

## **CHANGING DIRECTIONS**

Steering science, technology and innovation towards the Sustainable Development Goals



# Appendix contents

This Appendix provides further details for some of the chapters in the main STRINGS report: *Changing Directions: Steering science, technology and innovation towards the Sustainable Development Goals.* 

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## Appendix 1: A review of existing literature

This section of the Appendix relates to **Chapter 2** in the main report.

## 1.1 Methodology

We searched was two types of documents in our literature review: scientific publications (articles and reviews) and grey literature (policy documents) published between January 2014 and September 2020. In order to identify which documents were relevant for our purposes, we used the following approach.

#### Academic literature

- Used a query<sup>1</sup> to search for relevant publications in the Web of Science<sup>2</sup>, Scopus<sup>3</sup> and Scielo<sup>4</sup>
- Downloaded bibliographic information from those publications (e.g., abstract, title and citation numbers)
- Read abstracts and ranked them from 1 to 5, as follows: 1 = irrelevant; 2 = not interesting enough;
  3 = relevant but not enough (for example, low citations or too vague) 4 = relevant; 5 = extremely relevant
- Checked backward and forward citations of publications ranked 5, and analysed whether some of those should also be included in our set
- Summarized and quoted paragraphs/sentences from all publications ranked 4 or 5s

#### **Grey literature**

- Searched in Google, Dimensions<sup>5</sup>, ODI<sup>6</sup> and Interacademies<sup>7</sup> for relevant policy reports
- Asked partners (UNDP, UKRI, Advisory Committee) for other relevant grey literature (for example, specialized reports and working papers)
- Read abstracts and ranked them from 1 to 5, as follows: 1 = irrelevant; 2 = not interesting enough;
  3 = relevant but not enough; 4 = relevant; 5 = extremely relevant
- Checked backward and forward citations of publications ranked with 5, and analysed whether some of those should also be included in our set
- Summarized and quoted paragraphs/sentences from all publications ranked 4 or 5

<sup>&</sup>lt;sup>1</sup> Example: (("science" OR "research" OR "technolog\*" OR "innovati\*")AND ("SDG\*" OR "sustainable development goal\*"))

<sup>&</sup>lt;sup>2</sup> https://www.webofknowledge.com

<sup>&</sup>lt;sup>3</sup><u>https://www.scopus.com</u>

<sup>&</sup>lt;sup>4</sup> <u>https://scielo.org</u>

<sup>&</sup>lt;sup>5</sup><u>https://www.dimensions.ai</u>

<sup>&</sup>lt;sup>6</sup><u>https://www.odi.org/search/site</u>

<sup>&</sup>lt;sup>7</sup> http://www.interacademies.org/35255/SDG

After identifying and discussing what the most relevant publications were, we complied a final list of 58 publications (academic and grey literature) which were integrated into our analysis.

We confined the scope of our analysis to publications that had "SDG\*" or "sustainable development goal\*" in the title/abstract, rather than those that mentioned sustainable development more generally. We also chose to exclude publications that discuss the potential contribution of specific technologies (for example, machine learning, biotechnology) to the achievement of specific SDGs. To undertake a literature review that includes all branches of research into development and sustainability would be a herculean task. Therefore, we followed a more pragmatic approach, while acknowledging its limitations.

## Appendix 2: A global map of science

This section of the Appendix relates to **Chapter 4** in the main report.

### 2.1 Data and methods

#### 2.1.1 Identifying SDG-related research, and the countries in which it is produced

Scientific publications were assigned to a specific SDG (1-16, excluding SDG17) using a 3-steps method. First, we built a query with a set of key terms (composed of one or a combinations of words) that are strongly associated to a specific SDG because it is used in several documents from different sources that refer to that SDG. Second, we used those SDG-related queries to search academic documents in research areas that are generated by citation relations between all publications in the Web of Science (WoS) since 2000. Third we selected all publications in the research areas that featured a share of publications retrieved by the query above a given threshold.

Since research areas were obtained from a publication-level clustering algorithm based on direct citations (Traag, Waltman, and van Eck 2019), the advantage of this approach is that they can be seen as a combination of papers that address (or are related to) a specific topic, and contribute knowledge around that topic. In comparison to a standard query-based approach that selects individual publications if they contain the key terms, our approach allows to include publications that despite not using a specific SDG-related term in their abstract or title, are likely to be related to a research effort related to the SDG. The reason why specific documents may not use key terms selected in our first step may be multiple, including the use of different ontologies or terms across different disciplines, or focusing on aspects that were not explicitly mentioned in SDG policy reports and publications, but which may still be relevant to the SDG. For instance, with reference to health and well-being (SDG3), policy documents may mention a number of tropical diseases, but it is unlikely that all of them will be ever mentioned. Since research is a cumulative and collaborative process, and it is groups of researchers rather than individuals that study challenges, we believe this approach is more adequate for our research question.

We next explain each of the three steps in more detail.

#### First step

The methodology used to obtain a final list of keywords per SDG consists of a series of sub-steps. First, we collected texts from various documents that contained descriptions of specific SDGs. Instead of relying only on official United Nations sources to identify relevant terms, we chose to include also a wide array of policy reports, grey literature, scientific publications, and web forums. In this way, we aimed to capture a broader understanding of SDGs that is shared in different types of publications and authors. Second, we extracted relevant fragments from these texts, which referred to a particular SDG and met a certain criterion.<sup>8</sup> This step allowed us to exclude text content that is not SDG specific and text that is about more than one SDG. Third, we partitioned the text referring to

<sup>&</sup>lt;sup>8</sup> These fragments must contain text referring specifically to at least one SDG. The text must refer to problems associated to the SDG(s), making a clear connection between the problems and goal(s), e.g., using the term "Sustainable Development Goal". References to "sustainability" alone were not considered sufficient for the document to be included. References to issues associated to the SDGs (e.g., poverty or hunger) but with no explicit mention of the SDGs were also not considered sufficient for the document to be included.

an SDG in different entries, maintaining the authors' structure. Fourth, we extracted relevant keywords from these text entries combining two different algorithms: Textrank (Mihalcea and Tarau 2004) and Vosviewer (van Eck and Waltman 2010) algorithms. Fifth, we carried out a manual selection of the keywords extracted through these filters and shared these lists with other team members and experts to check for missing or irrelevant terms.

#### Second step

After building queries composed of the selected key terms for all 16 SDG, we applied those queries to search in the title and abstracts of publications in the CWTS WoS dataset (between 2015-2019). We used a classification system generated by (Waltman and van Eck 2012) at CWTS that separates all WoS publications since 2000 in 4,013 micro clusters of publications. The algorithmically created clusters at this level prove to be an optimal granularity for normalization of citations (Ruiz-Castillo and Waltman 2015). However, it is still a matter of debate what is the most useful degree of granularity for topic delineation, with some research groups using 20,000 or even 100,000 clusters (Boyack, Smith, and Klavans 2020). All research areas are described by labels that represent the most frequent terms that also differentiate a cluster from the others.

#### Third step

For each research areas that had at least one publication retrieved by our queries we computed the share of publications that contain at least one of our SDG-related terms in their abstract or title. To select relevant research areas, we defined two thresholds for each SDG:

- 1. A maximum threshold, which corresponds to a strict interpretation of what may constitute SDG-related research. Above this threshold all research areas were considered to be directly related to the SDG by at least two team members, based on manual revisions of the labels that define the research area and a sample of their most cited publications, against the SDGs targets. The first research area below this threshold was not considered directly related to the SDG (according to the SDGs targets) by at least one team member, based on the labels that define the research area and a sample of its most cited publications.
- 2. A minimum threshold, which corresponds to a loose interpretation of what may constitute SDG-related research. Above this threshold the majority of research areas were considered to be related (directly or indirectly) to the SDG by at least one team member, based on manual revisions of the labels that define the research area and a sample of their most cited publications, against the SDGs targets. The majority of the research areas below this threshold were considered not relevant (directly or indirectly) by all team members, based on manual revisions of the labels that define the research area and a sample of not relevant (directly or indirectly) by all team members, based on manual revisions of the labels that define the research area and a sample of their most cited publications, against the SDGs targets. The loose interpretation, therefore, contains all research areas that are included in the strict interpretation.

We then associated with a certain SDG all publications that belong to a research area has a share of publications containing a term from the SDG query in the abstract and title above the maximum threshold (strict interpretation of SDG-related research) or the minimum threshold (loose interpretation of SDG-related research).

As a robustness check, after a first initial analysis of what clusters are associated to what SDGs,<sup>9</sup> we compared our results with the results obtained using the publicly available queries developed by SIRIS Academic using a different approach.<sup>10</sup> We checked which clusters where selected by our STRINGS query and the SIRIS query. Again, using the labels of the research areas, we could improve our:

- Recall (type II error, false negative), namely research areas that should be associated with a certain SDG but were not identified by our SDG queries.
- Precision (type I error, false positives), namely research areas that were associated with a certain SDG by our SDG query but were not relevant.

After comparing our results using the two approaches for all SDGs, we changed some of our key terms to improve recall and precision. We then recalculated the maximum and minimum thresholds to include research areas. We ran a sensitivity analysis between the two thresholds and the correlation of results between the two is very high. Each SDG specific thresholds can be provided upon request, and the platform<sup>11</sup> that we use to understand which publication researcher areas are associated with an SDG is openly available (Chapter 12).

The metrics for comparisons between countries and organisations were created based on the address of all authors, using unweighted fractional counting: each publication was allocated to all countries and organisations reported among the authors' affiliations, with an equal share for all countries/organisations included (independently from the number of authors from the country). Based on publications with multiple authors from different countries, we also computed the metrics for the collaborations between countries: the number of collaborations between country A and B is the number of publications that are co-authored by authors in both countries. The metrics for comparison between disciplines were based on the WoS subject category of each paper.

#### 2.1.2 Country clusters

To identify mutually exclusive groups of countries that are similar with respect to their research system, we clustered countries using the following variables: the share of SDG-related publications in each SDG (1-16) and the number of publications per capita (using fractional counting), normalized between 0 and 1 – so that all variables are on the same scale. We removed countries with less than 500 publications over 2015-19 (100 publications per year), as their shares are extremely skewed.

Using these 17 variables we aimed to identify clusters of similar countries based on (relatively) similar within-group value. We applied a data-driven, complete-linkage hierarchical agglomerative clustering. Agglomerative clustering starts by assuming that all observations (countries) are different, and iteratively combines the closest two groups. Complete-linkage clustering uses the farthest pair of observations between two groups to determine the similarity or dissimilarity of the two groups. We then used the Calinski-Harabasz pseudo-F index to choose which hierarchical level shows the largest diversity between groups. <sup>12</sup> Although 6 clusters maximized the diversity between groups, we chose to

<sup>&</sup>lt;sup>9</sup> Aggregate indicators such as the share of SDG related publications across countries for each SDG are similar for the strict and the loose interpretation.

<sup>&</sup>lt;sup>10</sup> <u>http://science4sdgs.sirisacademic.com/</u>

<sup>&</sup>lt;sup>11</sup> <u>https://public.tableau.com/profile/ed.noyons#!/vizhome/UKStringsSDGtocommunities/Dashboard1</u>

<sup>&</sup>lt;sup>12</sup> StataCorp. 2019. Stata: Release 16. Statistical Software. College Station, TX: StataCorp LLC.

use the iteration with four clusters because it has a similar pseudo-F index, but it is less complex to interpret.

Finally, we computed average values for the share of SDG-related publications in each SDG (1-16), the number of publications per capita (not normalized), and the SDG index to compare the four clusters of countries (Table A.2.3). The value for each country, together with the cluster number, is reported in Table A.2.4.

#### 2.1.3 Research synergies between SDGs

We computed synergies between two SDGs, X and Y, using the number of publications that are associated with both SDG X and SDG Y. Because we map research to SDGs on the basis of research areas (i.e., clusters of publications) rather than on the basis of individual papers, one research area may be related to one or more SDGs. All publications in that research area are then linked to one or more SDGs. The larger the number of research areas that are related to the same pair of SDGs X and Y, the higher the probability that research on the two SDGs is related, leading to synergies. Besides the number of common research areas, we also considered the number of shared publications (within the shared areas). The larger a shared research area, the higher the synergy.

#### 2.1.4 A typology of SDG research

The characterization of publications related to SDGs is based on the characteristics of the research micro cluster to which these publications belong. If a publication belongs to micro cluster X, it inherits the average characteristics of X (Noyons 2019). For each characteristic and SDG, except for Multi-disciplinarity, we used the same approach: we computed the ratio of publications with a certain characteristic (e.g., funded) across all topics related to the SDG, compared to all publications in those research topics (those with and without the characteristic). In Table A.2.1 we describe more specifically how these characterizing indicators are defined.

Characteristic	Description: publication which	
	Eastures as outbors from at locat two	Number of publications with
	different countries	internetional calleborations with
conaporation	different countries	international collaborations in research
		areas related to an SDG divided by total
		number of publications in those
		research areas
Collaborations HIC-rest	Features at least 2 co-authors from at	Number of publications with HIC-rest of
	least one HIC and one non-HIC	the world collaborations in research
		areas related to an SDG divided by total
		number of publications in those
		research areas
Funded	Mentions at least one funding	Number of funded publications in
	organization in the acknowledgements	research areas related to an SDG
		divided by the total number of
		publications in those research areas
Industry	Features at least one co-author from a	Number of industry publications in
	private company	research areas related to an SDG
		divided by the total number of
		publications in those research areas
Patent use	Are being cited in a patent listed in the	Number of publications cited by at least
	PATSTAT <sup>13</sup> database	one patent in research areas related to
		an SDG divided by total number of
		publications in those research areas
Reputation	Belong to the top 10% most highly cited	Number of publications among the top
	publications in a WoS subject category	10% most cited publications across the
		whole WoS, in a subject category, in
		research areas related to an SDG
		divided by the total number of
		publications in those research areas
Open Access	Are registered at CWTS as being Open	Number of open access publications in
	Access papers (Gold, Green, Bronze,	research areas related to an SDG
	etc)	divided by the total number of
	0.00	nublications in those research areas
Policyuse	Are being mentioned or cited in a policy	Number of publications cited in a policy
	document in the Overtone <sup>14</sup> database	document in research areas related to
	between 2015- June 2020	an SDG divided by total number of
	between 2015-00ne 2020	nublications in those research areas
Newsuse	Are being mentioned in a news item in	Number of publications mentioned in
	the Almetric <sup>15</sup> database between 2015-	news items in research areas related to
		an SDG divided by the total number of
	Julie 2020	nublications in those research areas
Twitteruse	Are being mentioned on Twitter in the	Number of papers montioned at least
	Almetric database between 2015- June	once on Twitter in research areas
	2020	related to an SDGs divided by total
	2020	number of publications in these
		research areas

Table A.2.1: Definitions of the characteristics used to identify a typology of SDG-related publications

We next computed the average value of each indicator for the entire WoS between 2015-2019. To harmonize all scores, we computed the ratio between the indicator by SDG and the WoS average. Hence, all scores above one indicate a higher than average share of publications with a given characteristic for a given SDG, with respect to the WoS average. Symmetrically, all scores below one

<sup>13</sup> https://www.epo.org/searching-for-patents/business/patstat.html

<sup>&</sup>lt;sup>14</sup> <u>https://www.overton.io</u>

<sup>&</sup>lt;sup>15</sup> <u>https://www.altmetric.com</u>

indicate a lower than average share of publications with a given characteristic for a given SDG, with respect to the WoS average.

The last indicator, the degree of multidisciplinarity of an SDG is based on weighted multidisciplinarity indicator of clusters associated with that SDG. The multidisciplinarity of a given cluster is estimated with the Rao-Stirling diversity measure (Stirling 2007), according to the distribution of publications in the cluster across WoS Subject Categories (as applied to departments in (Rafols et al. 2012)). Rao-Stirling diversity is equivalent to the Herfindahl-Hirschman index but weighted by the cognitive distance between WoS categories. This distance was estimated as the cosine similarity between WoS categories according to cross-citation patterns for 2017. Publications in the WoS category 'Multidisciplinary sciences' were fractionally re-assigned to the categories in their reference list.

### 2.2 Additional figures and tables

#### 2.2.1 Countries' research capabilities and sustainable research

Table A.2.2: Collaborative publications between country groups for all publications (including non-SDG-related)

Country groups	HIC	UMIC	LMIC	LIC	HIC	UMIC	LMIC	LIC
	Panel A: % d	of total publica	itions		Panel B: % group	6 of publicat	ions within (	country
HIC	61.44%				92.25%	5.94%	1.66%	0.16%
UMIC	3.96%	22.52%			14.76%	84.07%	1.08%	0.09%
LMIC	1.11%	0.29%	4.88%		17.55%	4.59%	77.43%	0.43%
LIC	0.10%	0.02%	0.03%	0.15%	34.32%	8.06%	8.95%	48.67%
Total collaborations	9,110,239 (66.61%)	3,664,754 (26.79%)	861,662 (6.30%)	41,229 (0.30%)				

**Notes:** Panel A: This shows what proportion of all global collaborative publications occurred within (diagonal) and between (off the diagonal) country groups, for all publications, including non-SDG-related. For example, a publication co-authored by authors in the USA and the UK (both HICs) would contribute to the percentage in the top left cell. A publication co-authored by authors in the USA and the Second row of the first column). The sum of all cells equals 100%. Panel B: This shows what proportion of the collaborations within each country group occurred within and between country groups. For example, the first row shows the country groups involved in all collaborative research undertaken by HIC. The row total sums to 100%. HIC: High-income countries; UMIC: Upper-middle-income countries; LMIC: Lower-middle-income countries. Figures are based on WoS data (CWTS version), 2015-19.

