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## International mobility of doctoral graduates in Japan

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Since 1995, Japan has implemented Science and Technology (S&T) Basic Plans, based on the S&T Basic Law. Each plan covers a period of five years.. Since the inception of the 2nd S&T Basic Plan, Japan has strongly promoted the prioritization of R&D investment, doubling competitive research funding, and enhancement of industry-academia-government cooperation, all with some degree of success. The 3rd S&T Basic Plan put emphasis on the role of “Wisdom,” implying a shift from “hard” to “soft” in areas such as human resources. The 4th S&T Basic Plan started in August 2011. Under this plan two major innovations, Green Innovation and Life Innovation, are expected to be strongly promoted, leading to the creation of new markets and new jobs.

Also emphasized in the 4<sup>th</sup> S&T Basic Plan are promoting basic research and fostering the science and technology personnel, reinforcing the importance of graduate school education. It highlights the significant role played by graduate school education in fostering human resources with high levels of expertise required internationally and in instilling extensive abilities to work actively in diverse fields. To make graduate schools more attractive to students and improve career path environments, it is necessary to respond to various social expectations and promote efforts for improving the quality of education and research. The plan emphasizes management competence, basic knowledge in multiple scientific fields, and robust career development support for students.

At the request of Council for Science and Technology Policy (CSTP), when drafting the 4th plan the National Institute of Science and Technology Policy (NISTEP) conducted follow-up studies on the third S&T Basic Plan. These studies focused on the education systems of universities and graduate schools, innovation systems, and science and technology policies in major countries, and identified the current situations and major

challenges in these fields in Japan.

As one of these studies NISTEP conducted a survey on the diversity of career paths and the international mobility of recent doctoral graduates in Japan. This survey collected career path information for all doctoral graduates from Japanese universities from 2002 to 2006. Data were collected from 414 universities and around 75,000 graduates. This was the first-ever comprehensive survey in Japan on doctoral graduates from all universities in the country offering doctoral courses.

Concerning the general trend of doctoral graduates of Japanese universities, 81% are Japanese and 18% foreign students. Of the Japanese students, 16% are adult students who mainly work in private companies. The number of foreign students has been increasing these years; in particular, the number of Chinese students is growing rapidly.

Among those who completed doctoral courses between 2002 and 2006, approximately half assumed an R&D-related position immediately after graduation. Among graduates of the physical sciences, engineering, and agricultural sciences, the percentage of those taking up an R&D-related position was particularly high. In physical sciences and agricultural sciences, the percentage becoming postdoctoral fellows was also high at around 30 percent each.

As for the locations immediately after completing doctoral courses, 73 % of Japanese graduates remained in Japan, while just 2 % moved overseas. North America and Europe were the main overseas destinations.

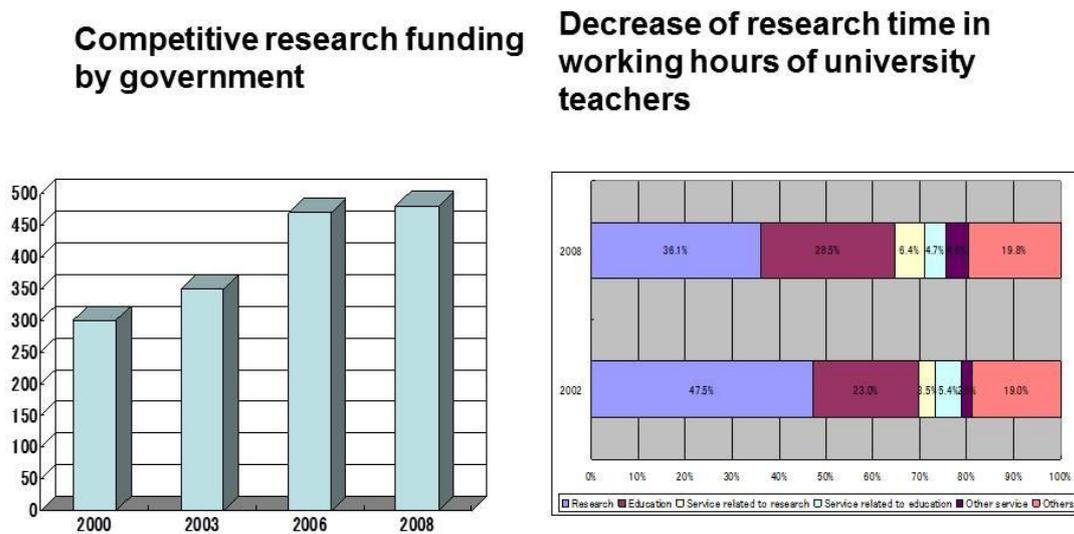
We believe that this figure is too small compared with other Asian countries. Most Japanese graduates who relocated overseas became postdoctoral fellows in the U.S. or Europe. In addition about half of the Japanese postdoctoral fellows in the U.S. returned to Japan after five years.

