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## Brunei Publications in the Science Citation Index Expanded (1973-2016): Bibliometrics and comparison with other tropical countries

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**Abstract:** Brunei is a small tropical country –located in Southeast Asia– for which there are no previous bibliometric studies. Here we analyze papers published by Brunei scientists from 1973 to 2016 in the Science Citation Index Expanded and compare results with other tropical countries. We identified 1 547 publications and 11 document types. The most productive categories were ecology, multidisciplinary geosciences, inorganic and nuclear chemistry, and environmental sciences. *Singapore Medical Journal* published most of these papers, and the three most productive institutions were Universiti Brunei Darussalam, RIPAS Hospital, and Universiti Teknologi Brunei. UK and Malaysia were the most frequent collaborating countries. M.A. Ali from the Universiti Brunei Darussalam was the most prolific author and a Brunei independent article written by C.K. Morley from the Universiti Brunei Darussalam in 2002 had the highest number of citations of the whole period and the highest number in 2016. The tropical countries of Central America and Asia have a few similarities but also important differences, and both are highly heterogeneous in scientific organization and productivity. Rev. Biol. Trop. 66(3): 1090-1100. Epub 2018 September 01.

**Key words:** tropical country; publication type; scientific collaboration; scientific productivity; research areas.

In recent years there has been an increasing number of analyses about the scientific publications of tropical countries, for example, Costa Rica (Monge-Nájera & Ho, 2012), Panama (Monge-Nájera & Ho, 2015), Nicaragua (Monge-Nájera & Ho, 2017a), Honduras (Monge-Nájera & Ho, 2017b), and El Salvador (Monge-Nájera & Ho, 2017c). In these studies, trends of articles and citations per publication by year (Chuang, Olaiya, & Ho, 2012), citations per publication and country's number of articles by type of collaboration and authorship (Chuang & Ho, 2015), and percentage of publications and number of journals in each Web of Science category (Monge-Nájera & Ho, 2017b) found a general increase in quantity and quality over the years. However, there are fewer

studies along the same line for the Asian tropics (Payumo & Sutton, 2015).

Negara Brunei Darussalam, the Abode of Peace, is a tropical country in Borneo Island, South East Asia. It consists of four main districts: Brunei-Muara, Tutong, Belait and Temburong, of which the latter is separated from the other three by Limbang, a district in the Sarawak state of East Malaysia. The country's main Gross domestic product (GDP) comes from crude oil and natural gas. The population of Brunei Darussalam is less than half a million, and the people are given free medical and education services, and do not pay taxes. Previously a British protectorate state, Brunei Darussalam gained its Independence in 1984. The official language is Malay, but other

languages such as English and Chinese are widely spoken.

In this study, we analyse Brunei publications in the SCI-EXPANDED as follows: document type, language of publication, publication year, collaboration pattern, journal and Web of Science category, and highly cited articles.

## MATERIALS AND METHODS

We used the Science Citation Index Expanded (SCI-EXPANDED), the Web of Science Core Collection, and Clarivate Analytics. We searched for documents with the word “Brunei” in the address field and found 1 590 documents, published between 1900 and 2016 (Date of search: August 04, 2017). Results were refined by countries/territories with “Brunei” (Monge-Nájera & Ho, 2015). Documents with the word “Brunei” but not actually from Brunei -for example Univ Brunei Darussalam, Malaysia; Univ Brunei, Tanzania; and Brunei Shell Petr Co, Malaysia- are not included. In total, 1 547 documents were finally found as valid publications by authors from Brunei. We reclassified articles from England, Scotland, Northern Ireland, and Wales as “United Kingdom” (UK). Articles from Hong Kong before 1997 were reclassified as being from China (Chuang, Wang, & Ho, 2011).

Web of Science Core Collection citations can change over time and cannot be easily compared; to solve this limitation, Ho’s group proposed a new indicator,  $TC_{year}$  (Chuang et al., 2011; Wang, Fu, & Ho, 2011), i.e. total citations from publication to the end of the most recent year (or last year), for example 2016 in this study ( $TC_{2016}$ ). Citations per publication ( $CPP_{2016}$ ) is  $TC_{2016}$ /number of publications ( $TP$ ) (Ho & Ho, 2015). In addition,  $C_{2016}$ , the total citations only in 2016, was also applied (Ho, 2012). The advantage of  $TC_{year}$  and  $C_{year}$  is that they are invariable and ensure repeatability compared with the index of citation from the Web of Science Core Collection (Fu, Wang, & Ho, 2012). It was also pointed out that it is not appropriate to use a single indicator to evaluate the impact of an article (Ho & Hartley,

2016). Researchers should pay more attention to the top articles with  $C_{year}$  but not to those with  $TC_{year}$  only, because some highly cited articles with  $TC_{year}$  have not had a high impact in recent years (Ho & Hartley, 2016). In 2004, a particular analysis of document types and their citations per publication was proposed by Hsieh, Chiu, Lee, and Ho (2004) and we follow it here.