### 2.2.2 Which disciplines contribute to SDG-related research?

Table A.2.5. Discipli		C Highest		St Share O		ncu public	ations										
Discipline	SDGO	SDG14	SDG2	SDG3	SDG4	SDG5	SDG6	SDG7	SDG8	SDG9	SDG10	SDG11	SDG12	SDG13	SDG14	SDG15	SDG16
Substance Abuse	6.94%	0.05 %	0.05 %	86.99 %	0.03 %	3.32%	0.10%	0.00 %	0.11%	0.01%	0.40 %	0.04 %	0.10%	0.03 %	0.00 %	0.01%	1.80%
Oncology	11.50%	0.00 %	0.17%	88.15%	0.00 %	0.08%	0.01%	0.00 %	0.01%	0.00 %	0.03 %	0.04 %	0.00 %	0.00 %	0.00 %	0.01%	0.00%
Tropical Medicine	12.25%	0.02 %	0.63%	84.85 %	0.00 %	0.50%	0.86%	0.03 %	0.00 %	0.01%	0.04 %	0.06 %	0.00 %	0.10%	0.02 %	0.55%	0.07%
Parasitology	15.41%	0.00 %	0.12%	83.06 %	0.00 %	0.03%	0.06 %	0.01%	0.00 %	0.00 %	0.00 %	0.02 %	0.01%	0.08 %	0.27%	0.92%	0.01%
Public, Environmental & Occupational Health	16.63%	0.40 %	1.37%	65.59%	0.23%	5.85%	0.77%	0.35%	0.45 %	0.12%	2.08%	3.09%	0.32%	0.96%	0.05 %	0.25%	1.48%
Health Policy & Services	16.89%	0.37%	0.60 %	73.96%	0.42 %	3.46%	0.11%	0.06 %	0.54 %	0.15%	1.54%	0.35%	0.15%	0.24 %	0.00 %	0.04%	1.11%
Criminology & Penology	16.96%	0.02 %	0.07%	24.94 %	0.52%	8.78%	0.01%	0.03 %	0.58%	0.08 %	0.31%	0.32 %	0.10%	0.13%	0.04 %	0.28%	46.84 %
Primary Health Care	18.79%	0.25%	0.64 %	74.01%	0.04 %	4.69%	0.00 %	0.04 %	0.07%	0.01%	0.41%	0.13%	0.06 %	0.10%	0.00 %	0.01%	0.74%
Ornithology	19.14%	0.00 %	0.09 %	1.30%	0.00 %	0.00%	0.13%	1.34%	0.00 %	0.00 %	0.00 %	0.60 %	0.02 %	3.68%	0.93%	72.78 %	0.00%
Social Sciences, Biomedical	20.40 %	0.47%	0.64 %	57.80%	0.77%	12.44 %	0.18%	0.07%	0.56%	0.09 %	2.93%	0.65%	0.19%	0.51%	0.00 %	0.21%	2.10%
Materials Science, Composites	98.12%	0.00 %	0.00 %	0.19%	0.00 %	0.00%	0.32%	0.64 %	0.01%	0.03 %	0.00 %	0.04 %	0.59%	0.05 %	0.00 %	0.01%	0.00%
Literature, British Isles	98.18%	0.00 %	0.00 %	0.59%	0.34 %	0.22%	0.00 %	0.00 %	0.00 %	0.00 %	0.06 %	0.19%	0.00 %	0.11%	0.00 %	0.09%	0.23%
Mathematics	98.20 %	0.00 %	0.00 %	1.30%	0.21%	0.00%	0.04 %	0.04 %	0.02 %	0.01%	0.01%	0.02 %	0.01%	0.08 %	0.01%	0.03%	0.01%
Physics, Nuclear	98.59%	0.00 %	0.01%	1.21%	0.00 %	0.00%	0.05 %	0.05 %	0.00 %	0.01%	0.00 %	0.05 %	0.01%	0.01%	0.00 %	0.01%	0.00%
Medieval & Renaissance Studies	98.70%	0.01%	0.03 %	0.45%	0.05 %	0.12%	0.02 %	0.03 %	0.00 %	0.00 %	0.02 %	0.11%	0.03 %	0.27%	0.00 %	0.16%	0.00%

Table A.2.3: Disciplines with the highest and lowest share of SDG-related publications

Classics	98.99%	0.00 %	0.00 %	0.46%	0.18%	0.05%	0.02 %	0.02 %	0.01%	0.00 %	0.03 %	0.10%	0.01%	0.05 %	0.00 %	0.03%	0.05%
Quantum Science & Technology	99.23%	0.00 %	0.00 %	0.49%	0.00 %	0.00%	0.03 %	0.17%	0.00 %	0.00 %	0.00 %	0.03 %	0.01%	0.03 %	0.01%	0.00%	0.00%
Logic	99.63%	0.00 %	0.02 %	0.20%	0.00 %	0.03%	0.00 %	0.07%	0.00 %	0.00 %	0.00 %	0.01%	0.01%	0.00 %	0.00 %	0.03%	0.00%
Physics, Particles & Fields	99.72%	0.00 %	0.00 %	0.24%	0.00 %	0.00%	0.00 %	0.01%	0.00 %	0.00 %	0.00 %	0.01%	0.00 %	0.00 %	0.00 %	0.00%	0.00%
Astronomy & Astrophysics	99.77%	0.00 %	0.00 %	0.03%	0.00 %	0.01%	0.01%	0.02 %	0.00 %	0.00 %	0.00 %	0.05 %	0.00 %	0.08 %	0.01%	0.02%	0.00%

Notes: Share of publications unrelated to any of the SDGs (SDGO) and share of publications related to each SDG, by discipline. Top 10 row: disciplines with the highest share of SDG-related publications; bottom 10 rows: disciplines with the lowest share of SDG-related publications. Figures based on WoS data (CWTS version).

Discipline	SDGO	SDG1	SDG2	SDG3	SDG4	SDG5	SDG6	SDG7	SDG8	SDG9	SDG1 0	SDG11	SDG1 2	SDG13	SDG1 4	SDG15	SDG16
Development Studies	31.13%	4.44 %	7.22%	6.77%	0.98 %	3.20%	2.38%	1.99%	6.78%	6.28 %	4.91%	7.43%	2.83 %	6.28%	0.22 %	3.77%	3.38%
Regional & Urban Planning	31.33%	0.45 %	3.06%	4.31%	0.59 %	0.56%	2.18%	3.67%	5.78%	11.65 %	1.84%	17.19%	3.76 %	7.59%	0.31%	5.23%	0.50%
Environmental Studies	25.29 %	0.15%	2.91%	2.97%	0.44 %	0.17%	3.69%	8.94%	4.02%	7.17%	0.55 %	9.96%	6.03 %	15.23 %	1.70%	10.42 %	0.36%
Agricultural Economics & Policy	45.05 %	1.88%	14.35 %	5.03%	0.20 %	1.09%	1.36%	3.72%	5.29%	4.60 %	1.23%	1.92%	5.17%	5.64%	0.35 %	2.98%	0.13%
Environmental Sciences	39.96 %	0.03 %	1.88%	9.75%	0.08 %	0.07%	10.18 %	5.20%	1.24%	2.10%	0.06 %	6.95%	3.85 %	8.59%	2.35 %	7.67%	0.04%
Green & Sustainable Science & Technology	44.89 %	0.06 %	1.51%	1.56%	0.47 %	0.05%	3.34%	18.47 %	3.00%	5.44 %	0.09 %	3.48%	7.56 %	7.01%	0.22 %	2.82%	0.04%
Social Sciences, Interdisciplinary	54.69 %	0.63 %	0.70%	15.44 %	3.60 %	4.63%	0.46%	0.87%	3.33%	3.21%	2.65 %	3.05%	1.41%	1.99%	0.11%	0.99%	2.21%
Geography	44.53 %	0.30 %	4.76%	4.50%	1.40%	0.81%	1.83%	1.72%	2.26%	2.91%	1.72%	14.42 %	3.12%	7.94%	0.53 %	6.36%	0.89%
Urban Studies	24.98 %	0.12%	0.55%	6.14%	1.88%	0.55%	1.21%	2.51%	1.88%	3.93 %	4.91%	38.09 %	2.13%	4.40%	0.19%	5.63%	0.89%
Economics	50.22 %	1.38%	0.98%	4.58%	1.28%	1.40%	0.33%	2.95%	14.54 %	7.80 %	4.37 %	2.66%	2.18%	2.95%	0.09 %	0.80%	1.49%
Area Studies	61.00 %	0.87 %	5.66%	3.59%	0.72 %	2.01%	0.51%	0.80%	3.54%	2.50 %	1.77%	7.79%	1.01%	1.81%	0.21%	1.00%	5.21%
Engineering, Environmental	49.06 %	0.01 %	0.94%	4.12%	0.10 %	0.00%	13.34 %	9.50%	1.45%	3.21%	0.01 %	3.68%	6.84 %	5.01%	0.67 %	2.05%	0.01%
Sociology	48.83 %	0.85 %	1.59%	11.37%	4.37 %	8.62%	0.35%	0.33%	3.35%	0.81%	8.87 %	2.67%	1.74%	1.49%	0.05 %	0.84%	3.87%
Water Resources	32.30 %	0.02 %	1.89%	3.85%	0.01 %	0.01%	27.56 %	3.95%	0.20%	1.41%	0.02 %	4.29%	0.98 %	14.72 %	2.20 %	6.59%	0.02%
Social Issues	52.61%	0.85 %	0.66%	17.92 %	2.04 %	5.84%	0.36%	0.59%	4.24%	2.17%	5.34 %	1.43%	0.38 %	1.85%	0.05 %	0.59%	3.10%
Public Administration	63.84 %	0.35 %	0.40%	3.75%	1.08%	1.16%	1.26%	2.05%	5.98%	3.48 %	4.78 %	3.13%	1.13%	4.55%	0.06 %	1.51%	1.49%
International Relations	58.46 %	0.17%	0.80%	1.46%	0.20 %	0.60%	0.90%	1.38%	4.60%	3.28 %	1.18%	0.95%	0.74 %	2.65%	4.21%	4.05%	14.36 %
Demography	40.02 %	2.42 %	0.69%	19.77%	1.50%	19.03 %	0.10%	0.10%	1.63%	0.99 %	6.69 %	3.86%	0.15%	1.04%	0.02 %	0.30%	1.69%

#### Table A.2.4: Disciplines with the highest and lowest median share of SDG-related publications

Biodiversity Conservation	24.69 %	0.02 %	1.12%	3.17%	0.01 %	0.01%	1.79%	1.26%	0.62%	0.42 %	0.02 %	1.96%	1.13%	12.79 %	8.74 %	42.26 %	0.00 %
Political Science	74.61%	0.16%	0.98%	2.00%	0.44 %	1.24%	0.40%	0.83%	4.32%	1.16%	3.11%	1.56%	0.46 %	1.62%	0.09 %	0.53%	6.49%
	70.07	0.00		00 / 0	0.00			0.00		0.00	0.01		0.00	0.00	0.00		
Anesthesiology	72.84 %	0.00 %	0.23%	26.48 %	0.00 %	0.41%	0.00%	0.00 %	0.01%	0.00 %	0.01 %	0.01%	0.00 %	0.00 %	0.00 %	0.01%	0.01%
Astronomy &	99.77	0.00	0.00		0.00			0.02		0.00	0.00		0.00		0.01		0.00
Astrophysics	%	%	%	0.03%	%	0.01%	0.01%	%	0.00%	%	%	0.05%	%	0.08%	%	0.02%	%
Physics, Atomic,		0.00			0.00						0.00		0.02		0.00		0.00
Chemical	95.20 %	0.00 %	በ በ1%	195%	0.00 %	N NN%	በ 92%	1 12 %	በ በበ%	በ በ1%	0.00 %	በ 66%	0.02 %	በ በ5%	0.00 %	በ በበ%	0.00 %
Chernoul	60.21	0.00	0.0170	39.62	0.00	0.00%	0.0270	0.00	0.00%	0.00	0.00	0.0070	0.00	0.0070	0.00	0.0070	0.00
Transplantation	%	%	0.09%	%	%	0.04%	0.00%	%	0.00%	%	%	0.00%	%	0.01%	%	0.00%	%
Gastroenterology &	28.54	0.00	0 700/	70.98	0.01	0.000/	0.010/	0.00	0.000/	0.00	0.00	0.010/	0.00	0.010/	0.00	0.010/	0.00
Hepatology	%	% 0.00	0.36%	%	% 0 33	0.08%	0.01%	% በ በበ	0.00%	% 0.00	% 0.01	0.01%	% 0.00	0.01%	% 0.00	0.01%	%
Neuroimaging	82.17%	%	%	17.10%	%	0.18%	0.00%	%	0.00%	%	%	0.01%	%	%	%	0.00%	0.18%
		0.00		88.15	0.00			0.00		0.00	0.03		0.00	0.00	0.00		0.00
Oncology	11.50%	%	0.17%	%	%	0.08%	0.01%	%	0.01%	%	%	0.04%	%	%	%	0.01%	%
Otorhinolaryngolog	66.39	0.00	0.00%	32.96	0.05	0.00%	0.01%	0.00	0.00%	0.00	0.00	0.00%	0.00	0.00	0.00	0.01%	0.00
y Urology &	% 39.54	% በ በበ	0.20%	% 59.28	% በ በበ	0.29%	0.01%	% በ በበ	0.00%	% በ በበ	% በ በ1	0.06%	% በ በበ	76	% በ በበ	0.01%	70
Nephrology	%	%	0.16%	%	%	0.87%	0.00%	%	0.00%	%	%	0.01%	%	0.02%	%	0.00%	0.08%
	60.70	0.00		38.14	0.00			0.00		0.00	0.01		0.00		0.00		
Surgery	%	%	0.24%	%	%	0.80%	0.00%	%	0.00%	%	%	0.04%	%	0.02%	%	0.00%	0.02%
Delegatelegy	86.24 ∞	0.00 %	0.02%		0.00 %	0 00%	0.04.%	0.00 %	0 00%	0.00 %	0.00 %		0.00 %	E 70%	1. 10%	7 07%	0.00 %
Faleontology	<sup>7</sup> ° 35.95	/° 0.00	0.02 /0	63.50	0.00	0.00 %	0.04 /0	0.00	0.00 %	/o 0.00	0.01	0.05%	0.00	0.00 %	4.10%	3.03 /0	0.00
Hematology	%	%	0.40%	%	%	0.07%	0.00%	%	0.00%	%	%	0.03%	%	0.02%	%	0.01%	%
	88.25	0.00			0.01			0.00		0.00	0.01		0.00	0.00	0.00		
Orthopedics	%	%	0.07%	11.40%	%	0.22%	0.00%	%	0.00%	%	%	0.03%	%	%	%	0.00%	0.01%
Crystallography	94.76 ∞	0.00 ∞	0.02%	1. 30%	0.00 ∞	0 00%	0 12%	0 70%	0 00%	0.00 ∞	0.00 ∞	0.02%	0.01 ∞	0.04 ∞	0.00 %	0.00%	0.00 ∞
Physics, Particles	<sup>7</sup> ° 99.72	0.00	0.02 %	4.52 /0	0.00	0.00 %	0.12 /0	0.70%	0.00 %	0.00	0.00	0.02 /0	0.00	0.00	0.00	0.00%	0.00
& Fields	%	%	%	0.24%	%	0.00%	0.00%	0.01%	0.00%	%	%	0.01%	%	%	%	0.00%	%
Cell & Tissue	73.78	0.00		26.15	0.00					0.00	0.00		0.00		0.00		0.00
Engineering	%	%	0.02%	%	%	0.01%	0.02%	0.01%	0.00%	%	%	0.00%	%	0.01%	%	0.00%	%
Rheumatology	37.04 %	0.00 %	0.01%	٥2.82 %	0.00 %	0.08%	0.00%	0.00 %	0.00%	0.00 %	0.01 %	0.03%	0.01 %	0.00 %	0.00 %	0.00%	0.00 %
Rheumatology	37.04 %	0.00 %	0.01%	02.02 %	0.00 %	0.08%	0.00%	0.00 %	0.00%	0.00 %	0.01 %	0.03%	0.01 %	0.00 %	0.00 %	0.00%	0.00 %

	97.28	0.00	0.00					0.00		0.00	0.00		0.00		0.00		0.00
Poetry	%	%	%	0.00%	0.14%	0.00%	0.00%	%	0.00%	%	%	0.56%	%	1.92%	%	0.09%	%
Quantum Science &	99.23	0.00	0.00		0.00					0.00	0.00		0.01		0.01		0.00
Technology	%	%	%	0.49%	%	0.00%	0.03%	0.17%	0.00%	%	%	0.03%	%	0.03%	%	0.00%	%
	99.63	0.00			0.00					0.00	0.00		0.01	0.00	0.00		0.00
Logic	%	%	0.02%	0.20%	%	0.03%	0.00%	0.07%	0.00%	%	%	0.01%	%	%	%	0.03%	%

Notes: Share of publications unrelated to any of the SDG (SDGO) and share of publications related to each SDG, by discipline, ordered by the median share across all SDGs. Top 20 row: disciplines with the highest median share of SDG-related publications; bottom 20 rows: disciplines with the lowest median share of SDG-related publications. Figures based on WoS data (CWTS version).

