Chapter 3
Good Health and Well-Being

In this Chapter, we assess research related to SDG3, which aims to ensure healthy lives and promote well-being for all at all ages. Statistics are provided for the top 5 countries publishing research in this field along with Colombia, Mexico, and Brazil.

3.1 **Key Findings**

Goal 3: Ensure healthy lives and promote well-being for all at all ages

WORLD RESEARCH OUTPUT

60,034

Number of SDG3 publications, 2007-2016.

SDG3 PATENTS

888

Number of SDG3 patents, 2007-2016.

COLOMBIA RESEARCH OUTPUT

284

Colombia's SDG3 publications, 2007-2016.

COLOMBIA RESEARCH OUTPUT CAGR

21%

Compound annual growth rate for Colombia's 2007-2016 SDG3 publications.

COLOMBIA TOP TEN PERCENTILE FOR CITATION

37

Colombia's SDG3 publications within the top ten percentile for citations, 2007-2016.

COLOMBIA FIELD WEIGHTED CITATION IMPACT

1.25

Average field-weighted citation impact for Colombia's SDG3 publications, 2007-2016.

3.2 SDG3 – Ensure healthy lives and promote well-being for all at all ages

According to the United Nations,

> *"Ensuring healthy lives and promoting the well-being for all at all ages is essential to sustainable development. Significant strides have been made in increasing life expectancy and reducing some of the common killers associated with child and maternal mortality. Major progress has been made on increasing access to clean water and sanitation, reducing malaria, tuberculosis, polio and the spread of HIV/AIDS. However, many more efforts are needed to fully eradicate a wide range of diseases and address many different persistent and emerging health issues."*[8]

The targets for SDG3, according to the United Nations are:

- *"By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births.*
- *By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births.*
- *By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.*
- *By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.*
- *Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol.*
- *By 2020, halve the number of global deaths and injuries from road traffic accidents.*
- *By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes.*
- *Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.*
- *By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.*
- *Strengthen the implementation of the world Health Organization Framework Convention on Tobacco Control in all countries, as appropriate.*
- *Support the research and development of vaccines and medicines for the communicable and noncommunicable diseases that primarily affect developing countries, provide access to affordable essential medicines and vaccines, in accordance with the Doha Declaration on the TRIPS Agreement and Public Health, which affirms the right of developing countries to use to the full the provisions in the Agreement on Trade Related Aspects of Intellectual Property Rights regarding flexibilities to protect public health, and, in particular, provide access to medicines for all.*
- *Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States.*
- *Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks."*[8]

[8] http://www.un.org/sustainabledevelopment/health/

Research can play a huge role in supporting the above goals. To identify research that aims to support the above goals and SDG3 in general, the following search terms were used in combination with sustainab* OR "sustainable development goal" in a query of the Scopus database. The full conditions of the search query, including methodology for identifying search terms and subject limitations imposed on the query, can be found in Appendix B.

The analyses within this chapter give an overview of scholarly output and impact in the field as well as leading countries, institutions, researchers, and journals in terms of scholarly output.

3.3 SDG3: Leaders in the field

3.3.1 Top 5 countries conducting SDG3 research

The top 5 countries publishing on SDG3 based on cumulative publication output from 2007-2016 are shown in Table 3.1 and Figure 3.1. The United States ranks 1st according to Publication Count, Percentage of Global Output, and Citation Count, followed by the United Kingdom, China, Australia and Canada. The United Kingdom ranks 1st in FWCI with 1.92, which is much higher than the world average of 1.18. Except for China, all other countries' FWCI exceeds the average as well.

Table 3.1— *Top 5 countries based on publication output from 2007-2016. (Source: Scopus)*

Country	Publication count	Percentage of Global Output	Citation Count	FWCI
United States	15,300	25.49%	258,237	1.69
United Kingdom	6,112	10.18%	114,372	1.92
China	5,576	9.29%	45,802	0.96
Australia	4,044	6.74%	70,541	1.70
Canada	3,220	5.36%	57,484	1.74
World	60,034	100.00%	263,499	1.18

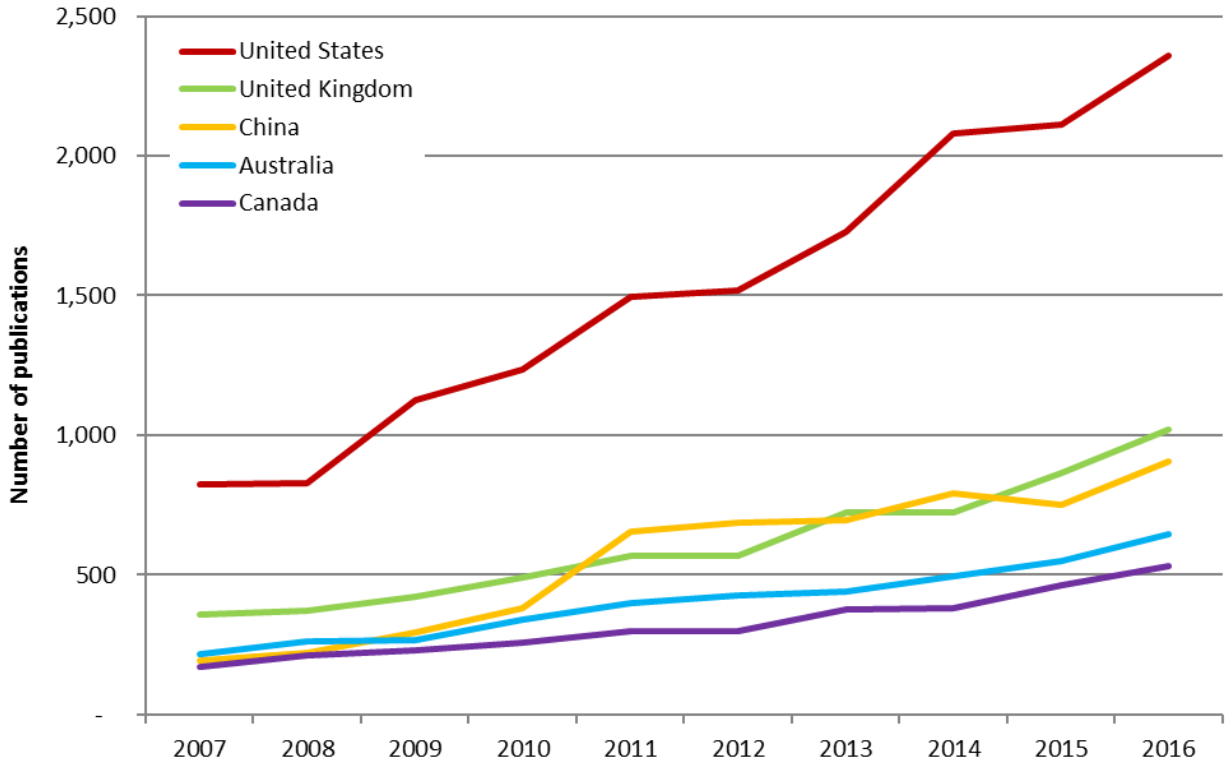

Figure 3.1— *2007-2016 trend in publication output for the top 5 countries publishing SDG3 research. (Source: Scopus)*

