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Patterns of Productivity of High Impact Scientists in the Philippines and its ASEAN Neighbors

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ABSTRACT

Using the database developed by scientists from Stanford University and Elsevier Science, the study explored patterns of the scientific production of Filipino and other ASEAN scientists listed in the top 2% of scientists in the world across disciplines. The number of Filipinos in the list of top scientists was much lower compared to more developed ASEAN countries, and Philippine universities hosted a smaller percentage of top scientists compared to those in other countries. An overwhelming majority of the publications of the top ASEAN scientists involve international collaborations published in top-tier (top decile, top quartile) journals. The top 1% were also identified as having fewer national collaborations and publications in lower-tier journals. Two factors that might be associated with the low scientific impact of Filipino researchers relative to their ASEAN counterparts were discussed: a weak, isolated research ecosystem and low research skills of the university faculty. The identifiers of high scientific impact were discussed as possible indicators for supporting research of faculty researchers in Philippine universities.

Keywords: : Scientific productivity; scientific impact; scientific publications; research universities; science research; Philippines; Southeast Asia; ASEAN

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Abbreviations: ANOVA, analysis of variance; ASEAN, Association of Southeast Asian Nations; CHED, Commission on Higher Education, DBM, Department of Budget and Management, FWCI, field weighted citation impact; HEI, higher education institution, MANOVA, multivariate analysis of variance; Q1, Q2, Q3, & Q4, first, second, third, and fourth quartile journals in terms of citation impact; THE, Times Higher Education

INTRODUCTION

In the history of science, a relatively small number of individuals have made a significant and lasting impact on science and society. Historically, these individuals tended to come from Europe and North America; this unequal trend is still reflected currently, although more of these individuals making an impact on science are coming from a more diverse set of countries (Aagard et al. 2020; Xie 2014). The social processes that sustain the national variations in scientific impact and influence have been studied by social scientists of science, and a particular focus on the scientific elite has been motivated by the desire to understand the contexts and experiences that have allowed them to thrive. Such topics of inquiry may be relevant to countries like the Philippines and some of its ASEAN neighbors that are aspiring to strengthen their national scientific systems, guided by the principles of scientific and technology-driven economic development (Wang 2007) and sustainable development (Bachmann et al. 2022). Understanding aspects of the productivity of the top-tier scientists might reveal features of their work that could be supported by research-oriented organizations, like higher education institutions that provide employment and the work environment for scientists in many countries.

This study aims to explore the productivity of top scientists in the Philippines and their ASEAN neighbors using a database developed by scientists from Stanford University and Elsevier Science (Ioannidis et al. 2019). No specific hypotheses were tested, but research has already shown that the scientific productivity of the Philippines is lower compared to its leading ASEAN counterparts (Sukoco et al. 2023). Researchers have also documented these low levels of productivity across (Gopez et al. 2024) and within regions (Cerado and Naanep 2023; Eguac and Pelones 2024; Mala et al. 2021) and in specific disciplines (Fernandez et al. 2022; Navarrete and Asio 2014). To begin exploring research productivity in Philippine universities, observations were focused on the work of university-based scientists, their publications and citations, the journals they publish in, and their types of scientific collaborations.

The top 2% scientists

Evaluating the merit and achievements of scientists is never a clear-cut undertaking, as there are many perspectives on what constitutes the most important contributions of scientific work (Heinze 2013). However, there is a long-standing consensus that citations are important indicators of success and status in science, and numerous different rankings have been developed using citations to assess the relative achievements of scientists in different fields. This study uses the ranking developed by scientists from Stanford University and Elsevier Science who built a composite indicator of scientific impact using six indicators: total citations; Hirsch h-index; coauthorship-adjusted Schreiber hm-index; number of citations to papers as single author; number of citations to papers as single or first author; and number of citations to papers as single, first, or last author (Ioannidis et al. 2019). The relative merits and limitations of this metric (c.f., Ioannidis et al. 2016) are not discussed in this study; it is acknowledged that the list that purportedly identifies the "top 2% of scientists in the world across all scientific disciplines" seems to have been well-accepted over the years, perhaps because of the metric's transparency.

Since 2019, the Ioannidis et al. team has published annual updates of the list of the top 2% (e.g., Ioannidis 2025). There are two lists provided annually, one pertains to citations data from 1996 onwards, and comprises what is referred to as the career-long scientific impact; the other pertains to citation data for publications in the most recent five years and comprises what is referred to as the single-year scientific impact. Both lists feature changes every year, although the latter list involves more cases of additions and delisting of individual scientists. But for purposes of this exploratory study, the single-year list was analyzed as it most likely reflects current patterns and trends in contemporary research and publications environments.

The relevance of the top 2%

Different Philippine higher education institutions and professional organizations have celebrated their researchers who have been included in the Top 2% lists. Beyond acclaiming the achievement of Filipino scientists, is there anything else that can be known from the list? What can higher education institutions learn from the individuals with the highest scientific impact? It is already known that the individual scientists included in the list publish more and receive more citations than most scientists. But perhaps there can be a more nuanced understanding regarding what is "more" or what factors make more of a difference than others. Such insights might guide higher education institutions regarding what they should aspire to and support among their faculty researchers.

Such insights will need to be contextualized within the Philippine higher education context, where institutions are still trying to develop a scientific research culture. Research on the Philippine higher education institutions points to constraints in the research environment (Ocampo et al. 2022). For example, Ocampo and colleagues identified institutional support, reward system, research funding, mentoring, and electronic information resources as the most crucial factors that predict research productivity of higher education in the country. Other smaller studies that focus on individual universities point to the same factors, but in addition, to difficulties of engaging in research because of the teaching workload (Gaikwad 2021; Palmiano 2024) and faculty members' research-related motivations, interests, knowledge, and skills (Camilon et al. 2024; Meneses and Moreno 2019; Pentang and Domingo 2024). Thus, aside from resource constraints, there also seem to be capacity factors that limit the research activities of faculty researchers in Philippine higher education institutions.

In this regard, the aspiration of doing scientific work that ranks among the top 2% is probably not an aspiration of many higher education institutions in the Philippines, much less of many of the individual faculty members of these institutions; so understanding the productivity of these scientists may be seen as a matter of very minimal significance or relevance to developing scientific research cultures in the Philippines. There is merit in this perspective, as there is a danger in narrowly focusing discourses on scientific research development on metrics that are based on activities and infrastructure that do not exist in most Philippine universities. But perhaps the relevance can be appreciated in the fact that there are 45 Filipinos who are currently affiliated with 17 Philippine universities who are in the list, and perhaps there is something to learn from their scientific activities and those of their counterparts in ASEAN.

