GIS-based assessment indicators for SDGs implementation in South Korea

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Professor of Department of Environmental Science and Ecological Engineering
Korea University
CONTENTS

1. How to understand SDGs?
2. How to assess SDGs implementation?
3. How to achieve SDGs?
1. How to understand SDGs?
2. How to assess SDGs implementation?
3. How to achieve SDGs?
1. How to understand SDGs?

→ ALL ASPECTS

• The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership.
The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership.
1. How to understand SDGs?

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership.
1. How to understand SDGs?
2. How to assess SDGs implementation?
3. How to achieve SDGs?
2. How to assess/evaluate SDGs implementation: **SDSN Dashboards**

SDG Dashboard for OECD countries
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

<SDG Dashboard for Eastern Europe and Central Asia>

<SDG Trend Dashboard for Eastern Europe and Central Asia>
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

- SDSN Dashboard of South Korea (2018)

  - Dashboard Evaluation Result
    - 27th 2016 ☞ 31th 2017 ☞ 19th 2018
    - Changes in the evaluation method had the greatest impact on the change of the results
    - Most goals indicate improvement or status quo, but decrease for goals 13,15
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

- SDSN Dashboard of Kazakhstan (2018)

  - Dashboard Evaluation Result
  - 54th 2016 ☞ 6th 2017 ☞ 65th 2018
  - Most goals indicate improvement or status quo.
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

- SDSN Dashboard of Kyrgyzstan (2018)

  - Dashboard Evaluation Result
    - 67th 2016 ☞ 49th 2017 ☞ 51th 2018
    - Most goals indicate improvement or status quo.
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

• SDSN Dashboard of Uzbekistan (2018)

  - Dashboard Evaluation Result
  - n/a 2016 ☞ 45th 2017 ☞ 52th 2018
  - Most goals indicate improvement or status quo.
2. How to assess/evaluate SDGs implementation: SDSN Dashboards


  - Dashboard Evaluation Result
    - 65th 2016 > 48th 2017 > 45th 2018
    - Most goals indicate improvement or status quo.
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

- SDSN Dashboard of Afghanistan (2018)
  - Dashboard Evaluation Result
    - 139th 2016 ➔ 150th 2017 ➔ 151th 2018
    - Most goals indicate status quo.
2. How to assess/evaluate SDGs implementation: **SDSN Dashboards**

- **SDSN Dashboard of Tajikistan (2018)**

  - Dashboard Evaluation Result
    - 72th 2016 🟢 72th 2017 🟢 73th 2018
    - Most goals indicate improvement or status quo but decrease for goals 4, 11.
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

- SDSN Dashboard of Turkmenistan (2018)

  Dashboard Evaluation Result
  - n/a 2016 ☞ 117th 2017 ☞ 110th 2018
  - Most goals indicate improvement or status quo but decrease for goal 13.
2. How to assess/evaluate SDGs implementation: SDSN Dashboards

- SDSN Dashboard of North Korea (2018)

  • Dashboard Evaluation Result
    - n/a 2016
    - n/a 2017
    - n/a 2018
  - Most goals indicate improvement or status quo.
2.1 Analysis of SDSN Dashboards Indicators
### 2.1 Analysis of SDSN Dashboards Indicators in South Korea

<table>
<thead>
<tr>
<th>SDSN Indicators</th>
<th>National Statistics</th>
<th>SDSN (value)</th>
<th>SDSN (Normalized value)</th>
<th>SDSN Dashboards (2018)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of undernourishment (%)</td>
<td>9.0</td>
<td>2.5</td>
<td>94.1</td>
<td></td>
<td>FAO(2017)</td>
</tr>
<tr>
<td>영양 부족 현황(%)</td>
<td>2.5</td>
<td>2.5</td>
<td>95.0</td>
<td></td>
<td>Unicef, WHO, World Bank(2017)</td>
</tr>
<tr>
<td>Prevalence of stunting, under-5s (%)</td>
<td>0–7% (Yu, 2009)</td>
<td>0.9</td>
<td>94.5</td>
<td></td>
<td>Unicef, WHO, World Bank(2017)</td>
</tr>
<tr>
<td>5세미만의 발육 부진 현황(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of wasting, under-5s (%)</td>
<td>0~7% (Yu, 2009)</td>
<td>0.9</td>
<td>94.5</td>
<td></td>
<td>Unicef, WHO, World Bank(2017)</td>
</tr>
<tr>
<td>5세미만의 저체중 현황(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of adult obesity (%)</td>
<td>39.84</td>
<td>4.7</td>
<td>94.0</td>
<td></td>
<td>WHO(2017)</td>
</tr>
<tr>
<td>성인 비만 현황(%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cereal yield (t/ha)</td>
<td>6.8</td>
<td>6.8</td>
<td>77.0</td>
<td></td>
<td>FAO(2017)</td>
</tr>
<tr>
<td>곡물 수확량(t/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sust. Nitrogen Management Index</td>
<td>0.6</td>
<td>44.8</td>
<td></td>
<td></td>
<td>Zhang, X. &amp; Davidson, E.(2016)</td>
</tr>
<tr>
<td>지속가능한 질소 관리 지수</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

