International joint research: current situation and challenges for the Japan-Russia collaboration in the field of agriculture

Anna Lyude¹, Boris Boiarskii² and Hideo Hasegawa¹

¹Niigata University, 950-2181, Niigata prefecture, Niigata, Japan
²Federal State Budget Scientific Institution All-Russian Scientific Research Institute of Soybean, 675-000, Blagoveschensk, Amur Region, Russia

E-mail: lyudeanna@gmail.com

Abstract. International communication has sharply increased between educational and research institutions in the various sciences between Japan and Russia amidst globalization's rapid progress. Niigata University has been deliberately increasing collaboration with counterparts in the Russian Far East in the field of agriculture. However, literature comprehending current trends and issues of the bilateral joint research is insufficient. It implies strategic evaluation of the existing projects' efficiency and allocation of future collaboration tasks and funding. This study aimed to grasp the actual situation of Japan-Russia international joint research and its implications for agriculture. The authors used the Web of Science database aggregated by Clarivate Analytics to evaluate the general condition of research output and international joint research in both countries, fields of bilateral co-authorship, and Niigata university collaborative projects' results in terms of publication output in agricultural sciences. Results demonstrated steady efforts to promote international joint research in both countries. However, in terms of the research field, the bilateral relations are strongly manifested in materials science and physics, where the co-authorship rate is high. Agricultural sciences remain insignificant in bilateral cooperation. The number of co-authored publications has slightly increased due to the projects run by the Niigata university from 2015, both in Russian student enrolment and joint research specializing in agriculture. Therefore, the present study concluded that further profound qualitative and quantitative research on factors fostering bilateral collaboration, including international students' role, is needed.

1. Introduction

Since the Japan-Russia Summit meeting in May 2016, when the "8-Point Russian Economic Cooperation Plan"[1] was presented, cooperation between Japan and Russia has been given great importance. Against the backdrop of the "radical expansion of human exchange" included in the 8-point plan, in 2017, Hokkaido University and Niigata University jointly proposed the " Human Resource Development Platform for Japan-Russia Economic Cooperation and Personnel Exchange (HaRP Platform) " which was established as a project to strengthen the global expansion capabilities of Japan and Russia. "Association of Institutions of Higher Education of the Russian Federation and Japan" was established and has gradually expanded to 54 universities in two countries. In line with the 8-point Cooperation Plan between Japan and Russia, these projects endeavor to help fundamentally expand and develop bilateral exchanges in eight fields: health and medical care, city development, exchanges between small and medium-sized companies, energy development, promotion of industrial
diversification, industrial promotion in the Far East, cooperation in developing advanced technologies, and expansion of people-to-people exchanges [2].

In addition, in an era when science and technology innovation activities are expanding beyond national borders, in order to enhance competitiveness, both countries announce policies to build an international research network, to create a mechanism for efficient utilization of intellectual resources spread around the world, and to promote international joint research. To become more involved in global innovation networks, the Russian government launched "Project 5-100" (21 universities) in 2013, and the Japanese government launched the "Top Global Universities Project" (13 universities) in 2014. Top-tier universities in each country were selected for their potential to be ranked in the top 100 universities globally and to increase the share of respected counties in the global research output, including joint research. Japan had been widely criticized for the low speed of globalization, but it has taken the internationalization of Japan’s universities beyond conventional frameworks. Such programs as the 300,000 International Students Plan and global human resource development [3] were also launched.

To make decisions concerning programs’ efficiency and future development, relevant governmental institutions, funding entities, and other stakeholders need tools to evaluate an output resulting from collaborative scientific work. The statistical analysis of scientific literature is a tool for evaluating scientific productivity by different variables [4]. At the same time, it is a modern technique for the evaluation of international scientific communication activities. Usually, the number of co-authored papers, which is the primary publication media of research activities results, is focused as an objective evaluation indicator of international scientific collaboration efficiency [5]. At the same time, the experience of multiple projects run by the Niigata University in the field of agriculture revealed that research collaboration and co-authored paper writing are not always equal. Moreover, there is no clear definition of success or failure of international collaboration as seen from the society and external funding organizations. Previous studies in the Japan-Russia cooperation in the agricultural sciences are scarce.

Based on the above problem statement, the present study assumes that a more substantive and objective review of existing bilateral projects' achievements and results would remove barriers to international exchange and promote smoother joint research between Japan and Russia. Assuming that to grasp the actual conditions and allocate efficiency criteria of the international collaboration will not be an easy task, by providing relevant bibliometric background and a Niigata University case example, this study aims to facilitate future quantitative and qualitative research.

