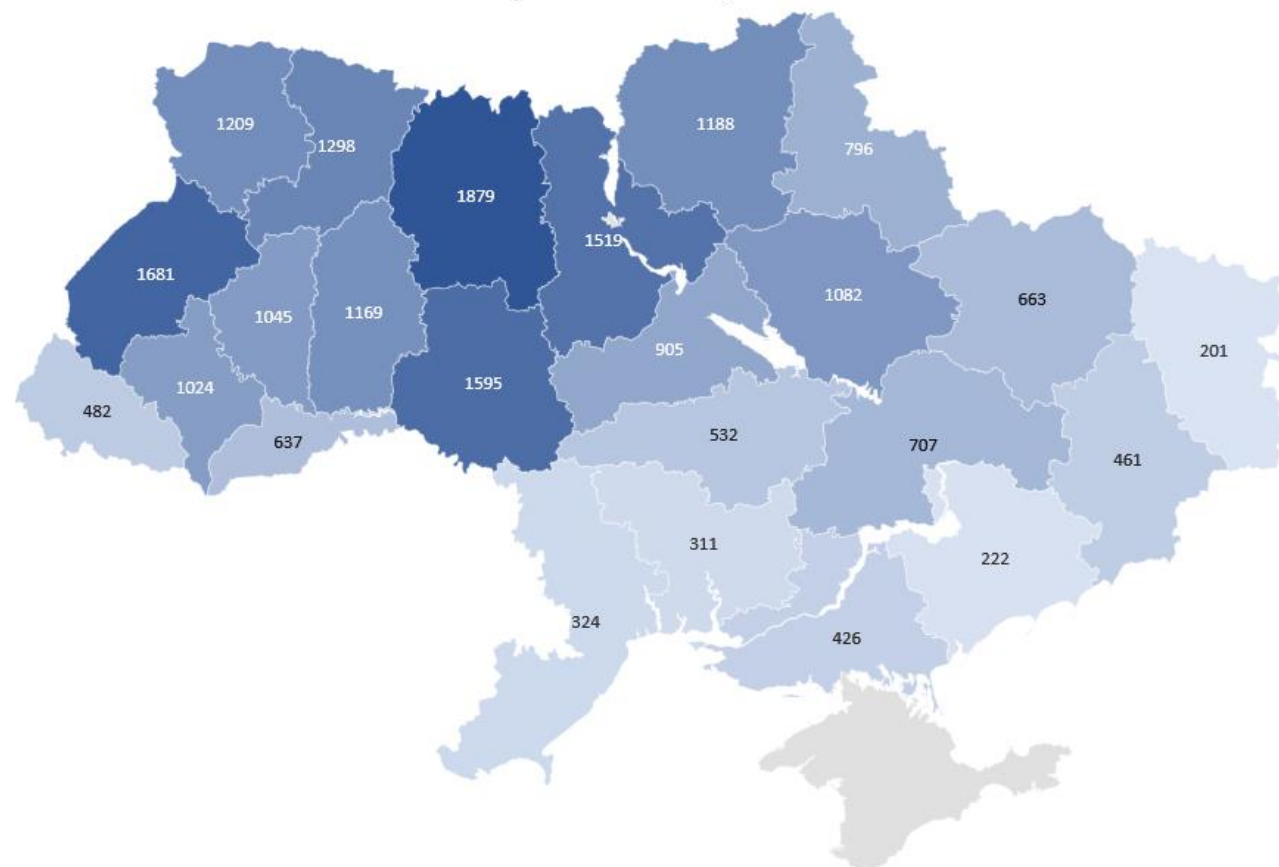
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Pre-war potato production by regions



Potato production 2021, thds tonnes



- Local potato production is common throughout Ukraine. Locally grown potato can satisfy demand in virtually every region of Ukraine.

# Comments on scenarios and food balances: Potato

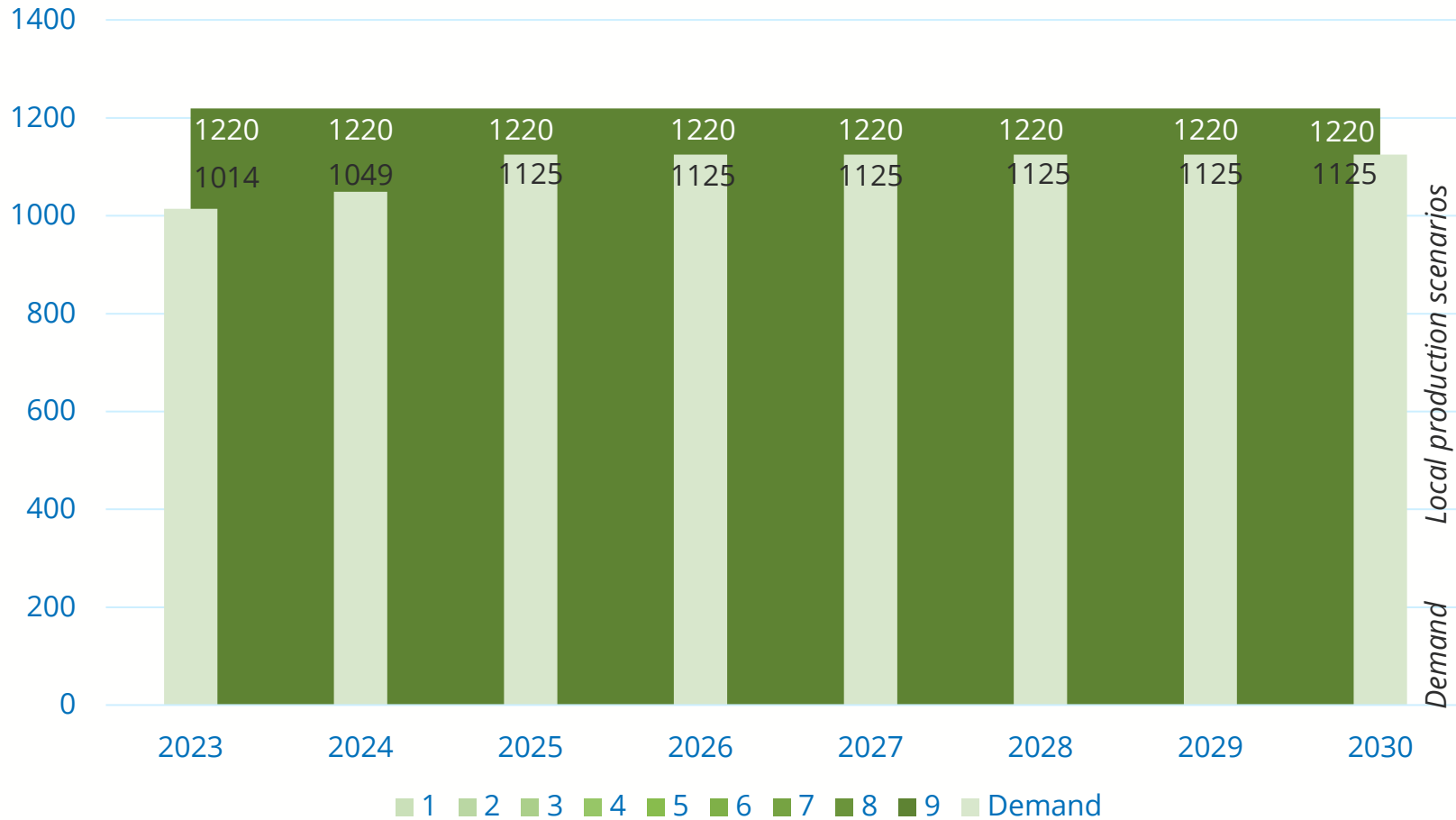


- Over 90% of consumed potato in Ukraine is produced by locally by people who grow potatoes for own consumption or informal sales.
- Potato is the core food product for Ukrainians who consume over 130 kg of potato per year, which is the second largest per capita consumption in the world after Belarus.
- No significant quantities of potato is imported or exported. Infrastructure damage has very little impact on total potato production. This does not, however, mean that potatoes – and other locally grown products - could not be harmed by other adverse events, as evidence by for instance the [Kakhovka dam destruction](#).
- The longer the war persists, the higher production and thus consumption of potatoes will be.

# Supply and demand analysis: Sugar (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Local production of sugar satisfies local demand. Ukrainian government restricted the export of sugar for the period of June 5 – September 15 2023 to 20 thousand tonnes (which is rather low compared to total consumption of over 1,000 thousand tonnes).
- Production of sugar beetroot and sugar itself is concentrated in Vinnytsia oblast, which is located far from the war front.
- Change in logistics costs and attacks on the ports will have limited impact on production.



