Janka Betáková
PhD (Economics), Associate Professor,
DTI University
533/20 Sládkovičova Str.,
Dubnica nad Váhom, 018 41,
Slovak Republic
betakova@dti.sk
ORCID ID:
http://orcid.org/0000-0002-9317-6317

Katarina Haviernikova
PhD (Economics), Assistant Professor,
Alexander Dubček University in Trenčín
3 Študentská Str.,
Trenčín, 911 50,
Slovak Republic
katarina.haviernikova@tnuni.sk
ORCID ID:
http://orcid.org/0000-0002-9019-8684

Dana Jašková
PhD (Geometry and Topology),
Assistant Professor,
Alexander Dubček University in Trenčín
3 Študentská Str., Trenčín, 911 50,
Slovak Republic
dana.jaskova@tnuni.sk
ORCID ID:
http://orcid.org/0000-0002-7250-9207

Vladimír Hagara
PhD (Economics), MBA, Associate Professor,
DTI University
533/20 Sládkovičova Str., Dubnica nad Váhom, 018 41,
Slovak Republic
hagara@dti.sk
ORCID ID: http://orcid.org/0000-0003-2964-2958

Robert Zeman
PhD (Economics), Associate Professor,
Head of the Department,
University of South Bohemia in České Budejovice
13 Studentská Str., České Budejovice, 37005,
Czech Republic
rzeman@ef.jcu.cz
ORCID ID: http://orcid.org/0000-0002-3983-442X

Potential for clustering in the agricultural sector assessment: the case of Slovakia

Abstract. Agricultural activity has a long tradition in Slovakia. One of the ways to contribute to the development and enhance the competitiveness of this sector is to involve various agricultural interests in cluster cooperation. In the world, there are several known cases of clusters in the agricultural sector, which significantly contribute to regional competitiveness. In that context, the main aim of this paper is to assess the current state of conditions necessary for the emergence of clusters in the agricultural sector in Slovakia and identify key regions eligible for the establishment of agricultural clusters. The methods used are: Data Envelopment Analysis (DEA) and Localization Coefficient (LQ). Theresults obtained were transformed into a BCG matrix. DEA was used to assess regional efficiency and LQ - to assess regional potential for clustering. Using of these methods created the base for the cluster potential identification in the most efficient region from the point of view of agriculture.
The uniqueness of this paper is the focus on a new area of clustering, which could contribute to increased regional competitiveness in the Slovak Republic. From the point of view of the Slovak agricultural efficiency assessment, the most important regions for clustering are Nitra and Trnava. From the point of view of the cluster potential assessment, the appropriate regions are Nitra and Prešov. Based on the results of the applied methods, basic preconditions for clustering have been created mainly in the Nitra region.
Keywords: Agriculture; Efficiency; Cluster; Clustering; Competitiveness; Region; Regional Actors
JEL Classification: O13; O18; Q19; R30
Acknowledgements: *The article is related to the VEGA project No. 1/0953/16 «The evaluation of clusters' impact measurement on regional development of the Slovak Republic». This article was created with the support of the Grant Agency of the University of South Bohemia in České Budějovice: project GAJU 074/2017/S «Development of the South Bohemian Region - the potential for the application of the European Commission's initiative - Smart Region».*
DOI: https://doi.org/10.21003/ea.V167-05

Бетакова Я.
кандидат економічних наук, доцент, Університет DTI, Дубниця-над-Вахом, Словацька Республіка
Гаверніkова К.
кандидат економічних наук, старший викладач, Університет Олександра Дубчека в Тренчині, Тренчин, Словацька Республіка
Яскова Д.
кандидат географічних наук, старший викладач, Університет Олександра Дубчека в Тренчині, Тренчин, Словацька Республіка
Гагара В.
кандидат економічних наук, MBA, доцент, Університет DTI, Дубниця-над-Вахом, Словацька Республіка
Земан Р.
кандидат економічних наук, доцент, завідувач кафедри, Університет Південної Богемії в Чеських Будейовицях, Чеські Будейовиці, Чеська Республіка