3.3.2 Top 20 institutes conducting SDG3 research

A list of the top 20 research institutes publishing SDG3-related research is shown in Table 3.2. The Chinese Academy of Sciences (China) ranks 1st in Publication Count and surpasses the next ranked institute by more than 200 publications. The other 19 top institutes in this research field have published 300-550 SDG3-related publications. Although the Chinese Academy of Sciences ranks highest in terms of publication count, Arizona State University (United States) has the highest FWCI and citation count. All of the top 20 institutes have a mean FWCI above the world average for research in this field. The trends in publication output from 2007-2016 are shown in Figure 3.2. (Note that the figure is limited to the top 8 institutes to facilitate visualization. To see the trends for all 20 institutes, please refer to accompanying data files.)

Rank	Institution (Country)	Publication count	Citation Count	FWCI
1	Chinese Academy of Sciences (China)	776	9,752	1.32
2	Harvard University (United States)	553	14,217	3.11
3	Wageningen University & Research (Netherlands)	498	14,389	2.49
4	University of Toronto (Canada)	472	7,305	1.80
5	U.S. Department of Agriculture (United States)	441	12,726	2.44
6	University of British Columbia (Canada)	406	11,748	2.58
7	University of Queensland (Australia)	402	9,119	2.41
8	Johns Hopkins University (United States)	399	10,129	2.52
9	University of Washington (United States)	390	9,443	2.71
10	INRA Institut National de La Recherche Agronomique (France)	386	10,695	2.33
11	CNRS (France)	368	10,659	3.16
12	World Health Organization (Switzerland)	352	7,459	2.66
13	University of Sydney (Australia)	337	5,267	2.04
14	Arizona State University (United States)	329	16,850	3.27
15	University College London (United Kingdom)	310	7,262	2.69
16	University of Melbourne (Australia)	309	6,632	2.10
17	Monash University (Australia)	305	4,581	1.81
18	Columbia University (United States)	299	7,976	2.34
19	London School of Hygiene and Tropical Medicine (United Kingdom)	296	6,776	2.60
20	Imperial College London (United Kingdom)	292	9,239	2.93

Table 3.2— *Top 20 research Institutes ranked based on SDG3 publication output and FWCI from 2007-2016. (Source: Scopus)*

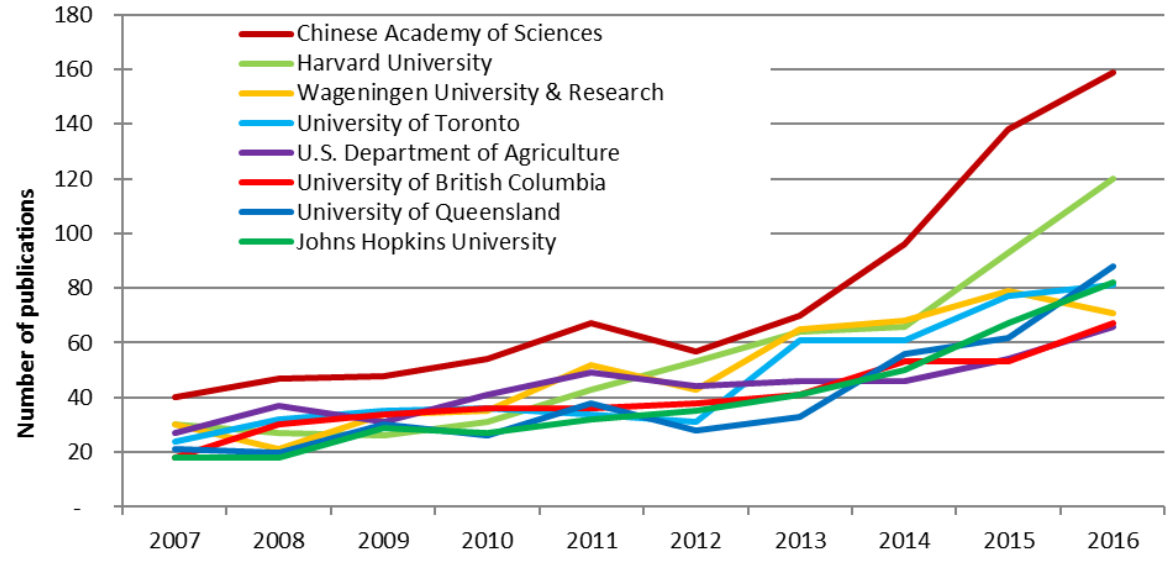

Figure 3.2— *2007-2016 trend in publication output for the top 8 institutes conducting research on SDG3. (Source: Scopus)*

3.3.3 Top 20 researchers conducting SDG3 research

A list of the top 20 researchers publishing in the SDG3 field based on publication output from 2007-2016 is shown in Table 3.3. Yang Z. ranks 1st in Publication Count followed by Blevis E. and Liu J.
Bhutta Z., Manchikanti L., and Polásky S. are the top 3 researchers in this list in terms of H-index.

Rank	Researcher	Institution (Country)	Pub count	Citation Count	FWCI	h-index
1	YANG Z.	Beijing Normal University (China)	32	531	1.34	50
2	Blevis E.	Indiana University (United States)	31	617	2.77	15
3	Liu J.	Michigan State University (United States)	29	1,804	4.08	44
4	Ouyang Z.	Research Center for Eco-Environmental Sciences Chinese Academy of Sciences (China)	29	1,154	2.15	43
5	Cooke S.	Carleton University (Canada)	26	942	2.88	56
6	Ulgiati S.	Universita degli Studi di Napoli Parthenope (Italy)	26	513	1.70	38
7	Salvati L.	Council for Agricultural Research and Economics (CREA) (Italy)	26	230	1.38	27
8	Bhutta Z.	Hospital for Sick Children University of Toronto (Canada)	24	1,060	10.08	87
9	Polásky S.	University of Minnesota System (United States)	22	2,599	12.20	63
10	Shao H.	Jiangsu Academy of Agricultural Sciences (China)	22	542	0.98	34
11	Wu J.	Arizona State University (United States)	21	2,208	4.01	50
12	Chen B.	Beijing Normal University (China)	21	346	1.66	46
13	Alves R.	Universidade Estadual da Paraiba (Brazil)	20	739	4.65	34
14	Manchikanti L.	Pain Management Center Paducah (United States)	19	533	3.49	78
15	Jabbour C.	Montpellier Research in Management (France)	19	319	2.68	22
16	Razman M.	Universiti Kebangsaan Malaysia (Malaysia)	19	205	2.05	14
17	Scholz R.	Fraunhofer-Institut fur Grenzflachen und Bioverfahrenstechnik - IGB (Germany)	18	399	2.19	39
18	Mihelcic J.	University of South Florida Tampa (United States)	18	253	1.33	26
19	Cesaretti G.	Simone Cesaretti Foundation (Italy)	18	104	0.83	7
20	Bellen J.	Hyundai Engineering and Construction Co. Ltd. (Singapore)	18	-	0.00	-