World Food Programme

Scenario number

NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

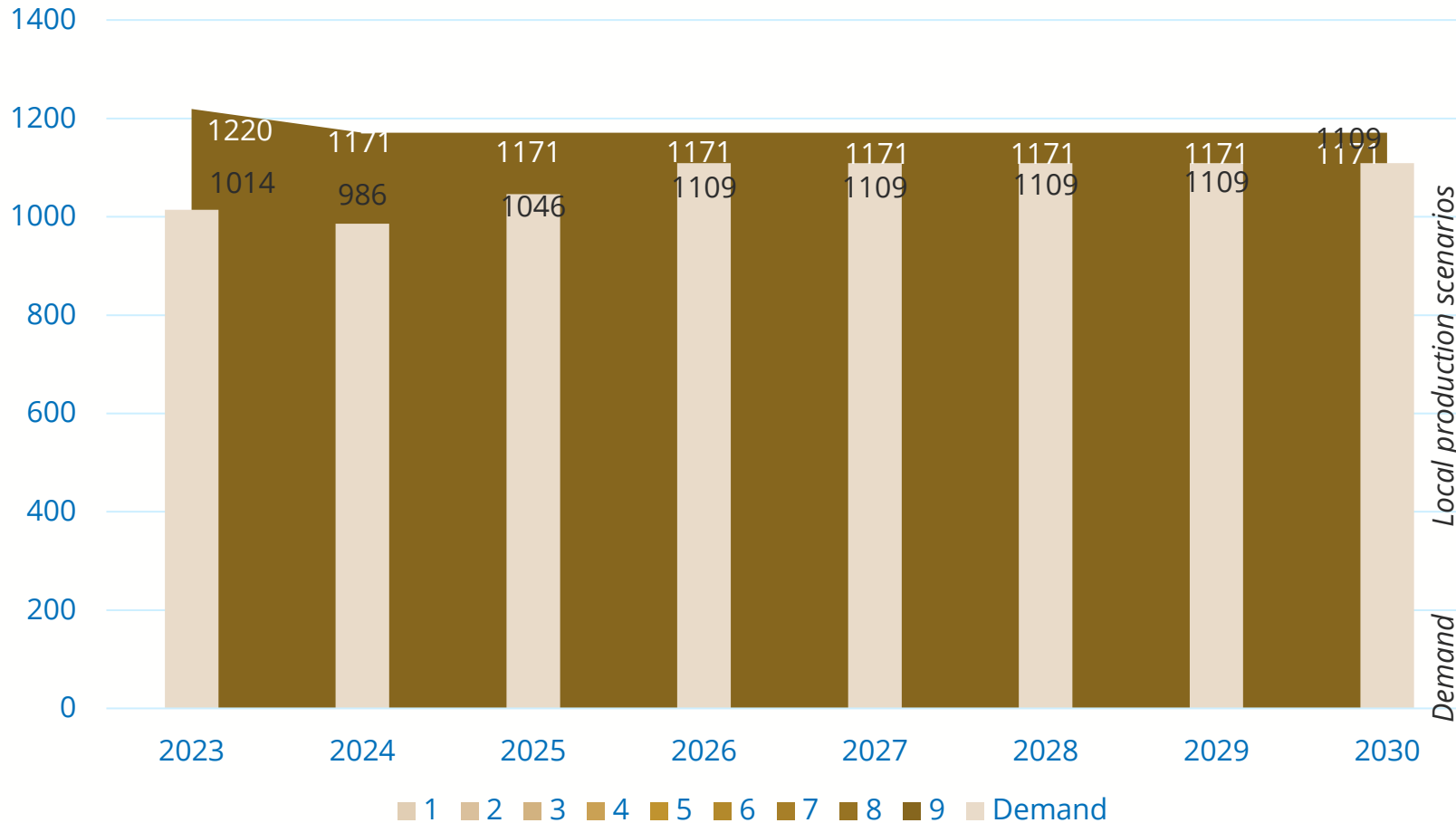




# Supply and demand analysis: Sugar (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- If the war continues for longer, production of sugar is likely to adapt to the existing demand for sugar.



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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)



# Comments on scenarios and food balances: Sugar

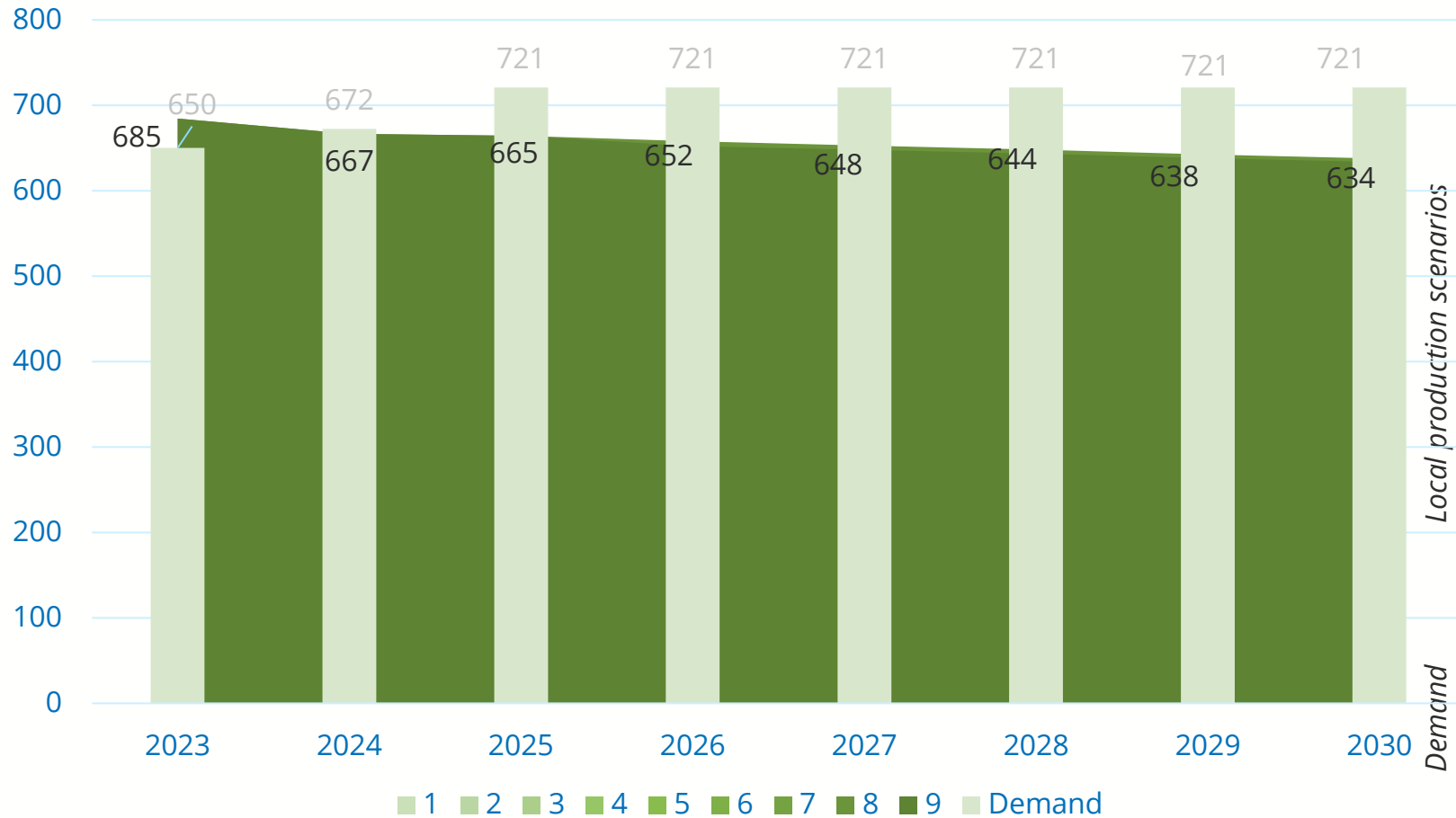


- Local demand for sugar is mostly covered by the local production. Sugar export during the war was legally constrained.
- Sugar production as well as production of sugar beetroot are located in the Western parts of Ukraine. An area has not been directly affected by hostilities, and sugar production in Ukraine has been growing even during the war.
- It is expected that attacks on the logistics infrastructure are likely to have little impact on sugar production, as it is tightly connected to consumption and is the area of specific attention from the government.

# Supply and demand analysis: Pork (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Pork is produced both centrally and locally by the households. Import and export of pork is fairly limited partially due to the strict regulations of pork import to the EU.
- Attacks on the infrastructure have rather limited impact on pork production due to its local nature.
- Overall trend of decline in pork production is associated mainly with shifts in consumer preferences to beef and poultry.