## RESULTS

**Document type and language of publication:** A total of 1 547 publications with at least one author from Brunei in the SCI-EXPANDED was found within 11 document types indexed in the Web of Science. The most used document type was article (81 % of 1 547 publications) followed distantly by the letters (6.2 %) and meeting abstracts (5.9 %) (Table 1). Reviews had twice as many citations per publication ( $CPP_{2016}$ ) than proceeding papers, articles, and notes. A review entitled “Dolomite: Occurrence, evolution and economically important associations” (Warren, 2000) from the Universiti Brunei Darussalam was not only the most frequently cited review with  $TC_{2016}$  of 343 but also the most frequently cited paper of any kind from Brunei. Number of authors per publication,  $APP$ , was also about double for reviews than for book chapters and articles. However, an article entitled “Mortality of emergency abdominal surgery in high-, middle- and low-income countries” (Bhangu et al., 2016) had the most authors (an extraordinary number: 1 480 authors). Of all document types, only articles were used for further analysis because they included whole research ideas and results (Ho, Satoh, & Lin, 2010). Language of publication is one of basic concerns in bibliometric studies as a big data analysis (Wang & Ho, 2011); in Brunei, all 1 257 articles were published in English.

**Publication year:** In recent years, a relationship between number of articles and their citations ( $CPP_{year} = TC_{year}/TP$ ) by decade (Ho, 2012) and year (Chuang et al., 2012; Chuang

TABLE 1  
Citations and authors according to document type

Document type	<i>TP</i>	%	<i>AU</i>	<i>APP</i>	<i>TC</i> <sub>2016</sub>	<i>CPP</i> <sub>2016</sub>
Article	1,257	81	7,545	6.0	13,583	11
Letter	96	6.2	170	1.8	96	1.0
Meeting abstract	91	5.9	487	5.4	5	0.055
Review	64	4.1	878	14	1 555	24
Proceedings paper	47	3.0	145	3.1	569	12
Editorial material	23	1.5	58	2.5	22	1.0
Correction	10	0.65	41	4.1	2	0.20
Note	4	0.26	10	2.5	41	10
Book chapter	1	0.065	7	7.0	3	3.0
Book review	1	0.065	1	1.0	0	0
Discussion	1	0.065	1	1.0	1	1.0

*TP*: number of articles; *AU*: number of authors; *APP*: number of authors per publication ( $AU/TP$ );  $TC_{2016}$ : total citations since publication to the end of 2016;  $CPP_{2016}$  citations per paper ( $TC_{2016}/TP$ ).

& Ho, 2015) was proposed as a figure. It has been applied for publication trends in countries in the tropics, for example Panama (Monge-Nájera & Ho, 2015), Nicaragua (Monge-Nájera & Ho, 2017a), Honduras (Monge-Nájera & Ho, 2017b), El Salvador (Monge-Nájera &

Ho, 2017c), Cameroon (Tchuifon Tchuifon, Fu, & Ho, 2017), and India (Elango & Ho, 2017). Figure 1 shows the distribution of the 1 257 articles from Brunei over years and their citations per publication ( $CPP_{2016} = TC_{2016}/TP$ ). From 1973 to 1991, there were less than