Table 3.3— *Top 20 researchers publishing SDG3 related research ranked based on 2007-2016 publication output and their FWCI. FWCI is based on SDG3 publications, h-index is based on all publications by the researcher that are indexed in the Scopus database. (Source: Scopus)*

3.3.4 **Top 10 journals publishing SDG3 research**

A list of the top 10 journals publishing SDG3-related research from 2007-2016 is shown in Table 3.4. *PLoS ONE* published 579 SDG3 related publications, making it the top journal in terms of SDG3 publications, closely followed by *Advanced Materials Research*. *PLoS ONE* also has the highest CiteScore among the top 10 journals publishing SDG3 research. *Journal of Cleaner Production* ranks 1st in terms of FWCI. There was considerable spread in the FWCI for the top 10 journals whereby 4 journals had a mean FWCI below the world average FWCI for all research (1.0. cells highlighted in green) and 4 journals had a mean FWCI above the average for all SDG3 research (1.18).

Rank	Journal	Publication count	FWCI	CiteScore
1	PLoS ONE	579	1.50	4.29
2	Advanced Materials Research	540	0.40	0.17
3	Acta Horticulturae	430	1.14	0.20
4	Sustainability	429	1.04	0.92
5	Acta Ecologica Sinica	376	0.23	0.55
6	Journal of Environmental Management	340	1.42	3.75
7	Journal of Cleaner Production	322	2.97	3.70
8	WIT Transactions on Ecology and the Environment	280	0.07	0.08
9	BMC Public Health	238	1.46	2.62
10	Lecture Notes in Computer Science	227	0.93	0.50

Table 3.4— *Top 10 journals based on SDG3 publication output from 2007-2016. FWCI is mean FWCI for any SDG3 publications in the journal during the period; CiteScore is based on data for the journal as a whole. (Source: Scopus)*

3.4 Research efforts focused on SDG3

3.4.1 Research output

Research output as measured by volume of publications (i.e. articles, reviews and conference proceedings indexed in Scopus) is shown in the charts and tables in this section. Publication output is provided for the top 5 countries based on publication output during the period 2007-2016. In addition, metrics are provided for Colombia, Mexico, and Brazil. As shown in Figure 3.3, the United States is by far the leader in terms of research output related to SDG3. The United Kingdom and China both follow with just over one third the publication count of the United States. Among comparators, Colombia has the lowest output in this field, just below Mexico. However, as shown in Table 3.5, Colombia, along with Brazil and China, have seen the greatest growth in research output in this field with a Compound Annual Growth Rate (CAGR) over 18 %. All countries analysed have a CAGR above 12%.

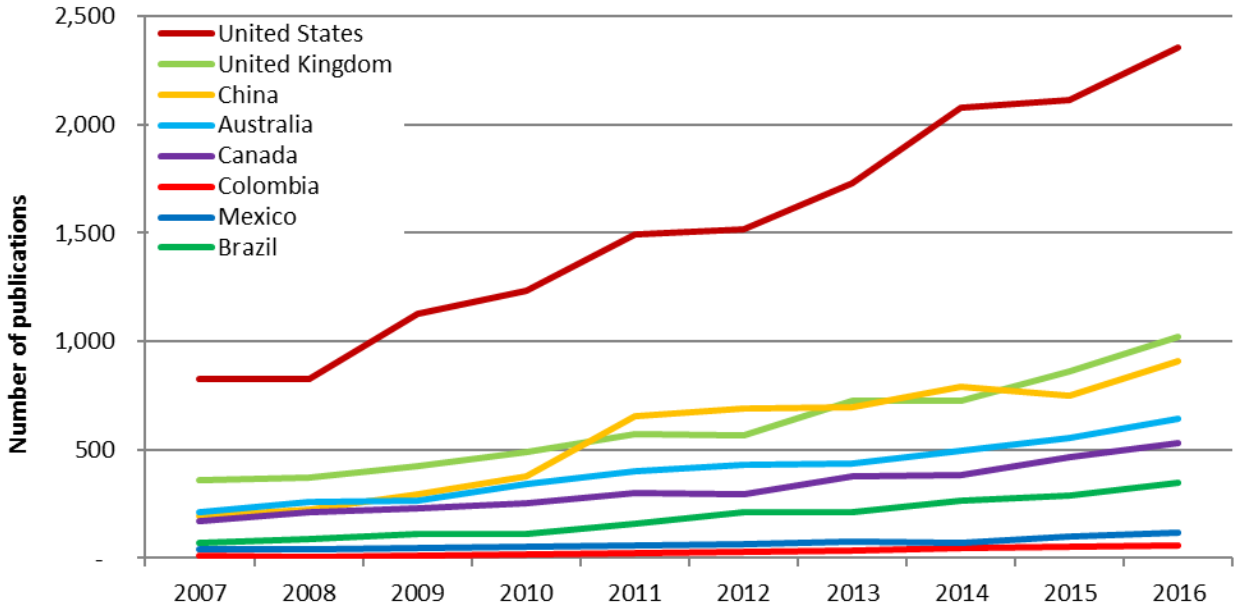

Figure 3.3— *Total number of publications; per country for Colombia, Mexico, Brazil, and the 5 most prolific countries for the period 2007-2016. (Source: Scopus)*

Country	Publication count	CAGR
United States	15,300	12.40%
United Kingdom	6,112	12.30%
China	5,576	18.80%
Australia	4,044	13.00%
Canada	3,220	13.20%
Colombia	284	21.10%
Mexico	668	12.50%
Brazil	1,860	19.50%
World	60,034	11.60%

Table 3.5— *Number of publications per country and the Compound Annual Growth Rate (CAGR) for publication output during the period 2007-2016. (Source: Scopus)*

3.4.2 Field Weighted Citation Impact

To understand the scientific impact of research, we use a citation measure called field-weighted citation impact (FWCI). FWCI reflects the number of citations that a publication receives relative to the number of citations expected based on the subject, age, and type of publication. An FWCI of 1.0 represents the world average for all research done worldwide. The mean FWCI for SDG3 related research from 2006-2017 is 1.18.

Country	FWCI
United States	1.69
United Kingdom	1.92
China	0.96
Australia	1.70
Canada	1.74
Colombia	1.25
Mexico	1.48
Brazil	1.16
World	1.18

Comparing the FWCI of SDG3 publications from each of the eight countries included in this chapter reveals that the United Kingdom leads in terms of FWCI (Table 3.6). The United States, Australia, Germany, and Colombia all have an FWCI close to 1.4. Among countries analysed, only China has an FWCI below the world average for this subject.

