



Indonesia's Place in the Research Landscape of Southeast Asia

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ABSTRACT

This article presents a scientometric analysis of 330,729 journal articles indexed in the prestigious Science Citation Index Expanded of the Web of Science database authored by researchers affiliated with institutions from five Southeast Asian countries (Indonesia, Malaysia, Philippines, Thailand, and Vietnam) and published in the first two decades of the 21st century (2001–2020). With a focus on Indonesia, this article examined the scientific production of those five nations as well as the citedness of their research publications from both the static and dynamic perspectives and compared various indicators of countries in absolute and relative terms, including the socio-economic aspects of population size, gross domestic product, and research and development expenditures. The key findings are: a) the overall research production of all five countries has been growing, b) Indonesia is the weakest nation in all relative scientometric indicators except the average number of citations per paper where it is ranked second, c) Malaysia is generally the leading nation, but Vietnam has the most remarkably positive development in both production and citedness, and d) the Philippines is extremely efficient in the mean number of citations per paper as well as per expenditure on research and development.

Keywords

Indonesia; publications; Southeast Asia; citations; Web of Science

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INTRODUCTION

Southeast Asia is an important and dynamically developing region of the world and Indonesia is the largest and most populous country in this part of the planet. Among many different viewpoints which may be used to study the development of nations including social, economic, demographic and other aspects, scientometrics (as “the science of science”) may help discover interesting facts about the status and development of a country in science and technology. To this end, the present study aims to use scientometric approaches to analyze the current state and trends in research performance of five comparable Southeast Asian nations (Indonesia, Malaysia, Philippines, Thailand, and Vietnam), with a special focus on Indonesia and its place in science and technology production of Southeast Asia in the first two decades of the 21st century. Therefore, this study will investigate 330,729 publication records of journal articles indexed in the prestigious Science Citation Index Expanded of the Web of Science database that were published in the period 2001–2020. This study would thereby like to answer the following research questions: Has the Southeast Asian scientific production been growing in recent years? What are the basic scientometric indicators of these countries like absolute publication and citations counts, mean number of citations per publication, and relative numbers of publications and citations per population, gross domestic product, and research and development expenditure? How did these metrics evolve over twenty years of time from 2001 to 2020? And what is Indonesia’s standing compared to the other nations as measured by those various indicators?

The research performance of countries in relation to various socio-economic factors has been studied many times in the past (e.g. King, 2004; May, 1997) and is thus a well-established tool to determine the “health” of a nation. Furthermore, Indonesia’s research production or impact has been the focus of multiple studies in general (Achsan et al., 2019; Iskandar et al., 2021a; Nandiyanto et al., 2020b) or with a focus on a specific scientific field or discipline such as social sciences (Achwan et al., 2020), renewable energy (Akbar et al., 2020), library and information science (Hasanah et Rachman, 2021), e-learning (Iskandar et al., 2021b), mathematics and statistics (Nadhiroh et al., 2018), chemical and material sciences (Nandiyanto et al., 2020a), cancer research (Puspitaningtyas et al., 2021), innovation systems (Putera et al., 2020), or Covid-19 (Syamsurrijal et al., 2021). In addition, some investigations were concerned with the research performance of Indonesian universities (Darmadji et al., 2018; Ibrahim et Fadhi, 2021; Prasojo et al., 2019) and yet some others explored Indonesia’s research as part of a group of different countries generally (Pohl, 2020) or with concentration on a specific topic like Islamic finance (Tijjani et al., 2020). On the other hand, science in Southeast

Asia has been the concern of multiple general analyses (Arunachalam et Garg, 1986; Nguyen and Pham, 2011; Purnell, 2021) or of studies with a certain focus on ethnobiology (Hidayati et al., 2015), dentistry (Sirisinha et al., 2011), Covid-19 research (Tantengco, 2021), schistosomiasis research (Tantengco and Rojo, 2022), chemical engineering (Yin, 2009), and research collaboration (Kumar et al., 2014) to name a few of the more recent ones.

Most of the aforementioned research was based on data from the Scopus database (www.scopus.com) and none dealt specifically with data from the Science Citation Index Expanded (see next section) in the context of Indonesia and Southeast Asia in the first two decades of the 21st century, making the analysis presented here truly unique. Let us also remark that the terms publication, article, and paper will be used interchangeably throughout this text.

METHOD

The data for this study were collected on 17 February 2022 using the standard Web of Science user interface. This study searched for papers published by authors from specific countries and included five to some extent comparable countries (Indonesia, Malaysia, Philippines, Thailand, and Vietnam – in alphabetical order) and deliberately omitted other countries from the region that were either too small as to population and/or publication output (Brunei, Cambodia, East Timor, Laos, Myanmar) or had a different character of a developed nation (Singapore). This study focused on the time range 2001–2020 and only in the documents found in the Science Citation Index Expanded being of type article, review article or proceedings paper. Our search resulted in a set of 330,729 document records.

The Science Citation Index Expanded (SCIE)¹ draws data from more than 9,500 prestigious scientific journals across 178 disciplines of science, technology, and medicine and contains over 53 million article records dating as far back as 1900. It has been long used for scientometric measurements in numerous studies and has at times achieved a kind of monopoly as the underlying data source of such analyses (Ball & Tunger, 2006; Larsen & von Ins, 2010). Moreover, SCIE's citation data are considered reliable and robust (Bornmann et al., 2009) and result in the calculation of the so-called journal impact factors in the yearly Journal Citation Reports² by Clarivate (formerly Clarivate Analytics). These and other reasons formed the basis of our decision to use

¹ <https://clarivate.com/webofsciencelibrary/solutions/webofscience-scie/> (accessed 1 March 2022)

² <https://jcr.clarivate.com/>

SCIE publication and citation data to examine Indonesia's research performance in the context of four other Southeast Asian nations.