✓ Differences between National Statistics and SDSN value
✓ If NS is not available, low evaluation (ex. Nitrogen)
While SDG2 (Zero Hunger) is generally rated ‘good’, the adult obesity is showing an increasing trend.
## 2.1 Analysis of SDSN Dashboards Indicators in South Korea

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<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-income countries: population using safely managed water services (%)</td>
<td></td>
<td>98.9</td>
<td>98.5</td>
<td>98.2</td>
<td>JMP (2018)</td>
</tr>
<tr>
<td>안전하게 관리되는 식수 서비스를 이용하는 인구 비율</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other countries: population using at least basic drinking water services (%)</td>
<td>-</td>
<td>NA</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>High-income countries: population using safely managed sanitation services (%)</td>
<td>93.2</td>
<td>98.5</td>
<td>97.8</td>
<td></td>
<td>JMP (2018)</td>
</tr>
<tr>
<td>안전하게 관리되는 위생시설 서비스를 이용하는 인구 비율</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other countries: population using at least basic sanitation services (%)</td>
<td>-</td>
<td>NA</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Freshwater withdrawal as % total renewable water resources</td>
<td>44.8 (2007)</td>
<td>57.6</td>
<td>48.5</td>
<td></td>
<td>FAO (2018)</td>
</tr>
<tr>
<td>총 재생가능한 수자원 중 깨끗한 취수 비율</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imported groundwater depletion (m3/year/capita)</td>
<td>-</td>
<td>10.8</td>
<td>75.0</td>
<td></td>
<td>Dalin et al. (2017)</td>
</tr>
<tr>
<td>세계 식량 무역에 포함된 지하수 고갈 정도</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- National Statistics has more detail indicator than SDSN.
- Indicator integration will be needed.
✓ Indicators relevant to SDG 6 have been produced as a time series data since 1990s in South Korea.
✓ There is a tendency to be improved in water related indicators.
2.1 Analysis of SDSN Dashboards Indicators in South Korea

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</tr>
</thead>
<tbody>
<tr>
<td>Access to electricity (% population)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>SE4All (2018)</td>
</tr>
<tr>
<td>Access to non-solid fuels (% population)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>SE4All (2018)</td>
</tr>
<tr>
<td>CO2 emissions from fuel combustion / electricity output (MtCO2/TWh)</td>
<td>-</td>
<td>1.1</td>
<td>65.9</td>
<td>IEA (2016)</td>
</tr>
<tr>
<td>Share of renewable energy in total final energy consumption (%)</td>
<td>2.84</td>
<td>2.7</td>
<td>-</td>
<td>World Bank (2018)</td>
</tr>
</tbody>
</table>

✓ National Statistics indicators have equal or similar value to SDSN indicators.
Access rates to the electricity and fuel are very high in South Korea, and the ratio of renewable energy is also improving with a rapid pace.
### 2.1 Analysis of SDSN Dashboards Indicators in South Korea

- **Annual mean concentration of particulate matter of less than 2.5 microns of diameter (PM2.5) in urban areas (μg/m³)**
  - SDSN (value): 28.7
  - SDSN (Normalized value): 72.3
  - Source: Brauer et al. (2016)

- **Improved water source, piped (% urban population with access)**
  - SDSN (value): 98.9
  - SDSN (Normalized value): NA
  - Source: WHO and UNICEF (2018)

- **Satisfaction with public transport (%)**
  - SDSN (value): 75.0
  - SDSN (Normalized value): 87.7
  - Source: Gallup (2018)

- **Rent overburden rate (%)**
  - SDSN (value): 3.5
  - Source: OECD (2018)

- **South Korea**: ✓

There are differences between SDSN indicators and National Statistics.
PM10 steadily decreased from 1995 to 2016.

Source: Annual air quality, 2016
2.1 Analysis of SDSN Dashboards Indicators in South Korea

There is only one directly comparable indicator.

The source of the data is the research paper and it is difficult to obtain accurate Korean data.