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Scenario number

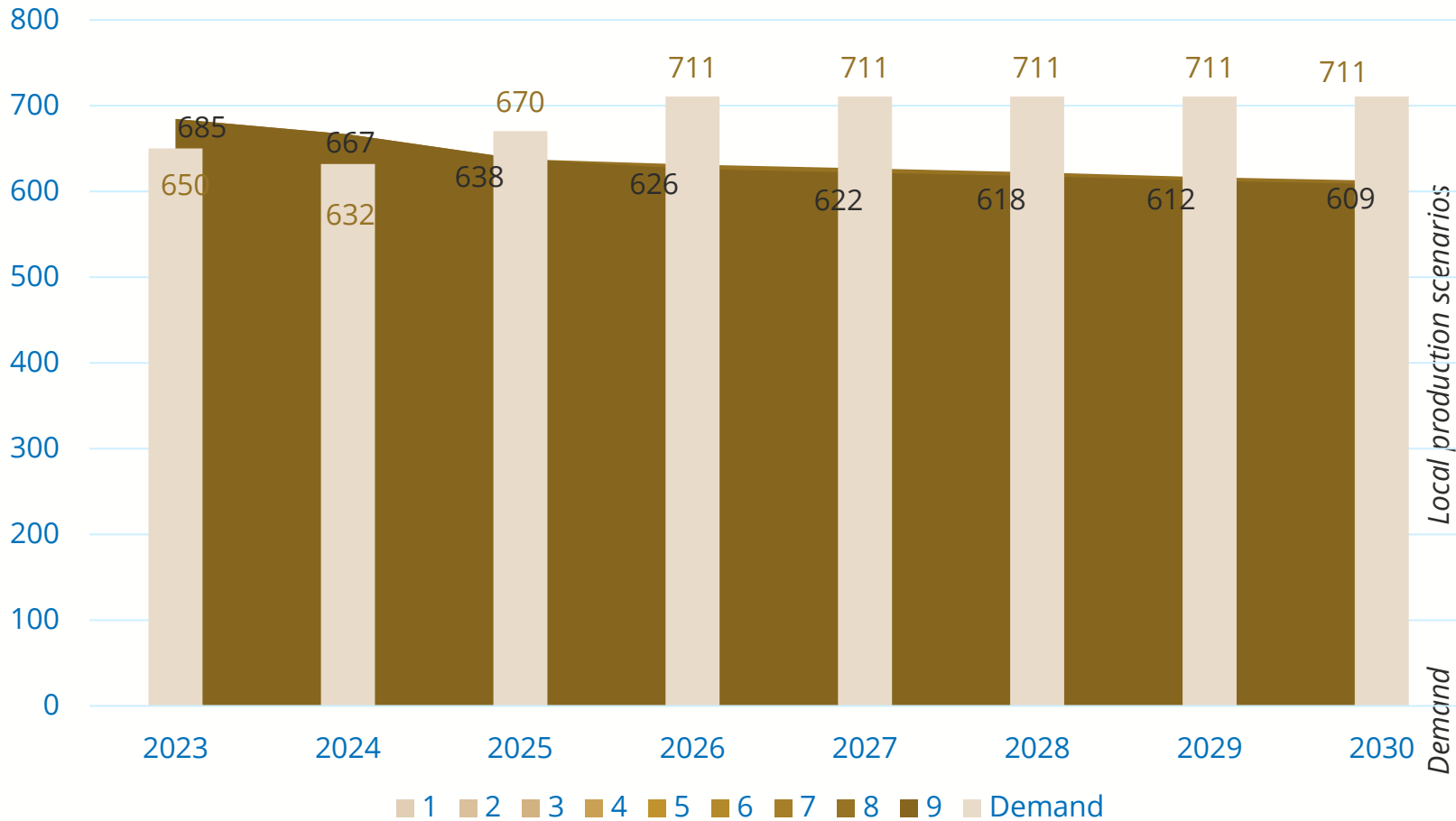
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Supply and demand analysis: Pork (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Longer duration of the war does not fundamentally change the overall picture of pork demand and supply.



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Scenario number

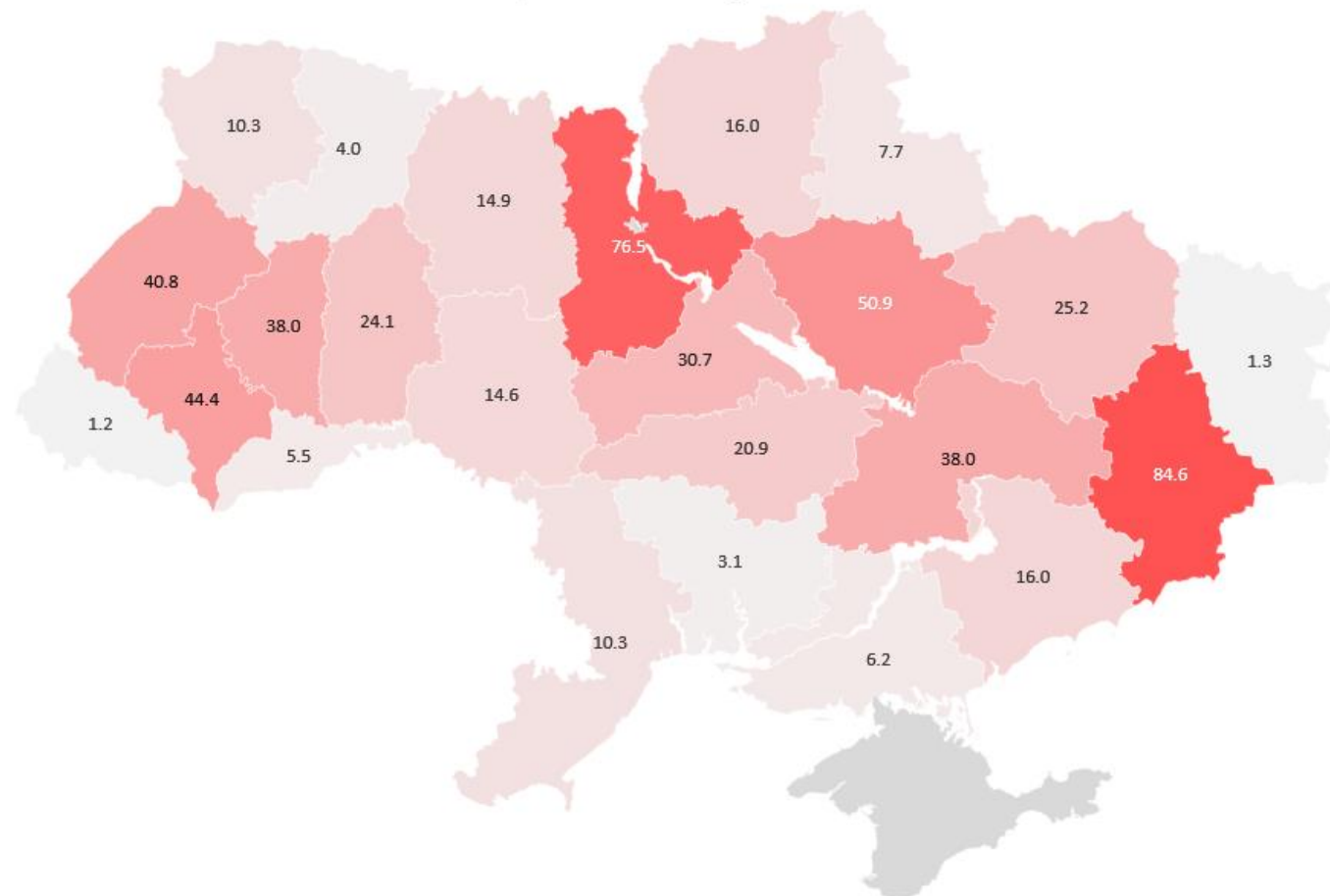
NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

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# Pre-war pork production by regions



Pork production 2021, thsd tonnes



- Pork production is dispersed across the country with notable share of production located in Donetsk, Kharkiv and Kyiv oblast heavily affected by the war.