Table 3.6— *FWCI per Comparator, 2007-2016. FWCI values below the world average for all research (i.e. below 1.0) are highlighted in green. (Source: Scopus)*

3.4.3 Top 10 Percent Most Highly Cited

The top ten percent most highly cited publications (also known as top ten percentile) are those publications that have an FWCI greater than 90% of papers worldwide. Contribution to the top ten percentile gives an indication of how many publications from a country are among the 'most influential' papers. As shown in Figure 3.4 and Table 3.7, the United States leads in terms of SDG3 publications with 2,717 publications that are among the top 10% most cited. The United Kingdom follows with less than half the number of top 10% publications as the United States. Colombia has 37 publications among the top 10% most cited during this time period.

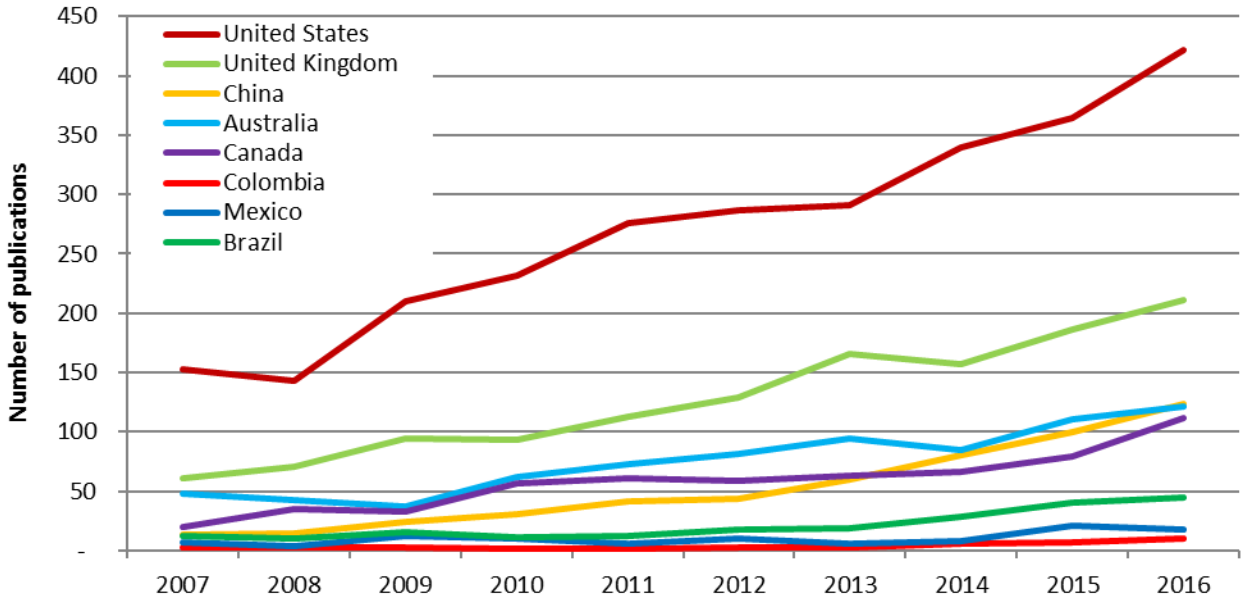

Figure 3.4— *Top 10% most cited publications on SDG3 from 2007-2016 per country. (Source: Scopus)*

Country	Count of Top 10% Publications	CAGR
United States	2,717	11.93%
United Kingdom	1,280	14.78%
China	530	28.48%
Australia	754	10.82%
Canada	584	21.10%
Colombia	37	19.58%
Mexico	102	11.06%
Brazil	210	15.82%
World	7,377	13.90%

Table 3.7— *Top 10% most highly cited publications and their Compound Annual Growth Rate (CAGR) for each country's SDG3 publications from 2007-2016. (Source: Scopus)*

3.4.4 Patents citations in articles

Typically, a patent application will include one or more claims that define the invention. As such, many patent applications cite publications to support claims that the invention is novel. The number of publications cited in patent applications is therefore an indicator of the success with which research findings published in the journal literature are used to justify the patentability of an invention. It is also a measure of how much the research is supporting translation into real world applications. Table 3.8 provides the count of SDG3 publications from each country that have been cited in patents and the number of patents that have cited these publications. For the United States, 152 US publications on SDG3 have been cited in 401 patents. All countries including Colombia had at least one patent cited publication.

Country	Patent Cited Publications	Patents Citing Publications
United States	152	401
United Kingdom	56	100
China	26	93
Australia	26	53
Canada	21	48
Colombia	1	1
Mexico	8	28
Brazil	8	22
World	416	1,061

Table 3.8— *Number of publications cited in patent and patents citing publications on SDG3 from 2007 to 2016. (Source: Scopus)*

3.4.5 Patents

By mining the LexisNexis TotalPatent database, we counted the number of patents issued that focus on SDG3. To identify patents relevant to SDG3, we retrieved all the patents citing any SDG3-related publication. Patents retrieved were limited to those in the following patent authorities: WIPO, EPO, and USPTO. From 2006 to 2016, the United States had the highest number of SDG3-related patents (both applied for and granted) with 150 patent applications and 371 patents granted (Table 3.9). Except for Mexico, all countries have patents related to SDG3. Note that China and Australia may have patents in a local patent office not included in this analysis.

Country	Patents applied for	Patents Granted	Total	% of World Total
United States	150	371	521	58.67%
United Kingdom	21	4	25	2.82%
China	10	3	13	1.46%
Australia	11	20	31	3.49%
Canada	16	17	33	3.72%
Colombia	2	-	2	0.23%
Mexico	-	-	-	0.00%
Brazil	1	1	2	0.23%
World	405	483	888	

Table 3.9— *Number of patents applied for and granted during the period 2006-2016. (Source: Lexis-Nexis)*

3.4.6 **Research Focus**

Within the topic of SDG3-related research, there can be differences in research focus from country to country. This can occur as researchers are motivated by national interests, countries build upon their own inherent research strengths, and countries set different social and economic priorities that influence their respective scientific agenda. In this section, we investigate the differences in research focus in SDG3-related research from Colombia, Mexico, Brazil and the top five most prolific countries in this research field. To do this, we employ Elsevier's Fingerprint Engine™, which uses natural language processing (NLP) technology and domain-specific thesauri to analyze the information contained in textual publication data from the title, abstract and keywords, and assigns to each publication a collection of key phrases (weighted) that represent it. Key phrases based on Fingerprint technology are of higher quality and more representative than standard sets of author-provided keywords which often suffer from problems such as duplicates, synonyms, and inclusion of irrelevant terms. A word cloud of the 50 most relevant key phrases in each country's SDG3 research is shown in Figure 3.5. More details on the methods employed for key phrase analysis and generation of relevance scores can be found in Appendix A.