#### 2.2.3 Country clusters

Clusters	SDG index	Publications (pc)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	80.18	3.61	62.11%	0.05%	0.77%	20.34%	0.71%	0.75%	1.19%	2.47%	0.78%	0.90%	0.44%	1.16%	0.87%	2.79%	1.25%	2.92%	0.51%
2	78.61	1.80	68.12%	0.07%	0.57%	17.63%	0.67%	0.55%	1.15%	2.36%	0.88%	0.88%	0.38%	1.15%	0.82%	1.80%	0.64%	1.95%	0.37%
3	69.88	0.29	70.54%	0.08%	0.79%	14.16%	0.48%	0.38%	1.81%	2.97%	0.75%	0.79%	0.20%	1.04%	0.88%	1.77%	0.75%	2.39%	0.23%
4	58.67	0.06	38.46%	0.28%	3.40%	32.65%	0.43%	3.25%	2.26%	1.70%	0.57%	0.54%	0.30%	1.47%	0.75%	4.80%	1.03%	7.32%	0.80%

#### Table A.2.5: Country clusters by SDG publication shares and publication output per capita (2015-19)

Notes: Average values of the country clusters in Figure 4.6 of Chapter 4. SDG index: average value of the SDG index 2021; Publications (pc): average number of publications per capita; 0: average share of publications not related to any SDG; 1-16: average share of publications related to each of the 16 SDGs. Yellow: average SDG index, number of publications per capita, share of publications related to all SDGs, and share of publications related to each SDG Dark red: lowest SDG index, number of publications related to each SDG. Dark green: highest SDG index, number of publications per capita, share of publications related to each SDG. Dark green: highest SDG index, number of publications per capita, share of publications related to each SDG.

		inc-		Publicati																	
Clust er	Country	ome group	SDG index	ons(per capita)	0(%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	8 (%)	9 (%)	10 (%)	11 (%)	12 (%)	13 (%)	14 (%)	15 (%)	16 (%)
1	Australia	HIC	75.58	4.12	58.21	0.0 9	0.93	22.3 0	0.9 4	1.01	1.44	2.01	0.71	0.71	0.45	1.34	0.76	3.16	1.60	3.69	0.65
						0.0		21.9	0.4												
1	Canada	HIC	79.16	2.72	62.92	8 0.0	0.75	1 24.5	6 0.4	1.04	1.30	1.78	0.45	0.50	0.37	1.09	0.53	2.43	0.94	2.80	0.65
1	Denmark	HIC	84.86	4.81	58.23	5	1.00	8	2	0.34	1.22	4.09	0.68	1.07	0.47	0.96	1.05	2.22	1.10	2.21	0.33
1	Finland	HIC	85.90	3.10	64.97	0.0 5	0.69	16.18	0.91	0.54	1.20	2.75	0.78	1.43	0.47	1.28	1.02	3.25	0.72	3.42	0.34
1	lceland	HIC	78.17	3.74	58.67	0.0 2	0.45	18.0 3	1.02	0.96	0.95	2.29	1.78	0.88	0.63	1.13	1.30	3.50	3.30	4.64	0.46
	Netherlan					0.0		26.0	0.6						0.4						
1	ds New	HIC	81.56	3.42	58.38	5	0.94	0 18 7	7	0.78	1.20	1.98	0.64	1.00	4	1.37	0.79 n g	2.50	0.68	1.92	0.66
1	Zealand	HIC	79.13	2.92	60.32	0.07	1.28	6 20.3	1.01	1.03	1.16	1.39	0.82	0.70	0.41	1.25	0.0	3.25	0	5.02	0.63
1	Norway	HIC	81.98	3.89	58.84	5	0.65	5	1.07	0.84	0.93	2.73	0.83	1.10	0.59	1.15	0.93	3.87	2.20	3.12	0.74
1	Singapore	HIC	69.89	3.47	74.20	0.0 4	0.31	14.1 4	0.3 7	0.3 0	1.59	3.55	0.46	0.60	0.16	1.10	0.65	1.11	0.4 2	0.78	0.2 4
						0.0							0.8						0.6		
1	Sweden Switzerlan	HIC	85.61	3.65	61.63	6 0 0	0.66	21.17	0.71	0.86	1.11	2.69	0	1.15	0.59	1.25	1.12	2.72	0	2.32	0.55 0.4
1	d	HIC	80.10	3.87	66.89	3	0.77	1	0.19	0.52	0.97	1.96	0	0.74	0.25	0.81	0.51	2.62	4	2.18	0
0			00.00	1.01	71.15	0.0	0.50	16.0	0.2	0.7/	0.00	0.00	0.70	0.05	0.07	0.00	0.00	0.7/	0.2	0.00	0.10
2	Austria	HIC	82.08	1.81	/1.15	2	0.58	/	6	0.34	0.86	2.22	0.78	0.85	0.23	0.96	0.89	2.34	4	2.02	0.18
2	Belgium	HIC	82.19	2.11	67.66	0.07	0.84	19.16	0	0.68	1.05	1.87	0.57	0.63	0.39	1.02	0.69	1.73	0.57	1.98	0.47
0	Out at it.		00.70	1.00	00.00	0.0	0.50	16.4	0.6	0.45	1 00	2.4	0 17	1 77	0.70	1 0 0	1 ( 0	1.05	1.00	0.17	0.70
Z	Croatia	HIC	80.38	1.26	66.90	Ь	0.58	3 14.2	b 2.3	0.45	1.09	U	2.17	1.37	0.39	2.0	1.48	1.25	1.00	2.13	0.38
2	Cyprus	HIC	74.87	1.90	66.54	0.07	0.48	6	2	0.58	1.57	4.32	1.23	1.13	0.31	0	1.15	1.95	0.55	1.25	0.30
0	0		01 70	1.00	77.0/	0.0	0.70	10.4	0.4	0.00	1.07	1 50	0.07	1 / 5	0.70	1 / 1	0.07	1 70	0.10	0.01	0.2
Ζ	Czechia	HIC	81.39	1.02	75.94	5	0.70	5 10.6	9	0.26	1.04	1.50	2.24	1.45	0.39	1.41	0.95	1.70	0.19	2.91 4.4	4
2	Estonia	HIC	81.58	1.65	67.07	0.01	0.72	5	1.41	0.55	1.56	2.90	1.01	1.01	0.59	1.28	0.71	3.91	1.91	4	0.26
0	France		01 67	1 07	70 71	0.0	0.50	17.5	0.17	0.07	0.00	1 5 0	0.4	0.51	0.10	0.00	0 47	1.00	0.7/	1.07	0.1/
2	riance	пь	01.0/	1.23	12.31	4	0.59	0	0.15	0.27	0.80	1.50	Ζ	0.51	0.18	0.00	0.47	1.00	0.74	1.95	0.14

Table A.2.6: Country clusters by SDG publication shares (%) and publication output per capita (2015-19): countries WB

						0.0		16 /	03												
2	Germany	HIC	82.48	1.45	72.40	4	0.54	5	2	0.38	0.83	1.83	0.57	0.58	0.35	0.65	0.57	1.98	0.51	1.77	0.25
0	Graage	ше	75 / 1	1 / 7	66.23	0.0	0 56	18.5	0.4 6	0 19	16/	3 17	0.05	0 77	0.15	1 77	1 01	1.05	0.8	1 70	0 12
Z	Greece	пс	75.41	1.45	00.23	0.0	0.00	22.6	0	0.10	1.04	3.17	0.95	0.77	0.15	1.77	1.01	1.95	U	1.70	0.12
2	Ireland	HIC	80.96	2.43	62.56	6	0.79	7	1.26	0.86	1.06	2.84	0.63	0.79	0.49	0.89	0.82	1.45	0.68	1.55	0.60
2	Israel	HIC	75.04	2.01	69.16	0.0 6	0.41	20.8	0.8 8	1.04	0.85	0.94	0.35	0.26	U.4 4	0.89	0.33	1.08	0.46	1.36	0.67
						0.0		21.4					0.6								
2	Italy Korea	HIC	78.76	1.67	66.03	6	0.68	7	0.18	0.25	0.96	2.61	0	0.82	0.23	1.00	0.91	1.68	0.65	1.71	0.15
	(Republic					0.0		19.6									0.4				
2	of)	HIC	78.59	1.52	72.13	2	0.26	8 23 Q	0.14	0.17	1.22	2.55	0.33	0.54	0.16	0.64	4	0.83	0.29	0.48	0.11
2	Lebanon	UMIC	66.84	1.97	62.96	0.15	0.62	6	2	0.78	1.71	3.52	0.35	0.71	0.23	1.34	0.77	1.11	0.23	0.83	0.39
0	Luxembou	ше	7/. 01	1 70	77 70	0.4 5	0.27	11.0	0.7	0.6	1.06	1 07	1 10	1 5 0	1 10	1.00	0.00	1 70	0.16	1 07	0 70
Z	iy	пс	74.21	1.70	13.72	0.0	0.23	9 15.6	2	0.4	1.00	1.07	1.10	1.50	0.2	1.90	0.90	1.70	0.10	1.27	0.59
2	Portugal	HIC	78.64	2.02	66.58	3	0.50	2	0.61	2	1.58	3.36	0.95	1.21	4	1.11	1.18	2.17	1.33	2.89	0.23
2	Slovenia	HIC	81.60	1.89	72.69	0.0 2	0.41	14.0 2	0.4 5	0.25	0.91	1.96	1.11	1.10	0.22	1.20	0.99	1.45	0.36	2.29	0.57
						0.0		18.2													
2	Spain	HIC	79.46	1.73	66.01	6	0.73	9	0.71	0.50	1.56	2.54	0.86	1.07	0.33	0.95	0.94	1.89	0.78	2.49	0.28
	Taiwan (Province					0.0		20.3	0.3												
2	of China)	HIC		1.56	71.11	2	0.25	1	5	0.17	1.06	1.85	0.58	0.83	0.10	0.89	0.59	0.85	0.34	0.63	0.07
	United			0.47	0/ 57	0.0		20.7	0.7	0.07	0.54	1.00	0.00	0.07	0 50		0.07	0.44		4 55	0.07
2	Kingdom United	HIC	/9.9/	2.43	64.53	y	0.66	5	8	0.97	0.74	1.88	0.86	0.87	0.59	1.14	0.67	2.14	0.68	1.//	0.87
	States of							24.7	0.7					0.4							
2	America	HIC	76.01	2.16	61.83	0.10	0.58	8	2	1.44	0.82	1.43	0.41	0	0.50	0.98	0.37	1.91	0.75	2.21	0.78
3	Albania	UMIC	71.02	0.10	63.56	4	0.54	18.51	3	0.29	1.29	1.65	1.24	1.15	0.45	2.63	0.95	2.0 0	0.93	3.06	0.78
						0.0			0.0				0.0								0.0
3	Algeria	LMIC	70.86	0.08	81.06	0	0.36	4.49	6	0.01	3.53	6.73	8	0.15	0.01	0.48	0.37	0.94	0.38	1.33	2
3	Argentina	UMIC	72.80	0.26	67.56	4	1.03	7	0.14	4	1.04	1.05	0.27	0.18	0.22	0.53	0.28	2.67	1.80	6.18	0.10
3	Armonia		71 70	0.10	86.42	0.01	0.11	77/.	0 13	0.0	0.34	1 / 0	0.23	0.0	0.03	0.71	1 17	0.73	0.12	0.69	0.0
J	AIIIIEIIId	UNIC	/1./3	0.10	00.42	0.01	0.11	7.74	0.15	0.0	0.54	1.40	0.23	3	0.05	0.71	0.4	0.75	0.12	0.00	
3	Azerbaijan	UMIC	72.41	0.03	87.68	4	0.19	4.28	0.12	9	0.82	2.28	1.08	0.96	0.12	0.22	4	0.75	0.10	0.54	0.31

						0.0		23.5							0.2						
3	Bahrain Bangladas	HIC	66.06	0.19	61.93	0	0.18	0	1.08	0.26	2.36	3.71	0.76	1.37	4	1.14	1.17	1.47	0.23	0.39	0.22
3	h	LMIC	63.45	0.02	68.78	0.18	1.91	3	0.13	0.65	1.88	3.64	0.32	0.52	0.13	1.61	0.73	2.63	0.89	1.86	0.30
3	Belarus	UMIC	78.82	0.04	88.63	0.0 0	0.23	6.70	0.0 8	0.0 0	0.8 0	0.69	0.14	0.21	0.05	0.38	0.13	0.65	0.19	1.08	0.0 4
	Bosnia and Herzegovi					0.0		17.8	0.5												
3	na	UMIC	73.70	0.21	66.86	2	0.57	4 20 5	3	0.49	0.76	3.20	1.42	1.68	0.06	1.38	1.00	1.41	0.10	1.93 4 0	0.75
3	Brazil	UMIC	71.34	0.36	64.36	4	1.54	3	0.19	0.34	1.51	2.11	0.2	4	0.12	0.61	0.75	2.07	1.04	2	0.16
	Brunei Darussala					0.0	0.4		0.8						0.2						
3	m	HIC	68.27	0.56	66.52	5	4	8.19 14 0	6 0.3	0.50 0.0	4.79	6.38	0.41	0.72	4	1.11	0.58	3.21	1.46 0.4	3.87	0.68
3	Bulgaria	UMIC	73.81	0.35	75.11	0	0.35	6	4	8	1.06	1.97	0.45	0.58	0.06	1.05	0.43	1.32	2	2.66	4
3	Chile	HIC	77.13	0.52	66.21	0.0 9	0.77	14.7 5	0.91	0.52	1.49	2.29	0.77	0.67	0.70	1.24	0.69	2.79	1.74	4.09	0.29
3	China	UMIC	72.06	0.34	74.51	0.0 2	0.4 2	14.8 9	0.12	0.0 9	1.68	2.80	0.41	0.52	0.06	0.96	0.63	1.47	0.2 4	1.13	0.0 4
7	Colombia		70 56	0.17		0.0	0.00	15.9	0.4	0 45	1 00	7 50	0.64	0.02	0 77	1 00	0.01	2.26	1.02	6.01	0 50
5	COIOIIDIa	UNIC	70.50	0.15	00.24	0	0.09	Z	7 0.5	0.45	1.00	0.02	0.04	0.92	0.55	1.00	0.91	2.20	1.02	11.2	0.50
3	Costa Rica	UMIC	73.55	0.16	57.55	0.11 0.0	1.78	11.14 20.5	7	0.29	1.95	2.27	0.38	0.53 0.2	0.36	0.64 0.4	0.98	5.92	4.14	6	0.15
3	Cuba	UMIC	73.65	0.07	64.63	2	1.25	2	0.10	0.17	1.82	2.01	0.31	4	4	4	1.03	1.67	1.76	3.93	0.06
3	Ecuador	UMIC	72.54	0.11	64.18	0.17	1.54	0	1.26	0.43	1.74	3.61	1.06	1.00	0.41	1.22	1.19	3.36	1.41	6.24	0.19
3	Egypt	LMIC	68.65	0.14	70.08	0.0 2	0.49	20.2 1	0.10	0.19	2.51	3.51	0.12	0.18	0.06	0.58	0.46	0.64	0.28	0.54	0.05
3	Fiii		71 24	0 30	56 44	0.29	0 91	9.81	0.8 2	0.8 0	1 69	4 10	2 25	1 89	0.21	2 56	145	6.07	4 05	6 53	0.13
-	·		71.27	0.00	50.11	0.0	0.01	13.7	0.2	0	1.00	1.10	2.20	1.00	0.21	2.00		0.07	1.00	2.4	0.10
3	Georgia	UMIC	72.23	0.10	74.86	0 0.0	0.16	8 17.5	5 0.2	0.58 0.2	2.39	0.48	0.96	0.76	0.14	0.35	0.34	2.11	0.21	0	0.21
3	Hungary	HIC	78.78	0.79	71.32	3	0.51	6 10.8	6	4	1.03	1.61	0.59	0.62	0.26	0.98	0.57 0.4	1.33	0.18	2.75	0.17
3	India	LMIC	60.07	0.06	79.32	4	0.76	3	8	0.13	1.63	3.20	0.12	0.22	0.05	0	2	1.20	0.36	0.97	0.06
3	Indonesia	UMIC	66.34	0.05	69.91	0.12	0.92	8.66	1.66	0.43	2.14	3.43	1.04	1.47	0.2 4	1.84	1.54	2.68	1.13	2.54	0.25

