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Influence of COVID-19 pandemic on fertilizer companies: The role of competitive advantages

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ARTICLE INFO

Keywords:

Fertilizer companies
Crisis
COVID-19
Competitive advantages
Environmental turbulence
Fertilizer industry

ABSTRACT

The global crisis caused by COVID-19 pandemic exerted significant impact upon most industries, however, the fertilizer industry has shown some resilience in the supply chain during the crisis. The main research question of the paper concerns the major factors ensuring the resilience of fertilizer companies under such circumstances. The paper presents current situation on the mineral fertilizers market, the influence of COVID-19 pandemic on fertilizer companies, and identifies the main market and industry trends. Then, it offers analytical framework for revealing key factors of success (potential competitive advantages) in the fertilizer industry as well as discusses their role in ensuring resilience of the companies during the crisis. The paper suggests categorization of competitive advantages that helps to identify the sustainable ones. It also reveals special role played by competitive advantages, based on core competencies, and justifies why they need to be developed in this new situation caused by the pandemic. One of the main findings in the paper is the conclusion about «global immunity» of fertilizer companies to environmental turbulence, as well as the conclusion about the new role and the need to transform traditional competitive advantages for the further successful growth of fertilizer companies.

1. Introduction

Fertilizers are critical for all agricultural practices. The fertilizer industry is engaged in the mining and processing of raw materials, such as phosphate ores, potassium salts, sulfur ores, and in the manufacturing of the final products - mineral fertilizers - from these materials.

The use of fertilizers has increased vastly over the twentieth century. The total fertilizer nutrient demand was estimated at about 20 million tons in 1950 compared to about 190 million tons in 2019 and 2020 (the latter was estimated by International Fertilizer Association (IFA) in November 2020) (Fig. 1), and it is expected to continue growing in the future (Public Summary Short-Term Fertilizer Outlook 2020–2021, 2021). The global fertilizer market was valued at USD 155.80 billion in 2019, and it is projected to maintain a CAGR (compound annual growth rate) of 3.8% over the period 2020–2025 (Mordor Intelligence, 2020).

Historically, demand for fertilizers shows strong resilience, as annual application is needed in order to maintain yields (Yara Corporate Release, 2020). Predicting growth for the 2020–2021 agricultural year and beyond could be more difficult than usual as a result of uncertainty

produced by the COVID-19 pandemic, as most of the world economies had to follow measures undertaken by their governments generating disruptions to the food chain and supply networks that have affected the fertilizer industry (Yara Corporate Release, 2020). Despite this, the IFA predicts a slight increase in demand (Fig. 1). Fundamentals of the fertilizer industry are strong even during the crisis. Mostly, the demand is driven by the increasing use of fertilizers in crop production to meet the growing food demand. It was estimated that in the absence of mineral fertilizers farmers would be able to produce only half of the current global food output (World Bank Brief, 2020).

World fertilizer industry is influenced by a number of macroeconomic factors ensuring a steady growth in demand for fertilizers. The following factors are crucial for stable global fertilizers consumption pattern: population growth (the world's population is expected to increase from 7.7 billion in 2019 to 9.7 billion in 2050 (Azuizion, 2020)); reduction of land suitable for cultivation (Phosagro, 2020); growth of the world GDP (Knoema. World GDP, 2020); changes in diet (Phosagro, 2020); alternative uses of crops (e.g. bioethanol) (Phosagro, 2020), etc.

Despite the attractive industry fundamentals, the world fertilizer

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<https://doi.org/10.1016/j.resourpol.2021.102019>

Received 21 October 2020; Received in revised form 5 February 2021; Accepted 5 February 2021

Available online 18 February 2021

0301-4207/© 2021 The Authors.

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industry is characterized by high price volatility (Fig. 2).

The maximum fertilizer prices for the last 10 years were recorded in 2010–2013. Later, the fertilizer market was influenced by a number of factors that reduced its prices; expanded U.S. fertilizer production, volatile energy prices, uneven global nutrient demand, depressing crop prices, and rising market competition were the key (Mordor Intelligence, 2020; (Widmar, 2020)). Thus, fertilizer prices have been volatile over the past ten years.

Currently, fertilizer prices are not high, but they are not extremely low either. Moreover, prices have increased by the end of 2020. Triple Superphosphate recorded the minimum in January 2020 (239 USD/T) and DAP (Diammonium Phosphate) - in December 2019 (238 USD/T) (before the pandemic), while Potassium Chloride reached the minimum price in July 2020 (202 USD/T) and Urea's price is slightly below the average (240–250 USD/T in the fall of 2020 in comparison to the minimum of 142 USD/T in June 2016). This indicates that the world fertilizer industry is not highly influenced by the pandemic period, as fertilizer prices have been declining steadily over the past 9 years and during the COVID-19 pandemic in 2020 they remained at average or slightly lower levels.

As for the world leading fertilizer companies (Nutrien – Canadian Fertilizer Company formed through the merger of PotashCorp and Agrium (Canada) in 2017; The Mosaic Company – the largest U.S. producer of potash and phosphate fertilizer; Yara International – the global fertilizer company operating in regional organizational structure), according to their statements, the operation through COVID-19 remains stable and demand across the global fertilizer market remains solid (Nutrien News Release, 2020; Woodroof, 2020; Yara Corporate Release, 2020). Fig. 3 shows that total revenues of the companies for 3Qs of 2019 and 2020 are almost at the same level or slightly decreased. In general, foreign leading fertilizer companies maintained the resilience of the supply chain during the pandemic, reporting fairly solid financial results. Strong sales volumes of the companies and reduced cost of goods sold were more than compensated for the lower selling prices. For example, potash cash cost of product manufactured by Nutrien was a record low 52 USD per ton in the second quarter of 2020 (Nutrien News Release, 2020).

Leading Russian fertilizer companies also declare stable performance during the pandemic period; supply chains and distribution channels continue to maintain resilience. PhosAgro (one of the world's largest producers of phosphate fertilizers) has announced sustainability of

operations with good sales dynamic; revenue has slightly decreased (Fig. 3). It could be considered as a good result as prices for DAP were lower in 2020 against 2019. EuroChem Group AG has reported that half-year results of 2020 are almost at the same level with results of 2019, confirming the company's resilience despite the effects of the COVID-19 pandemic. Moreover, due to the availability of unique natural resources in Russia, products manufactured by the Russian fertilizer industry are of high quality and are sold at competitive prices, as their production is based on phosphate ore and very high quality potassium (Dmitrieva et al., 2017; Phosagro. Official Website, 2020; Uralkali.).

Based on the above, we can conclude that fertilizer companies have not suffered significant losses in their revenues. On the one hand, this is primarily due to the fact that fertilizers are critical to ensuring food security and nutrition (Policy Brief: The Impact of COVID-19 on Food Security and Nutrition, 2020), but, on the other hand, this has been made possible by the way companies operate, by their strategies and competitive advantages, that allow them to remain stable in a volatile environment.

In previous study (Dmitrieva et al., 2017), price volatility on mineral fertilizer markets, as well as other unpredictable factors (agricultural policy, regulations on international and domestic trade, the balance between supply and demand, characteristics of arable farming in different regions, etc.), that can change dramatically and affect the industry, generating turbulence in the external environment were examined. It was revealed that the degree of turbulence in the fertilizer industry can be set at the fourth (discontinuous environment), and occasionally at the fifth level (unpredictable environment) (Ansoff and Sullivan, 1993; Grant, R., 1995; Dmitrieva et al., 2017).