Among the top 20 key phrases for SDG3 research from Colombia, terms that stand out as unique to Colombia are 'Arecaceae,' 'Elaeis guineensis', and 'coffee.' Among the top 50 key phrases the terms 'Conservation of Natural Resources', 'Delivery of Health Care', 'Health', 'Economics', 'Environments', and 'Ecosystem Service' were common among the countries analyzed. Figure 3.5 provides a visualization of the top 50 key phrases for SDG3 research from each country. The accompanying data files provide a list of the key phrases as well as the relevance score for each key phrase.

Colombia

Mexico

Figure 3.5— *Research focus; per country for Colombia, Mexico, and Brazil and the top prolific countries from 2012-2016. (Source: Scopus, SciVal and Elsevier's Fingerprint Engine)*

Brazil

United States

United Kingdom

China

Australia

Canada

3.5 The reach of Colombia's SDG3 research

Citation impact is a lagging indicator: for citations to accrue, newly published articles must be read and referenced in newly written articles that are then accepted for publication and included in a citation index such as Scopus. Measures such as article downloads can give a broader and more rapid perspective of how much the research is being used or read. In this report, the number of downloads accrued by ScienceDirect (SD) articles are used as a proxy to understand research usage (more details on the methodology can be found in Appendix A).

To facilitate the analysis of download counts across publication sets, the number of ScienceDirect article downloads is normalized against the total number of ScienceDirect articles within the set, resulting in a metric called 'mean downloads per ScienceDirect Paper.' To account for differences in subject area and publication year an indicator similar to the field-weighted citation impact, called field-weighted download impact (FWDI), is also used here.

3.5.1 Downloads

As shown in the Figure 3.6, the mean count of downloads per ScienceDirect publication is similar across all countries. For Colombia, there are some prominent peaks in 2007 and 2016 and valleys in 2010-2011. These peaks and valleys are the result of very small counts of SD articles (and no SD articles in 2011) and should not be given too much weight in interpretations. It should be noted that for Colombia and Mexico, the results shown are based on less than 150 SD articles and should be interpreted with caution.

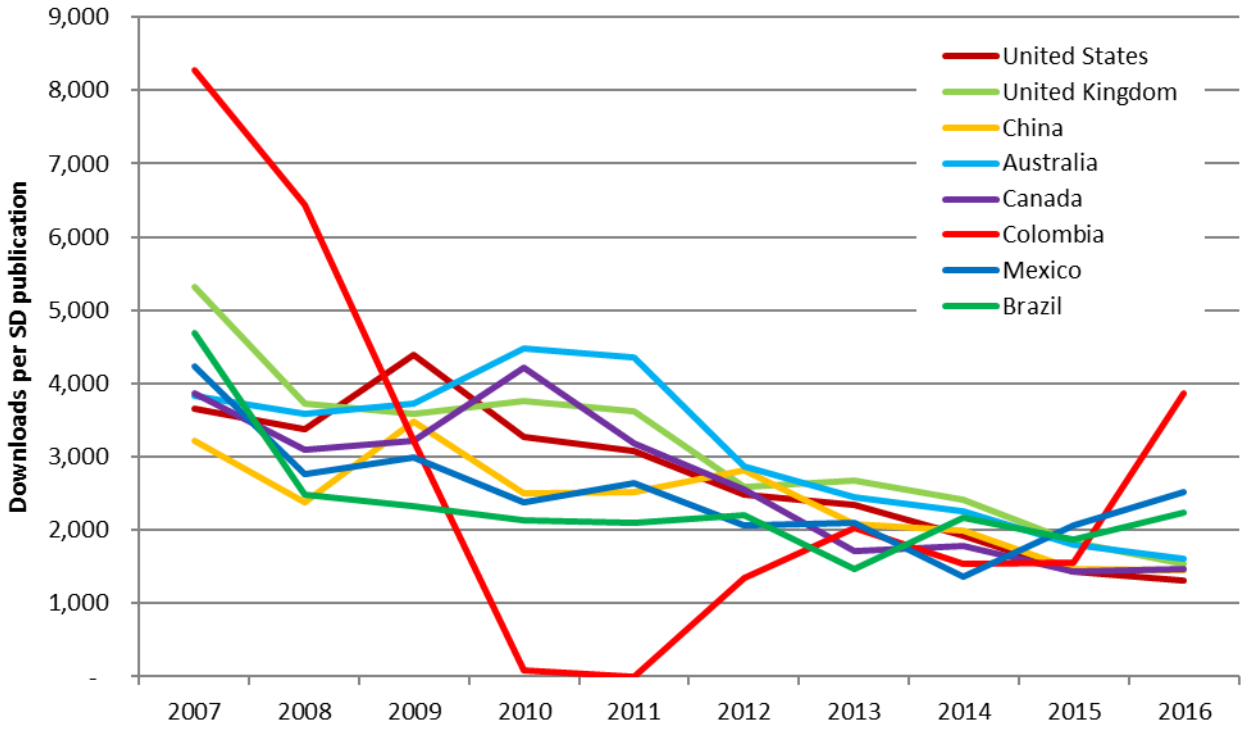

Figure 3.6— *Average downloads per ScienceDirect (SD) publication for Colombia, Mexico, Brazil, and the 5 most prolific countries from 2007-2016. (Source: ScienceDirect)*

3.5.2 Field Weighted Download Impact (FWDI)

Field weighted download impact (FWDI) measures 'ScienceDirect Downloads' normalized against the world benchmark of downloads received for all ScienceDirect articles of the same type, age, and subject. Interestingly, Colombia has the highest mean FWDI for the period of 2007-2016 (Figure 3.7). However, given the very low count of SD publications from Colombia and Mexico (i.e. less than 150 SD publications for the full period) interpretation of this metric should focus on the top 5 countries only. All top 5 countries had an FWDI above the average for all SDG3 research.

