Countries’ research priorities in relation to the Sustainable Development Goals

Hugo Confraria\textsuperscript{12}, Ed Noyons\textsuperscript{3}, Tommaso Ciarli\textsuperscript{14}

\textsuperscript{1}SPRU, University of Sussex
\textsuperscript{2}UECE, ISEG, University of Lisbon
\textsuperscript{3}CWTS, Leiden University
\textsuperscript{4}UNU-MERIT, Maastricht University

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CONCORDi 2021- Industrial innovation for competitive sustainability
‘We are seriously off-track’ UN chief António Guterres

END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE

THE GLOBAL PANDEMIC IS EXACERBATING WORLD HUNGER

PANDEMIC WILL WORSEN CHILD MALNUTRITION

WORLDWIDE, AN ADDITIONAL 83-132 MILLION PEOPLE ARE LIKELY TO HAVE EXPERIENCED HUNGER AS A RESULT OF THE PANDEMIC IN 2020

THE CLIMATE CRISIS CONTINUES, LARGELY UNABATED

RISING GREENHOUSE GAS EMISSIONS REQUIRE SHIFTING ECONOMIES TOWARDS CARBON NEUTRALITY

THE CLIMATE CRISIS CONTINUES, LARGELY UNABATED

CLIMATE FINANCE INCREASED

2020 GLOBAL AVERAGE TEMPERATURE AT 1.2°C ABOVE PRE-INDUSTRIAL BASELINE

WEFULLY OFF TRACK TO STAY AT OR BELOW 1.5°C AS CALLED FOR IN THE PARIS AGREEMENT

END HUNGER, ACHIEVE FOOD SECURITY AND IMPROVED NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE

ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

BILLIONS OF PEOPLE STILL LACK ACCESS TO SAFE DRINKING WATER, SANITATION AND HYGIENE

IN 2020

BILLIONS OF PEOPLE

2 BILLION PEOPLE

26%

SAFE MANAGED DRINKING WATER

2 BILLION PEOPLE

29%

SAFE MANAGED SANITATION

2 BILLION PEOPLE

29%

SAFE MANAGED HYGIENE

2.3 BILLION PEOPLE LIVE IN WATER-STRESSED COUNTRIES

BETWEEN 1970 AND 2015, NATURAL WETLANDS SHRANK BY 35% ↓

3 x THE RATE OF FOREST LOSS

129 COUNTRIES ARE NOT ON TRACK TO MAX SUSTAINABLY MANAGED WATER RESOURCES BY 2030

CURRENT RATE OF PROGRESS NEEDS TO DOUBLE

125 OF 154 DEVELOPING COUNTRIES ARE FORMULATING AND IMPLEMENTING NATIONAL CLIMATE ADAPTATION PLANS

HIGHEST PRIORITY AREAS INCLUDE

In this paper

• We use the SDGs to analyse the extent to which countries’ research priorities align with their greatest SDG challenges.

• Based on the notion of building capabilities to address challenges (Pavitt, 1998; Salter and Martin, 2001), here we make the very general assumption that a misalignment between a country’s research priorities and its SDG challenges may reduce the effectiveness of investments in research to address those goals.
Data and Methods

• "Revealed" research priorities of countries related to a certain SDG
  - Web of Science (WoS) publication data
  - 4-step approach: Text mining -> Topic modelling -> Queries -> CWTS clusters -> Loose threshold
  - Specialisation Index: Score between -1 (No research) --- 0 (World average) --- 1 (All research)

• Societal challenges of countries in a certain SDG
  - Combination of all available/relevant indicators from: UN SDG database + SDG Index
  - 4-step approach: Data collection -> Normalisation -> Distance to the frontier -> PCA per SDG
  - Societal Challenges: Score between -1 (country at the frontier) --- 1 (major challenge)
STRINGS Approach: Four Steps

1. **Search** reports (policy documents, grey literature), scientific publications and other web content that describes specific SDGs (e.g. descriptions, progress and major problems).

2. **Select relevant text** from the documents and divide it in blocks of entries (paragraphs with an idea) that can be machine-analysed.