The objective of this research is to investigate a basis for reliable operation of fertilizer companies in the crisis caused by COVID-19. A research hypothesis is based on an assumption that fertilizer companies, operating in a highly turbulent environment for a long time, have developed a reliable business model and supply chain, based on a set of competitive advantages, that allow them to maintain stability of operations during the pandemic. In the paper, we address the following research questions:

1. What ensures the resilience of the supply chain in the fertilizer industry during the COVID-19 pandemic?

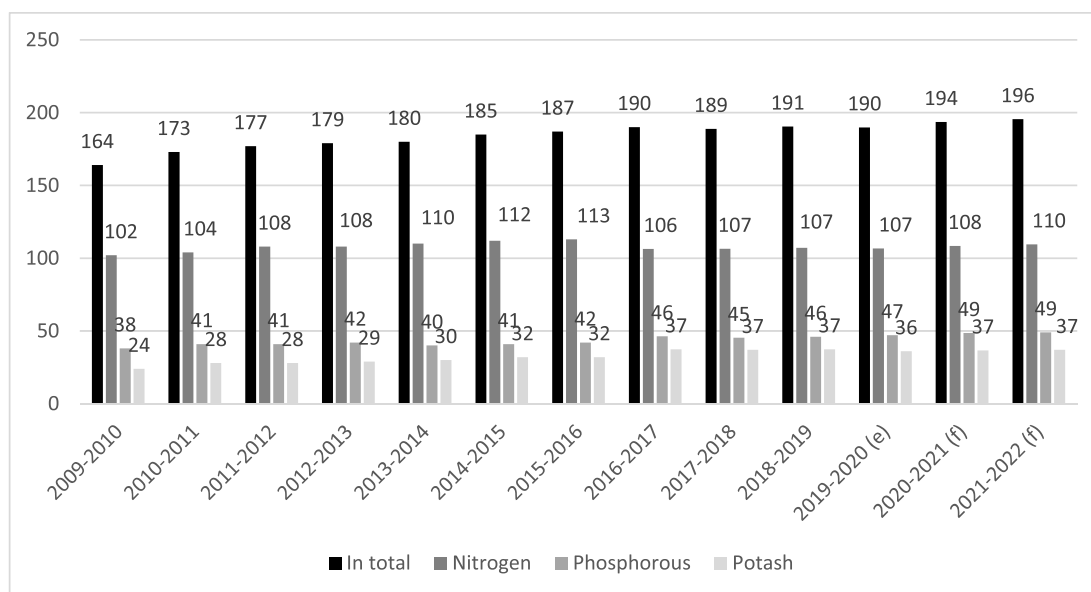


Fig. 1. Global consumption of fertilizers (agricultural years), million tons. Source: created by the authors, data from IFA, 2020

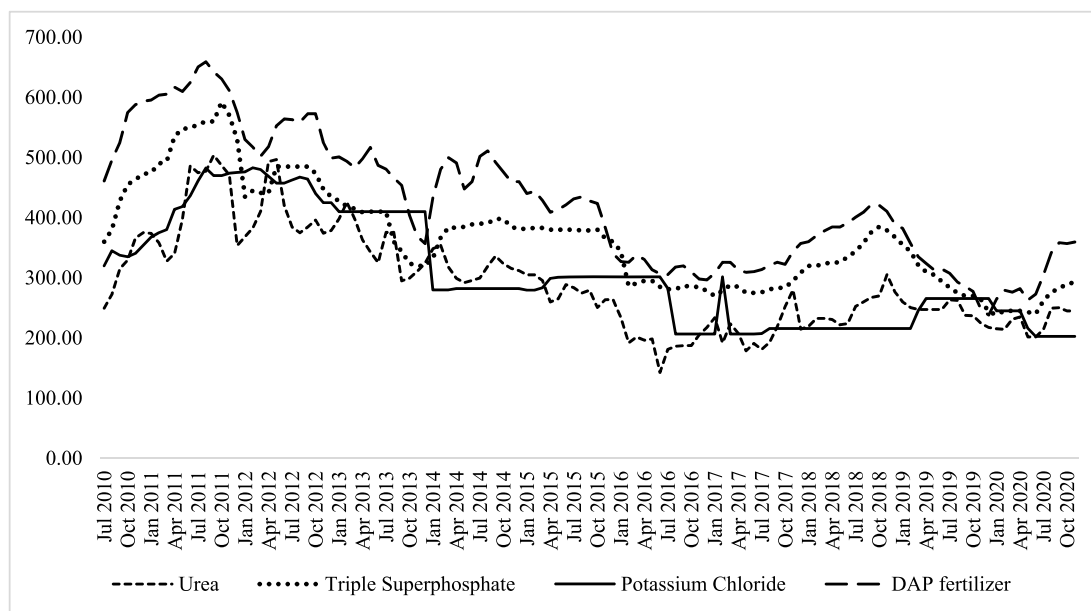


Fig. 2. Fertilizer price performance, USD/T. Source: created by the authors, data from Index Mundi. Commodity prices, 2020

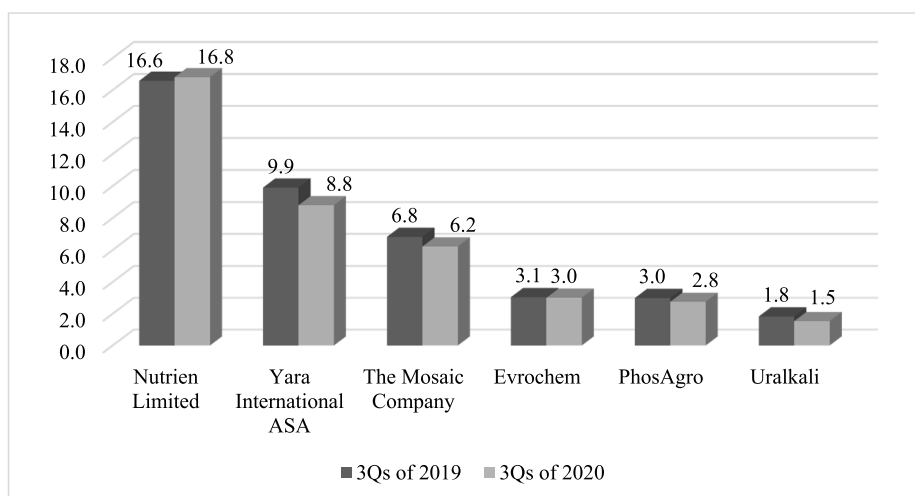


Fig. 3. Comparison between total revenues of the largest fertilizer companies in 3Qs of 2019 and 2020, millions USD. Note: For Eurochem data for the first half of 2019 and 2020. Source: created by the authors using information from companies' official websites.

2. What are the nature and the new role of competitive advantages of fertilizer companies in the post-crisis period that could provide not only resilience in a turbulent environment but further growth?

To address the objective and answer the research questions, we start by determining the features of fertilizer market and industry using Porter, Thompson, and Strickland's approaches (Porter, 1980; Thompson and Strickland, 2003). Next, we identify the list of potential competitive advantages (key factors of success) in the fertilizer industry, focusing on competitive positioning and the resource-based views on their creation. Finally, we analyze the use of identified competitive advantages by the world leading fertilizer companies and classify them using the VRIO (Valuable, Rare, Hard to imitate, Organized to Capture Value) framework. We also determine the special role of sustainable competitive advantages and competitive advantages, based on core competencies (Prahalad and Hamel, 1990). To summarize, we discuss the transformation and the new role of competitive advantages in the mineral fertilizer industry, resulting from a new situation caused by

COVID-19.

2. Literature review

Many studies related to the mineral fertilizer industry have emerged, each tackling different aspects, such as: analysis of evolution and prospects of different segments of the fertilizer industry (Al Rawashdeh and Maxwell, 2011; Al Rawashdeh et al., 2016), the development of phosphate and potash resources and reserves (Cooper et al., 2011; Ciceri et al., 2015; Mew, 2016), the evolution of the fertilizer market (Al Rawashdeh and Maxwell, 2014), environmental and social aspects of fertilizers usage (Scholz and Geissler, 2018), and interdependence between economic decisions and the fertilizers' resource cycle (Grame et al., 2019). Other papers have addressed managerial aspects ranging from capital investment (Geman and Eleuterio, 2013) up to the efficiency performance of the leading phosphate rock mining companies (Geissler et al., 2015). Recent studies in this sphere underline the importance of the fertilizer supply chain (its foundations and

perspectives in different aspects) (Mew et al., 2018), as well as present its current status (Geissler et al., 2019).

