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## **Analysis of foreign experience in involving women in science**

### **Abstract**

**Object:** The purpose of this article is to analyze foreign experience in supporting women scientists in order to develop recommendations for Kazakhstan.

**Methods:** This article used an integrated approach to the choice of methodology. The research methods were generally scientific, these are dialectics, a systematic approach, methods of analysis and synthesis, typology, generalization and refinement. That is, the methodology section includes a set of methods used to analyze the state of women scientists in the world based on foreign documents.

**Findings:** During the study, indicators of the share of female scientists among the total number of scientists in the countries of the world were studied. It was found that in the post-Soviet countries the proportion of women scientists is more than 50%, in developed countries the proportion of women scientists is relatively low. Here, firstly, we can see a large number of scientists in developed countries, and secondly, we can see a large number of foreign women scientists. And the situation in Kazakhstan and the CIS states is the opposite. In addition, programs to support women scientists in the leading countries of the world were discussed.

**Conclusions:** In conclusion, the opportunities and rights of women scientists abroad are wider than those of domestic scientists. The potential of domestic women scientists is not revealed in the development of the country's economy. In this regard, directions were proposed to support women-scientists in Kazakhstan. The theoretical value of this article is to fill the theory in the problem of studying the empowerment of female scientists. The practical significance of this study is the proposed provisions that can be checked by public administration bodies.

**Keywords:** economics, scientists, gender, social inequality, stem, science.

### **Introduction**

Today, research plays a key role in monitoring relevant trends in areas such as economic development, environmental security, innovation, climate change and science. Women will play a significant role in the realization of sustainable development goals, identifying global problems and proposing solutions. According to UN experts, there is a gender imbalance, which manifests itself in the unequal representation of women and men in many scientific and research disciplines (UN, 2020). In addition, UN experts note that the promotion of gender equality will contribute to reducing the income gap and improving the quality of life for both women and men. In this regard, the promotion of gender equality in science will allow Kazakhstani economy to keep up with the growing demand for the development of knowledge-intensive industries and will contribute to the competitiveness of the economy.

There is significant gender segregation in Kazakhstan, and this is particularly evident in innovation, technology and science. The lowest percentage of women leaders is found in many areas of science, and women made up only 7% of the members of the Kazakh National Academy of Sciences. There is also a gender pay gap, with women earning about 75% of their male colleagues' salaries (Bureau of National Statistics, 2021). Moreover, there are practically no Kazakhstani studies aimed at a comprehensive study of the underrepresentation of women in science, the presence of gender stereotypes and the impact of the cold academic climate. In this regard, the aim of the study is to analyze foreign experience in supporting women scientists in order to develop recommendations for Kazakhstan. It is important for Kazakhstan to utilize the untapped potential of women in science. In developed countries, great attention is paid to the development of

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women, namely in the field of science and technology. Effective utilization and promotion of women in science will give a new impetus to sustainable economic development. In this regard, support and empowerment of women scientists will give a new impetus. In many foreign countries, there is a demand for highly intelligent human capital and a shortage of such personnel. Therefore, to fill this deficit it is necessary to recruit a pool of women including women scientists. According to global labor market trends, the demand for STEM professions will grow. Studying this problem, international organizations such as UNESCO, ILO and others propose an initiative to fill this deficit by encouraging women scientists in STEM fields. However, as practice shows, there is a gender imbalance in the labor market of scientific activity, not all women scientists can have rights and opportunities as men scientists. Thus, the relevance of this problem reveals the shortage of women-scientists and the failure to unlock their potential.

### ***Literature Review***

Currently, the issue of women's potential is being discussed very widely. Opportunities and potential of women can be used in a positive aspect not only in science and innovation, but also in other spheres and sectors of the economy (Cotter et al., 2004). Looking from the social aspect, there are studies that raise the problem of inequality among women and men (Posel, 2014). Other studies deal with legal issues in gender equality. Many raise the issue of infringement of women's rights in decision making (Akisheva, 2023). Unequal treatment of women by the law is one of the most visible forms of gender inequality (Ogu, Areji, 2023). Although there have been signs of women's rights in the workplace, in governance, in income equality, but the legal environment around the world is still far from providing equal conditions for women (Bekyashev, Sheremet, 2023). Also, there is a problem of stereotypes and discriminations towards women, where it is said that women cannot make the right decisions in public administration or solve complex problems in any field or industry. Most of the studies are about discrimination in the labor market, income level, etc. (Reuben et al., 2014; Deemer et al., 2016; Ahrens, Scheele, 2021).

