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## Research Article

### Georgia's Post-Independence Scientific Output and Prospects

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#### ABSTRACT

After the collapse of the USSR and the gaining of independence, the breaking of the informationally limited space led Georgia to the need to adopt new goals, policies, or reforms in the field of science, which should bring Georgia closer to the international scientific community. The purpose of the article is to study the evolution of Georgia's scientific output after gaining independence and analyse the prospects of development. To achieve the set goal, a systematic methodological approach is used: desk research, induction, deduction, statistical, time and space comparison, analysis, synthesis, etc. The paper discusses as separate directions the historical background; The institutional landscape and the role of leading scientific institutions; The challenges of Georgian scientific journals and the issue of indexing in international scientific databases; Scientific publication activity; The number and structure of Georgian researchers; Involvement of the state in the formation of the scientific landscape; Expenditure on research and development; Scientific cooperation. The study showed that since independence, the scientific sector of Georgia has encountered two major issues: financial constraints and the outflow of scientists from the country. Yet, the scientific situation has slightly improved, although the number of scientists is still not high. In recent years, the number and quality of scientific articles have increased, especially in medicine and engineering. In the future, for increasing scientific productivity, Georgia can increase research funds, promote holding talented scientists, and improve cooperation with international bodies. Creating programs for innovation and strengthening patent mechanisms will also be an input into technological progress.

**Keywords:** *Georgia, Scientific Output, Scientific Landscape*

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## **Introduction**

Georgia is a small nation with a rich historical and cultural heritage, which gained political and scientific independence in 1991. Before that, it was a systematic part of the Union of Soviet Socialist Republics and fully shared the characteristics of the scientific conjuncture. In the USSR, science was centrally managed, and research priorities were mainly in line with military goals, which, among other factors, led to the uneven development of other fields. In addition, the scientific and technological centres were unevenly distributed and mainly operated in the capitals and large cities of the member states. One of the major problems is that there was limited scientific cooperation between the USSR and the West, which was manifested in several directions (Gzoyan, et al. 2015, 198-199).

Along with gaining independence, countries often face the challenge or opportunity to reshape the scientific landscape, which in turn promotes discovery, knowledge dissemination and sustainable development. Along with gaining independence, Georgia experienced a multi-faceted transformation not only in political and socio-economic issues, but also in the field of scientific research and development. The study of the mentioned scientific output is of great importance, because it not only reflects the evolution of the scientific situation but also presents the country's intellectual ability and its application capabilities. In addition, research on the scientific landscape or its individual areas is scarce in Georgia, and there is a research gap, which this study will help to fill to some extent.

The aim of this article is to study the scientific output of Georgia after gaining independence and to analyse the country's prospects. By examining key indicators (research objectives) such as historical context, institutional landscape, scientific publication activity and journals, number of researchers, state involvement, expenditures on R&D and scientific cooperation this study seeks to present a comprehensive overview of Georgia's scientific journey. The article ends with conclusions and actionable recommendations that can increase the

scientific output of Georgia. Achieving all of the above research objectives will significantly contribute to the understanding and perception of Georgia's scientific policy.

## **Methods**

After gaining independence, the necessary methods for data collection and processing were used to study the scientific output of Georgia: desk research, induction, deduction, statistical, time and space comparison, analysis, synthesis, and other methods. Thus, the methodology used in the research is a systematic approach, which, by combining quantitative and qualitative analysis, aims at an objective reflection of the country's scientific landscape and future perspectives. This methodology was chosen because it is necessary to analyze Georgia's scientific productivity in both historical and international contexts. Also, comparative analysis was important to identify progress and challenges before and after independence. In addition, a mixed methodology was used to provide a comprehensive and objective assessment of the scientific landscape, focusing on both quantitative indicators (e.g., number of publications, patents, number of researchers) and qualitative assessments (e.g., policy impact, institutional evolution).

To cover the relevant depth of research, materials were collected from various available sources (timeframes for analysis 1991-2023): academic databases; from the repositories of Georgian or foreign publications; from institutional records; from open databases of international or local organizations and others. The following types of scientific publications and resources are used in the article: scientific journal articles; reports; reviews and more. Data validation is created by selecting peer-reviewed journals, reputable institutions, or high-impact factor publications. Various scientific indicators of Georgia were defined as criteria for selection of relevant material. The study relied on the data extracted from the Scimago Journal & Country Rank portal, the Scopus database, the World Bank official website, the National Statistics Office of Georgia, and the National Academy of Sciences of Georgia.

## Result and Discussion

### Historical Context

Before gaining independence, modern authors positively evaluate the state of development of Georgian science and point to large-scale numbers for a small nation. In contrast, the transition period after the collapse of the USSR and the restoration of independence is associated with several challenges (e.g. Mekvabishvili 2011, 74-75; Tabatadze 2023). With the collapse of the USSR, decades of centralized governance and politics based on ideology came to an end for Georgia. As a result, Georgia faced the challenge of maintaining its national identity and establishing itself in the global community. The multifaceted innovation accompanying self-determination also changed the goals and approaches of the scientific community. After the collapse of the USSR, as well as other former member states, Georgia also faced the problem of financing scientific and research institutions with its own budget. This was accompanied by the outflow and accumulation of intellectual capital in the Russian Federation. Finally, the countries of the South Caucasus (including Georgia) found themselves in need of a new scientific policy or reforms, which, along with the transition to a market economy, served the purpose of getting closer to the international scientific (especially the European community) community (Gzoyan, et al. 2015, 198-199).

In the 2000s, Georgia's efforts were aimed at restoring or strengthening the research infrastructure, which was mainly manifested in the revival of universities and scientific research institutions. During this period, there was a large outflow of scientific personnel abroad, however, in the following years, these processes were followed by a wave of educational reforms and the deepening of international cooperation with the European scientific community.