						0.0		17 /	0.0						0 0						
3	Iran	UMIC	70.01	0.48	76.20	3	0.54	7	5	0.14	2.96	3.20	0.13	0.23	4	0.66	0.50	0.85	0.17	0.78	0.05
3	Iraq	UMIC	63.82	0.04	77.97	0.01	0.28	9.48	0.12	0.13	3.90	4.17	0.19	0.25	0.05	1.11	0.73	0.73	0.12	0.53	0.23
z	lanan	но	70.85	0.87	72 1/	0.0	0.20	21.2 5	0.0	0 10	0 56	1 / 7	0.20	0.26	0.0 8	0 47	0 33	1.07	0 51	1.05	0.05
0	Uapan	nic	73.05	0.07	72.14	5	0.23	18.8	0.3	0.10	0.00	1.47	0.23	0.20	0	0.47	0.00	1.04	0.51	1.05	0.00
3	Jordan	UMIC	70.14	0.22	68.60	0.01	0.72	2	3	4	1.97	3.23	0.36	0.48	0.06	1.53	0.84	1.09	0.15	1.05	0.32
3	Kazakhsta n	UMIC	71.64	0.05	80.77	0.0 5	0.34	7.86	U./ 0	0.26	1.28	2.09	0.84	1,18	0.21	1.06	0.68	1.20	0.07	1.14	0.27
Ū		01110	,	0.00		0.0		19.5	, and a second s	0.20		2.00					0.00				0.27
3	Kuwait	HIC	62.54	0.27	67.99	0	0.41	6	0.41	0.21	2.07	2.89	0.53	0.66	0.07	1.53	0.89	0.79	0.79	1.02	0.19
3	Latvia	HIC	79.15	0.97	66.82	0.0 3	1.27	8.11	1.62	0.37	1.05	6.03	1.86	2.23	0.68	1.42	2.58	2.93	0.5	2.51	0.18
_						0.0		14.7	0.0						0.2						
3	Libya	UMIC		0.04	68.97	0	0.61	6	9	0.12	2.99	6.54	0.21	0.68	0	0.91	0.68	1.17	0.48	1.58	0.01
3	Lithuania	HIC	76.70	1.11	69.98	5	1.18	11.16	6	0.35	0.93	2.46	1.83	4	0.46	1.41	1.75	2.50	0.46	2.48	0.29
7	Malausia		70.00	0.55	77 / 5	0.0	0.50	0.00	0.5	0.07	0.00	7 70	0.01	1 70	0.15	1/5	1 50	1 5 7	0.4	1 10	0.10
3	Malaysia	UMIC	70.88	0.55	/3.45	5	0.50	9.89	y	0.27	2.66	3.78	0.91	1.39	0.15	1.45	1.59	1.53	Z	1.18	0.18
3	Malta	HIC	75.75	0.97	66.97	1.43	0.19	8	1.59	1.76	0.27	2.99	0.83	0.79	0.39	1.62	0.79	0.98	1.73	2.53	0.16
z	Mouritiuo	ше	66 71	0.22	E0 70	0.0	0.4	0 / 2	2.2	0.2	1 71	7 / 0	Z 07	1.00	0 70	1 10	1. 01.	1 05	0.06	E 10	0.05
5	riduittius	пс	00.71	0.22	50.70	0.0	4	9.42 15.1	0.2	4	1.01	7.49	3.07	1.99	0.30	1.10	4.04	1.00	0.90	0.12	0.05
3	Mexico	UMIC	69.13	0.16	68.06	9	0.95	2	5	0.35	1.92	2.33	0.36	0.37	0.16	0.82	0.78	2.30	1.60	4.32	0.23
3	Moldova		73 68	0.05	83.83	0.0	0 33	7 77	0.2	0 33	1.26	154	98.0	0 93	0 10	0 54	0 38	90 0	0.0 8	0 73	0 16
0	Montenegr	LINC	70.00	0.05	00.00	0.0	0.00	1.11	0.3	0.00	1.20	1.04	0.00	0.00	0.10	0.54	0.00	0.00	0	0.70	0.10
3	0	UMIC	68.21	0.37	78.35	0	1.31	8.10	5	0.17	0.73	1.05	0.95	0.73	0.03	1.31	0.93	1.25	1.24	3.13	0.36
3	Morocco	I MIC	70.53	0.08	76.42	0.01	0.45	8.34	0.3	0.07	2.60	6.83	0.21	0.47	0.03	0.79	0.61	0.94	0.45	1.46	0.03
Ū		21.110	,	0.00		0.2		25.6	0.4		2.00	0.00	0.2.		0.00			2.0	0.3		0.00
3	Nigeria	LMIC	48.93	0.03	53.97	2	1.68	3	3	1.72	2.46	2.90	1.07	1.10	0.28	2.18	1.22	4	0	2.10	0.70
3	Oman	HIC	70.13	0.19	69.73	0.0	0.76	9	0.7 3	0.34	3.34	4.05	0.74	0.98	0.17	1.63	1.02	1.43	0.8 0	1.44	0.03
								14.8													
3	Pakistan Palastina	LMIC	57.72	0.07	72.03	0.10	1.43	1	0.18	0.33	1.94	3.07	0.54	0.61	0.11	0.74	0.79	1.33	0.17	1.66	0.16
3	State of	LMIC		0.08	62.55	0.0	0.52	0	6	0.54	3.75	5.56	0.5	0.83	0.22	1.86	1.08	0.61	0.14	0.91	0.57
_	_		-					23.2	0.3												
3	Peru	UMIC	71.09	0.06	54.87	0.21	2.08	8	8	1.42	1.18	1.74	0.81	0.93	0.51	0.84	0.96	3.63	1.44	5.23	0.48

	Philippine								0.9									4.4			
3	S	LMIC	64.51	0.02	63.21	0.26	2.62	11.17	3	0.51	2.27	3.19	0.87	0.83	0.47	1.57	1.15	4	2.14	4.03	0.32
7	Delered		00.00	1.07	70 / /	0.0	0.70	14.9	0 11	0.10	1.07	1.07	0.9	0.70	0.1/	1 00	1.00	1 5 7	0.77	0.17	0.07
3	Poland	HIC	80.22	1.05	/2.44	ა იი	0.70	2	0.11	0.18	1.63	1.94	U	0.79	0.14	1.09	1.06	1.55	0.33	2.15	0.07
3	Natar	HIC	66 73	0.75	69 16	6	0.22	15 91	0.2 5	0.29	3 26	5.83	በ 45	0.64	0.13	1 26	0 55	0.93	0.28	0 59	N 19
0	Republic	nio	00.70	0.75	00.10	U	0.22	10.01	J	0.20	0.20	0.00	0.40	0.04	0.10	1.20	0.00	0.00	0.20	0.00	0.10
	of North								0.6												
3	Macedonia	UMIC	72.53	0.25	71.10	0.07	0.22	13.31	2	0.51	1.14	1.75	2.80	1.94	0.64	1.97	1.14	0.98	0.15	1.00	0.68
						0.0			0.8	0.3											
3	Romania	HIC	74.97	0.73	71.29	6	0.61	12.71	6	0	1.78	2.70	1.75	1.88	0.28	1.66	1.25	1.29	0.15	1.13	0.28
7	Russian		77 75	0.10	00.07	0.01	0.00	E 02	0.2	0.0	0 / 7	1.00	0 / 7	0 4 0	0.0	0 / 0	0.00	1.70	0.61	1 / 1	0.07
3	Saudi	UMIC	/3./5	0.16	00.0/	0.01	0.22	5.9Z	4	9	0.47	1.00	0.43	0.49	9	0.40	0.22	1.30	0.01	1.41	0.07
3	Arabia	HIC	66.30	0.36	73.47	0.01	0.28	6	0.18	0.18	2.52	3.45	0.2	0.34	0.03	0.55	0.41	0.99	0.61	0.91	0.10
-						0.0		18.3	0.3												0.2
3	Serbia	UMIC	75.59	0.97	68.86	2	0.72	7	9	0.26	1.39	2.19	0.76	0.72	0.14	1.60	1.11	1.41	0.19	1.67	0
						0.0			0.5	0.3	0.8				0.4				0.0		
3	Slovakia	HIC	79.57	1.04	73.19	6	0.56	9.95	0	0	0	1.96	3.21	2.55	0	1.62	1.06	1.53	8	2.03	0.17
7	South		63 7/	0.70	57.60	0.21	1 77	18.0	1 75	0 17	2 1/	27/	0 00	0.00	0 37	1 10	0 07	2 65	1 17	F 22	0.7/
5	Anica	UNIC	03.74	0.50	57.00	0.21	1.77	9 20 4	0.5	2.10	2.14	2.74	0.09	0.09	0.37	1.12	0.97	2.00	1.15	0.22	0.74
3	Sri Lanka	LMIC	68.10	0.07	59.93	0.14	1.44	5	3	0.62	2.63	3.23	0.35	0.85	4	1.39	1.08	2.85	0.74	3.07	4
						0.0		28.3	0.2					0.0							
3	Sudan	LIC	49.48	0.01	58.82	3	0.86	0	4	0.99	1.96	2.57	0.29	9	0.07	0.46	0.67	1.97	0.22	2.18	0.28
	Syrian																				
7	Arab		F0 01	0.01	71.17	0.0	1 10	19.8	0.0	0.00	1 01	0.05	0.3	0.2	0.0	0.00	0.4	0.05	0 77	0.07	0.01
3	керирііс	LIC	58.01	0.01	/1.14	U	1.18	4	/	0.28	1.91	2.05	U	U	U	0.26	U	0.85	0.37	0.93	0.21
3	Thailand	UMIC	74 19	0.20	66.04	0.01	0 71	20.1	0.31	0.32	1 68	4.0 N	0.54	0.69	0.06	0.82	144	1 50	2	1 2 3	9.0
U	manaria	01110	7 1110	0.20	00101	0.0	0171	_	0.0	0.0		U	0.01	0.00	0.0	0.02			_		Ŭ
3	Tunisia	LMIC	71.44	0.38	78.17	5	0.48	9.38	9	8	2.72	3.46	0.52	0.58	9	0.50	0.69	1.02	0.76	1.36	0.05
						0.0		19.5	0.5												
3	Turkey	UMIC	70.38	0.56	69.55	3	0.51	9	7	0.31	1.50	2.26	0.67	0.57	0.12	0.82	0.88	0.98	0.34	1.09	0.23
7	1.11		75 51	0.0/	00.55	0.01	0.10	1 71	0.10	0.0	0.07	1 11	0.71	0.07	0.00	0.07	0.10	0.50	0.00	0.77	0.0
3	Ukraine	LMIC	/5.51	0.04	90.55	0.01	0.16	4.71	0.12	8	0.64	1.11	0.31	0.27	0.06	0.27	0.18	0.50	0.22	0.77	4
	Δrah					0 0	0.2	10.2	0.6												
3	Emirates	HIC	70.17	0.33	72.55	4	0	9	8	0.31	2.29	5.93	0.84	1.22	0.19	1.07	1.11	1.51	0.57	0.93	0.27
-		-	-			0.2		17.0	0.4												
3	Uruguay	HIC	74.55	0.39	62.08	0	2.60	2	0	0.71	0.82	2.11	1.02	0.59	0.74	0.62	0.76	2.38	1.94	5.67	0.33

	Uzbekista					0.0				0.0					0.0				0.0		
3	n	LMIC	69.84	0.00	85.54	2	0.58	7.36	0.15	4	1.40	0.78	0.14	0.23	9	0.18	0.21	1.86	6	1.33	0.03
						0.0		20.0	0.3				0.4				0.2				
3	Venezuela	UMIC	59.32	0.03	64.51	5	1.45	6	6	0.11	0.83	0.96	2	0.31	0.12	0.67	4	2.20	2.23	5.31	0.18
								10.5													
3	Viet Nam	LMIC	72.85	0.04	76.13	0.13	0.68	7	0.21	0.33	2.12	2.19	0.63	0.57	0.17	0.89	0.79	1.91	0.74	1.80	0.14
7	Mana an		F0.00	0.01	77 / 5	0.0	0 / 0	10 71	0.0	0.10	2.0	1.07	0.0	0 / 7	0.00	0.77	0.00	0.07	0.7/	0 ( 0	0.05
3	remen	LIC	52.80	0.01	/3.45	U	0.46	19.31	6	0.16	U	1.83	U	0.47	0.06	0.33	0.06	0.93	0.34	0.48	0.05
4	Benin		49.87	0.04	49 16	0.25	442	Z1.0 Z	0.0	0.88	2 17	1 39	0 38	0 33	0.28	0 97	0.75	5 71	0.83	q	0.27
т	Denin	LINC	40.07	0.04	40.10	0.20	7.72	19.6	02	0.00	2.17	2.0	0.00	0.00	0.20	0.57	0.75	5.71	0.00	13.4	0.27
4	Bolivia	LMIC	67.60	0.02	46.06	0.14	2.75	7	8	0.67	2.71	0	0.64	0.69	0.19	1.30	0.95	7.07	1.31	5	0.13
						0.0		23.9													
4	Botswana	UMIC	61.92	0.22	47.31	8	1.33	6	1.09	4.34	2.71	2.13	0.62	0.45	0.11	1.45	1.28	4.56	0.38	7.70	0.51
	Burkina							40.7	0.0												
4	Faso	LIC	53.51	0.03	27.82	0.27	5.55	9	0	2.72	2.58	2.73	0.56	0.57	0.29	1.52	0.87	6.13	0.15	6.77	0.69
,			o /  E /	0.07	0 / 07	0.01	E 07	41.2	0.7	7.07	0.07	4	0.57	0.50	0.40	0.00		/	1.00		4 174
4	Cambodia	LMIC	64.54	0.03	24.83	0.21	5.03	<u>ა</u>	8	3.04	2.93	1.77	0.53	0.59	0.19	2.08	1.11	5.74	1.00	7.24	1.71
4	Comoroon		55.26	0.05	F0 37	0.20	1 5 7	28.0	U.U 5	1 / 1	1 01	1 70	0.73	0 56	0.4	0.03	0.97	3 /.7	U.Z	/ 60	0.36
7	Cameroon	LINC	55.20	0.05	52.57	0.20	1.57	46.7	0.0	1.41	1.01	1.72	0.75	0.50	4	0.35	0.00	5.47	7	4.00	0.00
4	Condo		49.30	0.01	30.11	0.07	2.38	9	0.0	5.52	1.97	0.34	0.34	0.34	0.05	1,19	0.29	2,92	0.07	6.10	1.52
·	Côte	2.0	10100	0.01			2.00	29.3	0.0	0.07				0.0.1			0.20	2.02		0.10	
4	d'Ivoire	LMIC	57.56	0.02	42.28	0.85	3.43	6	5	1.86	2.35	1.65	1.44	1.20	0.82	1.53	1.07	4.66	0.65	6.11	0.70
								39.1					0.3		0.2						
4	Ethiopia	LIC	54.52	0.04	31.63	0.36	6.68	2	0.18	3.20	3.03	1.71	0	0.37	0	1.30	0.77	4.32	0.16	5.84	0.84
								30.9	0.7												
4	Ghana	LMIC	62.49	0.08	36.43	0.73	3.66	7	3	3.21	2.34	2.51	1.63	1.72	0.72	3.45	1.85	4.57	0.56	3.99	0.92
1.	lomoioo	LIMIC	60 07	0.17	<b>/ 1 7</b> C	0.0	1 5 7	35.6 z	1 20	<b>Z</b> 0/.	1 77	0.7/	1 76	0 / 7	0.61	1 ⊑ /.	0 5/	/. 17	1.06	2.07	1 07
4	Jamaica	UMIC	00.97	0.15	41.70	0 /	1.55	3/1 2	1.20	5.64	1.55	0.74	1.30	0.43	0.01	1.54	0.54	4.15	1.06	2.95	1.23
4	Kenva		60 60	0.07	32.81	0.4	5 15	6	0.61	4 75	2 52	1 4 8	0.31	0.51	0.33	126	N 89	5 81	N 88	6 99	1 በ4
	Madagasc	LINO	00.00	0.07	02.01	0.2	0.10	26.7	0.2	1.70	2.02	1. 10	0.01	0.2	0.00	1.20	0.00	0.01	0.00	14.9	1.0 1
4	ar	LIC	49.01	0.01	42.14	2	3.15	6	7	0.82	1.20	1.33	0.15	4	0.13	0.51	0.53	5.60	1.81	8	0.15
								53.7	0.6										0.2		
4	Malawi	LIC	51.37	0.05	19.51	0.19	5.82	9	2	8.62	3.12	1.04	0.18	0.25	0.25	1.16	0.32	2.21	0	2.20	0.53
									0.2						0.2						0.4
4	Mongolia	LMIC	63.79	0.09	56.47	0.11	0.65	18.91	9	0.39	1.95	1.10	0.74	0.52	4	1.96	0.39	6.87	0.11	8.87	2
,	Mozambiq		F1 0F	0.00	07.46	0.07	7 10	41.4	0.4	5.70	0.07	1.01	0.70	0.8	0.77	1.10	0.40	5.07	0.10	0.00	1.00
4	ue	LIU	51.05	0.02	27.46	0.07	3.19	9	8	5.30	2.23	1.81	0.76	U	0.33	1.10	0.49	5.24	2.16	6.00	1.09

						0.0		27.8	0.2						0.0						
4	Myanmar	LMIC	64.95	0.01	53.50	9	1.72	5	6	1.65	0.93	1.20	0.11	0.11	4	0.88	0.36	3.10	1.37	6.62	0.21
									0.3												
4	Namibia	UMIC	61.77	0.11	51.34	0.11	0.89	17.18	7	1.22	3.54	2.13	0.52	0.79	0.11	1.66	0.55	4.11	3.26	12.11	0.11
								31.0													
4	Nepal	LMIC	66.52	0.05	38.33	0.41	3.67	9	0.11	2.34	2.72	2.73	0.28	0.31	0.21	2.73	0.75	7.15	0.15	6.27	0.75
	_					0.0		14.3	0.0	- / <del>-</del>				0.0	0.0			= 64		21.5	
4	Panama	HIC	67.98	0.13	46.93	6	1.21	5	4	0.45	1.35	0.64	0.10	9	4	0.27	0.10	7.81	4.99	0	0.07
,	Duranda			0.07	77 70	0.4	7.07	40.1	0.7	( 01	1.07	0 / 7	0 / 7	0.00	0.4	1 17	0.71	7 5 7	0.07	7 70	1.00
4	Rwanda	LIU	57.58	0.03	33.32	Z	3.93		U	4.61	1.67	2.47	0.47	0.98	Z	1.17	0.71	3.53	0.07	3.72	1.69
1.	Sanagal		E0 /.Z	0.04	60.07	0 77	7 01	29.0	0.17	2.0	167	1 0 0	0 55	0 70	0 5 7	0 00	0.20	<b>7</b> 01	1.07	7 5 7	0 50
4	Selleyal	LIIIC	50.45	0.04	49.20	0.55	5.21	7		4	1.05	1.02	0.55	0.32	0.55	0.00	0.20	5.91	1.94	5.55	0.59
4	Tanzania		56.43	0.03	30.72	0.28	4 08	00.7 Q	0.J 7	4 33	2.83	1 23	0.46	0 33	0.22	1 34	0.73	4 18	1 32	6 61	0 98
т	Trinidad	LING	50.45	0.00	00.72	0.20	4.00	5	,	4.00	2.00	1.20	0.40	0.00	0.22	1.04	0.70	4.10	1.02	0.01	0.00
	and							22.6													
4	Tobago	HIC	63.50	0.27	49.92	0.10	1.67	5	1.09	0.81	1.55	3.24	0.94	1.25	0.29	2.74	1.10	4.11	2.20	5.01	1.34
								50.6	0.5												
4	Uganda	LIC	53.46	0.05	23.23	0.23	3.17	5	5	7.04	1.77	1.47	0.48	0.34	0.26	1.35	1.07	3.11	0.15	3.31	1.81
	2					0.6		47.3	0.4												
4	Zambia	LMIC	53.39	0.04	21.86	4	4.71	0	7	7.30	1.79	1.88	0.33	0.41	0.56	1.48	0.76	4.01	0.49	5.44	0.57
						0.4		28.5	0.6										0.3		
4	Zimbabwe	LMIC	58.66	0.06	31.73	8	7.14	3	2	5.51	4.16	1.56	0.52	0.22	0.37	1.85	1.04	5.55	0	9.05	1.37

Notes: Country values of the country clusters in Figure 4.6 of Chapter 4. WB income group: World Bank country groups: high income (HIC), upper middle income (UMIC), lower middle income (LMIC), low income (LIC); SDG index: average value of the SDG index 2021; Publications (pc): average number of publications per capita; 0: average share of publications not related to any SDG; 1-16: average share of publications related to each of the SDG index, number of publications per capita, share of publications related to all SDGs, and share of publications related to each SDG index, number of publications per capita, share of publications related to all SDGs, and share of publications related to each SDG index, number of publications per capita, share of publications related to each sDG index, number of publications per capita, share of publications related to each SDG index, number of publications per capita, share of publications related to each sDG index, number of publications per capita, share of publications related to each SDG index, number of publications per capita, share of publications related to each SDG. Dark green: highest SDG index, number of publications per capita, share of publications related to each SDG.