Оцінка потенціалу кластеризації в сільськогосподарському секторі: приклад Словаччини
Анотація. Сільськогосподарська діяльність має давню традицію в Словаччині. Одним зі способів сприяння розвитку та підвищення конкурентоспроможності цього сектора є залучення різних сільськогосподарських суб'єктів до кластерного співробітництва. У світі існують приклади кластерів у сільськогосподарському секторі, які в значній мірі сприяють регіональній конкурентоспроможності. У цьому контексті основною метою даного дослідження є оцінка поточного стану умов, необхідних для виникнення кластерів у сільськогосподарському секторі Словаччини, і визначення ключових регіонів, що мають потенціал для їх створення. Використовувані методи: DEA аналіз даних і коефіцієнт локалізації (LQ), результати яких були перетворені на матрицю BCG. DEA використовувався для оцінки регіональної ефективності, LQ – для оцінки регіонального потенціалу кластеризації. Використання цих методів створило базу для ідентифікації кластерного потенціалу в найбільш ефективній області з точки зору сільського господарства. Нами виявлено, що найбільш важливими за ефективністю регіонами для кластеризації в Словаччині є Нітранський і Трнаваський краї. З точки зору оцінки потенціалу кластера, відповідними регіонами є Нітранський і Пряшівський краї. Виходячи з результатів використаних методів, зроблено висновок про те, що основні передумови для кластеризації створені головним чином у Нітранському краї.
Ключові слова: сільське господарство; ефективність; кластер; кластеризація; конкурентоспроможність; область; регіональний суб'єкт.

Бетакова Я.
кандидат экономических наук, доцент, Университет DTI, Дубница-над-Вахом, Словацкая Республика
Гаверникова К.
кандидат экономических наук, старший преподаватель, Университет Александра Дубчека в Тренчине, Тренчин, Словацкая Республика
Яскова Д.
кандидат географических наук, старший преподаватель, Университет Александра Дубчека в Тренчине, Тренчин, Словацкая Республика
Гагара В.
кандидат экономических наук, MBA, доцент, Университет DTI, Дубница-над-Вахом, Словацкая Республика
Земан Р.
кандидат экономических наук, доцент, заведующий кафедрой, Университет Южной Богемии в Ческе-Будеевице, Ческе-Будеевице, Чешская Республика

Оценка потенциала кластеризации в сельскохозяйственном секторе: пример Словакии
Аннотация. Сельскохозяйственная деятельность имеет давнюю традицию в Словакии. Одним из способов содействия развитию и повышения конкурентоспособности этого сектора является вовлечение различных сельскохозяйственных субъектов в кластерное сотрудничество. В мире существуют примеры кластеров в сельскохозяйственном секторе, которые в значительной степени способствуют региональной конкурентоспособности. В этом контексте основной целью настоящего исследования является оценка текущего состояния условий, необходимых для возникновения кластеров в сельскохозяйственном секторе Словакии, и определение ключевых регионов, имеющих потенциал для их создания. Используемые методы: DEA анализ данных и коэффициент локализации (LQ), результаты которых были преобразованы в матрицу BCG. DEA использовался для оценки региональной эффективности, LQ – для оценки регионального потенциала кластеризации. Использование этих методов создало базу для идентификации кластерного потенциала в наиболее эффективной области с точки зрения сельского хозяйства. Нами выявлено, что наиболее важными по эффективности регионами для кластеризации в Словакии являются Нитранский и Трнаваский края. С точки зрения оценки потенциала кластера, соответствующими регионами являются Нитранский и Прешовский края. Исходя из результатов использованных методов, сделан вывод о том, что основные предпосылки для кластеризации созданы главным образом в Нитранском крае.
Ключевые слова: сельское хозяйство; эффективность; кластер; кластеризация; конкурентоспособность; область; региональный субъект.

1. Introduction

Current economic activity is characterized by the forces of globalization, technology, deregulation and democratization, collectively creating an extremely complex operating environment for companies and policy-makers. (Gorzen-Mitka, Okreglicka, 2015). In this current globalized environment, economic subjects established in various regions are looking for different opportunities for cooperation, which would bring an increase in regional competitiveness and economic growth. One of them is the clustering of cooperation. Clustering is an effective tool of networking of the involved, mainly regional, stakeholders from different sectors, which together share the benefits of participation. Thereby, their competitiveness is increased and also by their progress they affect the overall level of competitiveness and economic growth of particular regions (see also Perez-Aleman, 2015, Chen et al., 2013). As shown by many studies, the agricultural field also gets to the forefront of interest of economists, politicians and regional stakeholders in many directions, the cluster concept not excluded. It is possible to find the clusters in this field mainly if the enterprises are using sophisticated methods in their production, advanced technologies and offer unique products and services. Prosperous agriculture stimulates the social and economic development of the region, contributes to the balanced reproduction and structure of human capital and thus contributes to the mitigation of regional differences. In spite of the actual declining share of agriculture in GDP and employment in the Slovak economy, which accelerates the trend of economic growth, its importance is indispensable for the sustainable and safe development of Slovak regions. Due to the long history of Slovak agriculture and current trends, the way to new options to enhance overall productivity and competitiveness of the Slovak economy through clustering in the agricultural sector thus becomes opened.