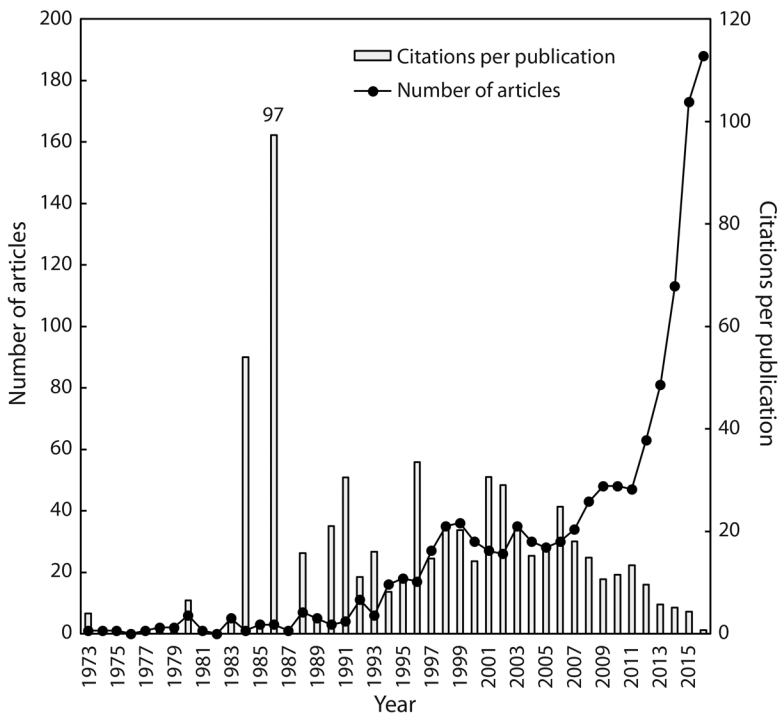


Fig. 1. Trends of articles and citations per publication from 1973 to 2016.

TABLE 2  
20 most collaborative countries

Country	<i>TP</i>	<i>TP R (%)</i>	<i>FP R (%)</i>	<i>RP R (%)</i>	<i>TC</i> <sub>2016</sub>	<i>CPP</i> <sub>2016</sub>
UK	160	1 (13)	2 (5.3)	2 (5.7)	2,074	13
Malaysia	159	2 (13)	1 (7.5)	1 (7.3)	1,472	9.3
Australia	143	3 (11)	4 (3.5)	3 (3.6)	1,738	12
USA	133	4 (11)	6 (3.2)	5 (3.3)	2,673	20
Singapore	93	5 (7.4)	5 (3.3)	6 (3.1)	727	7.8
China	91	6 (7.2)	3 (4.3)	3 (3.6)	916	10
Germany	72	7 (5.7)	8 (1.4)	8 (1.5)	908	13
India	54	8 (4.3)	12 (1.0)	16 (0.65)	409	7.6
Bangladesh	50	9 (4.0)	16 (0.72)	16 (0.65)	750	15
France	44	10 (3.5)	10 (1.2)	9 (1.1)	896	20
Japan	43	11 (3.4)	11 (1.1)	11 (1.1)	833	19
Canada	41	12 (3.3)	13 (1.0)	12 (0.81)	892	22
Sri Lanka	40	13 (3.2)	13 (1.0)	12 (0.81)	347	8.7
South Korea	39	14 (3.1)	7 (2.1)	7 (1.7)	309	7.9
Taiwan	35	15 (2.8)	9 (1.4)	9 (1.1)	275	7.9
Switzerland	26	16 (2.1)	16 (0.72)	12 (0.81)	284	11
Thailand	26	16 (2.1)	24 (0.32)	24 (0.32)	610	23
South Africa	24	18 (1.9)	19 (0.56)	19 (0.57)	453	19
Pakistan	23	19 (1.8)	28 (0.24)	24 (0.32)	132	5.7
Saudi Arabia	23	19 (1.8)	33 (0.16)	28 (0.24)	232	10

*TP*: number of collaborative articles with Brunei; *FP*: first-author articles; *RP*: corresponding-author articles; *R*: rank; *TC*<sub>2016</sub>: total citations since publication to the end of 2016; *CPP*<sub>2016</sub>: citations per paper (*TC*<sub>2016</sub>/*TP*).

10 articles per year, and then there were 11 articles in 1992; this was followed by a slightly fluctuating increase and a sharp increase 2010.

In 1986 only three articles had *CPP*<sub>2016</sub> higher than 97, which can be attributed to the article “Fault geometries in basement-induced wrench faulting under different initial stress states” (Naylor, Mandl, & Sijpesteijn, 1986) by authors from Oman, Netherlands, and Brunei, respectively, with a *TC*<sub>2016</sub> of 291. Similarly, only one article, “Paleomagnetism of the sveconorwegian mobile belt of the fennoscandian shield” (Stearn & Piper, 1984) had a high *CPP*<sub>2016</sub> of 54. The earliest Brunei article in SCI-EXPANDED was “Minimum phase criterion of sampled signals” published in *IEEE Transactions on Geoscience and Remote Sensing* in 1973 (Berkhout, 1973) with a *TC*<sub>2016</sub> of 4.