**Sources:**
- SDGs targets and indicators
- SDGs website (Progress & Info)
- UN website
- Wikipedia
- Scientific publications retrieved from Scopus
- Forums
- SDG related reports and policy documents from several sources
- Backwards and forward citations in selected publications
3. Selection of terms and generation of queries

- We combined two topic modelling methodologies: Textrank (Mihalcea and Tarau, 2004) and Vosviewer keywords extraction.
  - Select terms that are relevant because they occur across different text partitions, but not always (e.g. “SDG”, “Sustainability”), and are well connected to other terms
  - Keep most terms with more than one word or most frequent
  - Eliminate duplicates

- We manually assess those terms (min -> three project members)
  - Clearly related to the SDG across contexts (to vague or irrelevant removed)
  - Associated to an SDG, but may need specification
    - “habitat degradation” with “ocean” OR “sea” OR “marine”
    - “fishing resource” with “conservation” OR “sustainable”
  - Manually check all disagreements, and add associated terms where needed

- We performed a robustness check against SIRIS terms
- >1800 terms
STRINGS Approach: Four Steps

4. Search publications in WoS and distribute this “seeds” across publication-level classification (Waltman & van Eck, 2012)

- **Assumption:** Publications that frequently cite/are cited by the publications that contain SDG terms, may also be contributing to the same SDG, even if they do not use SDG terms

- Why research areas/clusters instead of queries?
  - Science is a collaborative effort
  - Less dependent on current jargon
  - Policy language vs scientific language
  - Long term impact
Targets related to:
- levels of hunger
- malnutrition
- agricultural productivity
- sustainable food production systems
- genetic diversity of seeds, etc.
How to evaluate what countries perform better in what SDGs?

• We collected all available/relevant indicators from: [UN SDG database](https://www.un.org/sustainabledevelopment/sustainable-development-goals/) + [SDG Index](https://www.sdgindex.org/)

  • For the selected **80 indicators** we did a linear transformation (1 - Best and 0 - Worst) in three periods -> 2008-2017; 2008-2012; 2013-2017

    \[ N_{ct} = \frac{\text{Worst}_t-x_{ct}}{\text{Worst}_t-\text{Best}_t} \]

  • For each variable, we calculated the **relative distance of each indicator/country to the frontier** of that indicator (top5% - percentile 95), and we changed all values below zero to zero.
  • We calculated **z-scores** for each relative distance to the frontier (top5%).
  • We computed a principle component analysis (PCA) (Jackson, 1991) for each SDG with more than one indicator available, and we forced the PCA to give us only one component per SDG.
  • We predicted the scores of all SDGs for all countries and we normalized the results between -1 and 1 (1 = Worst country in a SDG; -1 = Best country).
Positive relation (alignment) in SDG 2

Targets related to:
- levels of hunger
- malnutrition
- agricultural productivity
- sustainable food production systems
- genetic diversity of seeds, etc.
Negative relation (misalignment) in SDG 12

Targets related to:
- Domestic material consumption per capita, (total tonnes)
- Electronic waste generated, per capita (Kg)
Negative relation (misalignment) in SDG 13

Targets related to:
- CO₂ emissions embodied in imports
- Energy-related CO₂ emissions
- Integrate climate change measures into national policies, strategies and planning (13.1, 13.2, 13.3 no data)
Different patterns depending on the SDG

<table>
<thead>
<tr>
<th>SDG</th>
<th>Pwcorr t ↔ t</th>
<th>RQ1 t → t</th>
<th>RQ2 t → Δ</th>
<th>RQ3 Δ → Δ</th>
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</thead>
<tbody>
<tr>
<td>1 No poverty</td>
<td>+</td>
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<td></td>
<td></td>
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<tr>
<td>2 Zero hunger</td>
<td>-</td>
<td>+</td>
<td></td>
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<tr>
<td>3 Health well-being</td>
<td>+</td>
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<tr>
<td>4 Quality education</td>
<td>-</td>
<td>-</td>
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<tr>
<td>5 Gender equality</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
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<tr>
<td>6 Clean water sanitation</td>
<td>-</td>
<td>+</td>
<td>+</td>
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<tr>
<td>7 Affordable clean energy</td>
<td>-</td>
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<td>8 Decent work growth</td>
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<tr>
<td>9 Industry infrastructure innovation</td>
<td></td>
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<tr>
<td>10 Reduced inequalities</td>
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<tr>
<td>11 Sustainable cities</td>
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<tr>
<td>12 Responsible consumption</td>
<td>-</td>
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<tr>
<td>13 Climate action</td>
<td>-</td>
<td></td>
<td>+</td>
<td></td>
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<tr>
<td>14 Life below water</td>
<td></td>
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<tr>
<td>15 Life on land</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
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<td>16 Peace justice institutions</td>
<td></td>
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</tbody>
</table>

