

The impact of scientists on environmental protection: from scientific research to practical developments (gender aspect)

Dana Kangalakova^{1,*}, *Zaira Satpayeva*¹, and *Kanat Kangalakov*²

¹Institute of Economics Science, Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan, Almaty, Kazakhstan

²Satpayev University, Almaty, Kazakhstan

Abstract. Environmental protection is one of the world community's main tasks for preserving planet Earth. This study raises the issue of the importance of the role of scientists and researchers in ecology and the environment. In this regard, this study aims to analyze the publication activity and patent developments of scientists in the field of environmental protection from a gender perspective. The study shows that recently, due to changes in climatic and environmental conditions, scientists have been actively publishing and patenting scientific research aimed to reduce the effects of industrial development and the ecological footprint. In addition, it was revealed that there is a vast potential hidden in the gender aspect, which can contribute to increased research activity and diversification of developments. This document serves as a valuable source of information for policymakers, researchers, and those interested in environmental protection.

1 Introduction

Environmental protection is one of the critical issues facing international organizations and countries, including scientists. The development of economic and industrial processes, agriculture, urbanization, and innovative technologies has led to more and more interventions in the environment, which causes damage to the environment. Interference in the environment has consequences, such as air pollution, reservoirs, and the biological component of the earth. All changes have the opposite effect on the planet's inhabitants in the form of natural disasters, climate change, the creation of new diseases, the extinction of animals, etc. [1-3]. The consequences of these changes can be catastrophic, threatening people's health and well-being. In this regard, effective solutions will require research on environmental protection issues. In this case, the scientific potential of scientists is of particular importance, and their research will help to understand the environment better and use scientific developments to reduce humanity's impact on the world's ecology. The contribution of scientists can be viewed from different angles. This may be reflected in monitoring, where scientists observe changes in the environment and can identify their

* Corresponding author: dmuratbekovna@mail.ru

sources for a quick response to the problem. Also, scientists are the source of the idea of technology to reduce the ecological footprint. In addition, scientists can influence policy decisions regarding the environment [4-7]. Thus, researchers can contribute in three directions: firstly, to investigate a scientific problem; secondly, to act as a developer and implement the technology into use; and thirdly, to be involved in political decisions regarding the environment [8]. Thanks to scientists' research, countries will have the opportunity to prevent environmental disasters and minimize their ecological footprint. This study aims to analyze the publication activity and patent developments of scientists in environmental protection from a gender perspective.

2 Methods

The influence of scientists on environmental protection has been preparing for the last ten years as society feel the effects of human intervention on the environment. Many authors have studied this problem [9-11]. This study covers a set of methods and several analysis tools. The research algorithm consists of several stages (Fig.1).

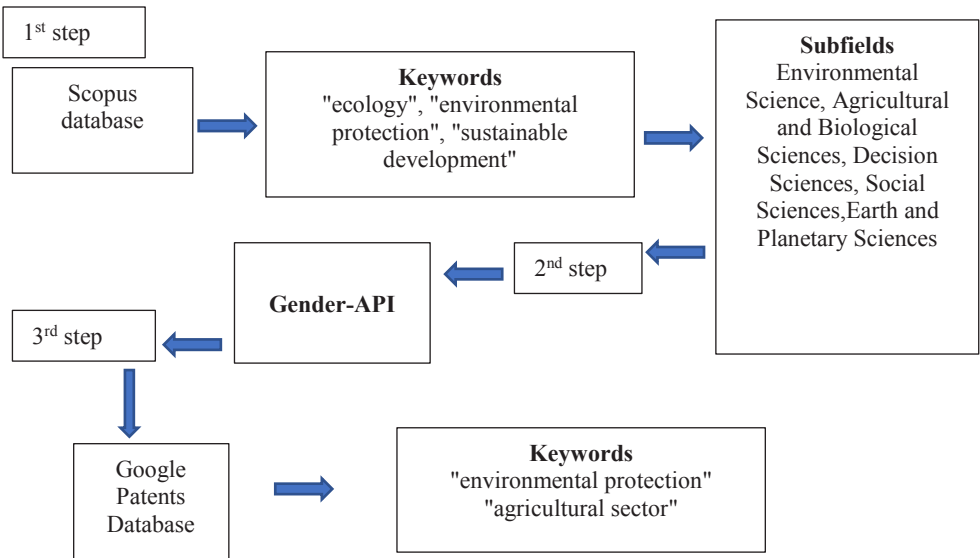


Fig. 1. Design of the study.

In the first stage, the Scopus analysis method and database were used, where articles were sorted by the keywords "ecology," "environmental protection," and "sustainable development." In the parameters section, the sciences fields were selected separately: Environmental Science, Agricultural and Biological Sciences, Decision Sciences, Social Sciences, and Earth and Planetary Sciences. The data was collected by the number of publications, by country. In the second stage of the study, data from the Scopus database was analyzed and processed using the Gender API program, which sorts the authors of the publication by gender. In the third stage, data from the Google Patent database was used, where 137 patents were selected using the keyword "environmental protection" and were divided by gender. The research methodology aims to identify the popularity of environmental problems among scientists.