We surveyed 1,200 senior experts to ascertain why young researchers do not study or work abroad. The reasons pertained to career prospects of a researcher on return to Japan: low financial returns, concern about a dearth of good academic positions for postdoctoral fellows, and a lack of guaranteed positions for working individuals.

There are few posts available to young researchers or postdoctoral fellows in Japanese universities. Moreover private companies prefer recruiting master's degree program graduates rather than doctoral program graduates. One reason of this tendency is that generally Japanese doctors studying at graduate schools sometimes do not have broad perspectives on science and technology, being adept only in knowledge of their specialist fields.

As explained with regard to the S&T Basic Plan, the Government has been increasing its competitive research funding for universities during this five-year period, aiming to

double the 2001 level. Its efforts have been successful to some extent, but the increase in competitive funding has decreased the proportion of research time invested by individual professors and other teachers. Figure 1 shows the results of a survey analyzing the working hours of approximately 400 university researchers. It shows that research time decreased from 47% to 36% on average.



**Figure 1 Competitive research funding and research time**

Another survey shows that it is becoming more difficult for university researchers to set aside 3–4 hours of uninterrupted research time. Consequently, some senior researchers are reluctant to send young researchers to laboratories abroad, due to concerns that the younger researchers’ absence will unduly increase and intensify the workloads in their laboratories.

When analyzing the international mobility of doctoral graduates from Japan, about 90 % of those who stayed in Japan or moved to Korea and China were home country natives, while the remaining 10 % were foreign nationals, who are mainly Japanese, Chinese, and South Korean. On the other hand almost all of those who moved to Southeast/South Asian countries were home country natives, while not many Japanese, Chinese, and South Korean graduates moved to these countries.

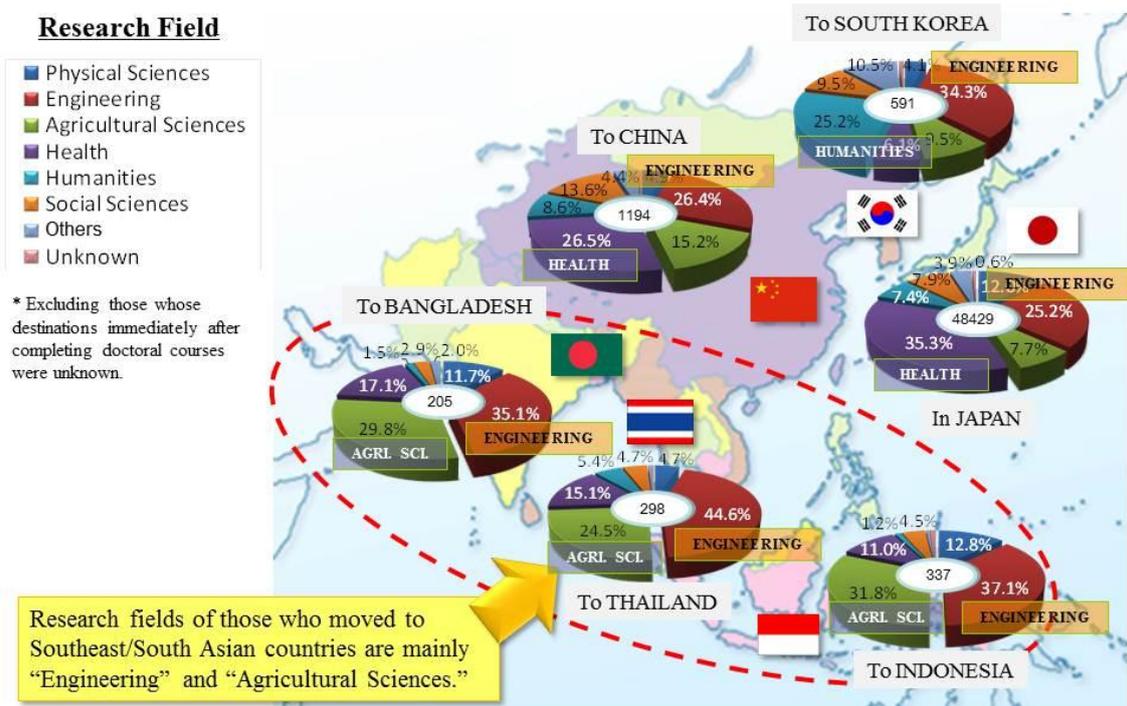
The top 10 overseas destinations are China, the U.S., South Korea, Indonesia,