Note: Multivariate regression analysis (OLS), we use scientific specialisation (2015-2019) by SDG/country as our dependent variable, and SDG Score (2013-2017) as our main independent variable. In model (1) we control for previous scientific specialisation due to the path-dependant nature of scientific production. In models (2 and 3) we work with growth rates and control for country’s scientific productivity.

- Controlling for other factors, we found negative or inconclusive relationship between research prioritisation and SDG challenges for the majority of SDGs.
- Historical patterns of research specialisation matter more than SDG challenges (SDG1, SDG2, SDG3).
- Countries that have major challenges in SDG6 (Clean Water and Sanitation) are relatively (or becoming) specialised (or becoming) in research related to this SDG.
- Countries that have major challenges in SDG15 (Life on Land) are NOT relatively (or becoming) specialised in research related to it.
In a nutshell

• We have developed **new methods** to analyse the alignment between countries’ research priorities and their SDG-related challenges. Results might help policy makers to understand these relations and bring **directionality** to the debate.

• While most SDG challenges are worst in lower income countries, only a small fraction of SDG related research is performed in those regions
  • Nevertheless, lower income countries are on average specialised in SDG related research.
  • Global effort to allocate research funds to lower income contexts?

• At the SDG level, we find different patterns depending on the SDG:
  • Countries with higher challenges relating to **SDG1** (No poverty), **SDG2** (Zero hunger), **SDG3** (Good health and well-being) and **SDG6** (Clean water and sanitation) are relatively specialised in research in these areas — **Alignment strongly related to historical patterns of research specialisation**
  • **For all other SDGs, we found a misalignment or inconclusive relationship.** For example, the countries with the most unsustainable consumption/production patterns, generate more CO2 emissions, and contribute more to biodiversity loss, are usually higher income countries that are not specialized in research related to **SDG12** (Responsible consumption and production), **SDG13** (Climate action) or **SDG15** (Life on land).
Limitations

- Uncertainty and ambiguity of our estimates of SDG research priorities (Armitage et al., 2020) and SDG challenges (Miola and Schiltz, 2019)

- Synergies & trade-offs (e.g. Sharlemann et al. 2020)

- The marginal impact of increasing research investments in areas related to a certain SDG on the improvement of that SDG might be different across SDGs (e.g., local research in health (SDG3) may lead to significant improvements in the health outcomes of a country. In contrast, more local research on Poverty (SDG1) may not lead to similar marginal improvements.
Thank you!

If you want to know more about this research and STRINGS check tomorrow’s special session (SS -2C1) on:

"Mapping and interpreting the relation between STI and the SDGs"

Thursday 4 November at 10:30-12:00 local time (GMT+6).
Misalignment between SDG challenges and SDG research by income group

- **High income** (50 countries)
  - LI with higher challenges and lower SDG research share
- **Upper-middle income** (36 countries)
- **Lower-middle income** (28 countries)
- **Low income** (11 countries)

SDG Global Research Share % vs. SDG Score 08-17 (Distance to top5%)
SDG4: Quality Education

- High income
- Upper-Middle income
- Lower-middle income
- Low income
SDG7: Affordable and Clean Energy

- High income
- Upper-Middle income
- Lower-middle income
- Low income

SDG Research Specialisation 15-19 vs SDG Score 08-17 (Distance to top5%)

- SDG7: Affordable and Clean Energy
SDG14: Life Below Water

- High income
- Upper-Middle income
- Lower-middle income
- Low income

SDG Score 08-17 (Distance to top5%)

-1 -0.5 0 0.5 1
SDG15: Life on Land

SDG Research Specialisation 15-19

SDG Score 08-17 (Distance to top5%)

High income
Upper-Middle income
Lower-middle income
Low income