Table 1 presents an overview of the numbers of publications and citations determined for the individual five countries under study along with some basic socio-economic indicators, this study will further work with in analysis, most notably their population size, gross domestic product (GDP), and R&D (research and development) expenditure.

RESULTS AND DISCUSSION

In terms of population, Indonesia is the largest country with almost 267 million inhabitants and Malaysia is the smallest with roughly 32 million people. This is also somehow reflected in the amount of GDP generated, which is by far the largest for Indonesia albeit not quite proportional with its vast population. In fact, Malaysia's GDP *per capita* (i.e. taking account of the population size) is almost three times higher than Indonesia's. In this respect, Malaysia can be considered three times "richer" than Indonesia and the "poorest" nation appears to be Vietnam, which is placed well below the Philippines and Indonesia and far behind both Thailand and Malaysia. However, Vietnam seems to put some efforts into boosting its R&D sector because its national expenditures on research and development stand at 0.53 % GDP, which is about a half of this indicator in the more developed Malaysia and Thailand, and two or three times higher than in both Indonesia and the Philippines. As far as the absolute and the relative R&D expenditures are concerned, Thailand and Malaysia are ranked first, respectively, with the Philippines always occupying the last place. Indonesia, with its 9.12 USD *per capita* is 12 times less generous than Malaysia and only slightly better than the Philippines, but its absolute R&D expenditures are higher than those in Vietnam as well as those in the Philippines.

Table 1*Basic indicators for five Southeast Asian countries under study.*

	Indonesia	Malaysia	Philippines	Thailand	Vietnam
Population [millions]	266.8	32.0	106.5	69.2	96.5
GDP [million USD]	1,058,424	337,006	361,489	501,644	271,158
GDP <i>per capita</i> [USD]	3,967	10,531	3,394	7,249	2,810
R&D expenditure in % GDP	0.23	1.04	0.16	1.00	0.53
R&D expenditure [million USD]	2,434	3,505	578	5,016	1,437
R&D expenditure <i>per capita</i> [USD]	9.12	109.53	5.43	72.49	14.89
# Publications	31,364	134,122	18,303	112,580	49,326
# Citations	712,485	2,918,467	591,879	2,530,091	974,706
# Citations per publication	22.72	21.76	32.34	22.47	19.76
# Publications per (million of) population	118	4,191	172	1,627	511
# Citations per (million of) population	2,670	91,202	5,558	36,562	10,101
# Publications per (billion USD of) GDP	29.6	398.0	50.6	224.4	181.9
# Citations per (billion USD of) GDP	673	8,660	1,637	5,044	3,595
# Publications per (million USD of) R&D expenditure	12.88	38.27	31.65	22.44	34.32
# Citations per (million USD of) R&D expenditure	293	833	1,023	504	678

Note: Population data from the United Nations Population Division Version 3 (October 2018) (<https://population.un.org/wpp/Download/Standard/Population/>); GDP 2020 data (current USD – United States dollars) from The World Bank (<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=ID-MY-PH-TH-VN> – accessed 1 March 2022); R&D expenditure in % GDP data from The World Bank (<https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=ID-MY-PH-TH-VN>) – most recent data for Indonesia and Malaysia from 2018, for Thailand and Vietnam from 2017, and for the Philippines from 2015; other data based on own research/calculation.

Publications

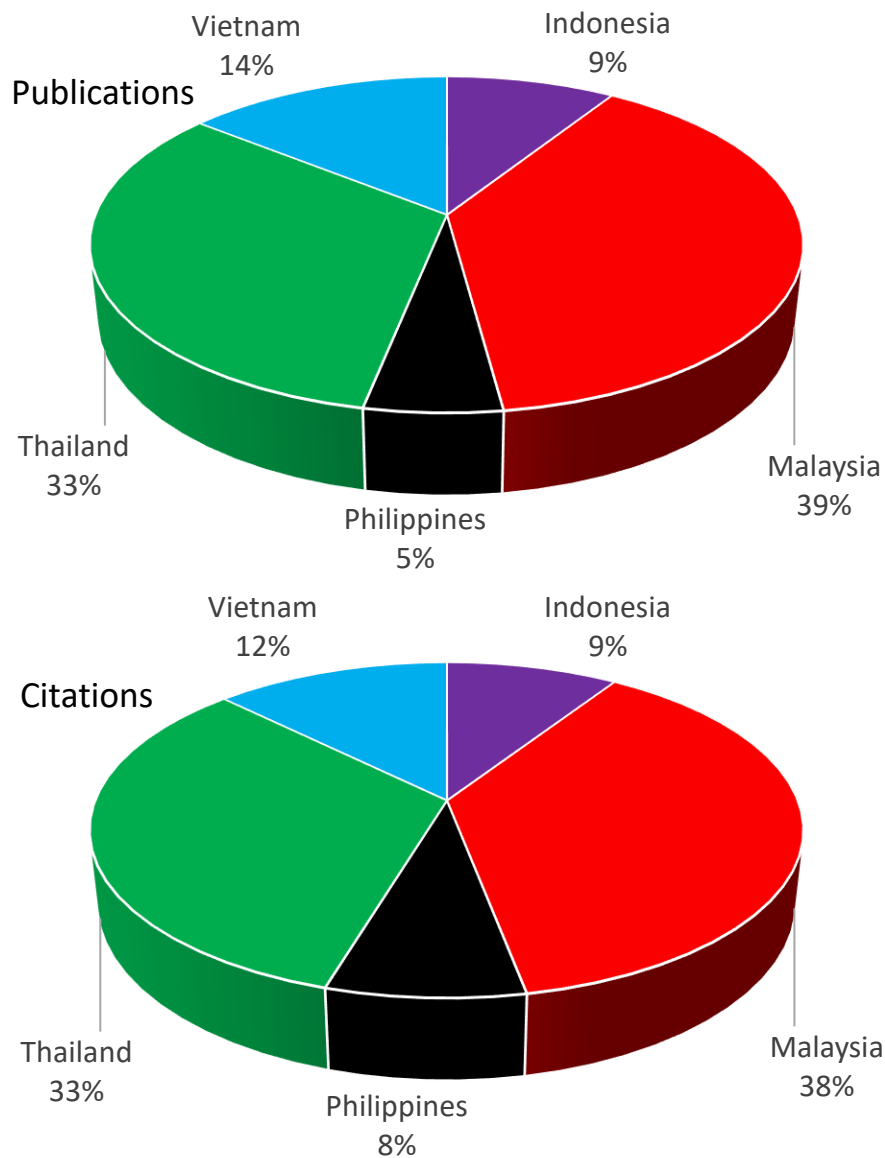
As can be viewed in [Table 1](#), the largest number of publications (134,122) were authored by researchers affiliated with Malaysian institutions, and the lowest number of papers (18,303) were written by scientists from institutions located in the Philippines. Indonesia's contribution is 31,364 articles, which is the second lowest and represents about 9% of all articles published (see [Figure 1 top](#)). Please note that the numbers of papers published by the individual five countries shown in [Table 1](#) do not add up to the total number of publications (330,729), but their sum is actually higher because the so-called full counting is applied here and some papers co-authored by scholars from several countries are thus counted multiple times. (For this reason, the percentages in [Figure 1](#) are only approximate without any decimal digits given, but the proportions are correct.)