Conceptually, this paper is composed of two parts. **In the first part,** based on the data available in the database of the Statistical Office of the Slovak Republic, we have verified the efficiency of Slovak agriculture because efficiency of this economic sector belongs to the preconditions for successful clustering. For the evaluation of efficiency, the method known as Data Envelopment Analysis (DEA) and its process of application will be used in accordance with Jablonský & Dlouhý (2004). DEA is a non-parametric method, which was designed to assess the efficiency of Decision Making Units (DMUs) and is considered as a one of the most appropriate tools for efficiency measurement (Bojnec & Latruffe, 2013; Grmanová, 2010). DEA models can be input oriented (I - input) or output oriented (output - O). In this study we used Banker-Charnes-Cooper's Input model (BCC - I). For details about the other DEA models (the alternatives and the modified ones) see Grmanová (2010).

In the second part of this article, we performed a sectoral analysis of the Slovak regions, with a focus on the field of agriculture (A) and a sub-sector of industrial production (10) Food processing. These economic sectors belong to important areas for clustering in many economies and the data about food production has been included in this research also, because agricultural production is the basis for food and

drink production at a much greater intensity than it used to be in the past. For the sectoral analysis we used the static results of the Localization Coefficient *(LQ)* within the two compared periods and for the needs of clustering we also assessed the dynamics of LQ values. The resulting values are incorporated into the BCG matrix, based on which we have identified significant regions for agricultural clusters' establishment.

Localization coefficient $LQ_{e,i}$ shows the relation:

$$LQ = \left(\frac{LF_{e,i}}{LF_i}\right) / \left(\frac{LF_{e,N}}{LF_N}\right), \quad (1)$$

where: LQ is the Localization Coefficient for the region in the selected economic sector; $LF_{e,i}$ is the number of employees in the economic sector in the region i; LF_i - is the total number of employees in the region, $LF_{e,N}$ is the number of employees in the economic sector at the national level, LF_N is the total number of employees at the national level, e is the number of employees, N is the national level. If the value of $LQ > 1$, *this* points to regional specialization. It means that this economic sector employs a greater share of the regional labor force than in the higher territorial unit. The value $LQ < 1$ means the opposite. To identify regional specialization, the values of $LQ > 1$, 2 are mostly taken. High values of LQ indicate potential for a cluster's establishment in a stated economic sector or in a region if a regional comaparison is undertaken. The next step consists of incorporation of the obtained values of the LQ into the *BCG matrix*, in accordance with Chen et al. (2013). The BCG matrix consists of four quadrants in which the Slovak regions are placed: *(1) Stars:* regions with high and positive results of LQ for the observed sector, which are increasing over time (a positive value of ΔLQ). Regions in this quadrant represent potential for a cluster's creation in the observed sector. *(2) Mature:* regions that have a high level of LQ, but with a declining trend (a negative value of ΔLQ). It is recommended to support the growth of the observed sector in this region. *(3) Emerging:* regions with a low value of LQ and increasing value of ΔLQ. Development policy should be directed towards maintaining or promoting the growth of the observed sector in this region, if that sector grows at the national level. *(4) Transfroming:* represents the regions with a very low value of LQ and decreasing value of ΔLQ. It is recommended to either leave the observed sector in this region without substantial support or to support it if it has local significance, or is important for another sector.