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</tr>
</thead>
<tbody>
<tr>
<td>E-waste (kg/capita)</td>
<td>-</td>
<td>15.9</td>
<td>32.6</td>
<td></td>
<td>UNU-IAS (2015)</td>
</tr>
<tr>
<td>재활용되지 않은 도시 고형 폐기물</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater treated (%)</td>
<td>4951</td>
<td>84.8</td>
<td>84.8</td>
<td></td>
<td>Hsu et al. (2016)</td>
</tr>
<tr>
<td>처리되는 폐수 비율</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production-based SO2 emissions (kg/capita)</td>
<td>-</td>
<td>14.5</td>
<td>79.4</td>
<td></td>
<td>Zhang et al. (2017)</td>
</tr>
<tr>
<td>생산 기반 SO2 발생량</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net imported SO2 emissions (kg/capita)</td>
<td>-</td>
<td>11.2</td>
<td>62.7</td>
<td></td>
<td>Zhang et al. (2017)</td>
</tr>
<tr>
<td>총 수입된 SO2 발생량</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen production footprint (kg/capita)</td>
<td>-</td>
<td>33.9</td>
<td>62.5</td>
<td></td>
<td>Oita et al. (2016)</td>
</tr>
<tr>
<td>질소 생산 발자국</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net imported emissions of reactive nitrogen (kg/capita)</td>
<td>-</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>Oita et al. (2016)</td>
</tr>
<tr>
<td>총 수입된 활성 질소 발생량</td>
<td>14.8</td>
<td>0.5</td>
<td></td>
<td></td>
<td>World Bank (2012); OECD (2017a)</td>
</tr>
</tbody>
</table>
2.1 Analysis of SDSN Dashboards Indicators in South Korea

 ✓ Ratio of recycled waste rises steadily.
 ✓ The amount of national wastewater is decreasing.
2.1 Analysis of SDSN Dashboards Indicators in South Korea

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</tr>
</thead>
<tbody>
<tr>
<td>Energy-related CO2 emissions per capita (tCO2/capita)</td>
<td>601.0</td>
<td>11.6</td>
<td>51.1</td>
<td>Oak Ridge National Laboratory (2018)</td>
<td></td>
</tr>
<tr>
<td>Imported CO2 emissions, technology-adjusted (tCO2/capita)</td>
<td>13.5</td>
<td>-1.6</td>
<td>100.0</td>
<td>Kander et al., (2015)</td>
<td></td>
</tr>
<tr>
<td>Climate Change Vulnerability Monitor (best 0-1 worst)</td>
<td>31,862,144</td>
<td>0.0</td>
<td>90.3</td>
<td>HCSS (2015)</td>
<td></td>
</tr>
<tr>
<td>CO2 emissions embodied in fossil fuel exports (kg/capita)</td>
<td>48.3</td>
<td>0.8</td>
<td>100.0</td>
<td>UN Comtrade (2018)</td>
<td></td>
</tr>
<tr>
<td>Effective Carbon Rate from all non-road energy, excluding emissions from biomass (€/tCO2)</td>
<td>-</td>
<td>9.9</td>
<td>-</td>
<td>OECD (2018)</td>
<td></td>
</tr>
</tbody>
</table>

- There are large differences between national statistics and SDSN values.
- As a result, it was evaluated as bad (red).
2.1 Analysis of SDSN Dashboards Indicators in South Korea

- Climate change-related emissions are steadily increasing.
- Increasing rate is decreasing.
## 2.1 Analysis of SDSN Dashboards Indicators in South Korea

SDSN value shows a similar level compared to national statistics.

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<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean area that is protected in terrestrial sites important to biodiversity (%)</td>
<td>36.55</td>
<td>36.6</td>
<td>33.5</td>
<td>Birdlife International et al., (2018)</td>
<td></td>
</tr>
<tr>
<td>생물 다양성에 중요한 풍림지역에서 보호되는 평균 면적 (%)</td>
<td>36.77</td>
<td>36.8</td>
<td>36.6</td>
<td>Birdlife International et al., (2018)</td>
<td></td>
</tr>
<tr>
<td>Red List Index of species survival (0-1)</td>
<td>0.78</td>
<td>0.78</td>
<td>37.8</td>
<td>IUCN and Birdlife International (2018)</td>
<td></td>
</tr>
<tr>
<td>Annual change in forest area (%)</td>
<td>0.5</td>
<td>3.5</td>
<td>83.7</td>
<td>Global Forest Watch (2014) &amp; EPI (2018)</td>
<td></td>
</tr>
<tr>
<td>Imported biodiversity threats (threats per million population)</td>
<td>-</td>
<td>7.3</td>
<td>72.7</td>
<td>Lenzen et al., (2012)</td>
<td></td>
</tr>
</tbody>
</table>

| Source | |
|--------| |
| Birdlife International et al., (2018) | |
| IUCN and Birdlife International (2018) | |
| Lenzen et al., (2012) | |
2.1 Analysis of SDSN Dashboards Indicators in South Korea

Protection Area Rate
담수, 육지생물다양성 보호구역 비율(%)

South Korea

✓ Protection area is once increased in 2008 and maintained.
## Analysis of SDG Indicators among UN, SDSN, K-SDGs