According to recent research (Verma and Gustafsson, 2020), there are many studies addressing COVID-19 and its influence on business. This topic is extremely urgent and pertinent. Some of them concern general aspects of economic challenges and adaptation to the new environment during and after the pandemic (Seetharaman, 2020). Also, catastrophic impact of COVID-19 on mining companies is highlighted (Laing, 2020). Some researches discuss the resilience of industries during economic shocks (Wang et al., 2020).

Despite the wide range of scientific papers devoted to the different aspects of the mineral fertilizer industry development, from the one hand, and to COVID-19 from another, no research papers have been found that focus specifically on the fertilizer companies operating in conditions of COVID-19. This highlights the timeliness and relevance of the study.

In accordance with the aim of this paper and its research hypothesis, we studied theoretical and methodological studies that are dedicated to the emergence and development of competitive advantages as the basis of business strategies. Under the traditional approach to strategic management, a competitive advantage is described as a factor that gives a company consistently higher earnings and a higher rate of return than its competitors (Porter 1980, 1985; Schoemaker, 1990; Grant, 1995). Some authors define competitive advantage as a quality that distinguishes the firm from others and keeps it going and growing (Smith and Flanagan, 2006).

In times of globalization and intensive business competition, it becomes more and more difficult to gain and maintain competitive advantages (Nilsson and Dernroth, 1995; Brown and Eisenhardt, 1998; Eisenhardt and Martin, 2000; Hamel, 2000), as nearly all of them (resources, technologies, information, market opportunities, competencies, etc.) can be copied and replicated by competitors (Singh, 2012; Goldsmith, 2013). No competitive advantage will be permanent since companies are able to get the skills needed to duplicate the benefits of a firm's value creating strategy (Lei and Slocum, 2005). Research studies address the problem of achieving and creating competitive advantages (D'Aveni, 1994; Soloduchko-Pelc, 2014), representing two major approaches to the identification of the sources of competitive advantages: the market (competitive positioning) view (Porter, 1980) and the resource based view (RBV) (Wernerfelt, 1984; Peteraf, 1993; Barney et al., 2001). Some researches highlight these approaches in the context of creating sustainable competitive advantages (Evans, 2016; Maury, 2018). At the same time, many studies tried to reveal how the two views impact a company's performance (McGahan and Porter, 1997; Hawawini et al., 2003; Crook et al., 2008).

Modern approaches, based on the concept of core competence introduce by C.K. Prahalad and Gary Hamel in 1990 as the «most powerful way to prevail» (Prahalad and Hamel, 1990), also consider core competence as the foundation on which competitive advantage can develop (Aghazadeh, 2015; Oliveira et al., 2018; Baartartogtokh et al., 2018).

Competitive advantages can be classified by the degree of their sustainability (sustainable and non-sustainable (unsustainable)) (Beal, 2013; May and Stahl, 2017). In general, in this theory, sustainability is an attribute of an advantage that indicates whether competitors can replicate it or not. The sustainability of competitive advantages is a widespread subject in academic debates. Many previous studies were devoted to sustainable competitive advantages (Chaharbaghi and Lynch, 1999; Kotabe and Murray, 2004; Takala et al., 2013) and many definitions of sustainable competitive advantage have been proposed (Barney, 1991; Chaharbaghi and Lynch, 1999; Barney et al., 2001; Liu, 2013; Guimarães et al., 2018). Some authors define a sustainable competitive advantage as an “above-average performance in the long run” (Porter, 1985; Ghemawat, 1986).

According to Barney's concept (Barney, 1991, 1997), company's resources must exhibit four attributes in order to be categorized as

sustainable competitive advantages. They must be valuable, rare, imperfectly imitable, and they cannot have strategically equivalent substitutes that are valuable but neither rare nor imitable (non-substitutable). According this concept, a VRIO framework is used to categorize competitive advantages and reveal the sustainable ones (Barney, 1991).

Thus, the literature review has led to the conclusion that the issue of competitive advantages has been studied quite well in the academic literature, including in terms of their impact on the operation and sustainability of companies, as well as their ability to compete on the markets.

In addition, we draw attention to factors that ensured competitive advantages to the fertilizer industry in the past. For a long time, in scientific literature cost reduction has been considered the major source of competitive advantages (Arovuori and Karikallio, 2009). Traditionally, competitive advantages of mining companies have also been sought in the use of unique raw material assets (Ponomarenko et al., 2018). As research views in this sphere evolved, other factors were highlighted as sources of competitive advantages, such as product differentiation and the development of distribution systems (Wilson et al., 2015) or even a supply chain (Geissler et al., 2015). It was found out that fertilizer companies build their strategies on the diversification of production (complex processing of mineral raw materials; increasing the degree of extraction of useful components; use a variety of raw materials; the development of supply chain and infrastructure; further integration) in order to reduce the negative impact of factors dependent on price fluctuations and increase competitiveness (Ramanauskas et al., 2014). Mergers, acquisitions, and/or foreign investments are seen as common instruments used by companies to extend the supply chain in the form of backward and forward integration (Geissler et al., 2015). At the same time, no research has been found that would highlight the role of competitive advantages to fertilizer companies under the currently experienced global changes. This paper sets out to fill this research gap and contribute existing studies by investigating of fertilizer companies' reliable operation during the COVID-19 pandemic, identifying and evaluating their existing competitive advantages, as well as new ones emerging from their nature and a new role played in the crisis and post-crisis period.

3. Materials and methods

In order to resolve our research problems, we need to identify and reveal competitive advantages of fertilizer companies that provide a basis for their resilience in the times of crisis. As it was mentioned, sources of competitive advantage could be formed in line with two major approaches: the competitive positioning (market) view and the resource based view (RBV).

Market view assumes that the external environment, including the industry in which the firm operates and the markets within which it competes, is analyzed first, before an internal analysis of the organization is carried out. This view is founded on the belief that a firm's efficiency derives from the interaction of external forces ('Five Forces' model (Porter, 1980)). According to it, an organization is successful when it successfully implements a range of strategies required by the external environment (Volbedra et al., 2011). So, according to this view sources of competitive advantage stem from protected market position (Maury, 2018).

Quite on the contrary, the RBV suggests that sources of competitive advantages stem from resources owned by that company. The process starts with an internal analysis that focuses on companies' ownership of different types of resources and capabilities, which enable them to develop diverse strategies (Evans, 2016; Sarangaa et al., 2018).

In order to reveal potential competitive advantages of the fertilizer industry we adopt these approaches to the industry taking into account its highly turbulent environment and suggest the following framework (Fig. 4).