2. Brief Literature Review

Clusters represent the strategic cooperation of regional stakeholders from business bodies with local and regional authorities, universities, research institutes, mediating organizations and other subjects. The results of existing clusters showed that their effects are seen in the reduction of costs, attraction of new customers, common entry into new markets, participation in improving innovation, wage growth, employment, increasing job opportunities, entrepreneurship and business diversification (Mura & Sleziak, 2014; Kordos et al., 2016). Clusters are usually located in one region, but can also have a cross-regional, national or transnational dimension, specializing in certain sectors such as mechanical engineering, electrical engineering, creative industries, biotechnology, but also in agricultural production such as growing grapes and producing wine, dairy, fruit and vegetables, planting flowers and so on. The innovation clusters, especially in the agricultural complex, are beginning to prevail over the traditional industrial clusters. (Todorova, 2017). Gálvez-Nogales (2010) defines an Agro-based cluster (AC) as very broadly including crop production and services, livestock, food processing, agricultural machinery and equipment, as well as agricultural-related transportation and distribution. Various aspects of clustering in the field of agriculture are also observed by several authors in different studies and scientific papers. (Zen et al., 2014; Murray and Overton, 2016; Bondarenko et al., 2016). Clusters that concern any area of agriculture, would in this case have to generate innovation, provide business development, improve the performance of their members, and ultimately contribute to the development of the whole region (see also Maya-Ambía, 2011). For these reasons, authors such as Beciu et al. 2011, Borbasova et al., 2015, Ivanova et al., 2017 and many others are focused on the importance of agro-based clusters' creation in regions. They used various methods for location and identification of cluster potential in regions as well as to assess the cluster structures by: expert assessments, SWOT analysis, assessment of the potential of mono-industry sectors, evaluation of investment project effectiveness, calculation of Localization Coefficients, factor analysis, statistical cluster and discriminant analysis, use of production inter-branch balances, etc.

3. Purpose

The possibility of using various methods has determined the purpose of this research. Theoretical and methodological aspects of the cluster theory, official statistical publications, expert opinions and our own calculations form the basis of this study. The requirements for agricultural development affect other factors that need to be taken into account at present. These include: the economic potential of raw materials and food production at the local level with lower import dependence, the necessity and economics of food transport and their impact on the economy, climate, etc., the impacts on soil, the impacts on public health, etc. In this context, the focus on issues of clustering is at the forefront. Clustering could contribute to the development of agriculture not only by increasing production but also by the increase of interest in additional research, development and innovation, which finally could contribute to the overall competitiveness of regions and the whole economy of a country.

4. Results

The main indicator for the detection of cluster potential in Slovak regions in this study is the number of employees. The regions of Western Slovakia (Trnava, Trenčín and Nitra) have the largest share of total employment in the agriculture sector. That is why these regions are in the focus of this study.

For analyzing the degree of efficiency of agricultural units we examined four indicators in 23 districts (listed in Table 3) of Western Slovakia for the year 2016. Each of the districts *(DMU_1,..., DMU_{23})* is characterized by four data: I_1 is the share of agricultural land compared to the total area (ha), I_2 is a census of the areas sown with crops (ha), O_1 is hectare yields of selected crops (t/ha), O_2 is production of selected crops *(t)*. Nine models were compiled from these inputs and we computed both Technical efficiency and Super-efficiency. As we considered the necessity of including all inputs and outputs, we analyzed in more detail the model with two inputs and two outputs. The efficiency analysis of selected areas of Slovak agriculture was carried out by using a BCC - I model. The optimization problem has n = 23 production units (districts), m = 2 inputs, r = 2 outputs. For each input and output parameter, the descriptive statistics were calculated. An overview is given in Table 1.

A correlation analysis was conducted to describe the degree of connection between analyzed parameters. Table 2 shows the results.

None of the analyzed parameter pairs showed statistically significant negative correlation. A negative correlation means that an increase in input results in a reduction of output and this is considered to be unacceptable.

Tab. 1: **Descriptive characteristics of the analyzed indicators**

	Descriptive characteristic (Intput data)								
	Average	Median	Min	Max	Variance	Standard deviation	Coeffcient of Variation	Skewness	Kurtosis
I_1	0.6	0.6	0.276	0.8	2.928677E-02	0.2	29.06999	-0.256402	-1.27490
I_2	32396.7	18000.1	2584.420	103125.3	8.555137E+08	29249.2	90.28451	1.209093	0.47673
O_1	108.9	108.7	79.950	137.0	2.209803E+02	14.9	13.64463	-0.119992	-0.35300
O_2	235913.3	150778.1	7169.913	701596.7	3.908615E+10	197702.2	83.80289	0.842541	-0.26288

Source: Own calculation based on the data of the Statistical Office of the Slovak Republic, elaborated in the programme Statistica

Tab. 2: **Pearson coefficient of correlation of analyzed indicators (p < .05000)**