<table>
<thead>
<tr>
<th>SDGs</th>
<th>UN Indicators</th>
<th>SDSN Indicators (UN indicators, SDSN indicators)</th>
<th>Domestic Statistics (UN indicators, SDSN indicators)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOAL 2</td>
<td>13 (100)</td>
<td>5 (38.4), 6 (100)</td>
<td>9 (69.2), 5 (83.33)</td>
</tr>
<tr>
<td>GOAL 6</td>
<td>11 (100)</td>
<td>3 (27), 4 (100)</td>
<td>9 (82), 3 (75)</td>
</tr>
<tr>
<td>GOAL 7</td>
<td>6 (100)</td>
<td>3 (50), 4 (100)</td>
<td>4 (66.7), 3 (75)</td>
</tr>
<tr>
<td>GOAL 11</td>
<td>15 (100)</td>
<td>2 (13.33), 3 (100)</td>
<td>12 (80), 3 (100)</td>
</tr>
<tr>
<td>GOAL 12</td>
<td>13 (100)</td>
<td>4 (30.8), 7 (100)</td>
<td>8 (61.5), 2 (28.6)</td>
</tr>
<tr>
<td>GOAL 13</td>
<td>8 (100)</td>
<td>3 (37.5), 4 (100)</td>
<td>7 (87.5), 4 (100)</td>
</tr>
<tr>
<td>GOAL 15</td>
<td>14 (100)</td>
<td>4 (28.6), 5 (100)</td>
<td>12 (85.7), 5 (100)</td>
</tr>
</tbody>
</table>

✓ K-SDGs is better than SDSN in number of indicators to UN Indicators.
2.1 Analysis of SDSN Dashboards Indicators in South Korea

• Result of the analysis of SDSN Dashboard indicators
  • Significance
    • Easy to understand SDG achievement for each countries
    • Comparability among countries
    • Based on 2030 goals, the current achievement/implementation level can be identified
  • Limitation
    • Insufficient indicators to assess SDGs
    • Differences between national statistics and SDSN values
      • In case of South Korea, SDGs can be better evaluated with Korean National Statistics
    • A time-series evaluation is not possible.
  • Future Direction
    • Need to increase the number of SDGs indicators
    • Values need to be same or similar to the National Statistics
    • Indicators should be consistent to make time-series evaluations
2.2 Availability of Spatial Indicators for SDGs
2.2 Availability of Spatial Indicators of SDGs

- SDGs achievement should be evaluated at the local level in a countries.
- Spatial indicators are essential for local level evaluation.

<Map of the administrative units in South Korea>
2.2 Availability of Spatial Indicators of SDGs

- Availability analysis algorithms to determine spatial data availability for SDG indicators
- Analysis of the index that can spatially assess Korea’s sustainable development goals (K-SDGs)
## 2.2 Availability of Spatial Indicators of SDGs

<table>
<thead>
<tr>
<th>#</th>
<th>UN Indicators</th>
<th>Applicability in S, Korea</th>
<th>Availability</th>
<th>Proxy Indicators</th>
<th>Quantified Data</th>
<th>Quantification</th>
<th>Spatial Data</th>
<th>Spatialization</th>
<th>Source</th>
<th>Attributes</th>
<th>Space Resolution</th>
<th>Time Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2.1</td>
<td>Prevalence of stunting among children under 5 years of age</td>
<td>O</td>
<td>O</td>
<td>-</td>
<td>O</td>
<td>-</td>
<td>X</td>
<td>O</td>
<td>MOHW</td>
<td>Stat.</td>
<td>Nat’l</td>
<td></td>
</tr>
</tbody>
</table>
<pre><code>                                                  |                             |               |               |                 |                 |               |             |               |        |            | 2) 1998–2016     |
</code></pre>
<p>| 2.3.1 | Volume of production per labour unit by classes of farming/pastoral/for estry enterprise size | O                          | O             | -                | O               | -             | X            | O             | KOSTAT  | Stat.      | Sido            | 2003–2017        |</p>
## 2.2 Availability of Spatial Indicators of SDGs

<table>
<thead>
<tr>
<th>#</th>
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<th>Spatialization</th>
<th>Source</th>
<th>Attributes</th>
<th>Space Resolution</th>
<th>Time Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.2</td>
<td>Average income of small-scale food producers, by sex and indigenous status</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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</tr>
<tr>
<td>2.4.1</td>
<td>Proportion of agricultural area under productive and sustainable agriculture</td>
<td>O</td>
<td>X</td>
<td>O</td>
<td>O</td>
<td>–</td>
<td>X</td>
<td>O</td>
<td>KOSTAT</td>
<td>Stat.</td>
<td>Nat’l</td>
<td>X</td>
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<tr>
<td>2.5.1</td>
<td>Number of plant and animal genetic resources for food and agriculture</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>2.5.2</td>
<td>Proportion of local breeds classified as being at risk</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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## 2.2 Availability of Spatial Indicators of SDGs