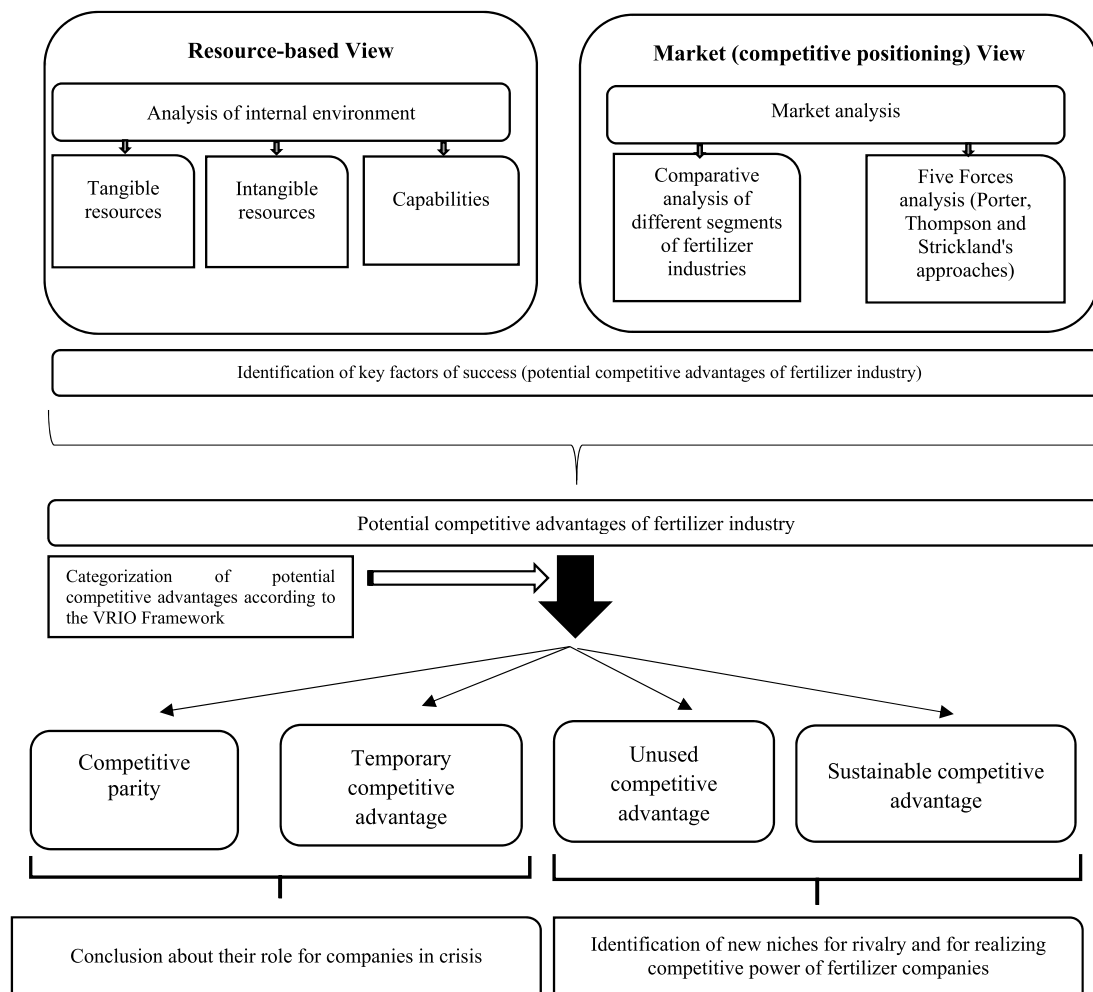


Fig. 4. Framework for revealing competitive advantages of fertilizer companies. Source: authors' compilation using Hooley et al., 1998; Berber et al., 2018.

To identify the characteristic features of the oligopolistic fertilizer market, competition in the industry, and specificities of the product we use an adapted version of the Porter's Five Forces, using five key parameters, as well as Thompson and Strickland's methods of strategic analysis of the industry (Porter 1980; Thompson and Strickland, 2003). The data for the analysis were collected from the open sources, official websites of major foreign and Russian fertilizer companies, the official website of the International Fertilizer Association (IFA), and its analysts' reviews.

Next, we analyze the internal environment of fertilizer companies. We analyze tangible (material, financial, human, etc.) and intangible resources and capabilities of the companies that could be used to find or create competitive advantages.

Using this framework, we identified key factors of success (potential competitive advantages) for the fertilizer industry.

After that, we take each revealed competitive advantage through the VRIO framework (Barney, 1991, 1995; Rothaermel, 2012; Oliveira et al., 2018) and categorize it based on the traits it exhibits into one of the following groups: competitive parity, temporary competitive advantage, unused competitive advantage, or sustainable competitive advantage. The VRIO framework suggests evaluating competitive advantages in four aspects: value, rareness, imitability, and organization. Value criteria show if a potential competitive advantage adds value to the company whether it could strengthen its position. The rareness criteria means that if a particular potential competitive advantage is available to numerous competing firms, if it is valuable but common (i.

e., not rare) than it is not a competitive advantage but competitive parity. Imitability shows the possibility of company's competitive advantages being copied or substituted by competitors. Organization criteria show if a company has organized itself to successfully exploit a potential competitive advantage. If companies are not organized to use potential competitive advantages they become "unused competitive advantages". The VRIO framework is presented in the table below (Table 1).

If potential competitive advantage satisfy certain criteria, we put "+" in result table, otherwise, we put "-".

Based on the conducted categorization, we have drawn conclusions about competitive advantages in the fertilizer industry, its condition and perspectives, as well as defined directions for further development

Table 1
VRIO framework for potential competitive advantages' categorization.

Is it valuable?	Is it rare?	Is it hard to imitate?	Are the companies organized to use?	Competitive consequences
+	-	-	+	Competitive parity
+	+	-	+	Temporary competitive advantage
+	+	+	-	Unused competitive advantage
+	+	+	+	Sustainable competitive advantage

oriented at the core competence concept (Prahalad and Hamel, 1990). Core competencies are “a harmonized combination of multiple resources and skills that distinguish a firm in the marketplace” (Prahalad and Hamel, 1990). According to the core competencies approach, the source of competitive advantage for a company lies in management’s ability to consolidate specific and collaborative technologies, skills, processes and attitudes into competencies that will allow the company to adapt to the emerging opportunities. Core competence should meet three conditions: provide access to many markets; contribute significantly to the benefits obtained from the products, and be difficult to get imitated by competitors (Prahalad and Hamel, 1990). It stresses the critical role of the possibility to integrate internal and external capabilities to adequately respond to rapid environmental changes (Hsiao and Hsu, 2018).

4. Results

4.1. Analytical framework and competitive advantages of fertilizer companies

With orientation to the presented framework (Fig. 4), we believe that a comprehensive analysis of the fertilizer industry could help us to reveal its main features and their strategic importance. The latter is a basis for determining key factors of success (potential competitive advantages) in the industry that, among others, provide reliable business models and supply chains during the crisis. We start with analyzing different segments of the fertilizer industry to emphasize the main differences between them (Table 2).

As shown in the table, markets of different fertilizers have their own characteristics. Thus, potash and phosphate segments are similar in a certain sense, since they are based on mineral resources, which are limited. However, all segments are capital intensive which creates high

Table 2
Comparative analysis of different segments of fertilizer industry.

Characteristics	Potash Segment	Phosphate Segment	Nitrogen Segment
Raw materials	Potash ores - potassium chloride	Phosphoric ores - phosphoric acid	Natural gas - ammonia
Geographical availability of raw materials	Limited	Limited	Available in many countries
Potential market volume (for 2018/2019 agricultural year)	Around 37 million tons CAGR about 3.5–5% (2009/2019)	Around 57,4 million tons CAGR about 2–3% (2009/2019)	Around 107 million tons CAGR about 1–1.5% (2009/2019)
Cost of new capacities	About 1,7 billion USD for 3 million tons (KCl)	About 1.1 billion USD for 2 million tons (P2O5)	About 1.2 billion USD for 1 million ton (NH3)
Development of new capacities	More than 7 years	More than 7 years (taking into account delays of development)	About 3 years
Leading producing countries (2019)	1. Canada 2. Russia 3. Belarus 4. China	1. China 2. USA 3. India 4. Russia	1. China 2. India 3. USA 4. Russia
Leading importing countries (2019)	1. USA 2. Brazil 3. China 4. India	1. Brazil 2. India 3. USA 4. Indonesia	1. Brazil 2. India 3. USA 4. France
Market participants	About 10 major players	Several large players (dozens)	A significant number of players (dozens or hundreds)

Source: authors’ compilation based on data from the websites EuroChem, Uralkali, Nutrient Company, Phosagro, Acron International Fertilizer Association, Trade statistics for international business development, 2020

barriers to market entry.

The availability of natural gas in many countries determines large volumes of nitrogen fertilizers in the market. It should be noted that nitrogen fertilizers are mainly complementary to large producers of fertilizers (potash and phosphorus) and are used in complex fertilizers (NPK – Nitrogen, Potash, Phosphate), or can be used by small regional industries. The latter explains the presence of a significant number of players; large fertilizer companies producing nitrogen and other fertilizers compete in the world market, while local producers serve nearby regions. The data also show that the fertilizer market is global, and the industries (including Russian ones) of the leading producing countries are export-oriented. CAGR indicates that the industry is mature (Porter, 1980).