The current exploratory study

The research questions are grouped into two broad inquiries. The first inquiry relates to the Philippines' top scientists vis-à-vis other ASEAN countries: How does the Philippines compare to its ASEAN neighbors in terms of the number of top 2% scientist across disciplines across the five-year period of 2020-2024? In 2024, how does the Philippines compare to its ASEAN neighbors in terms of the number of top 2% scientist based in higher education institutions? The second inquiry relates to predictors of the highest levels of scientific impact: In 2024, what factors distinguish the top 1% from the top 2% ASEAN scientists? Citation-related factors? Publication/journal-related factors? Authorship-related factors?

The first inquiry will hopefully provide some assessment of whether the Philippine higher education institutions are providing the environment for doing high-impact scientific research, while the second inquiry could provide information that guides higher education institutions' research development policies that relate to nurturing scientific impact. These points of inquiry are not expected to provide definitive guides to research development in Philippine universities; instead, it aims to provide additional stimulus for further debate and reflection.

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METHODS

The datasets

affiliations with any of the ASEAN countries. These five updated datasets contain the single-year list and metrics for years 2020, 2021, 2022, 2023, and 2024 (referring to accomplishments up to the years 2019, 2020, 2021, 2022, and 2023, respectively). These five datasets are all publicly accessible at the Elsevier Data Repository: https://elsevier.digitalcommonsdata.com/datasets/btchxktzyw/2. Note that after the current analysis was completed, a 2025 list was published, but these were not included in the study.

After extracting all ASEAN-affiliated authors, details from the 2024 single-year dataset were curated. First, the institutional affiliation of each other was classified as either a higher education institution or not. In cases when the affiliation was not clearly identified as a university or a college, additional verification was undertaken through internet research. Then the median rank (i.e., 113,890) was identified for all entries in the list, and the ASEAN scientists who rank higher than the median were classified as being in the top 1%. This list was then merged with data from the SciVal, which is a platform for advanced analytic solutions using Scopus data to generate information on the research performance of individuals, research groups, institutions, and countries. For purposes of the study, the SciVal research performance of individuals from 2019 to 2023 was extracted for each of the ASEAN scientists in the 2024 single-year list that updated Ioannidis et al. (2019). The full name of the scientist was used to merge the data files; the name, as stated in the Ioannidis et al. database, was searched in the SciVal database, and the institutional affiliation was verified; the pertinent data from the matching entries were saved in the merged file. Not all ASEAN scientists listed in Ionnaidis et al.'s 2024 single-year list were found in SciVal; in some cases, the same name was associated with different institutions and even different countries. In the latter cases, other bits of information were considered (e.g., area or discipline of research publications, dates of publication) to ascertain whether the name matches were the same individual scientists. The data were merged when the names and disciplines matched, even if the scientist's affiliation changed, as long as the affiliation is in the same ASEAN country. All cases where an exact match cannot be ascertained were deleted from further analysis for the reason that the SciVal data were missing for these non-matching cases. These cases typically involved scientists who were listed in SciVal as being affiliated with an institution in a non-ASEAN country, which should not be surprising, as top scientists are likely to be offered positions in other countries. But otherwise, there is no readily available explanation for why these non-matches occur, or whether the non-matches are not random. The specific variables that were analyzed from the merged datasets are described in detail in the results section.

RESULTS

Top scientists in higher education institutions: The Philippines and the ASEAN

The first inquiry in this study related to the Philippines' number of top scientists relative to the other ASEAN countries. As Figure 1 shows, the number of top scientists from the Philippines is comparable in magnitude to Indonesia, and noticeably lower than Singapore, Malaysia, Thailand, and Vietnam, all of which have smaller populations than the Philippines. Thus, although the Philippines is home to some of the world's best scientists, the country has fewer of them compared to its top ASEAN peers. If we consider the 2024 single-year list (see Table 1), 2,863 scientists from eight ASEAN countries were listed among the top 2%. Table 1 also shows that the Philippine-based scientists accounted for only 2% of this total. Moreover, Singapore has 18 scientists in the top 2% for every 1,000 persons in the population; the Philippines has about 1/2 a scientist in the top 2% for every 1,000 persons in the population. These differences probably reflect the different rates of national expenditure on research and development across the countries.

Looking at the 2024 single-year list, most of the top Filipino scientists are based in universities. Those who are not university-based conduct their scientific work at research centers like the International Rice Research Institute, the Philippine Institute for Development Studies, etc. The Philippine data are in contrast with the cases of Malaysia, Thailand, Vietnam, and Indonesia, where nearly all the top scientists are based in universities. This contrast suggests that Philippine universities do not play as dominant a role in producing top scientists compared to these four countries. This is neither good nor bad because it means that non-

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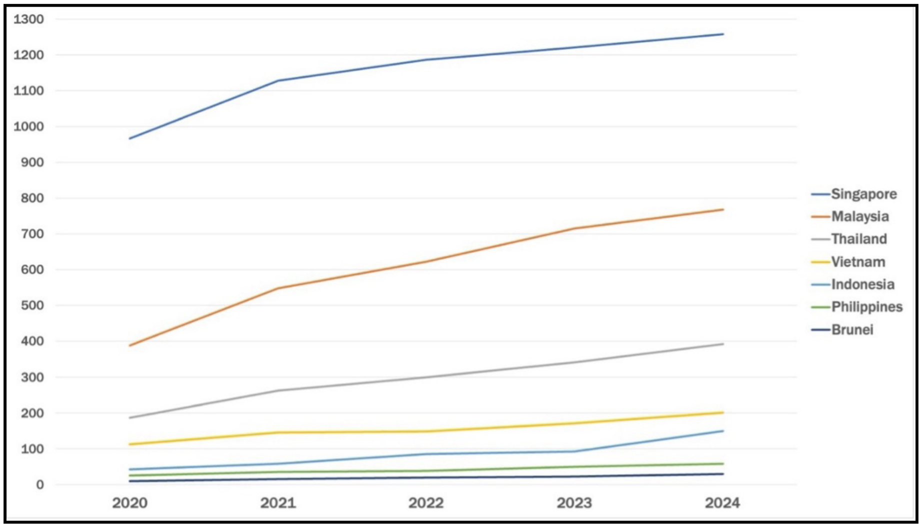

Figure 1. Frequency Graph of Top 2% Scientists in ASEAN from 2021 to 2024.

Table 1. Statistics for top 2% scientists based in ASEAN with university affiliation for 2024.

	2023 Population (000)*	2024			
		Total	% of ASEAN total	HEI-based	% HEI-based
Singapore	6,917.6	1258	43.9%	1006	80.0
Malaysia	33,379.5	769	26.9%	765	99.5
Thailand	65,038.8	392	13.7%	347	88.5
Vietnam	100,309.2	201	7.0%	188	93.5
Indonesia	278,696.2	150	5.2%	146	97.3
Philippines	**111,912.4**	**58**	**2.0%**	**45**	**77.6**
Brunei	450.5	29	1.0%	23	79.3
Cambodia	17,091.5	6	0.2%	4	66.7
Laos	7,545.8	0	0%	0	0.0
Myanmar	56,243.0	0	0%	0	0.0
*From ASEAN (2024); HEI = higher education institution					

educational institutions can also host top scientists, similar to Singapore, which has very productive non-university research centers (e.g., Agency for Science, Technology and Research) and hospitals engaged in research.

