Scientometrics (2015) 105:83–95
DOI 10.1007/s11192-015-1655-x

Scientific publications in Vietnam as seen from Scopus during 1996–2013

Ho Dung Manh[1]

Received: 10 July 2015 / Published online: 13 August 2015

Abstract This paper investigates Vietnam's scientific publications between 1996 and 2013 from Scopus database, focusing on international collaboration. The total scientific output of the country increased about 16 publications per year during 1996–2001 and quickly increased 20 % per year during 2002–2013. However, the share of international collaboration was about 77 % of the total output. Biological and agricultural science, medicine dominated the total output, but 80–90 % of these publications are from international collaboration. In contrast, mathematics is the only field that domestic output is larger than collaboration output. Japan is the largest collaborating country, followed by United States, France, South Korea and United Kingdom. Analyzing titles of publications with these collaborating countries, we found high frequency of "Vietnam" or "Vietnamese" words. This result suggested that many study subjects of these research collaborations were from Vietnam. Furthermore, corresponding authors of these research collaborations are mainly from collaborating countries, which suggested that these research collaborations mainly led by foreign authors. Although the total output was quickly increased, especially collaboration output, Vietnamese researchers should be aware about their low contribution to these collaborations.

Keywords Vietnamese publications · International collaboration · Scopus data · Scientific output

✉ Ho Dung Manh
manhhodung@gmail.com

[1] Faculty of Chemical and Environmental Engineering, Lac Hong University, Bien Hoa, Dong Nai, Vietnam

Introduction

Science and Education are known as the driving force to build the economy of all countries. Although Vietnam has lately become the middle lower income country, its economy and science are far way to catch up with many countries in the regions. Nguyen and Pham (2011) analyzing peer-reviewed journals indexed by Institute of Scientific Information (ISI) found that scientific publications of Vietnam have been increasing. However, it is low compared with South-East Asia's countries (ASEAN). In ASEAN countries, Singapore is the leading country. Thailand and Malaysia were in the second group, while Vietnam, Indonesia and Philippines was in the third group. Hien (2010) also using data from ISI index journals reported low publication output of Vietnam compared with East Asia countries.

However, no study has analyzed the collaborating countries with Vietnam as well as the driving force behind these collaborations. In addition, none of these cited papers above used Scopus as the data source. In this research, we collected data of Vietnam's publication output in Scopus from 1996 to 2013. Using R statistical programing language, we separated collaboration output from domestic output—publications that list only authors from the home country. In collaboration output, we reported the top five collaborating countries, field of these publications and the percentage of domestic corresponding authors. Using several packages in R, we performed text analysis for all titles of collaboration publications in order to gain insight of these collaborations.

Methods

Data collection

Scopus was launched since 2004 and covers scientific literature correctly from 1996. Therefore, I collected all Vietnam's publications using criteria as following. "Country = Vietnam, year = 1996–2013, type = Article, Language = English, source type = Journal". The search was done on 27 June 2014.

To assess publications that were solely published by domestic authors, I selected Vietnam and excluded all 74 other countries having collaboration with Vietnam (Japan, United States, France, South Korea, Germany, etc.). To assess collaboration publications with each country, Vietnam and the collaborating country were included. Country addresses of corresponding authors were retrieved in these collaboration publications.

Data cleaning and analysis

R Statistical Environment (R Core Team 2014) was used to clean and analyze the data. The advantage of collecting data from Scopus over ISI is that I could download the csv files, which is then easier to use statistical programing language to analyze the data. After downloading csv file of total publications and domestic publications, I matched domestic publications in total publications and then separated collaboration publications from the total publications. I used "ggplot2", "reshape2" packages in R to make graphs. In addition, "grep" function was used to find country addresses of corresponding authors. Other packages were used to analyze frequency of words in publication titles including "tm" and "SnowballC".

