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DETERMINING THE GEOGRAPHICAL COVERAGE OF A MARKET ON THE EXAMPLE OF THE SECTOR OF COMPLEX MULTIPLE-COMPONENT FERTILISERS

Abstract

The paper has two goals. The firstone is to test the method proposed by Pietrzak in re-spect of the practical assessment of the geographical coverage of the agri-business sector, on the example of complex multiple-component fertilizers. The other goal was to verify the adequacy of the national level of analysis in that sector against the actual economic and spa-tial circumstances. The comprehensive analysis, which included the assessment of demand, supply and political as well as legal factors, carried out with the use of paired comparisons, weighting and point evaluation of individual factors, has shown that the relevant reference level in the analysis of complex multi-component fertilizers and decisions based on those analyses is the semi-global level, i.e. the supra-national regional level.

Keywords: multiple-component fertilizer, mineral fertilisers, non-tariff barriers, bargaining power, economies of scale, distribution channel.

Introduction

Market environment analysis is a key element in the process of developing vision and strategy (Ghemawat P., 1999; Makadok R., Barney J.B., 2001; Process Classification Framework..., 2013). Defining properly the borders of a market/sector where a given enterprise or its strategic business unit operates is a barrier frequently faced by an analyst of competitive environment. Should an analyst studying market environment of an entity producing multiple-component fertilisers focus on the domestic market, where the entity's share is several dozen percent, or on the global market (market share less than ten percent), or maybe on the European market (market share between ten and twenty percent)? Questions of this kind may also be important for political decision-makers, provided that they have a substantial influence on the functioning of a given sector, which is frequently the case in agribusiness.

A substantial portion of economic studies and analysis is based on national mass statistics relating to sectors. Thus it seems legitimate to bring up a question whether such a way of defining geographic dimension of a market is appropriate? Geographic borders of a sector are not fixed, but are subject to change along with economic processes, such as globalisation and regionalisation. Defining market/sector geographical area incorrectly may negatively impact the quality of market/sector diagnosis and analysis, leading to erroneous conclusions (Scherer F.M., 1970). Therefore, geographical coverage of a market should be verified systematically. An important tool for such verification may be the method of determining geographical coverage of a market/sector, proposed by Pietrzak (2014).

The goals of this paper are: 1) to test the method proposed by Pietrzak in practice, using it for an assessment of the geographical coverage of sectors, based on the example of a selected agribusiness sector; 2) to verify if the national level of analysis of the complex multiple-component fertilisers sector is adequate, considering actual economic and spatial conditions of this market. The choice of analysed sector was deliberate (the justification and manner of selection are presented in the following chapter). The materials on which this paper is based are secondary data, originating from numerous publicly available sources, including: International Fertilisers Association (IFA) database, FAOSTAT database, analysis and information bulletins of advisory firms, IERiGŻ-PIB reports, publications of Fertiliser Europe. Also the results of studies conducted by other authors, published in literature on the subject, have been used. The above-mentioned materials have been used to analyse forces extending as well as factors limiting sector's geographical coverage. These factors have been broken down into demand, supply and political/legal factors. Weighted average of scores given for individual forces/factors has been used in synthesizing the results. Weighting of forces/factors was preceded by their ranking, using the paired comparison method.

The choice and manner of determining the borders of the sector of complex multiple-component fertilisers

One of key decisions in organizing agricultural production is the choice of mineral fertilisation model, i.e. the dosage pattern, the form and the specific product which will provide the source of primary nutrients (NPK) for plants.

It is estimated that NPK fertilisation accounts in ca. 50% for the yielded crop (Górecki H., 2012). Based on the nutrients they contain, mineral fertilisers may be divided into single-component (containing one prominent component, i.e. nitrogen, phosphorus, potassium) and multiple-component fertilisers, which provide plants with several nutrients at the same time. Multiple-component fertilisers, compared to single-nutrient ones, have many advantages, including e.g.: the possibility to provide nutrients in balanced proportions, higher effectiveness in fertilising simultaneously with several nutrients, the possibility of adjusting the percentage of individual components to the nutritional needs of plants, lowering fertilisation costs by reducing the number of applications or the costs of transport (Mastalerz P., 1996).

Multiple-component fertilisers are made either predominantly by chemical reactions (complex fertilisers) or by physical mixing of straight fertilisers (mixed fertilisers). Complex multiple-component fertilisers, even though they are similar to mixed fertilisers, constitute a distinguishable part of the fertiliser sector. This refers to both the supply side, i.e. fertiliser producers (e.g. a different production process), and to the demand side, i.e. the level of meeting customers (farmers) needs. Mixed fertilisers, unlike complex fertilisers, do not require extensive industrial facilities, and the very process of blending may take place in immediate agricultural environment. Main feasibility criteria in this case include the possibility of precise weighing out and homogenous blending of individual components (Mastalerz P., 1996).

