Possibilities of applying the cluster approach in the study of the stability of the regional territorial organisation of production areas

Zakir N. Eminov1, Zaur T. Imrani1, Elnura E. Gasimova2, Oleksandr Y. Vysotskyi3

1Institute of Geography named after academician H.A. Aliyev, Baku, Azerbaijan
2Baku State University, Baku, Azerbaijan
3Oles Honchar Dnipro National University, Dnipro, Ukraine, vysalek@gmail.com

Abstract. Various assessment criteria are applied to ensure the sustainability of production sites. These evaluation criteria are based on quantitative indicators and reflect the corrected performance of production areas. Adequate assessment analyses the territorial organisation of production areas, efficient operation, process management, etc. more clearly in the future, and makes it possible to conduct their comparative analysis. One of the methods of such an approach is the cluster. A cluster is a group of objects with similar properties. In English, cluster means bunch, gathering, concentration, and group. From this point of view, the formation of the infrastructure organised in connection with the production, which contributes to the increase of competitiveness between the production areas, and the application of an innovative cluster approach are required in this research work. This approach allows the creation of a new product, increases production efficiency, and helps form a sustainable production network. This article presents the analysis of the GDP in Azerbaijan in the period of 1995-2021 carried out taking into account the ratio of the AZN to the US dollar, calculates the volume of GDP per capita, determines the regional trend of economic development, and provides the variability of the dynamics in the fields of the economy in a related manner. Later, all these indicators were summarised, clustering was carried out, coefficient values of quantitative indicators for production areas were determined, and indicators of clustering of production areas for economic regions of Azerbaijan were calculated. Consequently, the article concludes that the application of the regional cluster approach indicates the potential power of production enterprises, the scale of their activities, economic-geographical relations, etc., which makes it possible to increase regional competitiveness between production areas. Thus, the cluster approach determines competitive advantages related to the organisation and operation of production, stimulates regional development, and can also lead to an increase in revenues to the local budget.

Keywords: production, industry, agricultural industry, tourism industry, territorial organisation, sustainable development, cluster, innovation, investment, evaluation.
Introduction

It is impossible to make an assessment of regions for determining sustainable development without reference to production areas in the aggregate. This is also possible by applying the cluster method. Because the cluster method, as a rule, acts as a coordinator in the formation of large production centres and in the use of both natural and economic resources within a specific area, it plays an auxiliary role in ensuring sustainable development.

The cluster ensures the stability of regional territorial organization by creating competitiveness between production areas, as well as increasing the income level of the population and creating additional business opportunities. Taking into consideration these advantages, the primary mission of our research work is to form a competitive environment between production areas by applying the regional cluster policy. This is because the cluster both characterizes the specific characteristics of the specialized production areas or their directions of activity from an economic-geographic point of view and once again proves the importance of applying a new approach. To achieve the goal, the solution of the following tasks have been set:
- application of the cluster approach to determine the stability of production areas;
- to determine the factors that form the regional cluster environment characterizing production chains;
- to analyze the competitive advantages between the production areas by economic activity areas;
- carry out clustering of regional production areas.

Application of the cluster in production areas is an important tool for creating a competitive economy. The cluster approach allows more rational use of resources, increasing profitability, and return on investment made in terms of scientific and technical development with maximum return (Plakhin and Sibiryayev, 2017). The cluster approach is an effective and promising method of stimulating regional sustainable development and can closely participate in solving several socio-economic problems. Thus, the regional cluster approach creates conditions for attracting domestic and foreign investments. The creation of clusters in production areas has the following advantages:
- cost reduction by creating interaction mechanisms between production areas;
- the ability to unite in the direction of identifying and solving common problems, regional socio-economic and ecological problems;
- introduction of advanced technologies by attracting investments to move to innovative activities;
- the ability to independently find ways of optimising production-technological processes;
- minimisation of operational risks of enterprises included in the cluster network;
- independence of regional socio-economic activity and stimulation of development of gradual integration into the world market system, etc.