Citations

Now let us have a look at the citations received by the countries' publications. Indonesia's articles attracted more than 700,000 citations (see [Table 1](#)), which is again an approximate 9% share in total cites (see [Figure 1 bottom](#)). The contribution of Indonesia's research output to the overall citedness of Southeast Asian (i.e. of those five nations under scrutiny) scholarly papers is thus in line with the expected proportion of total citations (full counting is applied here too). The same can be said about Malaysia, Thailand, and (to a lesser extent) about Vietnam but does not hold for the Philippines whose expected citation share is 5% (as its publication percentage) but is actually about 8%, which is 1.6 times higher.

Figure 1

Publication (top) and citation (bottom) shares of five countries in 2001–2020 using full counting.



The better-than-expected citation performance of the Philippines is confirmed by the highest average number of citations per publication (also called *citations per paper* – CPP) standing at 32.34 whereas Indonesia, Malaysia, and Thailand have all around 22 CPP and Vietnam slightly below 20. Therefore, if we consider citedness as a proxy for research quality and its influence, the Philippines has perhaps surprisingly the most influential research and Indonesia is comparable or slightly better than the other nations. On the other hand, if we take a different perspective through the lens of population size, Indonesia is the last country according to both of these criteria (see [Table](#)

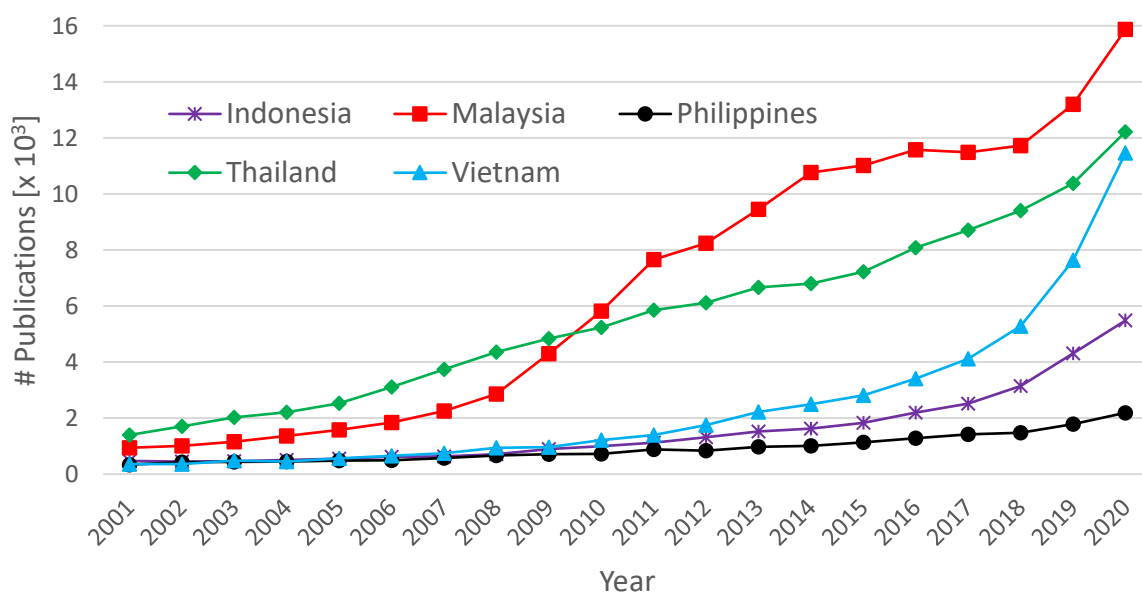
1): number of publications per million of population (118) and number of citations per million of population (2,670). The “winner” is always Malaysia followed by Thailand, Vietnam, and the Philippines in both rankings and it is clearly the reverse order of countries sorted by population size.