If in the second half of the 20th century, science was properly valued and prestigious, over the years this attitude has changed, the main reason of which is seen in low wages (Papava 2023). In connection with this, it should be said that according to the unified national strategy of education and science of Georgia for 2022-2030, the improvement of educational and scientific infrastructure is listed as a future priority. In particular, in order to eliminate the problem of updating the outdated and unadapted physical infrastructure, the lack of expensive equipment and the fragmentation of scientific-research resources or their uneven distribution, it is planned to increase the annual funding of the scientific-research infrastructure by 2030 (Unified National Strategy of Education and Science of Georgia 2022-2030, 2022).

To summarize, from 1991 to the present, the formation of the scientific landscape of Georgia can be conventionally divided into three periods (Table 1):

Table 1. Stages of scientific output of Georgia in the period 1991-2023

| 1991-2000   | 2001-2010   | 2011-2023  |
|---|---|--|
| <b>Dawning of Scientific Autonomy</b>   | <b>Evolving Research Landscape</b>  | <b>Advancements and Global Engagement</b>  |
| <ul style="list-style-type: none"> <li>Transformation of research institutions;</li> <li>Collection of infrastructure;</li> <li>Development of scientific and research policy.</li> </ul> | <ul style="list-style-type: none"> <li>Consolidation of research efforts;</li> <li>Active work on increasing the quality of scientific products.</li> </ul> | <ul style="list-style-type: none"> <li>Accelerated development;</li> <li>Heightened international partnerships.</li> </ul> |

**Source:** Compiled by the authors

### Institutional landscape

The country's scientific progress is largely related to the effectiveness of academic or

research institutions. After the collapse of the USSR, during the transition period (1991-2000 years), several organizations operating in the

field of research and development were transformed into independent entities, which required their competitiveness in obtaining funding. All this led to the fact that many of them were merged, some became the structure of educational institutions, and some were closed altogether (Gzoyan, et al. 2015, 201). Therefore, it is quite logical that the focus of research during this period was limited due to funding and resource constraints, and the focus was on the restoration of scientific infrastructure and institutions.

Since 2010, the implementation of large-scale reforms in the field of research and development, which served the purpose of increasing the effectiveness and integration of scientific and research activities, began. Scientific centres with the status of a legal entity under public law were reorganized and integrated into higher educational institutions as separate structural units. Despite the reforms, several institutions remained autonomous entities on state funding. Despite such activation, based on the analysis of the indicators of the education and science system of the World Economic Forum Global Competitiveness Report 2008-2016, Gagnidze & Maisuradze indicate the insufficient effectiveness of the reforms and note that "All this indicate low effectiveness of the activities and policies implemented in the system of higher education and science" (Gagnidze and Maisuradze 2016, 31-32).

Today, with autonomous rights and state funding, LSI "National Academy of Sciences of Georgia", LSI "Academy of Agricultural Sci-

ences of Georgia" and public associations of scientists are operating in Georgia, which are involved in issues of science and technology development, in the formation of the country's policies and priorities, in the implementation of state scientific technology programs or in the development and implementation of projects (Law of Georgia on science, technology and their development 1994, A: 6).

The Academy of Sciences of Georgia is a symbol of statehood and intellectual stability of the country. According to the legislation, he is subordinate to the government and is considered an adviser to the government. The Academy of Sciences of Georgia was established in February 1941, and Tbilisi State University and the branch of the Academy of Sciences of the Soviet Union made a great contribution to its preparation. The previously existing scientific schools of mathematics, psychology, oriental studies, and physiology found further development in the academy system. The fact that 14 scientific-research institutions, including all nine institutions of the Georgian branch of the Academy of Sciences of the Soviet Union, entered its system since its establishment is a confirmation of the scale of the Georgian Academy of Sciences. There may be critical views of the Academy in the society and its operation may be considered a Soviet relic, however, the fact is that today the institution is actively engaged in scientific activities (See Table 2) and includes 9 scientific departments (Law of Georgia on the National Academy of Sciences of Georgia 2007).

Table 2. The scientific activity of the Georgian National Academy of Science, 2006-2022

| Years | Members | Books, Manuals, Articles | Accepted grants | Participation in scientific conferences | Patents obtained |
|-------|---------|--------------------------|-----------------|---|------------------|
| 2006  | 116     | 267                      | 62              | 76                                      | 7                |
| 2007  | 109     | 333                      | 46              | 98                                      | 14               |
| 2008  | 105     | 356                      | 49              | 105                                     | 9                |
| 2009  | 127     | 494                      | 58              | 165                                     | 9                |
| 2010  | 116     | 490                      | 45              | 215                                     | 8                |
| 2011  | 109     | 447                      | 55              | 269                                     | 12               |
| 2012  | 103     | 384                      | 40              | 167                                     | 11               |
| 2013  | 107     | 372                      | 46              | 206                                     | 7                |
| 2014  | 99      | 354                      | 68              | 174                                     | 9                |
| 2015  | 97      | 344                      | 50              | 212                                     | 4                |
| 2016  | 92      | 348                      | 51              | 212                                     | 5                |

| Years | Members | Books, Manuals, Articles | Accepted grants | Participation in scientific conferences | Patents obtained |
|-------|---------|--------------------------|-----------------|---|------------------|
| 2017  | 91      | 384                      | 59              | 211                                     | 9                |
| 2018  | 91      | 373                      | 49              | 190                                     | 3                |
| 2019  | 87      | 365                      | 37              | 187                                     | 1                |
| 2020  | 86      | 317                      | 37              | 71                                      | 10               |
| 2021  | 78      | 294                      | 25              | 129                                     | 4                |
| 2022  | 78      | 246                      | 26              | 99                                      | 11               |

**Source:** Georgian National Academy of Science Reports 2006-2022

As for the Academy of Agricultural Sciences of Georgia, it mainly coordinates scientific-research institutions of an agrarian profile and submits appropriate recommendations to the interested government agencies (Law of Georgia on the National Academy of Sciences of Georgia 2007, A: 16 (1)). Its goals are to promote the development of agricultural science in the country and to predict future ways; coordination of relevant studies; developing recommendations on the country's agrarian priorities and submitting them to the government; Demonstrating achievements in the relevant field both to the local community and to the international arena and others (Academy of Agricultural Sciences of Georgia 2023).