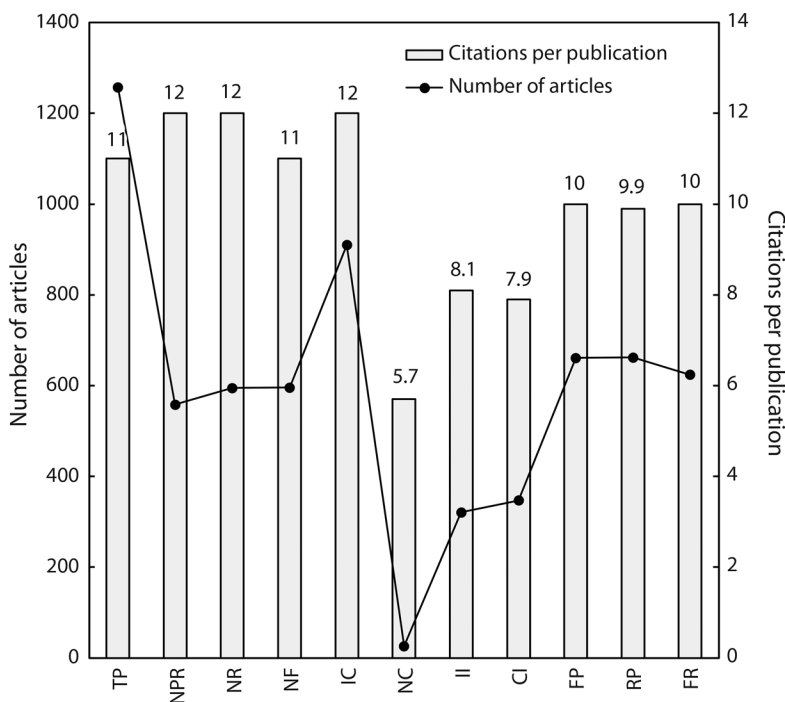
**Collaboration:** to evaluate the impact of publication type, Ho’s group proposed a

relationship between publication type and citations per publication (*CPP*<sub>year</sub>) (Chuang & Ho, 2015). It has recently been applied in tropical countries such as Nicaragua (Monge-Nájera & Ho, 2017a), Honduras (Monge-Nájera & Ho, 2017b), and El Salvador (Monge-Nájera & Ho, 2017c). Types included *TP* (total publications), *NFR* (both first and corresponding-authors are not from the country), *NR* (corresponding-author is not from the country), *NF* (first-author is not from the country), *IC* (internationally collaborative publications), *NC* (nationally collaborative publications), *II* (institutional independent publications), *CI* (country independent publications), *FP* (publications with first-author in the country), *RP* (publications with corresponding-author in the country), and *FR* (both first and corresponding-authors are from the country) (Chuang & Ho, 2015; Monge-Nájera & Ho, 2017a, 2017b; Elango & Ho, 2017). Internationally collaborative articles (*IC*) received higher *CPP*<sub>2016</sub> than those with

local institutional collaboration and those in which the corresponding author was from Brunei (Chuang & Ho, 2015).

A total of 160 articles were done in collaboration with UK institutions, and 159 articles were based on collaborative efforts with Malaysia (followed by Australia and the USA) (Table 2). Malaysia has had more leading role in collaborative relationships: 7.5 % of all articles had a first-author affiliated with a Malaysia institution (7.3 % of 1 236 articles with corresponding information). International collaboration with Thailand had the highest  $CPP_{2016}$  (23). Canada, France and the USA also had high  $CPP_{2016}$  values (22, 20, and 20, respectively). On the other hand, international collaboration with Pakistan had the lowest  $CPP_{2016}$  (5.7) followed by India, Singapore, Taiwan, and South Korea (Fig. 2).

**Leading institutions and authors:** there were some institutions with identical names and misspellings in the Web of Science database (Elango & Ho, 2017). Data from institutes that have changed names were grouped together under the new name. For instance, articles from Univ Brunei Darussalam, Univ Brunei, UBD, and Univ Brunei Darussalam Jalan Tungku Link, were grouped under Universiti Brunei Darussalam (UBD). In total, 26 % were single institution articles and 74 % were inter-institution collaborative articles, including 1.9 % nationally collaborative articles and 72 % internationally collaborative articles. It is not surprising to have such low percentage of nationally collaborative in Brunei because the country has only few institutions. Universiti Brunei Darussalam published 70 % of 1257 Brunei articles as it was the first university in



**Fig. 2.** Citations per publication and number of articles by type of collaboration and authorship. *TP*: total articles; *NFR*: both first and corresponding-authors are not from Brunei; *NR*: corresponding-author is not from Brunei; *NF*: first-author is not from Brunei; *IC*: internationally collaborative publications; *NC*: nationally collaborative publications; *II*: institutional independent publications; *CI*: Brunei independent publications; *FP*: first-author is from Brunei; *RP*: corresponding-author is from Brunei; *FR*: both first and corresponding-authors are from Brunei.