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<tr>
<th>#</th>
<th>UN Indicators</th>
<th>Applicability</th>
<th>Availability</th>
<th>Proxy Indicators</th>
<th>Quantified Data</th>
<th>Quantification</th>
<th>Spatial Data</th>
<th>Spatialization</th>
<th>Source</th>
<th>Attributes</th>
<th>Space Resolution</th>
<th>Time Scale</th>
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<tr>
<td>2.a.1</td>
<td>The agriculture orientation index for government expenditures</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
<td>KOEXIM Stat.</td>
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<td>2.c.1</td>
<td>Indicator of food price anomalies</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td>2012−2016</td>
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</table>

*KOEXIM: Korea Export-Import Bank*
2.2 Availability of Spatial Indicators of SDGs

- Prevalence of undernourishment
- Percentage of hazardous waste per person
- National recycling rate

National Level Data  |  Local Level Data  |  Small Local Level Data

<Prevalence of undernourishment>  |  <Percentage of hazardous waste per person>  |  <National recycling rate>
### 2.2 Availability of Spatial Indicators of SDGs

- Most of UN Indicators are applicable in South Korea.
- Most of UN Indicators are available in South Korea.
- Spatial indicators for local level are not available.

<table>
<thead>
<tr>
<th>SDG</th>
<th>Applicability to South Korea</th>
<th>Availability of Indicators</th>
<th>Spatial Data (National/Regional/Local)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOAL 2 (13)</td>
<td>12 (92.3%)</td>
<td>9 (69.2%)</td>
<td>9 (9/2/0)</td>
</tr>
<tr>
<td>GOAL 6 (11)</td>
<td>10 (90.9%)</td>
<td>9 (81.8%)</td>
<td>9(7/3/0)</td>
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<tr>
<td>GOAL 7 (6)</td>
<td>6 (100%)</td>
<td>6 (100%)</td>
<td>6 (6/0/0)</td>
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<tr>
<td>GOAL 12 (13)</td>
<td>13 (100%)</td>
<td>12 (92.3%)</td>
<td>12 (12/2/2)</td>
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<tr>
<td>GOAL 13 (8)</td>
<td>7 (87.5%)</td>
<td>7 (87.5%)</td>
<td>7 (6/4/0)</td>
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<tr>
<td>GOAL 15 (14)</td>
<td>13 (92.9%)</td>
<td>12 (85.7%)</td>
<td>12 (12/5/2)</td>
</tr>
</tbody>
</table>
2.2 Availability of Spatial Indicators of SDGs

• SDGs Achievement in local level in Republic of Korea
  • Assess the SDGs implementation by local government
  • Local SDGs implementation can be supported by identifying strong and weak points.

SDGs Achievement by Local Government
2.2 Availability of Spatial Indicators of SDGs

- Spatial Indicators for Local Government are preparing
  - For supporting SDGs implementation of local government

<Spatial indicators for Goal 6>
2.2 Availability of Spatial Indicators of SDGs

• Results of availability of spatial indicators of SDGs
  • Significance
    • Identified the possibility of spatial SDGs indicators at the local level as well as national level with domestic data
    • Identified the possibility of spatial SDGs evaluation at the local level as well as national level
  • Limitation
    • Insufficient spatial data for SDGs indicators at the local level
    • There exist differences in calculation methods between UN indicators and national statistics
  • Future Direction
    • Spatial data for SDGs at the local level should be available.
    • Indicator development using various spatial data for South Korea is necessary.
1. How to understand SDGs?
2. How to assess SDGs implementation?
3. How to achieve SDGs?
3.1 Synergy and Trade-off
3.1 Synergy and Trade-off

• What is Nexus?
  • Nexus concept is the complex interdependencies between the various sectors and seek to analyze them as a single system to promote resources sustainability.
3.1 Synergy and Trade-off

- Through the Nexus among SDGs, plan to reduce Trade-offs and increase Synergy can be made.
3.1 Synergy and Trade-off

• Previous Research
  • The Land Development Phases (LDPs) and SDGs
    • The Land Development Phases (LDPs) can be identified by GDP, GDP per capita and forest area change (Song et al., 2017)
    • The forest management should be different by the level of LDPs.
    • The synergy and trade-offs among SDGs can be varied on the different forest management by each level of LDPs.

- Land Degradation Phases
  - Central Asia, North Korea

- Restoration phases
  - China, Northern Africa

- Sustainability Phases
  - Europe, North America, South Korea

Land Development Phases (considering GDP and GDP per capita with forest area change (Source: Song et al. 2017))
3.1 Synergy and Trade-off

- Previous Research
  - The LDPs and synergy/Trade-off among forest SDGs
    - In the Degradation Phase, the regulations should be carried out against the high need of timber (Goal12) and food production (Goal2).
    - In the Restoration Phase, the policies is adapted to prevent forests (Goal15) from being converted for other development purpose such as road, industry complex (Goal 9).
    - In the Sustainability Phase, the government highlights the cultural function of forest.

