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FERTILIZERS USE EFFICIENCY: WESTERN BALKAN

Abstract

In the case of the crisis, such as the current conflict in the Ukraine, the question of input effectiveness in agricultural production has become very important. In that context, the main objective of this paper is to find the level of fertiliser efficiency in the Western Balkan countries. The paper also aims to discuss health of the soil in the region and its dependence on fertilisers imports. Results showed that fertilizer use efficiency is higher in the region than in the EU. However, considering the high dependence on imports and the most likely prolongation of the crisis, certain suggestions for improving the situation were given. This conclusion can be useful for the creators of the agricultural policy as well as for agricultural producers.

Key words: *fertilisers efficiency, Ukrainian war, food, crisis*

JEL classification: *Q1, R11, Q24*

ЕФИКАСНОСТ УПОТРЕБЕ ЂУБРИВА: ЗАПАДНИ БАЛКАН

Апстракт

У кризним ситуацијама, као што је текући сукоб у Украјини, питање учинковитости инпута у пољопривредној производњи постаје врло значајно. У том контексту, главни циљ овог рада је утврђивање нивоа ефикасности примене ђубрива у земљама Западног Балкана. Истовремено, фокус овог рада је здравље земљишта у региону, као и зависност региона од увоза ђубрива. Резултати су показали да је ефикасност ђубрива већа у региону него у ЕУ. Међутим, с обзиром на високу зависност од увоза и највероватније продужење кризе, дати су одређени предлози за побољшање ситуације. Закључци овог рада могу бити од користи креаторима пољопривредне политике као и пољопривредним произвођачима.

Кључне речи: *ефикасност ђубрива, рат у Украјини, храна, криза*

Introduction

Historically, agricultural production was inconceivable without fertilizers that serve to ensure sustainable and stable production. But at the same time they fraught with some problems also - they facilitate large-scale monocultures and act as disrupters of ecosystems especially during the boom-and-bust season (Van Sundert, et al., 2021). Over time, the

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fertilizers market showed explosive growth. It amounted to more than 193 billion US dollars in 2021, an increase of roughly 12 percent in comparison with the previous year. It is forecast that it will surpass 240 billion US dollars by 2030 (Statista, 2022).

However, the current global crisis has had a significant impact upon most industries, including the fertilizer industry. Although the fertilizer industry showed a high degree of “immunity” to the COVID-19 pandemic (Ilinova et al., 2021), fertilizer prices increased by 80% during 2021 driven by surging energy costs, supply curtailments, and trade policies (Baffes et al., 2022). The Russia-Ukraine crisis substantially elevates the risk of disruptions in the global fertilizer trade and longer-term complications in the food system (Ben Hassen & El Bilali, 2022). The war has both short and long-term impacts on global food security. Immediate effects include logistic blockages, restrictions on exports, increase in prices (energy/gas, fertilizers, food), inflation, etc. Among other, indirect and cascading impacts include economic recession, income and purchasing power losses, political instability and unrest, increase in malnutrition, deterioration in the diet quality, panic buying, delayed sowing/cultivation, and decrease in yield due to lower fertilizers use.

All three mineral fertilizers, nitrogen (N), phosphate (P), and potash (K) that are crucial for agricultural productivity (Hebebrand et al., 2022) are sold in global markets, and their production is geographically concentrated and dominated by a handful of miners (P and K) and a somewhat larger group of chemical companies (N) (Rabobank, 2022). The Russia-Ukraine conflict and the subsequent sanctions have instantly disconnected global markets from Russian and Belorussian fertilizers. Russia and Belarus are a key mining and production region for potash. Russia accounts for 20.66% of global exports, 19.01% of production, while Belorussia accounts for 20.51% of exports, and 17.48% of potash production, according to Rabobank research (2022). Russia also plays a significant role in the nitrogen fertilizer market. According to the same source, Russia is responsible for global export of 22.71% of ammonia, 2.54% ammonium-sulphate, 45.81% ammonium-nitrate, and 4.14% calcium-ammonium-nitrate. Russia's role in the market for phosphate fertilizers is also not negligible. It accounts for 9.18% of phosphate rock exports, 14.52% of mono-ammonium phosphate exports, and 8.24% of di-ammonium phosphate exports. In addition, Russia is a key supplier of natural gas, which is critically important for the EU and India, as those countries' nitrogen production depends on imported raw material. As a result of the drastic rise in natural gas prices, ammonia production in Europe significantly decreased and several factories were forced to halt work (The Guardian, 2022). China, a major producer of phosphate fertilizers, through its export restriction from July 2021 through June 2022 put additional pressure on the volatile fertilizer market (Benton et al., 2022).