Brunei. The university also published the most single institutional articles (175 articles; 54 % of 323 single institutional articles); inter-institutional articles (75 % of 934 inter-institutional articles); first-author articles (37 % of 1 257 first-author articles); corresponding-author articles (36 % of 1 236 corresponding-author articles); and single-author articles (63 % of 167 single-author articles).

Both the RIPAS hospital and the Universiti Teknologi Brunei (UTB) published the same number of articles (139 articles each). The RIPAS hospital ranked second on single institutional articles (23 %), first-author articles (7.1 %), and corresponding-author articles (7.2 %) while the Universiti Teknologi Brunei ranked second on inter-institutional articles (13 %) and single-author articles (10 %). Other institutions published less articles, including Brunei Shell Petroleum Co. Sendirian Berhad (35 articles), Ministry of Health (15), Jerudong Park Medical Centre (12), High Commission of India (9), Department of Agriculture (8), Sultan Saiful Rijal Technical College (8), and Suri Seri Hospital (6).

Of 12 authors with 20 or more articles, nine were from Universiti Brunei Darussalam, two from RIPAS hospital, and one from Universiti Teknologi Brunei (Table 3). It is generally

accepted that the first-author actually made the greatest contribution, and should receive a greater proportion of the credit (Riesenberg & Lundberg, 1990). Convention among the experimental sciences suggests that the most important authorship positions are the first and the last, who often include the corresponding-author (Costas & Bordons, 2011). M.A. Ali, from the Universiti Brunei Darussalam, was the most productive author with 54 Brunei articles including 41 first-author articles and 42 corresponding-author articles, followed by V.H. Chong from the RIPAS hospital with 52 articles, who was also ranked 1<sup>st</sup> on corresponding-author articles. W. Roth from Universiti Brunei Darussalam published 13 articles including 12 single-author articles ranked top in Brunei. In addition, A.H. Mirza from the Universiti Brunei Darussalam and P.U. Telisinghe from the RIPAS hospital published only two first-author articles and no any corresponding-author and single-author articles.

#### Journal and Web of Science category:

In this context, 1 257 Brunei articles were published in 712 journals across 157 Web of Science categories in SCI-EXPANDED. Among these, 70 % of 712 journals contained only one Brunei article; 16 % contained two, and

TABLE 3  
Top 12 authors published at least 20 articles in Brunei

Author	Institution	<i>R (TP)</i>	<i>R (FP)</i>	<i>R (RP)</i>	<i>R (SP)</i>
M. A. Ali	Universiti Brunei Darussalam	1 (54)	1 (41)	1 (42)	N/A
V. H. Chong	RIPAS hospital	2 (52)	2 (29)	1 (42)	7 (5)
J. N. Sahu	Universiti Teknologi Brunei	3 (47)	106 (1)	10 (12)	N/A
H. Mirza	Universiti Brunei Darussalam	4 (42)	66 (2)	N/A	N/A
L. B. L. Lim	Universiti Brunei Darussalam	5 (33)	13 (9)	4 (15)	N/A
D. J. Marshall	Universiti Brunei Darussalam	5 (33)	9 (11)	8 (13)	29 (1)
T. U. Grafe	Universiti Brunei Darussalam	7 (30)	17 (7)	18 (8)	N/A
B. K. Morley	Universiti Brunei Darussalam	8 (29)	4 (15)	4 (15)	4 (7)
P. U. Telisinghe	RIPAS hospital	9 (23)	66 (2)	N/A	N/A
V. D. Didenko	Universiti Brunei Darussalam	10 (21)	3 (21)	3 (19)	10 (4)
P. Becker	Universiti Brunei Darussalam	11 (20)	6 (12)	8 (13)	15 (3)
R. Ramasamy	Universiti Brunei Darussalam	11 (20)	41 (3)	12 (11)	N/A

*R*: rank; *TP*: number of articles; *FP*: first-author articles; *RP*: corresponding-author articles; *SP*: single-author articles; N/A: not available.



6.9 % contained three Brunei articles. A total of 1 178 articles were published in 662 journals with impact factor information in 2016,  $IF_{2016}$ , and 79 articles were published in 50 journals without  $IF_{2016}$ .