Results

Scientific publication output in Vietnam between 1996 and 2013

Table 1 shows the number of scientific publications in Vietnam from 1996 to 2013. The total number of publications was 14,738 articles. The number of domestic publications was 3421 (23 %), while the number of collaborative publications was 11,317 (77 %).

Figure 1 shows the trend of the total output. From 1996 to 2001, a linear model was fitted, $y = 248 + 16 \times t$ ($R^2 = 0.86$), where y is yearly output and $t = 0$ at year of 1996. In this period, the annual growth was about 16 publications per year. From 2002 to 2013, a non-linear model was fitted, $y = 336.5 \times 1.2t$ ($R^2 = 0.997$), where y is the number of yearly output and $t = 0$ at year of 2002. The increased rate of this period was about 20 % per year. This period starts with a sharp increase in collaboration output, as we can see in Table 1, from 2002 to 2003, the share of collaboration increased from 71.1 to 81.4 %.

Research areas and publication outputs

Figure 2 shows the number of publications in each field separated by domestic and collaboration publications. Generally, agricultural and biological science, and medicine dominated in total outputs. In these fields, however, collaboration output contributed to 80–90 % of publications.

In domestic output, the highest number of publications was mathematics (39.3 %), followed by physics and astronomy (18.1 %), engineering (16.9 %), materials science (14.4 %). Collaboration output in each field was calculated by subtracting domestic output from the total output in each field. Agricultural and biological science (24.5 %), and

Table 1 Domestic and collaboration output

Year	Domestic	%	Collaboration	%	Total
1996	69	27.5	182	72.5	251
1997	73	26.4	203	73.6	276
1998	67	26.1	190	73.9	257
1999	75	25.2	223	74.8	298
2000	69	22.0	245	78	314
2001	112	33.7	220	66.3	332
2002	88	28.9	216	71.1	304
2003	78	18.6	342	81.4	420
2004	76	15.4	416	84.6	492
2005	96	16.2	496	83.8	592
2006	123	17.9	566	82.1	689
2007	139	17.4	661	82.6	800
2008	231	22.4	800	77.6	1031
2009	258	22.0	916	78	1174
2010	314	22.3	1096	77.7	1410
2011	417	25.7	1208	74.3	1625
2012	530	25.8	1525	74.2	2055
2013	606	25.1	1812	74.9	2418
Sum	3421		11,317		14,738