Such disruptions in the market put in focus fertilizers use efficiency as a critically important concept for evaluating crop production systems (Fixen et al., 2015). Efficient fertilizer use that can be defined as maximum returns per unit of fertilizer applied (Mortvedt et al., 2001) is the result of interactions between plant genotype and the environment, including both abiotic and biotic factors (Barlóg et al, 2022). In its recent report a Food and Agricultural Organization (FAO) recognized importance of fertilizer's effectiveness and urged for it within a framework of long-term sustainable solutions to avert the risk of deepening the existing crisis (FAO, 2022).

There is a general lack of literature about fertilizers efficiency in the Western Balkan region (Table 1). Thus, this paper aims to provide some new empirical evidence of this issue.

Table 1. Literature review

Paper	Material and methods	Main results
Lampietti et al. (2009)	This reports analysis the challenges facing rural and the agri-food sector in the Western Balkan using different indicators.	A key part of adaptation to climate change in Western Balkan will be promotion of more efficient use of fertilizers and pesticides.
Mizik (2011)	Analysis of the Western Balkan countries' agriculture using different indicators.	The results showed that unsatisfactory level of fertilizer use could be the reason of lower maize and wheat yields than in the EU.
Custovic et al. (2012)	Analysis of the climate change effects on Western Balkan's agriculture	Among a numerous short-term adaptation measure to climate change authors suggested prudent use of fertilizers.
Lovre (2016)	Three indicators: output per unit of labour, output per unit of land, and the aggregate total factor productivity were used to determine the agricultural productivity of the Western Balkan countries.	Out of all Western Balkan countries the highest growth rate of total factor productivity (TFP) was registered in Bosnia and Herzegovina thanks to the substantial intensification of agricultural production, among other the high use of mineral fertilisers.

Source. The authors' composition.

Materials and Methods

The sample is made up of five countries of the Western Balkan region (Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, and Serbia) over a 14-year period (2006-2019).

In the first step, we presented global fertilizers prices using OECD/FAO (2022) data. Then, Western Balkans policy decisions related to the Ukrainian crisis were shown. Third, the soil health in the region was analysed based on a recently published report (Zdruli et al., 2022). Fourth, using ICT (2022) data, an analysis of the dependence of the countries of the Western Balkans on the fertilisers imported from Russia and Belarus was done. Fifth, the efficiency is expressed as a ratio between the cereal production and fertilizers' application (Liu et al., 2015). For that purpose, we used annual FAOSTAT data.

Global Fertiliser Prices

The Ukrainian war stimulates further increase of already high levels of fertiliser prices (Figure 1). High fertiliser prices are caused by five key drivers: strong fertilizer demand, supply chain disruptions, high raw material prices, domestic policies, and geopolitical risks (Cross, 2022). The spike in natural gas prices due to its pivotal role in the production of nitrogen fertilizers is especially concerning. Adverse weather conditions around the world hampered the production of renewable energy and coal, leading to higher gas demand and a sharp increase in the prices of natural gas in 2021. The EU introduced post-war sanctions, the reduction in fossil fuels imported from Russia

and reduced gas flow to Europe ramped up prices. As a consequence, six months into the Russia-Ukraine war, natural gas prices in Europe increased by about 127.6% (Anadolu Agency, 2022).



Source: OECD/FAO (2022)

Disturbances in the fertilizer supply chain cause disruptions throughout the whole food system (CNBC, 2022). The most endangered are emerging market economies, meaning further deepening of the gap between rich and poor. Poorer countries will likely cut fertiliser usage in response to the price hikes, which threaten to reduce food production and deepen the global food crisis. High fertilizer prices will prevent farmers from expanding domestic production, and grains (and fertilizers) may become too expensive for the population. Disruption to the supply of fertilisers (and foods), together with COVID-19 pandemic consequences and droughts in many regions, could even cause social unrest (Financial Times, 2022). Hunger and possibly starvation will follow.

Western Balkans policy decision related to the Ukrainian crisis

The countries of the Western Balkans face skyrocketing inflation, with fears of food shortages and social unrest. The highest pressure is on the poor, who spend on food,

bills and energy the biggest share of their incomes. Food inflation in Serbia rose by 20.4 percent year-on-year in September of 2022; 28.70 percent in North Macedonia; 26.90 percent in Montenegro, 25.62 percent in Bosnia and Herzegovina (August); and 14.90 percent in Albania (August) (Trading Economist, 2022). Western Balkans governments have issued varying measures in response to the Ukrainian crisis (Table 2).