The cornerstone of the Georgian scientific landscape is Shota Rustaveli National Science Foundation (SRNSFG) of the Ministry of Education and Science of Georgia, whose goal is to promote the development of the system of science, technology and innovation in the country. It was established in 2010 as the successor of the National Scientific Foundation of Georgia and the Georgian Foundation of Humanities and Social Sciences (Rustaveli Foundation). Through various grant programs, the foundation finances researchers, scientists and institutions (in many research areas) (Order of the Minister of Education and Science of Georgia No. 62/N on the establishment of a legal entity under public law - Shota Rustaveli

National Science Foundation of Georgia and approval of its charter 2010).

The Innovation and Technology Agency (GITA) also contributes to the creation of scientific results of Georgia. Although GITA is more focused on the promotion of innovation and technology, it indirectly carries out the following activities promoting the scientific field: Promoting innovation ecosystem; Research and development funding; Technology transfer and commercialization; Education and capacity building; International collaboration; Innovation policy development etc. (Georgian Innovation and Technology Agency n.d.).

Currently, based on socio-economic and scientific-technological development forecasts, science and technology development priorities are determined. Therefore, the state undertakes to create favorable conditions for the activity of scientific and scientific-technical public associations. As a result of cooperation with them, it provides information to the population about the importance of new technologies and products. (Law of Georgia on science, technology, and their development 1994, A: 7; 13). Information about the total number of institutions engaged in scientific and research activities in Georgia is available in the official data of the National Statistical Service of Georgia. Since 2019, their number is increasing, and the volume of work performed by them is characterized by a changing trend (see Table 3).

*Table 3. The number of institutions engaged in scientific research activities and the volume of performed works, 2019-2021*

|   | 2019  | 2020  | 2021  |
|---|-------|-------|-------|
| Number of institutions, total (unit)    | 48    | 58    | 59    |
| Volume of completed works (million GEL) | 140.2 | 139.9 | 151.1 |

**Source:** National Statistics Office of Georgia

Thus, the scientific institutional landscape of Georgia almost exactly reflects the development of the country after gaining independence: through transformations, growth and development of scientific and research institutions, Georgia continues to move towards the main goals set in the scientific field. It should also be noted that recent studies confirm that scientific and research productivity is determined not only by the personal factors of the individual, but also by institutional support and the work and research environment (Camilon & et al. 2024), which emphasizes the connection between institutional development and scientific productivity in a country.

### Scientific journals

Since 1991, Georgian scientific publications have undergone many changes. After the collapse of the USSR, the publishing of scientific journals accepted in the past continued in Georgia, where the works were mainly printed in Georgian and Russian languages. In addition to the previously existing magazines, new ones were also founded, which were mainly aimed at the local audience. Due to the absence of language barriers, availability or other factors, the interest of Georgian scientists in such local journals was quite high. Over time, the policy of encouraging foreign publications became more active, national journals with English-language publications or abstracts increased, indexing in international scientific databases increased, etc. (Gzoyan, et al. 2015, 203).

A significant part of scientific journals (as well as conference materials) is published by the organization of educational or scientific institutions. Today, the number of local scientific journals is not small, however, the quality

of the majority is not high, as indicated by the level of published papers; the problem of indexing in various international scientific databases; Maintaining release stability and more. The reasons for these results are mainly related to limited funding and lack of high editorial or research standards.

In recent years, several Georgian journals have introduced digital platforms, which enable online submissions, electronic peer-review processes, and distribution to the wider scientific community - most journals are also published in digital format along with physical ones. Another important trend can be observed in the technical characteristics of local scientific journals we mainly find open access journals, for the purpose of electronic publication of which even a multidisciplinary open access platform was created in the form of Openjournals (openjournals.ge). All of these contribute to the availability of research results both inside and outside the country.

Indexing in well-known and extensive international scientific databases is important for scientific journals at the initial stage of development, because as a result, the journal's visibility, credibility, accessibility to the scientific community, volume of citations and global collaboration increase. Nowadays, one such abstract & citation database is Scopus. According to the 2022 data of The SCImago Journal & Country Rank portal, the total number of Georgian journals indexed in the Scopus database is seven (See Table 4), which is not a lot at all. It should be noted that among the Georgian journals indexed in Scopus, Georgian medical news leads by the number of articles and the H index.

Table 4. Georgian Journals in Scopus and scientific metrics, 2022

| N | Title  | SJR   | H index | Total Documents |    |
|---|--|-------|---------|-----------------|----|
| 1 | Memoirs on Differential Equations and Mathematical Physics | 0.222 | Q4      | 18              | 33 |
| 2 | Bulletin of the Georgian National Academy of Sciences      | 0.203 | Q3      | 13              | 85 |
| 3 | Advanced Studies: Euro-Tbilisi Mathematical Journal        | 0.145 | Q4      | 3               | 37 |

| N | Title  | SJR   | Q4 | H index | Total Documents |
|---|--|-------|----|---------|-----------------|
| 4 | Transactions of A. Razmadze Mathematical Institute | 0.145 | Q4 | 11      | 49              |
| 5 | Georgian medical news                              | 0.131 | Q4 | 19      | 221             |
| 6 | Bulletin of TICMI                                  | 0.111 | Q4 | 5       | 7               |
| 7 | Lecture Notes of TICMI                             | 0.102 | Q4 | 2       | 0               |

**Source:** Scimago Journal & Country Rank

No specific trend can be observed in the number of publications indexed in Scopus (See

Figure 1) over the years (Scimago Journal & Country Rank n.d.).



Figure 1. Georgian publications indexed in Scopus 1999-2022 (Journals, conference & proceedings)

**Source:** Scimago Journal & Country Rank

### Scientific publication activity

The effectiveness of scientific publication depends on psychological, economic, sociological, technological, political, cultural, and other factors (Borgman 2000). Accordingly, the subsequent events of the collapse of the USSR and the gaining of independence were reflected in the volume and quality of academic publications. For the transitional period, Gibradze points to the informality of scientific communication and notes that at this time, the amount of gray literature, which was created by newly created informal groups and disseminated through simple web technologies, was especially growing. By the beginning of the 21st century, several challenges appeared in Georgian scientific publishing, where the following problems can be emphasized in their scale (Gibradze 2004):

- Rapidly decreasing formal venues for scholarly and scientific publishing caused by economic crisis and disproportionately

large legacy of scholarly and scientific infrastructure.