Against the background of expanding and amid the strong demand for cooperation between Japan and Russia in the field of agriculture, authors are convinced that collaborative research in this area has significant potential. This study aims to promote the development of Japanese-Russian research in the field of agriculture, where international collaboration tends to lag behind while providing implications for international joint research across disciplines.

2. Materials and methods
Quantitative analysis of this research is based on the data aggregated by the Clarivate Analytics, Inc. Web of Science (WoS), which was accessed through the Niigata University domain. To identify trends in Japanese-Russian research collaboration, basic bilateral co-authorship data during the 1991-2020 fiscal year in terms of the number of papers was analyzed. To analyze data from the Clarivate Analytics Citation Index source list, R Software 4.0.2 was used. R package ‘bibliometrix 3.0’ was used to analyze bibliographic and citation databases and visualize the results.

The qualitative part of this study addressed issues in the collaboration between Japan and Russia based on two programs run by the Niigata University, Japan, from 2015.

3. Results and discussion
3.1. International joint research status in Japan and Russia
In terms of number of scientific papers, which is one measure of R&D outputs, the number of Japanese
papers (the average of PY2016–2018) is ranked 4th after China, the United States, and Germany, when counted by the fractional counting method that measures the degree of contribution to paper production. Japan is ranked 9th both in the number of adjusted top 10% papers and the number of adjusted top 1% papers. According to the Institute for Scientific Information, in 2018, it devoted over 3% of GDP to R&D, higher than the EU average of 2% and the 2.7% invested in the US. The number of researchers in Japan in 2019 was 678,000 (in FTE: Full-time equivalent), the third largest following China and the United States [6]. In the OECD evaluation for 2018, 9.9 researchers per one thousand were employed in the country [7].

Remaining one of the most research-intensive countries globally (figure 1), Japan faces several major challenges. According to the National Science Board, the percentage of international co-authored papers in 2016 was 27.4% in Japan, the lowest among the science and technology developed countries, compared to 54.8% in France, 51% in Germany, 57.1% in the United Kingdom, and 37% in the United States. While the international co-authorship rate in the world has been steadily increasing over the past 30 years, the number of natural science papers in Japan decreased at an average rate of 1.3% between 2006 and 2016, and Japan's share of the world's papers decreased from 7.0% to 4.2% [8].

The White Paper on Science and Technology, 2013 [9], establishing strategical development program for until 2020, argued that the stagnation of science and technology activities was partly due to inactive international collaboration and concluded that one way to revitalize Japan's research activities is to promote collaborative research across national borders. The National Institute for Science and Technology Policy (NISTEP) in 2020 research study aimed to reveal the factors behind the drop in the number of papers produced in Japan, scrutinized long-term macro data on the number of papers, researchers, and R&D expenditures at Japanese universities since the 1980s. The results highlighted factors for the drop in the research output in Japan since the mid-2000s. First is the decrease in the number of post-graduate (philosophy doctor or PhD) students, which dropped down about 30% from the 2004th year peak. Another factor is the decrease in expenditures on research implementation (since around 2010) [10]. The decrease in the number of PhD students in Japan, especially in the field of science, engineering and agriculture, is due to multiple complex factors, including a shrinking and rapidly aging population, the decline in the number of children, which cannot be addressed in the short term. In this context, the expansion of international student acceptance is gathering attention as an important solution. In the United States, leading the world's research, nearly half of graduate students and post-doctoral researchers (PD) are international students, and the role of foreign graduate students and PD is essential when considering internationalization in science[11].

The number of international co-authorship papers and co-authorship rate and its change depends not only on the country but also on the discipline. A country's distribution of publications by field of science can indicate its research priorities and capabilities. The largest global field of science with the international co-authorship rate exceeding 30% in 2016 was physics, which had the highest co-authorship rate compared to other disciplines, followed by clinical medicine, chemistry, materials science, and engineering at about 20% [12]. In the Japanese science and technology research portfolio analyzed by the National Science Board by field in 2016, engineering accounted for 17.1%, and physics accounted for 12.4%, while agriculture accounted for only 1.5%, showing to be a minor field in international joint research [8].

The total number of researchers in Russia in the OECD evaluation for 2018 was 405,772 (in FTE: Full-time equivalent) in 2019; there were 5.6 researchers per one thousand employed in the country [7]. The Russian government has been undergoing a fundamental reform of Russia's two main research and education systems - the Russian Academy of Sciences and Higher Education System - for the last 15 years, shifting financial resources in order to secure a leading position in the international scientific arena (the target is the fifth place). While in 2016, the indicator of the science intensity of GDP, i.e., the share of spending on research and development in GDP, was 2.2% in the world, in Russia it was two times lower (1.1%) [12]. However, placing scientific research performance based on scientific metrics at the center of the entire reforms made Russia leap from 14th to 7th position in the list of the world's largest-producing science regions, as measured by publication output, between 2008 and 2018. The
average annual growth rate in article publication amounted to 9.88%, rising Russia’s global share in the number of publications to 3.19%, more than doubled during this period (figure 2) [13]. In 2018, Russia collaborated over 23% of its total publications (relatively low rate) [13].