# Comments on scenarios and food balances: Pork

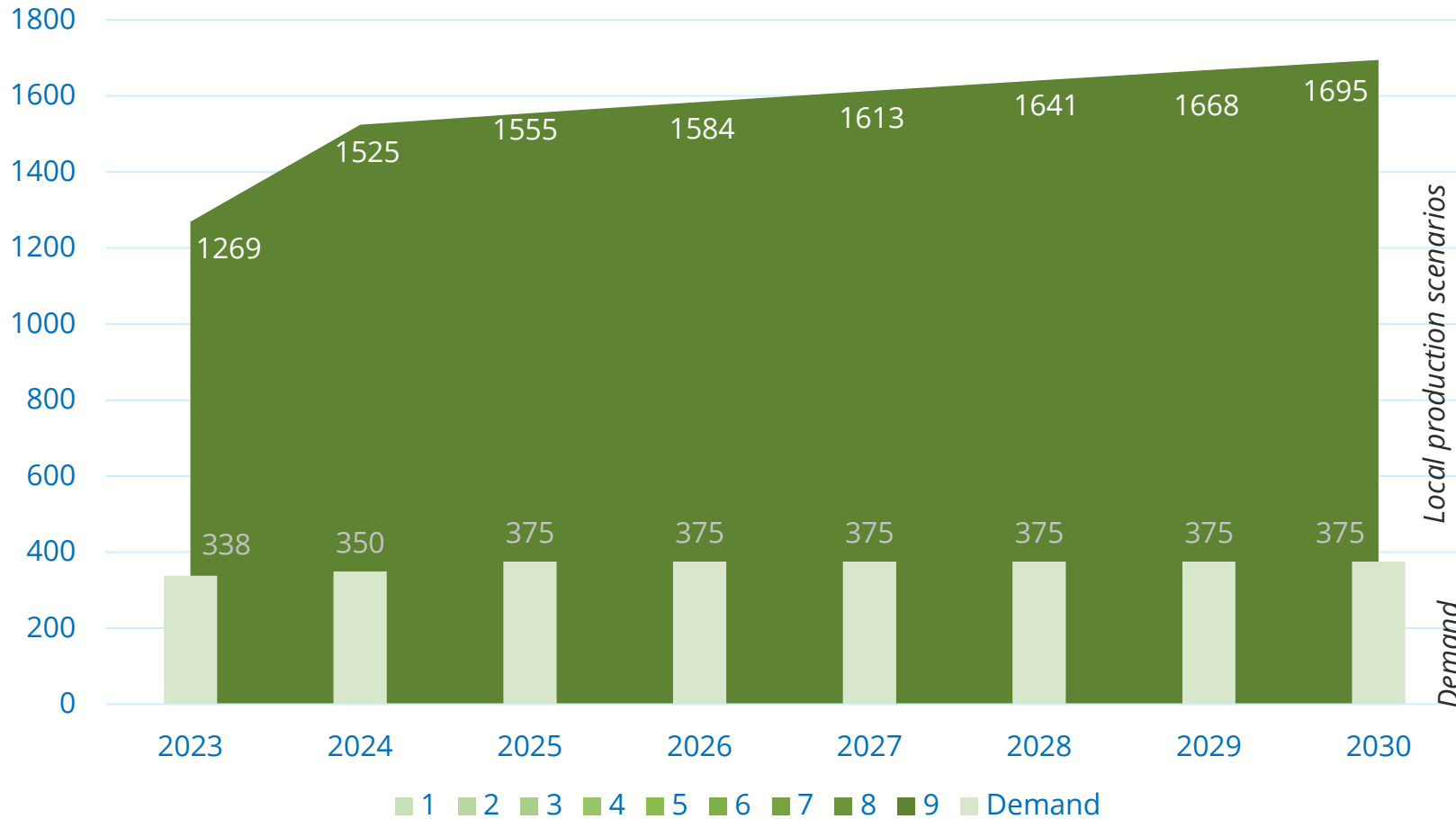


- Pork is almost entirely locally produced. Export and import of pork are relatively minor.
- Large share of pork production in Ukraine is de-centralized with pigs grown in households. Thus, attacks on logistics and port blockades have a limited impact on pork production. The effects are only indirect.
- Limited availability of food exports may create a short-term effect of cheaper feeding materials inside Ukraine, which in turn leads to greater attractiveness of meat production. However, this effect is temporary and does not change the overall picture.
- In case the population increases due to the re-capturing of the territories and the pork production trend continues, it is possible that the market will face shortages of pork after the war ends.

# Supply and demand analysis: Poultry (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Poultry is actively exported even during the war. Yearly export volume dropped by about 10%, but the volume is still over 400 thousand tons.
- Poultry is exported mainly through land corridors from Western regions of Ukraine, so there is no direct effect of the port blockade on poultry exports.
- Due to low cost of poultry production in Ukraine, volume of poultry production is likely to increase.



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Scenario number

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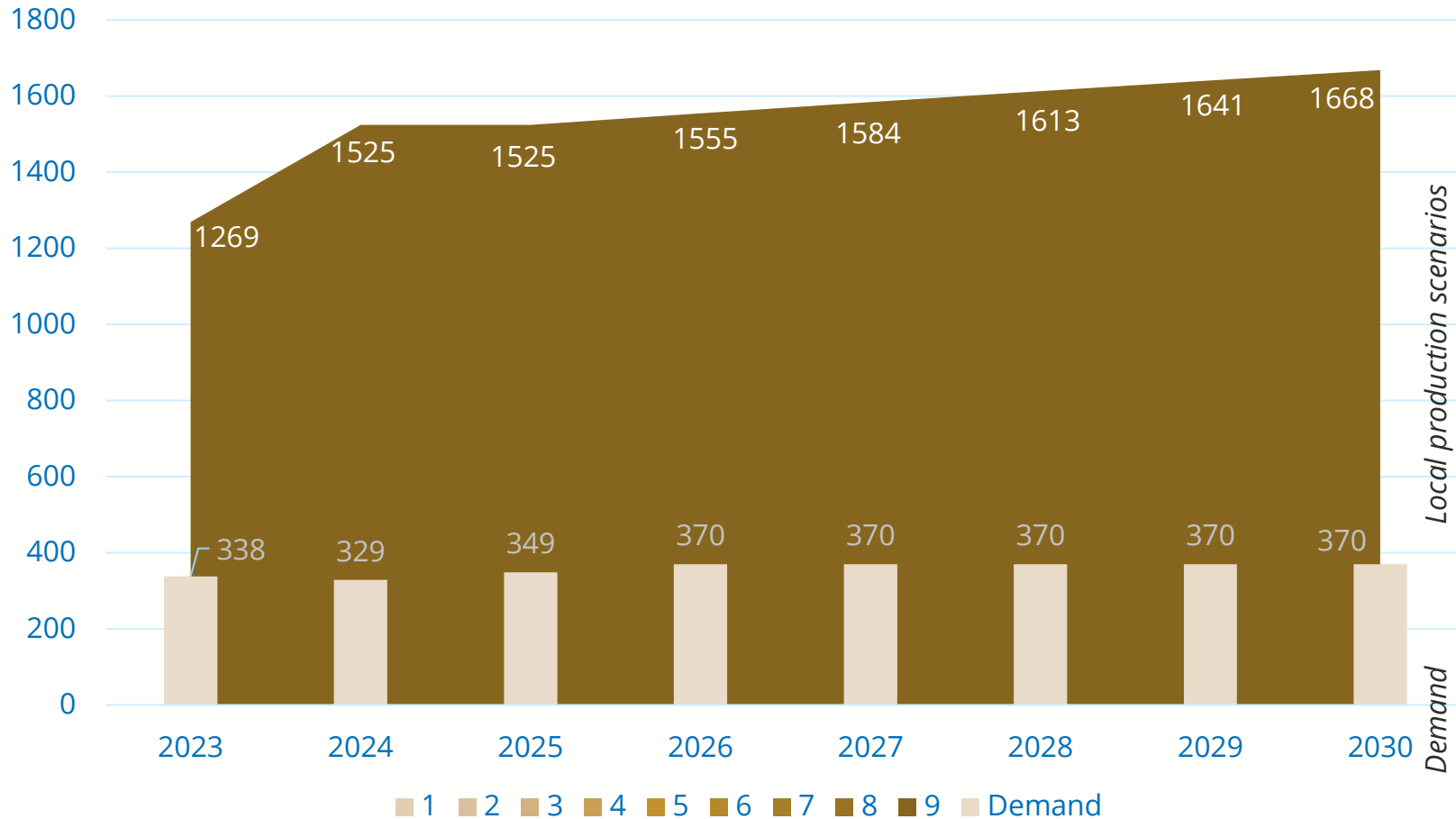
NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)



# Supply and demand analysis: Poultry (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Longer war duration would have only some effect on poultry production, but will not change the overall picture.



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Scenario number

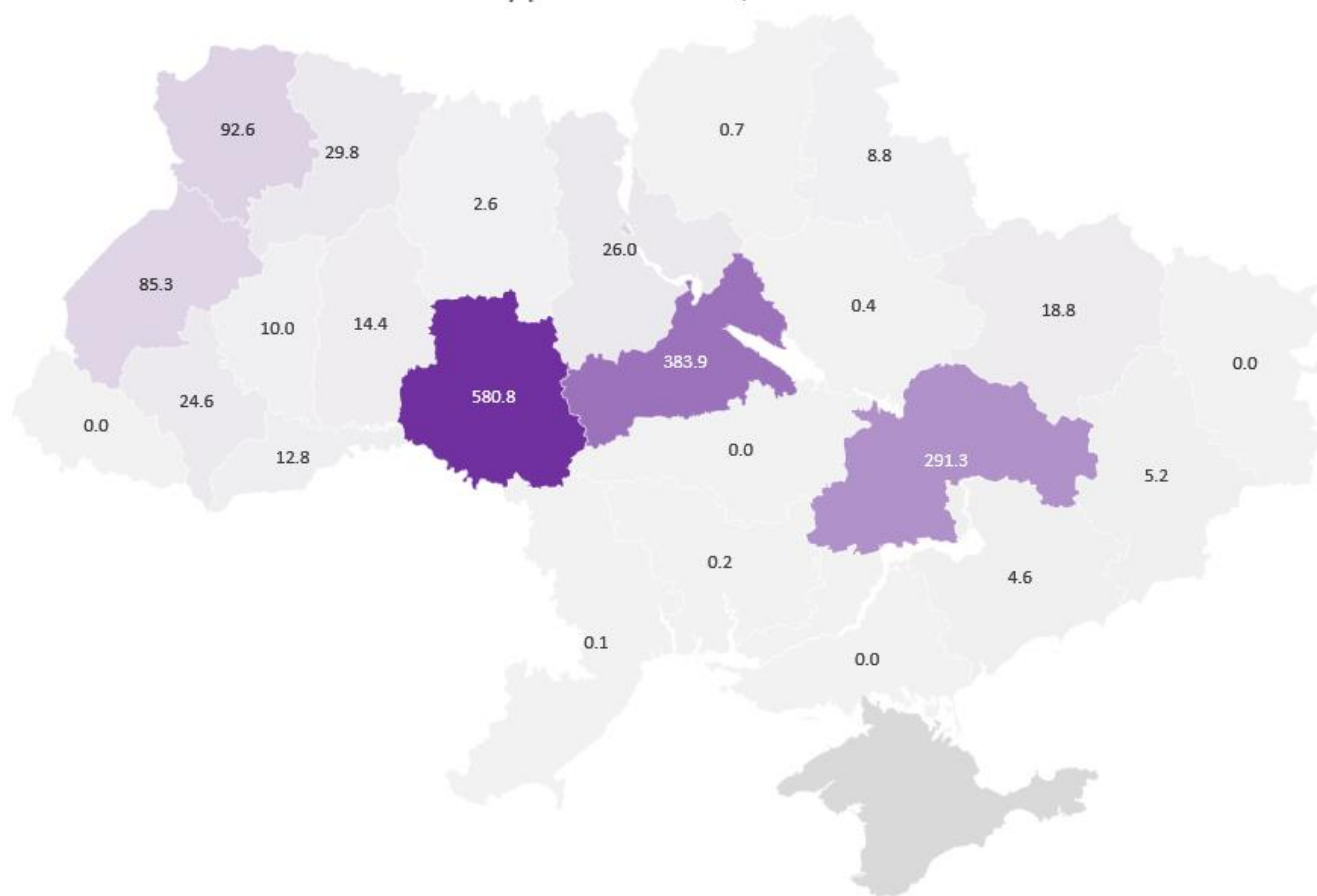
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Pre-war poultry production by regions