The situation on the market of multiple-component fertilisers is determined by conditions prevailing on the markets for three basic fertiliser components, namely nitrogen, phosphorus and potassium. Nevertheless due to their technological and functional distinctiveness, complex multi-component fertilisers should be regarded as a specific and relatively separated part of the fertiliser sector. Such an approach may be regarded as complementary to the approach most frequently encountered in literature, namely seeing the market of fertilisers through the prism of three elements (N, P, K).

Characteristics of the sector of complex multiple-component fertilisers

Multiple-component fertilisers constitute a group of highly diversified products in terms of composition and relative proportion of nutrients they contain. Producing ammonium phosphates is of key importance for the production of complex multi-component fertilisers (Fig. 1). Ammonium phospathes may take the form of monobasic ammonium phosphate (MAP) and diammonium phosphate (DAP). The diagram presented below is referred to as a mixed route. An alternative for this technology is the so-called nitrophosphate route, where nitrogen and phosphate compounds in the form of nitrophosphates are the base for composing multiple-component fertilisers. The nitrophosphate technology, due to higher raw material requirements (the primary source of phosphorus is apatite), is used much less frequently, but it allows for eliminating the burdensome phosphogypsum creation process. Depending on the level of integration, the production process used by various companies may comprise all or just some of the stages shown on Figure 1.

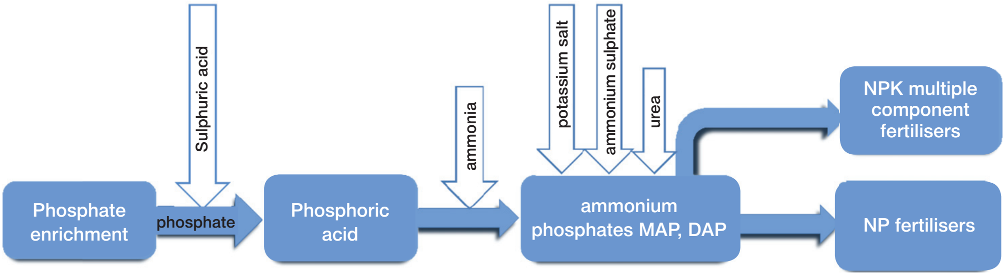

Fig. 1. Simplified scheme of manufacturing complex multiple-component fertilisers, using mixed technology.

Source: own presentation, based on (Mastalerz P., 1996).

Global consumption of mineral fertilisers equals about ca. 172.2 million tons of pure component, out of which nitrogen accounts for 104.3 million, phosphorus for 40.5 million, and potassium for 27.4 million. The largest purchasers include South and East Asia, North America and Europe. Between 2002 and 2010, the use of nitrogenous fertilisers increased substantially. For phosphorus and potassic fertilisers the situation varies depending on the region, nevertheless an increase has been recorded in their total global consumption (Fig. 2). Also the use of N+P+K fertilisers per 1 ha of agricultural area is highly diversified between different regions of the world. The highest level of intensity is observed in South and East Asia, and the lowest in Central Asia, Oceania and Africa. On average 22 kg of N, 8 kg of P205 and almost 5 kg of K2O is applied per 1 ha worldwide. In Poland, the use of mineral fertilisers is ca. 120 kg of NPK per 1 ha, with an increase by ca. 15% projected by 2017, compared to 2011 (Zalewski A., Igras J., 2012).

The share of multiple-component fertilisers in total mineral fertilisers consumption differs, depending on the nutrient. Globally, on average multiple-component fertilisers are most important in the case of phosphorus. According to an estimate based on IFA data, in 2010 their share was 80%. The share of potassium from multi-component fertilisers in the total volume of this nutrient supplied in 2010 was ca. 30%; the corresponding figure for nitrogen was ca. 16%.

Demand for fertilisers is condition by demand for food. Thanks to the increasing level of fertilisation and the use of chemical plant protection products, global food production has risen twofold in past four decades, whereas the area occupied by crops has increased by mere 6% (Zalewski A., Igras J., 2012). In view of the forecasted increase of global population and the limited arable land resources, global demand for fertilisers should keep growing.

