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Analysis on research activities in developing countries and international
networking of researchers

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[Summary]

1. Background and objectives of the survey

Researchers in developing countries, mostly in Asia, are expected to be promising partners when Japanese researchers try to expand their international academic network. Therefore, it is critical to understand the status of research activities in developing countries in order to promote Japanese academic activities. For this reason, the primary objective of this survey is to provide quantitative understanding of research activities in developing countries based on scholarly papers in the field of Natural Science, which is considered to be an index to measure the performance of research activities. With regard to researchers who stay in developing countries and publish papers in international journals, details of their activities (e.g., incentives to publish international joint papers or creation of international networking) have been little known so far. The second objective is to shed light on the reality of these research activities and identify the issues to be addressed so as to better understand the outcome of data analysis and learn how to collaborate with researchers in developing countries.

2. Structure of the survey

This survey is organized into two parts. The first part is based on a quantitative analysis on the data of scholarly papers, which consists of analysis on both worldwide studies and case studies targeting six developing countries. Specifically, we analyze the relationship between academic publishing and income level as well as the characteristics of international coauthorship based on Thomson Reuter Scientific's data (National Science Indicators, 1981–2006, Deluxe Version [hereinafter referred to as “NSI 2006”]) and Web of Science [hereinafter referred to as “WoS”]), and then attempt to grasp the trends of countries holding the ownership of sources as well as tendency of coauthor countries, focusing on the six developing countries.

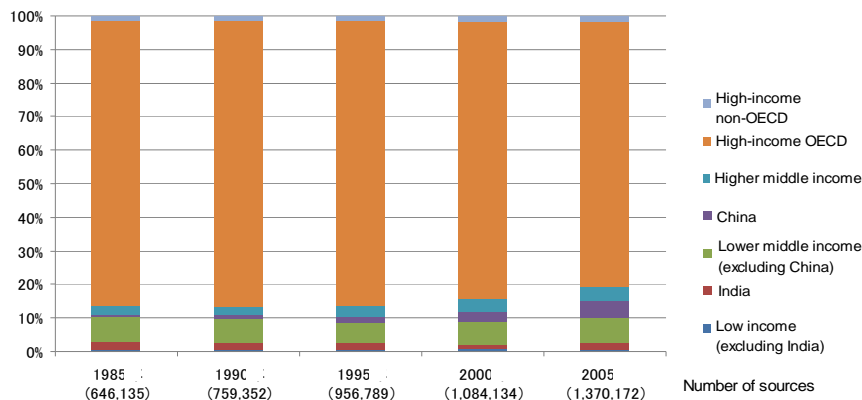
The second part is based on a qualitative analysis to shed light on research status in developing countries, which consists of an interview in the Philippines and Indonesia and its preliminary study in Japan. We will target researchers who stayed in those countries and published a substantial number of papers in international journals, and study the local research environment as well as the status and challenges in education for researchers.

3. Results of data analysis

3.1 Global academic publishing

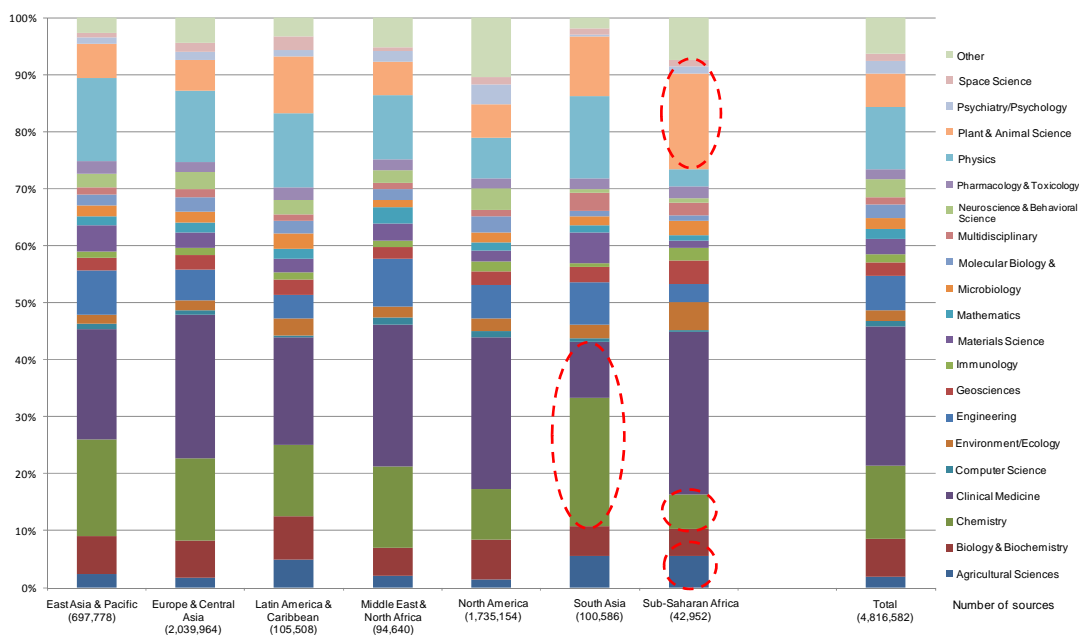
(1) Trends in the number of papers and the status of developing countries