Poultry production 2021, thds tonnes



- Majority of poultry in Ukraine is produced in three oblast: Dnipro, Cherkasy and Vinnytsia – the regions that were not directly affected by the war.

# Comments on scenarios and food balances: Poultry

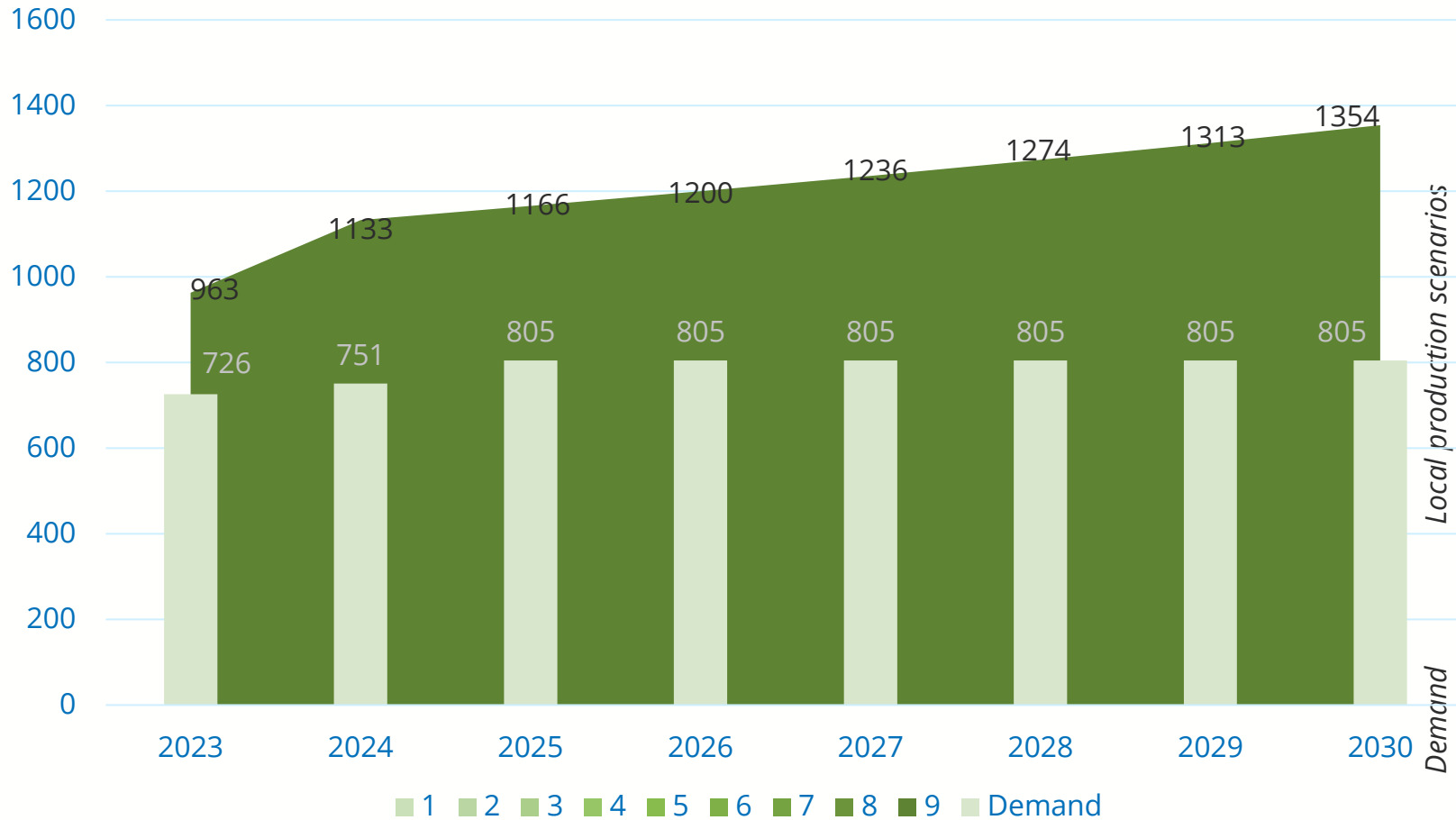


- Poultry is the most consumed meat type in Ukraine. Production of poultry is concentrated in regions that are unaffected by hostilities, so there was only indirect effect of war on poultry production.
- In 2023 Ukraine has been increasing export of poultry due to lifted limits of poultry export to the EU. It is expected that the amount of export will be increasing and attacks on logistics infrastructure has only limited impact on poultry production.

# Supply and demand analysis: Eggs (end of war 2024)



Local production and demand by scenario, million pc.



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	<b>1</b>	<b>2</b>	<b>3</b>
Export infrastructure: Danube + land	<b>4</b>	<b>5</b>	<b>6</b>
Export infrastructure: land only	<b>7</b>	<b>8</b>	<b>9</b>

- Trends of egg production are similar to poultry.
- Problems with the export of crops will stimulate greater production of eggs.



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Scenario number

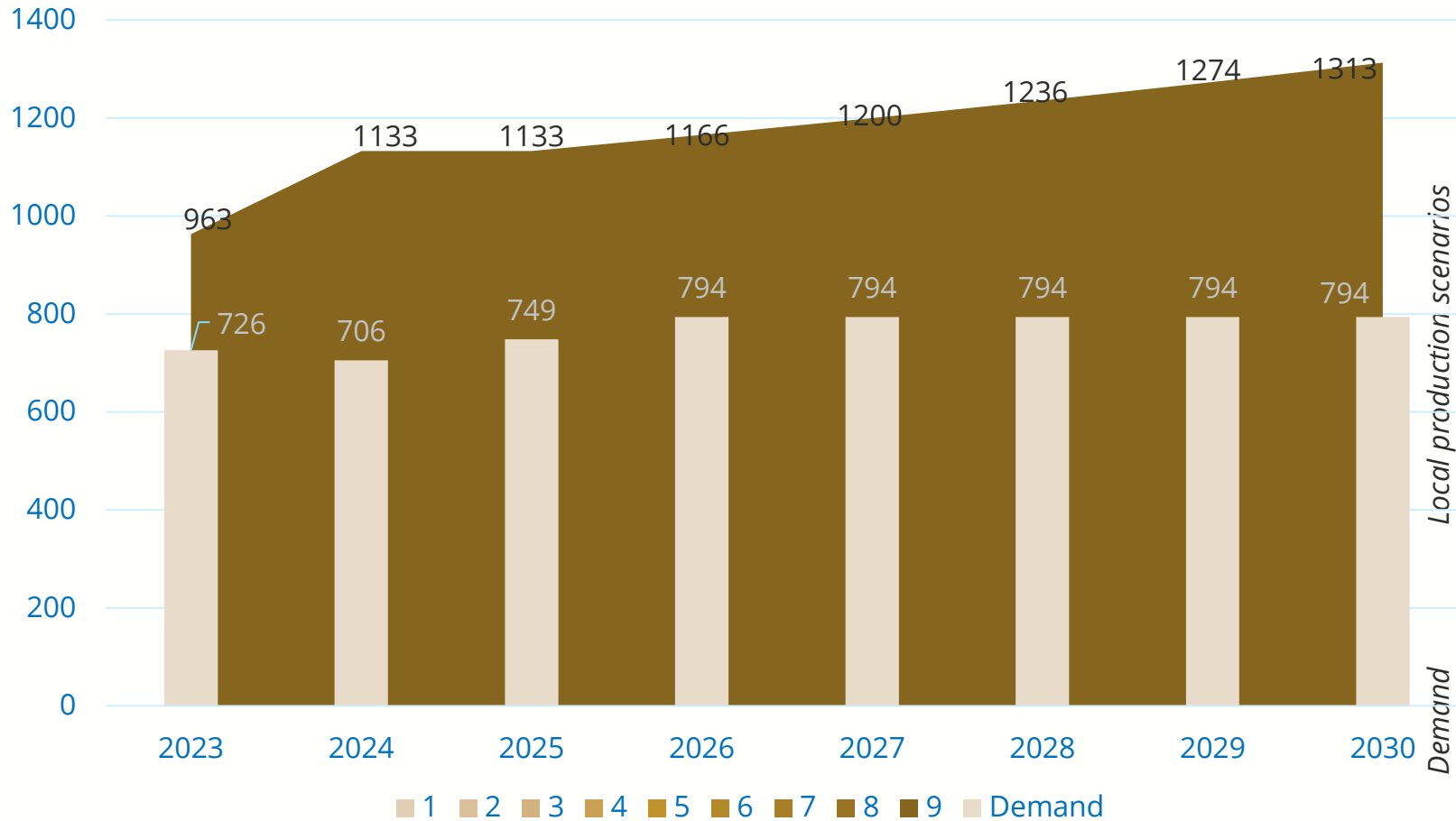
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Supply and demand analysis: Eggs (end of war 2025)



Local production and demand by scenario, million pc



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Recovery of egg production is expected regardless of the war end.