Moving on, we determine the characteristic features of the world fertilizer market, characteristics of the competition in the oligopolistic fertilizer market, as well as specificities of the products, customers, and suppliers using M. Porter’s model (Table 3). Strategic importance of the parameters for companies’ operation is determined in accordance with A. Thompson and A. Strickland’s concept or, more precisely, with their views on how the economic characteristics of the industry affect the strategies of enterprises operating in it (Thompson and Strickland, 2003).

Together with market research and the characteristics of the fertilizer industry, we analyze resources (minerals, labor, material, organizational and others) and capabilities of fertilizer companies using the latest industry and company reports (EuroChem, Uralkali, Nutrient Company, Phosagro, Yara). We understand capabilities (or organizational capabilities) – collective skills, abilities, and expertise of a company (Smallwood and Ulrich, 2004) – as the ability to achieve goals.

The above listed aspects provide the basis for identification of key factors of success in the industry (Table 3), which include “consumer properties of the product, experience and knowledge, competitive opportunities, market success, and in general everything that increases the profitability of the companies” (Thompson and Strickland, 2003). We call them potential competitive advantages, as “achieving clear superiority over a competitor in one or more key factors of success is a sure way to gain sustainable competitive advantage” (Thompson and Strickland, 2003). We pay more attention to the importance of identified key factors success (potential competitive advantages) during the pandemic of COVID-19.

4.2. Sustainable competitive advantages of fertilizer companies

In order to substantiate our research hypothesis we analyze fertilizer companies in the context of gaining competitive advantages, identified in the research (Table A1). The information for the analysis was taken from annual reports of fertilizer companies, as well as from the interviews with its CEOs’ published in open sources. Table A1 shows some of competitive advantages already achieved by all large fertilizer companies. For example, all large companies have a vertically oriented business model covering all business segments – from raw material extraction to logistics and distribution of final products. Therefore, this is neither a space for rivalry nor an opportunity to get a position that is more profitable.

In order to categorize competitive advantages of a fertilizer company we used the VRIO framework (Table A2). From the table we can conclude that almost all potential competitive advantages belong to the “competitive parity” category. It means that most companies in the fertilizer industry enjoy almost the entire range of possible competitive advantages that provide a stable basis for fertilizer companies’ strategies and allow them to remain stable during global disturbances. A vertically integrated business model, own logistic and distribution systems, as well as flexible business and sales models helped companies to stay independent from supplies, compensate volatility of demand, timely reorient production and sales and altogether have led to the industry’s stability. This combined with the fact that the industry has always been turbulent

Table 3
Five competitive forces in global fertilizer industry and their strategic importance.

Characteristic Features	Description	Strategic importance	Key factors of success (potential competitive advantages)	Importance in COVID 19
Suppliers Internal suppliers in most cases (integration of the companies)	Fertilizer companies are large vertically integrated industrial enterprises with the high level of dependence on the supply of the main limited raw materials (potash ores, phosphoric ores, natural gas). Companies, in most cases, try to provide access to main kinds of mineral resources in accordance with the list of fertilizers produced, as well as try to operate independently of the terms and conditions offered by suppliers.	Determines lower production costs for integrated companies, threatens non-integrated producers who are vulnerable due to possible irregularities in the supply chain and a variability in supply prices	Vertically integrated business model Access to all types of mineral resources Access to unique mineral resources	Resilience of the supply chain of raw materials Low production costs during low prices
Customers Huge amount of customers	The customers, in most cases, are the final consumers (several hundred thousand farms), spread across continents, countries and regions, which determines seasonal fluctuations of demand and remoteness places of consumption from places of production. Production is sold through own sales divisions, international traders and by digital retail platforms in some companies (for example, Nutrien). None of the customers can affect market transactions and the level of competition in the market.	Determines lower costs and security of supply for the companies with own logistic and distribution systems, as well as explains the special role of possibilities to transform the production and sale systems depending on the demand for fertilizers in regions and by types	Own logistic system Own distribution system Flexible business model (quick change of the manufactured products) Flexible sales model (quick change of delivery regions)	Independence from individual consumers Resilience of the supply chain of fertilizers Low distribution costs during low prices Constant utilization of production facilities Maintaining production and sales efficiency
Industry barriers High barriers to entry in the industry	There are high barriers to entry because of considerable costs of gaining a share in the oligopolistic market. In addition, production is very capital-intensive.	Increases requirements for start-up capital, contributes to maintaining the positions and income of existing companies	Significant market share	Restrains increased competition in the market during the crisis (restrains the entry of new players, maintains the existing market share of the companies)
Characteristics of the product Many types of standardized products and several types of modified products with various service offerings; no substitute products	Fertilizers produced by different manufacturers are almost identical and completely interchangeable, however, some types of modified (innovative) products appear. The content of harmful substances may vary (depending on the quality of the ore). At the same time different quality of ore substantiate disparity for companies' costs. Whereas a few years ago, consumers bought products from any seller provided the best prices and delivery conditions, today buyers began to appreciate modified products, environmentally friendly fertilizers, as well as after-sales services and digital solutions that facilitate the purchases and use of fertilizers	Eliminates cross-industry competition; determines the orientation of companies towards diversification and a low cost strategy at the production stage and a differentiation strategy at the sales stage. Emphasizes the special role of ecological safety, digitalization and integration with farmers	Wide standardized product range Access to unique mineral resources (high quality of ore) Modified (innovative) products Digital solutions After-sales services	Diversification of production (decreasing risks) Digital offerings that are particularly relevant in crisis (purchases through digital platforms, ready-made solutions) Satisfaction of individual inquiries of buyers and increasing their loyalty
Competitive rivalry Competition of limited number of companies in mature industry with high environmental turbulence	Consolidated global market structure, large firm's market power. High degree of concentration in the market determines strong competition. Market share of OCP company on the world fertilizer product market - about 31% (OCP Group, 2020). The share of 5 largest phosphate fertilizers producers - about 38% ^a .	Determine the global competition of fertilizer companies with the need to retain a market share; define the special role of strategies for survival in a mature industry	All presented above	All presented above

Source: authors' compilation with the use of [Dmitrieva et al., 2017](#)); [Food and Agriculture Organization of the United Nations, 2017](#); [IFA, 2020](#); [Phosagro \(2020\)](#); [Litvinenko and Sergeev \(2019\)](#); [Litvinenko \(2020\)](#); [Plotkin and Khaikin \(2017\)](#).

^a Calculated by the authors based on IFA reports.

lets us conclude that the fertilizer companies approached COVID-19 crisis prepared as they have developed certain "immunity" to global disturbances, which gives them resilience in the times of crisis.

The analysis of results shows that based on the VRIO framework only

four competitive advantages are sustainable and could lay foundations for further competition and development. At this stage of the research, the question arises what underpins these competitive advantages - marketing opportunities, resources, or organizational capabilities?

Obviously, mineral resources are a classic example of resources and reflect a resource-based approach to creating a competitive advantage (Ponomarenko et al., 2018). By virtue of the specifics of the industry, such resources are core, since all the operational activities of the fertilizer companies are based on them. That is, possessing mineral resources it is not a company's wish but a necessity. However, access to all types of resources, also to unique ones, constitutes a real sustainable competitive advantage, but not because the companies are unable to achieve it but because mineral resources are limited and spread around the world. Only two large companies in the world (Nutrien and EuroChem) have access to all types of fertilizers' raw materials. This gives them a long-term sustainable competitive advantage due to limitation of the resources. Therefore, such competitive advantages are not business achievements but come as a result of a combination of circumstances and external factors remaining beyond the company's control. Thus, in our opinion, such competitive advantages can not be identified as the basis for long-term sustainable growth. Then companies are faced with the necessity to develop new niches for rivalry and for realizing their competitive power.

Competitive advantages, such as digital solutions and after-sales services are of a different nature than those discussed above; they relate to the integration of resources and capabilities, and we deploy the core competencies approach to analyze them (Prahalad and Hamel, 1990; Hsiao and Hsu, 2018).