Analysis on data of 161 countries between 1985 and 2005 from NSI 2006 shows that the number of papers increased in all income levels, regions, and countries (India and China are examined separately from the region categorized). The oligopoly of high-income countries slightly weakened (the number of articles increased nearly 3.8 times from 549,813 to 1,077,096 but the share decreased from 85.0% to 78.6%), while the share of middle-income countries including China increased. In the meantime, the share of low-income nations, which represent the lowest income bracket, dropped (i.e., the number of sources excluding India jumped about two times from 4,932 to 9,596, but the share decreased from 0.8% to 0.7%. In Sub-Saharan Africa, the number of articles increased approximately 1.8 times from 6,537 to 11,801, but the share declined from 1.0% to 0.9%).



(2) Subject categories of sources by region

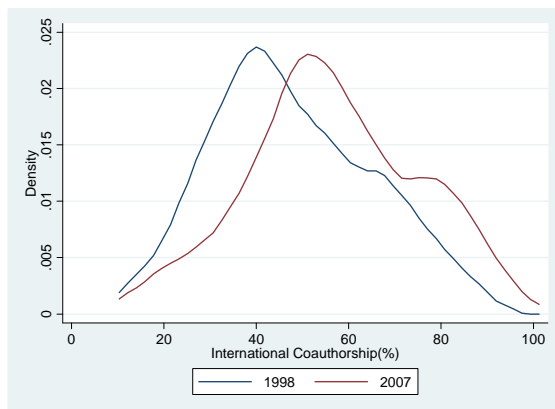
Each region shows a different category structure in academic publishing. In Sub-Saharan Africa, Agricultural Sciences and Plant & Animal Science accounts for a large share, while Chemistry and Physics is scarce, compared with sources of the whole world. In the meantime, South Asia shows that they have a large number of scholarly papers in the field of Chemistry but a small number in Clinical Medicine.



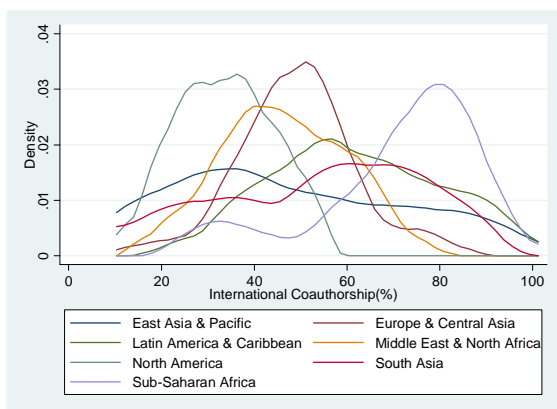
(3) Characteristics of international coauthorship

An analysis of 103 countries using the WoS data calculated by the National Institute of Science and Technology Policy shows that the percentage of international coauthorship rose for these countries over the 10 years between 1998 and 2007. A trend of international coauthorship varies by region. According to regional analysis on international coauthorship by country and by year, Sub-Saharan Africa records almost 80% in the mode (the largest number of countries), which is the highest among seven regions, while that of North America peaks at approximately 30%, which is the lowest. Europe and Central Asia peak at around 50% (see the main text for details).