	Correlation (Input data)			
	I_1	I_2	O_1	O_2
I_1	1.000000	0.736805	0.555426	0.775055
I_2	0.736805	1.000000	0.290990	0.970620
O_1	0.555426	0.290990	1.000000	0.447410
O_2	0.775055	0.970620	0.447410	1.000000

Source: Own calculation based on the data of the Statistical Office of the Slovak Republic, elaborated in the programme Statistica

In the next part of this study, we have calculated the technical efficiency for each DMU. Table 3 presents the results of the BCC - I model. The stated optimalization task has 28 input variables and 5 restrictive conditions. In this model the unit rate of efficiency is assigned to effective DMUs. It means that there could be a greater number of effective DMUs. From this reasoning, Super Efficiency was calculated (column 4). This allows the classification of effective units (DMUs) from the most to the least significant. The most effective districts are Galanta, Trnava and Nové Zámky. Twelve DMUs were marked as ineffective. The least efficient DMU, which is the worst to recover its input, is the district of Myjava. At the same time, the coefficients of the linear combination of the original inputs for effectiveness achievement are calculated in columns 5-8. The results of the DEA's calculation confirm that evaluated regions belong to efficient agricultural regions, which are also determined by their long agricultural history and the natural conditions of the evaluated regions.

Due to the lower number of monitored indicators, it was pointless to subject the data to a PCA analysis. By the cluster analysis, using the procedure of agglomerate hierarchical clustering, Ward's method (the highest Cophonetic Coefficient and the lowest Delta criterion) and Euclidean distance rates, five clusters were identified (C1: D. Streda, Komárno, Trnava, Nitra; C2: Galanta, Piešťany, Topoľčany, Levice, Nové Zámky; C3: Hlohovec, Zlaté Moravce, Senica, Nové Mesto n. Váhom, Šaľa; C4: Skalica, Bánovce n. Bebravou, Partizánske, Prievidza, Trenčín; C5: Ilava, Myjava, Púchov, Považská Bystrica) - see Figure 1.

As shown in many studies in the Slovak Republic devoted to the mapping and the impact of existing clusters on regional development their importance is growing, especially in industry, ICT, key enabling technologies and tourism (Vojtovic, 2015). In the analysis of Slovak clusters carried out in the frame of the VEGA project No. 1/0953/16 in 2016 we found out that there are more than 30 clusters in eight self-governing Slovak regions (Bratislava - BA, Trnava - TT, Trenčín - TN, Nitra - NR, Žilina - ZA, Banská Bystrica - BB, Prešov - PO and Košice - KE). It is possible to find several agro-food clusters in the official Register of Association of Legal Entities (Bioeconomy cluster, Agroenvironmental Cluster - Association of Legal Entities and Food Cluster, which are registered in the Nitra region and Cluster Agriculture and Rural areas in the Trnava region), but only one of them (the Bioeconomy cluster) is carrying out its activities. However, its activities correspond more with the focusing of Key enabling technologies clusters.

The next part of this study is focused on the calculation of the Localization Coefficients (Table 5) for eight Slovak self-governing regions.

Observed periods were the years 2009 and 2016. The data from the databases of the Statistical Office of the Slovak republic about the average registered number of employees in the agricultural sector (A) and sub-sectors of industrial production (10) Food processing according to SK NACE Rev. 2 were used for the calculation.

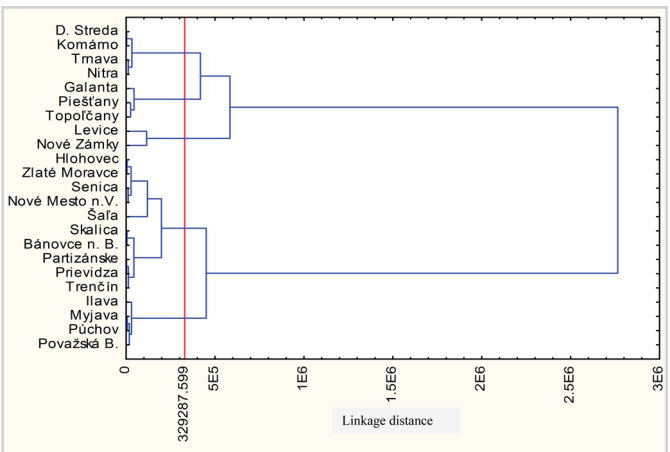

Fig. 1: **A dendrogram of objects drawn up using Ward's method of matrix data**

Source: Own calculation based on the data of the Statistical office of the Slovak Republic, elaborated in programme NCSF 11