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Scenario number

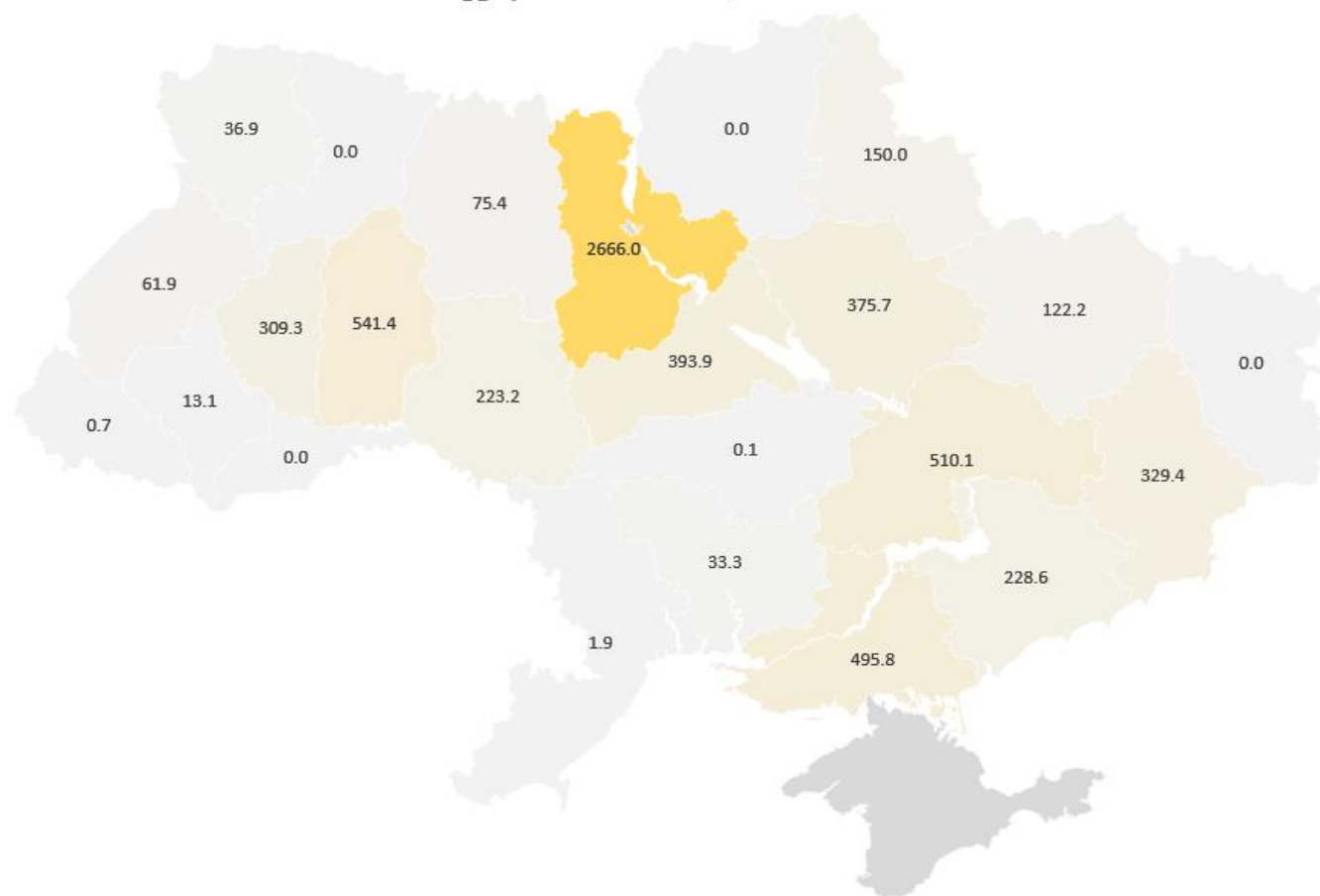
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Pre-war egg production by regions



Eggs production 2021, million units



- Egg production is concentrated in Kyiv oblast, which was partially captured in the beginning of war leading to disruption in production process.

# Comments on scenarios and food balances: Eggs

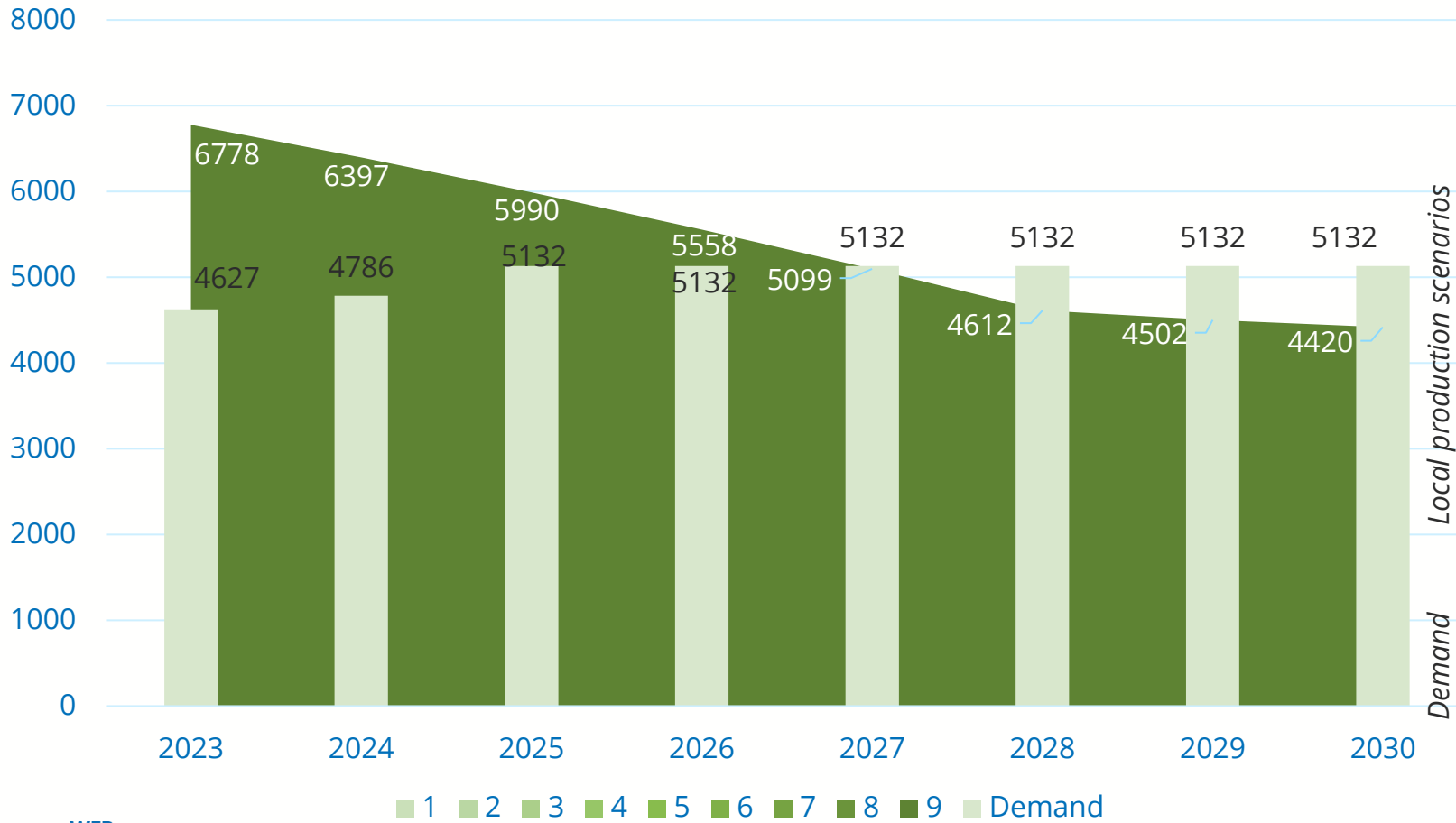


- Although production of eggs in Ukraine has been declining since 2021, the produced volume is still substantially higher than local consumption.
- In 2023 Ukraine has been increasing export of eggs due to lifted limits of poultry export to the EU. It is expected that amount of export will be increasing and attacks on logistics infrastructure has only limited impact on egg production.