Movements in the international coauthorship rate (1998 and 2007)

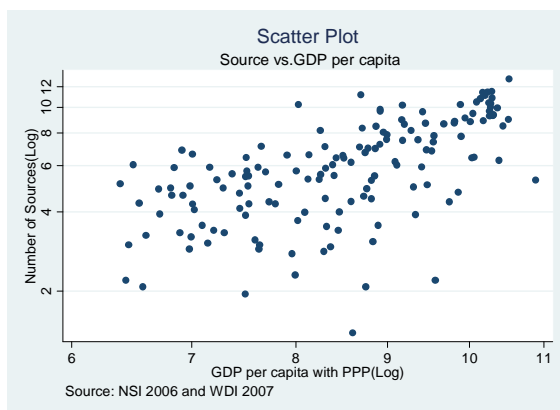


Distribution of the international coauthorship rate by region

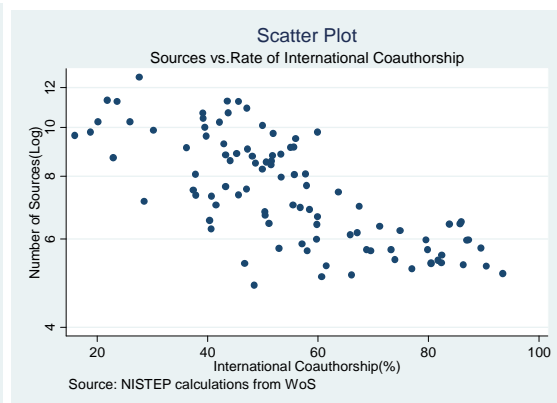


The following scatter plots show a positive correlation between the number of papers and GDP per capita, while negative correlation can be identified between the number of papers and the international coauthorship rate. There could be certain factors behind the relationships among the number of papers, income levels, and international coauthorship. For example, high income levels would activate research activities and as a result increase academic publishing. Furthermore, if a country publishes a large number of papers as deliverables, it means that the country has enough research resources to produce academic articles by themselves, with little need to rely on international coauthorship.

Number of articles and GDP per capita



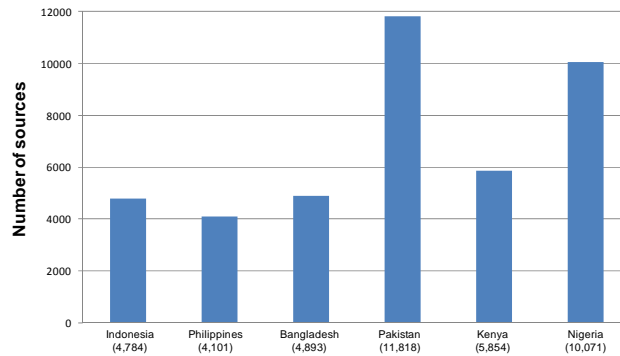
Number of articles and the international coauthorship rate



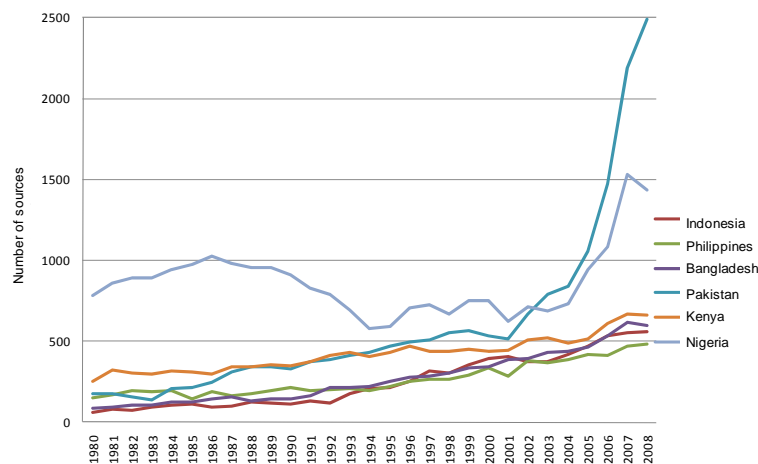
3.2 Academic publishing in six target countries (case study)

(1) Movements in the number of scholarly papers and socioeconomic situation

We chose six countries among nations that published more than 5,000 scholarly papers between 1981 and 2006 as targets for the case study, considering income level (low income level) and regional balance. These consist of two each from three regions: Indonesia and Philippines from Southeast Asia, Bangladesh and Pakistan from South Asia, and Kenya and Nigeria from Sub-Saharan Africa. According to the WoS data, the number of papers published between 1998 and 2008 reached more than 10,000 in Pakistan and Nigeria, while that of the other four countries remained around half that figure (4,101 in the Philippines and 5,854 in Kenya).



The number of papers in the five countries, excluding Nigeria, increased monotonously between 1980 and 2008, although there was a little fluctuation. Pakistan is notable for its rapid increase from 2000. For Nigeria, the number of papers was three times as large as those of the other five countries in 1980, but it began to decline in 1986 and took 20 years (until 2006) to finally return to the same level as before the decline. In Nigeria, the GDP per capita and the average life expectancy declined or remained sluggish during this 20-year period. This suggests that the decline or slump in Nigeria's academic publishing can be attributed to an outflow of researchers triggered by not only aggravated people's lives but also the deteriorated research environment at universities.