In recent years, the importance of supporting women in science has been raised. One of the first organizations to try to make the case for the importance of involving women in science is the IAEA (IAEA, 2022). This organization has awarded 55,000 fellowships to women scientists in fields ranging from nuclear engineering to radiochemistry. Also, various UN entities, namely UNESCO, UNIDO, which give awards to women scientists and scholarships to young female researchers every year. There are also studies that focus on the problem of realizations as a specialist of women in STEM fields.

This issue is popular among researchers in the near abroad. The importance of women in science is raised not only in the aspect of rights, but also in the aspect of opportunities for women scientists in different fundamental and applied research. In Kazakhstan, the problem of women in science for the realization of innovation potential in the economy is pioneering. We can agree that there are Kazakhstani scientists who raise the issue and problem of gender equality in labor (Kireyeva et al., 2023), participation in entrepreneurship (Kireyeva et al., 2022), rights and violence against women.

Thus, there is no research that addresses the issue of capacity utilization in science and innovation. Therefore, the study of this issue will be able to identify, emphasize the importance of the role of women scientists in the implementation of strategic goals on the path of development of innovation economy, and ways and mechanisms for the use of women's potential in science and innovation will be given.

### ***Methods***

The study will utilize an integrated approach in selecting a scientific research methodology. The integrated approach will consist of several stages, which will contribute to the identification of the role of women scientists in the global community.

In the first stage, general scientific methods will be used: methods of dialectics, system approach, analysis and synthesis, typology, generalization and concretization. Namely, a literature review will be conducted in Google Scholar and Semantic Scholar databases about women in science. With the help of general scientific methods, the relevance and importance of studying the problems of women scientists on the way of economic development will be justified.

In the second stage, the method of statistical analysis, analogy and synthesis will be used. In this stage, the reports and documents of international organization will be reviewed. According to their report, ranking method will be used. In this report, the statistical data presented are not homogeneous in terms of the period of information collection. However, this obstacle does not affect the quality of the study. The algorithm of the research is shown in Figure 1.

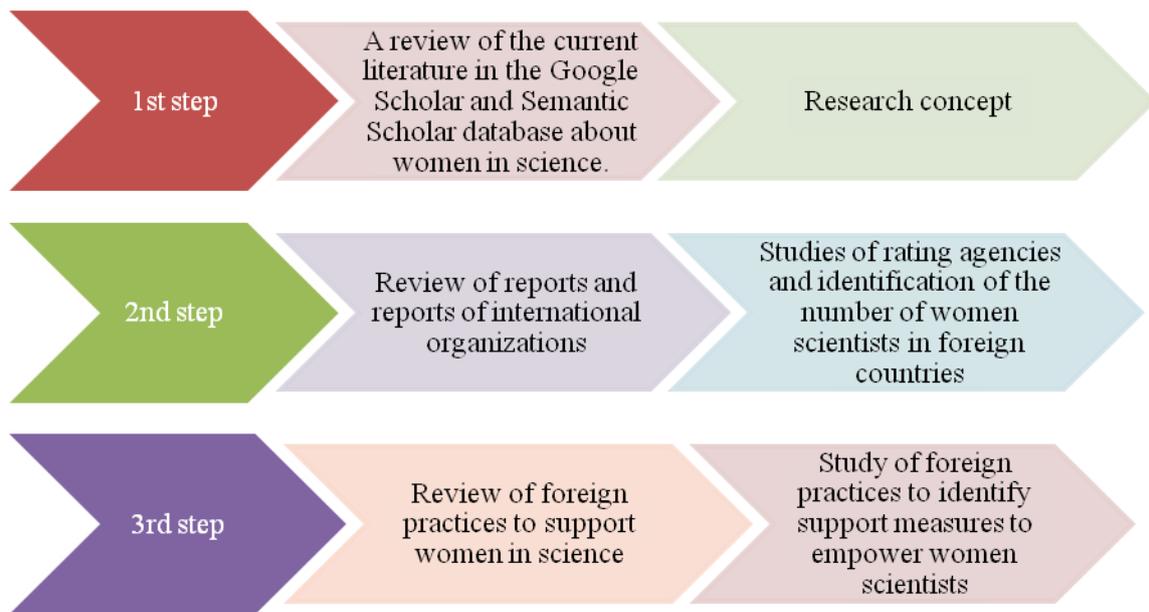


Figure 1. Stages of the research

Note – compiled by the authors

In the third stage of the study, the method of analogy will be used. Support programs for women scientists in different countries will be considered. It will be based on the ranking of the leading countries in the world in terms of spending on science from *statista.com*. This organization generates statistics from OECD, Eurostat and UNESCO.