- The problems of adjusting to the new reality of the state-run or subsidized scientific publishers in the past, and the parallel activation of NGO-based publishing entities.
- Non-existence of an organized system of scientific repositories.
- The tendency to replace Russian with English as the language of scientific communication, which was especially relevant in the case of young scientists.

Scientific publications and citations are important indicators of a country's research output and the degree of influence in the scientific community. If we look at the number of articles in Georgian scientific and technical journals (See Figure 2, Figure 3), we will see that since 1996, their number has been increasing, however, there are also cases of decrease. In the overall results of the countries, Georgia is included in the group of countries with the lowest number of publications (The World Bank n.d.).

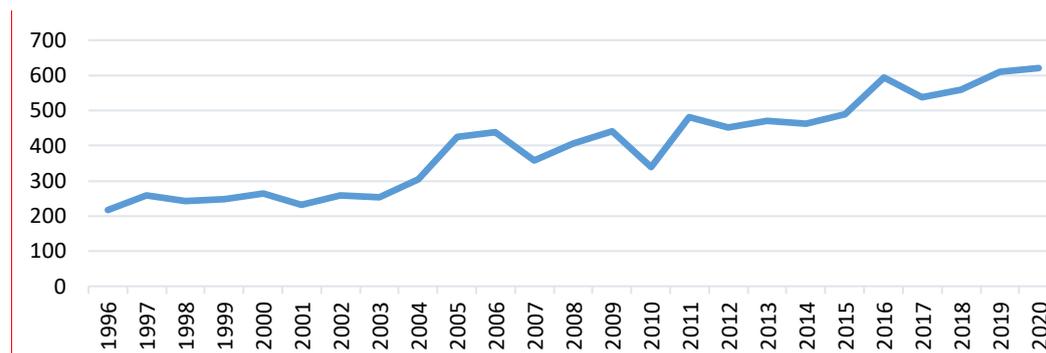


Figure 2. Scientific and technical journal articles for Georgia, 1996-2020

Source: The World Bank

Source Note: Articles refer to the number of scientific and engineering articles published in the following fields: physics, biology,

chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences.

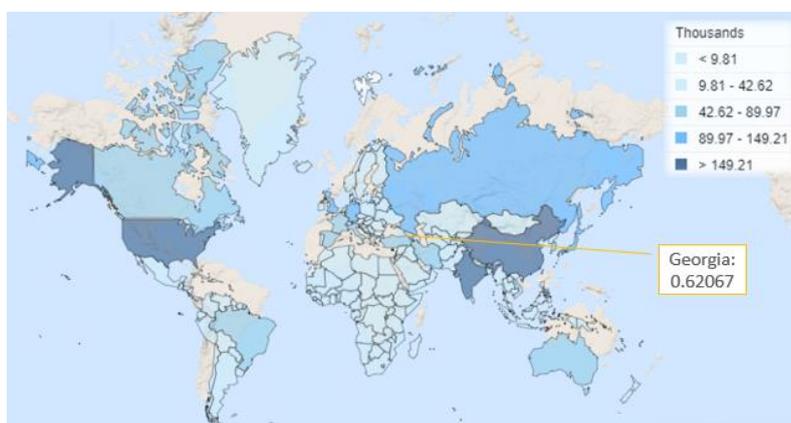


Figure 3. Scientific and Technical Journal Articles for the World, 2020 year

Source: The World Bank

In addition to global data, the number of scientific publications in 2021 by topic and region is available in Georgian data (See Table 5), based on the analysis of which it can be said that the largest number of publications is recorded in social sciences, and the smallest - in natural sciences. As for the regional distribution, the most active capital is Tbilisi (National Statistics Office of Georgia T. G.), which is prob-

ably related to the fact that it is a place of institutional gathering. The largest number of publications recorded in social sciences is mainly related to the relevance of social issues in the country; with the interdisciplinary nature of social sciences; access to data related to social aspects; with the existence of relevant research infrastructure and, in general, with the existence of an educational base.

Table 5. Number of scientific publications, 2021

| Fields<br>(OECD classification)   | Number of<br>abstracts, total | Including by region |         |         |
|-----------------------------------|-------------------------------|---------------------|---------|---------|
|                                   |                               | Tbilisi             | Imereti | Kakheti |
| Natural sciences                  | 141                           | 140                 | 1       | -       |
| Engineering work and technologies | 259                           | 254                 | 5       | -       |

| Fields<br>(OECD classification)  | Number of<br>abstracts, total | Including by region |         |         |
|----------------------------------|-------------------------------|---------------------|---------|---------|
|                                  |                               | Tbilisi             | Imereti | Kakheti |
| Medical sciences and health care | 179                           | 178                 | 1       | -       |
| Agricultural Sciences            | 206                           | 203                 | 3       | -       |
| Social Sciences                  | 452                           | 437                 | 8       | 7       |
| Humanitarian sciences            | 146                           | 64                  | 65      | 17      |
| Sum                              | 1383                          | 1276                | 83      | 24      |

**Source:** National Statistics Office of Georgia

**Source Note:** Published in Techinform's Georgian journal.

In addition to the number of scientific papers, other scientific indicators are also interesting (See Table 6). According to the data of The SCImago Journal & Country Rank portal for the years 1996-2022, Georgia's documents, citable documents, citations, self-citations, citations per document and H-index have high indicators compared to neighboring Armenia and

Azerbaijan (Scimago Journal & Country Rank n.d.). The same cannot be said about the same indicators of Russia and Turkey, however, in this case, the scale of the country, the number of population and many other factors that directly or indirectly affect the above scientific indicators should be considered.

