

WAR-TIME UKRAINIAN AGRICULTURE

• FUEL NOT SUBSTITUTED • CROPS CHOICE CHANGES • ORGANIC FARMING AFFECTED DIFFERENTLY

October 2023

Amidst enduring **full-scale war of Russian Federation against Ukraine**, Ukrainian agriculture has suffered \$8.7 billion of damages (27% of physical assets in agriculture) and \$31.5 billion of losses.¹ Severe export complications, decrease in output prices, destruction of assets, and one more significant obstacle to agricultural production – increase in energy prices.

Energy is very important for the sector – it is consumed either directly, through machinery fuel combustion, or indirectly, through the use of nitrogen fertilizer. According to the A-95 Consulting Group data², in December 2022, as compared to December 2021, prices for gasoline, diesel and LPG in Ukraine have grown by 65%, 120% and 50%, respectively. Natural gas prices have been increasing since the beginning of 2020, and peaked in June 2022.

This brief is based on advanced statistical analysis of the database of 3234 producers' data on costs and inputs, and survey of agricultural producers' expenditures in 2022. The research **discovers how Ukrainian agricultural producers adapt to changes in prices of production inputs, energy and fertilizer in particular.**

FINDINGS

For understanding how Ukrainian agricultural producers change their production technologies or production patterns in response to the changes in prices for fuel and fertilizer, we use long-run and short-run elasticities of demand for production inputs. The data on production costs, prices and volumes of 3234 producers are used for fitting seemingly unrelated regressions for transformed functions of total and variable costs separately for wheat, corn, sunflower and soybeans. The coefficients obtained from the regressions are converted into substitution elasticities, own- and cross-price elasticities of demand for inputs.

Findings:

Use reduces when prices go up: Increase in fuel and fertilizer prices by 10% reduces the use of these inputs by 6%.

Fuel not substituted: When fuel use changes (increases or decreases), the use of land, labor and/or other material inputs does not change.

Production becomes **more labor-intensive** as the utilization of fertilizer decreases in response to growing prices.

For wheat, corn, soybeans and peas production, an increase in both fuel and fertilizer cost shares is observed in 2022.

For sunflower and barley production, fertilizer cost share increases in 2022, while fuel share remains relatively unchanged.

More land is allocated to barley in both conventional and organic production.

Organic producers are less affected by the increase in energy prices due to higher labor intensity and smaller farm size.

Change in **demand for fuel** in response to a 1% increase in its price is found to be equal to -0.61% on average among the studied crops. The smallest change is observed for soybeans production (-0.43%) and the highest for corn (-0.78%).

Demand for fertilizer follows the same pattern. It would decrease by 0.62% on average in response to a 1% increase in its price. The smallest change is observed for sunflower production (-0.34%) and the highest for soybeans (-0.78%).

¹ KSE Agrocenter. Agricultural War Damages, Losses, and Needs Review. Issue 3. April 24, 2023. - <https://kse.ua/wp-content/uploads/2023/05/RDNA2.pdf>

² Minfin Media. Ціни на бензин, дизпаливо, газ на АЗС України. За інформацією Консалтингової групи А-95. - <https://index.minfin.com.ua/ua/markets/fuel/a95/>