Brunei published the most articles in *Singapore Medical Journal* ( $IF_{2016} = 0.667$ ) with 36 articles, followed by *Polyhedron* ( $IF_{2016} = 1.926$ ) with 24, *Biotropica* ( $IF_{2016} = 1.730$ ) with 15, *Transition Metal Chemistry* ( $IF_{2016} = 1.358$ ) with 14, *Zootaxa* ( $IF_{2016} = 0.972$ ) with 13, *Desalination and Water Treatment* ( $IF_{2016} = 1.631$ ) with 12, *PLoS One* ( $IF_{2016} = 2.806$ ) with 12, and *Marine and Petroleum Geology* ( $IF_{2016} = 2.888$ ) with 10. *Lancet* ( $IF_{2016} = 47.831$ ) with only one article, entitled “Hyperkalaemia in a Thai man” (Smit, 1999), had the highest  $IF_{2016}$ . However, this single-author article was cited once in 2001 and 2011, respectively

with  $TC_{2016}$  of 2 and  $C_{2016}$  of 0. Brunei also published articles in other high impact journals, for example *Nature* ( $IF_{2016} = 40.137$ ), *Science* ( $IF_{2016} = 37.205$ ), *BMJ-British Medical Journal* ( $IF_{2016} = 20.785$ ), *Gastroenterology* ( $IF_{2016} = 18.392$ ), and *Cell Metabolism* ( $IF_{2016} = 18.164$ ).

The number of journals per Web of Science category (Fig. 3) indicate that ecology dominated, with 153 journals publishing the most Brunei articles (8.0 % of 1 257 articles), followed by multidisciplinary geosciences (6.5 %), inorganic and nuclear chemistry (5.3 %), environmental sciences (5.0 %), electrical and electronic engineering (4.3 %), mathematics (4.2 %), general and internal medicine (3.9 %), zoology (3.9 %), energy and fuels (2.3 %), applied mathematics (3.6 %), multidisciplinary materials science (3.5 %), multidisciplinary sciences (3.3 %), plant sciences (3.3 %), physical chemistry (3.3 %), and chemical engineering (3.2 %).

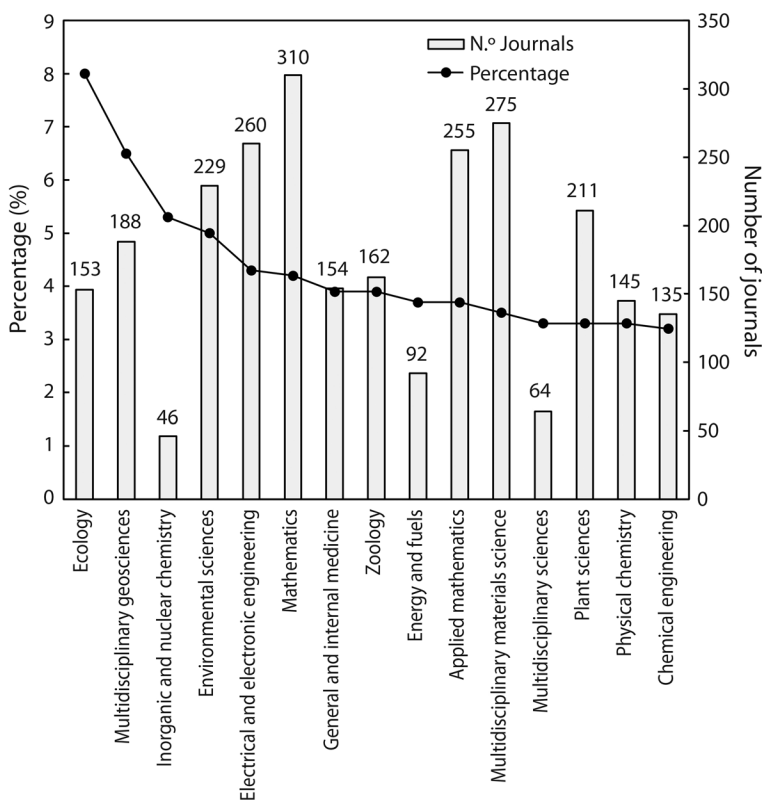


Fig. 3. Percentage of publications and number of journals in each Web of Science category.