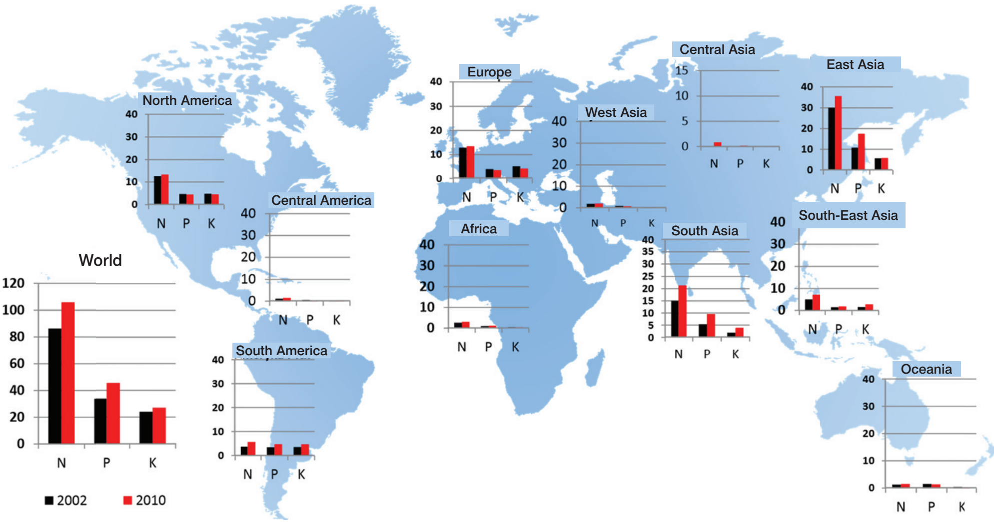

Fig. 2. Diversification of usage of N+P+K fertilisers in different regions of the world in 2002 and 2010 (million tons of pure component)

Source: Own presentation, based on data from International Fertiliser Industry Association.

Currently, world fertiliser industry manufactures ca. 190 million tonnes of fertilisers, expressed as pure NPK component. The estimated production value in this sector is ca. EUR 100 billion (Górecki H., 2012). In EU-27, the fertiliser sector produces ca. 18 million tonnes of NPK annually, worth ca. EUR 17 billion. Since the beginning of 21st century, a growing importance of developing countries has been observed in geographical global production structure. Main factors that determine such processes include the growing demand for fertilisers in these countries (with simultaneous decline in demand in highly developed countries), cheaper labour force, and frequently access to raw materials that are necessary for fertiliser production. In result of the ongoing changes, the share of developed countries in the global production of fertilisers has dropped to 30%, whereas the share of developing countries has increased to 70% (Zalewski A., Igras J., 2012).

Demand factors

Customer needs

The degree of similarity between the needs of customers in different geographical regions determines whether it is possible to apply global strategy or it is necessary to adjust to local conditions (Yip G.S., 2004). For the purpose of the analysis conducted, it has been assumed that the needs of farmers for fertiliser products is determined by such factors as: the scale of operations, geographic location and the kind of agricultural production.

The scale of production, apart from having a direct impact on the demand for fertilisers in terms of quantity, is also connected with several characteristics of farmers, relevant from the fertiliser industry perspective. Bigger farms are characterised by higher work efficiency and they use technical innovation more frequently. Such farms base their production on fertilisers and chemical plant protection products, and they play a decisive role in food production (Podedworna H., 2001, 2005; Sulewski P., 2007; Tomczak F., 2005). The larger the farm area, the bigger is the share of farmers with higher education, including in the field of agriculture. The importance of education for agricultural activity has been discussed, in publications by such authors as e.g. Gołębiewska and Klepacki (2001), or Kołoszko-Chomentowska (2008). The average level of fertilisation with three basic macro-elements is distinctly higher in farms with a large arable area. Large farms have higher requirements regarding various fertiliser parameters as well as supplementary services, as the bargaining power of such customers is bigger (Olson K., Boehlje M., 2010). Larger agricultural producers (or groups of producers) may also seek a possibility of direct purchase.

Farm location factor – due to sociological determinants (e.g., differences in agricultural practice), organizational determinants (e.g., mechanization degree) and resource determinants (e.g., soil quality) – affects the degree of use of production potential, and it determines whether the model of agriculture adopted is a more extensive or a more intensive one. This translates directly into farmers' demand for fertilisers (both in terms of quantity and quality). Also natural conditions contribute to regional differences in agriculture, consequently affecting the need for fertilisers (Krasowicz S., Kopiński J., 2006). Similar factors also determine differences in agriculture on a supra-national scale (Hazell P., Wood S., 2008). Geographic location of a farm may also be a factor differentiating the production means purchasing models among farmers (Roberts D., Majewski E., Sulewski P., 2013). The level of economic and technological development as well as knowledge transfer efficiency are important factors associated with location; differences in this scope may be observed both between regions and countries (Czapiewski K.Ł., Floriańczyk Z., Janc K., 2006; Margarian A., 2012). Such differences are generally much more profound in the latter case, being determined by general level of economic development (FAO 1995; Kwa A., 2001). In underdeveloped countries, insufficient food production in relation to the needs is a major problem, translating into a growing demand and affecting its conditions (FAO 2009). Purchasers in such countries have lower requirements, e.g., regarding fertiliser quality or the level of service.