### Results

The reports of foreign organizations were considered in the research. The UNESCO report from 2020 has statistics on the proportion of female scientists by region of the world. The highest proportion of female scientists is found in Latin American and Asian countries, particularly Myanmar, Guatemala and Kyrgyzstan, ranging from 57.6% to 75.1%. Among European countries and North America, North Macedonia stands out with 54.2%, Serbia with 52.3% and Montenegro with 52.1%. In Latin America and the Caribbean Islands, the proportion of women scientists is higher in the countries of Venezuela — 55.3% and Argentina — 53.5%. In West Asia, the high proportion of women in science is found in Azerbaijan — 55.4% and Georgia — 53.3%. In Africa and Sub-Sahara countries in the island of Mauritius — 48.5% and South Africa — 46.2% (UNESCO, 2020).

Table 1. The proportion of women among scientists in the world, % (data for the period from 2014 to 2021), high rates

Regions	Country		
Central and Southern Asia	Kyrgyzstan	Kazakhstan	Sri Lanka
	(57.6% – 2020)	(54.5% – 2021)	(44.5% – 2018).
Eastern and South-Eastern Asia	Myanmar	Mongolia	Philippines
	(75.1% – 2021),	(56.9% – 2020),	(55.6% – 2018).
Europe and Northern America	North Macedonia	Serbia	Montenegro
	(54.2% – 2021)	(52.3% – 2021)	(52.1% – 2019)
Latin America and the Caribbean	Guatemala	Venezuela	Argentina
	(62.8% – 2021)	(55.3% – 2020)	(53.5% – 2020)
Northern Africa and Western Asia	Azerbaijan	Tunisia	Georgia
	(55.4% – 2021)	(54% – 2021)	(53.3% – 2021)
Sub-Saharan Africa	Mauritius	South Africa	Cabo Verde
	(48.5% – 2021)	(46.2% – 2019)	(45.8% – 2014)

Note – compiled by author based on data from UNESCO (2020)

Observing the trends, we can conclude that the representation of women in science varies from country to country. Table 2, shows the countries with the lowest proportion of women scientists. In Asian countries, Iran has 32.3% female scientists out of the total number of scientists. The same situation is observed in India

with 16.6%. Also, it is a surprising fact that in South Korea and Japan the proportion of female scientists is 21.4% and 17.5% of all female scientists. In African countries, the proportion of female scientists has the lowest proportion in Jordan with 19.5%7 in African countries the proportion of female scientists is 8.7% and 3.4% (UNESCO, 2020).

Table 2. The proportion of women among scientists in the world, % (data for the period from 2014 to 2021), low rates

Regions	Country	
Central and Southern Asia	Iran	India
	(32.3% – 2019)	(16.6% – 2018)
Eastern and South-Eastern Asia	Rep. of Korea	Japan
	(21.4% – 2020)	(17.5% – 2020)
Europe and Northern America	Czechia	Luxembourg
	(27.6% – 2020)	(27.4% – 2019)
Latin America and the Caribbean	Mexico	Peru
	(32.3% – 2020)	(31.2% – 2020)
Northern Africa and Western Asia	Palestine	Jordan
	(22.6% – 2013)	(19.5% – 2018)
Sub-Saharan Africa	Dem. Rep. of the Congo	Chad
	(8.7% – 2015)	(3.4% – 2018)

Note — compiled by author based on data from UNESCO (2020)

In this case, we can conclude that in some countries scientific activity is prestigious and highly paid. For example, in Japan, the salary of scientists is 90 thousand dollars a year. The highest paid scientists live in the United States (125 thousand dollars), Switzerland (110 thousand dollars), Norway (105 thousand dollars) and Germany (100 thousand dollars). In addition, there are countries that attract scientists for R&D, these are China and Saudi Arabia (Kilmer et al., 2023).

Next, we examine the rapid growth in the proportion of female scientists among the total number of scientists over the past 10 years. The fastest growth of female scientists is in Pakistan, with the proportion of female scientists among the total increasing from 27.2% to 42.3%. Tajikistan has seen an increase in the proportion of female scientists from 24.3% to 37%. In South Korea, the proportion of female scientists is 16.7% in 2011, increasing to 21.4% by 2021. Japan, Qatar, and Iran are also experiencing rapid growth of female scientists among the total number of scientists.