Materials and methods

The logic of geographical analysis is primarily based on the dialectical (constant change, reasoning) theoretical-methodological ideas of research, practically using functional (dependency) sources during research. This requires a science-based creative process relevant to the nature of the research. Based on such a purposeful view, the article has tried to explain the regional territorial organisation of production areas using the cluster approach method.

Cluster

One of the most widely used research methods in world practice in recent years to determine sustainability in production areas includes the ‘cluster’ method. Thus, the cluster method approach to economic and innovation-oriented development aims to describe this development more clearly. The cluster
plays an auxiliary role in determining production areas based on regional communications between demand and supply (Kupriyanov and Stryabkova, 2007). According to M. Porter, a cluster comprises geographically connected areas (manufacturers, etc.) and the infrastructure that connects them. The distinguishing feature of the cluster is its innovative orientation and the transition to the quality category. The most successful cluster indicates that a ‘leap’ in the field of production technology has occurred or is expected (Porter, 2007). During the analysis of several clusters, M. Porter came to the conclusion that the competitiveness of production areas is related to their participation in national, regional, and global value chains (Porter, 2005).

Cluster is a form of hierarchy (subordination relationship of a system from bottom to top) that ensures the close location of production areas and the establishment of mutual economic relations among them. In some cases, the cluster goes beyond the network and incorporates the cross-cutting and dynamic interactions between entrepreneurs, enterprises, and organisations (Uskova, 2008). For instance, the concentration of production areas within a region creates the need for them to compete, and in this case, the formation of territorial development centres becomes a demand.

When analysing the cluster method, statistical data on production areas are first collected, and then objects engaged in the same type of activity are grouped. Afterwards, their development trend is determined based on a multidimensional database (Imrani, 2015). The cluster aids in conducting an overall analysis of areas that link national and regional development. Advantages of the cluster include:

- the cluster helps to reveal positive and negative trends for the development of the area;
- intra-cluster interactions lead to the creation of new methods of competition;
- the cluster creates conditions for the formation of regional innovation systems;
- the cluster accelerates the process of creation of factors favouring investments in production areas;
- the cluster creates conditions for meeting the demand for material and technical provision and service of producers;
- the cluster leads to competition between producers, product specialisation, and search for new markets;
- the cluster strengthens the integration potential of the region;
- being one of the forms of cooperation in production areas, the cluster ensures the economic development of the region.

Analysis and discussion

The complete characterisation of sustainable development in production areas with the application of the cluster method requires analysing the economic indicators used in practice, especially the gross domestic product (GDP) indicators.

GDP is the primary indicator of economic development; it expresses the monetary value of final products and services produced in the country during a specific period (Demidenko, 2020). F. Lequiller indicates GDP is ‘the symbol of the statistical world’ (Lequiller and Blades, 2014). Thus, GDP is the leading indicator measuring the socio-economic development of a country. It is difficult to imagine its modern economic characteristics without analysing the dynamics of GDP in any region (Zolov, 2019).

GDP characterises the level of economic development in terms of the volume and scale of the economy and expresses its effectiveness not directly but only indirectly (Muzaffarli and Muradov, 2021). In this case, the diversification of the economy is reflected by investment in local production, and the specialisation of production is as close as possible to the optimal field structure. The dynamics of GDP play a role in determining the place and position of the economy in the trend of global sustainable development.

While analysing the GDP in Azerbaijan from 1995 to 2021, it becomes clear that there are hesitations and contradictions. Thus, considering the ratio of the manat to the US dollar, it can be observed that a general trend is taking place in the country’s economy. If the development trend of the economy is expressed in terms of manat, it could be seen that the increase was 43.7 times between 1995 and 2021. This is a very high indicator. However, if the development is taken in terms of US dollars, it is determined that the increase was 22.7 times, but in some years (2008-2009 and 2019-2020), it was less, and in some years (2014-2016) there was a sharp decrease (Statistical indicators of Azerbaijan, 2022). The reason for the decline was the economic crises that occurred in the world, the devaluation of the manat, as well as the weakening of trade relations during the COVID-19 pandemic.