#### 2.2.4 A typology of SDG research

#### Table A.2.7: Characterization of SDG-related publications

	(1) International	(2) Collaborations	(3)	(4)	(5)	(6) Patent	(7) Policy	(8)	(9)	(10)	(11) Multi-
SDG	collaborations	HIC-rest	Funded	Industry	Reputation	use	use	News use	Twitter use	Open access	disciplinarity
1	1.13	1.21	0.67	0.26	0.89	0.00	10.54	1.92	1.44	1.14	1.37
4	0.62	0.45	0.39	0.12	0.87	0.00	3.33	0.82	1.20	0.80	1.29
5	0.90	0.95	0.66	0.28	0.94	0.00	5.04	2.45	1.82	1.06	1.28
8	1.11	0.92	0.55	0.30	1.06	0.00	6.58	0.68	0.82	1.00	1.22
9	1.12	0.99	0.60	0.46	1.27	0.00	4.38	0.58	0.78	0.94	1.31
10	0.87	0.50	0.62	0.20	0.89	0.00	8.54	1.92	1.54	1.07	1.30
16	0.75	0.53	0.50	0.16	0.92	0.00	6.63	1.76	1.87	0.84	1.27
2	1.19	1.50	0.92	0.54	1.00	0.25	2.96	1.29	1.17	1.08	1.17
6	1.10	1.40	1.15	0.86	1.26	0.75	1.33	0.47	0.74	0.74	1.14
7	1.00	1.24	0.99	1.04	1.50	0.75	1.58	0.53	0.53	0.81	1.07
11	1.11	1.25	0.91	0.66	1.18	0.00	3.54	1.03	0.98	1.01	1.32
12	1.05	1.18	0.83	0.64	1.25	0.25	2.83	0.66	0.71	0.86	1.29
3	0.98	0.89	0.97	0.96	1.04	1.50	1.88	1.76	1.56	1.26	1.00
13	1.42	1.50	1.15	0.56	1.19	0.00	4.00	1.58	1.30	1.12	1.18
14	1.46	1.18	1.21	0.72	1.00	0.00	4.38	1.87	1.59	1.07	1.10
15	1.41	1.48	1.18	0.46	0.94	0.00	2.92	1.58	1.48	1.10	1.06
No SDG	0.99	1.01	1.01	1.06	0.96	1.00	0.50	0.74	0.82	0.92	0.98
all WoS	25.0%	11.7%	53.6%	5.0%	10.3%	0.4%	2.4%	3.8%	33.0%	43.3%	43.4%

Notes: Each coloured cell reports the ratio between the share of publications in each category in all of the WoS (the average, bottom row) and the share in each SDG (or no SDG). Numbers above one (green shade) indicate that share of publications with that characteristic in the SDG is higher than the WoS average (the number measures how many times higher); numbers below 1 indicate that the share of publications with that characteristic in the SDG is lower than the WoS average (the number measures the ratio). International collaborations (1): share of publications with an author from at least two countries.

Collaborations HIC-rest (2): share of publications with at least one author from a HIC and one author from any other income group.

Funded (3): share of publications that have reported funding from any source in the publication acknowledgement.

Industry (4): share of publications with at least one author from industry. Reputation (5): share of top 10% most cited publications in any WoS category. Patent use (6): share of publications cited in patents. Policy use (7): share of publications cited in policy reports. News use (8): share of publications mentioned in the news. Twitter use (9): share of publications mentioned in Twitter. Open access (10): share of publications in open access journals. Multidisciplinarity (11): Rao-Stirling diversity index based on WoS categories. Based on strict representation of SDG-related research. Figures based on WoS data (CWTS version).

#### 2.2.5 Which SDGs attract most research and how has this changed over time?



Figure A.2.1: Share of SDG-related publications for different income groups (2011-2019)

Notes: The graph shows the proportion of publications that relate to any of the SDGs (1-16). It is based on the total number of publications in countries in each of the four World Bank income groups (2021 definition): high-income countries (HIC); upper-middle-income countries (UMIC); lower-middle-income countries (LIC). Based on loose interpretation of SDG-related research. Figures based on WoS data (CWTS version).



#### Figure A.2.2: Share of publications by SDG, over total and group publications (2015-19)







*Notes: The graphs show the publications index for each SDG and World Bank income country group (2021 definition). The number of publications in 2001 is set to 100. Numbers for other years show the percentage growth in the index since 2001 (for example, 1000 would indicate ten times as many publications as in 2001). Based on the loose interpretation of SDG-related research. Figures based on WoS data (CWTS version).* 







Notes: Number of SDG-related publications in a given SDG in the countries in each World Bank income group (2021 definition). HIC: High-income economies; UMIC: Upper-middle-income economies; LMIC: Lower-middle-income economies; LIC: Low-income economies. Strict representation of SDG-related research. Figures based on WoS data (CWTS version).

#### 2.2.6 Countries' research capabilities and sustainable research

Figure A.2.2: Distribution of SDG-related publications by country (total and per capita) (2015-19)



0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 Publications per capita (1000 population)

*Notes: Total SDG-related publications (box size) and total SDG-related publication per 1000 population (colour density) per country. Strict representation of SDG-related research. Figures based on Web of Science data (CWTS version) and United Nations population data (most recent year available).* 





Notes: The hierarchal dendrogram represents the similarity between countries based on their share of publication by SDG, non-SDG-related publications and total SDG-related publications per capita. The length of the vertical branches measures the difference between different groups of countries. Strict representation of SDG-related research was used to undergo the analysis. Countries with less than 500 total SDG-related publications between 2015-19 were removed because of skewed shares. Figures based on WoS data (CWTS version).

#### 2.2.7 Which disciplines contribute to SDG-related research?

Figure A.2.7: Map of SDG-related publications' disciplinary focus: base map





Notes: Each circle represents one of the 254 subject categories in the WoS. Base map: each circle has an identical weight, to show the full extent of the base map of subject categories. Some labels are dropped to improve readability.

#### 2.2.8 Research synergies between SDGs

Figure A.2.8: Research synergies across SDGs



#### 🔥 VOSviewer

Notes: each node identifies one SDG (the size of the node is proportional to the number of publication). Each colour identifies one cluster of SDGS, related by the research communities that publish research on the SDG. The links connect SDGs that share a number of research communities: the thicker the link between two SDGs, the higher the number of publications attributed to the same research community on both SDGs. Loose representation of SDG-related research was used to undergo the analysis. Figures based on WoS data (CWTS version).



Figure A.2.9: Distribution of research communities by number of SDGs

*Notes: on the x-axis we plot the number of research areas; on the y-axis the number of SDGs attributed to each area. Strict representation of SDG-related research was used to undergo the analysis. Figures based on WoS data (CWTS version).* 

-		,						,										
Area		_	5 1	\$ 4	<u>م</u> -	9	2	ω	ഗ	10	11	12	13	14	15	16	I SDGs	(0
Res.	Label	SDG	SDG	SUG SUG	SDG	SDG	SDG	SDG	SDG	SDG	SDG	SDG	SDG	SDG	SDG	SDG	Tota	Pub;
30	Soil organic carbon; soil microbial community; soil enzyme activity; soil carbon stock: loess plateau	1											1		1		3	11148
310	Environmental Kuznets curve; financia environmental regulation; decompositi	l developn on analys	nent; ec is	onomic	growth;		1	1	1			1	1				5	9276
259	Biogas production; anaerobic digestion biochemical methane potential	n; biogas;	methan	e yield;		1	1					1					3	8447
825	Sustainability transition; solar home sy electrification	stem; fee	d; socia	accepta	ance; rura	l	1		1				1				3	6786
442	Adverse childhood experience; child se childhood adversity; foster care; child maltreatment	xual abus	e; 1		1											1	3	6770
416	Co-management; community forestry; decentralization; natural resource man	water gov agement	rernance	;		1							1		1		3	6628
423	Intimate partner violence; domestic vio rape; battered woman; IPV	olence;	1		1											1	3	6372
522	Coral; octocorallia; coral bleaching; Sc	eractinia;	Anthoz	ра									1	1	1		3	5768
733	Biomass; biofuel; switchgrass; life cycl	e assessr	nent; en	ergy			1					1	1				3	5731
1256	Life cycle assessment; LCA; green che cycle	mistry; en	vironme	ental ass	essment;	life	1		1			1	1				4	4400
1134	Water footprint; virtual water; water er market	nergy food	nexus;	food; wa	iter	1	1						1				3	4264
1125	Effect; sea level rise; mangrofe; China;	impact											1	1	1		3	4143
1662	Life cycle assessment; greenhouse gas emission; carbon footprint; food waste LCA	5 ;; 1					1					1	1		1		5	3904
1536	Acculturative stress; racial discriminat identity; microaggression; African Ame woman	ion; racial erican	1		1					1							3	3237
1658	Pervious concrete; permeable paveme development; highway runoff	nt; stormv	vater; lo	w impac	t	1			1		1						3	3127
1845	Municipal solid waste management; fue	el; energy	recover	y; energ	/ plant; wa	aste	1				1	1					3	2818

#### Figure A.2.10: Most synergetic research areas, ordered by number of publications (strict representation)
2072	Ecological footprint; degrowth; human appropriation; sustainability indicator; net primary production 1 1 1 1 1	4	2177
1917	Child labour; sex ratio; birth order;  1  1    microfinance; sex selection  1  1	3	2099
2513	Industrial symbiosis; circular economy; industrial ecology; eco industrial park; steel 1 1 1 1 1	4	1997
2280	Human trafficking; prostitution; sex work; female  1  1  1    sex worker; commercial sexual exploitation  1  1  1	3	1795
2738	Food insecurity; social determinants; material hardship; food bank; medical legal partnership 1 1 1 1 1	4	1745
2263	Posidonia Oceanica; Zostera marina; eelgrass; thalassia testudinum; seagrass meadow 1 1 1 1	3	1670
2712	Indoor air pollution; biomass fuel; exposure; child; cookstofe 1 1 1	3	1414
3049	Life cycle assessment; energy return; EROI; energy payback time; indium 1 1 1	3	1022
2765	Beaver; castor fibre; castor canadensis; tamarix spp; Tarim river 1 1 1	3	994
3035	Cacao; theobroma cacao l; cocoa; genetic diversity; agroforestry system 1 1 1	3	928
3162	Mekong delta; Poyang lake; resettlement; largest freshwater lake;  1  1    Cambodia  1  1	3	881
3296	Elder abuse; elder mistreatment; abuse; neglect;  1  1  1    elder self neglect  1  1  1  1	3	546
3614	Lake Baikal; Aral Sea; Uzbekistan; thermal bar; Mongolia1	3	260
3760	Homicide; suicide; neonaticide; filicide; maternalIIfilicide; denial11	3	154

Notes: each cell is coloured when a research community (first column) publishes research in relation to a given SDG. The second column reports the label that describes the community (the main topics across the community's publications) The last two columns indicate the total number of SDGs on which each community publishes and the total publications by community. The last row indicates the total number of communities that publish on a given SDG (for communities that publish in relation to at least 4 SDGs). Strict representation of SDG-related research was used to undergo the analysis. Figures based on WoS data (CWTS version).

#### Figure A.2.11: Most synergetic research areas, ordered by number of publications (loose representation)

Label Res. Area SDG10 SDG12 SDG13 SDG15 SDG14 SDG11 SDG16 SDG5 SDG6 SDG8 SDG9 SDGs SDG2 SDG3 SDG4 SDG7 Pubs SDG1 310 Environmental Kuznets curve; financial development; economic growth; 6 9276 1 1 1 environmental regulation; decomposition analysis Disaster risk reduction: 7335 696 6 1 1 vulnerability; flood; flood risk assessment; natural disaster 5 154 Microcystin; rotifera; cylindrospermopsin; 1 1 6957 1 cyanobacterial toxin; daphnia 6 825 Sustainability transition; solar home system; feed; social acceptance; rural 1 6786 electrification Co-management; community forestry; 7 6628 416 water governance; decentralization; natural resource management Ammonia; bacterial community; 5 6312 471 1 1 abundance; community structure; community composition Data envelopment analysis; DEA; efficiency; 1 535 5 6212 1 productivity; DEA model Biomass; biofuel; switchgrass; life cycle 733 5731 1 5 assessment; energy Income inequality; social capital; 494 5 5652 1 multilevel analysis; socioeconomic status; income 631 Groundwater vulnerability; hydrogeochemistry; 5 5345 chemical weathering; fluoride; nitrate contamination Theory; intention; planned behaviour; 5015 1096 1 1 1 1 6 physical activity; implementation intention Payment; ecosystem service; 8 4561 1521 1 1 1 environmental service; economic valuation; biodiversity offset Food sovereignty; Zimbabwe; land 1 884 1 5 4430 1 reform; South Africa; apartheid 1256 Life cycle assessment; LCA; green chemistry; environmental 6 440 1 1 assessment; life cycle 0

1134	Water footprint; virtual water; water energy food nexus; food; water market	1			1	1	1			1	1	1		1		8	4264
1110	Rural China; urbanization; evidence; 1 China; Guangzhou	1					1	1	1	1					1	7	4106
1005	Adoption; conservation agriculture; 1 Malawi; crop insurance; agricultural research	1						1			1	1		1		6	4034
1419	Climate change; climate variability; aquacrop model; adaptation strategy; uncertainty	1			1						1	1		1		5	3979
1212	Agent; land use change; cellular automata;	1					1			1		1		1		5	3932
739	Endogenous growth; public capital; 1 demographic transition; fertility; income convergence	1					1	1	1	Г						5	3930
1662	Life cycle assessment; greenhouse gas emission; carbon footprint; food waste; LCA	1				1	1	1			1	1	1	1		8	3904
1052	Discrete choice experiment; contingent valuation; willingness; conjoint analysis; consumer proference	1	1		1					1		1	1	1		7	3544
1319	Hypoxia; denitrification; Chesapeake Bay; nitrogen: Northern Gulf	1			1					1	1	1	1	1		7	2882
1473	Multidimensional poverty; Gini index; 1 poverty dynamic; deprivation; income mobility	1		1			1		1							5	2882
1827	Climate change; mortality; effect; 1		1			1				1		1				5	2846
1845	Municipal solid waste management; fuel; ene	rgy reco	overy; er	nergy plant; w	/aste	1		1		1	1	1				5	2818
1232	Circumcision; voluntary medical 1 male circumcision; child marriage; phimosis; orphan		1	1 1			_		1				_		1	6	2708
2220	Urban agriculture; community garden; bird; bird community: urban forest	1	1					1		1	1	1		1		7	2425
1975	Reuse; greywater; rainwater harvesting syste	em;	1		1					1	1	1				5	2295
2072	Ecological footprint; degrowth; human appropriation; sustainability indicator; net primary production	1			1	1	1	1	1	1	1	1	1	1		11	2177
2301	Sanitation; access; hygiene; 1 sustainability; water service	1	1		1					1						5	2140

1917	Child labour; sex ratio; birth order; 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	6	2099
1955	Emergy; emergy analysis; emergy  1  1  1  1    evaluation; heat recovery steam generator;  1  1  1  1    combined cycle power plant  1  1  1  1  1	5	2034
2513	Industrial symbiosis; circular economy; industrial ecology; eco industrial park; 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	7	1997
2815	Hydraulic fracturing; oil; shale gas; water; China 1 1 1 1	5	1993
2027	Retirement; older worker; pension 1 1 1 1 1 1 1 1 1 1	5	1930
2172	Methane; methane oxidation; methanotroph; bacterium; landfill leachate 1 1 1 1 1 1	5	1858
2624	Job insecurity; unemployment; job  1  1  1  1    loss; economic crisis; financial crisis  1  1  1  1	5	1691
2417	Bangladesh; biofloc; periphyton; biofloc  1 <td>7</td> <td>1620</td>	7	1620
2422	Informal settlement; participatory 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	6	1605
2188	Enterococci; faecal indicator bacterium; microbial  1  1  1  1  1    source tracking; faecal pollution; sediment  I  I  I  I  I  I	5	1491
2868	Higher education; university; sustainability education;  1  1  1  1  1    sustainable development; engineering	6	1464
2712	Indoor air pollution; biomass fuel; 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	8	1414
2641	Foreign aid; aid effectiveness; aid;  1  1  1  1  1  1    Millennium Development Goal; IMF  Image: Comparison of the second secon	5	1224

Notes: each cell is coloured when a research community (first column) publishes research in relation to a given SDG. The second column reports the label that describes the community (the main topics across the community's publications) The last two columns indicate the total number of SDGs on which each community publishes and the total publications by community. The last row indicates the total number of communities that publish on a given SDG (for communities that publish in relation to at least 4 SDGs). Loose representation of SDG-related research was used to undergo the analysis. Figures based on WoS data (CWTS version).