The university-based top Filipino scientists are affiliated with one of 17 universities, and most of these university-based scientists (53.3%) are affiliated with only three institutions: University of the Philippines Manila, Ateneo de Manila University, and De La Salle University, with 9, 8, and 7, respectively. Of the 17 universities, 8 are in Metro Manila and host 33 of the 45 university-based Filipino top scientists, including those for the three universities mentioned. The other Metro Manila universities are University of the Philippines Diliman (3), Mapua University (2), National University (2), Far Eastern University (1), and University of Santo Tomas (1). Six of the university-based top Filipino scientists work at institutions in the Visayas: University of the Philippines Visayas hosts 2, and Cebu Technological University, University of Antique, Visayas State University, and West Visayas State University each host 1. Five of these scientists work in three institutions in Luzon: University of the Philippines Los Baños hosts 3, and Bataan Peninsula State University and Batangas State University both have one. The only institution in Mindanao that has a top scientist is Mindanao State University-Iligan Institute of Technology, with one. Figure 2 is a visual summary of the regional location of the top 2% Filipino scientists.

A slight majority (53.3%), or 24 of the 45 university-based top Philippine-based scientists, are affiliated with the 11 state universities (note: the four autonomous campuses of the University of the Philippines were counted as distinct units); and the rest (46.7%) are affiliated with six private universities. This trend is in contrast with other ASEAN countries, where the overwhelming majority of the top 2% listed scientists are affiliated with state universities; for example, in Indonesia, 87% of their top scientists based in universities were affiliated with public institutions, and only 13% with private institutions.

To summarize the results pertinent to the first inquiry, the number of Philippine-based scientists who are ranked among the top 2% in terms of scientific impact is smaller in number compared to the leading ASEAN countries. Although most of the ranked Philippine-based scientists are based in universities, the percentage of university-based top scientists in the Philippines is lower compared to Malaysia, Thailand, Vietnam, and Indonesia, and is comparable to Brunei. The top-ranked Philippine-based scientists are concentrated in institutions in Metro Manila, particularly in three universities: University of the Philippines Manila, Ateneo de Manila University, and De La Salle University; and it seems like private universities account for a relatively large share of top scientists in the Philippines compared to in other ASEAN countries.

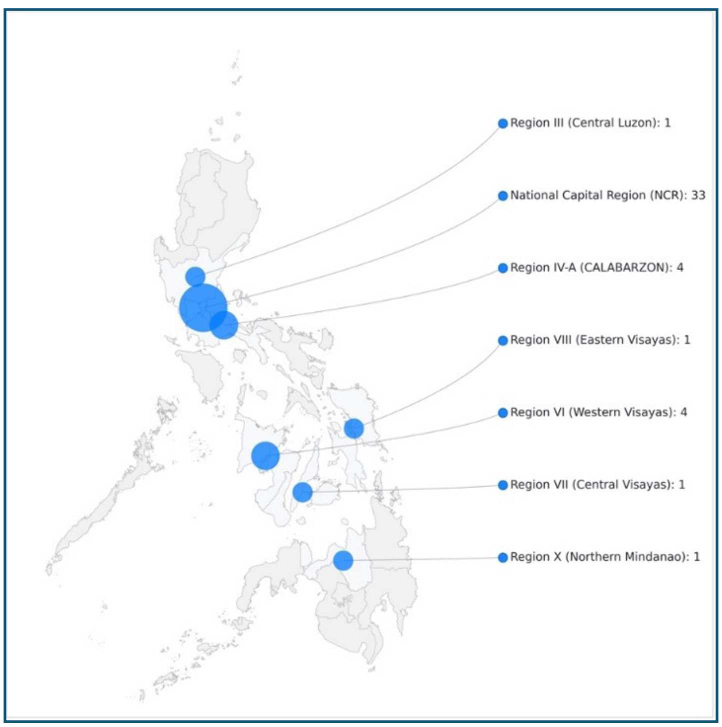

Figure 2. Map of top 2% scientists in Philippine higher education institutions per region.

Top 1% vs 2%: Indicators of scientific impact

The second inquiry relates to research productivity indicators that differentiate the top 1% from the top 2% among the ASEAN scientists. To address this inquiry, the variables described in the following paragraphs were first compared between the top 1% and the top 2% using multivariate analysis of variance, and it was expected that those in the top 1% will have better metrics in most cases. But because the variables are likely to covary, not all those metrics might be equally important. The second analysis used was logistic regression analysis to determine which among the variables best distinguished between the two top groups of scientists. For these analyses, three sets of variables related to scientific productivity were considered in this analysis.

The first set is 10 citation-related variables that were the most closely associated with the metrics used to rank the top 2%. Five of these factors were derived from the Ioannidis et al. (2019), and as such, directly contributed to the rankings: (a) number of papers published from 1960 to 2023; (b) number of papers from 1960 to 2023 that were cited at least once; (c) number of distinct citing papers, (d) ratio of total citations to distinct citing papers, and (e) hm-index, which is computed similarly to the h-index, but after the citations of each publication were divided by the number of co-authors. The other five factors were derived from SciVal: (f) h-index, (g) h5-index, or the h-index for the articles published in the last five years, (h) total citations, (i) citations per publication, and (j) field weighted citation index or FWCI, which is the citation performance of the scientist that is normalized within the scientific field, or in comparison to the average in the field.

The second set of eight variables relate to scientific productions in indexed journals, which were all derived from SciVal: (a) number of Scopus publications, (b) number of SciVal publications (from 2019 to 2023), (c) percentage of publication in the top decile in terms of citations, (d) percentage of publication in the top decile journals, (e) percentage in Q1 journals, (f) percentage in Q2 journals, (g) percentage in Q3 journals, and (h) percentage in Q4 journals.

The final set was six authorship-related variables, all derived from SciVal: (a) percentage of sole-authored papers, (b) percentage of papers from international collaborations, (c) percentage of papers from national collaborations, (d) percentage from institutional collaborations, (e) percentage from corporate collaborations, and (f) number of collaborations.

Before presenting the results that address the second inquiry, it should be noted that among the 45 top Filipino scientists based in universities, only 16 were classified in the top 1%. Ten of the 16 were from eight universities in Metro Manila: two each from De La Salle University and University of the Philippines Manila, and one each from Ateneo de Manila University, Far Eastern University, Mapua University, National University, University of Santo Tomas, and University of the Philippines Diliman. The other six were from Luzon and Visayas; two from University of the Philippines Visayas, and one each from Bataan Peninsula State University, Batangas State University, University of the Philippines Los Baños, and Visayas State University. A slight majority (56.3%) of the 16 top 1% Filipino scientists were affiliated with state universities, and the rest (45.7%) were with private universities.