Figure 1. The number of articles co-authored by Japanese authors with other countries: A. Publication activities by years, from 1997 to 2020. B. The number of articles distributed by co-authoring country.

Figure 2. The number of articles co-authored by Russian authors with other countries: A. Publication activities by years, from 1997 to 2020. B. The number of articles distributed by co-authoring country.

In both countries, however, there is a phenomenon that the number of research and educational institutions mainly contributing to the number of international co-authored papers and to the production of high-profile papers (Top 10% and Top 1% of citations) is very low, being primarily the nation’s ultra-elite universities (figure 3).

Such universities usually have a long history and strong schools in research; have access to voluminous funding both from governmental and private external funding organizations. They produce expected and stable results steadily and so create favorable conditions for further smooth access to funding. The situation is very different for educational and research organizations at the beginning of their joint research endeavors, particularly in the fields like agriculture, traditionally lagging behind in terms of their impact on the research output.

In 2013-2018, the disciplines with the highest international co-authorship rates were electrical and electronic engineering, interdisciplinary materials science, interdisciplinary chemistry, cancer research, and applied physics [12]. The present study identified 7,143 bilaterally co-authored papers and 22,260 multilateral co-authored papers for the period 1991-2019 in the WoS Core Collection. Observed results revealed that the top 4 disciplines of Japanese-Russian co-authorship and visible stagnation of agriculture-related research validate the global trends (figure 4) [14].
Figure 3. The number of papers in co-authorship between Russia and Japan distributed by Institutions (during 1991-2019 fiscal years, WoS Core Collection).

Figure 4. The number of co-authored papers between Russia and Japan by research areas during 1991-2019 fiscal years, WoS Core Collection.

3.2. Niigata University international exchange and collaboration projects with Russian counterparts in the field of agriculture

In the university group classification by the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT) using the share of the number of papers, Niigata University belongs to Group 3 (0.5% to 1% share) [6], and there is plenty of room to improve its position. Niigata University has cooperated with Russia for 26 years in the fields of medicine, natural and social sciences, and since 2014, the university has been purposefully accelerating its activities in the area of agriculture.

Niigata University has pursued both international joint research and international student acceptance programs. In the field of agriculture, it has been running two programs. First is the government-sponsored (MEXT) international students Special Allocation Program "the Higher Agricultural Specialist Program for the Russian Federation Far East", since 2015. The first stage of the program was oriented on enrollment of PhD level students only; from 2018, the program expanded for both the masters and PhD student’s enrollment. The second project was selected by the Ministry of Agriculture, Forestry and Fisheries, Japan (MAFF) as a "Pilot program of international collaborative research (Collaborative research based on a joint call with Russia)". It started in 2017 under the MAFF "Projects for promotion of strategic international collaborative research in agriculture, forestry and fisheries" auspice. This project has engaged research with one educational and two research partner institutions in the Russian Far East on three different research topics.

During the project realization, and thanks to the trustworthy relationships earned through years of collaboration, it became possible to construct a broad and multi-layered human and intellectual network
throughout the country. The research team was able to expand research to new horizons, acquire novel research methods, access valuable resources of the partner country, and obtain rich results. Meanwhile, the project has faced various difficulties. In terms of project operation, there were troubles with English as a lingua franca. Severe problems were imposed by differences in the fiscal year start (April in Japan and January in Russia) and peculiarities in accounting systems and funding management in two countries. Difficulties in obtaining genetic resources and equipment necessary for research were very discouraging. The project faced the limitations of research scope caused by the difference in expectations, experience in international activities, managerial practices, resources, and research facilities of all four partner institutions. Authors of the present study are convinced that if all partners had access to information on the above peculiarities of the Japanese and Russian research management systems in advance, during the preparation period, it could have helped create a more efficient team structure and collaborate with less stress. Therefore, authors are assured that the present and future analysis of the bilateral joint research in the underexplored agricultural sciences area is vital.

PhD students from the Far East of Russia enrolled through the Special Allocation Program actively participated in the joint research with domestic and overseas research institutes and related companies and confirmed that young researchers strongly contribute to strengthening the team and often become the bridge of trust in domestic and overseas network creation. The number of enrolled PhD students in the first phase of the project was small: three persons in 2015, five in 2016, and three in 2017. However, even a small case of the Niigata University program with a small number of students has shown promising results in terms of the number of internationally co-authored papers (figure 5).