The kind of agricultural production should be considered as the third major factor that may differentiate the need for fertilisers. This is most important for plant producing farms, which do not produce organic fertilisers that may substitute chemical ones. For example, the consumption of fertilisers in plant production farms is almost 30% higher than in farms producing live pigs (Kopiński J., 2006). It should also be mentioned that the kind of agricultural production is frequently connected with geographic location. In Poland, for example, dairy production is highly regionally diversified (Ziętara W., 2006). Considerable differences may also be observed in the intensity of animal production, both within and between countries.

Purchasers and distribution channels

In literature, the existence of global clients and global distribution channels is considered as an important factor which may become the catalyst of globalisation. Global client should not be equated with international purchaser, i.e. a buyer making purchases in many countries. What defines a global client, is not only the international scale but also the centralisation of purchases. Distribution channels may function in a similar way, with purchases made globally (Zip G.S., 2004). On the other hand, strictly local nature of the clients and distribution channels is a factor limiting the globalisation potential of the sector.

The sector of agricultural producers is highly fragmented, and it has a local character. The level of fragmentation of the sector of agricultural producers in Poland is high, and thus 90% of purchases are made via agents (Piwowar A., 2011). It may be assumed that even in the case of a relatively big plant producing farm, the annual demand for fertilisers is so low that purchasing such an amount directly from the producer[1] would be economically questionable, due to the costs of transport. Various forms of farmers' association, e.g. producer or purchasing groups, offer some possibilities of taking over the distribution function. However, despite the fact that collective forms of framers' organisations play quite a significant role in the distribution of fertilisers in Western Europe, the direct purchasing model is of little importance (IFA-UNEP 2000).

A relatively high fragmentation of agriculture results in a situation where the role of distributors in fertiliser supply chain is pivotal. The distribution system in Poland is characterised by high fragmentation – there are few dominant players and over a hundred of small, unspecialised distribution companies (Cioch G., Kłosowska D., 2009). On mature markets, on the other hand, one can observe consolidation and expansion of distribution companies that previously operated mostly on a local or regional market (within a country). For example, in Germany distributors associated in regional agricultural cooperatives (Genossenschaften) are planning to expand internationally or are already expanding beyond national borders (Cioch G., Kłosowska D., 2009). Fertiliser distributors from highly developed countries gradually become semi-global and, while searching for new sources of competitive advantage, may still be expanding in the future.

[1] Some producers allow for a possibility of individual purchase, provided that the volume of goods is high enough.

Marketing and customer service

Transferability of marketing and of customer service between various geographical areas offers a possibility to employ a uniform marketing strategy on several markets, e.g., a globally uniform branding strategy (Yip G.S., 2004). A key question, therefore, is: to what extent it is possible to transfer marketing and customer service elements between various areas, thus allowing for the extension of market boundaries, and to what extent such elements should be adjusted locally, thus limiting market geographical coverage?

Multiple-component fertilisers are characterised by high physical and chemical variety of individual products. In generally adopted nomenclature, a given kind of fertiliser is marked by the content of nitrogen, phosphorus and potassium N:P:K, e.g. NPK 6-20-30. Such marking of the product on the market is a kind of the so-called generic brand. Complex muliple-component fertilisers are offered, apart from generic brands, under specific brand names, e.g., YaraMila, Polifoska 8, etc. In this context, the brand as an element of marketing may be considered as transferrable; however care must be taken to select a name easy to pronounce. Also it must be verified that the name selected has no negative connotations in a relevant foreign language, etc. Using a uniform brand name facilitates the use of uniform advertising. However, a barrier exists in this area, associated with the diversity of world agriculture. The choice of media and the content of advertising message will largely be determined by technological advancement of the sector in a given area, by farmers' knowledge, education and lifestyle, and also by cultural factors.

Due to the diversity of world agriculture, customer service needs to be tailored to local conditions, in particular at the stage of building relations with final consumers. Such customer service makes it possible to introduce elements diversifying the offer or tying the farmer to a given producer of fertilisers (e.g., advisory services). Thus the ability to adapt to local conditions is one of the key factors that determine marketing success. It should be borne in mind, however, that the importance attached by farmers to customer service will vary at the global scale – in developed countries, customer service will play a bigger role, whereas in developing countries, the main purchase criterion will be the price.

Supply factors

Economies of scale

The occurrence of returns to scale is connected with the shape of long range average cost curve (LRAC) resulting from the combination of the minima of average cost curves (AC) for various production scales. As long as the LRAC curve is increasing along with a growing scale of production, we can talk about the increasing returns to scale (Tirole J., 1988; Carlton D.W., Perloff J.M., 2005). From the perspective of defining potential coverage of the sector, the proportions between minimal efficient scale (MES) resulting from the shape of the LRAC curve and the size of the market within defined geographic borders are of crucial importance.

For example, a situation where the optimal production volume is higher than the capacity of domestic markets fosters international expansion.