**Highly cited articles:** The number of highly cited publications has been used as indicator for ranking universities (Waltman et al., 2012), and top universities publish more classic articles (Ho & Hartley, 2016). Regarding the top 10 Brunei articles which have received more than 100 citations (Table 4), seven were published after 2000. Only four had a first-author (including two single-authored articles) from Brunei and three had corresponding-author

(including two single-authored articles) from Brunei. Highly cited single-author articles were published by C.K. Morley from the Department of Petroleum Geoscience in the Universiti Brunei Darussalam with  $TC_{2016}$  of 208 (rank 4th) and  $C_{2016}$  of 25 (rank 7th) and S. Mohamad from the Department of Mathematics in the Universiti Brunei Darussalam with  $TC_{2016}$  of 155 (rank 6th) and  $C_{2016}$  of 3 (rank 267th).

TABLE 4  
Top ten articles with  $TC_{2016} > 100$

Rank ( $TC_{2016}$ )	Rank ( $C_{2016}$ )	Article title	Country	Reference
1 (328)	5 (28)	Explaining the abundance of ants in lowland tropical rainforest canopies	USA, Brunei	Davidson et al. (2003)
2 (291)	18 (14)	Fault geometries in basement-induced wrench faulting under different initial stress states	Oman, Netherlands, Brunei	Naylor et al. (1986)
3 (274)	3 (32)	Levothyroxine treatment in euthyroid pregnant women with autoimmune thyroid disease: Effects on obstetrical complications	Italy, Brunei	Negro et al. (2006)
4 (208)	7 (25)	A tectonic model for the Tertiary evolution of strike-slip faults and rift basins in SE Asia	Brunei	Morley (2002)
5 (156)	133 (4)	The preparation, characterization, crystal structure and biological activities of some copper(II) complexes of the 2-benzoylpyridine Schiff bases of S-methyl- and S-benzylthiocarbazate	Brunei, Bangladesh, Canada	Hossain et al. (1996)
6 (155)	196 (3)	Global exponential stability in continuous-time and discrete-time delayed bidirectional neural networks	Brunei	Mohamad (2001)
7 (141)	34 (11)	Biological activity of palladium(II) and platinum(II) complexes of the acetone Schiff bases of S-methyl- and S-benzylthiocarbazate and the X-ray crystal structure of the [Pd(asme)(2)] (asme=anionic form of the acetone Schiff base of S-methylthiocarbazate) complex	Brunei, USA, Malaysia	Ali et al. (2002)
8 (123)	16 (15)	The influence of selenium supplementation on postpartum thyroid status in pregnant women with thyroid peroxidase autoantibodies	Italy, Brunei	Negro et al. (2007)
9 (120)	2 (36)	Height-diameter allometry of tropical forest trees	UK, Brazil, Ghana, Netherlands, Bolivia, USA, France, Canada, Japan, Brunei, Malaysia, Australia, Colombia, Cameroon, Gabon	Feldpausch et al. (2011)
10 (106)	90 (6)	Vegetational history of a site in the central Amazon basin derived from phytolith and charcoal records from natural soils	Panama, Brunei	Piperno and Becker (1996)

$TC_{2016}$ : total citations since publication to the end of 2016;  $C_{2016}$  citations in 2016 only.

A Brunei independent article entitled “A tectonic model for the Tertiary evolution of strike-slip faults and rift basins in SE Asia” (Morley, 2002) ranked top in both  $TC_{2016}$  and  $C_{2016}$ . The earliest highly cited article was published in 1986 in collaboration with Oman and Netherlands with  $TC_{2016}$  of 291 (rank 2nd) and  $C_{2016}$  of 14 (rank 18th) and the most recent one in 2012 was collaboration with the UK with  $TC_{2016}$  of 120 (rank 9th) and  $C_{2016}$  of 36 (rank 2nd). Number of total citations for a publication is widely considered to be an indicator for highly cited publications. However, the highly cited articles are not always in top citations (Ho, 2014). Impact in the most recent year,  $C_{2016}$ , was also compared for the high impact publications (Ho, 2012). Only four highly cited articles ranked top ten in both  $TC_{2016}$  and  $C_{2016}$  including articles published by Davidson, Cook, Snelling, and Chua (2003), Negro et al. (2006), Morley (2002), and Feldpausch et al. (2011). In addition, three of the 10 highly cited articles were published in the Web of Science category of multidisciplinary geosciences: Naylor et al. (1986), Feldpausch et al. (2011), and Piperno and Becker (1996).

## DISCUSSION

The dominance of article, over letters, notes, proceedings and other types of scientific documents, found in Brunei's publications, has also been found in most tropical countries studied this far (Monge-Nájera & Ho, 2012, 2017c). The reason seems to be that articles are the basic unit of scientific work because they present a particular problem and its solution according to the scientific method, while letters and other documents do not include all the necessary aspects of detailed methods, full results and thorough analysis.