The analysis and results presented involve all the ASEAN scientists in the 2024 single-year list. From the original total of 2,863 ASEAN scientists, the number was down to 2,415 after excluding those who did not have verified matches with the SciVal database. Of the remaining 2,415 ASEAN scientists, 1,045 were ranked in the top 1%, and 1,370 were in the top 2%. The proportions of non-matches for the two groups were fairly similar (16.5% and 15.0%), which suggests that the reasons for the non-matches are probably not associated with the ranks.

Citation-related variables

Table 2 summarizes the results of the comparison between the two top tiers of ASEAN scientists. The MANOVA indicated a statistically significant difference between the citation-related variables of the two groups: Pillai's $V = 0.36$, $F(23, 2388) = 59.24$; $p < .0001$. Table 2 reports the individual ANOVAs for each variable, which indicates no differences in the h-index, h5-index, number of citations, and FWCI of the two groups. The significant results almost always indicate higher scores for the top 1%, except for the number of distinct citing papers.

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Table 2. Descriptive statistics and ANOVA for citation-related factors across two top tiers of scientists

Citation-related factors	Top 2% ASEAN scientists	Top 1% ASEAN scientists	ANOVA	
	M (SD)	*M (SD)*	*F* (1, 2413)	*P*
No. of papers published from 1960 to 2023[1]	135.343 (99.406)	216.072 (167.911)	216.993	<.001
No. of papers from 1960 to 2023 cited at least once[1]	77.645 (49.282)	146.773 (116.457)	390.974	<.001
No. of distinct citing papers[1]	361.798 (230.917)	332.338 (325.635)	6.758	<.001
Ratio of total citations to distinct citing papers[1]	1.186 (0.220)	1.261 (0.216)	70.630	<.001
h-index[2]	39.835 (20.612)	41.466 (22.247)	3.424	.064
h5-index[2]	15.423 (9.739)	15.968 (10.377)	1.759	.185
hm-index[1]	4.590 (1.374)	7.952 (3.033)	1326.887	<.001
Citations[2]	97.008 (230.447)	89.702 (225.068)	0.608	.436
Citations per publication[2]	41.857 (61.068)	47.870 (70.894)	4.996	.026
Field weighted citation index[2]	2.636 (5.182)	2.739 (4.456)	0.267	.605

[1] indexes computed and reported in Ioannidis et al. (2019)
[2] indexes reported in the SciVal (accessed April to July 2025)

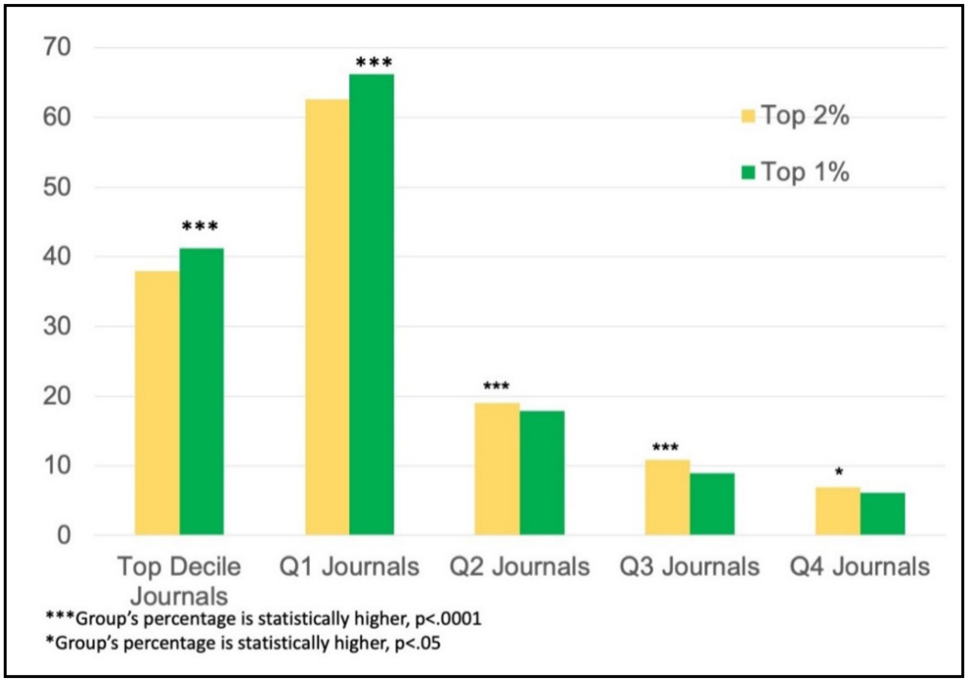

Figure 3. Comparison of journal publications of top 2% and top 1% ASEAN scientists

Table 3. Results of logistic regression analysis for top-tier ASEAN scientists with citation-related variables as predictors.

Significant predictors	*B*	*S. E.*	*z*	Wald χ^2	p	95% CI	
						LL	*UL*
No. of papers from 1960 to 2023[1]	-0.003	0.001	-3.199	10.233	.001	-0.005	-0.001
No. of papers (1960 to 2023) cited at least once[1]	0.005	0.002	2.376	5.648	.017	0.001	0.008
No. of distinct citing papers[1]	-0.001	0.000	-5.407	29.231	<.001	-0.002	-0.001
Ratio of total citations to distinct citing papers[1]	0.339	0.271	1.252	1.568	.210	-0.192	0.870
h-index[2]	-0.002	0.003	-0.645	0.416	.519	-0.009	0.004
h5-index[2]	0.007	0.007	1.030	1.063	.303	-0.007	0.021
hm-index[1]	1.090	0.052	21.138	446.798	<.001	0.989	1.191
Citations[2]	0.000	0.000	0.834	0.695	.404	-0.000	0.001
Citations per publication[2]	0.003	0.002	1.268	1.607	.205	-0.001	0.006
Field weighted citation index[2]	-0.033	0.032	-1.041	1.084	.298	-0.096	0.029

[1] indexes computed and reported in Ioannidis et al. (2019)
[2] indexes reported in the SciVal (accessed April to July 2025)

The logistic regression model tested to determine which among the variables best predicted membership in the two top groups was statistically significant, $\chi^2(2404) = 1338.65$, $p< .001$. The model explained 57.1% (Nagelkerke R2) of the variance between the two groups of ASEAN scientists, which was expected to be high given that the ranking of the top 2% was based mainly on citation-related factors. As shown in Table 3, the significant predictors distinguished by the two groups were only four variables. A higher number of papers cited at least once and hm-index both positively predicted being grouped in the top 1%, but the number of papers from 1960 to 2023 and distinct citing papers both negatively predicted being in the top 1%. The mean scores for distinct citing papers indicate that the top 1% ASEAN scientists have, on average, fewer papers citing their works. The number of papers published by those in the top 1% is higher than that of those in the top 2% (see Table 2), so the negative coefficient is not likely to represent an inverse relationship. The negative coefficient is likely to be a statistical artifact given the relatively high correlations among the number of papers published, the number of papers cited at least once, and hm-index (r's from 0.50 to 0.79), indicating possible multicollinearity and/or suppression effects. [A secondary analysis that excluded the two highly correlated factors indicated that the number of papers published positively predicted being in the top 1%.]