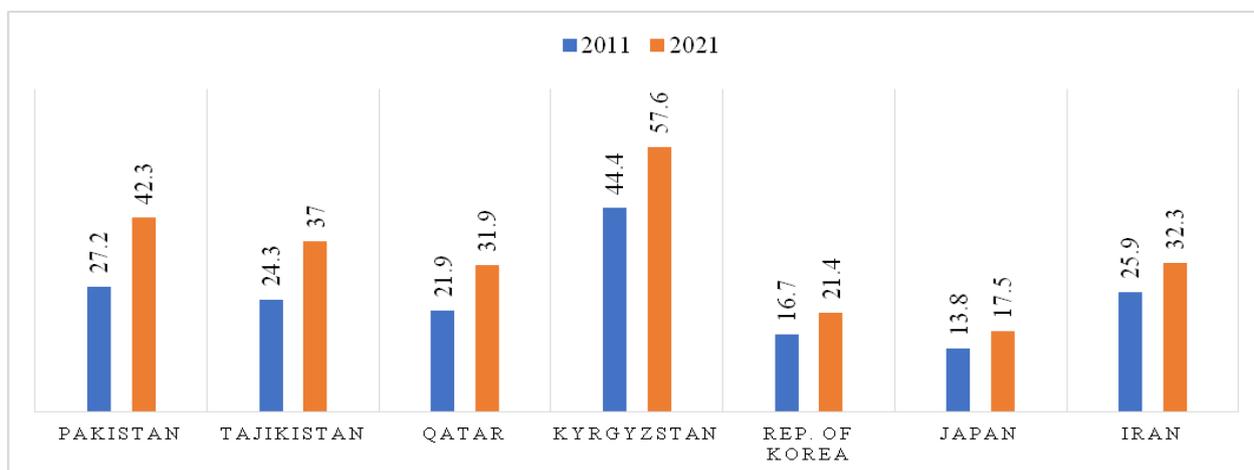


Figure 2. The proportion of women among scientists in the world, %, 2011 and 2021

Note — compiled by author based on data from UNESCO (2020)

Observing the dynamics, we can draw the following conclusions that the role of women in science depends on the role of scientific activity in the country. In Figure 3, in countries with strict stereotypes, the role of women is underestimated, the potential is not fully revealed. Thus, there are two challenges to developing and unlocking the potential of women scientists. First, the development of scientific activity in the country, increasing the prestige of science. Secondly, empowerment of women scientists to advance their

careers. In addition, organization of special programs and activities to improve the working conditions of women scientists. Table 3 presents data on the proportion of women scientists in the top 10 countries in terms of science funding.

Table 3. The growth rate of the proportion of female scientists in the Top 10 countries most funded by science, %, 2015–2021

Countries	2015	2016	2017	2018	2019	2020	2021
China	33,7	39,2	39,1	38,7	39,8	40,3	40,9
Japan	15,3	15,7	16,2	16,6	16,9	17,5	17,8
Germany	28	..	27,9	..	28,1	..	29,4
South Korea	18,9	19,7	20,1	20,4	21	21,4	22,2
France	27	28	28,3	..	..	29,4	29,9
United Kingdom	38,6	38,7	38,7	..	..	..	..
Sweden	33,7	..	32,6	..	33,3	..	34,6

Note — compiled by author based on data from Statista.com

By analyzing this table we can see how women scientists are represented in scientifically developed countries. In terms of science funding, the United States is in the first place, however, data is not available for this country. In the second place is China, in 2015 the share of women among scientists was 33.7%, in 2021 the trend shows positive dynamics and the indicator increases to 40.9%. The situation is different in Japan, which spends about 4% of GDP on science, at the same time the share of women is only 17.8% in 2021. The growth is 2.5%. This tendency takes place in the countries of Germany, Korea, France, Great Britain and Sweden. Where the share of women scientists is increasing by only 2-3% over the last 5-6 years.

Total, in developed countries, the share of women scientists tends to grow slowly. This may be due to several reasons. Firstly, the role of science in the country's economy. Secondly, the prestige and highly paid scientific activity.