# Supply and demand analysis: Milk (end of war 2024)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Production of milk has been steadily declining even before the war (decline from 10.64 million tons produced in 2015 to 8.71 million tons in 2021). During the war, the decline trend continued and is likely to persist.
- 65% of produced milk in Ukraine is coming from private households. Such de-centralized production makes it immune to the attacks on the logistics infrastructure.
- It may be possible that by the end of the decade local production would be cover local demand.



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Scenario number

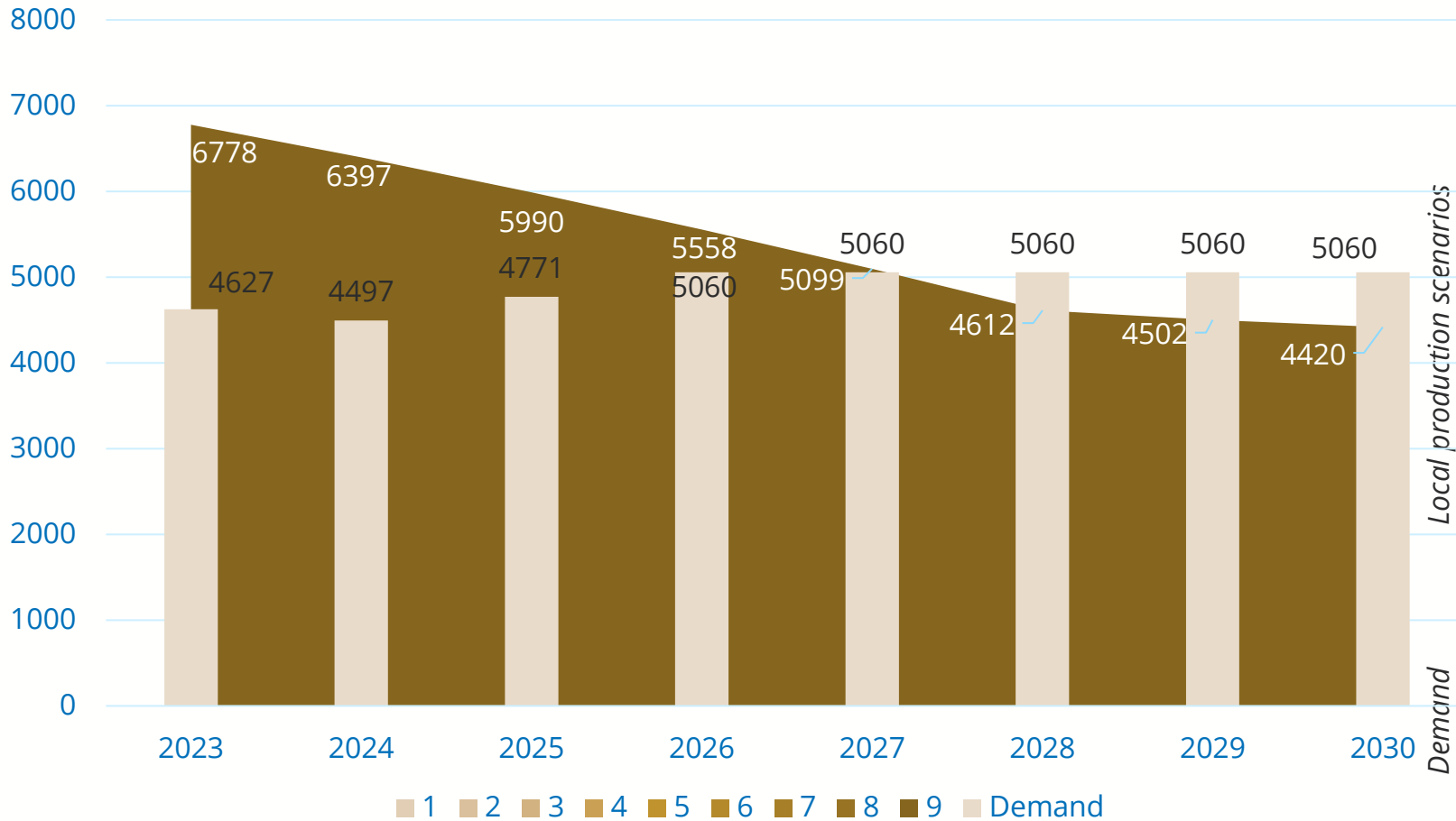
NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)



# Supply and demand analysis: Milk (end of war 2025)



Local production and demand by scenario, thsd tons



SCENARIO CODES

	Attacks on infrastructure SMALL	Attacks on infrastructure MEDIUM	Attacks on infrastructure LARGE
Export infrastructure: Odesa + Danube + land	1	2	3
Export infrastructure: Danube + land	4	5	6
Export infrastructure: land only	7	8	9

- Longer war would not have substantial impact on the milk production.
- It is fairly possible that in the medium run production of milk falls below local consumption and the raw milk gets imported from the EU.



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Scenario number

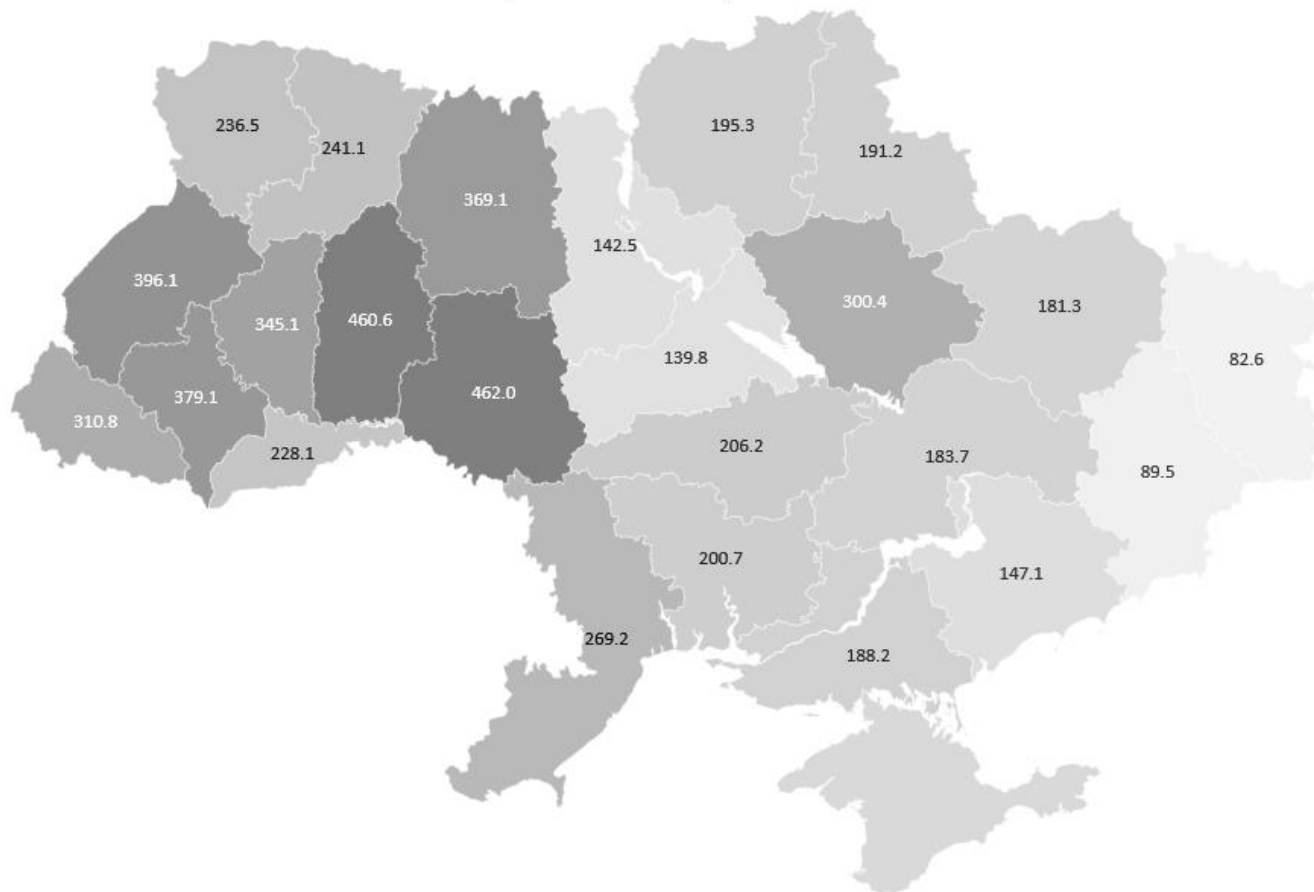
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NOTE: Demand volume represents the normative consumption as stated in the Government-issued Food Basket (2016). Actual consumption is typically higher than the normative (see Additional materials section)

# Pre-war milk production by regions



Milk production 2021, thds tonnes



- Milk production is concentrated in Western parts of Ukraine that were not directly affected by the war.