Components of sustainable competitive advantages of fertilizer companies are presented in Fig. A1 and Table 4. Fig. A1 presents

competitive advantage "digital solutions" in order to show detailed process of how a competitive advantage based on core competencies is revealed.

We identified sustainable competitive advantages and proved that two of them are resource-based, and the other two are competitive advantages based on core competencies. We view them as possibilities of fertilizer companies to create sustainable competitive advantages in a changing and unpredictable environment (Papula and Volna, 2013).

Answering the question about what lies behind sustainable competitive advantages we can conclude that an intersection of market opportunities (market approach) with available and used resources (resource based approach) in combination with collective skills, processes, abilities, and expertise of a company provide the basis for developing new niches for sustainable growth of fertilizer companies, whereas competitive advantages from the «competitive parity» category give them «global immunity» and the basis for survival in a highly turbulent environment. However, it was demonstrated that such competitive advantages provide companies not only with survival opportunities, but also with the stability of operations during the crisis.

For example, developing digital tools for providing support at all stages of the value chain could be one of directions in creating a sustainable competitive advantage. After-sales services could be rendered through agro consulting offered to clients within an innovative approach to service and technological transformation that fundamentally change strategies and practices in decision making, fertilizer application, farm automation, and traceability. For example, Yara invests in developing

Table 4
Components of sustainable competitive advantages of fertilizer companies.

Component	Access to all types of mineral resources	Access to unique mineral resources	After-sales services	Digital solutions
External environment:				
	Independence of the terms and conditions offered by suppliers	High quality products with low costs;	Standardized products	Standardized products
	Limitation of natural resources	Limitation of natural resources; oligopolistic market with large players	Need of differentiation (customers' request for services and solutions based on agronomic advice and analytics)	The importance of delivery in-time and reliability of supply
	Oligopolistic market with large players	Standardized products	Industry's mature; limited resources for competition and development in resource sphere; necessity of development new niches for rivalry	Services and solutions based on agronomic advice and analytics
Internal environment:				
Resources	Mineral resources of all types (phosphate, potash and nitrogen) Production assets	Unique mineral resources Production assets	Qualified personnel (human capital) Wide distribution network	Investments over 60 million USD per year Own production, logistic, distribution and digital assets Qualified personnel (human capital)
Capabilities	Possibility to control all process – from exploration to sales to the end consumers Production capabilities	Production capabilities Technical and technological capabilities	Possibility to control all process – from exploration to sales to the end consumers Brand Capability to get agricultural knowledge	Possibility to control all process – from exploration to sales to the end consumers E-commerce capability Integration of technology, innovation and data Support from people, products, extensive distribution network and systems
Core competencies			Strong industry knowledge and direct customer relationships across the value chain, providing unique insights on trends and developments in the agriculture industry Support from people, products, extensive distribution network and systems	Support from people, products, extensive distribution network and systems Competency in cybersecurity in conjunction with cybersecurity strategy, policy and framework
Result and contribution to reduction of the negative influence of external factors in the long run	Raw material independence of the company	Customers' loyalty due to production quality Low costs	Increase customers' loyalty, increase sales, provide effective usage of fertilizers, grow the company's market share	Digital offerings increase customers' loyalty, drive down costs, reduce working capital and grow the company's market share

Source: authors' compilation based on data from Table 3 and websites of EuroChem, Uralkali, Nutrient Company, Phosagro, Yara International and The Mosaic Company.

farmer centric solutions that integrate knowledge (Yara, 2020).

Therefore, the most perspective direction for creating sustainable competitive advantage is the development of digital solutions for after sale services – online consulting and support or digital individual consultants for consumers. This could be offered through the development of a large-scale digital platform filled with knowledge about crop and farming practices in the agriculture retail sector. The platform could be designed as a one-stop shop for account management, integrated farm planning and agronomic tools, e-commerce service, and crop input financing.

Creating a leading platform for the agriculture retail sector requires a huge investment (over 60 million USD per year (Nutrien, 2020)). It may also require some acquisitions of digital companies to enhance company’s ability to provide real-time sustainable solutions and agronomic advice to the customers. Deep industry knowledge and direct customer relationships across the value chain providing unique insights on trends and developments in the agriculture industry are also needed.

Nutrien is the first fertilizer company that has engaged into a digital retail platform. As we can see in Fig. 5, total online sales exceeded 170 million USD in the US in the first quarter of 2020 compared to about 3 million USD over the same period in 2019 and accounted for approximately 40 percent of US sales of products that are currently available for purchase online (Nutrien, 2020).

Total sales through the company’s digital retail platform exceeded 1 billion USD in the first nine months of 2020, outperforming the annual goal of 500 USD million (Fig. 6).

The 2020 crisis has stimulated the development of the online sector in many spheres, especially in retail. The pandemic significantly increased online trade and consulting. Remote activities are introduced in all spheres all over the world, while displacements between cities, regions and countries are hindered. So, it could be concluded that competitive advantages connected with digital activities are the basis for further development of fertilizer companies.

5. Discussion

Business models of large fertilizer companies are based on the idea of vertical integration. For quite a long time (and now, but to a lesser extent), such a model ensured the sustainability of fertilizer companies. However, today, when the nature and speed of changes in the external environment have changed significantly, traditional approaches to maintaining sustainability (vertical integration, access to raw materials, diversification of production and sales, a developed logistics system,

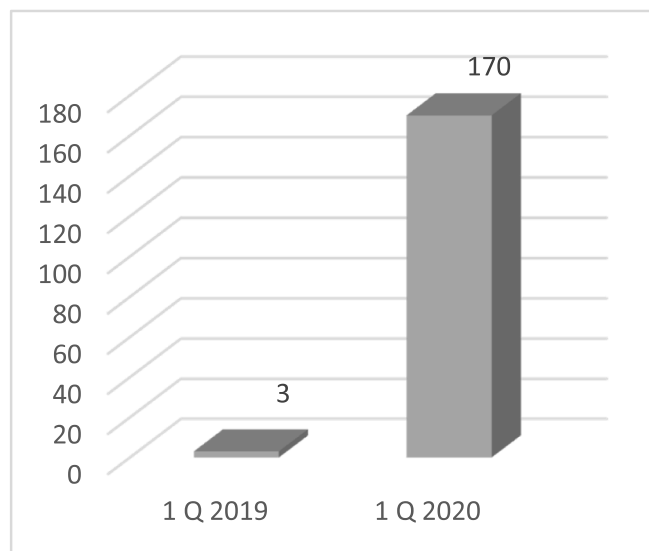


Fig. 5. Total on-line sales of Nutrien (million USD).

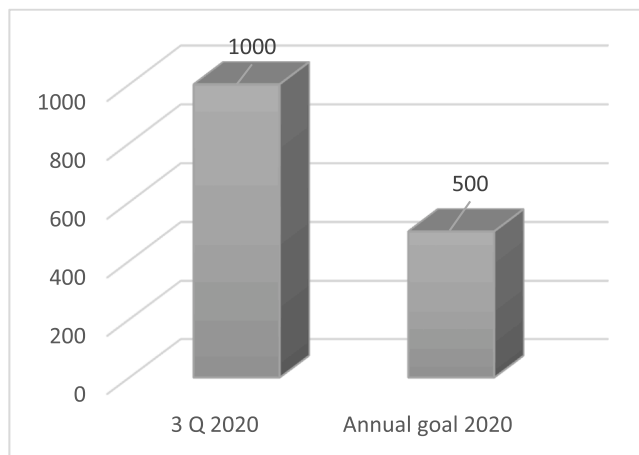


Fig. 6. Total sales through company’ digital retail platform (million USD).

etc.) are undergoing a transformation. Deep technological advances destroy old approaches and working methods, allow gradually change productivity and, as a result, efficiency. This new environment requires the companies to do things differently than they have used to (Papula and Volna, 2013). An important response to the challenges of the external environment is the integration of fertilizer companies with end-users combined with simultaneous digitalization, reflected in the development of core competencies. This makes demands not only on the need to develop technologies and increase the digital competencies of companies, but also on the labor market and personnel.