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# Appendix 3: A global map of technological inventions

This section of the Appendix relates to **Chapter 5** in the main report.

### 3.1 Patents selection procedure

To identify patents that are potentially related to one of the first 16 SDGs,<sup>16</sup> we use a rather conservative approach that prioritizes precision. In this way, we aim to focus on inventions that some stakeholders are likely to consider relevant for the SDGs, and exclude inventions that, while potentially relevant, may be controversial for many stakeholders. Our procedure is based on four steps.

To prevent double counting, all the analyses have been carried out for patent families, as patents in different patent authorities can be filed to protect the same invention.

### Step 1 - Identification of patents via citations and keywords

As we discuss in Appendix 2 and Chapter 12, retrieving scientific documents related to the SDGs using keywords that are related to the SDGs is highly controversial. It is even more problematic for patents, which use technical language to convince examiners of the novelty of their invention, and rarely mention other aims such as sustainability – except possibly for green technologies, which focus on a very specific set of SDGs. Therefore, we complemented a search strategy based on keywords with a strategy that identifies patents as related to SDGs if they cite at least one academic publication in a research area assigned to that SDG, following the method explained in Chapter 4 (see Appendix 2 for details).<sup>17</sup> This combined strategy allowed us to identify potentially relevant inventions even though no connection between the invention and an SDG was established when analysing the text of the patent document.

We use all patents filed between 2001-2017 in any of the following authorities, all of them included in PATSTAT: United States Patent and Trademark Office (USPTO), European Patent Office (EPO), China National Intellectual Property Administration (CNIPA), Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the African Regional Industrial Property Organization (ARIPO) and the World Intellectual Property Organization (WIPO).

The result of this first step is a set of 466,242 patent families. At least one member of each selected patent family either contain in their title and/or abstract one of the selected keywords, or cites a scientific publication which has been considered relevant for a given SDG.

<sup>&</sup>lt;sup>16</sup> We exclude SDG 17, following the same rationale adopted for publications.

<sup>&</sup>lt;sup>17</sup> In line with the aim to maximise precision, we use the restrictive interpretation to include research areas as related to a given SDG.

### Step 2 – Selection of relevant patent IPC sub-classes

Because patents may cite publications that are general (for example, methods or generalpurpose technologies), we exploit the similarity among patents that were assigned by examiners to a given International Patent Classification (IPC) category. We select only the subset of patents resulting from Step 1 that are in IPC categories that contain a given share (outlined below) of patents citing SGD-related publications.

Starting from the sample of patents extracted in Step1, we selected the patents assigned to IPC sub-classes that are among the top quartile (25%) by *number* of *patents citing* SDG-related publications, and among the top decile(10%) by *share* of *patents citing* SDG-related publications (over the total number of patents in the sub-class).<sup>18</sup> That is, we select only IPC sub-classes that have both a large number and a large share of patents that cite SDG-related publications and therefore may be relevant to the SDGs.

Next, considering that only a few patents cite publications, to include patents that were assigned to sub-classes that may be below the top quartile for number of patents, but which may have high relative rates of citations to SDG-related publications, we also selected patents assigned to IPC sub-classes that are in the top quartile (25%) by *number* of *citations* to SDG-related publications and in the top decile (10%) by *share* of *citations* to SDG-related publications (over total citations in the sub-class), or which had at least one patent retrieved by the SDG keywords used for publications.<sup>19</sup>

Finally, in consideration to patents that do not cite publications, we also include patents that were assigned to IPC sub-classes that are in the top quartile (25%) by *number* of *patents* retrieved by the SDG related keywords, and in the top quartile (25%) by *share* of *patents* retrieved by the SDG keywords (over the total number of patents in the sub-class).

We ended up with a sample of 396,976 patents. This is smaller than the group selected in Step 1 and contains only patents in the IPC sub-classes selected above.

### Step 3 – Selection of relevant patent IPC Main groups

To further restrict the selected patents that may be relevant to the SDGs, we ran the Step 2 procedure for the IPC main groups (a lower IPC hierarchical level of classification).

From the sample of patents in Step2, we first selected the patents that were assigned to IPC main groups that are in the top quartile (25%) by *number* of *patents citing* SDG-related publications, and in the top decile(10%) by *share* of *patents citing* SDG-related publications(over the total number of patents in the main group). That is, we selected only IPC main groups that have both a large number and a large share of patents that cite SDG-related publications and therefore may be relevant to the SDGs.

<sup>&</sup>lt;sup>18</sup> To exclude very large Sub-classes that have many different patents.

<sup>&</sup>lt;sup>19</sup> Note that the Sub-Class must still be in the top decile (10%) of the IPC Sub-classes by share of patents citing SDG-related publications (over total patents in the Sub-class).

Next, considering that only few patents cite publications, to include patents that were assigned to main groups that may be below the top quartile for number of patents, but which may have high relative rates of citations to SDG-related publications, we also selected the patents assigned to IPC main groups that are in the top quartile (top 25%) by *number of citations* to SDG-related publications and in the top decile (top 10%) by *share of citations* to SDG-related publications (over the total number of citations in the main group), or which had at least one patent retrieved by the SDG keywords used for publications.<sup>20</sup>

Finally, in consideration to patent that do not cite publications, we also included patents assigned to IPC main groups that are in the top quartile (25%) by *number* of *patents* retrieved by the SDG keywords, and in the top quartile (25%) by *share* of *patents* retrieved by the SDG keywords (over the total number of patents in the main group).

To capture potentially relevant patents in large sub-classes, which may have a relatively low share of patents citing publications but clustered in certain main groups, we also selected patents in main groups with a *number* of *citing applications* above the top decile (10%) and a *share* of *citing applications* in the top percentile (1%) and that were selected in Step 2.

### Step 4 – final sample

We pull together all patents selected in Steps 2 and 3. This forms our final sample of patents related to the SDGs.

### Definition of criteria for the selection of sub-classes and main groups

The procedure and threshold for the inclusion of IPC sub-classes and main groups used above was defined by manually checking the relevance of patents in IPC classes, sub-classes, and main groups in relation to different thresholds of the number and share of patents citing SDG-related publications; number and share of citations to SDG-related publications; and the number and shares of patents retrieved by the STRINGS SDG-related keywords.

We manually checked the procedures and thresholds (comparing several thresholds) for three SDGs: SDG 2 (Zero hunger), which combines technical and social solutions; SDG 7 (Affordable and clean energy) which is dominated by technical solutions; and SDG 12 (Responsible consumption and production) which combines technical and social solutions.

Next, we manually checked the relevance of all selected sub-classes, for all SDGs. This led to two fundamental decisions. First, we decided not to include in the final selection all patents in the sub-classes and main groups selected in Steps 2 and 3. Because several sub-classes and main groups host very mixed inventions, it was not possible to distinguish those relevant to the SDGs from those which are not related or which may be harmful to the SDGs. We thus decided to keep only the inventions that cite SDG-related publications, or which were retrieved by keywords (in sub-classes and main groups selected in steps 2 and 3).

<sup>&</sup>lt;sup>20</sup> Note that the main group must still be in the top decile (10%) of the IPC main groups by share of patents citing SDG-related publications (over total patents in the main group).

Second, we decided to drop from the analysis a number of SDGs, which had only a handful of potentially relevant sub-classes and main groups. These are SDGs that are mainly related to social rather than technical solutions, such as SDG 1, SDG 5, SDG 8, SDG 9, SDG 11 and SDG 16.

# 3.2 SDGs included and excluded from the analysis

(those that are excluded are shown in red)

### SDG1No poverty

- SDG 2 Zero hunger
- SDG 3 Good health and well-being
- SDG 4 Quality education

### SDG 5 Gender equality

- SDG 6 Clean water and sanitation
- SDG 7 Affordable and clean energy
- SDG 8 Decent work and economic growth
- SDG 9 Industry, innovation and infrastructure

### SDG 10 Reducing inequality

- SDG 11 Sustainable cities and communities
- SDG 12 Responsible consumption and production
- SDG 13 Climate action
- SDG 14 Life below water
- SDG 15 Life on land
- SDG 16 Peace, justice and strong institutions
- SDG 17 Partnerships for the Goals

# 3.3 Patenting activity (overall and SDG-related) by patent authority

Table A.3.1 indicates the total number of patent families and SDG-related patent families per patent authority.

	ARIPO	CNIPA	EPO	JP0	KIPO	USPTO	WIPO
Total patent families	7,016	8,085,386	2,238,558	6,145,209	2,662,139	6,327,358	2,777,776
SDG-related families	1,673	186,595	131,935	99,646	59,232	183,812	178,136
% SDG-related families	23.8%	2.3%	5.9%	1.6%	2.2%	2.9%	6.4%

Table A.3.1 Total patent families and SDG-related families by patent authority (2001-2017)

Based on the figures reported in Table A.3.1, Figure A.3.1 depicts the percentage of SDG-related inventions by patent authority. It can be observed how ARIPO accounts for the highest percentage of SDG-related inventions (23.8%). However, this percentage corresponds to a low number of inventions, as ARIPO accounts for a rather low overall number of inventions. CNIPA could represent the opposite case, with a relatively low percentage of SDG-related inventions (2.3%) which actually represent a quite high number of inventions, given that CNIPA is one of the largest patent authorities worldwide. The red line in the figure represents the overall percentage of inventions related to the SDGs (1.8%), considering all the patent authorities simultaneously and considering unique inventions (the same invention might be protected in several patent authorities).



Figure A.3.1 Percentage of SDG-related inventions, by patent authority

**Notes**: The chart depicts the percentage of patent families (2001-2017) that are related to the SDGs within each of the patent authorities. The red line represents the percentage of SDG-related patent families identified when considering all unique inventions, regardless of the patent authorities where protection was sought. Figures are based on PATSTAT data (CWTS version).

Figure A.3.2 shows that SDG 3 is clearly accounting for the highest percentage of SDG-related inventions across patent authorities.



Figure A.3.2 SDG-related inventions by SDG within patent authorities

**Notes**: The chart shows, for each of the patent authorities considered in the study, a breakdown of patent families by SDG. Figures are based on PATSTAT data (CWTS version), 2001-17.

# 3.4 Missing data in PATSTAT for SDG-related inventions

Some information about the inventor's and/or applicant's countries was missing in PATSTAT for around one-third of the SDG-related patent families. Table A.3.1 shows the total number of SDG-related patent families, as well as the number of SDG-related inventions with missing data, for each of the patent authorities.

Inventor country was missing for 120,521 SDG-related inventions. Most patent families at CNIPA lack the inventor country information: close to 60% of the inventions do not contain this information (Table A.3.2). CNIPA accounts for nearly 90% of the SDG-related inventions without country information (Table A.3.3).

Country information was also missing in around 12% of the SDG-related inventions found at JPO (Table A.3.2), and JPO represents 9.6% of all the SDG-related patent families without country information (Table A.3.3).

Patent authority	SDG-related patent families	Missing inventor country (%)
ARIPO	1,673	0(0%)
CNIPA	186,595	107,771(57.8%)
EPO	131,935	9(0.01%)
JP0	99,646	11,659 (11.7%)
KIPO	59,232	1,040 (1.8%)
USPTO	183,812	0(0%)
WIPO	178,136	404(0.2%)
Total unique inventions	369,253	120,521(32,6%)

Table A.3.2 Number of SDG-related patent families within each patent authority with no inventor and/or applicant country information in PATSTAT

**Notes:** For 515 patent families, details of the inventor are not available. For some inventions, protection was sought in more than one patent authority.

Table A.3.3 Breakdown by patent authority of SDG-related patent families with no inventor and/or applicant country information in PATSTAT

Patent authority	Missing inventor country (%)
ARIPO	0(0%)
CNIPA	107,771(89.2%)
EPO	9(0.01%)
JPO	11,659(9.6%)
KIPO	1,040(0.9%)
USPTO	0(0%)
WIPO	404(0.3%)
Total inventions	120,883

# 3.5 Countries within each country group and their contribution to SDG-related inventions

The following tables show the SDG-related inventions developed or co-developed, by income group and by individual countries within each of the income groups. To allocate inventions to specific countries, we used the location of the inventors rather than that of the applicants, as this reflects better the place where the invention was developed.

Country group	# countries	Min	Max	Standard deviation
HIC	73	0.5	105,411.8	12,681.3
UMIC	48	0.5	15,733.9	2,242.2
LMIC	44	0.3	3,604.2	535.6
LIC	22	0.1	8.9	2.7

Table A.3.4 Descriptive statistics by income group

Table A.3.5 HIC countries and their contribution to SDG-related inventions (fractional)

ISO code	Country	# inventions	% inventions
US	United States	105411.8	47.1%
KR	South Korea	21905.7	9.8%
JP	Japan	16433.0	7.3%
DE	Germany	15568.8	6.9%
GB	United Kingdom	9681.9	4.3%
FR	France	9211.9	4.1%
СА	Canada	6189.0	2.8%
IT	Italy	4263.6	1.9%
СН	Switzerland	3822.6	1.7%
NL	Netherlands	3776.5	1.7%
IL	Israel	3628.5	1.6%
ES	Spain	3177.3	1.4%

AU	Australia	2995.3	1.3%
SE	Sweden	2443.9	1.1%
DK	Denmark	2418.6	1.1%
BE	Belgium	2365.1	1.1%
TW	Taiwan	1934.9	0.9%
AT	Austria	1289.6	0.6%
SG	Singapore	1049.7	0.5%
FI	Finland	894.9	0.4%
NO	Norway	748.7	0.3%
IE	Ireland	630.0	0.3%
PL	Poland	506.8	0.2%
NZ	New Zealand	506.7	0.2%
HU	Hungary	370.5	0.2%
PT	Portugal	347.9	0.2%
CZ	Czech Republic	307.9	0.1%
GR	Greece	291.8	0.1%
SA	Saudi Arabia	282.6	0.1%
НК	Hong Kong	245.8	0.1%
CL	Chile	240.6	0.1%
SI	Slovenia	183.3	0.1%
IS	Iceland	107.4	0.0%
LV	Latvia	86.3	0.0%
HR	Croatia	81.7	0.0%
RO	Romania	77.2	0.0%

SK	Slovakia	74.8	0.0%
EE	Estonia	68.3	0.0%
LU	Luxembourg	58.4	0.0%
LT	Lithuania	54.0	0.0%
AE	United Arab Emirates	47.5	0.0%
СҮ	Cyprus	35.3	0.0%
KW	Kuwait	24.1	0.0%
MC	Monaco	23.0	0.0%
UY	Uruguay	20.3	0.0%
LI	Liechtenstein	18.2	0.0%
QA	Qatar	16.0	0.0%
МО	Масао	12.3	0.0%
BM	Bermuda	10.3	0.0%
MT	Malta	7.8	0.0%
PR	Puerto Rico	7.0	0.0%
КҮ	Cayman Islands	6.7	0.0%
ΡΑ	Panama	6.6	0.0%
VG	British Virgin Islands	6.5	0.0%
SC	Seychelles	6.3	0.0%
BB	Barbados	4.5	0.0%
TT	Trinidad and Tobago	4.2	0.0%
BS	Bahamas	3.8	0.0%
ВН	Bahrain	3.7	0.0%
OM	Oman	2.5	0.0%

TC	Turks and Caicos Islands	2.5	0.0%
SM	San Marino	2.1	0.0%
MU	Mauritius	2.0	0.0%
BN	Brunei	1.8	0.0%
KN	St. Kitts and Nevis	1.8	0.0%
AD	Andorra	1.7	0.0%
NC	New Caledonia	1.7	0.0%
AG	Antigua and Barbuda	1.6	0.0%
GI	Gibraltar	1.5	0.0%
PF	French Polynesia	1.0	0.0%
PW	Palau	0.8	0.0%
VI	United States Virgin Islands	0.6	0.0%
FO	Faeroe Islands	0.5	0.0%

Table A.3.6 UMIC countries and their contribution to SDG-related inventions

ISO code	Country	# inventions	% inventions
CN	China	15733.9	80.2%
RU	Russia	866.2	4.4%
BR	Brazil	689.3	3.5%
TR	Turkey	415.4	2.1%
МХ	Mexico	336.7	1.7%
ZA	South Africa	332.4	1.7%
MY	Malaysia	269.6	1.4%
AR	Argentina	181.9	0.9%
CU	Cuba	109.7	0.6%