Table 6. The SCImago Journal & Country Rank for Georgia & Neighbors, total data for 1996-2022 years

| Rank | Country            | Region         | Documents | Citable documents | Citations | Self-citations | Citations per document | H index |
|------|--------------------|----------------|-----------|-------------------|-----------|----------------|------------------------|---------|
| 12   | Russian Federation | Eastern Europe | 1592214   | 1549285           | 13720248  | 4515841        | 8.62                   | 702     |
| 19   | Turkey             | Middle East    | 838530    | 779735            | 11280898  | 2197485        | 13.45                  | 562     |
| 87   | Georgia            | Eastern Europe | 28021     | 25288             | 544319    | 56819          | 19.43                  | 228     |
| 92   | Armenia            | Eastern Europe | 22486     | 21714             | 413380    | 69286          | 18.38                  | 221     |
| 94   | Azerbaijan         | Eastern Europe | 21274     | 20716             | 205239    | 38243          | 9.65                   | 141     |

**Source:** Scimago Journal & Country Rank

Thus, because of the analysis, it can be seen that the number of scientific publications in Georgia and related scientific indicators have fluctuated over the years, which is based on more than one reason. Among them, the main issues are: availability of financing; research and publication infrastructure; Possibility of international cooperation and state policy. For years now, solving the various problems of scientific publishing has been seen as one big goal - rapprochement with the Western and American scientific community, for which it is necessary to work in many directions. One of the

important issues is the organization, digitization, and creation of a unique repository of various types of scientific works (Gibradze 2004, 51). This process started years ago and is becoming more and more effective. A number of educational, scientific-research and library institutions have already created their own digital storage or institutional repositories (open-science.ge; openlibrary.ge; dspace.tsu.ge and others), where the research papers, theses, dissertations and scientific or not scientific papers.

### Number of researchers

The number of researchers in R&D per million inhabitants of the country is also a relevant measure of scientific landscape assessment. According to the data of the World Bank (See Figure 4), this number has been increasing for

Georgia since 2013, and if we judge by the data of 2015, 2018, it is quite close to the same indicator of the world. It should be noted here that the number of Georgian researchers per million people falls behind the European and Central Asian indicators every year.

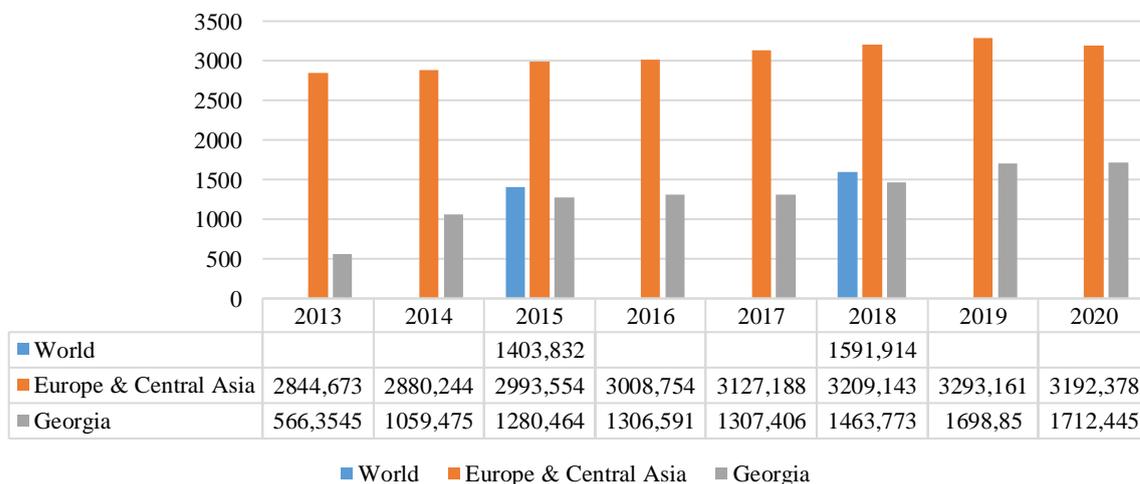


Figure 4. Researchers in R&D for Georgia, Europe & Central Asia, and the World (per million people)  
Source: The World Bank

When talking about the number of scientists and researchers, it is necessary to consider the number of the population. As of January 1, 2023, the population of Georgia was 3,721,900 people. Against this background, if we look at the available Georgian data of the last years

(See Table 7), we will notice that in the staff employed on R&D, the number of researchers is increasing every year, and the number of researchers prevails, where the category of female gender is greater than male (National Statistics Office of Georgia n. d.).

Table 7. Number of Staff Employed on R&D by status, Georgia, 2019-2021

|                                 | 2019          |              |              | 2020          |              |              | 2021          |              |              |
|---------------------------------|---------------|--------------|--------------|---------------|--------------|--------------|---------------|--------------|--------------|
|                                 | Sum           | Female       | Male         | Sum           | Female       | Male         | Sum           | Female       | Male         |
| <b>Personnel, total</b>         | <b>13 732</b> | <b>7 477</b> | <b>6 255</b> | <b>14 589</b> | <b>8 011</b> | <b>6 578</b> | <b>14 040</b> | <b>7 537</b> | <b>6 503</b> |
| <u>among them:</u>              |               |              |              |               |              |              |               |              |              |
| <b>Researcher</b>               | <b>10 191</b> | <b>5 339</b> | <b>4 852</b> | <b>11 859</b> | <b>6 334</b> | <b>5 525</b> | <b>12 030</b> | <b>6 408</b> | <b>5 622</b> |
| Technical and related personnel | 1 790         | 1 080        | 710          | 1 380         | 817          | 563          | 1 162         | 637          | 525          |
| Other support staff             | 1 742         | 1 052        | 690          | 1 322         | 840          | 482          | 848           | 492          | 356          |
| Unidentified                    | 9             | 6            | 3            | 28            | 20           | 8            | -             | -            | -            |

Source: National Statistics Office of Georgia

The number of researchers according to the level of education is also available (See Table 8), where there is a preponderance of those

with a doctorate or equivalent degree (National Statistics Office of Georgia n.d.), which is a logical and expected fact.