Publication and journal-related variables

Table 4 summarizes the results of the comparison between the two top tiers of ASEAN scientists in terms of the publication and journal-related variables. The first thing to note is that the highest impact ASEAN scientists mostly publish in Q1 and Q2 journals, and overwhelmingly more so in Q1 journals. In fact, a significant portion of their publication are in the top 10% of journals in terms of impact (c.f., 41.2% for the top 1% and 37.9% for the top 2%). The MANOVA indicated a statistically significant difference between the journal-related variables of the two groups: Pillai's $V = 0.07$, $F(8, 2392) = 23.92$; $p <.0001$. Table 4 reports the individual ANOVAs for each variable, which indicates that there were differences in six variables: the number of Scopus publication and number of publications in top decile, Q1, Q2, Q3 and Q4 journals (see Fig. 3). Thus, although all the top ASEAN scientists publish in top tier journals, the top 1% ASEAN scientists have more Scopus publications and more publication in top decile and Q1 journals, but fewer Q2, Q3, and Q4 publications.

Table 4. Summary of descriptive statistics and ANOVA for publication and journal-related factors across two top tiers of scientists.

Publication and journal-related factors	Top 2% ASEAN scientists	Top 1% ASEAN scientists	ANOVA	
	M (SD)	*M (SD)*	*F* (1, 2397)	*P*
No. of Scopus publications[1]	152.196 (141.833)	248.338 (291.620)	168.927	<.001
No. of SciVal publications (2019 to 2023)[2]	111.547 (101.185)	114.264 (101.982)	0.517	.472
% publications in top decile[2]	24.1 (15.8)	25.1 (15.6)	2.381	.123
% publications in top decile journals[2]	38.0 (24.4)	41.2 (24.3)	11.949	<.001
% Q1 publications[2]	62.6 (23.3)	66.2 (22.4)	15.847	<.001
% Q2 publications[2]	19.0 (12.2)	17.9 (12.0)	5.435	<.001
% Q3 publications[2]	10.8 (10.4)	8.9 (8.8)	23.517	<.001
% Q4 publications2	6.9 (10.4)	6.1 (9.6)	4.545	.033

[1] indexes computed and reported in Ioannidis et al. (2019)
[2] indexes reported in the SciVal (accessed April to July 2025)
Note: High SD for % % Q4 publications is due to high kurtosis (data were 0 for 28.5% of the cases)

Table 5. Results of logistic regression analysis for top-tier ASEAN scientists with publication and journal-related variables as predictors

Significant predictors	*B*	*S. E.*	*z*	Wald χ^2	*p*	95% CI	
						LL	UL
No. of Scopus publications[1]	0.004	0.000	11.969	143.250	<.001	0.003	0.005
No. of SciVal publications (2019 to 2023)[2]	0.000	0.000	0.795	0.633	.426	-0.000	0.001
% publications in top decile[2]	0.126	0.318	0.397	0.158	.691	-0.496	0.749
% publications in top decile journals[2]	-0.058	0.358	-0.161	0.026	.872	-0.760	0.644
% Q1 publications[2]	0.024	0.496	0.049	0.002	.961	-0.948	0.997
% Q2 publications[2]	-0.155	0.543	-0.286	0.082	.775	-1.221	0.910
% Q3 publications[2]	-2.006	0.662	-3.029	9.176	.002	-3.303	-0.708
% Q4 publications[2]	0.012	0.619	0.019	0.000	.985	-1.201	1.225

[1] indexes computed and reported in Ioannidis et al. (2019)
[2] indexes reported in the SciVal (accessed April to July 2025)

Another logistic regression analysis was conducted to determine which of the journal-related variables predicted membership in the two top groups. The regression model was statistically significant $\chi^2(2392) = 213.97$, $p < .001$, and explained 11.4% (Nagelkerke R2) of the variance between the two groups of ASEAN scientists. As shown in Table 5, the significant predictors distinguished by the two groups were two variables. Having more Scopus publications and fewer Q3 publications predicted inclusion in the top 1% tier of scientists. Note that all top ASEAN scientists published mostly in Q1 journals, so the difference seems to be most evident in the lower-tier journals..

Authorship-related variables

Table 6 summarizes the results of the comparison between the two top tiers of ASEAN scientists in terms of the publication and journal-related variables. First, single-authored papers constitute a minuscule portion of the top scientists' publications (i.e., around 3%). Instead, the majority of their publications involve international collaborators and co-authors (55.9% to 63.0%). The MANOVA indicated a small but statistically significant difference between the authorship-related variables of the two groups: Pillai's V = 0.01, $F(6, 2412) = 2.67$; $p = .014$. Table 6 also reports the individual ANOVAs for each variable, which indicates that there were statistical differences only in the percentage of national and corporate collaborations. The top 1% ASEAN countries had a lower percentage of national collaborations and a higher percentage of corporate collaborations, but the latter represent a small portion of their scientific output.

Table 6. Summary of descriptive statistics and ANOVA for authorship-related factors across two top tiers of scientists

Authorship-related factors	Top 2% ASEAN scientists	Top 1% ASEAN scientists	ANOVA	
	M (SD)	*M (SD)*	F (1, 2413)	*p*
% single authorships	3.0 (9.2)	3.3 (9.9)	0.766	.382
% international collaborations	53.1 (25.0)	55.5 (24.8)	0.764	.382
% national collaborations	21.6 (18.0)	19.9 (17.4)	5.368	.021
% institutional collaborations	21.7 (18.5)	20.4 (18.0)	2.820	.093
% corporate collaborations	5.8 (12.6)	7.1 (13.7)	5.299	.021
Total no. collaborations	197.547 (189.254)	204.536 (202.605)	0.760	.383
Notes: indexes reported in the SciVal (accessed April to July 2025)				

Table 7. Results of logistic regression analysis for top-tier ASEAN scientists with authorship-related variables as predictors.

Significant predictors	*B*	*S. E.*	*z*	Wald χ^2	*p*	95% CI	
						LL	UL
% single authorships	0.301	0.455	0.662	0.439	.508	-0.590	1.192
% international collaborations	-0.067	0.103	-0.648	0.420	.517	-0.268	0.135
% national collaborations	-0.652	0.255	2.552	6.511	.011	-1.153	-0.151
% institutional collaborations	-0.344	0.257	-1.339	1.794	.180	-0.847	0.159
% corporate collaborations	0.703	0.327	2.152	4.630	.031	0.063	1.344
Total no. collaborations	0.000	0.000	0.789	0.623	.430	-0.000	0.001

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The final logistic regression analysis was conducted to determine which among the authorship related-variables between predicted membership in the two top groups. The logistic regression model was statistically significant, $\chi^2(2407) = 16.62$, $p = .011$. Although significant, the model explained only 0.9% (Nagelkerke R2) of the variance between the two groups of ASEAN scientists. As shown in Table 7, the significant predictors distinguished by the two groups were the same two variables that were significantly different in the MANOVA (see Table 5). The top 1% tier of scientists had fewer national collaborations and more corporate collaborations than their top 2% counterparts.