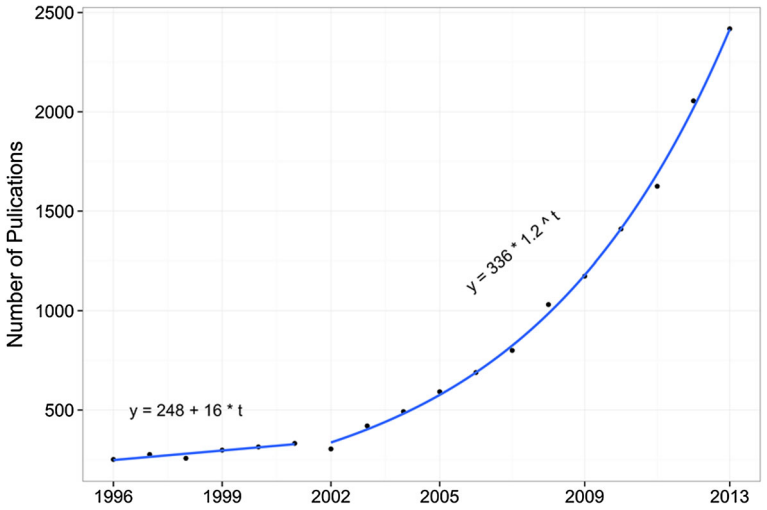

Fig. 1 Total scientific publications in Vietnam from 1996 to 2013

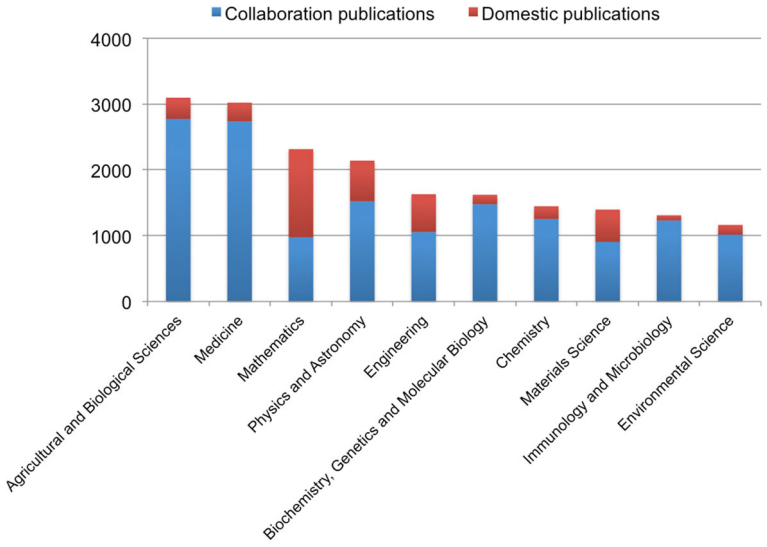

Fig. 2 Collaboration and domestic output by fields

medicine (24 %) dominated in the collaboration output, followed by physics and astronomy (13.4 %), biochemistry, genetics and molecular biology (13 %), chemistry (11 %).

Top 20 popular journals in domestic and collaboration output

To evaluate the quality of these publications, we could not use citation analyses because they are different among different disciplines. For example, papers in medical research usually get more citations than those in mathematics (King 2004). Therefore, the journal

rank in each field was shown from the SCImago Journal Rank (SIR). SIR is a portal that includes the journals and country scientific indicators developed from the information contained in the Scopus® database (Elsevier B.V.). This platform takes its name from the SCImago Journal Rank indicator developed by SCImago from the widely known algorithm Google PageRank™. This indicator shows the visibility of the journals contained in the Scopus® database from 1996. The quartile of journal in each field in 2013 was reported.

Table 2 shows the 20 most popular journals published by domestic authors. There are five journals in Q1, seven journals in Q2, five journals in Q3, three journals in Q4. Many journals belong to mathematics (eleven journals) and physics (five journals). The most popular journal is "Advance in Natural Sciences: Nanoscience and

Table 2 Top 20 journals published by domestic authors

Journals	Number of articles	Quartile (Q1–Q4)	Field
Advances in Natural Sciences: Nanoscience and Nanotechnology	126	Q2	Material Science
Livestock Research for Rural Development	78	Q3	Animal Science and Zoology
Nonlinear Analysis, Theory, Methods and Applications	74	Q1	Applied Mathematics
Journal of Mathematical Analysis and Applications	57	Q1	Applied Mathematics
Journal of Optimization Theory and Applications	50	Q2	Applied Mathematics
Journal of the Korean Physical Society	49	Q3	Physics and Astronomy
Acta Mathematica Vietnamica	46	Q4	Mathematics
Electronic Journal of Differential Equations	43	Q3	Analysis (Mathematics)
Journal of Magnetism and Magnetic Materials	34	Q1	Condensed Matter Physics
Communications in Algebra	27	Q2	Algebra and Number Theory
Asian Journal of Chemistry	26	Q3	Chemistry
Annales Polonici Mathematici	25	Q3	Mathematics
Physica B: Condensed Matter	25	Q2	Condensed Matter Physics
Physical Review B—Condensed Matter and Materials Physics	25	Q1	Condensed Matter Physics
International Journal of Mathematics	24	Q2	Mathematics
International Food Research Journal	23	Q2	Food Science
International Journal of Mathematical Analysis	23	Q4	Mathematics
Journal of Algebra	23	Q1	Algebra and Number Theory
Journal of Physics: Conference Series	23	Q4	Physics and Astronomy
Journal of Global optimization	22	Q2	Applied Mathematics