Tab. 3: **The Results of BCC-I model**

	DMU	ES	Super - Efficiency	VI1	VI2	VO1	VO2
1	Dunajská Streda	0.86	86.13%	0.65	0.35	0.00	0.62
2	Galanta	1.00	Big	0.00	1.00	63131546	0.02
3	Hlohovec	1.00	176.02%	0.00	1.00	17.2	0.00
4	Piešťany	1.00	133.54%	0.00	1.00	2.31	1.38
5	Senica	0.71	71.10%	0.81	0.19	0.07	0.30
6	Skalica	0.69	69.34%	0.00	1.00	1.02	0.36
7	Trnava	1.00	Big	0.00	1.00	2.06E+09	4.82E+08
8	Bánovce n. Bebravou	1.00	146.94%	0.97	0.97	4.22	0.00
9	Ilava	1.00	103.64%	0.43	0.43	2.9	0.00
10	Myjava	0.50	50.48%	0.92	0.08	0	0.06
11	Nové Mesto n. Váhom	0.89	89.27%	0.79	0.21	0.23	0.39
12	Partizánske	0.91	90.62%	0.34	0.66	0.83	0.39
13	Považská Bystrica	1.00	129.35%	1.00	0.00	0.00	0.00
14	Prievidza	1.00	101.83%	0.89	0.11	0.30	0.28
15	Púchov	1.00	121.72%	0.00	1.00	2.72	0.37
16	Trenčín	0.86	86.83%	1.00	0.00	0.52	0.11
17	Komárno	0.83	82.99%	0.66	0.34	0.00	0.59
18	Levice	0.98	98.98%	1.00	0.00	0.00	0.61
19	Nitra	0.88	88.50%	0.71	0.29	0.00	0.63
20	Nové Zámky	1.00	Big	0.06	0.94	18823426	25841060
21	Šaľa	0.66	66.37%	0.78	0.22	0.00	0.40
22	Topoľčany	0.97	97.49%	0.71	0.29	0.09	0.62
23	Zlaté Moravce	0.82	83.35%	0.76	0.24	0.00	0.39

Notes: ES - Technical efficiency, VI - Virtual input, VO - Virtual output

Source: Own calculation based on the data of the Statistical Office of the Slovak Republic, elaborated in the DEAP programme (Distributed Evolutionary Algorithms in Python)

The results showed that the basic preconditions for cluster cooperation establishment in the sector of agriculture are met in all Slovak regions except Bratislava, Žilina, Trenčín and Košice regions. In the year 2016, we can observe a significant level of LQ (> 1.2) in Nitra, Trnava, Banská Bystrica and Prešov regions. From the point of view of clustering, it is important to follow the changes in the observed period. The positive results in the sector of agriculture were achieved only in the case of the Nitra and Prešov regions, if we take into account the result of an LQ higher than 1,00. From the created BCG matrix for the agricultural sector (Figure 2), it is clear that the key regions for clustering are Nitra and Prešov. Both regions belong to the group of regions which often stay behind in overall economic assessment. That is why it is possible to use their potential and develop the agricultural sector through the involvement of related interests in the cluster. Although the Trnava region belongs to regions with effective agriculture, in the case of LQ calculation it achieved a high level of LQ, but with a decreasing tendency, thus these regions are placed in the BCG matrix among Mature regions.

Tab. 4: **Development of LQ in sector of agriculture in the Slovak regions**

Region	LQ	(A) Agriculture	(10) Food processing	Region	LQ	(A) Agriculture	(10) Food processing
BA	LQ_{2009}	0.24	0.50	ZA	LQ_{2009}	0.45	0.81
	LQ_{2016}	0.20	0.41		LQ_{2016}	0.85	0.77
	$\Delta LQ_{2016-2009}$	**-0.04**	**-0.09**		**$\Delta LQ_{2016-2009}$**	**0.4**	**-0.04**
TT	LQ_{2009}	2.31	1.43	BB	LQ_{2009}	2.02	0.88
	LQ_{2016}	1.77	1.36		LQ_{2016}	1.64	1.00
	$\Delta LQ_{2016-2009}$	**-0.54**	**-0.07**		**$\Delta LQ_{2016-2009}$**	**-0.38**	**0.12**
TN	LQ_{2009}	1.59	1.31	PO	LQ_{2009}	1.32	1.8
	LQ_{2016}	1.03	1.13		LQ_{2016}	1.38	2.00
	$\Delta LQ_{2016-2009}$	**-0.56**	**-0.18**		**$\Delta LQ_{2016-2009}$**	**0.06**	**0.2**
NR	LQ_{2009}	1.39	1.66	KE	LQ_{2009}	0.56	0.81
	LQ_{2016}	2.52	1.98		LQ_{2016}	0.71	0.92
	$\Delta LQ_{2016-2009}$	**1.13**	**0.32**		**$\Delta LQ_{2016-2009}$**	**0.15**	**0.11**