Ecosystem services by each land development phase (Source: Song et al. 2017)
3.1 Synergy and Trade-off

• Previous Research
  • A Case of Degradation Phase: North Korea
    • Stock forest is the largest source of water supplier on land.
    • The sharp decrease of stock forest (Goal 15) has significant reduced water supply (-40%) → Trade-off
    • Unfortunately, the expanded agricultural land has increased water demand(+60%) (Lim et al., 2018) → Trade-off

The change of Forest water supply and agricultural land water demand due to the deforestation (Lim et al., 2019)

Spatial extraction with original croplands and converted croplands using the organic carbon loss of rice paddies (Lim et al., 2019)
3.1 Synergy and Trade-off

• Previous Research
  • The case of sustainability Phases: South Korea
  • Forest ecosystem service should take into account the environmental and social conditions of forest (Burkhard et al., 2012)

The ecosystem services become high, when there is high air pollutant and density of population (Cho et al, 2016)

When city are under drought, there is a high demand of water service (Cho et al, 2016)

Causal Loop Diagram for tourism development within Cat Ba Island (Mai, T., & Smith, C., 2015)
3.1 Synergy and Trade-off

• **Nexus Pathway**
  • Water-Food-Ecosystem Nexus as a solution to achieve SDGs at the regional and global level is key instrument for understanding synergy and trade-off.
  • The responsible consumption and production (Goal 12) of food (Goal 2), water (Goal 6), bioenergy (Goal 7) on the land and terrestrial ecosystem (Goal 15) can help to combat climate change (Goal 13) in cities and communities (Goal 11) through infrastructure (Goal 9) and institution (Goal 16) in the Mid-Latitude Region.
3.2 Latitudinal Cooperation
3.2 Latitudinal Cooperation

- Mid-Latitude region can be broadly defined as horizon belt between 30°- 45° latitude, encompassing about 36 countries from North-East and Central Asia, Black Sea, Mediterranean, Southern part of Europe, North America.
  - Temperate climate: average temperature ranges from 10 to 20°C, representing dry and semi-dry region
  - Demographics: about 50% of world’s population live in Mid-Latitude countries (20°N-40°N), experiencing water and food shortage driven by extreme climatic and environmental condition.
3.2 Latitudinal Cooperation

- **Main challenges of SDGs in the Mid-Latitude region will be Desertification, Water and Food Shortage**
  - The land cover of Mid-Latitude is comprised mostly of arid or semi-arid dry land due to extreme climatic and environmental condition, bring about desertification.
  - And most of Mid-Latitude region are suffering from water stress
  - Water shortage scarcity has negative impacts on crop productivity and bring about food shortage

→ Need to consider Water(Goal 6)-Food(Goal 2)-Ecosystem(Goal 15) Nexus in the Mid-Latitude

---

Environmental Condition in Mid-Latitude Region

Annual precipitation over 30 years (produced based on WorldClim data)

Baseline Water Stress (World Resource Institute)
3.2 Latitudinal Cooperation

- Ecologically (SDGs 15), Mid-Latitude are experiencing **Land Cover/Use Conflicts**
  - Major part of this Mid-Latitude ecotone is known as transition from forest to steppe zone
  - In the Mid-Latitude region, mixed forest, croplands, and grasslands are latitudinally distributed
  - And there appears Land cover/use conflicts among forests, croplands, grasslands

→ Need to consider **Sound Production and Consumption (SDGs 12) of Water (Goal 6) and Food(Goal 2)** in **Terrestrial Ecosystem(Goal 15)** in the Mid-Latitude

[Diagram of land cover types in the Mid-Latitude region]
3.2 Latitudinal Cooperation

- Regarding Climate Change (SDGs 13), Mid-Latitude can impact on Variability of Global Carbon Budget
  - High carbon sink production is mainly the tropical forest but inter-annual variability of the sink are dominated by semi-arid ecosystems. → SDGs 13 and SDGs 15
  - Carbon cycle in semiarid area is strongly associated with precipitation and temperature
  - It is more efficient to increase the carbon sequestration amount in semi-arid area than the tropical area.

The dominant role of semi-arid ecosystems in the trend and variability of the land CO$_2$ sink
3.2 Latitudinal Cooperation

- Regarding Climate Change (SDGs 13), **Mid-Latitude can impact on Global Hydrological Cycle**
  - Mid-Latitude afforestation can be capable of driving changes in circulation of general circulation and precipitation
  - The impoverishment and death of forests over this region will have negative impact on carbon budget

→ Need to consider the Afforestation and Forest Management in the Terrestrial Ecosystem Management (Goal 15) for Climate Change adaptation (Goal 13) and Water Security (Goal 6) in Mid-Latitude