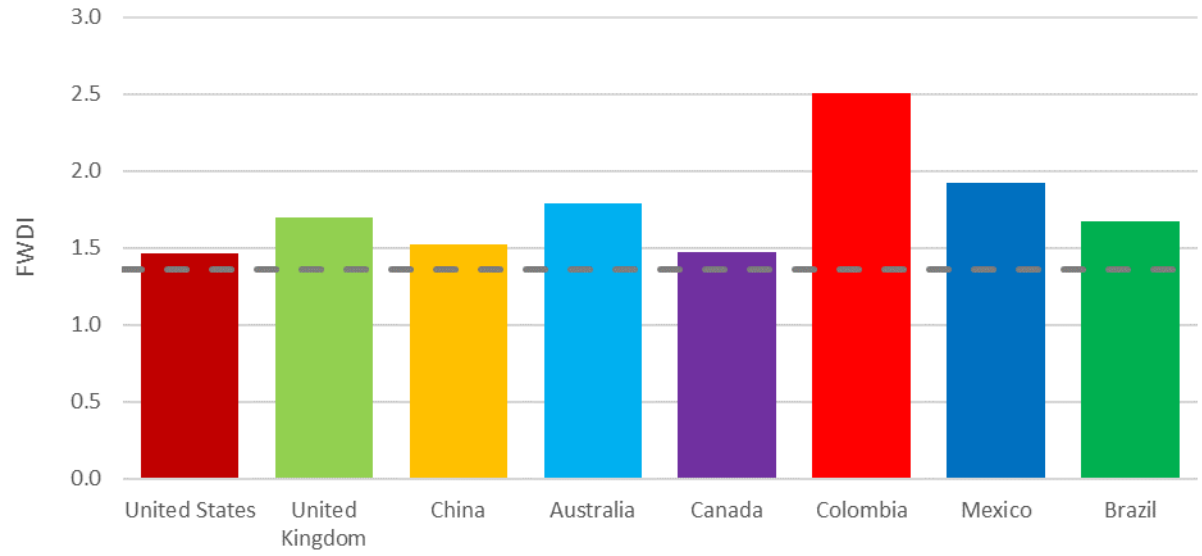

Figure 3.7 — *Field Weighted Download Impact (FWDI) for Colombia and selected countries, 2007-2016. Grey dotted line indicates average for all SDG3 research. (Source: ScienceDirect)*

3.6 SDG3 collaboration network

3.6.1 Top Collaboration Partners

Understanding and comparing the top foreign institutes that each country partners with for SDG3-related research can provide insight on potential international partnerships that Colombia can pursue. Tables 3.10-3.17 provide a list of top international collaboration partners identified as the research institutes with which each country co-publishes the most high impact SDG3 publications with. Among academic partner institutes, Colombia has published the most SDG3 papers in collaboration with Wageningen University & Research (Netherlands; 10 publications). The highest mean FWCI for collaborated publications came from Colombia's co-authored publications with the University of Sydney (Australia), which yielded a mean FWCI of 17.62.

Country	Institution (Country)	Publication Count	FWCI
Colombia	Wageningen University & Research (Netherlands)	10	8.03
	Aarhus University (Denmark)	9	7.47
	International Crops Research Institute for the Semi-Arid Tropics (India)	9	3.26
	Harvard University (United States)	8	8.54
	IRD (France)	8	2.44
	London School of Hygiene and Tropical Medicine (United Kingdom)	7	9.76
	University of Toronto (Canada)	7	9.62
	University of the Witwatersrand (South Africa)	7	9.47
	University of Melbourne (Australia)	6	14.03
	Queen Mary University of London (United Kingdom)	6	11.18
	University College London (United Kingdom)	6	10.94
	Johns Hopkins University (United States)	6	10.55
	Karolinska Institutet (Sweden)	6	10.26
	United Nations (United States)	6	10.17
	Stanford University (United States)	6	8.90
	INRA Institut National de La Recherche Agronomique (France)	6	3.31
	Cornell University (United States)	6	3.28
	Universitat Politecnica de Catalunya (Spain)	6	1.37
	University of Sydney (Australia)	5	17.62
	Instituto Nacional de Salud Publica (Mexico)	5	13.29

Table 3.10— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for Colombia. (Source: Scopus)*

Country	Institution (Country)	Publication Count	FWCI
Mexico	Wageningen University & Research (Netherlands)	18	6.78
	Texas A and M University (United States)	16	2.42
	Harvard University (United States)	12	5.91
	U.S. Department of Agriculture (United States)	12	4.35
	World Health Organization (Switzerland)	11	10.89
	University of Washington (United States)	11	8.89
	University of Arizona (United States)	11	6.53
	University of Toronto (Canada)	10	9.61
	United Nations (United States)	10	7.51
	University of British Columbia (Canada)	9	10.02
	University of Cape Town (South Africa)	9	9.64
	Universidade de Sao Paulo (Brazil)	9	7.27
	INRA Institut National de La Recherche Agronomique (France)	9	5.16
	Arizona State University (United States)	9	4.23
	KU Leuven (Belgium)	9	2.46
	Imperial College London (United Kingdom)	8	12.93
	Stanford University (United States)	8	9.34
	McGill University (Canada)	8	8.83
	Cornell University (United States)	8	6.95
	CSIRO (Australia)	8	6.15

Table 3.11— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for Mexico. (Source: Scopus)*

Country	Institution (Country)	Publication Count	FWCI
Brazil	Harvard University (United States)	27	8.46
	World Health Organization (Switzerland)	27	4.69
	Wageningen University & Research (Netherlands)	26	5.77
	U.S. Department of Agriculture (United States)	18	5.27
	London School of Hygiene and Tropical Medicine (United Kingdom)	17	6.18
	University of Florida (United States)	17	3.00
	Universidad Nacional Autonoma de Mexico (Mexico)	16	4.67
	Imperial College London (United Kingdom)	15	11.70
	University of Oxford (United Kingdom)	15	9.17
	University of East Anglia (United Kingdom)	15	8.74
	University of Toronto (Canada)	13	8.44
	Yale University (United States)	13	8.31
	University of British Columbia (Canada)	13	8.19
	Columbia University (United States)	13	7.36
	Johns Hopkins University (United States)	13	6.75
	CNRS (France)	13	6.10
	IRD (France)	13	5.49
	CIRAD (France)	13	1.69
	University of Cambridge (United Kingdom)	12	10.61
	James Cook University Queensland (Australia)	12	8.64

Table 3.12— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for Brazil. (Source: Scopus)*

Country	Institution (Country)	Publication Count	FWCI
United States	World Health Organization (Switzerland)	160	3.68
	University of Toronto (Canada)	126	2.92
	Chinese Academy of Sciences (China)	117	2.93
	University of British Columbia (Canada)	111	5.42
	London School of Hygiene and Tropical Medicine (United Kingdom)	90	4.24
	Wageningen University & Research (Netherlands)	82	4.91
	University of Oxford (United Kingdom)	79	4.62
	University of Queensland (Australia)	75	5.66
	University of Cambridge (United Kingdom)	69	6.52
	University of Cape Town (South Africa)	68	4.44
	McGill University (Canada)	63	7.05
	Imperial College London (United Kingdom)	61	5.63
	CNRS (France)	55	9.10
	University College London (United Kingdom)	55	5.42
	Stockholm University (Sweden)	52	7.72
	James Cook University Queensland (Australia)	52	6.21
	University of the Witwatersrand (South Africa)	52	3.65
	Makerere University (Uganda)	52	2.57
	CSIRO (Australia)	48	6.35
	Universidade de Sao Paulo (Brazil)	46	4.90

Table 3.13— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for the United States. (Source: Scopus)*