The available literature on mineral fertilisers deals marginally with the significance of scale for the profitability of fertiliser production. Any deliberations on the issue are usually concluded by a statement that economies of scale do exist in the production of fertilisers[2], but no in-depth analysis are given. From the available FAO estimates, it may be concluded that in 1998 MES in ammonia producing plants was 365 thousand tonnes annually, i.e. the equivalent of 0.4% of global production at the time. Slightly more recent data provided by KBR Marketing demonstrate that the production capacity of installations designed at the beginning of the 21st century amounted to ca. 730-800 thousand tonnes, which is more less equivalent to MES. In this perspective, MES was equivalent to 0.6% of global production at the time. From the above-quoted FAO estimates, it may be concluded that in 1998 in phosphorus producing plants, MES was only 440 thousand tonnes annually, which was equal to the equivalent of ca. 2.2% of global production at the time.

Bargaining power dependent on transaction scale

As pointed out by Keat and Young (2003), economy of scale is a broader term than economies of scale. Larger production scale means not only lower production costs but also a possibility to gain a better negotiating position *vis-à-vis* suppliers and purchasers. Striving to increase the bargaining power may be an incentive to extend sector's geographical coverage, similarly to the economies of scale.

Considering the spatial dispersion of farmers but also (generally) of distributors, it seems that fertiliser producers who operate on a countrywide scale have a sufficient negotiation advantage over purchasers. Along with forecasted international expansion of distributors, gradual pressure on fertiliser producers to shift production to transnational scale may be observed in developed countries – in order to re-balance the bargaining power of distributors. Currently, however, a much significant imbalance exists – benefiting suppliers – in purchases of raw materials used in production of multiple-component fertilisers.

Natural gas suppliers have the strongest bargaining position. This position cannot be significantly balanced even by a highly increased scale of operation of fertiliser producers due to the insignificant dependence of gas suppliers on the purchases made in the multiple-component fertiliser sector. In the case of multiple-component fertilisers, unlike for nitrogenous fertilisers, phosphorus and potassium suppliers, who are "doomed" to the multiple-component fertiliser sector, are much more important than gas suppliers in terms of costs. Thus, a global player making centralised purchases could – at least partially – balance the bargaining power of gas suppliers, which may be one of the factors contributing to the growth of scale.

[2] For example, according to Polish entrepreneurs that produce fertilisers, the scale of production is one of main factors shaping the competitiveness (Piwowar A., 2011).

Geographical diversification of the costs of production factors

Differences between regions, countries or continents in the costs of production factors, important for manufacturing a given product, serve as a strong incentive to extend geographical borders of a market (Yip G.S., 2004). Let us assume that a product has been produced locally in a given country, which was determined, e.g., by high costs of transport of finished products. If there are significant differences in the costs of production factors between various regions of a country, then – along with technological advancement in transport technologies and the disappearance of cost-related barrier – the production will begin to concentrate in the regions with cost advantages, and finished products will be transported all over the country. Thus a local market will become nation-wide. Likewise, substantial differences in the costs of production factors between countries or continents become a driving force of semi-globalisation and globalisation of a given sector – concentrating businesses in countries where such costs are low allows for significant cost reduction.

Main raw materials used in multiple-component fertiliser production are phosphorites (processed into phosphoric acid) and potassium salt, and also natural gas to a lesser extent.

Raw materials, providing a source of phosphorus and potassium, are highly concentrated geographically which means that producers from other countries are heavily dependent on imports. Producers integrated with the extraction phase, compared with other producers of fertilisers, will have a cost advantage. The greater such an advantage, the more it will drive globalisation. Seeking integration in the form of establishing cooperation or acquiring a sylvinite and phosphorite mine leads in fact to evolution towards a global strategy – a good example in this context is Yara company.

Mining of phosphorites is heavily concentrated geographically – four biggest producers (countries) account for 3/4 of extraction in 2010. These producers are: China (37%), Morocco (15%), USA (15%) and Russia (6%) (Zalewski A., IRAs J., 2012). The high concentration results in a situation where prices are controlled by major exporters. The largest exporter is Morocco. The company that extracts phospohorites in Morocco is OCP, which plans to increase in the future not only the volume of extraction but also the production and export of ammonium phosphate (DAP/MAP).

Also the supply of potassium salt (sylvinite) is very concentrated – four major producers (countries) account for 74% of global production, including Canada – 29%, Russia – 21%, Belarus – 15%, and Germany – 9%. The share of four biggest companies in global sale of potassium salt is 63%. In 2010, two biggest companies controlled 65% of total world exports.