Publication Dynamics

So far we have been concerned with static indicators of research performance of nations, but now we might become interested in how these metrics have evolved over time. One of the first such insights is presented in [Figure 2](#) where we can observe the publication output counts in the individual years of the first two decades of the 21st century. What we may immediately grasp is the fact that all five countries have been increasing their scientific production in the past 20 years, but not at the same pace. While Thailand seems to raise its research output in a rather linear way and as the original number one country it has been overtaken by Malaysia since 2010, other nations have seen a more rapid development which even appears to resemble an exponential curve for Vietnam. Indeed, Vietnam’s scholarly output increased almost three-fold between 2017 and 2020 and if its publication output curve is extrapolated to the future, it will probably overtake Thailand very soon and Malaysia in the long run too. As far as Indonesia is concerned, its production tripled in a little longer time range (from 2015 to 2020) to reach 5,483 publications in the final year under study.

Figure 2

Publications of the five countries under study in individual years.

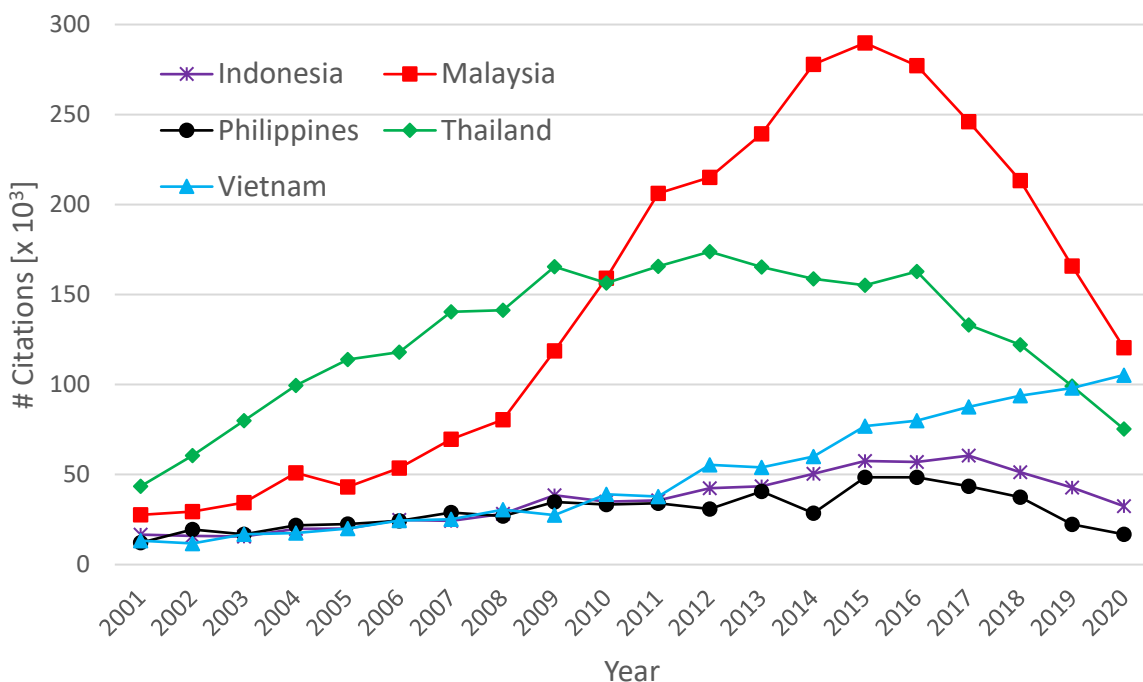


Citation Dynamics

The time evolution of the number of citations received, which is depicted in Figure 3, is more difficult to interpret. Every data point in the chart shows the number of citations the papers from a particular year have attracted since they were published. (Remember that data collection took place in February 2022 so all citations were made until then.) Obviously, more recent papers thus have a smaller citation window and less time to garner cites than older articles. This is well visible with Malaysia's citations past 2015 which steadily declined after reaching their peak (almost 300,000) in that year. And a similar drop in citations can be seen with all other countries except Vietnam. In fact, Vietnam's citations have been constantly rising despite the shortening citation window since 2014 and even peaked with well over 100,000 in 2020 ranking it second only to Malaysia, which is a truly extraordinary achievement. As for Indonesia, the most citations were obtained by its papers published in 2017 (more than 60,000) whereas Thailand's most cited articles appeared in 2012 (two years after quitting the first position) and those of the Philippines in 2015. Briefly, in the context of citation distribution over time Indonesia is not outstanding, unlike the *citations per paper (CPP)* indicator which will be shown in the following Figure 4.

Figure 3

Citations of papers of the five countries under study published in individual years.