### Discussions

Analysis of foreign literature, international organizations shows the representation of the proportion of women–scientists in different countries. It is not difficult to notice that the number of female scientists depends on the prestige of scientific activity in the country. Thus, we can make an assumption that in the countries where scientific activity is well financed and the salaries of scientists are high, the representation of the share of women scientists is low. However, the counterargument may be the situation in China, where among scientists women occupy 41%. Thus, in this case, women scientists have a hidden potential that is not fully unlocked for economic development. In the main objectives of the SDGs, gender inequality has its own message, which pursues the goal of sustainable development of the territory ([www.un.org](http://www.un.org), 2020). In this regard, it is necessary to consider the foreign practice of supporting women scientists in the top 10 countries in terms of science funding.

In 1998, UNESCO and the American company L'Oréal launched a program for women–scientists to support successful women in science (For Women In Science.com, 2024). Their motto is that the world needs science and science needs women. In this program, women scientists have explored different areas of science. For example, a female scientist presented new methods for understanding dengue fever, developed nanotechnology-based methods for monitoring water pollutants, developed a new public health system for the most vulnerable populations in Africa, etc.

AAUW (American Association of University Women) has launched a financial support program for women scientists — “STEM” (science, technology, engineering and maths). This financial assistance is intended to cover the costs of housing, tuition, travel, and minor child support. In addition, H.R. 321 — Inspiring the Next Space Pioneers, Innovators, Researchers, and Explorers (INSPIRE) Women Act was passed in the U.S. to encourage women scientists in the field of space exploration. Another American organization, GWIS — Graduate Women in Science, supports women scientists in the natural sciences. The Schlumberger Foundation is also an American program that supports women in doctoral and postdoctoral studies.

UNESCO statistics show that the percentage of women scientists in Japan in 2021 is 17.8%. As the Japanese argue, the role and significance of women scientists in the scientific field has not been disclosed. Thus, in Japan, there is the Japan Association of University Women, which was founded in 1946, which provides grant support to women scientists. In addition, the Science Council of Japan, which was established in 1949, also takes measures to support women scientists, namely the Juna Ashida Prize for researchers

under the age of 40 in any scientific field and the Marie Curie Prize for early career researchers in science and technology. Starting in 2022, the University of Tokyo also aims for gender equality in scientific practice by increasing the proportion of female professors and associate professors from 16% to 25% by 2027 (Jackson et al., 2023).

In Germany, there are a number of organizations and programs that help women combine academic careers and families. One of them is the Community of Women in German Higher Education. This organization helps with funding for the publication of PhD theses and dissertations. There is also the Christiane-Nüsslein-Volhard-Stiftung (Christiane-Nüsslein-Volhard-Stiftung, 2024), which provides financial support for women scientists with children. The main purpose of the funding is to pay for babysitting, daycare or the purchase of household appliances. Another organization that helps women scientists is the Bonn Center for Women in Research. This organization helps women scientists to find special grant, award and fellowship programs for women's research.

In South Korea, Basic Plans are being developed and one of them aims to create conditions for the growth of women scientists and engineers. This initiative supports scientists in general, regardless of their gender or age (Andrianov, 2023).

In the UK there is a number of programs that is aimed at promoting women scientists, women's involvement in science and research. Every year the British Council announces a competition for a scholarship program for women in STEM (British Council, 2024). The scholarship program provides financial support to the scholar including tuition fees, stipendium, travel expenses, visa fees and health insurance. The aim of this program is to inspire future generations of women to pursue careers in the exact sciences.

Thus, we have considered public and private programs to support women scientists in advanced countries, where funding for science is higher than in other countries. As the analysis of foreign experience shows, the importance of unlocking the potential of women scientists has a positive impact on the development of the economy, including filling the shortage of human resources in highly intellectual spheres of life of the country.

### **Conclusions**

The importance of this problem is that economic and technological progress requires new views and new approach. As the studies of different scientists show, women and men react differently to the solution of the problem. In this regard, the countries of the world and Kazakhstan face the importance of unlocking the hidden potential of women-scientists for economic development. Earlier studies of other scientists, reports of international organizations and experience of foreign support of women scientists were analyzed. Summarizing the results, for the development and support of women scientists we propose:

- build active support at the leadership level for gender equality in science and innovation. Confirm leadership support and manage at the organizational level the implementation of gender equality and human rights measures;
- equal opportunities, inclusion and non-discrimination. Provide opportunities to transition to flexible work arrangements, take extended leave, and return to work in positions with equal pay and equal work status. Provide opportunities for childcare and caring for dependents by providing services, resources and information to both women and men;
- education and professional development. Ensure equal access to all types of education and professional development programs in science and innovation;
- health, safety and freedom from violence. Work with staff to identify and address safety issues, including women's safety, during working hours, on the way to and from work, and on business trips, etc.