The fact that Brunei articles are 100 % in English, while those of Latin American countries are often in Spanish, may reflect the fact that Spanish has a greater scientific output than Malay, the main language of Brunei; but a second possibility is that Brunei articles in Malay appear in journals that are not included

in the Science Citation Index Expanded; similar results were reported previously for tropical countries (Monge-Nájera & Ho, 2012, 2015, 2017a, 2017b, 2017c).

The recent increase in the number of publications seems to be a general trend of tropical countries, both in Asia (Payumo & Sutton, 2015) and elsewhere (Monge-Nájera & Ho, 2017c).

Internationally collaborative articles ( $IC$ ) from Brunei received more citations per publication,  $CPP_{2016}$ , than institutional independent articles ( $II$ ), and were followed by nationally collaborative articles ( $NC$ ). This result is in agreement with other tropical countries, for example Nicaragua (Monge-Nájera & Ho, 2017a), Honduras (Monge-Nájera & Ho, 2017b), and El Salvador (Monge-Nájera & Ho, 2017c). International collaborative efforts tend to produce a higher number of authors and frequently wider exposure, and thus, are more likely to have higher citation rates (Glänzel, 2001; Payumo & Sutton, 2015). This matches our finding that articles with a first-author and/or corresponding-author from other countries tend to receive higher  $CPP_{2016}$  than those with a first-author and/or corresponding-author from Brunei. The same trend has also been observed in Southeast Asia (Payumo & Sutton, 2015). Nicaragua (Monge-Nájera & Ho, 2017a), Honduras (Monge-Nájera & Ho, 2017b), and El Salvador (Monge-Nájera & Ho, 2017c).

The UK and Malaysia were the most frequent research partners with Brunei. There were more collaborations with Malaysia but they had lower impact, similar to a report by Payumo and Sutton (2015). However, researchers in Brunei had higher impact than Nicaragua (Monge-Nájera & Ho, 2017a), Honduras (Monge-Nájera & Ho, 2017b), and El Salvador (Monge-Nájera & Ho, 2017c), possibly because the scientific infrastructure is much more developed in Brunei (Payumo & Sutton, 2015). The predominance of collaboration with neighbouring countries, and with former colonial powers, also matches what is known from the tropical countries of Central America (Monge-Nájera & Ho, 2017c).

Brunei publications were dominated by ecology, similar to Panama in Central America (Monge-Nájera & Ho, 2015). However, other tropical countries, for example Costa Rica, published the most articles in biology (Monge-Nájera & Ho, 2012), while public, environmental and occupational health dominated research in Nicaragua (Monge-Nájera & Ho, 2017a), Honduras (Monge-Nájera & Ho, 2017b), and El Salvador (Monge-Nájera & Ho, 2017c).

In conclusion, the tropical countries of Central America and Asia studied thus far have a few similarities but also important differences, and they are highly heterogeneous in their scientific organization and productivity: no simple generalizations can be made for the scientific output of tropical nations.

## RESUMEN

**Publicaciones de Brunei en el Science Citation Index Expanded (1973-2016): Bibliometría y comparación con otros países tropicales.** Brunei es un pequeño país tropical del sudeste asiático, sobre el cual no hay estudios bibliométricos. Aquí analizamos los artículos publicados por científicos de Brunei de 1973 a 2016 y comparamos los resultados con otros países tropicales. Examinamos los documentos del Science Citation Index Expanded en la colección principal del Web of Science. Hallamos 1 547 publicaciones de Brunei con 11 tipos de documentos, donde las categorías más productivas fueron ecología, geociencias multidisciplinarias, química inorgánica y nuclear, y ciencias ambientales. *Singapore Medical Journal* publicó la mayoría, y las tres instituciones más productivas fueron: Universiti Brunei Darussalam, RIPAS Hospital y Universiti Teknologi Brunei. Reino Unido y Malasia fueron los países que más colaboraron con Brunei. M.A. Ali de la Universidad Brunei Darussalam fue el autor más prolífico. El mayor número total de citas, y el mayor número de citas en 2016, correspondieron a un artículo exclusivamente de Brunei, escrito por C. K. Morley de la Universiti Brunei Darussalam en 2002. Los países tropicales de América Central y Asia tienen algunas similitudes pero también diferencias importantes, siendo heterogéneos en su organización científica y productividad.

**Palabras clave:** cienciometría; productividad; colaboración científica; temas principales de estudio.

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