ESCWA’s Contribution to Regional Geospatial Data For SDGs-Environment Indicators and Disaster Risk Management

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ESCWA-Statistics Mandates on Geospatial

The Geospatial Strategy for the United Nations aims to contribute to the data ecosystem by enabling location information for the Organization. The vision is to build synergy on activities and investments on geospatial information management in the United Nations, “Delivering as One” by bringing geospatial data to innovate and to act for a better world.

UNESCAWA-Statistics contribution to the UN-GGIM for the Arab States

UN Task Force on Population and Housing Census for Arab Countries in 2020 Census Round, going back to 2005

Geographical Information System (GIS) in population Censuses Dedicated Site for Arab Population and Housing Censuses Events and Resources

UNESCAWA-Statistics support to Member States on SDGs monitoring

Regional and Inter-regional methodologies and Capacity building:

- Regional Workshop on the Integration of Big Data and Geospatial Information for the Compilation of SDG Indicators in Arab Countries 13-15 October 2020
- Integration of Geospatial Information With Statistical Information in Support of the SDG Indicators.
- First Expert Forum for Producers and Users of Disaster-related Statistics, 07 - 10 June 2021 online Session 3 this afternoon on Geospatial Dimension.
Geospatial and Earth observations for SDGs


https://aries.integratedmodelling.org/

1. **UN-ESCWA and ETC-UMA EU-survey in 2018** for 3 countries: population, human settlements and infrastructure; land use and land cover; biodiversity; water; air quality and marine ecosystems. and that addressed the following: a) availability of relevant sources of spatial data for SDG indicator reporting b) data needs and data gaps select the thematic areas where data is needed to meet the requirements and c) spatial data analysis, management and storage capacities

2. **ESCWA’s Survey in 2018: Assessing the Status and Needs of Arab Countries to Produce and Utilize Geospatial Information as a Data Source for the SDGs**

3. **Questionnaire to monitor the status quo regarding administrative records, big data and geospatial information in the Arab countries in 2020**
1- Survey on Developing and Utilising Geospatial Data and Workflows to Monitor Environmental -Sustainable Development Goal in 3 countries

Country Scoping and Assessment

- Data availability for environmental SDG monitoring
  - Population, human settlements and infrastructure
  - Land use and land cover
  - Biodiversity, Water, Air Quality, Marine
- Data needs and data gaps select the thematic areas where data is needed to meet the requirements
- Spatial data analysis, management and storage capacities

2. National Workshops for stakeholders on SDGs, environmental data, and geospatial information systems, in Egypt Jordan and Palestine (May 2018)

3. Undertook basic training and raising awareness in these 3 countries on the importance of geospatial workflows, global initiatives and technologies, and publicly accessible data that is relevant to SDG monitoring.

4. Overview of data and expertise availability and needs for establishing effective geospatial workflows for measuring and monitoring SDGs.

5. Final report on [http://www.etc.uma.es/un_escwa_etcuma/](http://www.etc.uma.es/un_escwa_etcuma/)
**SDGs considered**

6.6.1 Change in the extent of water-related ecosystems over time

11.3.1 Ratio of land consumption rate to population growth rate

11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities

14.5.1 Coverage of protected areas in relation to marine areas

15.3.1 Proportion of land that is degraded over total land area
Workflow to develop SDG indicators based on spatial data

1. Data are available at national level and with time series?
   - Yes
   - No

2. Are data up-to-date, complete & comparable?
   - Yes
   - No

3. Are data valid? (validate by stakeholders or groundtruthing)
   - Yes
   - No

4. Improvement with alternative datasets

5. Alternative datasets available?
   - Yes
   - No

6. At which scale?
   - Local
   - Regional

7. Use of e.g. remote sensing data

8. Disaggregation to national level

9. SDG indicator calculation and mapping
Figure 4: Data gaps identified per thematic domain
### Data availability for environmental geospatial SDG indicators