Table 2. Policy decision

Country	Policy classification	Policy direction	Initial date
ALB	Unspecified social policy measures/ Fuel resources for production	Introduction	3/12/2022
ALB	Institutional reform measure	Introduction	3/18/2022
BIH	Tax on fuel/water Fuel resources for production	Introduction	3/18/2022
BIH	Value added tax (VAT)	Decrease	3/17/2022
MKD	Value added tax (VAT)/ Tax on fuel/water	Introduction	3/09/2022
MKD	Export ban	Introduction	3/10/2022
MNE	No data available		
SRB	Fuel resources for production/ Export ban	Introduction	3/11/2022

Source. Fapda (2022).

However, these measures did not significantly improve the position of agricultural producers in the region. That's why dissatisfied farmers often organize some kind of protests, among other kinds, because of rising prices for mineral fertilizers (Fertilizer Daily, 2022). While fertilizer use in the Western Balkans (as in many other countries) is likely to decline due to price hikes, a solution in line with FAO (2022a) recommendation could be the use of fertilizers more efficiently by cutting their use while optimizing yields. To that aim, it is necessary to use soil maps to identify the best blending of N, P, K fertilizers just as the Ethiopian producers did within the frame of the Ethiopian Soil Information System following the FAO standards. Unfortunately, the current data about many soil issues in the region is scarce. There are only partial results of the Joint Research Centre (JRC) - the European Commission's science and knowledge service that are presented further in the text.

Soil health in the Western Balkans

On their way to the EU, Albania, Bosnia and Herzegovina, North Macedonia, Montenegro, and Serbia are required to adapt their national legislations and to bring them into line with EU legislation in the area of agriculture and ecology.

The aforementioned is emphasized in the region's Green Agenda aimed to transition to a sustainable food system. It is designed through plans to cope with the climate change, clean energy transition, biodiversity, innovative solutions for smart and sustainable mobility, sustainable production and consumption, depollution of the air, water and soil, etc. The soil condition is incorporated in the Zero Pollution Action, Circular Economy Action Plan, the EU

Climate Law, Farm2Fork Strategy, Soil Mission, and all other important EU’ plans aimed to ensure healthy ecosystems and living environments (Zdruli et al., 2022).

The ratio between the soil without intensive farming and crop land in the Western Balkans is very favourable – 80 : 20 (Table 3). However, it does not imply perfect soil management practices.

Table 3. Land use/land, Western Balkans, 2020

Country	Pop. (mill)	Area (km ²)	Agricultural land (against total territory)						Organic farming (against total agric. land)	
			Cropland		Permanent crops		Total		km ²	%
			km ²	%	km ²	%	km ²	%		
ALB	2.8	28748	6143.5	21.4	846.5	2.9	6960.0	24.3	6.5	0.1
BIH	3.3	51130	12288.6	24	54.6	0.1	12343.3	24.1	9.0	0.1
MKD	2.0	25436	4130.5	16.2	401.3	1.6	4531.8	17.8	39.6	0.2
MNE	0.6	13888	92.1	0.7	26.6	0.2	118.7	0.8	8.7	7.3
SRB	6.9	88407	25699.3	29.1	2062.3	2.3	27761.6	31.4	212.6	7.7
Total	17.4	218609	51463.7	19.9	3597.9	1.5	55031.6	21.4	2780	2.6

Source. Zdruli et al., 2022 composition based on National Statistics

The Western Balkan’ soil is susceptible to the following problems: over fertilization, diminishing carbon stocks, water and soil erosion, land taking for housing, salinisation, desertification, pollutions due to mining and other industrial activities, etc (Zdruli et al., 2022). For instance, 45% of the total land is affected by erosion and about 10% by salinization, while more than 5% of agricultural land is overfertilized. Clearly, there is a need for urgent governments’ actions to prevent further deterioration of the land. Some of the measures recommended by international organizations are the adoption and widening of sustainable, environmentally friendly technologies, such as organic farming. In order to reach the goal outlined in the European Green Deal - 25% of organic farming, the region will have to increase the area under this type of production by 10 times (Table 3).

Dependence on fertilisers import

From the available data on fertiliser statistics, it is quite clear that the Western Balkans are not an important player in the world market for fertilisers (Statista, 2022). China is the country with the largest production of nitrogen fertilizer, followed by the United States and India. Russia is the main exporter of agricultural fertilisers worldwide, followed by China and Canada, while Brazil, the United States and India are the main importers. China is the world’s largest consumer of fertilisers, followed by India and the United States.