Country	Institution (Country)	Publication Count	FWCI
United Kingdom	World Health Organization (Switzerland)	93	4.90
	Wageningen University & Research (Netherlands)	93	4.46
	Harvard University (United States)	74	9.65
	Johns Hopkins University (United States)	58	4.69
	University of Cape Town (South Africa)	58	4.57
	Karolinska Institutet (Sweden)	52	3.55
	University of Queensland (Australia)	51	6.72
	INRA Institut National de La Recherche Agronomique (France)	51	3.97
	Ghent University (Belgium)	50	3.26
	University of British Columbia (Canada)	48	8.05
	University of Toronto (Canada)	47	4.41
	CNRS (France)	46	10.33
	University of Copenhagen (Denmark)	44	5.10
	University of Melbourne (Australia)	42	4.24
	University of Washington (United States)	41	7.67
	Columbia University (United States)	40	6.92
	University of the Witwatersrand (South Africa)	40	4.15
	University of Sydney (Australia)	38	4.94
	European Commission Joint Research Centre Institute (Belgium)	36	5.34
	Vrije Universiteit (Netherlands)	36	4.47

Table 3.14— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for the United Kingdom. (Source: Scopus)*

Country	Institution (Country)	Publication Count	FWCI
China	University of Hong Kong (Hong Kong)	44	3.27
	Hong Kong Polytechnic University (Hong Kong)	35	1.10
	U.S. Department of Agriculture (United States)	34	4.00
	Arizona State University (United States)	32	2.80
	Wageningen University & Research (Netherlands)	30	4.13
	Chinese University of Hong Kong (Hong Kong)	27	1.60
	CSIRO (Australia)	23	2.98
	University of Queensland (Australia)	22	5.00
	National University of Singapore (Singapore)	22	2.95
	City University of Hong Kong (Hong Kong)	22	1.67
	Harvard University (United States)	21	8.23
	World Health Organization (Switzerland)	20	10.54
	Georgia Institute of Technology (United States)	19	7.09
	Texas A and M University (United States)	19	1.05
	Stanford University (United States)	18	8.24
	University of Western Australia (Australia)	18	7.04
	Cornell University (United States)	18	5.35
	University of Minnesota (United States)	18	5.23
	University of Toronto (Canada)	18	5.04
	Colorado State University (United States)	18	1.42

Table 3.15— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for China. (Source: Scopus)*

Country	Institution (Country)	Publication Count	FWCI
Australia	World Health Organization (Switzerland)	48	4.31
	University of British Columbia (Canada)	43	6.89
	Imperial College London (United Kingdom)	42	5.56
	Wageningen University & Research (Netherlands)	41	6.15
	University of Toronto (Canada)	37	3.39
	University College London (United Kingdom)	36	4.13
	Harvard University (United States)	34	8.83
	Chinese Academy of Sciences (China)	32	2.80
	University of Cape Town (South Africa)	30	4.92
	University of Washington (United States)	29	8.35
	University of Oxford (United Kingdom)	29	7.41
	Stanford University (United States)	28	9.12
	University of Cambridge (United Kingdom)	27	9.68
	University of Auckland (New Zealand)	27	3.16
	U.S. Department of Agriculture (United States)	25	5.54
	Johns Hopkins University (United States)	24	6.14
	National University of Singapore (Singapore)	24	5.42
	University of Alberta (Canada)	23	3.44
	London School of Hygiene and Tropical Medicine (United Kingdom)	22	6.00
	NOAA (United States)	22	3.67

Table 3.16— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for Australia. (Source: Scopus)*

Country	Institution (Country)	Publication Count	FWCI
Canada	Harvard University (United States)	49	6.81
	University of Washington (United States)	38	6.08
	Stanford University (United States)	37	9.00
	University of Cape Town (South Africa)	35	5.52
	Johns Hopkins University (United States)	34	5.52
	World Health Organization (Switzerland)	32	4.52
	Arizona State University (United States)	29	10.62
	U.S. Department of Agriculture (United States)	29	3.03
	University of Queensland (Australia)	28	9.28
	University of Sydney (Australia)	27	5.97
	Cornell University (United States)	27	4.22
	Columbia University (United States)	26	6.53
	Wageningen University & Research (Netherlands)	25	8.28
	Chinese Academy of Sciences (China)	24	3.14
	University of Minnesota (United States)	23	14.37
	Stockholm University (Sweden)	23	12.38
	London School of Hygiene and Tropical Medicine (United Kingdom)	23	6.85
	James Cook University Queensland (Australia)	23	6.60
	University of East Anglia (United Kingdom)	23	4.93
	University of Michigan (United States)	22	7.57

Table 3.17— *A list of the top 20 partnerships based on cumulative publication output from 2007-2016 for Germany. (Source: Scopus)*

3.6.2 **Collaboration impact analysis**

To visualize the citation impact of collaborations, the ratio of FWCI from SDG3 collaborations relative to the FWCI for all of Colombia's internationally collaborated SDG3 publications (x-axis) was plotted against the ratio of FWCI from collaborations relative to the FWCI for all of the partner's international publications on SDG3 (y-axis). The citation impact of collaborations can then be assessed as either mutually beneficial for one, both or neither partner based on the quadrant that the partner lies within. For SDG3 research from 2007-2016, the majority of Colombia's collaborations with top 20 academic partners were mutually beneficial to both Colombia and the collaboration partner (Figure 3.8).