DISCUSSION

This study was undertaken to explore whether data on the ASEAN scientists listed among the top 2% of scientists in the world in terms of scientific impact can reveal insights that might be relevant to discussions on research development in Philippine higher education institutions. Before venturing into any exposition and discussion on the results, it is important to acknowledge some limitations in the scope and assumptions of the inquiry. First, the concept of "top scientist" was derived from metrics that were based on citations of publications in a subset of vetted journals, and citations by publications in the same journals. Many scientists and science policy makers contest this narrow definition of what it means to be a top scientist. It is not the aim of this paper to debate these definitions, and it is important to acknowledge that there are forms of scientific impact that are not measured by such citation metrics. But the current study assumes that there is merit in assessing the scientific impact of a scientist's knowledge products by referring to the degree to which it is references in the works of other scientists. After all, 96 of the 102 scientists who won Nobel Prizes in medicine/physiology, chemistry, physics, and economic sciences in the last 10 years are ranked in the top 2% based on career citation statistics.

Second, although the observations and analysis were derived from publicly available and verifiable data, one cannot assume that the data were 100% accurate. As noted, there were cases when the scientists' names listed in the Top 2% database did not match any of the authors listed in the SciVal database, which was supposed to be drawn from the same Elsevier data. There are also cases where the scientists listed as being affiliated in one of the ASEAN countries were listed as being affiliated in some other ASEAN country or some other non-ASEAN country in SciVal; movement from one institution in one country to another is a possibility that is very real, given the mobility of high-performing scientists. The point is that the databases that were merged are not flawless, and there is no certainty that the data loss was non-random. Nevertheless, there were enough data points to allow for some reflection, which was the aim of this exploratory study.

The Philippines in comparison to other ASEAN countries

The study first aimed to compare the Philippines' top scientists vis-à-vis other ASEAN countries, and the statistics indicate a non-favorable comparison, with the Philippines having a much lower share of top scientists compared to Singapore, Malaysia, Thailand, and Vietnam. The Philippine higher education system hosts fewer top scientists than the higher education systems of these other countries. It could be noted that the ASEAN Work Plan on Education was launched in 2011 (ASEAN 2013) and one of the objectives of the plan as it related to higher education was to focus on "delivering world-class teaching, learning and research" (ASEAN 2013, p. 13), particularly as research and innovation were asserted to be important enablers of continuous social development. This focus on research development was supposed to have been intensified in the next planning cycle (ASEAN 2016), which pushed more scholarships, student mobility, joint or collaborative research across the ASEAN. The extent to which the ASEAN countries produce top scientists is certainly aligned with these thrusts. Other data (Sukoco et al. 2023) also provide support for growth in research in the ASEAN, where a steady growth in scholarly outputs was observed in the six biggest ASEAN countries (Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam) from 2010 to 2019. During this period, Indonesia had the steepest growth in scholarly outputs; among the six, the Philippines had the most modest growth. This growth was sustained in these same countries when data from 2020 to 2024 were examined in SciVal. Again, Indonesia registered the fastest growth, and the Philippines had the most modest growth. These data suggest that the relatively smaller number of top scientists in the Philippines seems to mirror the relatively lower scientific output of the scientific community. But increasing the scientific output does not guarantee an increase in the number of top scientists, because Indonesia's volume of scientific output is not mirrored by the number of top scientists.

Specific to the focus of the study, the quality of a country's research universities might be another relevant factor that can explain the relatively low number of top scientists in the Philippines. Referring to the two most well-known global rankings of universities, the Philippines has fewer ranked universities compared to Singapore, Malaysia, Thailand, Vietnam, and Indonesia. In the Quacquarelli Symonds ranking, only Singapore and Malaysia have universities ranked in the top 100 universities, and in the top 500, Malaysia has another 9, Indonesia has 5, Thailand has 2, Vietnam and the Philippines have 1 each. In the Times Higher Education (THE) world ranking, where research indicators weigh heaviest in the criteria, only Singapore has 2 universities in the top 100 (both are in the top 50), and only Malaysia and Brunei have universities in the top 500 (7 and 1, respectively). Notably, no Philippine university ranks in the top 1000 universities in the THE, whereas Malaysia has 6 more, Brunei has 1 more, and Vietnam, Thailand, and Indonesia have 4, 3, and 1, respectively. The absence of Philippine universities in the higher ranks likely reflects the weak research environment that has been noted in numerous local studies (e.g., Ocampo et al. 2022), which likely explains the relatively small number of top Filipino scientists compared to its ASEAN counterparts.

What characteristics of Philippine higher education institutions prevent Filipino scientists from achieving greater scientific impact? The data analyzed in the current study cannot directly address this question, but previous studies suggest two possible factors – the research ecosystem and faculty research capacities. These two factors are discussed here only briefly, as the factors are not based on the data analyzed in this study.

A constraint that is frequently suggested relates to financial resources to support and sustain research. Research has shown how investments in research and education are associated with a country's research productivity (Wang 2007) and also with the productivity of individual researchers in a country (Jameel and Ahmad 2020; Lee 2021). But analyses do not always show a positive relationship between research funding and research productivity of universities (e.g., Auranen and Nieminen 2010; Savatsomboon et al. 2022). Instead, it seems that the nature of a country's research ecosystem might explain the association between national-level investments in research and productivity (Jaffe et al. 2020). High-income countries that invest more heavily in research have research productivity clusters that are also linked to other high-income countries with geographic, linguistic, economic/commercial, and geopolitical links. The investments are stable in the areas of research productivity in these countries, ensuring that the research productivity areas are also stable over time. In contrast, low-income countries like the Philippines have research ecosystems that are smaller and independent of other countries, and research priorities and investments tend to shift a lot over time. Thus, it is not just low investments in research that explain low research productivity. It might also be the absence of sustained investments in stable research productivity areas (linked to industrial development policies and that are networked with other countries) that relates to lower impact research.