Table 3 Top 20 popular journals based on international collaboration

Journals	Number of papers	Quartile (Q1–Q4)	Field
PLoS ONE	139	Q1	Medicine
Livestock Research for Rural Development	124	Q3	Animal Science and Zoology
Zootaxa	110	Q3	Animal Science and Zoology
Physical Review B—Condensed Matter and Materials Physics	88	Q1	Condensed Matter Physics
Journal of Magnetism and Magnetic Materials	79	Q1	Condensed Matter Physics
Aquaculture	76	Q1	Aquatic Science
American Journal of Tropical Medicine and Hygiene	70	Q1	Medicine
Journal of Natural Products	65	Q1	Organic Chemistry
Journal of Clinical Microbiology	64	Q1	Microbiology (medicine)
Tropical Medicine and International Health	64	Q1	Public Health, Environmental and Occupational Health
Journal of the Korean Physical Society	60	Q3	Physics and Astronomy
Asian-Australasian Journal of Animal Sciences	57	Q2	Animal Science and Zoology
Physical Review A—Atomic, Molecular, and Optical Physics	57	Q1	Atomic and Molecular Physics, and Optics
Advances in Natural Sciences: Nanoscience and Nanotechnology	56	Q2	Material Science
Transactions of the Royal Society of Tropical Medicine and Hygiene	55	Q1	Public Health, Environmental and Occupational Health
PLoS Neglected Tropical Diseases	54	Q1	Public Health, Environmental and Occupational Health
Southeast Asian Journal of Tropical Medicine and Public Health	54	Q3	Public Health, Environmental and Occupational Health
BMC Public Health	53	Q1	Public Health, Environmental and Occupational Health
Journal of the Faculty of Agriculture, Kyushu University	52	Q3	Agronomy and Crop Science
International Journal of Tuberculosis and Lung Disease	51	Q1	Medicine

Nanotechnology", which is published by Vietnam Academy of Science and Technology since 2010. This journal belongs to material science, with an international editorial board.

Table 3 shows top 20 popular journals in collaboration research. There were thirteen journals in Q1, two journals in Q2, five journals in Q3, and no journals in Q4. Nine journals are in public health and medicine. The results reflect the dominance of medicine, biological and agriculture science field in collaboration output. The quality is also much higher when compared with domestic output since about 65 % of journals belong to Q1. Especially, medicine field has eight journals in Q1.

Table 4 Publication in collaboration with top 20 countries

Rank	Country	Total	%	1996–2004	2005–2013	Increase rate
1	Japan	1948	17.2	420 (21.6)	1528 (78.4)	3.6
2	United States	1818	16.1	328 (18)	1490 (82)	4.5
3	France	1438	12.7	332 (23.1)	1106 (76.9)	3.3
4	South Korea	1328	11.7	100 (7.5)	1228 (92.5)	12.3
5	United Kingdom	1116	9.9	210 (18.8)	906 (81.2)	4.3
6	Germany	1027	9.1	228 (22.2)	799 (77.8)	3.5
7	Australia	1057	9.3	180 (17)	877 (83)	4.9
8	Netherlands	748	6.6	156 (20.9)	592 (79.1)	3.8
9	China	664	5.9	68 (10.2)	596 (89.8)	8.8
10	Thailand	632	5.6	121 (19.1)	511 (80.9)	4.2
11	Belgium	604	5.3	130 (21.5)	474 (78.5)	3.6
12	Sweden	551	4.9	145 (26.3)	406 (73.7)	2.8
13	Russian Federation	468	4.1	56 (12)	412 (88)	7.4
14	Italy	379	3.3	71 (18.7)	308 (81.3)	4.3
15	Taiwan	395	3.5	37 (9.4)	358 (90.6)	9.7
16	Switzerland	385	3.4	47 (12.2)	338 (87.8)	7.2
17	Canada	293	2.6	46 (15.7)	247 (84.3)	5.4
18	India	273	2.4	60 (22)	213 (78)	3.6
19	Denmark	283	2.5	28 (9.9)	255 (90.1)	9.1
20	Poland	232	2.1	27 (11.6)	205 (88.4)	7.6