Although the GDP development trend in 1995-2004 was not noticeable, it was based on relatively free market principles. Since 2004, the country’s economy has started to grow based on the state program that stimulates the development of regions. However, the global economic crisis in 2008-2009 began to be felt equally in the ratio of GDP to Azerbaijani manat (AZN) and US dollar, and a decrease was observed
within a year. In the following years, except for the years 2014-2015, there were only growth dynamics in the expression of GDP in AZN until the period of the COVID-19 pandemic. There is a sharp difference in the expression of GDP in US dollars. Thus, due to the depreciation of the AZN and the appreciation of the US dollar, devaluation took place twice in the country, which showed itself in the dynamics of GDP development. A sharp decrease occurred in 2014-2016, recording 1.9 times decrease (US$ 37.4 billion) (Fig.1). Devaluation had a negative impact on the country’s economy. As a result of devaluation, the value of the AZN has fallen twice compared to the US dollar, which hinders the sustainable and stable development of the country. For instance, this becomes evident when examining the level of average annual inflation in Azerbaijan. Thus, in 2014, the average annual inflation was 2.2% in January and decreased to 1.4% in the following months, while in 2015, this indicator increased and reached 4.0% in December. Currently, although the situation has somewhat stabilised, a sustainable strategic plan should be prepared in a short period to prevent such situations from happening in the future (Imrani, 2016). During the pandemic, as in the global economy, the GDP development trend in Azerbaijan showed a decrease. The weakening of domestic and foreign trade relations, the introduction of restrictions in socio-economic relations, education, health, tourism, and other areas, as well as the presence of delays in the transport infrastructure, have led to a decrease in income.

The tourism industry should be especially mentioned in the conducted research. Tourism has a positive impact on many sectors of the world economy because tourism unequivocally affects the growth of life and economic activity of the local population, increasing the socio-economic indicators of the region, improving the road infrastructure, and requiring their development (Imrani, Zeynalova, Mammadova, & Vysotskyi, 2022).

From a regional point of view, although the development of the tourism industry is considered one of the important conditions, the clustering of the tourism industry in Azerbaijan has not yet been carried out.

GDP is the primary tool for measuring economic development as well as the well-being of the country’s population, and the use of natural and human resources and their distribution (Zolov, 2019). However, this challenge is still under discussion and requires much deeper investigation through the examination of other indicators, including GDP per capita (Baneliene, 2021). For this purpose, GDP should be analysed by sectors of the economy, and its per capita share should be examined regionally, considering human resources.

Internationally, one of the analytical indicators of functional sustainable economic development is measured by the volume of GDP per capita. The volume of GDP in Azerbaijan and the development trend of GDP per capita continue their dynamic development in the form of an almost homogeneous unilinear plane. However, in this case, the differences between the AZN and the US dollar become noticeable.

The GDP per capita in Azerbaijan was very low (282.1 AZN, 310.3 US dollars in 1995) during the period of the decline of the country’s economy and the formation of new economic relations (the Contract of the Century and the Baku Declaration laid the foundation for economic development). However, the decisions made at the national and international levels laid the foundation for new prospects for development (signing of new oil and gas contracts, construction of pipelines of international importance, etc.). In a short period of time, the volume of GDP per capita

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Fig. 1. The volume of GDP in Azerbaijan, in million AZN and million USD (Source: Statistical indicators of Azerbaijan. Baku, 2022).
increased and reached 6268.0 AZN or 7990.8 US dollars in 2014. Despite all this, in the following years, the volume of GDP per capita increased, although it was in a variable trend with AZN, reaching 9303.8 AZN in 2021. Nevertheless, due to a comparative statistical analysis with the US dollar, the volume of GDP per capita went along a decreasing and changing line and was 5472.8 US dollars in 2021 (Fig. 2.).