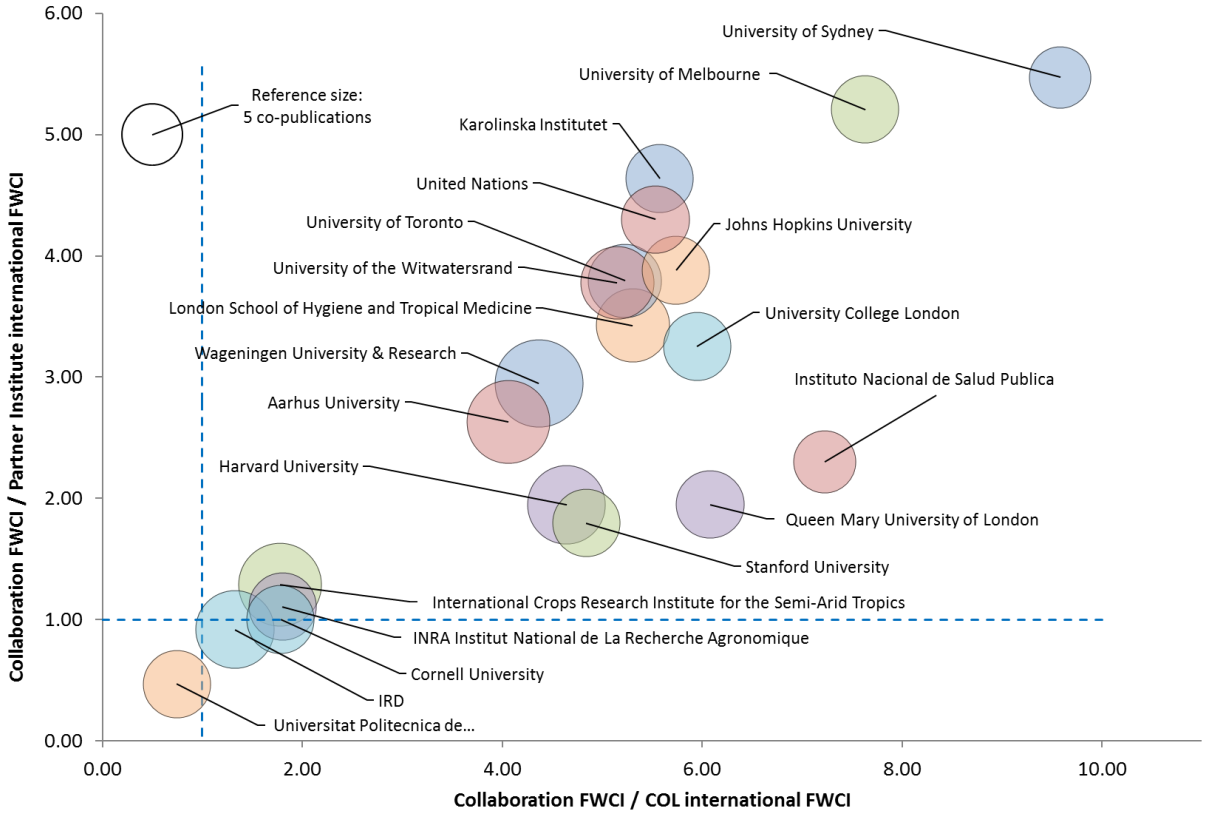

Figure 3.8— *Collaboration quadrant of Colombia's Top 20 collaborations in SDG3-related research with other institutions. Collaboration FWCI refers to the FWCI of all SDG3-related research co-authored by Colombia and the partner institute during the period 2007-2016. Bubble size corresponds to number of co-authored publications (reference bubble depicted at top left of chart). Impact of collaboration between partners can be interpreted based on quadrant position as described in legend on right. (Source: Scopus).*

3.6.3 **Collaboration chart**

Figure 3.9 provides an alternative perspective to visualize Colombia's most productive collaborations with foreign institutional partners on SDG3. While the sections above elaborate on the most productive and impactful partnerships that Colombia is engaged in, Figure 3.9 shows where there may be potential to improve output and impact through partnership. Colombia is already collaborating with the most prolific institutes among its top 20 partners. Among Colombia's top 20 partners, Stanford University and Queen Mary University of London have the highest FWCI for SDG3 research. Colombia may want to leverage its existing relationships with these institutions to increase its publication impact in SDG3 research.

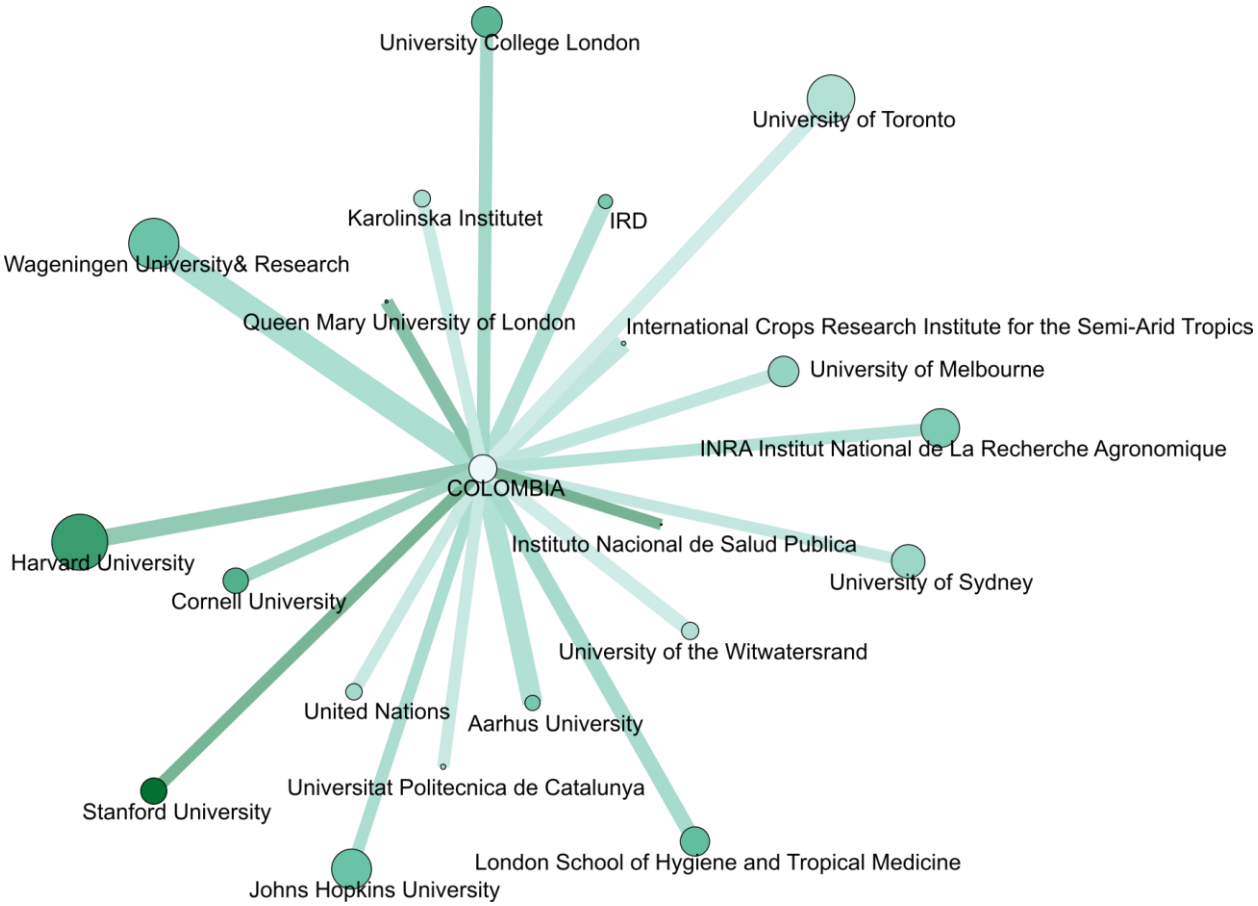

Figure 3.9— *Chart showing Colombia's top 20 collaborators on SDG3 from 2007-2016. Circle (node) size is proportional to the number of SDG3 publications by each entity (top institutional partners and Colombia); the thickness of connecting lines (edges) corresponds to the count of collaborated publications between Colombia and each partner institution. The colours of the nodes and edges reflect the FWCI of each institution's output and their collaboration with Colombia, respectively, with darkest shade of green indicating the highest FWCI (3.80) and lightest shade of green indicating the lowest FWCI (1.80). (Source: Scopus).*