Thailand, Bangladesh, Vietnam, Germany, Canada, and the U.K. Of those who moved to Western countries, around 70%–80% were Japanese, which sharply contrasts with those moving to Asian countries.

Figure 2 shows the research fields of doctoral graduates moving to Asian countries. Research fields for those who moved to China are “Health Sciences” and “Engineering,” for Korea are mainly “Engineering” and “Humanities,” for Southeast/South Asian countries are “Engineering” and “Agricultural Sciences.”

On graduating from Japanese universities, 36% of the Chinese students, who account for 39% of international graduates, remained in Japan. This figure is higher than the average for all international graduates. This is because the excellence of Chinese students is highly rated, including that of their language abilities. In recent times, intense efforts have been made by some companies to recruit Chinese graduates. Of the Chinese graduates who returned to their home country China, more than 60% secured either full- or part-time positions at Chinese universities.

**Research fields of graduates who moved to Asian countries immediately after completing doctoral courses**



**Figure 2 Research fields of graduates who moved to Asian countries immediately after completing doctoral courses**

The other survey was conducted on around 9,400 researchers from research organizations and universities in Japan. This survey shows that about 9% of them have

worked in foreign countries as full-time researchers. They were more actively involved in research exchanges at their institutions, and their productivity in terms of papers in the past three years was superior to that of researchers without overseas work experience. In regard to English papers and co-authored international papers, researchers with overseas work experience produced more than researchers without such experience.

We therefore believe that more Japanese researchers should go to work abroad in foreign research institutes, and more Japanese students should go to study in foreign universities. The government is trying to increase the budget to support students and researchers studying or working in foreign countries.

The counterparts of international co-authored papers in Japan have changed drastically in comparison to 10 years ago when Western countries were main counterparts. China and Korea and other Asian Pacific countries have become more important in terms of counterparts of research cooperation for Japanese researchers.

Figure 3 compares domestic papers and internationally co-authored papers in Japan. The ratio of the top 10% most cited papers and the number of times cited per international paper are double those of domestic papers produced only by Japanese researchers. The results show that Japanese universities should promote research cooperation by utilizing a network of doctoral graduates. Moreover, it shows that producing co-authored international papers leads to increased ranking and citations.

### Domestic papers and internationally co-authored papers in Japan (2005-2007)

	No. of Papers	Ratio of top 10% papers (%)	No. of times cited per paper
<b>All papers</b>	<b>198,251</b>	<b>8.0</b>	<b>7.9</b>
<b>Domestic papers</b>	<b>151,372</b>	<b>6.3</b>	<b>6.6</b>
<b>Internationally co-authored papers</b>	<b>46,879</b>	<b>13.6</b>	<b>11.8</b>

(NISTEP Research Material No.192)

**Figure 3 Domestic and internationally co-authored papers in Japan (2005-2007)**

## Conclusion

As explained previously, the “International mobility of Japanese Doctoral Graduates” contributes to discussions about the new S&T Basic Plan in Japan, and serves as a useful resource for universities in formulating internationalization policies and research strategies. In Japan, the next survey on doctoral graduates from all universities will be conducted in two or three years. Every country conducting a similar survey on doctoral graduates would contribute to a comprehensive understanding of the circulation of intellectual resources in the world.

Professor Tomoaki Wada is a Professor at the Tokyo University of Science (TUS), where he is in charge of internationalization and academia-industry collaboration. He is also an Affiliated Senior Fellow at the National Institute of Science and Technology Policy (NISTEP). Prior to taking up his appointment at TUS in 2010, he worked in the Ministry of Education, Culture, Sports, Science and Technology (MEXT) for 30 years. Between 2002 and 2004, he served in the Cabinet Office as Chief Secretariat for Science and Technology Policy (CSTP), where he prepared the draft of the 3rd Science and Technology (S&T) Basic Plan. In July 2008, he was appointed the Director General of NISTEP, where he summarized key reports of follow-up studies on the 3rd S&T Basic Plan.