Number of publications with collaborating countries

Table 4 shows the 20 largest collaborating countries. The biggest partner was Japan with 1948 publications (17.2 % of total collaboration output), followed by the US with 1818

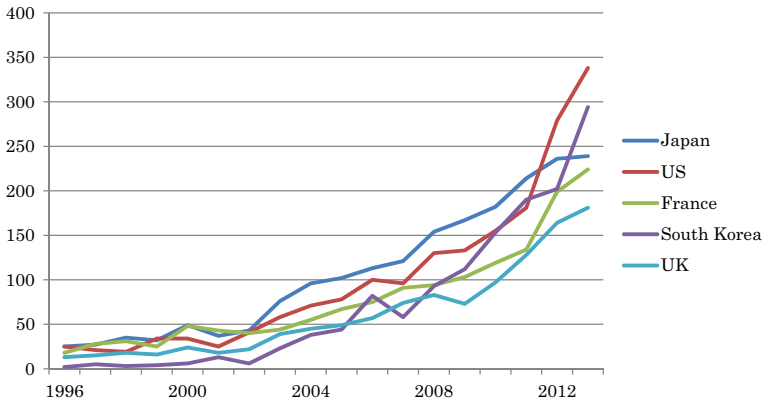

Fig. 3 Trend of collaboration output with top 5 countries

Table 5 Collaboration fields with top five collaboration countries

Field collaboration	Number	%
1. Japan		
Agricultural and Biological Sciences	518	26.6
Medicine	422	21.7
Biochemistry, Genetics and Molecular Biology	334	17.1
Physics and Astronomy	293	15.0
Immunology and Microbiology	254	13.0
Environmental Science	212	10.9
Chemistry	188	9.7
Earth and Planetary Science	158	8.1
Engineering	151	7.8
Material Science	139	7.1
2. US		
Medicine	668	36.7
Agricultural and Biological Sciences	328	18.0
Physics and Astronomy	249	13.7
Biochemistry, Genetics and Molecular Biology	230	12.7
Immunology and Microbiology	228	12.5
Social Science	168	9.2
Environmental Science	127	7.0
Mathematics	127	7.0
Chemistry	111	6.1
Earth and Planetary Science	97	5.3
3. UK		
Medicine	459	41.1
Agricultural and Biological Sciences	236	21.1
Immunology and Microbiology	198	17.7
Physics and Astronomy	175	15.7
Biochemistry, Genetics and Molecular Biology	141	12.6
Environmental Science	69	6.2
Social Science	64	5.7
Pharmacology, Toxicology and Phamarceuticals	56	5.0
Engineering	55	4.9
Earth and Planetary Science	50	4.5
4. France		
Physics and Astronomy	334	23.2
Agricultural and Biological Sciences	279	19.4
Medicine	249	17.3
Biochemistry, Genetics and Molecular Biology	199	13.8
Chemistry	190	13.2
Mathematics	181	12.6
Material Science	146	10.2
Immunology and Microbiology	139	9.7
Engineering	125	8.7
Earth and Planetary Science	119	8.3

Table 5 continued

Field collaboration	Number	%
5. South Korea		
Physics and Astronomy	328	24.7
Chemistry	274	20.6
Engineering	254	19.1
Material Science	246	18.5
Biochemistry, Genetics and Molecular Biology	224	16.9
Medicine	211	15.9
Pharmacology, Toxicology and Phamarceuticals	191	14.4
Agricultural and Biological Sciences	144	10.8
Immunology and Microbiology	112	8.4
Mathematics	98	7.4

publications (16.1 %), France (12.7 %), South Korea (11.7 %), and the UK (9.9 %). The biggest neighbor partner was China, which was ranked at 9th. In ASEAN countries, Thailand was the largest collaborating country. To see the trend of collaboration, we divided 1996–2013 into the two periods with the equal number of years, 1996–2004 and 2005–2013. We can see that in the top five countries, Korea is the collaboration partner with the highest increased rate of collaboration publications of over 12 folds. Other Asia countries such as China, and Taiwan showed the tenfold increase.