According to IFASTAT (2022) data about the total N + P2O5 + K2O production and imports in 2020, Serbia produced 151.9 thousand tonnes, but imported 401.2 thousand tonnes of these fertilisers. Bosnia and Herzegovina produced 7.7 thousand tonnes and imported 44.7 thousand tonnes. No production was recorded in Albania and North Macedonia. In 2020 those countries imported 51.6 and 29.3 thousand tonnes, respectively, of the total N + P2O5

+ K2O. The total consumption of NPK fertilisers was in Serbia, Bosnia and Herzegovina, Albania, and North Macedonia: 470.9, 51.0, 51.6, and 29.2 thousand tonnes, respectively. There is no fertilizers self-sufficient country in the region. All are relying on import to a greater or lesser extent. Three countries - Montenegro, Albania, and North Macedonia do not have a company capable of their manufacturing. Serbia imports about 70% of its needs, and Bosnia and Herzegovina even more, about 85%.

As could be seen from Table 4, out of all Western Balkan countries, the highest level of dependence on fertilizers imported from Russia and Belarus is expressed in Serbia. In 2020 Serbia imported 39.2% of nitrogen fertilisers, 85.1% of complex fertilisers, and 53.3% of potassic fertilisers from Russia. The significant participation of Russia and Belarus was shown in North Macedonia and Bosnia and Herzegovina, also. North Macedonia imports 42.7% and 15.6% of its potassic fertilizers from Russia and Belarus, respectively. In addition, the country imports 39.4% of the complex fertilisers from Russia. The participation of Russia and Belarus in the total potassic fertilisers imports of Bosnia and Herzegovina was 71.3% in 2020.

The situation is further complicated by the following facts: Serbia is the leading supplier on which the food security of the entire region largely depends (Brankov, 2022); after the bankruptcy of Azotara Pancevo, only one company in Serbia produces mineral fertilizer - Elixir Group (SerbiaBussines, 2020); there is no proper competition on the market since Elixir Group, the leading producer of fertilizers was also the leading importer in 2017 and 2018, but it was replaced in that position in 2019 by the PROMIST; and fertilizer prices showing a growing trend.

The average import price of nitrogen fertilizers (code: 3102) increased over three years (2019-2021) from 261 to 346 US dollars per ton, an increase of 32.6%. In the same period of time, the average import price of fertilisers containing two or three fertilising elements (N, P, K) (code: 3105) increased by 19.9% (ITC, 2022).

Table 4. Imports of fertilizers from Russia and Belarus (in parenthesis), 2020 (%)

Country	Code 3102: Nitrogen fertilisers (%)	Code 3103: Phosphatic fertilisers (%)	Code 3104: Potassic fertilisers (%)	Code 3105: fertilisers containing two or three of the fertilising elements N, P, K
ALB	27.3 (0)*	0 (0)	0 (0)	0 (0)
BIH	1 (0)	0 (0)	58.2 (13.1)	18.8 (0)
MKD	8.2 (0)	0 (0)	42.7 (15.6)	39.4 (0)
MNE	7.0 (0)	0 (0)	0 (0)	4.7 (0)
SRB	39.2 (0)	0 (0)	53.3 (1.3)	85.1 (0)

Source. The authors' composition based on FAOSTAT

Conclusion

The objective of this study was to estimate the Western Balkan region's level of fertilizer efficiency. It was found that fertilizer use efficiency is higher in the region than in the EU. However, this is no reason to remain "business as usual", because changes in global markets require adjustments.

The Russian-Ukrainian conflict has caused enormous disruptions in the global food system. Russia is the world's top exporter of natural gas and nitrogen fertilisers, the second leading exporter of potassic fertilisers, and the third leading exporter of phosphorous fertilisers. As the agri-food sector is highly-energy intensive, rising energy and fertilizer prices are translating into higher production costs and contributing to food price increases. Rising input (and food) prices are raising concern about global food security.

Considering the likeliest scenario that the grain and fertilizer crisis will last for at least another couple of years, the high dependence of the Western Balkans on fertilizer imports is raising concerns about declining economic access to food. Thus, the most sustainable long-term solution would be the recovery of the domestic fertilizer industry. The second solution is, certainly, the continuation of current efforts to diversify fertilizer suppliers. Third, the appropriate government's support of farmers (e.g., fuel and fertilizer subsidies) is extremely important. No less important is to improve the efficiency of fertilizer use and to critically review our energy policy.

Nonetheless, the Western Balkans should follow and adopt good European practices regarding soil health.

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