The production of multiple-component fertilisers also requires nitrogen, a source of which is ammonia synthesised from air, with the use of natural gas. Concentration of gas supplies is lower in this case, however the impact that supra-regional gas suppliers have on fertiliser producers is very high, especially in Europe, when one of major sources of natural gas is Russian Gazprom. Due to the negative consequences of dependence on a few sources of gas in Europe, the prices of gas increased by 221% between 2001 and 2012 (Janusz P., 2013).

Fertiliser production is, first of all, raw material intensive and energy intensive activity. In ZCh Police plant (which derive 85% of its revenue from fertiliser production), the costs of materials and energy account for 84% of operating costs. Labour costs, however, are also an important factor, e.g., in ZCh Police plant they account for 8% of operating costs (Police – Annual Report 2012). Labour costs vary enormously across the world – the hourly rate in the industry ranges from USD 1.2-1.4 in India and China to USD 64 in Norway (International Comparisons..., 2012).

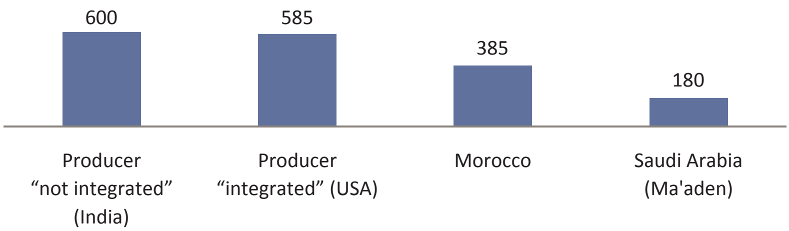

Fig. 3. Differences in the costs of DAP production by location ($/t).
Source: estimate based on a report by PhosAgro (2013).

Geographical diversification of the costs of production factors results in differences in the costs of production between companies from different regions of the world. For example, the access to own sources of phosphorites is of key importance for the profitability of production. Not integrated producers incur much higher costs than integrated ones; the latter are those that have their own mines or are integrated with phosphorite suppliers, e.g. through joint ventures. The example of DAP installation Ma'aden, Saudi Arabia, demonstrates the scale of advantage that may be gained by the producer having access to own sources of phosphorus and to local sources of sulphur and gas (Fig. 3). The above shows that there exists a significant globalisation driving force in the sector of multiple-component fertilisers, resulting from the differences in costs of production factors.

Inputs on R&D

The high costs of product/technology development with regard to sizes of domestic markets act as a globalisation driving force. In such a situation, it would be natural to want to spread such costs over several markets. This tendency increases in particular when product life cycles are short. The higher the costs of research and development, the greater sales volume justifies undertaking the same (Yip G.S., 2004).

Production technologies for most fertilisers are relatively well known, and today are consider as rather simple. Producers searching for new sources of competitive advantage do sometimes undertake research and development work to improve their products or production process, but the scope of such a work is not significant, especially for chemical industry (0.01% of revenues)[3].

Diseconomies of scale

Ecological and environmental constraints are the main source of potential diseconomies of scale in the sector of multiple-component fertilisers. A growing number and strictness of environmental and safety regulations is a noticeable worldwide trend, especially marked in Europe. In 1990-2009, the number of directives, decisions and regulations in this area increased almost sixfold – a trend resembling an exponential function. This phenomenon may be described as "hyper-regulation" (Pietrzak M., 2013). The area of multiple-component fertiliser production where diseconomies of scale may be observed is the storage and management of phosphogypsum (calcium sulphate), which is production waste in the so-called mixed process of decomposition of raw material containing phosphorus (substrate). In the process of manufacturing 1 tone of phosphoric acid ca. 5 tonnes of phosphogypsum is produced (Kowalska E. et al., 2004), which needs to be stored or managed. With growing production scale, the increasing volumes of phosphogypsum become a serious problem. In the context of existing EU regulations, this forced some companies (e.g., Spanish Fertiberia and Polish Fosfory) to cease their production of phosphoric acid, thus shortening the value chain, and to purchase the chemical compound externally (Fertiberia, 2009; http://www.chemiaibiznes.com.pl, 2014; Consolidated Annual Report of Ciech Group, 2007).

Difficulties and costs resulting from transportation and storage

Logistic factors may constitute a serious barrier to trade, and thus become a force limiting the potential geographic coverage of the sector. Such elements should be taken into account as the possibility of storage and transport (ADR, RID or IMDG), classification as dangerous goods, as well as economics of logistics (transport costs).

Multiple-component fertilisers are not considered as dangerous goods according to the United National Orange Book and international codes: ADR (road transport), RID (railway transport), IMDG (sea transport). Ammonia used as an intermediate product in multiple-component fertiliser manufacturing is an exception, and as a dangerous material must be transported in cooled tanks or pressure containers.