Collaboration analyses with five largest collaboration countries

Trend of collaboration publications

Figure 3 shows the trend of collaboration output with the five largest collaborating countries. From 2002 to 2011, Japan was the biggest collaboration partner with Vietnam. However, the US has surpassed Japan in 2012, and then South Korea has surpassed Japan in 2013.

Field of collaboration output

Table 5 shows field of collaboration with the five countries. Medicine was the main collaboration field with the US (36.7 %) and the UK (41.1 %). Vietnam–Japan collaboration was dominated by agricultural and biological sciences (26.6 %), and medicine (21.7 %). Physics, agricultural and biological sciences dominated Vietnam–France collaboration, while Vietnam–Korea collaboration was dominated by physics, chemistry and engineering.

Title analysis of collaboration output

Although the fields of collaboration are known, particular topics of these collaborations are unknown. Therefore, frequency of words was analyzed from the titles of the collaboration publications.

Table 6 Top 20 root words appear in the titles of collaboration publications

Japan		US		UK		France		South Korea	
Words	Freq (%)	Words	Freq (%)	Words	Freq (%)	Words	Freq (%)	Words	Freq (%)
Vietnam	25.4	Vietnam	27.1	Vietnam	22	Vietnam	13.8	Activ	8.8
Vietnames	7.1	Studi	6.4	Studi	7.4	Effect	6.5	Effect	8.7
Effect	6.9	Among	5.9	Infect	6.2	Studi	5.8	Vietnam	7.2
Studi	5.9	Virus	5.6	Dengu	5.3	Use	5.1	Use	7
Virus	5.5	New	5.3	Malaria	4.9	New	4.5	Properti	6.4
Use	5.4	Vietnames	5	Use	4.8	Vietnames	4.2	Cell	6.2
New	4.3	Use	4.9	Vietnames	4.7	Decay	3.8	New	5.3
Northern	4.2	Influenza	4.6	Decay	4.6	Measur	3.8	Studi	5.2
Delta	4.1	Infect	4.2	Children	4.5	Properti	3.7	Control	4.8
Gene	4	Effect	4	New	4.5	Structur	3.5	Structur	4.4
Isol	4	HIV	4	Measur	4.4	Analysi	3.3	Magnet	3.9
River	4	Human	4	Analysi	4.2	Mdel	3.2	Analysi	3.7
Analysi	3.8	Speci	3.5	Speci	4	Northern	3.1	Inhibitori	3.5
Influenza	3.3	h5n1	3.5	Influenza	3.9	Product	2.7	System	3.5
Develop	3.2	Analysi	3.2	Virus	3.9	High	2.6	Film	3.4
Model	3.2	Measur	3.2	Effect	3.8	Base	2.5	Asian	3.3
Character	3.2	Asia	3.2	Treatment	3.8	Carbon	2.4	Character	3.2
System	3.2	Vaccin	3.2	Adult	3.6	Film	2.4	Synthesi	3.2
Infect	3	Associ	3.1	Sever	3.6	Function	2.4	Method	3.2
Water	3	Risk	3.1	Human	3.5	Magnet	2.4	Asia	2.9

Table 6 shows the 20 most frequent root words in the titles of collaboration publications. In collaboration with Japan, the US and the UK, “Vietnam” and “Vietnamese” appeared at total frequency of about 30 %. This high frequency means that many studies had subjects or samples collected from Vietnam. With the US, root words such as “virus”, “influenza”, “infect”, “hiv”, “h5n1” appeared at high frequency. In medicine field, those words are related to infectious diseases. Similarly, with the UK, medical words such as “infect”, “dengu”, “malaria”, “influenza” appeared at high frequency. This means that United States and United Kingdom tend to collaborate with Vietnam on infectious diseases. These diseases are actually common in Vietnam. For Japan, many words such as “effect”, “virus”, “gene”, “isol (isolation)” and “river”, “delta” appeared at high frequency. Those words are related to both biological and medicine filed.