Source: Own calculation based on the data of the Statistical Office of the Slovak Republic

In the case of the (10) Food processing sector (in 2016), the basic precondition for clustering is not fulfilled in the Bratislava, Žilina, Trenčín, Banská Bystrica and Košice regions. The results of the BCG matrix (Figure 3) showed the same situation as in the case of sector (A) for agriculture.

5. Conclusion

Efficiency, spatial proximity and similarity of related economic activities, which we verified by using the DEA model and BCG matrix, represent the first step towards finding a potential for clustering in the agricultural sector in Slovak regions. Establishment and further development of clusters need to fullfill other conditions. Their formation is affected not only by the presence of corresponding factors of production in the region, but also by the presence of various stakeholders (i.e. companies, universities, foreign investors, local government institutions, secondary vocational schools, agencies and governmental bodies, etc.), which act as an anchor for the establishment of other regional market players and attract investment. For this reason it is necessary to also do qualitative analysis, which must be conducted directly in a region on concrete subjects that could be considered as the potential stakeholders of an agricultural cluster. It is necessary to undertake research on the mutual relations and interests of regional stakeholders from the agricultural sector, because important factors that have an impact on cluster cooperation are mutual relationships between these entities (personal, economic, and competitive), research on the level of cluster policy and cluster conception at the nation-wide and regional levels, the investigation of the level of R&D and further financial support for clusters, etc.. The results in this study showed that the preliminary precondition for clustering in the agricultural sector are fulfilled mainly in the Nitra region.

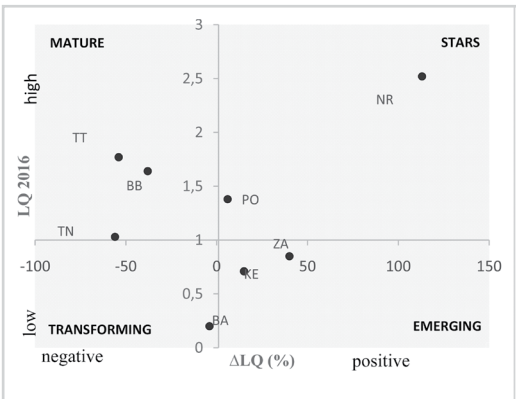

Fig. 2: **BCG matrix of specialization in the sector of agriculture (A)**

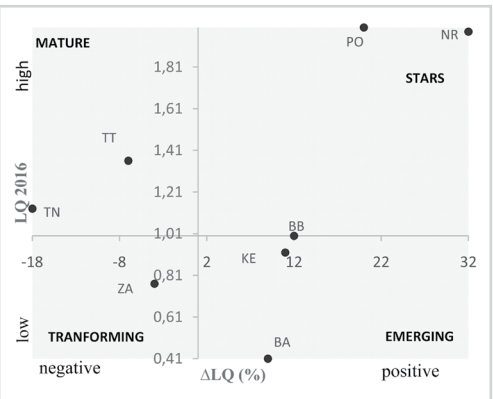

Fig. 3: **BCG matrix of specialization in the sector of (10) Food processing**

Source: Own calculation based on the data of the Statistical Office of the Slovak Republic