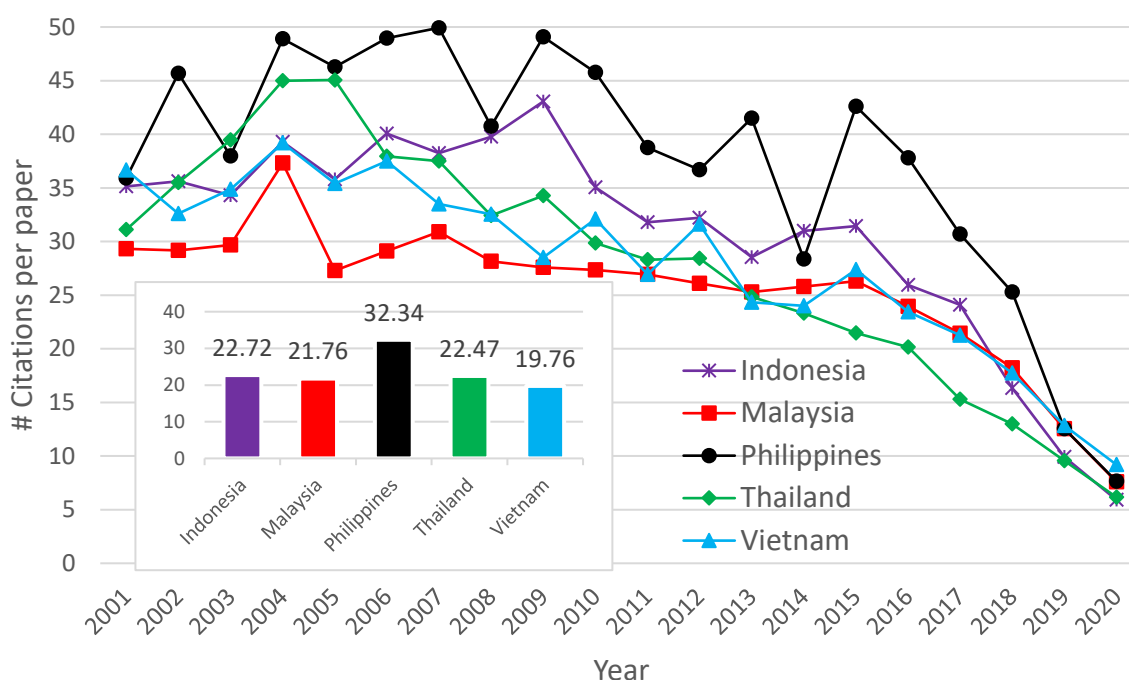


The inset chart in Figure 4 displays the overall CPPs of countries mentioned previously in Table 1 and clearly shows the Philippines leading before Indonesia in the

second place. This is also confirmed in the main chart where the Philippines is almost always ranked first and Indonesia is quite often ranked second. In fact, Indonesia achieved the first position once (in 2014), but its most successful articles (as to citations) were published in 2009 and attracted 43.06 cites on average. Otherwise, the generally declining trend visible in [Figure 4](#) for all countries is caused by the diminishing citation window of newer papers as explained earlier.

Figure 4

Average number of citations per paper in individual years (main chart) and in the whole period (inset).



Publications per Population

Another interesting perspective is presented in [Figure 5](#), in which the development of the publication counts per population size throughout the period 2001–2020 is depicted in the main chart and the total numbers of publications per million of the population are shown in the small inset chart. As we can see, Malaysia has the most publications per population in total as well as in all years of the period under investigation, whereas Indonesia is the last nation overall and ties the last place with the Philippines in most years and with Vietnam at the beginning of the period under investigation. Vietnam, however, started increasing its production per population after 2010 and has been detaching itself from the bottom two countries in recent years. In general, the trend of production per population is positive for all nations but with a different slope, which is

again remarkably different from the curves we can see in [Figure 6](#) dealing with citations per population.

Citations per Population

As [Figure 6](#) shows, the citation counts per million of the population rise until they reach a certain high, and then they fall again in all countries but Vietnam. This curve is particularly well pronounced for Malaysia, whose most influential articles (in terms of citations) were apparently published in 2015 and whose overall citations per population are far superior to all other nations as can be seen in the little inset chart. And a look at the same inset chart also discloses that Indonesia has the least citations per population of all nations, which is confirmed by Indonesia's curve in the main chart often being the bottom line in the individual years. Regarding Vietnam, it is a special case even here in [Figure 6](#) because its citations per population have been consistently growing since 2014 hitting a high of 1,091 in 2020 and placing it on a par with Thailand in that year. Based on this, we may claim that the future looks bright for Vietnam.

Figure 5.

Average number of publications per (million of) population in individual years (main chart) and in the whole period (inset).