#### Table 1: Data availability for environmental geospatial SDG indicators

<table>
<thead>
<tr>
<th>Relevant target</th>
<th>Indicators</th>
<th>Jordan</th>
<th>Palestine</th>
<th>Egypt</th>
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</thead>
<tbody>
<tr>
<td><strong>End hunger, achieve food security and improved nutrition and promote sustainable agriculture</strong>&lt;br&gt;2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality</td>
<td>2.4.1 Proportion of agricultural area under productive and sustainable agriculture</td>
<td>✅️</td>
<td>✅️</td>
<td>✅️</td>
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<tr>
<td><strong>Ensure availability and sustainable management of water and sanitation for all</strong>&lt;br&gt;6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally</td>
<td>6.3.1 Proportion of wastewater safely treated</td>
<td>✅️</td>
<td>✅️</td>
<td>✅️</td>
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<tr>
<td>6.3.2 Proportion of bodies of water with good ambient water quality</td>
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<tr>
<td>6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity</td>
<td>6.4.2 Level of water stress: freshwater withdrawal as a proportion of available freshwater resources</td>
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<tr>
<td>6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes</td>
<td>6.6.1 Change in the extent of water-related ecosystems over time</td>
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Assessment of Spatial Data in Jordan

On Population, human settlements and infrastructure
Land Cover
Biodiversity
Water
Air Quality
Marine Env
Explore the use of remote sensing for disaster monitoring and impact evaluation- ESCWA Pilot Project with Google Earth Engine and GEO

Objectives

◦ Explore the effectiveness of remote sensing for detecting disaster areas
◦ Estimate disaster areas
◦ Estimate the area of affected land cover types (urban vs vegetation)
◦ Estimate the number of affected population
What is Google Earth Engine?

- Earth observations platform powered by Google’s Data Center Infrastructure
- Access to petabytes of remotely sensed datasets
- Geospatial data processing
- Allows for focusing on analysis rather than data management and storage
- 40 years of Landsat data
- Non-satellite imagery (elevation, topography, climate data, …)
- Fully-featured development environment (JavaScript, Python APIs)
- Easy data ingestion and asset management

https://console.cloud.google.com/home/dashboard?project=ee-disasterimpacts-gee4geo

https://developers.google.com/earth-engine/images/ee_earth_satellite_1440.png
- Egypt is characterized by vast deserts.
- Mediterranean and Red Sea.
- Vegetation landcover concentrated around the Nile river and the Nile delta.
- Focus: coastal Egypt and the Nile basin.
<table>
<thead>
<tr>
<th>Remote Sensing Data</th>
<th>National Sources Data</th>
<th>Other Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentinel-2 Multispectral Optical Imagery</td>
<td>National data on disasters</td>
<td>GLIDE datasets – Asian Disaster Reduction Center (ADRC)</td>
</tr>
<tr>
<td>Copernicus Global Land Cover Layers: CGLS-LC100 Collection 3</td>
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<tr>
<td>CHIRPS Daily: Climate Hazards Group InfraRed Precipitation with Station Data (version 2.0 final)</td>
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2020 Floods

Background

- Heavy rain and bad weather resulted in floods
- More than 40 people were killed
- More than 400 were injured
- Infrastructure’s capacity to handle the rain was exceeded

- State of emergency declared.
- Airports and ports were shut.
- Heavy precipitation between March 11 and March 12, 2020.
- Maximum estimated daily precipitation: 139 mm.

2020 Floods Background

- Inspect SAR images before and after the flood
- Create a SAR difference image (after – before)
- Delimit the areas with detected inundation
- Use K-Means Clustering, an unsupervised machine learning algorithm, to extract the inundated areas
- Calculate the total area from the resulting image pixels
- Calculate the affected agricultural area and affected urban area
- Calculate the number of affected population

CHIRPS Daily Precipitation Data on March 12, 2020 for Egypt
Importance and Impact

For Egypt

- In-house capacity for use of the data available from satellite imagery for damaged areas detected for past disasters (training was provided to ESWA staff and Egypt Statistical office).
- Improve disaster assessment.
- Improve understanding of flood-prone areas (like Wadi Al Natron and Ras Ghareb).
- Highlights areas where remote sensing performs well for disaster detection.
- Understand limitations of remote sensing for damage assessment in the case where ground-truthing data is not available.
- Better understanding of future changes in the flow and level of the Nile river due to Al Nahda Dam

For the region

- Advocacy for better use and integration of geospatial data to improve data-driven decision making in Egypt and other Arab countries in relation to disaster risk management.
- Expand the case study of Egypt for applications in other areas in the Arab region.
- Inform on the SDGs Goals and Targets (1.5 and 13.1) related to disasters and The Sendai Framework for Disaster Risk Reduction 2015-2030 four priorities for action to prevent new and reduce existing disaster risks: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience and; (iv) Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction.
Case 1: Agriculture Monitoring
SDG: 2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility. GEOGLAM can also support other Targets (2.1, 2.4, 2.a, 2.3) and other Goals (12 and 13, with Indicators 12.3 and 13.3).