Table 8. Number of researchers by education level

|   | 2019          |              |              | 2020          |              |              | 2021          |              |              |
|---|---------------|--------------|--------------|---------------|--------------|--------------|---------------|--------------|--------------|
|   | Sum           | Female       | Male         | Sum           | Female       | Male         | Sum           | Female       | Male         |
| <b>Researchers, total</b>               | <b>10 191</b> | <b>5 339</b> | <b>4 852</b> | <b>11 859</b> | <b>6 334</b> | <b>5 525</b> | <b>12 030</b> | <b>6 408</b> | <b>5 622</b> |
| <u>among them:</u>                      |               |              |              |               |              |              |               |              |              |
| PhD or equivalent (ISCED 8)             | 7 277         | 3 816        | 3 461        | 7 992         | 4 206        | 3 786        | 8 393         | 4 435        | 3 958        |
| Master's degree or equivalent (ISCED 7) | 2 726         | 1 410        | 1 316        | 3 599         | 1 979        | 1 620        | 3 324         | 1 776        | 1 548        |
| Bachelor or equivalent (ISCED 6)        | 188           | 113          | 75           | 266           | 147          | 119          | 310           | 194          | 116          |
| Short Term/ Professional (ISCED 5/4)    | -             | -            | -            | 2             | 2            | -            | 3             | 3            | -            |

**Source:** National Statistics Office of Georgia

The review of the number of researchers showed that the number of researchers per million people in Georgia is like the world average, however, it is significantly lower than the regional average. It is necessary to consider the issue of personnel outflow during independence, which in turn was reflected in the general picture. The number of scientists-researchers is affected by the fact that science is not considered a popular activity in Georgia today, which in turn is primarily due to low pay. The ways to solve problems in the Georgian scientific field are mainly seen in investing more resources from the state side in the development of the country and recognizing science as a priority field (Papava 2023).

### **State involvement and spending on research and development**

In Georgia, the state is involved in the development of the field of science in the form of the Ministry of Education and Science, and the latter mainly in the form of SRNSFG. Along with other laws, the Law of Georgia "On Science, Technology and Their Development" and the Law of Georgia "On Higher Education" form the legal basis in the field of science and technology development. In addition to the educational direction, the latter focuses on the scientific and

research activities of higher educational institutions in Georgia.

According to the Development Strategy of Georgia "Vision 2030", one of the main challenges in the field of education and science of Georgia is the quality of education and institutional strengthening of educational and scientific-research institutions (Development Strategy of Georgia "Vision 2030" n.d.). Annual expenditures on research and development by the state are considered a criterion for the development of innovative economy, scientific fields, technological progress, or other directions. According to the law on science, technology and their development, the financing of science and technology development includes the use of state budget funds and various sources of non-budgetary financing, while the financing itself from the state budget is mainly carried out through a grant system (Law of Georgia on science, technology and their development 1994, A: 15).

Georgia belongs to the Europe & Central Asia region and is considered an upper middle-income country. If we look at the research and development expenditure for Georgia (See Figure 5), we can easily notice that for many years it is either decreasing or in a state of stagnation and does not even exceed 0.5% of GDP. The same indicator for Europe & Central Asia is

characterized by a growing trend and reached almost 1% of GDP in 2020. A similar, growing trend is evident in the case of the world as well, at which point the accelerated growth during

the last decade should be emphasized, where research and development expenditure has already exceeded 2.5% of GDP (The World Bank n. d.).

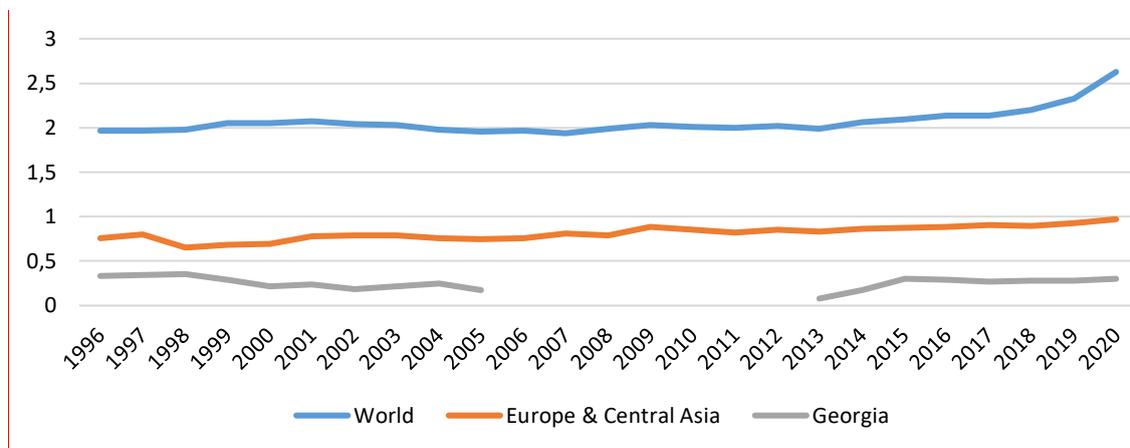


Figure 5. Research and development expenditure for Georgia, Europe & Central Asia and the World (% of GDP)

Source: The World Bank

Source Note: The gross domestic expenditure on R&D indicator consists of the total expenditure (current and capital) on R&D by all resident companies, research institutes, university and government laboratories, etc (in the four main sectors: Business enterprise, Government, Higher education and Private non-profit). It excludes R&D expenditures financed by domestic firms but performed abroad.

The stagnation of spending on the development of science over the years is mostly associated with insufficient attention from the state to the mentioned direction, and the solution is seen in such a solution, in which the state will play the role of a catalyst in the formation of the innovative economy, and small and medium-sized innovative companies will play a leading role in the country's economy (Mekvabishvili 2011, 76). Similarly, the growth of science and research funding is considered one of the key factors of innovative development of Georgia. Moreover, it is important that the priority of the state is the strengthening of science, and the latter is focused on solving existing problems in the direction of innovative development (Bakhtadze and Danelia 2020, 248).