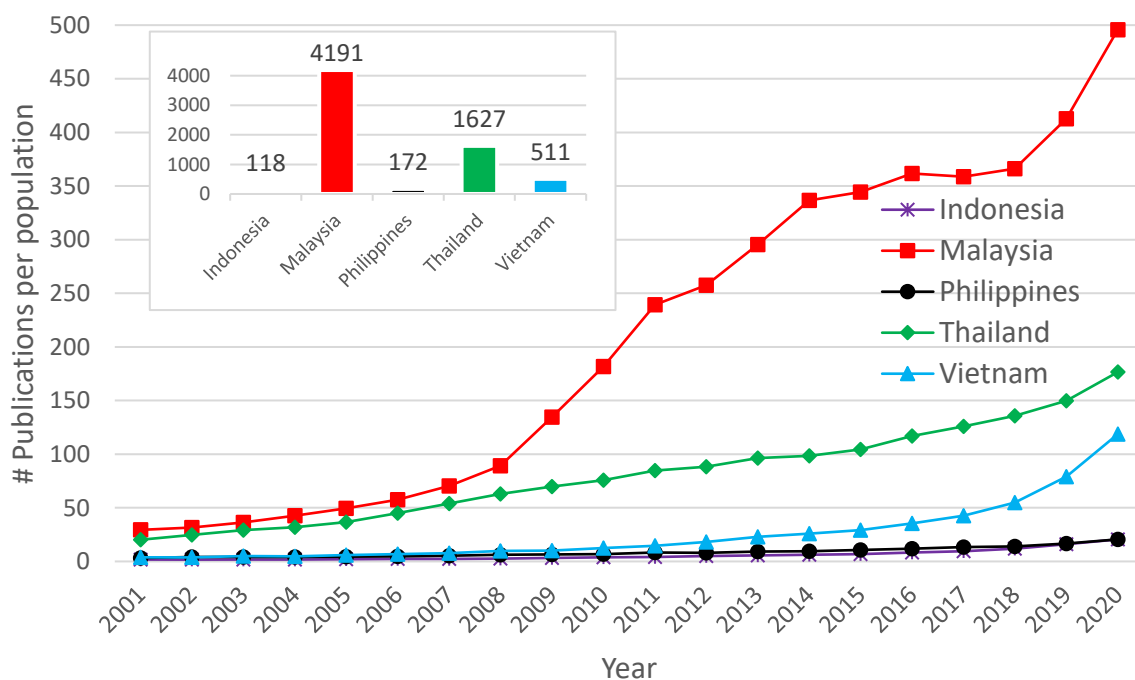
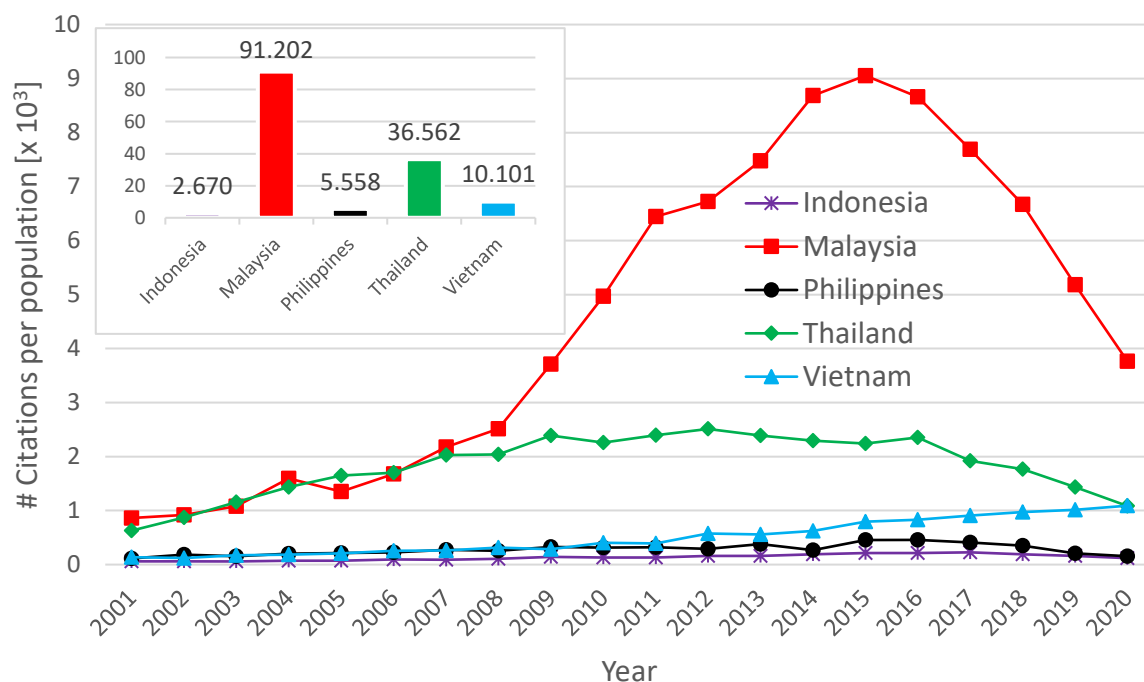


Figure 6

Average number of citations per (million of) population in individual years (main chart) and in the whole period (inset).