# Comments on scenarios and food balances: Milk and milk products

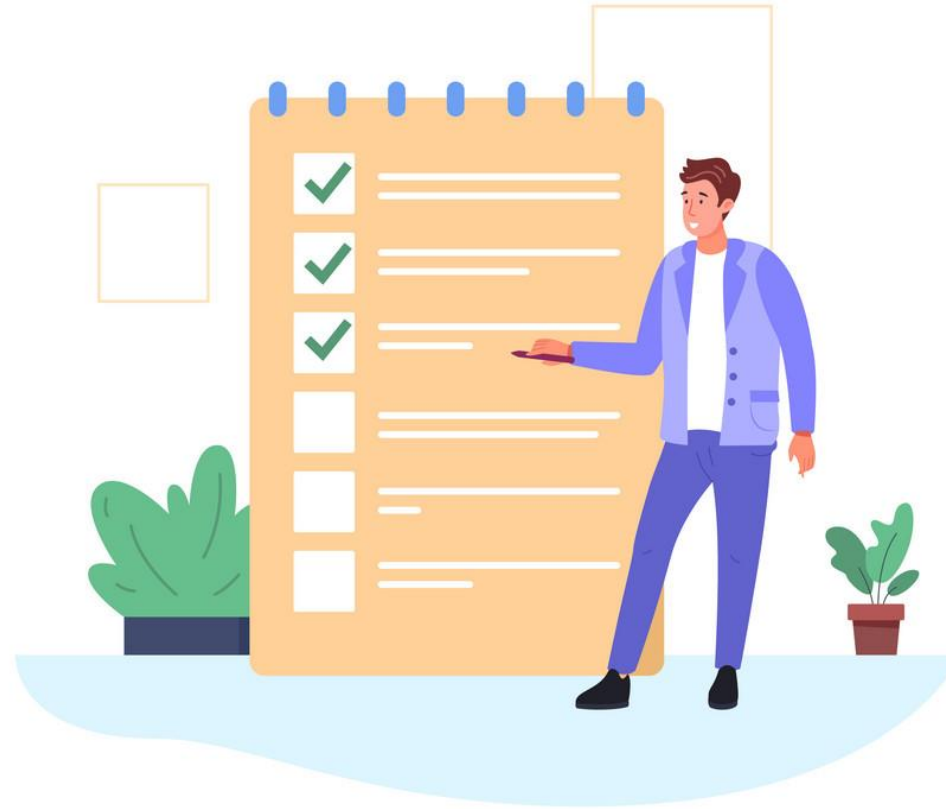


- Majority of Ukrainian milk is produced by households, not specialized milk farms. No attacks on infrastructure can disrupt this production.
- Milk production in Ukraine dropped by about 13% during the war primarily due to losses of territories. However, access to relatively cheap European milk and declining local demand make it unlikely that there is a lack of available milk for local consumption or production.
- However, it is getting less and less profitable to have a milk-producing business in Ukraine and if the trend continues amount of produced milk will be dropping under any considered scenario.



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## Section 4. Conclusions

# Conclusions

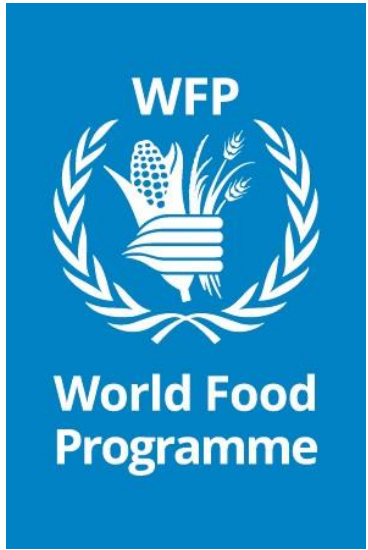
Access to exporting through Ukrainian ports and unhindered use of logistics infrastructure is paramount for Ukrainian agricultural production. If port export access is not made feasible, and if severe attacks on logistics infrastructure are sustained, a scenario modeling of production and demand shows that this can have a sizeable impact on the production of core agricultural products in Ukraine, such as wheat, maize, sunflower oil, etc. with potential impacts onto the Ukrainian economy.

The analysis does not forecast production or demand but rather illustrates what could happen over an eight-year period under various scenario combinations. It hence serves as an input into operational planning.

Under the most pessimistic scenarios - meaning full blockade of ports and medium or large-scale attacks on infrastructure - production of wheat may fall to the level below minimal local demand for one or two years. However, the presence of a large storage capacity for wheat could compensate for this gap. Still, the declining quality of Ukrainian grain and the dropped export volume will make the wheat industry in Ukraine struggle and send shockwaves across the entire Ukrainian economy. Prior to the war, the export of wheat amounted to an average of ca. 19 million MT/year, with a value of 5.1 billion USD in 2021.

Production of no other grains is likely to fall below minimal local demand in the near future. The production level of some grains that are not exported (such as buckwheat) is likely to match the local demand through the market self-regulation mechanisms. Furthermore, some grains that are used primarily for animal feeding (e.g. rye) are fairly resistant to the effects of attacks on Ukrainian infrastructure.

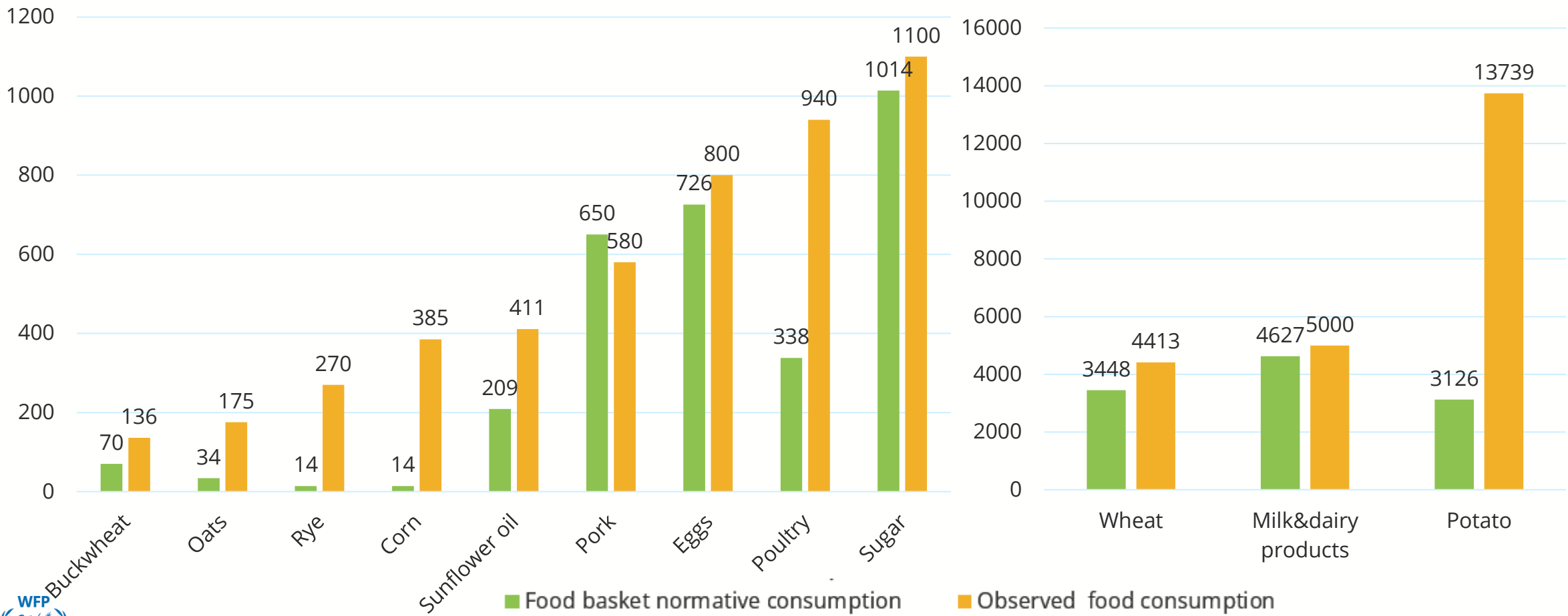
Many key Ukrainian food products, such as potatoes, sugar, milk and dairy, meat, and poultry are fairly unsusceptible to shocks from export blockages and attacks on the infrastructure included in this scenario analysis. This is because they are produced in a decentralized manner and consumed locally, or their production is concentrated in the Western regions of the country with the short distance to the EU borders where most of the export is going. This does not, however, mean that these products could not be harmed by other adverse events, as evidence by for instance the impact of the Kakhovka dam destruction.



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Additional materials and sources

# Food basket vs. observed food consumption of the key food products



Thousand tonnes, 2023



\* Food basket normative consumption is based on the Ukrainian Government approved food basket for children, working adults and pensioners (2016)

# Data sources

1. [Ukrainian Government Food Basket \(2016\)](#)
2. [World Bank Open Data Portal: GDP and employment data](#)
3. World market prices - [OECD-FAO Outlook 2023](#)
4. [World Energy Outlook](#)
5. [Agricultural workers estimates](#)
6. [Export value – USDA](#)
7. Production volumes: [Ukrainian State Statistics Service](#)
8. Sowing area: [Ukrainian State Statistics Service](#)
9. Export and import volumes: [UN Comtrade](#)
10. [The World Bank: Inflation in Ukraine](#)
11. Wheat quality: SGS, [UkrAgroConsult](#)