Mid-Latitude afforestation shifts general circulation and tropical precipitation

3.2 Latitudinal Cooperation

- Regarding SDGs 12, Mid-Latitude is suffering from still Land Degradation Phases
  - Land Development Phases by GDP and GDP per capita and forest area change rates
  - Most of Mid-Latitude as central Asia is suffering from still Land Degradation Phases, while it shows the Sustainability Phases in most of Europe and North America. Some countries as China and northern Africa is in the Restoration Phases

→ Need to consider balance between economic development (Goal 8) and land management (Goal 13)
3.2 Latitudinal Cooperation

- **Regarding SDGs, Lower Achievement in All SDGs in the Mid-Latitude Region**
  - Lower Achievement in All SDGs in Mid-Latitude Region
  - Low Achievement in SDGs 13 in USA-China/ROK/Japan-Europe
  - Lowest Achievement in SDGs 2,6,7,15 in Mid-Latitude Region
3.2 Latitudinal Cooperation

- Limitation of Longitudinal Approach: Confusions in SDGs Indicators/no significant patterns

→ Better SDGs (especially, 2,6,7) in the High Latitude
→ Worse SDGs 13 in the High Latitude
→ Mid-Latitude in the Middle and low variation
3.2 Latitudinal Cooperation

- **Existing Latitudinal Networks**
  - Circum-boreal Region in the high latitude, South-South Cooperation in the low latitude
  - Black Sea Economic Cooperation, SDSN Mediterranean, One Belt One Road, Korea-Japan-China Trilateral Cooperation in the Mid-Latitude
  - But **Lack of the Integrated Mid-Latitudinal Cooperation**

- **Difficult for each Mid-Latitude Countries to address GLOBALLY their COMMON ISSUES such as Water-Food-Ecosystem Nexus**
3.2 Latitudinal Cooperation

- **Vertical Differences in Korean Peninsula: Forest and Carbon Degradation in North Korea**
  - There’s a sharp contrast between the North and South regarding its NEP.
  - South Korea has well managed its forest and carbon budget, while North Korea has experienced forest degradation and decreasing carbon budget.
  - Difficult for each Mid-Latitude Countries to address GLOBALLY their COMMON ISSUES such as Water-Food-Ecosystem Nexus.

→ **Korean Peninsula has same environmental and climatic condition, but different carbon budget and SDGs.**

---

*Estimation of Forest Carbon Budget from Land Cover Change in South and North Korea between 1981 and 2010*

3.2 Latitudinal Cooperation

- **Vertical Differences in Korean Peninsula**: Forest and Land Degradation causes low Agricultural Productivity in DPRK
  - The assessing AWE was calculated with WB and VWC, Definitely negative condition in North Korea than South Korea
  - The poor AWE causes lower crop and agricultural productivity in North Korea

→ Deforestation and Forest Degradation (SDGs 15) bring about
  - poor water condition (SDGs 6)
  - poor crop and agricultural productivity (SDGs 2)
  - poor carbon budget (SDGs 13)
  - poor living and all SDGs
3.2 Latitudinal Cooperation

- The Development Chronology of South Korean Compressed Growth as a Reference
  - To understand the sustainable development, an integrated and holistic approach is necessary.
  - This study introduces the development of South Korea from economic, environmental, social and political perspectives.
  - The development phase of the countries in the mid-latitude region (MLR) are analyzed from this perspective.
3.2 Latitudinal Cooperation

• The Development Chronology of South Korean Compressed Growth as a Reference
  • Economic Development
    • Normalized with the maximum and the minimum values from 1950-2015
3.2 Latitudinal Cooperation

- The Development Chronology of South Korean Compressed Growth as a Reference
  - Environmental Development
    - Normalized with the maximum and the minimum values from 1950-2015
3.2 Latitudinal Cooperation

- The Development Chronology of South Korean Compressed Growth as a Reference
  - Social Development
    - Normalized with the maximum and the minimum values from 1950-2015
3.2 Latitudinal Cooperation

• The Development Chronology of South Korean Compressed Growth as a Reference
  • Political Development
    • Normalized with the maximum and the minimum values from 1950-2015
3.2 Latitudinal Cooperation

- Chronological Comparison
  - Current status of 46 countries
  - The values of indicators were normalized with the maximum and the minimum values of South Korean indicators and they were averaged for each sector.
3.2 Latitudinal Cooperation

- 6 Role Classes
  - Natural Breaks (Jenks) Optimization (Jenks, 1967; McMaster, 1997)
  - Six classes: role model, good, moderate, low, serious, and alarming
3.2 Latitudinal Cooperation

• 6 Role Classes
  • Natural Breaks (Jenks) Optimization (Jenks, 1967; McMaster, 1997)
  • Six classes: role model, good, moderate, low, serious, and alarming
3.2.1 Cooperation with SDSN-Korea

• UNSDSN (Sustainable Development Solutions Network)
  • Global network of knowledge institutions on global challenges
  • Director: Dr. Jeffrey Sachs, Columbia University Professor