Using traditional resources in the context of core competence approach is being shifted from the simple utilization thereof to using them in combination with resources, such as information and knowledge, as well as innovations and skills. If a company has got capabilities, which can be used to create additional customer value and which are difficult to imitate and unable to substitute, then it can be said that the company has core competencies that will ensure achieving sustainable competitive advantages (Papula and Volna, 2013) and further growth.

The aforesaid provides evidence for the transformation of competitive advantages for growth of fertilizer companies from the traditional competitive advantages to the advantages based on core competencies. We show this transformation on key parameters, presented in Table 5.

Data for the table were obtained from a review of academic literature, as well as from official reports of fertilizer companies. We combined practical data from the fertilizer companies with theoretical and methodological views on the formation of competitive advantages and competitive strategies discussed in detail in this paper in a way that presented this transformation in a conceptual form.

In order to show the framework within which competitive advantages transformation takes place, we use as parameters such general characteristics of the strategic management as the main competitive strategy of the company and the company’s strategic goal using M. Porter’s classification of the strategies and his approach to competitive strategy creation (Porter, 1980); based on the previously discussed approaches to the formation of competitive advantages (Porter, 1980; Evans, 2016; Sarangaa et al., 2018; Prahalad and Hamel, 1990), we see the essence of transformation in parameters such as the key foundation for competitive advantages creation and the key resources.

As shown above, with different types of competitive advantages underlying the strategy, fertilizer companies are changing directions of integration: the traditional backward integration approach dominates in order to reduce costs as much as possible, while the new approach - forward integration (integration with end users - farmers) – is applied for increasing consumer value. At the same time, the business model is being transformed from flexible in production to flexible in sales and services. The profit center shifts from production to the last stage of the

Table 5
Conceptual framework of transforming traditional competitive advantages into competitive advantages based on core competencies.

Parameter	Traditional competitive advantages	Competitive advantages based on core competencies
Main competitive strategy of the company	Cost leadership strategy	Cost leadership strategy and differentiation strategy
Strategic goal of the company	Reducing costs	Reducing costs and creation of additional customer value
Approach to strategy creation	RBV + MV	RBV + MV + Core Competencies
Key foundation for competitive advantages creation	Tangible assets	Intangible assets
Key resources	Mineral, production, logistics	Intelligent, organizational, digital
Type of vertical integration	Backward integration	Forward integration
Business model flexibility	Flexible production model	Flexible sales and services model
Profit increment	Production	Sales and services, digital solutions and offerings
Investments	In production facilities	In R&D, intellectual capital, digitalization
Diversification	Production	Sales and services
Type of competition	Price competition	Price, product and services competition

value chain, as well as to digitized operations.

As we can see in the table, the focus has partly shifted from the production and resources to the customization and services playing the leading role. Companies should be viewed not as a portfolio of strategic business units but as a portfolio of core competencies (Hamel, 2000). Fertilizer companies have already achieved a set of strong competitive advantages, mostly resource-based, that ensure their stable operations during global disturbances. Nevertheless, for further development and adequate reaction to external challenges it is necessary to look forward and adopt the core competencies approach.

6. Conclusion

Summarizing the conducted research, we could mention the following results:

- Identification and interpretation of the characteristic features of global fertilizer industry, as well as their strategic importance through comparative analysis of different segments and five competitive forces in the industry.
- Identification of the list of key factors of success (potential competitive advantages) in global fertilizer industry, which contribute to the reduction of the negative influence of external factors during the pandemics with the assessment of the degree of their achievement by world leading fertilizer companies.
- Analysis and categorization of competitive advantages of fertilizer companies using the VRIO framework with the explanation why the “competitive parity” category prevail and certain aspects of “global immunity” of the companies to global disturbances provides them with resilience during the crisis.
- Verification of the new role and nature of sustainable competitive advantages with the conceptualization of their transformation from traditional ones into competitive advantages based on core competencies through the conceptual framework of key parameters.

Key findings of the paper are the following

1. The first analytical finding informs that the COVID-19 pandemic has not affected the fertilizer industry and the operational performance

of fertilizer companies significantly. It could be assumed, that this is because fertilizers are critical for food security, however, if fertilizer companies were not ready to operate during the crisis (even if demand were high) uninterrupted, supply chains could be disrupted. We can conclude that this situation is a consequence of two factors: characteristics of the products and the readiness of the companies to ensure the resilience of the supply chain during crisis, which is explained by the fact that the mineral fertilizer market has been turbulent for a long time and prices are volatile.

2. The list of key factors of success in the fertilizer industry, as well as the analytical approach to categorizing the competitive advantages (VRIO framework), allowed us to find out that almost all fertilizer companies have the same competitive advantages. This observation laid the foundations for the conclusion that companies have developed « global immunity » to crisis by working in a highly turbulent environment for a long time, which allowed them to remain resilient during the crisis. The companies benefited from their preparedness during the COVID-19 pandemic. On the one hand, this ensures the sustainability of the entire industry, on the other hand, almost all the advantages come from the “competitive parity” category, which means companies are not different from each other.
3. Nevertheless, some competitive advantages are still not exhibited by all fertilizer companies. Having investigated such competitive advantages, we came to the conclusion that some of them result only from external opportunities beyond these companies’ control; the second group includes competitive advantages that allow companies to meet modern customer and environmental requirements that arose before the crisis and intensified during this period (additional services and digital solutions). Studies of the second group of competitive advantages allowed us to determine that they belong to the category of «core competencies» and could be considered as the basis for further growth of fertilizer companies. The key conclusion is that competitive advantages from the category « competitive parity » could ensure resilience of the supply chain, while those from the category « sustainable competitive advantages » could contribute to the further growth and reduction of the competitive parity in the industry.
4. The paper justifies the role of existing approaches to the formation of competitive advantages on the example of the fertilizer industry. We believe that the case discussed in the paper helped us to successfully prove that resource-based and marketing approaches to creating competitive advantages cannot fully ensure growth of industrial companies during the post-crisis period (or during the crisis since the end of the crisis is still in question). Environmental challenges dictate the requirements for creating such distinctive properties, based on a combination of resources and other components (experience, ability, skills, partnership), which are core competencies. We believe that, as in market-based theory, the external environment is important for the industrial business, however, key aspects of growth need to be identified based on the resource-based approach and core competencies of the company. Thus, we conclude that three competitive advantage approaches considered should be used together, and a special role should be given to core competencies approach.
5. The paper proves the need to transform traditional competitive advantages into competitive advantages based on core competencies for further growth of fertilizer companies. We understand that traditional competitive advantages, such as a vertically integrated business model, own logistic and distribution systems and other, will always be important for the companies, and they significantly contributed to the resilience of companies during the crisis, however, to ensure growth it is necessary to focus on creating core competencies. The difference between two groups of competitive advantages is shown in this paper as a conceptual framework based on key parameters. We discuss this comparison in order to show how key parameters change, as well as to show the nature of competitive advantages based on core competencies. It seems important for the

companies to “possess” competitive advantages, based on core competences. This means that it is irrational to make it possible to external partners to benefit from them (e.g., by using intermediaries in the provision of digital solutions and after-sales services).

The paper is based on the following main assumptions

- We conducted our research based on open source information, in this case, data used in the paper are publicly available.
- We focused our research on large vertically integrated fertilizer companies, assuming that during the crisis the performance of smaller companies and the way they compete on the marketplace could differ.
- We understand that not all competitive advantages are equally important to fertilizer companies in normal circumstances and during the crisis, but the importance criterion was not applied, assuming that we will be able to address it in our future studies.
- We did not pay any attention to social and ecological aspects of fertilizer companies’ activities (Litvinenko et al., 2020), assuming that they are more a consequence of corporate social responsibility, awareness of the companies’ management and necessity, rather than a competition strategy.
- We do not assess the sustainability of fertilizer companies as economic systems (Nedosekin et al., 2019), neither do we focus on sustainable development (Ponomarenko et al., 2020), delving into the sphere and nature of competitive advantages as the basis of the strategies.
- We understand that fertilizer companies in different countries have different characteristic features and competition strategies (also in the pandemic period); in this regard we consider the list of

competitive advantages proposed in the paper as universal, assuming, however, that it can change.