3 Results and discussion

The popularity of environmental topics is growing, as evidenced by the dynamics of scientists' publication activity in the Scopus database. Figure 2 (a) shows the number of publications for 2016-2024. The data indicate a positive growth trend, and the number of publications in the first three quarters of 2024 exceeds the figure for 2023, which indicates the popularity of the topic of environmental protection. Figure 2 (b) shows the number of publications related to environmental protection in the agricultural and biological sciences field, indicating the number of publications in 2024 and 2023. This amounts to 31 publications. A positive trend is also observed in the decision sciences, social sciences, and Earth and planetary sciences (Figure 2 (c)), where scientists published 44 publications in 2024. Thus, the number of scientific publications is growing yearly, indicating the concentration of scientists' work on environmental protection issues.

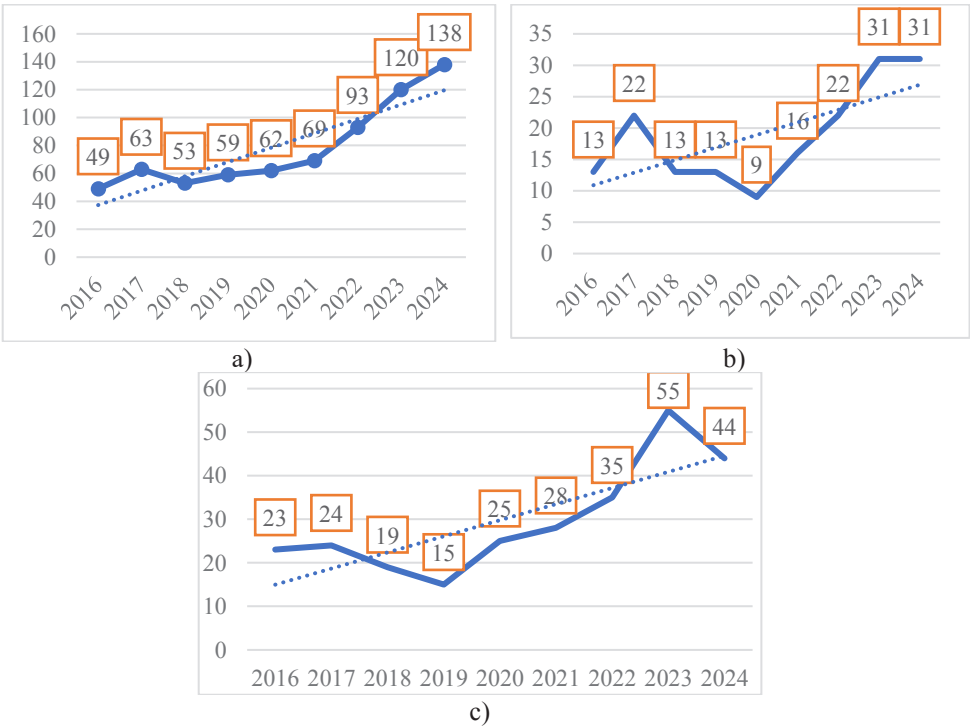


Fig. 2. Dynamics of the productivity of scientific publications from the database (a - Environmental Sciences, b- Agricultural and Biological Sciences, c - Decision-making sciences, social sciences, Earth and Planetary Sciences)

Figure 3 shows the activity of scientists in environmental research by country.

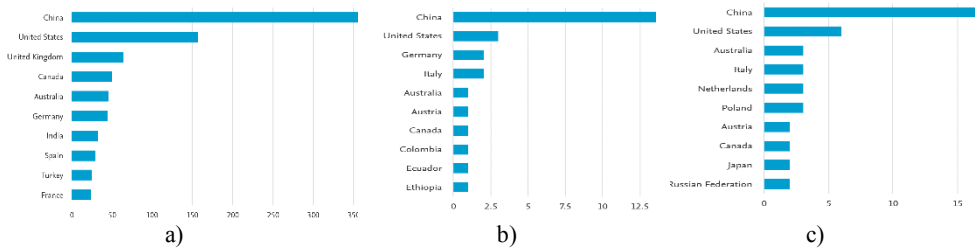


Fig. 3. Dynamics of the activity of scientific publications by country (a - Environmental Sciences, b- Agricultural and Biological Sciences, c - Decision-making sciences, social sciences, Earth and Planetary Sciences)

The data show that scientists from China and the United States are dealing with the issue of solving environmental and environmental problems. As we all know, rapid economic growth and industrialization in China have led to substantial environmental problems, including soil depletion and air and water pollution. At the same time, the United States also has massive production forces that pollute the air with greenhouse gases, which affect the climate. As the most prominent countries and economies in the world, both countries are influenced by global climate change, and both countries have a substantial scientific base for research on environmental problems. Both countries are implementing major national programs to reduce their carbon footprint and develop a closed-loop economy. For example, China is actively promoting the concept of "ecological civilization" included in government policy, and the United States is investing in a "green" economy as part of a program to reduce emissions and develop renewable energy.