The second factor is the efficacy of the higher education faculty, which has already been underscored in numerous local studies (e.g., Camilon et al. 2024; Pentang and Domingo 2024). This might be because most Philippine higher education institutions are focused on teaching (Bernardo 2024), and so research capability is not an important requirement for faculty hiring and promotion. In contrast, research is heavily weighted in the recruitment and retention of faculty members in universities of other ASEAN countries (Azman et al. 2016; Mok 2015). The human resource constraint is likely to be associated with the research ecology of the country. Higher-income countries that have well-resourced and stable research productivity clusters also have more viable and effective postgraduate education systems for the training of future researchers. These countries are also networked with other countries' research productivity clusters, creating other training grounds for future researchers. The supply of capable researchers allows the higher education system to impose more stringent requirements for faculty retention and promotion, and to strategically allocate resources and incentives for higher-impact research.

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Key observations on predictors of high productivity

Apropos to the preceding point, the results of the study point to some important predictors of high productivity that could guide policies and programs to promote higher impact research. Note that given that the rankings were determined using an assembly of metrics related to citations, it is given that scientific production that gets cited figures significantly in the data. However, some trends are only adjacent to citations. For example, ASEAN scientists ranked among the top 2% publish mostly in Q1 journals, and a sizable proportion in Q2 journals. Q3 and Q4 journals account for a much smaller ratio of their scientific outputs. This is a citation-adjacent metric, as the journal quartile is based on the journal citations, although there are wide variations in the citation patterns of individual articles published in a journal. This observation seems relevant as different research-oriented universities are using publications in ranked journals to evaluate and provide incentives for the faculty researchers (Orbay et al. 2020). However, there have been concerns about the focus on journal quartiles and ranking and its effects on innovative scientific research work (Garcia et al. 2012; Viiu and Paunescu 2021).

The top 2% ASEAN scientists also have more publications from international collaborations compared to national or institutional collaborations. Moreover, single-authored publications account for a mere 3% of the publications of these top scientists. The importance of international collaborations in advancing science has long been documented (Guerrero Bote et al. 2013), including in countries where science cultures are still developing (Kohus et al. 2022; Nguyen et al. 2017). However, there have been concerns about how international collaborations help develop the scientific research systems in the participating countries (Zanotto et al. 2016).

Predictors of highest scientific impact

It was expected that not many factors would significantly differentiate the top 1% ASEAN scientists from the top 2%, as differences are expected to be smaller at the extremes of any distribution. But the three logistic regression analyses indicated some significant predictors. Compared to their top 2% counterparts, the top 1% ASEAN scientists have more publications indexed in Scopus, have a higher hm-index, fewer publications based on national collaborations, fewer publications in Q3 journals, and fewer distinct citing papers. There is also an unexpected negative predictor of being in the top 1%, more publications from 1960 to 2023. This last finding indicates that although the top 1% ASEAN scientists have more publications, having more actually does not predict being in the 1%. This might be because scientific impact is not simply a function of publication volume. Instead, it seems impact relates more to publishing important collaborative research in the higher impact journals (or less in the second-tier journals).

These collaboration-related predictors are also worth unpacking. The top 1% and 2% ASEAN scientists publish fewer papers based on national and corporate collaborations. These two types of collaborative publications represent only around 25% of their scientific output (compared to over 60% from international collaborations). Previous bibliometric research does suggest that international collaborations are associated with greater scientific impact (Guerrero Bote et al. 2013; Wagner et al. 2017), but the differentials between the top 1% and 2% ASEAN scientists seem to split into publishing fewer papers with national collaborators and more papers with corporate collaborators. It would be interesting to explore how this pattern is reflected in specific ASEAN countries, but the datasets across the countries are not equally robust to allow for such an analysis. The result may reflect on the degree to which national scientific research systems are able to translate local science initiatives to measurable bibliometric scientific inputs, particularly in relation to the role of international collaborations in supporting the work of local scientists (Cimini et al. 2016).

The preceding discussion might also reflect differences in how the top 1% ASEAN scientists give less priority to certain types of scientific activities and outputs. This might not be an intentional deprioritization, but the top 2% have more publications from international collaborations relative to those from national and institutional collaborations, and fewer publications in lower-tiered journals (Q3 and Q4). Moreover, the percentage of their publications in the top 10% of journals is higher than the individual percentages in the Q2, Q3, and Q4 journals.

Implications for Philippine research universities

Previous research has documented how the research productivity of Philippine higher education institutions (Gopez et al. 2024), even the premier state-supported universities (Demeterio and Pada 2018), compares poorly to ASEAN and other leading international universities. Indeed, it might be apt to assert that the Philippine higher education system needs to attend to the more basic question of whether it has the appropriate orientation, policies, human and financial resources to sustain scientific research (Lunag et al. 2024). As such, the observations made in this study may not be the most useful for Philippine universities that do not (yet) aspire to higher levels of scientific contribution and impact.

But even as the Philippine numbers in the top 1% and 2% compare relatively poorly to Singapore, Malaysia, Thailand, Vietnam, and Indonesia, there are scientists from Philippine universities who are represented in the highest levels of scientific impact as measured by citations in the scientific literature. So perhaps the observations of the study might be relevant to universities that aspire to nurture a larger number of these high-impact scientists, but the implications relate mainly to the scientific production of these scientists.

Benchmarks of research productivity in research-oriented universities. The first implication relates to the performance benchmarks for research productivity in Philippine universities that aspire to develop high-impact scientific research. Over the years and in different countries, the paths and requirements for the professorship in universities have transformed, with stronger emphasis being placed on measurable outputs, especially related to research and publications (Abramo et al. 2023; Benz et al. 2021). ASEAN scientists in the top 2% (not the top 1%) have, on average, published around 152 papers in Scopus journals, and 111 of these were in the most recent five-year period (see Table 4). Those benchmarks may not be realistic across all scientific disciplines and across countries, especially as most universities do not expect all their professors to be in the top 2% in terms of scientific impact. In psychology (which is this author's discipline), a recent study of a top psychology department in the United States found that, on average, a faculty member who was awarded tenure published 17 peer-reviewed articles (or 2.43 articles per year over the tenure track period) (Byrnes 2024). Those numbers refer to norms for obtaining tenure, not for promotion to the professorship, but research also shows a strong pattern of productivity in the early and late careers of full professors (Kwiek and Roszka 2024).

There are no national policies that define such performance benchmarks. The closest policy is the Department of Budget and Management (DBM) and Commission on Higher Education (CHED) Joint Circular Number 3 (series of 2022) or "Guidelines on the Reclassification of Faculty Positions in State Universities and Colleges," which provides the process and guidelines for promotion in these universities. In the guidelines, research is one of the five key result areas, and the maximum points for research can be achieved with two solo-authored journal articles or four co-authored journal articles. And these guidelines do not apply to some state universities (e.g., the University of the Philippines System), to local universities or colleges, nor to private universities, which have their own guidelines. There is no data to indicate whether these performance benchmarks are higher or lower than those specified in the joint circular. Nonetheless, for research-oriented universities in the Philippines, the research performance benchmarks for faculty members are a matter that should be reconsidered.