References

1. Gorzeń-Mitka, I., & Okręglicka, M. (2015). Managing Complexity: A Discussion of Current Strategies and Approaches. *Procedia Economics and Finance, 27,* 438-444. doi: https://doi.org/10.1016/S2212-5671(15)01018-7
2. Perez-Aleman, P. (2005). CLUSTER formation, institutions and learning: The emergence of clusters and development in Chile. *Industrial and Corporate Change, 14*(4), 651-677. doi: https://doi.org/10.1093/icc/dth063
3. Chen, Ch.-P., Chien, Ch.-F., & Lai, Ch.-T. (2013). Cluster policies and industry development in the Hsinchu Science Park: A retrospective review after 30 years. *Innovation: Management, Policy & Practise, 15*(4), 416-436. Retrieved from http://search.informit.com.au/documentSummary;dn=225282439117503;res=IELBUS
4. Jablonský, J., & Dlouhý, M. (2004). *Efficiency models of production units.* Prague: Professional publishing (in Czech).
5. Bojnec, Š., & Latruffe, L. (2013). Farm size, agricultural subsidies and farm performance in Slovenia. *Land Use Policy, 32,* 207-217. doi: https://doi.org/10.1016/j.landusepol.2012.09.016
6. Grmanová, E. (2010). *The effectiveness of commercial insurance companies and banks evaluation by models of Data envelopment analysis.* Trenčín: Trenčianska Univerzita Alexandra Dubčeka (in Czech).
7. Mura, L., & Sleziak, J. (2014). Innovation and Enterpreneurship Network. In *5th Central European Conference in Regional Science (CERS) Proceedings,* (pp. 643-651). Košice: Technical University Košice. Retrieved from http://www3.ekf.tuke.sk/cers/files/zbornik2014/PDF/Mura,%20Sleziak.pdf
8. Kordos, M., Krajnakova, E., & Karbach, R. (2016). Cluster policies implementation in Slovakia. *Actual Problems of Economics, 181*(7), 90-96.
9. Todorova, L. (2017). Cluster development as a factor in improving the competitiveness of the agro-industrial complex of the Republic of Moldova. *Scientific Papers Series - Series Management, Economic Engineering in Agriculture and Rural Development, 17*(2), 375-379. Retrieved from http://managementjournal.usamv.ro/pdf/vol.17_2/Art52.pdf
10. Zen, A. C, Fensterseifer, J. E., & Prévot, F. (2014). The impact of export performance resources of companies belonging to clusters: a study in the French winery industry. *RBGN-Revista Brasileira De Gestao De Negocios, 16*(52), 374-391. doi: https://doi.org/10.7819/rbgn.v16i52.1523
11. Murray, W. E, & Overton, J. (2016). Fictive clusters: Crafty strategies in the New Zealand beer industry. *Norsk Geografisk Tidsskrift-Norwegian Journal of Geography, 70*(3), 176-189. doi: https://doi.org/10.1080/00291951.2016.1177587
12. Bondarenko, N. E., Maksimova, T. P., & Zhdanova, O. A. (2016). Agro-industrial clusters: Opportunities for innovative development and financing, *Journal of Internet Banking and Commerce, 21(*S6), 13. Retrieved from http://www.icommercecentral.com/open-access/agroindustrial-clusters-opportunities-for-innovative-development-and-financing.php?aid=82682
13. Maya-Ambía, C. J. (2011). Constructing agro-industrial clusters or disembedding of the territory? Lessons from Sinaloa as the leading horticultural export-oriented region of Mexico. *Open Geography Journal, 4,* 29-44. doi: https://doi.org/10.2174/1874923201104010029
14. Beciu, S., Ursu, A., Popa, O., & Nistor, S. (2011). Study on development of an experimental model of integrated regional cluster, as support for increasing the competitiveness of Romanian enterprises with an agro-industrial profile. In *Creating Global Competitive Economies: A 360-Degree Approach - Proceedings of the 17th International Business Information Management Association Conference, Volume 4* (pp. 1299-1304).
15. Borbasova, Z. N., Tolysbayev, B., & Ulakov, S. N. (2015). Potential opportunities of creating a sectoral cluster in an agro-industrial region. *Actual Problems of Economics, 169*(7), 214-221.
16. Ivanova, O. P., Antonov, G. D., Shabashev, V. A., Zobova, L. L., & Nesterov A. Y. (2017). Formation of an agro-industrial cluster on the priority social and economic development area of a mono-industry town. *Foods and Raw Materials, 5*(1), 192-204. Retrieved from https://www.researchgate.net/publication/318506077_Formation_of_agro-industrial_cluster_on_the_priority_social_and_economic_development_area_of_the_mono-industry_town
17. Vojtovic, S. (2015). Future for regional creative industry. In *International Scientific Conference on Knowledge for Market Use - Women in Business in the Past and Present Proceedings,* (pp. 1093-1099). Olomouc: Palacky University.

Received 23.08.2017