To summarize, achieving gender equality in academia is not only the right development goal, it is also a sound approach to economics.

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### Әйелдерді ғылымға тартудағы шетелдік тәжірибені талдау

#### Аңдатпа:

**Мақсаты:** Мақаланың мақсаты — Қазақстан үшін ұсыныстар әзірлеу мақсатында әйел ғалымдарды қолдаудағы шетелдік тәжірибені талдау.

**Әдісі:** Әдістемені таңдауда кешенді тәсіл қолданылды. Зерттеу әдістері ретінде жалпы ғылыми әдістер пайдаланылды, атап айтсақ: диалектика, жүйелі көзқарас, талдау және синтез әдістері, типология, жалпылау және нақтылау. Яғни, әдістеме бөлімінде шетелдік құжаттар негізінде әлемдегі әйел ғалымдардың жағдайын талдау үшін қолданылатын әдістер жиынтығы бар.

**Қорытынды:** Зерттеу барысында әлем елдеріндегі ғалымдардың жалпы санындағы әйел ғалымдар үлесінің көрсеткіштері қарастырылды. Посткеңестік елдерде ғалым әйелдердің үлесі 50 %–дан асатыны, дамыған елдерде ғалым әйелдердің үлесі салыстырмалы түрде төмен екені анықталды. Мұнда, біріншіден, біз дамыған елдердің көптеген ғалымдарын, екіншіден, көптеген шетелдік әйел ғалымдарды көре аламыз. Ал Қазақстан мен ТМД елдеріндегі жағдай керісінше. Сонымен қатар, әлемнің жетекші елдеріндегі әйел ғалымдарды қолдау бағдарламалары талқыланды.

*Тұжырымдама:* Қорытындылай келе, шетелдегі әйел ғалымдардың мүмкіндіктері мен құқықтары отандық ғалымдарға қарағанда кеңірек. Ел экономикасының дамуында отандық әйел ғалымдардың әлеуеті айтарлықтай. Осыған байланысты Қазақстандағы әйел ғалымдарды қолдау бағыттары ұсынылды. Мақаланың теориялық құндылығы — әйел ғалымдардың мүмкіндіктерін кеңейтуді зерттеу мәселесіне теориялық үлес қосу. Бұл зерттеудің практикалық маңыздылығы ұсынылған ережелер, ал оны мемлекеттік басқару органдары тексере алады.

**Кілт сөздер:** экономика, ғалымдар, гендер, әлеуметтік теңсіздік, негіз, ғылым.

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### **Анализ зарубежного опыта вовлечения женщин в науку**

#### **Аннотация:**

*Цель:* Целью данной статьи является анализ зарубежного опыта поддержки женщин-ученых с целью разработки рекомендаций для Казахстана.

*Методы:* В данной статье использовался комплексный подход к выбору методологии. Методы исследования были в целом научными, это — диалектика, системный подход, методы анализа и синтеза, типология, обобщение и уточнение. То есть раздел «Методология» включает в себя набор методов, используемых для анализа положения женщин-ученых в мире на основе зарубежных документов.

*Результаты:* В ходе исследования были изучены показатели доли женщин-ученых среди общего числа ученых в странах мира. Было установлено, что в постсоветских странах доля женщин-ученых составляет более 50 %, в развитых странах доля женщин-ученых относительно невелика. Здесь, во-первых, мы видим большое количество ученых в развитых странах, а во-вторых, большое количество иностранных женщин-ученых. А в Казахстане и странах СНГ ситуация прямо противоположная. Кроме того, были обсуждены программы поддержки женщин-ученых в ведущих странах мира.

*Выводы:* В заключение отметим, что возможности и права женщин-ученых за рубежом шире, чем у отечественных ученых. Потенциал отечественных женщин-ученых не раскрывается в развитии экономики страны. В связи с этим были предложены направления поддержки женщин-ученых в Казахстане. Теоретическая ценность исследования заключается в том, чтобы внести теоретический вклад в проблему изучения вопросов расширения прав и возможностей женщин-ученых. Практическая значимость данного исследования заключается в предложенных рекомендациях, которые могут быть проверены органами государственного управления.

**Ключевые слова:** экономика, ученые, гендер, социальное неравенство, *stem*, наука.