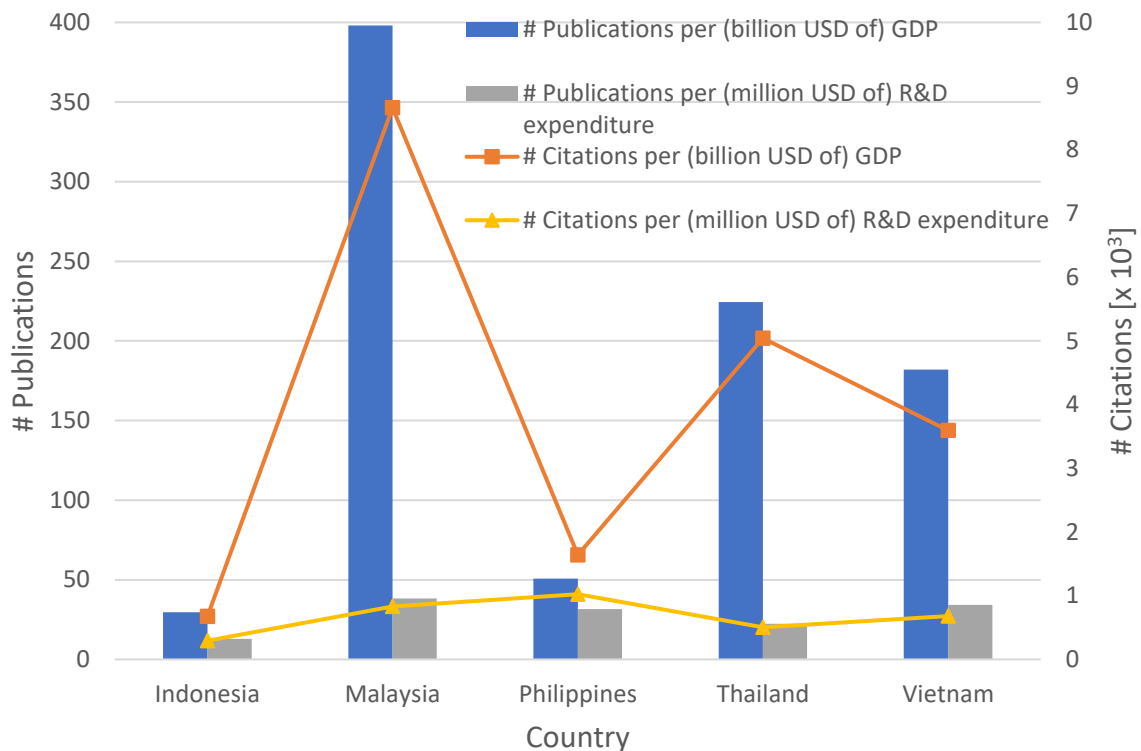


Publications and Citations per GDP and R&D expenditure

Before turning our attention to the last figure of this study, let us remark that the previous two charts displaying the evolution of publication and citation counts per population over time rely solely on the static population size given in Table 1. This is an obvious limitation of the charts as the population size of the countries surely did not remain static but also evolved over time in the investigated period 2001–2020. Therefore, as it would be very difficult, if not impossible, to determine the exact population count of each country in each year, the charts must only be considered as an approximation of the “true” development. For this and other reasons, the following [Figure 7](#) does not contain a time dimension because it was not feasible to ascertain the exact values of GDP and R&D expenditures of countries in each year.

Figure 7

Numbers of publications and citations per GDP and R&D expenditure for five Southeast Asian countries in 2001-2020.



Let us now return to Table 1 and have a look at its four bottom rows that are reflected in Figure 7. It is clearly visible that Malaysia has, by a wide margin, the best publications/GDP ratio with almost 400 publications per billion USD of GDP, followed by Thailand and Vietnam whereas this ratio is the lowest for Indonesia (about 30) with even the Philippines being almost twice as good. Malaysia is also the best as regards the relative proportion of publications count to research and development expenditures (around 38 papers per million USD of R&D expenditure), but the gap behind it is quite small and Vietnam and the Philippines follow suit closely. Indonesia's indicator of approximately 13 articles per million USD of R&D expenditure puts it in the last place once again. Regarding citations, the pattern differs a little from that with publications and Malaysia is clearly ranked first with almost 9,000 citations per billion USD of GDP, but it is the Philippines that occupies the top position by a narrow margin with more than 1,000 citations per million USD of R&D expenditure. Indonesia is ranked last according to both of these metrics with 673 and 293 citations, respectively.

Indonesia's Place

Before moving to the next topic, let us summarize what we have found out about Indonesia from Table 1 and the preceding figures so far. It is the most populous country with the largest absolute GDP and a mediocre GDP *per capita*. Its R&D expenditure in % GDP as well as R&D expenditure *per capita* are both second lowest and its overall R&D expenditure places it in the middle of the ranking. Indonesia's total publication and citation counts are both the second worst and the only indicator in which it stands out in the positive sense is the mean number of citations per paper which places Indonesia in the second place, slightly ahead of Thailand. According to all other remaining criteria that were examined (publication and citation counts per population, GDP, and R&D expenditure), Indonesia is always ranked last, which certainly leaves much room for the improvement of its place in the research landscape of Southeast Asia. As for the other countries investigated in this study, Malaysia is the leading nation in the region in almost all main aspects, generally followed by Thailand, but Vietnam's remarkable dynamics currently threatens Thailand's position and may even depose Malaysia from the throne in the not-so-distant future. Finally, the Philippines is notable for the very efficient production of highly-cited research supported by quite limited resources.

Top Collaborating Countries, Subject Categories, and Indonesian Institutions

The last tables in this study focus on some interesting features of Indonesia's 31,364 articles indexed in SCIE from 2001 to 2020. [Table 2](#) first lists the top 20 collaborating countries, Web of Science subject categories, and Indonesian institutions as extracted from Indonesia's papers and [Table 3](#) then deals with the top 20 journals publishing Indonesia's articles. As we may notice, the countries most frequently collaborating with Indonesia are Japan (21.4%), USA (14.2%), Australia (13.2%), UK (11.3%), and Malaysia (11.1%), which is at the same time the most common representative of Southeast Asia, all having contributed more than 3,000 papers with Indonesia-based co-authors. The scientific disciplines that are researched into the most by scholars affiliated with Indonesian organizations are "Environmental Sciences" with 2,410 articles, "Materials Science Multidisciplinary", "Multidisciplinary Sciences", "Food Science Technology", and "Ecology". And the top five (i.e. publishing the most articles) Indonesian institutions are "University of Indonesia" with 3,180 papers, "Gadjah Mada University", "Institute Technology of Bandung", "Indonesian Institute of Sciences", and "Bogor Agricultural University".

Top Publishing Journals

The journals publishing the most articles written by researchers with Indonesian affiliations are presented in [Table 3](#) along with their ISSN (International Standard Serial Number), publication count, and mean JIF (journal impact factor) percentile, which can be considered as an approximation of a journal's quality³. The most common journal is *PLOS One* with 518 Indonesia's articles, followed by *International Food Research Journal*, *Heliyon*, *Scientific Reports*, and *Zootaxa*. Among these journals only *Scientific Reports* is a Q1 journal, the others being ranked lower or not having their impact factor (yet) as with *Heliyon*. The only other Q1 journal from the Top 20 is *Forest Policy and Economics* with 104 articles, further indicating some room for improvement for Indonesian scholars who might want to target higher-ranked journals with the aim of attracting more citations to their research.

Table 2

Top 20 collaborating countries, Web of Science subject categories, and Indonesian institutions in Indonesia's 31,364 articles.