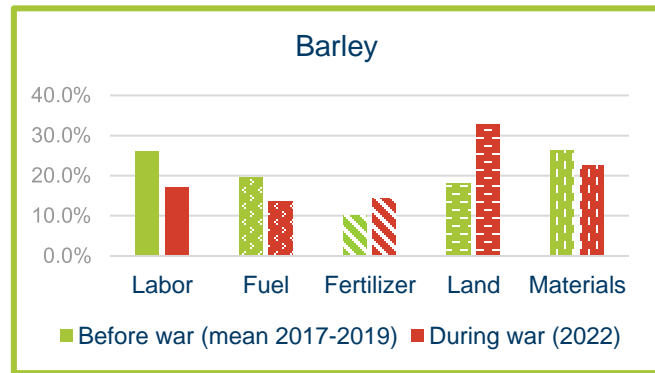
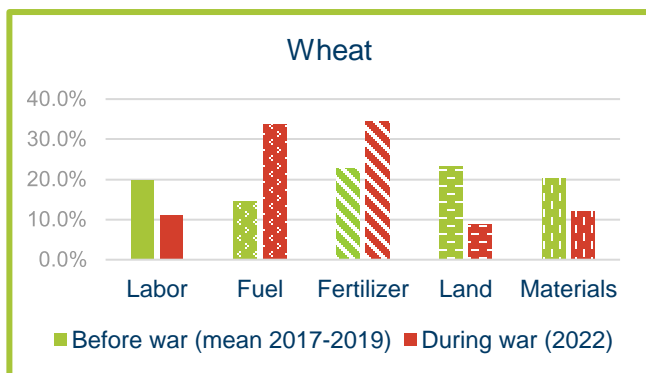
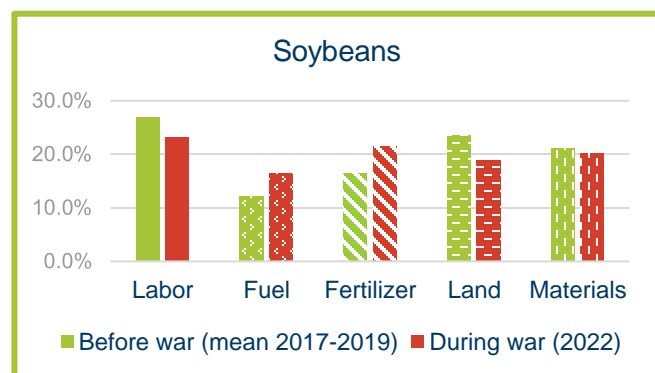
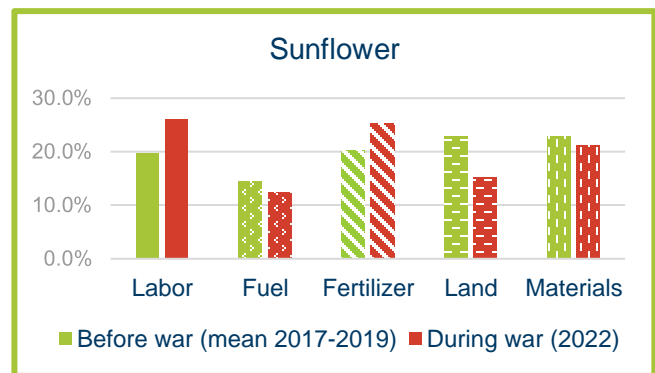
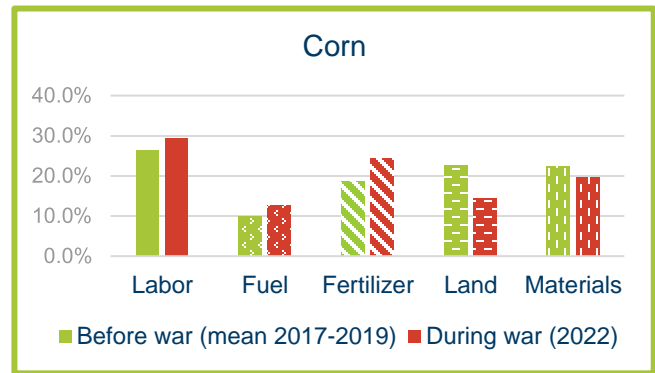
Demand for land, labor and other material inputs does not change significantly in **response to change in price of fuel**.

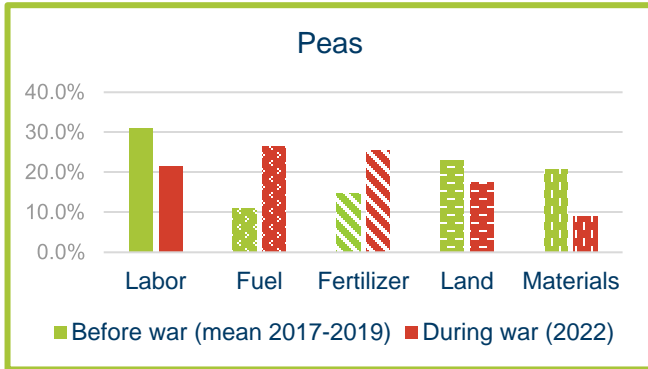
Demand for labor increases by 0.20%, 0.47% and 0.62% for wheat, corn, and soybeans production, respectively, in **response by 1% increase in fertilizer price**.

In the long run, **when land becomes a variable factor**, substitution relationship between the inputs seems to be absent. For wheat production the exception is fuel-labor pair, for which substitutability is observed. For soybeans production substitutability is observed for fertilizer-labor pair.

It is important to mention that the observed substitutability does not imply direct substitution of inputs, but rather indicates that **the production becomes relatively more labor-intensive as the utilization of fuel or fertilizers decreases in response to growing prices**. In this case, the elasticity of substitution provides insights into the observed reaction of production technology and resource allocation, in response to isolated fertilizer price change, while **everything else is held constant**.

According to the agricultural producers' survey of 2022 production expenditures, costs structure has changed noticeably for most of the studied crops. Total number of responses in the survey is 73, which includes expenditures on wheat, corn, sunflower, soybeans, barley and peas production. Corresponding cost shares comparison of after- and pre-invasion values is presented on the figures below.





Source: own calculations, based on data from SH-50 and SH-29 statistical forms (2017-2019 data) and own agricultural producers survey, conducted in May 2023 (2022 data)

There is a clear pattern for fertilizer costs share – it increases for all 6 studied crops.

Fuel share increases for wheat, corn, soybeans and peas production, while remaining relatively unchanged for sunflower and barley production.

The survey confirms the analysis: labor use increases in response to fertilizer price growth, which is reflected in the observed cost share changes. Labor share increased for corn and sunflower production.