The increase or decrease of GDP affects its areas of economic activity. As a result of the statistical indicators and their complex analysis, it could be seen that certain changes have occurred in the fields of economic activity in 2010 and 2021. The most critical areas that affect the country’s economy and its sustainable development indicators are the changes in industry: agro-industry and tourism industry. To reduce dependence on industry, mining (oil and gas production) and to stimulate regional development, new state programs have been adopted to direct investments in this area to the non-oil sector (investment through loans on a concessional basis), while priority directions for the development of the agro-industry and tourism industry (Strategic Roadmap) has been defined.

In the modern world, many countries regard the investment policy as an important component of their economic development strategy. Investments have a positive effect on production and employment and have also led to capital increase. In this context, geographical determinism (Vysotskyi et al., 2022; Vysotskyi et al., 2023) becomes a pivotal consideration, as the natural and topographical characteristics of a region inherently influence the structuring and efficiency of market economies, dictating the distribution and viability of various production sectors. This contributes to investments being utilized more fully and efficiently to ensure the successful development of sectors of the economy (Imrani, Mammadova, Hadjiyeva, & Vysotskyi, 2021). This, in turn, has led to a decrease in the industry share in GDP. So, while the industry share in GDP was 51.7% (21,942.2 million AZN) in 2010, this indicator decreased to 42.9% (39,956.6 million AZN) in 2021. The agricultural industry and the tourism industry recorded an increase. In 2010, the share of the agricultural industry was 5.5% (2,344.6 million AZN), and the share of the tourism industry was 1.7% (731.5 million AZN). In 2021, it was 5.7% (5,336.8 million AZN, respectively) and increased by 2.0 (1859.9 million AZN) (Fig. 3), it was not possible to achieve sustainable or regional development in precisely these areas. Thus, trade, transport, real estate, social security, taxes, and subsidies reached higher indicators in terms of percentage.

A high share of industry is the key to economic development. Achieving a competitive advantage through innovation in industry increases production efficiency and leads to higher value per capita (Sainsbury, 2020). The high share of industry in GDP helps to define that this sector needs to be rebuilt on a sustainable basis. Thus, developed and sparsely developed economic regions differ primarily in many indicators that can characterise their areas with the level of industrial development. In this regard, the complexity of regional sustainable economic development is related to the evaluation of the regions of the country. Although the assessment reflects economic indicators, it also helps to determine social differences (goods production per capita). The identified inequality requires changes in regional policy, improvement of the sectoral structure of production, and more effective use of existing local potential. In this connection, sectoral diversification of economic regions (in terms of production) is required.

![Fig. 2. GDP per capita in Azerbaijan, in AZN and US dollars (Source: Statistical indicators of Azerbaijan. Baku, 2022).](image-url)
Sustainable development is based on achieving a dynamic balance among economic, social, and environmental factors. Therefore, it is necessary to have appropriate indicators that incorporate these factors. This also requires finding a universal indicator of the general socio-economic situation, especially sustainable development, which is considered acceptable for consumers at the national, regional, and international levels (Rassadina and Klimentova, 2016). Analysing the economic indicators of production areas based on the cluster method is one of the most significant conditions. In this direction, the indicators of various production areas should be brought to a common form to conduct clustering based on them.

When the index of clustering has been determined, outliers that may affect production and its forms of organization should be removed from the grouping, taking into account the sensitivity of the area. Such an operating system must be strongly managed. Otherwise, the outliers can become part of the clustering and thus another original cluster can be formed (Novoselsky, Kagan, 2017). To determine the correct number of clusters, the available indicators must be compartmentalised. One of the methods of determining the correct choice of a cluster is the use of a coefficient that represents the combination of production areas within a certain area (Rousseeuw, 1987).

To achieve the goal of clustering, V.Yu. Pripoten’s socio-economic development assessment method includes: a stimulus that contributes to growth and a disincentive method that causes decline have been used. This method of approach eliminates the existing deficiency in the assessment of human development (Pripoten and Alferova, 2017). Z.T. Imrani proposed the following formula to summarise the quantitative indicators of various production areas and to carry out intra-regional clustering.

\[
I_{x_1 x_2 x_3 \ldots x_n} = \frac{I_{act} - I_{min}}{I_{max} - I_{min}},
\]

here, \(I_{x_1 x_2 x_3 \ldots x_n}\) means total coefficient of production \((x_1 - \text{industry}, x_2 - \text{agro-industry}, x_3 - \text{tourism industry}, x_n - \text{etc.})\), \(I_{max}\) — production cycle maximum income, \(I_{min}\) — production cycle minimum income, \(I_{act}\) — production cycle actual indicator.