Thus, compared to other industries, the impact of pandemic crisis on fertilizer industry is not crucial. The main factors of such resilience were revealed in the course of the research. First of all, the fertilizer industry plays an important role in food safety and fertilizer products are indispensable for people. The second aspect is that the fertilizer industry has always been turbulent, so fertilizer companies have some “immunity” to disturbances. Thirdly, fertilizer companies are strong and mature. Most of them have almost all range of competitive advantages. This leads to the situation when the strength of competitors gives resilience to the entire industry.

On the one hand, nowadays fertilizer companies aim at creating value for customers, shareholders, and society. On the other hand, today agricultural industry is ready to transform by developing innovative tools, solutions, and technologies for growers. That is why cooperating with partners throughout the food value chain is necessary to improve the efficiency and sustainability of agriculture and food production. Fertilizer companies need to develop solutions that increase nutrient availability and its digestion by agricultural crops, increase productivity, agricultural crop resilience, and reduce the overall environmental impact.

CRedit authorship contribution statement

Alina Ilinova: Conceptualization, Formal analysis, Funding acquisition, Investigation. **Diana Dmitrieva:** Conceptualization, Visualization, Methodology, Formal analysis. **Andrzej Kraslawski:** Conceptualization, Supervision.

Appendices.

Table A1
Competitive advantages of fertilizer companies

Competitive Advantages	Companies					
	PhosAgro	Eurochem	Uralkali	Nutrien Limited	Yara International ASA	The Mosaic Company
Vertically integrated business model	+	+	+	+	+	+
Access to all types of mineral resources	- (Phosphate and nitrogen)	+	- (Potash)	+	- (Nitrogen and phosphate)	-(Phosphate and potash)
Access to unique mineral resources	+	-	+	+	-	+
Own logistic system	+	+	+	+	+	+
Own distribution system	+	+	+	+	+	+
Flexible business model (quick change of the manufactured products)	+	+	-	+	+	+
Flexible sales model (quick change of delivery regions)	+	+	+	+	+	+
Significant market share	+	+	+	+	+	+
Wide standardized product range	+	+	-	+	+	+
Modified (innovative) products	+	-	-	+	+	-
Digital solutions	-	-	-	+	-	-
After-sales services	-	+	-	+	+	-

Source: authors’ compilation based on data from the websites of EuroChem, Uralkali, Nutrient Company, Phosagro, Yara International and The Mosaic Company.

Table A2
Analysis of competitive advantages of fertilizer industry using VRIO framework

Competitive	Is it valuable?	Is it rare?	Is it hard to imitate?	Are the companies organized to use?	Competitive consequences
Advantages					
Vertically integrated business model	+	-	-	+	Competitive parity
Access to all types of mineral resources	+	+	+	+	Sustainable competitive advantage
Access to unique mineral resources	+	+	+	+	Sustainable competitive advantage
Own logistic system	+	-	-	+	Competitive parity

(continued on next page)

Table A2 (continued)

Competitive	Is it valuable?	Is it rare?	Is it hard to imitate?	Are the companies organized to use?	Competitive consequences
Own distribution system	+	-	-	+	Competitive parity
Flexible business model (quick change of the manufactured products)	+	-	-	+	Competitive parity
Flexible sales model (quick change of delivery regions)	+	-	-	+	Competitive parity
Significant market share	+	-	-	+	Competitive parity
Wide standardized product range	+	-	-	+	Competitive parity
Modified (innovative) products	+	+	-	+	Temporary competitive advantage
Digital solutions	+	+	+	+	Sustainable competitive advantage
After-sales services	+	+	+	+	Sustainable competitive advantage

Source: authors' compilation based on data from the websites of EuroChem, Uralkali, Nutrient Company, Phosagro, Yara International and The Mosaic Company.

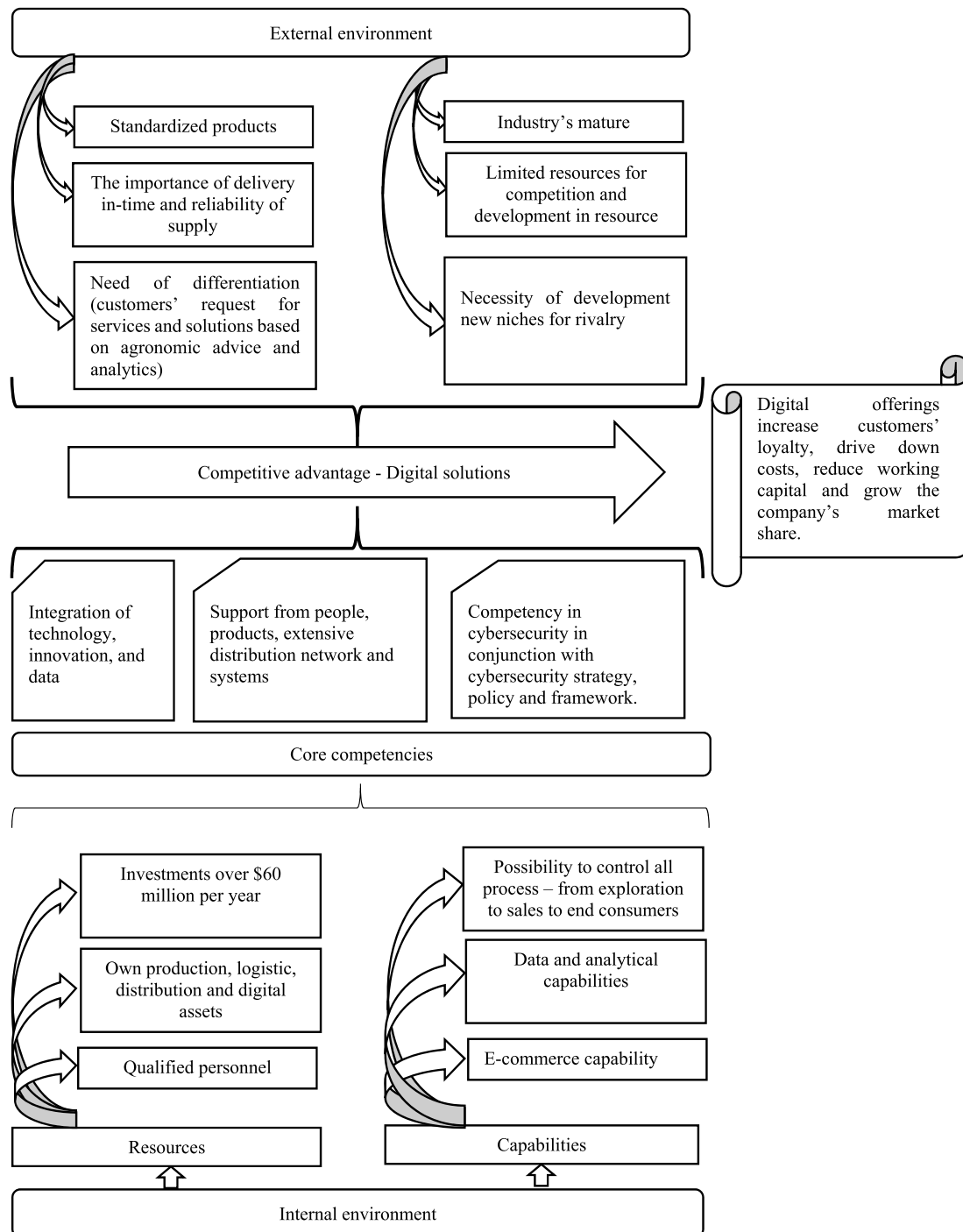


Fig. A1. Revealing sustainable competitive advantage of fertilizer companies.
 Source: authors' compilation based on results from Table 3 and data from the websites of Nutrient Company, Yara.

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