International experience in the field of science funding is very diverse and varies depending on the level of development of countries. Petersen (2021) addresses this kind of inequality and focuses on global and regional disparities in research funding, pointing to how the richer regions and countries, namely North America, Europe, and certain parts of the Far East, dominate scientific publication, with the rest of the world being inadequately financed. Even within the EU, vast inequalities exist, limiting research for poorer nations. The author argues that these imbalances fuel a vicious cycle, in which poorly funded researchers are unable to receive grants and produce high-impact papers. For example, in China, the distribution of funding is influenced by the affiliation of scientists to a particular institution, research specialization and past achievements. As a result, high-level institutions receive a significant share of funding. Wang et al. (2025) found that expanding the scope of funding is more effective in increasing research output than simply increasing funding intensity. Overall, China's funding system emphasizes talent cultivation and short-term research performance and continues to improve as it becomes more efficient and innovative. The external funding pressure

mounted on Finnish universities of applied sciences while state funding has been declining. Their strategies lay more stress on collaboration and strengthening research but often lack focused source of funds approaches. Competition as well as costs also gave birth to new forms of ownership where some are presently owned by classical universities, creating a changed fund environment (Kohtamäki & von Boguslawski 2024). Wencan et al. (2024) explored research funding across 171 SCI fields from 2011 to 2020, from over 13 million scientific articles in the Web of Science. It explores the interaction between funding and research influence via funding universality and multiplicity metrics. Outcomes reveal a growing pattern of funding, with life and earth sciences receiving the most funding. Engineering and computer science have experienced huge spikes in funding. Research that is financed is more influential, with citation advantage increasing with a build-up of finance grants. Regression analysis also confirms the citation advantage of financing, though its effect on usage is unclear. El-Ouahi (2024) examines acknowledgments of funding in 2.3 million scientific papers published between 2008 and 2021 to determine the research funding trend in the Middle East and North Africa (MENA) region. Saudi Arabia and Qatar lead countries in international collaboration, while Iran and Kuwait are funded locally. Government and university institutions lead in funding with minimal industry involvement.

### **Scientific cooperation**

Collaborative Networks and Partnerships between academic and research institutions are characteristic of scientific progress. After gaining independence, Georgia's scientific cooperation approach became more integrated and globally involved. It is essential to elucidate that the intricate historical narrative and heterogeneous cultural heritage of Georgia have precipitated collaborative affiliations with international counterparts, fostering mutual engagement in endeavors such as archaeological excavations, the safeguarding of historical monuments, and scholarly inquiries into cultural paradigms.

Gzoyan & others evaluate the international cooperation in the field of R&D of Georgia after gaining independence as mainly European-oriented: „The main objectives and priorities of R&D in Georgia include: adaptation of the National Strategy on the Development of R&D to European standards; commercialization of scientific results and participation in appropriate European programs, as well as, elaboration of special programs to support researchers in their research activities“ (Gzoyan, et al. 2015, 203). This consequence primarily emanated from the nation's earnest aspiration for integration into the European sphere. Consequently, through active engagement in European Union framework initiatives and other research undertakings of the European ilk, Georgian scholars were afforded the prospect of partaking in global ventures, thereby accessing diverse resources and securing funding for their endeavors. In parallel to its engagement in European collaborative endeavors, Georgia also directed its attention towards fostering regional synergies through partnerships with neighboring Armenia, Azerbaijan, and Turkey.

Scientific cooperation can be assessed in a certain way by the number of scientific papers published together with foreign co-authors. According to The SCImago Journal & Country Rank portal, since 1996, international collaboration in Georgian publications shows a growing trend with small fluctuations (See Figure 6). Compared to neighboring countries, it can be said that the above-mentioned figure for Georgia exceeds the same figure for Azerbaijan every year, while in the case of Armenia, Georgia's advantage is more or less variable. An analysis of the indicators of Georgia and Armenia reveals a dynamic pattern characterized by temporal fluctuations. Over a certain time frame, the indicator of Georgia surpasses that of Armenia in specific years, while in other years, it falls behind. This behavior suggests a non-linear trend in their comparative performance. Moreover, a closer examination of recent years demonstrates an observable shift in favor of Georgia. The data indicates that the indicator of Georgia has exhibited a consistent upward trajectory, surpassing that of Armenia in the most recent years (Scimago Journal & Country Rank n.d.).

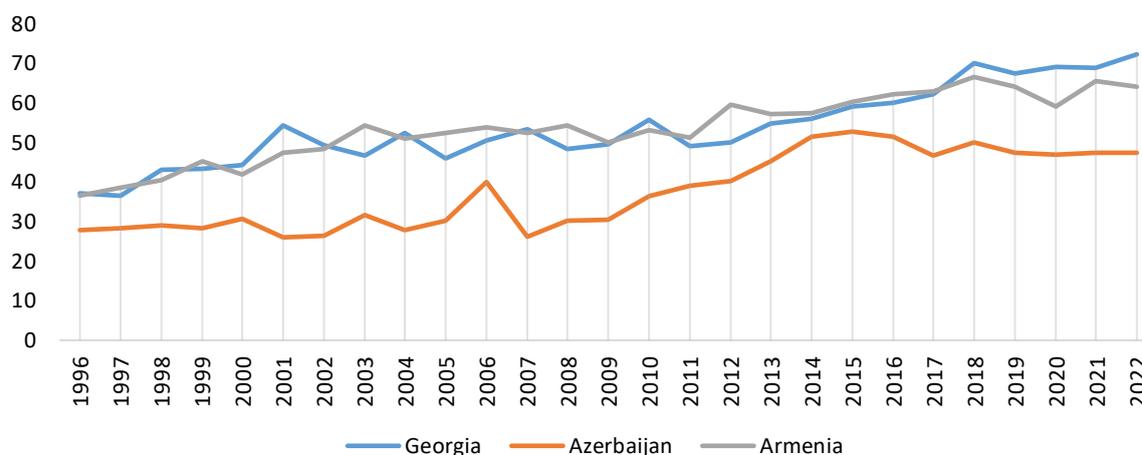


Figure 6. Country Comparison According to the International Collaboration (%), 1996-2022

Source: Scimago Journal & Country Rank

Despite more or less advantage with neighboring countries, international scientific cooperation in works is not high, and in order to increase activity, it is important to have financial support-encouragement opportunities; active work on increasing indexing in international scientific bases; to continuously raise the level of compliance with editorial and research standards; to have well-structured and strong publishing platforms; work in the direction of reducing the language barrier; There should be more funding for joint research initiatives specifically for foreign and local researchers, etc.