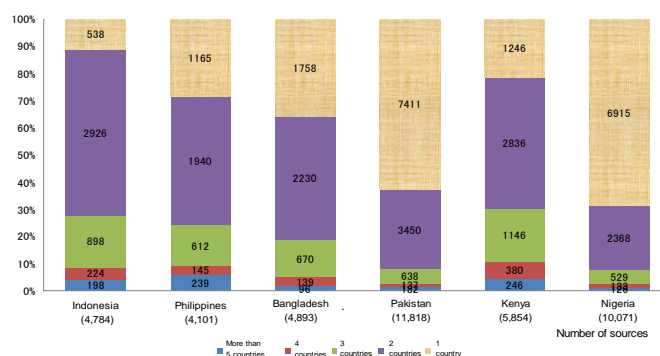
(2) Characteristics of the international coauthorship rate and the ownership of sources

The international coauthorship rate of four countries with a relatively small number of articles is high, ranging from 70% to 90%, while it is smaller in Pakistan and Nigeria with a relatively large number of articles (30–40%). In reality, the international coauthorship rate of these six countries is higher than that of the whole world (18.8%) between 2001 and 2005. With regard to the ownership rate of articles (the percentage of articles that include the name of the given country in the reprint address among the total articles of each country), Pakistan and Nigeria, which have many articles, show almost 80% (78.4% and 79.0% respectively), while Indonesia with a small number of articles shows as low as around 30% (exactly 28.3%).

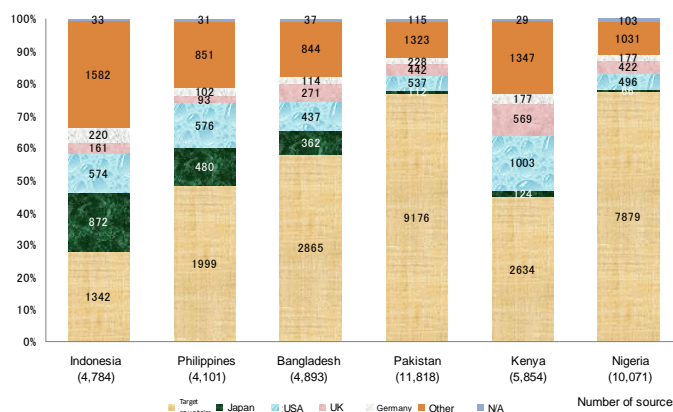
The U.S., Japan, the U.K., and Germany are commonly included in the top 10 countries, which are in the reprint address of the articles produced with six target countries. The U.S. accounts for a larger share in five out of six countries excluding Indonesia than the other major coauthor

countries, while Japan holds an important share in three countries that are geographically closer (Indonesia, the Philippines, and Bangladesh) among the six target countries. It is accordingly considered that the U.S. exerts a great influence on academic publishing in developing countries regardless of regions, while Japan tends to engage in international coauthorship with developing countries that are geographically close and is likely to hold the ownership of the articles.

Number of countries engaged in academic writing

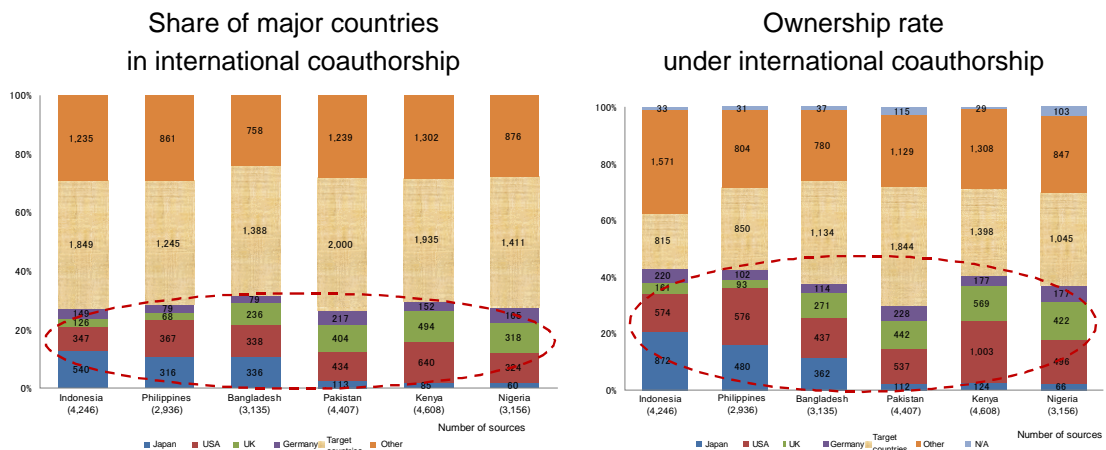


Ownership of sources (%)