For France, the words of “Vietnam” and “Vietnamese” appeared at total frequency of less than 20 %. Other frequent words such as “decay”, “property”, “structure”, “carbon”, “film”, “magnet”, which are often used in the physical field. For Korea, the frequency of the root words such as “active” (active, activity), “effect”, are the most frequent in the titles. Other words appeared at high frequency such as “property”, “cell”, “magnet”, “film”, etc. These words are often used in physics and biology, chemistry fields.

These results of title analysis were consistent with collaboration field analysis, and we know more clearly which subjects were popular in collaboration research with each country.

Addresses of corresponding authors in collaboration output

To understand the role of Vietnamese researchers in collaboration research, country address of corresponding authors in these publications were identified. Since the corresponding authors are considered particularly important authors who had role of leadership and responsibility (Wren et al. 2007).

Table 7 shows the percentage of corresponding author addresses from each collaboration country. Addresses of corresponding authors are highest from Japan (70.4 %), followed by South Korea (63.6 %), France (56.6 %), the US (49.3 %) and the UK (34.7 %). The total percentage of corresponding author addresses from the two collaboration countries was highest in Japan (86.4 %). This collaboration was probably mainly bilateral. The total percentage was low in UK (61.1 %) and US (65.7 %), which mean that these collaborations involved more international countries.

Addresses of corresponding authors from Vietnam have the highest percentage in collaboration with the UK. This is partly explained due to a large number of publications were from Oxford University Clinical Research Unit (OUCRU) based in Vietnam. OUCRU is established in 1991, which are results of collaboration between Vietnam hospitals and Oxford University. OUCRU has large clinical and scientific research programs, which focuses on the most significant infectious diseases in Vietnam. Many of these are also among the greatest threats to global health in the 21st century. We found that of the UK collaboration publications that had corresponding authors address from Vietnam, OUCRU contributed to 55 % publications (period of 2005–2013).

Discussion and conclusions

This study investigated Vietnam publications from Scopus database. Although the publication output has exponentially increased, the collaboration output contributed about 77 % of the total output. Only in the mathematics field, the number of domestic publications was higher than that of collaboration publications. Agricultural and biological science, and medicine dominated collaboration output and contributed to 80–90 % of total publications in these fields. In collaboration with the top five countries, the percentage of Vietnamese corresponding authors was very low while study subjects are mainly from Vietnam.

Table 7 Corresponding author address in collaboration publications

	Japan	US	France	South Korea	UK
Total collaboration publications	1948	1818	1438	1328	1116
Corresponding authors from collaboration country (%)	1372 (70.4)	896 (49.3)	814 (56.6)	845 (63.6)	387 (34.7)
Corresponding authors from Vietnam (%)	311 (16)	299 (16.4)	265 (18.4)	256 (19.3)	295 (26.4)
Corresponding authors from two countries (%)	1683 (86.4)	1195 (65.7)	1079 (75)	1101 (82.9)	682 (61.1)

Although collaboration is the right way to develop the science of the country, Vietnamese researchers should be aware of their low contribution in these collaborations.