Figure 5 shows achievements of the research teams formed with the participation of the PhD students of the Special "the Higher Agricultural Specialist Program for the Russian Federation Far East" at the Graduate School of Science and Technology against the background of total bilateral and multilateral co-authorship of researchers from the Niigata University and Russia. Given that WoS publications take up to two years from the acceptance, figure 5 does not yet reflect the full picture. Three of the graduates continue to contribute to the activation of the scientific collaboration as post-doctoral researchers. They have stimulated publication activities of their alma mater organizations in Russia, of the Niigata University, and involved new collaborators from entire Russia.

It is important to note that neither Niigata University belongs to the Top Global Universities, nor the research and education counterparts from Russia belong to the Project 5-100 or other global frameworks. Implications from the abovementioned collaborative experience would be useful to a broad range of research and educational organizations interested in the topic.

4. Conclusion
The share of joint research in agricultural sciences in the total volume of collaboration between Japan and Russia does not fully correspond to the importance of the field, which is supposed to contribute to the scientific output and ensure the food security of both countries.

Future research is necessary to systematically evaluate the factors that can improve research efficiency or create barriers and position international students' role in international collaborative
research. In order to do so, bilateral research diversity data such as the number of researchers, their organizational allocation (including enrollment of PhDs, PDs in the research teams) need to be analyzed. Further, it is essential to analyze the process of bilateral co-authorship network development, co-authored papers quality (the number of top 10 % and top 1% citations), the origin of the research funds, and the financial burden distribution. It is advisable to conduct a questionnaire survey to obtain such qualitative variables as the study's motivation, team configuration, study period, project management, and research environment. Practitioners of the Russo-Japanese joint research in the agricultural sector could share their valuable lessons learned from collaborative research and co-authored papers creation process.

This study's results should be disseminated to the relevant ministries and research funding agencies of both countries, contributing to more efficient evaluation of joint research results and creating a better funding allocation strategy. They will strengthen the Japan-Russia international research collaboration and contribute to the facilitation and acceleration of multilevel human resource interaction and research revitalization.

References

[1] MOFA 2016 Japan-Russia Summit Meeting https://www.mofa.go.jp/erp/rss/northern/page4e_000427.html
[2] Central Office for HaRP Hokkaido University 2017 Inter-University Exchange Project Human Resource Development Platform for Japan-Russia Economic Cooperation and Personnel Exchange (HaRP) https://russia-platform.oia.hokudai.ac.jp/en/deployment-power-en/
[3] MEXT 2018 Study in Japan Global Network Project https://www.mext.go.jp/en/policy/education/highered/title02/detail02/1373922.html
[4] Braam R R, Moed H F and van Raan A F J 1991 Mapping of science by combined co-citation and word analysis. II: Dynamical aspects J. Am. Soc. Inf. Sci. 42 252-66
[5] Glenisson P, Glänzel W, Janssens F and De Moor B 2005 Combining full text and bibliometric information in mapping scientific disciplines Inf. Process. Manag. 41 1548-72
[6] National Institute of Science and Technology Policy (NISTEP) 2020 Digest of Japanese Science and Technology Indicators 2020 (English ver.) Research Material-295 Science and Technology Indicators, and Scientometrics (Tokyo:NISTEP) p 24
[7] OECD 2020 Research and development (R&D) - Researchers https://data.oecd.org/rd/researchers.htm
[8] NSF - National Science Foundation 2018 Science and Engineering Indicators 2018 https://www.nsf.gov/statistics/2018/nsb20181/
[9] MEXT 2013 White Paper on Education, Culture, Sports, Science and Technology https://warp.da.ndl.go.jp/info:ndljp/pid/11402417/www.mext.go.jp/b_menu/hakusho/html/hpab201301/1360652.htm
[10] National Institute of Science and Technology Policy (NISTEP) 2020 Analyses on the production of scientific publications in Japanese universities using long-term input and output data. Discussion Paper 180. (Tokyo:NISTEP) p 94
[11] Igami M, Nagaoka S and Walsh J P 2015 Contribution of postdoctoral fellows to fast-moving and competitive scientific research J. Technol. Transf. 40 723-41
[12] Moed H F, Markusova V and Akoev M 2018 Trends in Russian research output indexed in Scopus and Web of Science Scientometrics 116 1153-80
[13] NSF - National Science Foundation 2019 Publications Output: U.S. Trends and International Comparisons | https://ncses.nsf.gov/pubs/nsb20206/publication-output-by-region-country-or-ec
[14] Clarivate Analytics 2020 Web of Science Core Collection http://apps.webofknowledge.com