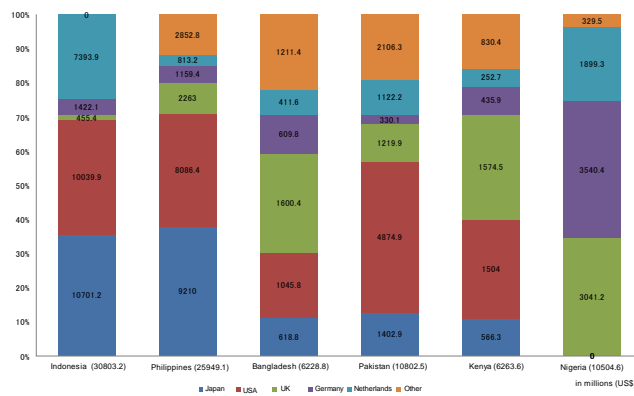


The total percentage of the ownership of four major coauthor countries (U.S., Japan, U.K., and Germany) to the six target countries is higher than their total international coauthorship rate. Therefore, these four countries could tend to play a leading role in international coauthorship. For Japan, the trend can be identified especially with two Southeast Asian countries as the country has many joint papers with them, and it is considered that Japan will often take leadership in academic writing with them.

Coauthorship of the six target countries might be influenced by financial relationships among countries. According to the following fund flow chart by country, which is based on the accumulation of funds between the six countries and the major coauthor countries for 10 years from 1998 to 2007, the U.S. assumes a dominant position in five countries excluding Nigeria. Japan has as large a share as the U.S. in Indonesia and the Philippines (35.7% in Indonesia and 37.8% in Philippines).



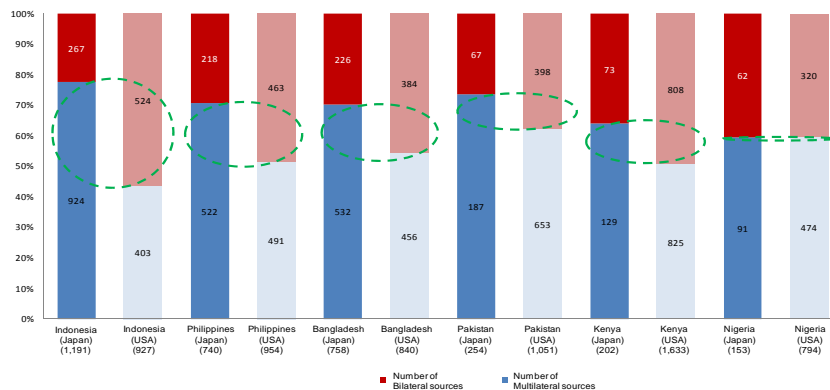
Fund flow chart between target countries and major international coauthor countries (accumulation of 10 years)



Source: Compiled based on OECD International Development Statistics

(3) Characteristics of international coauthorship in Japan

When we compare the characteristics of coauthorship between Japan and the target countries with those between the U.S. and the targets, it can be confirmed that a share of bilateral coauthorship is bigger than multilateral joint writing in regions geographically close to Japan such as Southeast Asia. In the meantime, the difference between Japan and the U.S. becomes narrower in regions that are far from Japan including two South Asian countries and two African countries. The U.S., compared to Japan, has more coauthors who belong to high-income OECD countries (see the main text for details).



4. Interview survey report

4.1 Domestic interview (preliminary survey) report

According to the interview focused on Japanese researchers who have a large number of joint papers with researchers in the Philippines or Indonesia, it was confirmed that the government measures, including acceptance of foreign students and international cooperation, helped exchange with these countries and that coauthorship was mainly conducted in the form of a joint paper with doctoral degree students who returned to their home countries or acknowledgements to natural resource providers. The following ideas were proposed with regard to future support: Research education for foreign students based on an assumption that they will continue research after getting a degree in Japan and returning to their home countries, and assistance to these researchers after their returning to home countries.