• SDSN Korea ([http://sdsnkorea.org](http://sdsnkorea.org))
  • The Korea chapter of the UNSDSN (Director: Woo-Kyun Lee)
  • The regional flagship project of SDSN Korea, “SDSN-MLRN”
    • Central Asian Countries (incl. Nepal, Bhutan: high mountain area))
    • [http://mlrnetwork.org](http://mlrnetwork.org)

• SDSN Youth Korea
  • Empowering youth globally to create sustainable solutions
  • Monthly SDG Youth Academy series
3.2.2 Cooperation with MLRN (Mid-Latitude Region Network)

- **EGMs for MLRN**
  - Since 2014, 7 EGMs (Expert Group Meetings) for Water-Food-Ecosystem Resilience in Mid-Latitude Region
  - 2014: Researchers identified the need for collaborative research on the Mid-Latitude Region
  - 2015: Task force team for establishing MLRN was organized
  - 2016: 'Mid-Latitude Region Network (MLRN)' centered on 26 experts from 13 countries was officially established

- **Open MLRN Web Site**
  - 2017: OJERI supports MLRN-office
  - 2018: Open MLRN Web Site ([http://www.mlrnetwork.org](http://www.mlrnetwork.org))/ Link MLRN Activities to SDSN-Korea Activities
3.2.2 Cooperation with MLRN (Mid-Latitude Region Network)

- MLRN (Mid-Latitude Region Network) [http://mlrnetwork.org](http://mlrnetwork.org)
- Established in 2016
- About 50 members and partners
- Region: Mid-Latitude Region
- Goal: Water-Food-Ecosystem Resilience/Nexus
- On Going Activities
  - Drought Monitoring
  - Disaster Risk Reduction (DRR)
  - Food Security
- Three Bodies
  - Governing body
  - Scientific Committee
  - Young Scholar Committee
- Be free to be a Member for MLRN
### 3.2.2 Cooperation with MLRN (Mid-Latitude Region Network)

#### Members of Expert Group

<table>
<thead>
<tr>
<th>No</th>
<th>Country</th>
<th>Name</th>
<th>Affiliation</th>
<th>Position</th>
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<td>1</td>
<td>Austria</td>
<td>Florian KRAXNER</td>
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<td>Deputy Director</td>
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<tr>
<td>2</td>
<td>Afghanistan</td>
<td>M. Daoud HAMIIDI</td>
<td>Jamii University</td>
<td>Lecturer</td>
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<td>3</td>
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<td>Dep. of Project Management, Ministry of Emergency Situations</td>
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<tr>
<td>4</td>
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<td>Rashad GASIMZADE</td>
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<td>5</td>
<td>Bhutan</td>
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<td>Bhutan Institute for Himalayan Studies</td>
<td>CEO</td>
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<td>6</td>
<td>Germany</td>
<td>Sabine FUSS</td>
<td>Mercator Research Institute on Global Commons and Climate Change (MCC)</td>
<td>Working Group Leader</td>
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<td>Greece</td>
<td>Haris KONTOES</td>
<td>National Observatory of Athens</td>
<td>Research Director</td>
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<td>8</td>
<td>Greece</td>
<td>Kanaris TSINGANOS</td>
<td>University of Athens</td>
<td>Professor</td>
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<td>Anar TULEUBAEVA</td>
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<td>Chief expert</td>
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<td>Tynshykbek KENJIEBAEV</td>
<td>Center for Crisis Management, Ministry of Emergency Situations</td>
<td>Leading specialist</td>
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</table>
3.2.2 Cooperation with MLRN (Mid-Latitude Region Network)

- Focuses of SDSN-MLRN
  - Earth Observation data based Water-Food –Ecosystem Monitoring
  - Assessing Vulnerability of Water-Food-Ecosystem Resilience
  - Developing latitudinal adaptive pathway for Food-Water-Ecosystem resilience

→ Water-Food-Ecosystem Nexus as a solution to achieve SDGs at the regional and global level: The responsible consumption and production (Goal 12) of food (Goal 2), water (Goal 6), bioenergy (Goal 7) on the land and terrestrial ecosystem (Goal 15) can help to combat climate change (Goal 13) in cities and communities (Goal 11) through infrastructure (Goal 9) and institution (Goal 16) in the Mid-Latitude Region
3.2.3 Cooperation with OJERI and ARC

- ARC (Asia Resilience Center) is a scientific opinion board with a bottom-up approach to long-term sustainable social-ecological systems in Asia
  - A joint initiative among the OJERI (OJeong Eco-Resilience Institute) of KU with other international research organizations

- Asia Resilience Center (ARC) Conference 2019


11(Mon) to 12(Tue) November 2019
@Republic of Korea
SUMMARY

1. How to understand SDGs?
   → Synergy

2. How to assess SDGs implementation?
   → Spatial Indicators

3. How to achieve SDGs?
   → Cooperation
Thank you...

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