The change intervals of coefficient values of quantitative indicators for production areas vary from 0.0 to 1.0. Thus, 0.0-0.2 indicates that they have very weak, 0.3-0.5 weak, 0.6-0.8 medium, and 0.9-1.0 high development indicators.

Generally speaking, cluster analysis divides the data structure into several homogeneous groups or clusters, which helps in conducting analyses and grouping. A cluster considers the basic nature and quantity of similarity between production areas

Fig. 3. GDP by economic activity in Azerbaijan, in % (Source: Statistical indicators of Azerbaijan. Baku, 2016, 2022).
(Bratchell, 1989). The cluster approach plays an auxiliary role in dialectical-geographical analysis and logical conclusion. The research works in this direction create conditions for determining the positive or negative aspects of development. Calculations were made based on the presented formula to determine the directions of development of production areas of Azerbaijan by region, while indicators of industry, the agro-industry, and the tourism industry were clustered. The obtained indicators once again prove the existing stark differences in regions (Table 1).

In industrial production, all economic regions, except for the Baku economic region, show very poor development. The Eastern Zangazur, Daghlig (Mountainous) Shirvan, Karabakh, Guba-Khachmaz, and Lankaran-Astara economic regions have the lowest indicators. The cluster indicators of these economic regions vary in the range of 0.000-0.007. It is not so difficult to understand the cluster indicators of the Eastern Zangazur and Karabakh economic regions; they remained under occupation, and despite the creation of new industrial production with the release of land, they do not operate, etc. However, it is not so encouraging that other economic regions are still lagging behind in spite of the implementation of adopted regulations, orders and state programs. Cluster indicators of agricultural industrial production are entirely different. Here, the Kazakh-Tovuz economic region shows high development indicators (0.9-1.0). The average development level (0.6-0.8) is observed in the Karabakh, Guba-Khachmaz, Central Aran, Mil-Mughan, Lankaran-Astara; Shaki-Zagatala, Shirvan-Salyan, and Nakhchivan economic regions have a weak development level (0.3-0.5). The rest of the economic regions are lagging behind in the general development trend of the agro-industry. Like other industries, the tourism industry has a very low level and a very weak development cluster in all economic regions, except for the Baku economic region. Regarding the tourism industry, the lowest development cluster belongs to the Eastern Zangazur, Mil-Mughan, Shirvan-Salyan, Kazakh-Tovuz, and Karabakh economic regions. Although the natural conditions and tourism potential of these economic regions are highly valued, transport infrastructure, service, etc. indicate that there are still problems in developing the tourism industry and forming a competitive cluster environment.

**Table 1.** Indicators of clustering production areas by economic regions of Azerbaijan (2021) (Source: regions of Azerbaijan. Baku, 2022). Note: calculations were made based on the formula presented by Z.T. Imrani