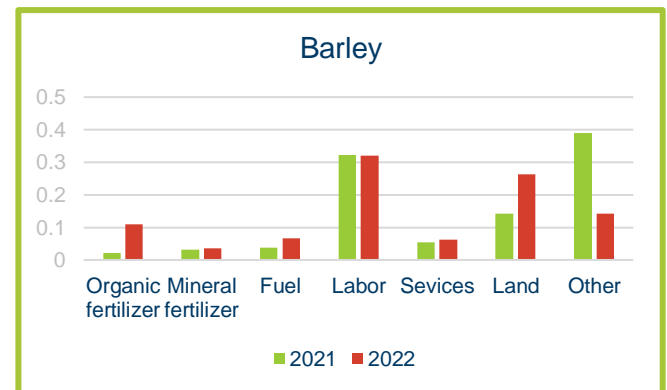
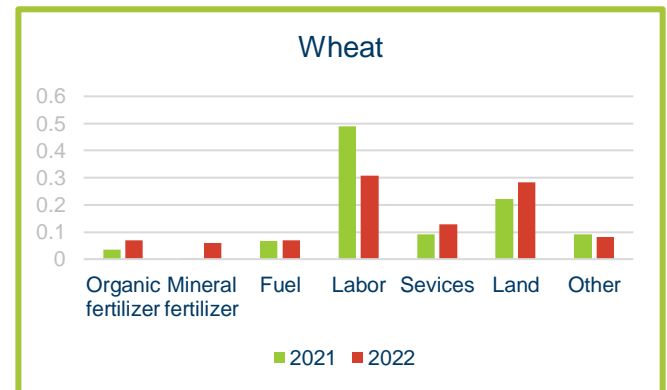
The only crop, for which share of land expenditures increased is barley. It could be explained by the increased production. **Farmers allocate more land for barley production:** in the pre-war sample, average share of sown area under barley was 1.7%, while in 2022 this number increased to 7.8%.

According to the organic producers' interviews on production expenditures, conducted in September 2023, they are **less affected by the increase in energy prices**, as compared to the conventional producers.

For wheat production, labor costs share decreased (49% to 31%), and share of expenditures on fertilizers, services and land increased. *“Mineral fertilizer” in organic production refers to the low soluble fertilizers of mineral origin, such as low soluble nitrogen. They are allowed for the use in organic farming according to the EU regulation, which most of the Ukrainian organic producers are certified to.* For barley production, shares of expenditures on fertilizers, services, and land are found to increase as well, while the biggest decrease is observed for miscellaneous material inputs, other than fertilizer and fuel.

Another important finding to mention is the fact that the areas dedicated to organic production increases among the interviewed producers. Among the crops of interest, wheat area remained relatively unchanged, sown area under corn decreased. Barley, sunflower, and soybeans areas are increased, with the **highest increase in barley area** (22%). Most organic producers, which were surveyed are small producers, with the total sown area less than 100 hectares.

Corresponding cost shares comparison of after- and pre-invasion values of organic producers' production expenditure's structure is presented on the figures below.



Source: own calculations, based on own interviews of organic agricultural producers, conducted in September 2023 (2021-2022 data). *“Mineral fertilizer” in organic production refers to the low soluble fertilizers of mineral origin, such as low soluble nitrogen. They are allowed for the use in organic farming according to the EU regulation, which most of the Ukrainian organic producers are certified to.*

WAY FORWARD

The increase in prices of fuel (petrol and diesel) and nitrogen fertilizer, which had happened as a consequence of the full-scale war in Ukraine, has

significantly impacted the costs of the crops production. Combined with the decrease in domestic prices of agricultural commodities, it led to a significant decrease in farmers' profits. Fuel and fertilizer are quintessential for the agricultural production and can hardly be substituted.

When evaluating support options for farmers, it becomes evident that a multifaceted approach is necessary. Direct subsidies for fuel and fertilizer, alongside efforts to promote the development and adoption of mineral fertilizer-free or less-intensive production technologies, as well as the production of alternative fuels in Ukraine, emerge as rational strategies.

Emphasizing the environmental advantages of less mineral fertilizer-intensive production is paramount, as is the strategic alignment with the European Union's agricultural standards. As Ukraine progresses towards EU accession, conforming to increasingly stringent crop production regulations becomes imperative. Additionally, fostering alternative fuel production and supporting mineral fertilizer-free agriculture not only advances the nation's EU accession goals but also reduces reliance on imported fuel.

While direct subsidies for fertilizer and fuel may offer immediate relief, they are inherently short-term solutions. A more sustainable approach involves providing financial aid to those affected by war damages and losses, particularly in the southern and eastern regions. By alleviating the direct impacts of conflict, this assistance enables vulnerable producers to cope with

heightened production costs and promotes greater parity among farmers from different regions.

This targeted aid strategy proves especially effective when government resources are limited, as it concentrates on assisting a subset of farmers most in need. By addressing both immediate challenges and long-term sustainability goals, Ukraine can foster resilience and equity within its agricultural sector, paving the way for enduring prosperity.

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