Country	Subject Category	Indonesian Institution
Japan	6,710 Environmental Sciences	2,410 University of Indonesia 3,180
USA	4,466 Materials Science Multidisciplinary	1,542 Gadjah Mada University 2,960
Australia	4,154 Multidisciplinary Sciences	1,488 Institute Technology of Bandung 2,847
UK	3,551 Food Science Technology	1,168 Indonesian Institute of Sciences 2,335
Malaysia	3,481 Ecology	1,150 Bogor Agricultural University 1,921
Netherlands	2,931 Geosciences Multidisciplinary	1,131 Airlangga University 1,465
Germany	2,527 Public Environmental Occupational Health	1,127 Universitas Padjadjaran 1,026
China	1,991 Energy Fuels	1,126 Center for International Forestry Research CIFOR 978
France	1,752 Engineering Chemical	1,123 Diponegoro University 828
South Korea	1,725 Infectious Diseases	1,070 Universitas Hasanuddin 823
Thailand	1,720 Plant Sciences	1,036 Institut Teknologi Sepuluh Nopember 822

³ JIF percentile greater than 75 basically means a Q1 journal (i.e. placed in the first quartile) according to the descending ranking of journals by their impact factor in a certain subject category.

Country	Subject Category	Indonesian Institution
Taiwan	1,521 Physics Applied	1,008 Brawijaya University 753
India	1,343 Chemistry Multidisciplinary	985 Universitas Syiah Kuala 683
Singapore	1,269 Pharmacology Pharmacy	970 Universitas Udayana 537
Switzerland	944 Zoology	896 Eijkman Institute 500
Italy	930 Engineering Electrical Electronic	813 Sebelas Maret University 473
Philippines	899 Chemistry Physical	800 Ministry of Health Indonesia 431
Canada	875 Biotechnology Applied Microbiology	799 Universitas Andalas 387
Vietnam	872 Forestry	797 Agency for the Assessment Application of Technology BPPT 373
Brazil	743 Biochemistry Molecular Biology	788 National Institute of Health Research Development Indonesia 301

Note: England, Scotland, Wales, and Northern Ireland were merged into the United Kingdom (UK).

Table 3

Top 20 journals publishing 31,364 Indonesia's articles.

Journal Title	ISSN	Count	Mean JIF Percentile
<i>PLOS One</i>	1932-6203	518	64,58
<i>International Food Research Journal</i>	1985-4668	204	12,94
<i>Heliyon</i>	2405-8440	199	NA
<i>Scientific Reports</i>	2045-2322	199	77,08
<i>Zootaxa</i>	1175-5326	171	31,90
<i>Sustainability</i>	2071-1050	140	44,99
<i>Asia Pacific Journal of Clinical Nutrition</i>	0964-7058	136	15,34
<i>American Journal of Tropical Medicine and Hygiene</i>	0002-9637	122	47,01
<i>Materials Research Express</i>	2053-1591	116	18,71
<i>IEEE Access</i>	2169-3536	113	62,23
<i>Malaria Journal</i>	1475-2875	105	61,02
<i>Forest Policy and Economics</i>	1389-9341	104	78,49
<i>Sains Malaysiana</i>	0126-6039	104	22,92
<i>Energies</i>	1996-1073	99	39,04
<i>Bioresources</i>	1930-2126	97	65,91
<i>Raffles Bulletin of Zoology</i>	0217-2445	97	40,52
<i>Journal of Natural Products</i>	0163-3864	96	68,73
<i>Journal of Volcanology and Geothermal Research</i>	0377-0273	96	53,25
<i>International Forestry Review</i>	1465-5489	94	50,00
<i>Southeast Asian Journal of Tropical Medicine and Public Health</i>	0125-1562	92	1,31

Note: The mean journal impact factor (JIF) percentile is calculated from the 2020 Journal Citation Reports (Clarivate, 2021) as the average JIF percentile in all relevant subject categories of all indexes.

Conclusions and Future Work

Scientometrics is one of the many perspectives we may take to look at the socio-economic development of nations and in this paper we presented a study that used this approach to compare Indonesia with four other Southeast Asian countries (Malaysia, Philippines, Thailand, and Vietnam) and to shed more light on its role in the research landscape of this important region of the world. We wanted to find answers to the following questions: Has the total science and technology research production in the region been growing in recent years? What are the basic scientometric indicators such as publication and citations counts, citations per paper, and publications and citations per population, GDP (gross domestic product), and R&D (research and development) expenditure? How did these indicators evolve over time? And what is Indonesia's standing in the rankings by these metrics?

On the way to find answers to the above questions we made the following contributions: We analyzed 330,729 publication records extracted from the primary Science Citation Index Expanded of the Web of Science database about journal articles written by authors with affiliations in the five countries under study and published between 2001 and 2020. We determined the absolute publication and citation counts of the nations and, based on various socio-economic indicators of these countries such as population size, GDP, and R&D expenditure we also calculated different relative scientometric indicators. We also compared (with a focus on Indonesia) and visualized the research performance of the five nations from both the static and dynamic perspectives and, finally, we determined Indonesia's top collaborating countries, scientific disciplines, institutions, and publishing journals. The main findings of our analysis are: a) the research production of all five countries has been growing in recent years, b) Indonesia is the weakest nation in all relative scientometric indicators except the mean number of citations per paper where it is ranked second, c) Malaysia is generally the leading country in all major aspects, but Vietnam has a remarkably steep rise in both production and citedness and may threaten Malaysia's top position in the future, and d) the Philippines is the most efficient in attracting citations compared to its publication output as well as relative to its expenditures on research and development.

A limitation of our study is the presence of constant values of population size, GDP, and R&D expenditure of countries even in charts showing the development of various scientometric indicators over time in a 20-year period because determining the exact

values in each individual year would have been too complicated or impossible. These charts thus represent only an approximation of the true situation and may be improved in the future. Also, this study should be repeated in a few years to see if the main conclusions are still valid.

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