<table>
<thead>
<tr>
<th>Economic regions</th>
<th>Volume of industrial production, thousand AZN</th>
<th>Production volume of agro-industrial products, thousand AZN</th>
<th>Volume of tourism industry (hotel) production, thousand AZN</th>
<th>Total quantity indicator $I_{s,a,t}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baku</td>
<td>45,309,744.1</td>
<td>115,974.2</td>
<td>128,542.7</td>
<td>1.000</td>
</tr>
<tr>
<td>Nakhchivan</td>
<td>1,069,655.7</td>
<td>572,096.7</td>
<td>2,411.1</td>
<td>0.017</td>
</tr>
<tr>
<td>Absheron-Khizi</td>
<td>4,125,777.1</td>
<td>238,490.5</td>
<td>1,871.6</td>
<td>0.013</td>
</tr>
<tr>
<td>Daghlig (Mountainous)</td>
<td>88,589.5</td>
<td>401,433.5</td>
<td>6,244.5</td>
<td>0.048</td>
</tr>
<tr>
<td>Ganja-Dashkasan</td>
<td>860,978.1</td>
<td>322,116.0</td>
<td>6,430.3</td>
<td>0.048</td>
</tr>
<tr>
<td>Karabakh</td>
<td>194,776.3</td>
<td>910,375.5</td>
<td>931.0</td>
<td>0.006</td>
</tr>
<tr>
<td>Kazakh-Tovuz</td>
<td>416,258.7</td>
<td>1,160,497.6</td>
<td>807.8</td>
<td>0.005</td>
</tr>
<tr>
<td>Guba-Khachmaz</td>
<td>305,979.6</td>
<td>909,613.2</td>
<td>29,891.0</td>
<td>0.231</td>
</tr>
<tr>
<td>Lankaran-Astara</td>
<td>340,950.5</td>
<td>810,736.4</td>
<td>10,045.6</td>
<td>0.077</td>
</tr>
<tr>
<td>Central Aran</td>
<td>646,114.9</td>
<td>901,565.6</td>
<td>1,332.4</td>
<td>0.009</td>
</tr>
<tr>
<td>Mil-Mughan</td>
<td>554,466.4</td>
<td>816,192.8</td>
<td>159.4</td>
<td>0.000</td>
</tr>
<tr>
<td>Shaki-Zagatala</td>
<td>440578.4</td>
<td>716,694.0</td>
<td>20,815.7</td>
<td>0.160</td>
</tr>
<tr>
<td>Eastern Zangezur</td>
<td>7,888.2</td>
<td>94,448.9</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Shirvan-Salyan</td>
<td>867,323.3</td>
<td>635,761.9</td>
<td>204.2</td>
<td>0.001</td>
</tr>
</tbody>
</table>

0.0-0.2 very weak
0.3-0.5 weak
0.6-0.8 medium
0.9-1.0 high
Conclusions

1. The scientific-theoretical approaches of the cluster are sharply different from each other. The regional cluster helps to increase the competitiveness of production enterprises; the vertical cluster is characterised as a hierarchical relationship of production; the industrial cluster expands territorial production, tends to free economic-trade relations; the agro-industrial cluster unites enterprises under a single operating system, leads to a decrease in the cost of the product; the tourism cluster assists in the zoning and designation of destination centres.

2. The article has carried out clustering according to the most optimal criteria for the regions of Azerbaijan (based on the quantitative indicators), and it was determined that the effectiveness of the cluster should be carried out not only by production areas but also at the regional level. From this point of view, the applied cluster allows us to analyse the regional sustainable development of Azerbaijan more visually and to increase its application possibilities.

3. It is required to effectively use the cluster approach for the sake of the economic and geographical interests of Azerbaijan. In this direction, the creation and development of a network of regional production clusters can lead to increasing inter-enterprise competitiveness and achieving long-term socio-economic advantages. Implementation of an effective cluster policy will ensure the development of production areas in a sustainable context.

4. In 2021, the volume of GDP in Azerbaijan was 93.2 billion AZN or 54.8 billion US dollars, of which 54.9% is non-oil, 37.0% is oil and gas, 8, 1% was obtained based on net tax on products and imports. It could be concluded that the share of the non-oil sector in the GDP has increased, which is a positive sign. This is related to the reduction of dependence on the oil and gas sector and the development of alternative types of economy (agricultural industry, tourism industry, etc.) in recent years.

5. Baku economic region stands out for its high level of development. The main reason is that a large part of industrial production is concentrated in the Baku economic region. This indicator, which affects the overall development, ultimately proves that sustainable regional development has not yet fully justified itself and that there are striking differences between the Baku economic region and other economic regions.

References


Z.N. Eminov, Z.T. Imrani, E.E. Gasimova, O.Y. Vysotskyi  