4.2 Overseas interview report (Philippines and Indonesia)

Support from the governments and universities to recent research activities

The Philippine government supports a project to organize research promotion measures and enhance graduate schools of Engineering. The Department of Engineering of the University of the Philippines has increased the number of faculty members and reduced their educational responsibility. Furthermore, they have increased faculty's salary, which is often reported as exceptionally low. In Indonesia, the University of Indonesia has introduced a new professor post that focuses on research (with higher salary and less teaching responsibility), and the Bandung Institute of Technology offers rewards to internationally published scholarly papers.

Academic career path of researchers and reasons for returning to home countries

All the target researchers have experienced research training in overseas for a degree. The main reason for returning to home countries after getting a degree was as follows: For the Philippines, family comes first; for Indonesia, an agreement with the sending organization (e.g., researchers are required to serve for a certain period [usually double the duration of overseas study + one year] after returning home) and willingness to contribute to the country were major reasons, in addition to family matters.

Incentives for international coauthorship

International publishing of scholarly papers is highly esteemed as accomplishments in the target universities in the Philippines and Indonesia. In the Philippines, faculty members who seek promotion to a professor post are required to continuously present papers in international journals, while in Indonesia, there are national standards for the evaluation of employment/promotion of faculty (i.e., certain points are given according to accomplishments) and international publishing of research results is provided with high points.

Breakdown of international coauthors and advantages of international coauthorship

Most of the coauthors are academic supervisors in recipient universities or acquaintances from overseas post doctoral period. Coauthorship is often conducted with academic supervisors immediately after researchers' return to their home countries; however, they gradually come to engage in joint writing with co-workers or domestic researchers including their students. In many cases, international coauthorship improves the quality of papers due to availability of a good experimental equipment of coauthors who belong to institutions in developed countries.

Academic supervisors have a substantial amount of international publishing as well as credibility within the academic community; thus, it is also pointed out that papers are more likely to be published in international journals under international joint writing with them.

Treatment of faculty and the research environment

The following factors were pointed out as the constraints of research activities: Insufficient experimental equipment or fewer subscriptions of international journals; heavy educational responsibility; lack of efficient research framework due to outflow like overseas study of excellent graduate students (young faculty) and inefficiency in administrative process. In the Philippines and Indonesia, “research culture” is not strongly rooted; thus, even if researchers have a strong willingness, it is difficult for them to keep up motivation of research. Development of researchers in the next generation due to lack of faculty members with ability to provide research guidance and insufficient treatment of faculty (i.e., low salary) would be their next challenge.

Support from Japan

The Japanese Embassies in the Philippines and Indonesia concern that the status of international students who have completed study in Japan (i.e., whether they return home or remain in Japan) is not well known and they are not well utilized after returning to their home countries. JICA has launched a project to support the Engineering department of major universities in ASEAN, which is highly appreciated among the faculty members we interviewed in both countries, for a great advantage including opportunities for university teaching staff in the region including Japan to know each other.

5. Summary of the results and discussion

In this survey, we attempted to have a quantitative understanding of the research outcomes of developing countries, which used to attract little attention, with focus on international coauthorship based on Thomson Reuter Scientific’s data considering scholarly papers. First of all, we found that the global trend of international joint writing amid the growth of the number of papers is that the international joint writing rate increased for 10 years from 1998, and identified regional differences in the international coauthorship rate.

Secondly, we analyzed six developing countries and found out that a country with a small number of papers shows a high international coauthorship rate, while ownership is low. For these six countries, the U.S., Japan, the U.K., and Germany are the major countries where coauthors belong. The U.S. is more likely to play a leading role in joint academic publishing with all six nations, while Japan is more likely to do so in joint publishing with two Southeast Asian countries

In order to maintain and expand international researchers’ networks, Japan, for example, should maintain the leadership role in those two countries in an advanced manner. They have a framework to motivate faculty to present their research results internationally (e.g., they highly value a paper published in international journals), although there are issues they should address, including the development of a research environment to utilize the system. In the meantime, Japan seems to have many joint papers published with these developing countries by cooperation between international students from these countries and their Japanese academic supervisors. Therefore, what Japan should to support them is to increase the number of foreign students who

study in natural science doctoral degree courses, provide training that considers their return to home countries, and support their research in their home countries.

The objective of this analysis is limited to the understanding of actual status; thus, it may be required to specify factors that have a substantial effect on the level of and change in the number of papers through a quantitative analysis, which would be our next theme related to this study. Furthermore, it might be necessary to get the picture of research activities in countries other than the two Southeast Asian nations.