United States and United Kingdom were the largest partners with Vietnam in medicine field, especial public heath. Medical research with human subjects is often expensive. It requires extensive human resources, sophisticated instrumentation, biochemical measurements, and follow-up of subjects. Vietnam is a tropical and developing country where infectious diseases are common. Because Vietnam lacks infrastructure and has limited research expenditure, collaboration with foreign researchers is necessary. In addition, in developed countries, where non-communicable diseases are more popular, researches on infectious diseases would be more difficult due to limited study samples. Therefore, it is more advantageous to study in developing countries like Vietnam. One of the interesting cases is the success of OUCRU, which was established as collaboration between Oxford University and the two national tropical disease hospitals in Vietnam. This clinical research has been very successful in producing a large number of high-quality publications.

In Asia, Japan is the largest collaborating partner, followed by South Korea, China, Thailand and Taiwan. Japan has early collaborated with Vietnam, and become the largest collaborating country until 2012. South Korea has quickly increased collaboration with Vietnam, and this country has lately surpassed Japan in collaboration with Vietnam. They mainly collaborate in physics, chemistry and engineering; while Japan mainly collaborate in agricultural and biological science and medicine. China and Taiwan are also speeding up collaboration with Vietnam. Between the two periods 1996–2004 and 2005–2013, number of their collaboration publications with Vietnam increases tenfold, which is comparable with 12-fold increase with South Korea.

In the recent years, due to a shortage of highly qualified academics in universities and colleges as a result of the over-expansion of higher education, the Ministry of Education has started several projects such as 322 or 911, which aim to send smart students to advanced countries for pursuing a postgraduate course. These projects request the student to return home to contribute to the science of the country. The program builds on Project 322, launched in 2000, which saw almost 4600 students sent abroad for advanced study. At the end of the program in 2011, some 3000 had returned to Vietnam, with over 1000 holding a doctoral degree. In 2010, another project named '911'—an extension of Project 322—was implemented with a more ambitious goal. With an investment of 700 million USD, the ministry aimed to provide full scholarships to 23,000 Ph.D. candidates to complete their courses, including 10,000 studying abroad. Although there is no research to evaluate the effects of these programs to scientific output, the increasing of Ph.D. students educated form advanced countries would be a positive sign for developing Vietnamese science.

Since 2008, the government has created new National Foundation for Science and Technology Development (NAFOSTED) to boost the scientific publications by make ease to the process of grant application, and to be fair for all researchers. Therefore, any researchers, especially for young researchers can apply. Importantly, it strictly required output with international publications. This new fund has remarkably improved the publication of Vietnam. A recent report shows the number of ISI papers supported by this fund have increased quickly. During 2009–2012, government spent 10 millions USD per year for NAFOSTED, and only accounted for 1.3 % of total investment of government for science, but the number of ISI papers funded by NAFOSTED contributed to 13 % of total ISI papers of the country. However, mathematics, physics and material science contribute a large number of publications from the fund. Since medicine or biological research often needs large capital, Vietnam still depends on collaborating research.

In conclusion, collaboration with advanced countries has increased number of scientific publications of Vietnam. However, Vietnamese scientists need to recognize their low contribution in these collaborations. More importantly, Vietnamese policy maker and funding agents should measure the effects of their policy to improve Vietnam scientific output. The simpler funding application and the international standard of output should be applied to encourage young Vietnamese scientist to publish their researches to international journals.

References

Hien, P. D. (2010). A comparative study of research capabilities of East Asian countries and implications for Vietnam. *Higher Education, 60*, 615–625. doi:10.1007/s10734-010-9319-5.

King, D. A. (2004). The scientific impact of nations. *Nature, 430*, 311–316.

Nguyen, T. V., & Pham, L. T. (2011). Scientific output and its relationship to knowledge economy: An analysis of ASEAN countries. *Scientometrics, 89*, 107–117. doi:10.1007/s11192-011-0446-2.

R Core Team (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org/

Wren, J. D., Kozak, K. Z., Johnson, K. R., Deakyne, S. J., Schilling, L. M., & Dellavalle, R. P. (2007). The write position. A survey of perceived contributions to papers based on byline position and number of authors. *EMBO Reports, 8*(11), 988–991. doi:10.1038/sj.embor.7401095.