Several reviews of recent years have shown that Georgia has quite good scientific and educational ties with the world's leading countries (Gagnidze and Maisuradze 2016), where the famous EU program Erasmus Plus occupies a central place. It promotes education, training, youth, and sports in Europe (Erasmus+ 2023). In addition, for the past few years, Georgia has been cooperating with a number of countries in the form of SRNSFG and financing joint grant programs, including: EURAXESS (euraxess: Georgian network n.d.); DAAD (DAAD Georgia 2023); French National Center for Scientific Research (Shota Rustaveli National Science Foundation of Georgia: international relations 2023); Science and Technology Center in Ukraine (STCU) (Shota Rustaveli National Science Foundation of Georgia : international relations 2023) and etc.

Based on separate statistical data, it is noted that the participation of Georgian scientists in international scientific competitions or programs is low. As a result, it is not possible to fully utilize the allocated funding. Polodashvili identifies several reasons for low activity: "Existence of double standards and requirements, double eligibility check of registered projects, language and cultural barriers..." and sees the improvement of the situation in such measures as: easing requirements for applicants; Liberalization of bureaucratic processes and increase in funding for national grant calls (Polodashvili 2020, 349).

Today, the obligation of the state to engage in the field of international scientific-technological cooperation is spelled out at the legislative level, namely: it subsidizes the import of the latest scientific achievements or technologies; Provides preferential lending and partial subsidies for the export of high-tech products. International or interstate scientific-technological cooperation between Georgia and foreign countries includes cooperation with scientific organizations, which is mainly manifested in the implementation of joint scientific-technological projects, as well as in the creation of centers and other forms of organizations for the common use of scientific information and scientific equipment of joint scientific groups. Cooperation also includes the exchange of scientific

tific and technical information, the use of resources and data bases of international or foreign funds; organization of scientific congresses, conferences, symposiums, colloquiums, or other events; Joint training and qualification raising of specialists through exchange of science, scientific-technical personnel, or students (Law of Georgia on science, technology and their development 1994, A: 22, 23).

## Conclusion

Thus, Georgia's independence was accompanied by a number of difficulties in scientific matters, starting with funding problems and ending with the outflow of scientists from the country. The beginning of the new century was accompanied by the birth of the beginnings of the development of the scientific landscape, during which efforts to deepen international cooperation also intensified. It should be said that the scientific environment in Georgia developed mainly through reforms aimed at consolidating institutions and increasing the efficiency of research, in which the National Academy of Sciences and the Shota Rustaveli National Science Foundation played a major role. The Agency for Innovation and Technology is no less actively involved in promoting innovations and promoting foreign partnerships. Despite the reforms, there are still many challenges in the scientific system, the overcoming of which largely depends on strong institutional support and continuous improvement.

For years, Georgian scientific journals have had a policy of encouraging and encouraging publication in English and registration in international databases. Recently, there has been a notable advancement in online platforms and open access journals, which contribute to greater accessibility of research. Despite this progress, today only a few Georgian journals are indexed in major databases and their global visibility has a long way to go.

The policy of Georgian scientific journals has been changing over the past decades. Today, publishing papers in English and registering in international databases is encouraged. There has also been significant progress in online platforms and open access journals, which contribute to greater accessibility of research. Despite the progress, today only a few

Georgian journals are indexed in large databases, and the rest have a long way to go.

Among other things, the number of researchers involved in research and development is also increasing, especially among women with PhDs. However, the number of researchers per population is still quite low compared to the region. This is mainly due to the low interest in scientific professions, low remuneration and brain drain from the country.

Compared to other parties, the state is the most involved in the development of science and technology. However, funding for research and development has remained flat in recent years and is less than 0.5% of GDP, while investment in science is increasing in other countries. Accordingly, to achieve innovation, economic progress and other outcomes in the long term, increased funding or other incentives from the state are necessary.

In terms of scientific cooperation, Georgia has become increasingly closer to the world, especially neighboring and European countries. EU programs have repeatedly contributed to strengthening the Georgian scientific network, however, the level of cooperation between Georgian scientists and foreign authors is still low. This result is mainly due to insufficient financial resources, language barriers, and bureaucratic obstacles.

For the future development of the country, these recommendations are important to consider:

- First, it is necessary to increase state funding and invest wisely in science. These efforts will attract and retain talented scientists and researchers in the long term, which in turn will lead to productive scientific outcomes for the country.
- The private sector plays an active role in shaping and developing the scientific environment. Encouraging public-private partnerships is a step in the right direction.
- Raising public awareness about the significance of science and research is incredibly important. By launching various campaigns and events, Georgia can turn science into a field that's popular and well-regarded.
- Increased involvement in global research programs is no less valuable. Increased vis-

ibility in the international scientific community in this way will lead to greater productivity in the future.

- Early-career researchers need to be assisted in order to foster the development and sustainability of Georgia's scientific community. Early-career researchers are often the drivers of innovation, but they have some problems to deal with, such as funding limitations, lack of professional development opportunities, and the fact that they are not known in the global research community. To effectively assist early-career scientists, the following programs need to be undertaken: Providing Financial Opportunities; Establishing Networking and International Exposure Opportunities; Providing Career Advancement Resources Facilitation; Maintaining Interdisciplinary Collaboration Opportunities etc.

Future research could investigate the impact of foreign collaborations on Georgian science, bridging the gap of funding and bureaucracy. The effectiveness of policies like "Vision 2030" and early-career researcher mobility and digitalization in publishing research would also help improve Georgia's science.

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