Research shows that women and men may have different approaches to environmental issues, as women are often concerned about issues related to public health, access to clean water, food, and sustainable development at the local level. In this regard, women scientists are more sensitive to environmental issues, and the involvement of more women scientists leads to the diversification of scientific research. Based on this, with the help of the Gender API program, publications were divided by the first author based on gender. Figure 4 show data on the publication activity of scientists on gender.

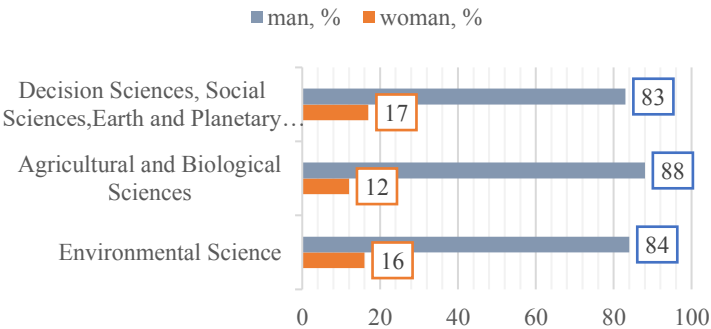


Fig. 4. Publication activity of scientists on gender in 2023-2024.

The data in Figure 4 shows that male scientists predominate in scientific research on environmental protection, while the share of publications by female scientists is only 17%. A similar trend is observed in scientists' publication activity in the agricultural sector and in decision-making, where the proportion of female authors is 12% and 16%, respectively. As mentioned earlier, increasing the activity of women researchers will lead to the diversification of scientific research, which will positively impact the overall scientific

potential of solving environmental problems. Innovations and technologies are the results of scientific research by scientists since their developments serve as the basis for technological progress. In the research process, new knowledge is generated, followed by innovative technologies and products. To do this, scientists collaborate with business structures and implement their research through patented innovations. Scientists often work on breakthrough technologies that can fundamentally change industries and markets. Such technologies range from renewable and environmentally friendly energy sources to environmentally friendly bioenergy. Patents obtained as a result of such research can protect unique technical solutions and become an essential tool for environmental protection.

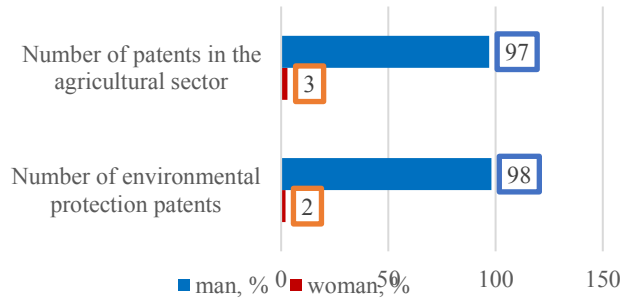


Fig. 5. Number of patents related to environmental protection and the agricultural sector by gender.

Figure 5 shows data from Google patents where 200 relevant patents are selected. Also, these patents were divided by gender into male and female using the Gender API program. Patent activity shows that male scientists are more inclined to create new technologies and developments in this area than women. There are several reasons for this. First, women scientists often choose sciences related to sustainable development and the social sphere of environmental protection, which are less focused on technological innovation and patenting. For example, they may focus on issues of biodiversity conservation or environmental pollution prevention, where patents are not used as often as in technical areas related to equipment and materials development. Secondly, women scientists often need greater access to laboratory equipment, infrastructure, and software, reducing their innovation ability. The third reason is that women scientists need more connections to promote scientific developments, which limits their participation in patent activities.

4 Conclusion

Scientists play a crucial role in environmental protection. The research results show that in recent years, scientists have published many publications demonstrating a high awareness of the problem of the environment and a desire to solve it. In particular, scientists from China and the United States actively develop evidence-based solutions to reduce environmental risks. From a gender perspective, it is observed that female scientists are less active in research on this issue and less enterprising in developing and implementing innovative technologies for environmental protection. However, human capital is a powerful engine for creating new knowledge and developments. In this regard, the scientific potential in this field can be activated at the expense of women scientists, which will contribute to the differentiation of research results. A similar situation is observed in the development of patents. Patent activity is vital for commercializing scientific developments and is the basis for the ecological solution of environmental problems. Patents in the field of environmental protection contribute to the emergence of new technologies aimed at reducing emissions of harmful substances, saving natural resources, and increasing resilience to climate change.

Thus, the contribution of scientists to patent activities stimulates innovations that help minimize the impact of humanity on nature and contribute to long-term sustainable development.

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