Data: remote sensing satellites such as: Sentinel 2, MODIS, Landsat.
- Is-Situ (on site data) such as temperature, and precipitation
- crowd-sourced information – e.g. land use, weather, and crop characterization

Methodology:
- crop land monitoring through remote sensing indices like Normalized Difference Index
- crop land monitoring through machine learning to predict crop type
- forecasting crop production based on NDVI, crop type, temperature, precipitation

Case 2: Water body threats include cyanobacterial (blue-green algal) blooms also known as algal blooms.
SDG: 6.3.2 Proportion of bodies of water with good ambient water quality

Data: Landsat 7, Landsat 8, sentinel 2, sentinel 3 and Freshwater shapefiles

Methodology:
- Algal bloom sensitive indices can be used
- Regression or other machine learning models can also be used to estimate the concentration

Case 3: Flood prediction and early warning
SDG: 6.5.1 Degree of integrated water resources management implementation (0-100)

Data: Global Satellite Mapping of Precipitation (GSMaP) dataset and ground observations

Methodology:
- Predict extreme weather events using forecasting/ml from calibrated satellite precipitation data
- River run off models (hydrological models)

Case 4: Mapping Extent and Annual Changes in the Global Mangrove Cover
Mangroves are of critical importance as breeding and nursery areas for birds, fish and shellfish and play an important role in the regulation of freshwater, nutrients and sediment inputs into the marine coastal waters

SDG: 6.6.1 Change in the extent of water-related ecosystems over time

Data: L-Band Synthetic Aperture Data (SAR): L band is great for vegetation structure detection
- Landsat 7, Landsat 8, Sentinel 2 (all are optical sensors) and SRTM elevation data

Methodology:
- Coastal masking and mangrove habitat location classification using SRTM, water mask (JRC 2016) and historical mangrove extent maps from around 2000 (USGS World Distribution of Mangroves and ITTO World Atlas of Mangroves).
- Mangrove extent classification of L-band SAR
- Compare classified images to see if they increased or decreased
Case 5: mapping urban growth
SDG: 11.3.1 Ratio of land consumption rate to population growth rate
- 3.9.1
Data: C-band SAR data (sentinel 1) and Optical data: landsat 7-8, sentinel 2
Methodology: SAR data can be thresholded for urban area detection or can be fed as an input to a ML model
- Optical data can be used to create a built up index or can also be used as an input to a ML model

Case 6: air pollution monitoring
Detection of PM2.5 and PM10 tiny particles in the air that reduce visibility and cause the air to appear hazy when levels are elevated
SDG: 11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)
- 3.9.1 Mortality rate attributed to household and ambient air pollution
Data: GOSAT, GOSAT-2, Sentinel 5 all are air quality focused satellites and On site air quality data
Methodology: Use pretrained numerical models to estimate aerosols and other air quality related particles (PM2.5, PM10)

Case 7: Water quality monitoring of barrier reef
SDG: 14.1.1 Index of coastal eutrophication and floating plastic debris density
Data: Modis Aqua satellite (optical satellite that detects bands required for water monitoring)
- Sentinel 3 can also be used
- In-situ (on site) ground truth measurements
Methodology: ML models can be used
- Some satellites can have bands that already provide the estimates directly

Case 8: Forest extent and change
SDG: 15.1.1 forest area as a proportion of total land area
- 15.2.1 progress towards sustainable forest management
Data: Landsat and sentinel optical imagery
- L-band sar can also be used
Methodology: Machine learning models can be used and image differencing
- L-band SAR thresholding and differencing can also be used
Thank You