Transport costs of fertilisers depend on the location of the point of shipment

[3] In 1996-2006, merely ca. 0.2% of patents granted in the USA in chemical industry were connected with fertiliser industry.

and delivery, the size of transported lot, the variation of transport rates determined, e.g., by general economic situation and energy prices. All this makes it very complicated to define average transport costs. Thus it is necessary to adopt simplifying assumptions, and to treat the obtained results only as approximate estimates. Ammonium sulphate DAP (18%N + 46% P2O5) is both an intermediate product and a fertiliser, frequently traded internationally. For this reason, it has been used as an example for the assessment of transport costs.

Europe is a region of intensive intra-regional trade in fertilisers. Germany, which is the main agricultural producer and a major consumer of multiple-component fertilisers in Europe (over 13% of total EU consumption, and a major importer), has been taken as a point of reference. Trade partners of Germany in Europe which account for at least 1% of foreign trade in terms of imports to Germany (13 countries) or exports from Germany (12 countries) have been taken into consideration. The distances between capitals of individual countries have been used as an approximation of average route length in trade exchange. It was assumed that a single packaging unit is a EUR palette containing 25 kg bags on EUR palettes loaded in a 20ft (21 tonne) container. The cost of transport of a single container by road was estimated at USD 1.72/km. For the assumptions made, the average cost of road transport, weighted by importance of individual routes in international trade of Germany, is USD 62/tonne of multiple-component fertilisers. Assuming average price of DAP 18-46-0 at USD 550/t, this represents 11.3% of fertiliser price. The analysis conducted, although simplified, shows that even within a single continent the costs of transport significantly affect the price.

Table 1

Main routes of DAP movements on a global scale and their significance; tariffs

Country of origin	Country of destination	Volume of freight (thousand tonnes of DAP)	Average duty rates
USA	India	3133	5.30%
Russia	India	1150	5.30%
China	India	704	5.30%
China	Vietnam	663	1.00%
Jordan	India	472	5.30%
Tunisia	Spain	400	5.70%
USA	China	387	15.50%
Tunisia	Turkey	367	5.40%
Morocco	France	367	5.70%
Australia	Pakistan	343	0.00%
Lithuania	UK	324	5.70%
Russia	Ethiopia	300	0.00%

Source: own presentation, based on data from Integrated Database (IDB) Notifications (2014).

According to data of Argus Fertilizers Freight (2012), in mid-2012 the costs of fertiliser freight transport, depending on the route, ranged between USD 20 and USD 70 per tonne. Table 1 shows main routes for the movement of goods for DAP on a global scale – representing almost 60% of world trade. Weighted average freight cost for the routes given in Table 1 may be estimated at USD 40/t. With the assumed prices of DAP 18-46-0, the cost of sea freight represents 72% of the value of DAP. The above figure, however, does not reveal a full picture of transport costs at global scale – it does not account for the costs of land transport. Such costs may be estimated at additional USD 5-8 (ca. 1-1.5% of the price of multiple-component fertiliser) per tonne for each 100 km of road transport[4]. Making a rather simplistic assumption that (on average) fertiliser travels 500 km by land from the port, it may be estimated that total average costs of transport at global scale represent ca. 12-16% of the price of multiple-component fertiliser.

Political and legal factors and potential geographical coverage of the NPK sector

In most cases, protectionist policy instruments will impede the growth of globalisation potential of the sector. A more liberal policy, easing restrictions in international trade, may stimulate market expansion of companies on a semi-global (np. EU) or global scale (Yip G.S., 2004).

Tariff barriers to the movement of products and services

Table 1 presents tariff rates for main routes for world import of DAP. Average duties – weighted by importance of trade turnover between individual countries listed in Table 1 – equals ca. USD 28/t, representing 5.1% of the assumed average DAP price. If we add duties to the averaged transport costs on global scale, the total cost will amount to 17-21% of the price of DAP. If we look at the issue in more detail, the picture gets more complicated. Duties on fertilisers within the European Union usually do not exceed 6.5%. However, to protect the EU fertilizer industry, the duty imposed on the imports of mineral fertilisers from Russia (which has a significant advantage in terms of production factors) is high, namely 27%. The situation has changed when Russia joined the WTO in 2012.[5] It should be pointed out that even though import duties play a dominant role, some countries also apply export duties to protect their markets against shortages (e.g. China imposes export duties on fertilisers, including multiple-component fertilisers. During peak vegetation seasons such duties amount to 110%, and off-season they decrease to 10-20%).

[4] The authors estimate the costs of container transport at: USD 1.73/mile (North America), USD 1.72/km (Europe), USD 1.2/km (South America).

[5] In January 2014, Russia requested the WTO Secretariat to consult the EU on the antidumping duties imposed by the UE in nitrogen fertilizers, which may be regarded as the first step towards a formal WTO lawsuit.