ТН	Thailand	104.5	0.5%
CO	Colombia	89.7	0.5%
IR	Iran	72.6	0.4%
BG	Bulgaria	50.4	0.3%
JO	Jordan	38.9	0.2%
ID	Indonesia	36.0	0.2%
АМ	Armenia	32.1	0.2%
KZ	Kazakhstan	29.0	0.1%
RS	Serbia	28.0	0.1%
CR	Costa Rica	26.4	0.1%
LB	Lebanon	25.1	0.1%
GE	Georgia	19.5	0.1%
BY	Belarus	19.0	0.1%
VE	Venezuela	14.2	0.1%
PE	Peru	14.2	0.1%
EC	Ecuador	13.0	0.1%
JM	Jamaica	10.1	0.1%
ΝΑ	Namibia	8.2	0.0%
IQ	Iraq	7.2	0.0%
ВА	Bosnia and Herzegovina	6.3	0.0%
МК	North Macedonia	5.4	0.0%
DO	Dominican Republic	5.0	0.0%
GT	Guatemala	4.9	0.0%
AZ	Azerbaijan	4.8	0.0%

GA	Gabon	4.6	0.0%
GY	Guyana	3.3	0.0%
BZ	Belize	2.8	0.0%
AL	Albania	2.4	0.0%
ME	Montenegro	1.5	0.0%
РҮ	Paraguay	1.5	0.0%
FJ	Fiji	0.8	0.0%
SR	Suriname	0.8	0.0%
LY	Libya	0.7	0.0%
ТО	Tonga	0.7	0.0%
AS	American Samoa	0.5	0.0%
BW	Botswana	0.5	0.0%
DM	Dominica	0.5	0.0%
GD	Grenada	0.5	0.0%
ТМ	Turkmenistan	0.5	0.0%

Table A.3.7 LMC countries and their contribution to SDG-related inventions

ISO code	Country	# inventions	% inventions
IN	India	3604.2	85.4%
UA	Ukraine	110.0	2.6%
EG	Egypt	96.2	2.3%
MA	Morocco	73.7	1.7%
VN	Vietnam	53.3	1.3%
РН	Philippines	43.1	1.0%
TN	Tunisia	36.5	0.9%

РК	Pakistan	27.2	0.6%
LK	Sri Lanka	25.0	0.6%
KE	Kenya	24.0	0.6%
BD	Bangladesh	19.5	0.5%
NG	Nigeria	11.5	0.3%
DZ	Algeria	10.7	0.3%
NP	Nepal	9.6	0.2%
UZ	Uzbekistan	8.4	0.2%
GH	Ghana	6.9	0.2%
MN	Mongolia	6.3	0.2%
СМ	Cameroon	6.2	0.1%
ZW	Zimbabwe	5.8	0.1%
MD	Moldova	5.6	0.1%
SN	Senegal	5.3	0.1%
КН	Cambodia	4.4	0.1%
TZ	Tanzania	3.7	0.1%
SV	El Salvador	3.3	0.1%
BJ	Benin	2.3	0.1%
CI	Ivory Coast	2.0	0.0%
LA	Laos	1.8	0.0%
VU	Vanuatu	1.8	0.0%
NI	Nicaragua	1.5	0.0%
CG	Congo-Brazzaville	1.3	0.0%
BO	Bolivia	1.2	0.0%

ZM	Zambia	1.1	0.0%
DJ	Djibouti	1.0	0.0%
HN	Honduras	0.9	0.0%
AO	Angola	0.8	0.0%
SB	Solomon Islands	0.7	0.0%
MR	Mauritania	0.5	0.0%
FM	Micronesia	0.5	0.0%
MM	Myanmar	0.5	0.0%
PS	West Bank and Gaza	0.5	0.0%
SZ	SWZ	0.5	0.0%
KG	Kyrgyzstan	0.3	0.0%
LS	Lesotho	0.3	0.0%
PG	Papua New Guinea	0.3	0.0%

Table A.3.8 LIC countries and their contribution to SDG-related inventions

ISO code	Country	# inventions	% inventions
ET	Ethiopia	8.9	14.9%
SD	Sudan	8.1	13.6%
KP	North Korea	7.1	11.9%
MG	Madagascar	6.0	10.1%
UG	Uganda	5.2	8.7%
NE	Niger	3.9	6.6%
GM	Gambia	3.7	6.3%
GN	Guinea	3.4	5.7%
SY	Syria	3.0	5.0%

YE	Yemen	1.6	2.7%
BF	Burkina Faso	1.5	2.5%
CF	Central African Republic	1.3	2.2%
CD	Congo-Kinshasa	1.3	2.1%
SL	Sierra Leone	1.2	2.0%
LR	Liberia	1.0	1.7%
ER	Eritrea	1.0	1.6%
RW	Rwanda	0.6	1.0%
ML	Mali	0.5	0.8%
TG	Togo	0.3	0.4%
HT	Haiti	0.1	0.2%

# 3.6 IPC subclasses identified by our methodology as most related to the various SDGs

											Unique	% SDG-
Subclas	SDG	0007	SDG	0000	0007	SDG1	SDG1	SDG1	SDG1	SDG1	invention	invention
S A61K	2	SDG3 128497	4	SDGP	SDG7		Z	3	4	5	S 128497	S 34.8%
Δ61P		88095									88095	23.9%
C12N	1040	49390		2003	3753		901	199		794	54516	14.8%
C07K	302	42477		2000	842		001	77		/01	43058	11.7%
GOIN	002	37517			012	398					37809	10.2%
C02F		1126		2532	3144	1360	4165	150	461	1031	33693	9.1%
0021		1120		2002		1000	100	100	101	1001	00000	0.178
C07D	355	32657									32871	8.9%
C12Q	239	31810		519					149	581	32512	8.8%
C12P	204	12667		1240	4143		1366	123	117	274	17186	4.7%
C07H	103	13919		194	597			32		136	14488	3.9%
A01N	1570	10786		442				75		502	12740	3.5%
A61B		12390									12390	3.4%
C07C		8820					2637				11417	3.1%
A23L	524	10132									10336	2.8%
B01D				6862		370	2635	294	167		10097	2.7%
H02J					8231						8231	2.2%
A01G	1904	1297		844	1473	307	494	440	171	1844	7988	2.2%
H01L					7757						7757	2.1%
G06Q		6614	138			962					7675	2.1%
H02S				70	7561	47		37			7649	2.1%
A01K	282	3570		734	626		363	80	580	555	6306	1.7%
F24J				205	5652			68		11	5830	1.6%
F24S				143	5165			41		10	5294	1.4%
B09B	25			340	384	353	3956	75	28	52	4929	1.3%
A61M		4723									4723	1.3%
A61N		4459									4459	1.2%
A61F		4455									4455	1.2%
C12M		2579		548	992		454		66	78	3991	1.1%
C01B				650	1536		1763	176	57		3908	1.1%
B01J				2633			1321				3899	1.1%
C07F		3618									3618	1.0%
A61L		3359									3359	0.9%
A23K	166	1957		202	383		446		148	243	3178	0.9%
A61Q		3170									3170	0.9%
C40B	15	3048							8	48	3083	0.8%
A01H	402	2423	5	115	249			53	22	136	3035	0.8%
A01P	991	1760	1	217				1		329	3024	0.8%
C05G	836	567				105	543	49	34	602	2557	0.7%

### Table A.3.9 Number of SDG-related patent families identified by our methodology by IPC subclass

F24H			1603	760		148	37			2499	0.7%
C05F	471	223	249	367	193	950	59	24	343	2485	0.7%
C10L			218	1494	113	732	102	24	31	2342	0.6%
F21S				2119	180					2281	0.6%
F21V				2092	197					2270	0.6%
F24D			752	1341	54	121	35			2215	0.6%
C04B			478		378	1186			285	2206	0.6%
F03D				2053	57		79	20		2163	0.6%
F03G				1973			175	26	19	2140	0.6%
F25B			331	1509			273			2058	0.6%
F24F			290	1430	104		147			1929	0.5%
A01C	904	414	111				42		372	1737	0.5%
E03B	16		1193	361	127		21	20	66	1718	0.5%

Notes: In total, 255 different IPC subclasses were identified as related to the various SDGs considered. This table contains only those subclasses contributing to at least 0.5% of all SDG-related inventions (i.e., 369,253 inventions). The same invention can be classified in more than one IPC subclass, when this happens, we assigned the whole invention to each and every IPC subclass without fractionalizing.

## 3.7 Co-occurrence of technology fields by SDG

The following networks depict the co-occurrence of the 35 technology fields across SDGrelated patents, for each SDG. The number of co-occurrences of two technology fields equals the number of inventions in which two different technologies occur. The size of each node is proportional to the number of inventions related to that technology, while the thickness of the lines is proportional to the number of inventions related to two technology fields simultaneously.

Figure A.3.3 Co-occurrence of SDG-related inventions among technology fields: SDG 2



A VOSviewer

### Figure A.3.4 Co-occurrence of SDG-related inventions among technology fields: SDG 3



🙈 VOSviewer

#### Figure A.3.5 Co-occurrence of SDG-related inventions among technology fields: SDG 4



### Figure A.3.6 Co-occurrence of SDG-related inventions among technology fields: SDG 6



A VOSviewer

### Figure A.3.7 Co-occurrence of SDG-related inventions among technology fields: SDG 7



A VOSviewer

### Figure A.3.8 Co-occurrence of SDG-related inventions among technology fields: SDG 11



A VOSviewer

### Figure A.3.9 Co-occurrence of SDG-related inventions among technology fields: SDG 12



A VOSviewer

### Figure A.3.10 Co-occurrence of SDG-related inventions among technology fields: SDG 13



A VOSviewer

### Figure A.3.11 Co-occurrence of SDG-related inventions among technology fields: SDG 14



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### Figure A.3.12 Co-occurrence of SDG-related inventions among technology fields: SDG 15



A VOSviewer
# Appendix 4: STI-SDG alignment across countries

This section of the Appendix relates to Chapter 6 in the main report.

**Figure A.1.** Scatter plots of relations between SDG challenges (2008-2017) and SDG research priorities (2015-2019) in SDGs 1, 3, 5, 7, 8, 9, 10, 11, 12, 14, 15, 16







#### SDG8: Decent Work and Economic Growth





## SDG12: Responsible Consumption and Production







 Table A.1. Multiple regression results for the relation between SDG challenges and SDG research priorities for all countries

	Pwcorr t ↔ t	RQ1 t→t	$ \begin{array}{c} RQ2 \\ t \to \Delta \end{array} $	$\begin{array}{c} RQ3\Delta \ \rightarrow \\ \Delta \end{array}$
1 No poverty	+			
2 Zero hunger	+		+	
3 Health well-being	+			+
4 Quality education	-	-		
5 Gender equality				+
6 Clean water sanitation	+	+	+	
7 Affordable clean energy	-			
8 Decent work growth				
9 Industry infrastructure innovation			+	-
10 Reduced inequalities				
11 Sustainable cities				
12 Responsible consumption	-			
13 Climate action	-		+	+
14 Life below water				
15 Life on land		-	-	
16 Peace justice institutions		-		

The patterns presented in the main text are based on correlations between research specialization and the SDG score. In order to control for confounding factors, we conducted three multiple regression analyses that include past research specialization and number of publications per capita as controls. In table A.1. we display results in four columns. Column "Pwcorr" displays the sign of positive/negative significant (0.05) correlations between our two main variables of interest (scientific specialization by SDG and SDG score). We observe positive significant correlations in SDG 1, 2, 3 and 6; and negative significant correlations in SDG 4, 7, 12 and 13. Then we use multiple regression analysis (OLS) to explore three research questions:

- RQ1: Are countries further away from the frontier in a certain SDG specialized in research related to that SDG?
- RQ2: Are countries further away from the frontier in a certain SDG becoming specialized in research related to that SDG?
- RQ3: Are decreases (or increases) in SDG scores associated to changes in future SDG research specialization?

In all RQ positive/negative signs indicate significant (0.05) relations between our main independent variable and dependent variable, controlling for other factors.

In RQ1 we use scientific specialization by SDG/country in 2015-2019 as our dependent variable, and SDG score (2013-2017) as our main independent variable, controlling for previous research specialization (2010-2014) due to the path-dependant nature of scientific production. In RQ2 we use the difference between scientific specialization by SDG/country in 2015-2019 and scientific specialization by SDG/country in 2010-2014 as our dependent variable, and SDG score (2008-2012) as our main independent variable, controlling for number of publications per capita in a specific SDG/Country (2010-2014). In RQ3 we use the difference between scientific specialization in 2015-2019 and 2010-2014 as our dependent variable, and the difference



between SDG scores in 2015-2019 and 2010-2014 as our main independent variable controlling for number of publications per capita in a specific SDG/Country (2010-2014). Overall, we found no alignment (no statistical relation) or a negative alignment (-) in most SDGs.

# Appendix 5: Future STI priorities

This section of the Appendix relates to **Chapter 7** in the main report.

# 5.1 STRINGS survey respondents

Table A.5.1: Distribution of participants' age groups

Age	n	%
35-44	416	31
45-54	337	25
55-64	264	20
25-34	193	14
65 or older	114	9
18-24	16	1
Prefer not to say	8	1
Not reported	2	0
17 and under	1	0

# Table A.5.2: Distribution of participants' education

Education	n	%
PhD (or equivalent)	1137	85
Master's degree (or equivalent)	143	11
Other, please specify:	31	2
Undergraduate degree (or equivalent)	22	2
Primary or Secondary diploma (or equivalent)	3	0
Not reported	2	0
Prefer not to say	1	0

#### Table A.5.3: Affiliated institution type

Affiliated institution type	n	%
Research (e.g., university; research institute; think tank)	1137	85
Public sector (e.g., government; armed forces)	66	5
Not-for-profit (e.g., NGOs)	40	3
Private sector (e.g., businesses; individuals)	35	3
Other, please specify:	31	2
Does not apply (e.g., students; not in employment)	28	2
Not reported	2	0
Table A.5.4: Participants' region of expertise		
Region	n	%
Western Europe	370	28
Northern America	284	21
Southern Europe	246	18
Sub-Saharan Africa	241	18
Latin America and the Caribbean	222	17
Northern Europe	192	14
South-eastern Asia	162	12
Eastern Europe	142	11
Eastern Asia	128	10
Southern Asia	192125	9
Oceania	106	8
Northern Africa	45	3
Central Asia	32	2
Western Asia	23	2

#### Figure A.5.1: Survey respondents' nationalities



# Table A.5.5: Roles of participants-

Role	n	%
Scientist, researcher or technology developer	926	69
Other	861	64
Understanding of science, technology or innovation	611	46
Apply for science, technology and innovation funding	551	41
Development of science, technology and innovation policy	355	27
Making of public funding decisions	220	16
Social movements to steer science, technology and innovation	216	16
Support applications / bids for science, technology and innovation funding	195	15
Development of grassroots innovations	131	10
Making of private funding decisions	85	6
Student	65	5
Not applicable	5	0
Prefer not to say	4	0

# Table A.5.6: Primary knowledge background of participants

Knowledge background	n	%
Social sciences and humanities	641	48
Life and earth sciences	302	23
Physical sciences and engineering	312	23
Medical and health sciences	166	12
Agricultural sciences	133	10
Mathematical and computer sciences	85	6

# Table A.5.7: Distribution of participants' gender

Gender	n	%
Male	838	62.60
Female	487	36.37
Prefer not to say	14	1.03%

# 5.2 Survey codebook of STI types

We developed a deductive coding codebook. This was constructed from project STI definitions and innovation literature. We revised it with two rounds of coding. The final STRINGS survey STI types codebook used 7 codes:

- 1. Scientific research area
- 2. Existing technology
- 3. Market-oriented innovation
- 4. Social innovation
- 5. Grassroots innovation
- 6. Policy innovation
- 7. Values and direction-setting

In the qualitative coding of survey responses, only one code was allowed per STI area in a question response. We recognise that in practice STI types are non-exclusive and more than one may fit a datum. For our data reduction and analysis, we only selected a single label, however, which was the coding label with the greatest perceived relevance to the subject STI area.