Credit and support for collaborations. One interesting aspect of the DBM and CHED joint circular is how points for research are fractionally awarded for collaborative work, based on the relative contribution of the faculty member. There is logic in this approach, the same logic that motivated the creation of the coauthorship-adjusted Schreiber hm-index (Schreiber 2008), which was used in the ranking of the top 2% scientists (Ioaniddis et al. 2019). The analysis also showed that the top 1% ASEAN scientists have higher hm-indexes compared to their top 2% counterparts, so that their scientific impact is higher even considering their multiple-authored scientific outputs. But the joint circular also gives weight to the relative contributions of the different authors, which all co-authors must agree; this is a reasonable way of accounting for different levels of engagement in the completion of the scientific outputs.

On the other hand, the data show that the top ASEAN scientists' scientific production overwhelmingly is collaborative output. The solo-authored publications account for only around 3% of their production, which is consistent with observations that science is increasingly collaborative in nature (Freeman et al. 2014; Wagner et al. 2018). In this regard, Philippine universities that aspire to be more strongly oriented in research should consider encouraging and providing more resources and support for collaborative work, and also consider evaluating assessment and incentive schemes that might discourage collaborative work.

In other countries, national-level policies and programs have been designed to support more collaborative research in specific research areas with positive outcomes (Li 2020; Matveeva et al. 2021). Such programs prioritize programmatic research (instead of single stand-alone projects) that will require the engagement of scientists and researchers from different institutions. Such programs also provide sufficient resources so that the engagement of the collaborators is sustainable. The possibility of industry-academic scientific research collaborations has also been the focus of recommendations for strengthening research in higher education (O'Dwyer et al. 2023; Rossoni et al. 2024). In many scientific fields, open science practices also make it easier for scientists in different institutions to engage in collaborative work (Thibault et al. 2023), but so far, there have not been strong policy statements or programs that push science in the Philippines in this direction, other than some preliminary discussions in some universities.

International collaborations. The data are unequivocal about how the top 2% ASEAN scientists are publishing more work from international collaborations. But it is not clear whether or how national research agencies support such international collaborations. The current observation is consistent with other research, especially in developing countries (Guerrero Bote et al. 2013; Kohus et al. 2022). But proposals from Philippine researchers emphasize the role of local collaborations (Castulo et al. 2025; Gopez et al. 2024), and are silent about international collaborations. There are reasons to be wary about international collaborations, as some tend to involve predatory and colonial practices that exploit local researchers without appropriate attribution. In this regard, there have been very helpful discussions on how to ensure more parity and respect in international collaborations (Haelewaters et al. 2021). The fundamental issue seems to be about the capacity of local national research systems to benefit positively from international collaborations (Cimini et al. 2016; Zanotto et al. 2016). That is, while individual scientists might benefit from international collaborations, their institutions and the national research system may not have the capacity to grow and benefit from the collaborations.

Consider that research collaboration among ASEAN countries was a component of the ASEAN development plan for research in education (ASEAN 2016). Other studies suggest that research collaborations tend to be among countries where there are already stable research productivity clusters (Jaffe et al. 2020), as these collaborations also to be aligned with other economic and geopolitical affinities (e.g., Singapore with East Asian countries; Malaysia with Arab countries), so these more developed research systems may not be looking to Filipino researchers are potentially high value collaborators. Philippine universities might need to first develop their value proposition as a collaborator, perhaps around research themes of mutual interest among ASEAN countries, and build up long-term collaborations that would further strengthen the capacities of the Philippine researchers and research center. But such clusters need to be supported and sustained over long periods to produce high-impact research outputs.

Publication options for scientific productions. Earlier, the suggestion was to consider the benchmarks for the volume of scientific output for assessing research productivity. That was more of a quantitative indicator, but there is also a qualitative indicator for those benchmarks. The top 2% ASEAN scientists are, on average, publishing around 60% of their scientific outputs in Q1 journals, and around 40% in top decile journals. In total and on average, the top 2% ASEAN scientists publish around 80% of all their scientific papers in either Q1 or Q2 journals. This metric is probably strongly correlated with the top 2% ASEAN scientists' scientific impact because papers published in higher-impact journals get read more and get cited more.

Most Philippine universities are still at the early stages of encouraging their faculty members to publish and finding ways to support and to incentivize publishing, but there needs to be some discernment regarding whether simply publishing in any type of journal is helping the researcher develop their contributions to the scientific community. In different universities in the Philippines, researchers debate the value of publishing in refereed journals, indexed journals, and ranked journals, and there is no clear consensus on how the Philippine scientific community puts value on journal ranking as an index, as the country's higher education system is still trying to develop a research culture with low levels of resources and support.

But good scientific work may not have its intended impact if it is published in journals that other scientists do not read, and so some consideration should be given to trying to ensure that Filipino scientists' research is being read by other scientists in other parts of the world. The global ecosystem is still characterized by citation inequalities; although citations are increasing outside the United States, there is uneven growth in non-US citations in Europe, Australia, and East Asia (Nielsen and Andersen 2021). Many developing countries are still being cited less, partly because they also publish less. Philippine universities and the national higher education system need to understand that not all publications take up space and have an impact on the larger scientific community. Universities that aspire to have a stronger impact in science will need to find ways to encourage and support their faculty researchers in efforts publish in the higher impact journals, and also remove the barriers and disincentives for doing so.

CONCLUSIONS

The exploratory analysis in this study was motivated by the aim of understanding whether and how Philippine universities can support Filipino scientists to make a stronger impact in the advancement of scientific knowledge. Although Filipino scientists do not compare favorably to some of their ASEAN counterparts, the representation of a few Filipino scientists in universities suggests that there might be potential if more universities support and incentivize the types of research and publications that characterize the work of the high-impact scientists.

The data in the current study cannot provide broad and systemic solutions to how to bring the Philippines university-based scientists to the same level as their ASEAN peers. The country needs better research that can inquire into causal and systemic factors that explain why our universities are not producing more high-impact scientists. Instead, it points to the need to rethink indicators of scientific or research productivity to motivate more Filipino scientists to produce at comparable levels of quantity and quality, which would require a more thoughtful assessment of what environment and research infrastructure are needed to sustain their motivations and productivity. These points can be considered by individual universities, but also by national agencies that shape and constrain what universities are allowed to do.

The insights from the study will need to be contextualized in an understanding that the country is still struggling to produce the critical mass of science and technology (Albert et al. 2020) and that there do not seem to be any Philippine higher education institutions that operate as research universities as defined in other ASEAN countries (Bernardo 2024). The aspiration to produce top scientists should be considered in relation to the need to build a viable and sustainable ecosystem for doing good scientific work in the Philippines, instead of the current isolated research centers, with inconsistent focus and intermittent support that produce the current sprinkling of productive high-impact researchers. And this aspiration begins with an appreciation and understanding of what it means to be doing high-impact research in the current global knowledge production landscape, as it is characterized in the current study.

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The author declares that generative artificial intelligence was not used in this work. The author takes full responsibility for the content, claims, and references.

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