Non-tariff barriers for the movement of products and services

Legal acts in force in individual countries regulate basic chemical and physical parameters that must be met by mineral fertilisers. Such acts usually regulate also the use of and trade in fertilisers. As a rule, legal acts do not represent a significant barrier in terms of globalisation potential, although companies that engage in international trade must know detailed regulations in force on a given territory and comply with such regulations. In the EU, Regulation No 2003/2003 of the European Parliament and of the Council of 13 October 2003 relating to fertilisers is in force. It introduces the marking „EC fertiliser". All fertilisers that are marked „EC fertiliser" can circulate freely on the European market. Obtaining the marking may be some sort of a barrier to globalization, especially for minor players. REACH (Registration, Evaluation, Authorisation and Restriction of Chemical Substances), a legislative package in force since 2007, may have a similar impact.

Potential geographical coverage of the sector of multiple-component fertilisers – a summary

Figure 4 presents a summary of assessment of geographical coverage of multiple-component fertilisers sector, performed using the method proposed by Pietrzak (2014). Figure 4 shows:

- Factors shaping the geographical coverage, broken down into demand, supply and political/legal factors; forces extending geographical coverage are aligned to the left and their graphical symbols (bars) are green; forces limiting geographical coverage are aligned to the right and their graphical symbols (bars) are red.
- The importance of individual forces from the point of view of competitiveness of companies (weights are given next to the names of factors and are also represented graphically by the width of relevant bars; weights of all factors add up to 100%).
- Score-based assessment of the impact that individual forces have on geographical coverage of the sector, where -2 means that a given force enhances local character of the market, and +2 - that it enhances global potential. This assessment is illustrated by the length of relevant bars (the shorter a bar, the smaller the impact of a given factor; green bars should be „read" from left to right, and red bars from right to left; a very important factor spans over the entire width).

Weighting the forces extending and limiting market geographical coverage is of key importance in interpreting the analysis performed. Towards this end, the authors, having defined the list of all forces, differentiated them, using paired comparisons. While comparing each pair of factors, the authors put forward a question: which of the forces has a greater impact on the competitiveness of companies? In this way, a ranking of factors was created, based on the number of "wins" in comparisons – the force "geographical differences in the costs of production factors" came first in the ranking, and the "inputs on R&D" came last. Ranking of factors was facilitated by assigning weights to them, taking at the same time into account:

– the aim to capture differences between decisive factors (e.g. weight of 40%), key factors (e.g. weight of 10%), important factors (e.g. weight of 5%) and secondary factors (other);
– assumption was made that the weights will add up to 100%.

Fig. 4. Assessment of geographical coverage of the sector of multiple-component fertilisers.
Source: own presentation, based on the method proposed by Pietrzak (2014).

The adopted approach demonstrated that even though several forces, such as major barriers associated with transport costs, with the local nature of clients and of most distributors, and with tariffs, impede market expansion, among the expanding forces there is a force with great weight, a decisive one, namely geographical differences in the costs of minerals, energy and labour (Fig. 4). In result, the weighted average of the limiting forces is -0.2 points, whereas the weighted average of the expanding forces is +1.1 points, which gives a resultant of **0.9 points. According to the scale adopted, this means that, synthetically speaking, the sector of multiple-component fertilisers is semi-global, i.e. supranational regiona**l. Therefore Polish producers of fertilisers, or politicians, when making decisions should use regional market as the reference market. The authors believe that, considering the specificity of the fertiliser sector (in particular, raw materials and energy ties), regional market should be understood as wider than the UE, i.e., as entire Europe, including East European countries and Norway.

Summary

Distances and areas are key management issues – they shape market prices, affect the location of production, and have an impact on geographical borders of the markets. Nevertheless, the market, even though it is a basic category in microeconomics, is not usually defined in geographical terms or it is tacitly assumed – in line with mass statistics – to correspond with national sector, without discussing the legibility of such an approach or the possible errors resulting from potential inadequacy of such a definition.

Our analysis of the market of multiple-component fertilisers has demonstrated that the method proposed by Pietrzak allows for a practical and operationalised assessment of geographical coverage of sectors. The above analysis allows for concluding that an analysis of the sector of complex multiple-component fertilisers at national level in inadequate, considering the actual economic and spatial conditions of the market that has semi-global (i.e. supra-national regional) potential.

It would be desirable in future research to extend the pool of sectors assessed in terms of geographical scope using a single method, as this would facilitate comparative analysis. It would also seem interesting to define the strategic implications of the structure and dynamics of forces shaping the geographical coverage of the market of multiple-component fertilisers. As has been shown, the structure of such forces is diversified, which indicates that it is possible to effectively implement various strategies, including offensive ones, which make use of factors implying a semi-global/global nature of this sector (e.g. standard versions of basic products at low price thanks to integration with mines of raw materials), as well as defensive ones, which protect domestic markets through focusing on factors of local/regional nature, e.g. customized offer addressing the needs of specific market segments, and emphasis on supplementary services and customer service.

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