Τ	able	A.5	.7:	STI	type	coding:	description	is and	sources
					- /				

STI area type	Description of coding label	Relevant sources
Scientific research area	This includes areas of scientific research, broad areas of research. identified analytical methodologies or tools	
	E.g., social sciences, agricultural insurance, statistics, monitoring, data and knowledge infra, science practices	
Existing technology	This is for technologies where broadly commercialisation is widespread and there are established markets for the technology	
	E.g., solar panels	
Market- oriented innovation	Innovation that is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brough into use by the unit (process), with an objective to protect the innovation, to appropriate the gains from innovation and cover the investment made for the innovation activity. The unit is typically firms, laboratories, universities that invest resources for such innovation improvements	OECD/Eurostat (2018), <i>Oslo Manual</i> 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg, <u>https://doi.org/10.1787/97892643</u> 04604-en.
	E.g., biodegradable plastics	

Social	Innovation that are simultaneously meets social needs and creates new social relationships or collaborations with new ideas (products, services and models). They aim to improve the welfare of individuals or communities E.g., new community insurance model, safe consumption sites (for drugs)	OECD/Eurostat (2018), <i>Oslo Manual</i> 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg, <u>https://doi.org/10.1787/97892643</u> 04604-en.
		The Young Foundation (2012). Social Innovation Overview: A deliverable of the project: "The theoretical, empirical and policy foundations for building social innovation in Europe" (TEPSIE), European Commission – 7th Framework Programme, Brussels: European Commission, DG Research. <u>https://youngfoundation.org/wp- content/uploads/2012/12/TEPSIE.D1.1.Report.Defi</u> <u>ningSocialInnovation.Part-1-defining-social- innovation.pdf</u>
Policy	Innovation that changes an administrative, legal, regulatory, or policy instrument. The unit is typically a government organisation, and the process is how they work, and the product are the instruments. E.g., ban on weapon sales	<ul> <li>Howlett, M. (2020). Policy instruments: Definitions and approaches. In A Modern Guide to Public Policy. Edward Elgar Publishing.</li> <li>OECD/Eurostat (2018), <i>Oslo Manual</i> 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities, OECD Publishing, Paris/Eurostat, Luxembourg, <u>https://doi.org/10.1787/97892643</u> 04604-en.</li> </ul>
Grassroots	Innovation that uses local inclusion and control to improve processes of technology development and social organisation E.g., conservation practices, non-tech innovation, community-based	<ul> <li>Kaplinsky, R., Chataway, J., Clark, N., Hanlin, R., Kale, D., Muraguri, L., &amp; Wamae, W. (2009). Below the radar: what does innovation in emerging economies have to offer other low-income economies? <i>International Journal of Technology Management &amp; Sustainable Development</i>, <i>4</i>(3), 177-197.</li> <li>Smith, A., Fressoli, M., &amp; Thomas, H. (2014). Grassroots innovation movements: challenges and contributions. <i>Journal of Cleaner Production</i>, <i>63</i>, 114-124.</li> </ul>
Values and direction- setting	There is an STI area of action that involves reorientation, promotion, strengthening and championing, advocacy etc of values, lifestyles, etc.	
	E.g., 'increased cultural valuing of care', or parental co-responsibility', or 'spiritual values based on honesty', 'sociotechnical literacy'	

# 5.3 STI-SDG synergies

# Table 1. STI-SDG synergies

STI	Synergies	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 6	SDG 7	SDG 8	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 14	SDG 15	SDG 16
blockchain	10	18	12		62	39			91		46	47	107		120		20
adaptive learning	8		57	383	25	11	19	10						11		76	
circular economy	7	207						16		11	37	47	75				152
curriculum	6		124		508	23	17		13								93
education access	6		50	30					92					33	27		113
freer migration	5	14	19		25				39	24							
artificial intelligence	4	45		30					422				44				
genetic engineering	4	23	49	28												41	
agroecology	4		23							12				26		198	
internet	4		10						130					204			204
policy and regulation	4			31									63		36	51	
infrastructure	3	252	10											12			
precision agriculture	3	21	14											14			
citizen science	3			47	128												22

STI	Synergies	SDG 1	SDG 2	SDG 3	SDG 4	SDG 5	SDG 6	SDG 7	SDG 8	SDG 9	SDG 10	SDG 11	SDG 12	SDG 13	SDG 14	SDG 15	SDG 16
indigenous sovereignty	3			12											148	207	
social science	3					54	235						22				
carbon price	3							19		96					11		
biodegradable plastics	3									25		41	75				

Notes: Columns are the SDGs. Rows are the STI areas with 3+ connections. The values in cells are the number of survey responses identifying that link (in Figure 7.7, this is the variable that is the thickness of connectors between an STI and SDG). 'Synergies' gives a count for how many SDGs an STI was linked to overall. Only relationships rated by 10 or more participants are displayed.

# 5.4 Influence of survey respondent backgrounds on STI-SDG perspectives

# By region

Table A.5.8: Top STI-SDG relationship by region of expertise. The STI-SDG relationship with greatest consensus on future likelihood of positive influence by region of expertise of survey participants

Region	SDG Target	STI	Average Rating	Consensus	Ratings (n)
	SDG 10.1: Income growth	redistributive taxation	4.92	94	12
Southern Asia	SDG 7.1: Energy access	renewable energy	4.9	94	21
	SDG 3.2: Newborn and children death	public health	4.88	93	26
	SDG 3.2: Newborn and children death	public health	4.91	94	33
	SDG 8.7 & 8.8: labour	education	4.85	92	26
Southern Europe	SDG 12.2: Natural resources	policy and regulation	4.82	92	11
	SDG 2.3: Agricultural productivity	community based water supplies	4.82	92	11
	SDG 6.2: Sanitation	engineering	4.82	92	11
	SDG 7.1: Energy access	renewable energy	4.86	93	43
Northern America	SDG 7.2: Renewable energy	wind farming	4.79	90	39
	SDG 10.5: Financial markets	closure of tax loopholes	4.71	90	34
	SDG 3.2: Newborn and children death	public health	4.88	93	24
Latin America and the Caribbean	SDG 8.7 & 8.8: labour	education	4.85	92	20
	SDG 14.2 & 14.5: Marine ecosystem protection	changes in consumer behaviours	4.82	92	22
	SDG 7.1: Energy access	renewable energy	4.95	95	19
Oceania	SDG 7.2: Renewable energy	wind farming	4.94	95	16
	SDG 4.7: Sustainable development education	(social) scientific literacy	4.83	92	12
South-eastern Asia	SDG 3.2: Newborn and children death	public health	4.96	96	27
	SDG 7.1: Energy access	renewable energy	4.91	94	23

Region	SDG Target	STI	Average Rating	Consensus	Ratings (n)
	SDG 11.6: Urban environment	low emission vehicles	4.81	92	26
	SDG 12.4: Chemicals	circular economy	5	100	11
Western Europe	SDG 16.1: Violence	education	4.85	92	26
	SDG 7.1: Energy access	renewable energy	4.83	92	66
	SDG 7.1: Energy access	renewable energy	4.9	94	41
Northern Europe	SDG 7.2: Renewable energy	wind farming	4.9	94	39
	SDG 12.2: Natural resources	policy and regulation	4.83	92	12
Sub-Saharan Africa	SDG 8.7 & 8.8: labour	education	4.87	93	15
	SDG 16.1: Violence	education	4.84	92	19
	SDG 16.5 & 16.6: Corruption	transparency in both public and private sectors	4.84	92	19
Eastern Asia	SDG 7.1: Energy access	renewable energy	4.91	94	22
	SDG 3.2: Newborn and children death	public health	4.86	93	22
	SDG 11.6: Urban environment	low emission vehicles	4.83	92	12
	SDG 3.2: Newborn and children death	public health	4.86	93	14
Eastern Europe	SDG 7.1: Energy access	renewable energy	4.84	92	25
	SDG 8.7 & 8.8: labour	education	4.84	92	19
Northern Africa	SDG 3.2: Newborn and children death	big data	4.36	89	14
	SDG 6.1: Drinking water	social science	4.5	85	12
Central Asia	SDG 1.1: Extreme poverty	circular economy	4.43	85	14

# By role

Table A.5.9: Top STI-SDG relationship by role. The STI-SDG relationship with greatest consensus on future likelihood of positive influence by role of survey participants

Role	SDG Target	STI	Average Rating	Consensus	Ratings (n)
Understanding	SDG 13.3: Climate education & awareness	education programmes at all scholar levels	4.92	94	12
of science, technology or ippovation	SDG 12.3: Food waste	circular economy	4.88	93	16
IIIIOvation	SDG 7.1: Energy access	renewable energy	4.82	91	120
Scientist, researcher or technology developer	SDG 12.3: Food waste	education, marketing to change consumers' behaviours	4.93	95	14
	SDG 16.1: Violence	education	4.79	92	78
	SDG 11.3: Urbanization	affordable housing	4.8	91	15
Other	SDG 12.3: Food waste	education, marketing to change consumers' behaviours	5	100	11
	SDG 10.2 & 10.3: Inclusivity	social justice	4.88	93	25
	SDG 7.1: Energy access	renewable energy	4.86	91	146
	SDG 7.1: Energy access	renewable energy	4.86	93	49
Social movements to steer science, technology and	SDG 16.5 & 16.6: Corruption	transparency in both public and private sectors	4.8	91	20
innovation	SDG 15.2: Forests	co-ordination and partnerships	4.75	90	12
Apply for science,	SDG 13.3: Climate education & awareness	education programmes at all scholar levels	4.93	95	15
technology and innovation	SDG 7.1: Energy access	renewable energy	4.88	93	107
funding	SDG 12.3: Food waste	circular economy	4.83	92	12
	SDG 7.1: Energy access	renewable energy	4.92	94	25
Development of grassroots innovations	SDG 10.5: Financial markets	closure of tax loopholes	4.74	90	19
	SDG 10.1: Income growth	redistributive taxation	4.7	90	20
	SDG 7.1: Energy access	renewable energy	4.78	91	74

Role	SDG Target	STI	Average Rating	Consensus	Ratings (n)
Development of science, technology and innovation policy	SDG 15.8: Invasive species	regulations and controls on invasive species introductions	4.79	91	14
	SDG 13.1: Climate hazards and disasters	climate governance	4.77	91	13
Support applications / bids for science, technology and innovation funding	SDG 16.5 & 16.6: Corruption	transparency in both public and private sectors	4.88	93	16
	SDG 7.1: Energy access	renewable energy	4.84	92	44
	SDG 4.2: Childhood development	environmental education	4.83	92	12
Making of public funding decisions	SDG 7.1: Energy access	renewable energy	4.84	92	32
	SDG 14.1: Marine pollution	extended producer responsibility	4.75	91	16
	SDG 15.5: Biodiversity	co-ordinated planning	4.24	90	17
	SDG 7.1: Energy access	renewable energy	4.74	90	19
Making of private funding	SDG 7.2: Renewable energy	wind farming	4.71	90	17
decisions	SDG 2.2: Malnutrition	climate-smart agriculture	4.64	89	11
	SDG 3.3: Communicable diseases	antimicrobial medicines	4.82	92	11
Student	SDG 4.3-4.5: Adult education	digital inclusion	4.79	91	14
	SDG 4.7: Sustainable development education	(social)scientific literacy	4.73	90	15

# By disciplinary background

Table A.5.10: Top STI-SDG relationship by background. The STI-SDG relationship with greatest consensus on future likelihood of positive influence by background of survey participants

Background	SDG Target	STI	Average Rating	Consensus	Ratings (n)
	SDG 7.1: Energy access	renewable energy	4.93	95	15
Agricultural sciences	SDG 16.2: Violence against children	human rights prosecution	4.91	94	11
	SDG 16.1: Violence	education	4.9	94	20
	SDG 3.2: Newborn and children death	public health	4.94	95	16
Life and earth sciences	SDG 4.1: Education	environmental education	4.89	93	18
	SDG 7.1: Energy access	renewable energy	4.84	92	44
Mathematical and computer	SDG 7.1: Energy access	renewable energy	4.82	92	22
	SDG 4.3-4.5: Adult education	digital inclusion	4.7	90	20
SCIENCES	SDG 5.5: Women & leadership	flexible working	4.67	89	12
	SDG 3.2: Newborn and children death	public health	4.94	95	17
Physical sciences and engineering	SDG 11.2: Transport	inclusive mobility standards	4.8	91	20
	SDG 7.1: Energy access	renewable energy	4.87	91	126
	SDG 10.2 & 10.3: Inclusivity	social justice	4.88	93	24
Social sciences	SDG 7.1: Energy access	renewable energy	4.82	91	77
and humanities	SDG 16.5 & 16.6: Corruption	transparency in both public and private sectors	4.78	91	40
Madiation	SDG 3.2: Newborn and children death	public health	4.93	92	84
health sciences	SDG 3.3: Communicable diseases	community public health	4.67	90	15
	SDG 4.3-4.5: Adult education	digital inclusion	4.61	89	18

# By SDG expertise

Table A.5.11: Top STI-SDG relationship by SDG of expertise. The STI-SDG relationship with greatest consensus on future likelihood of positive influence by SDG expertise of survey participants

SDG Expertise	SDG Target	STI	Average Rating	Consensus	Ratings (n)
	SDG 16.5 & 16.6: Corruption	transparency in both public and private sectors	4.87	93	15
1 - No Poverty	SDG 3.5: Substance abuse	community support and education	4.84	92	25
	SDG 7.1: Energy access	renewable energy	Average RatingConsensusRatings Consensusncy in both public4.879315ty support and4.849226to sponsive cory planning4.819226producer4.829317producer4.829118e energy4.849232e energy4.789112th constraint4.749019ty support and4.789132th constraint4.799132th constraint4.799132th constraint4.949518th constraint4.919132th constraint4.889334th constraint4.889334th constraint4.899332th constraint4.899332th constraint4.899332th constraint4.839332th constraint4.83		
	SDG 5.2: Violence against women and girls	gender responsive participatory planning	4.88	93	17
2 - Zero Hunger	SDG 14.1: Marine pollution	extended producer responsibility	4.82	92	11
	SDG 7.1: Energy access	renewable energy	d producer bility4.829211le energy4.789118le energy4.849232n4.759012n4.749019hity support and4.799138		
	SDG 7.1: Energy access	renewable energy	4.84	92	32
3 - Good Health and Well-being	SDG 16.1: Violence	education	4.75	90	12
	SDG 8.7 & 8.8: labour	education	4.74	90	19
	SDG 3.5: Substance abuse	community support and education	4.79	91	38
4 - Quality Education	SDG 8.7 & 8.8: labour	education	4.78	91	32
	SDG 16.1: Violence	education	4.79	91	14
	SDG 2.2: Malnutrition	education	4.94	95	18
5 - Gender Equality	SDG 8.1: Economic growth	skills training	4.91	94	11
	SDG 3.5: Substance abuse	community support and education	4.88	93	34
6 - Clean Water and Sanitation	SDG 16.5 & 16.6: Corruption	transparency in both public and private sectors	4.94	95	16
	SDG 7.1: Energy access	renewable energy	4.89	94	63
	SDG 3.2: Newborn and children death	public health	4.88	93	32
	SDG 3.2: Newborn and children death	public health	4.93	95	27
7 - Alfordable and Clean Energy	SDG 7.1: Energy access	renewable energy	4.85	91	222
	SDG 16.1: Violence	education	4.79	91	19

SDG Expertise	SDG Target	STI	Average Rating	Consensus	Ratings (n)
	SDG 3.2: Newborn and children death	public health	4.97	96	30
8 - Decent Work and Economic Growth	SDG 7.1: Energy access	renewable energy	4.78	91	41
	SDG 8.7 & 8.8: labour	Average RatingRating ConsenseRating Ratingpublic health9.379.3renewable energy4.789.3if enewable energy4.719.3if enewable energy4.719.3if enewable energy4.718.3if enewable energy4.718.3if enewable energy4.719.3if enewable energy4.719.3if enewable energy4.719.3if enewable energy4.719.3if energe energy4.719.3if energe energy4.719.3if energe energy4.719.3if energe energy4.719.3if energe energy4.719.3if energe energy9.39.3if energe energy9.39.3 <t< td=""></t<>			
0 Industry Innovation	SDG 7.1: Energy access	renewable energy	4.82	91	93
	SDG 7.2: Renewable energy	wind farming	4.71	90	87
and Infrastructure	SDG 3.5: Substance abuse	community support and education	4.71	88	24
	SDG 6.2: Sanitation	rgywind farming4.7190873ecommunity support and education4.718824engineering4.718824renewable energy4.799133itysocial justice4.859133tyenvironmental education4.759012ontransparency in both public and private sectors4.819216rgysolar energy4.819216			
	SDG 7.1: Energy access	renewable energy	4.79	91	33
10 - Reducing Inequality	SDG 10.2 & 10.3: Inclusivity	social justice	4.85	91	33
	SDG 2.5: Genetic diversity	environmental education	4.75	90	12
	SDG 16.5 & 16.6: Corruption	transparency in both public and private sectors	4.81	92	16
and Communities	SDG 7.2: Renewable energy	solar energy	4.81	92	16
	SDG 7.1: Energy access	renewable energy	4.83	92	109
	SDG 4.2: Childhood development	environmental education	5	100	11
12 - Responsible Consumption and Production	SDG 12.3: Food waste	education, marketing to change consumers' behaviours	4.94	95	16
	SDG 15.8: Invasive species	regulations and controls on invasive species introductions	4.91	94	11
	SDG 7.1: Energy access	renewable energy	4.87	93	126
13 - Climate Action	SDG 12.4: Chemicals	circular economy	4.87	93	15
	SDG 16.1: Violence	education	4.82	92	68
	SDG 15.8: Invasive species	regulations and controls on invasive species introductions	4.92	94	12
14 - Life Below Water	SDG 12.5: Waste	biodegradable plastics	4.91	94	11
	SDG 13.3: Climate education & awareness	education programmes at all scholar levels	4.82	92	11

SDG Expertise	SDG Target	STI	Average Rating	Consensus	Ratings (n)
	SDG 4.1: Education	environmental education	4.94	95	18
15 - Life On Land	SDG 3.2: Newborn and children death	public health	4.9	94	20
	SDG 7.1: Energy access	renewable energy	4.87	93	30
16 - Peace, Justice, and Strong Institutions	SDG 5.2: Violence against women and girls	gender responsive participatory planning	4.84	92	19
	SDG 10.2 & 10.3: Inclusivity	socialjustice	4.85	92	13
	SDG 5.3: Forced marriage and genital mutilation	social science	4.85	92	13
	SDG 3.2: Newborn and children death	public health	4.91	94	33
17 - Partnerships for the Goals	SDG 7.1: Energy access	renewable energy	4.86	93	29
	SDG 8.7 & 8.8: labour	education	4.75	91	20
	SDG 1.1: Extreme poverty	circular economy	4.07	89	15
l do not feel very familiar with the SDGs	SDG 1.3: Social protection systems	automated social security	4.12	85	16
	SDG 1.1: Extreme poverty	infrastructure	4	78	11

# By age

## Table A.5.12: Top 3 rated STIs by young people aged 35 years or less

SDG	STI	Mean Rating	Consensus(%)	Ratings (n)
SDG 3.2: Newborn and children death	public health	4.83	92	24
SDG 1.4: Economic rights	infrastructure	4.83	92	12
SDG 2.1: Food access	climate-smart agriculture	4.81	92	26

*Note. STI ratings are scaled from 1[definitely negative] to 5[definitely positive] with 3[neither] as a neutral midpoint.* 



Top areas of consensus by young people

Ratings by participants < 35 years old