2ND SESSION: EARTH OBSERVATION AND SPACE INTEGRATED APPLICATIONS FOR SUSTAINABLE DEVELOPMENT

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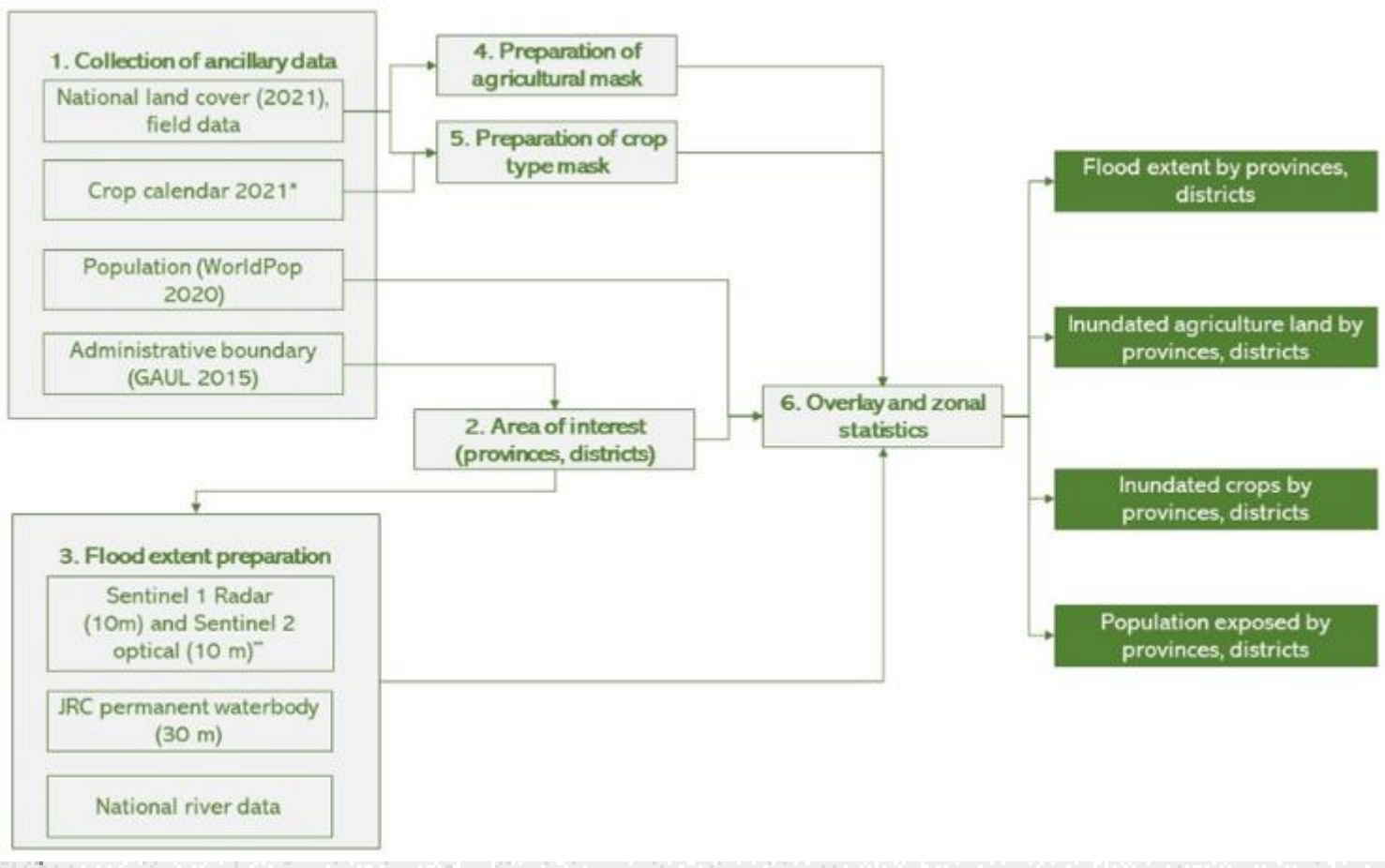
UN-Space - 19th Open Session

"Earth observation and integrated applications for disaster risk management and sustainable development"

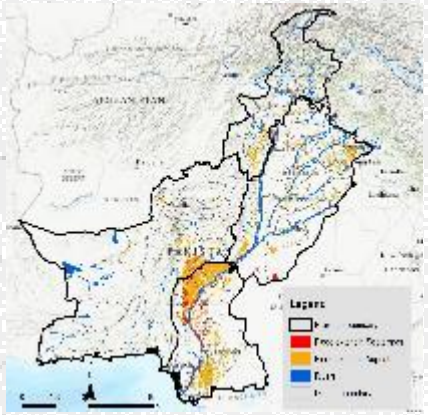
Brindisi, United Nations Global Service Center (UNGSC)
19 October 2023

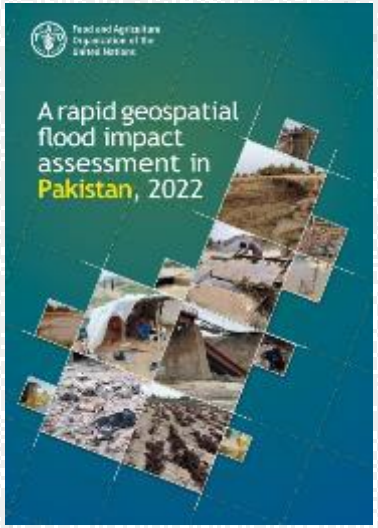
FLOOD IMPACT IN PAKISTAN 2022-23



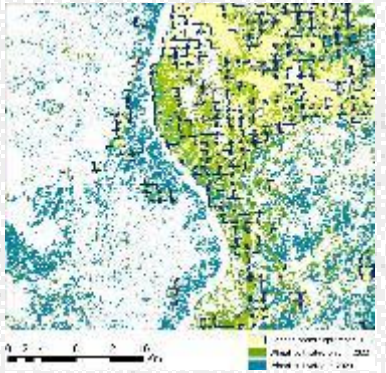
https://www.fao.org/geospatial/resources/detail/en/c/1629466/

3. Flood extent



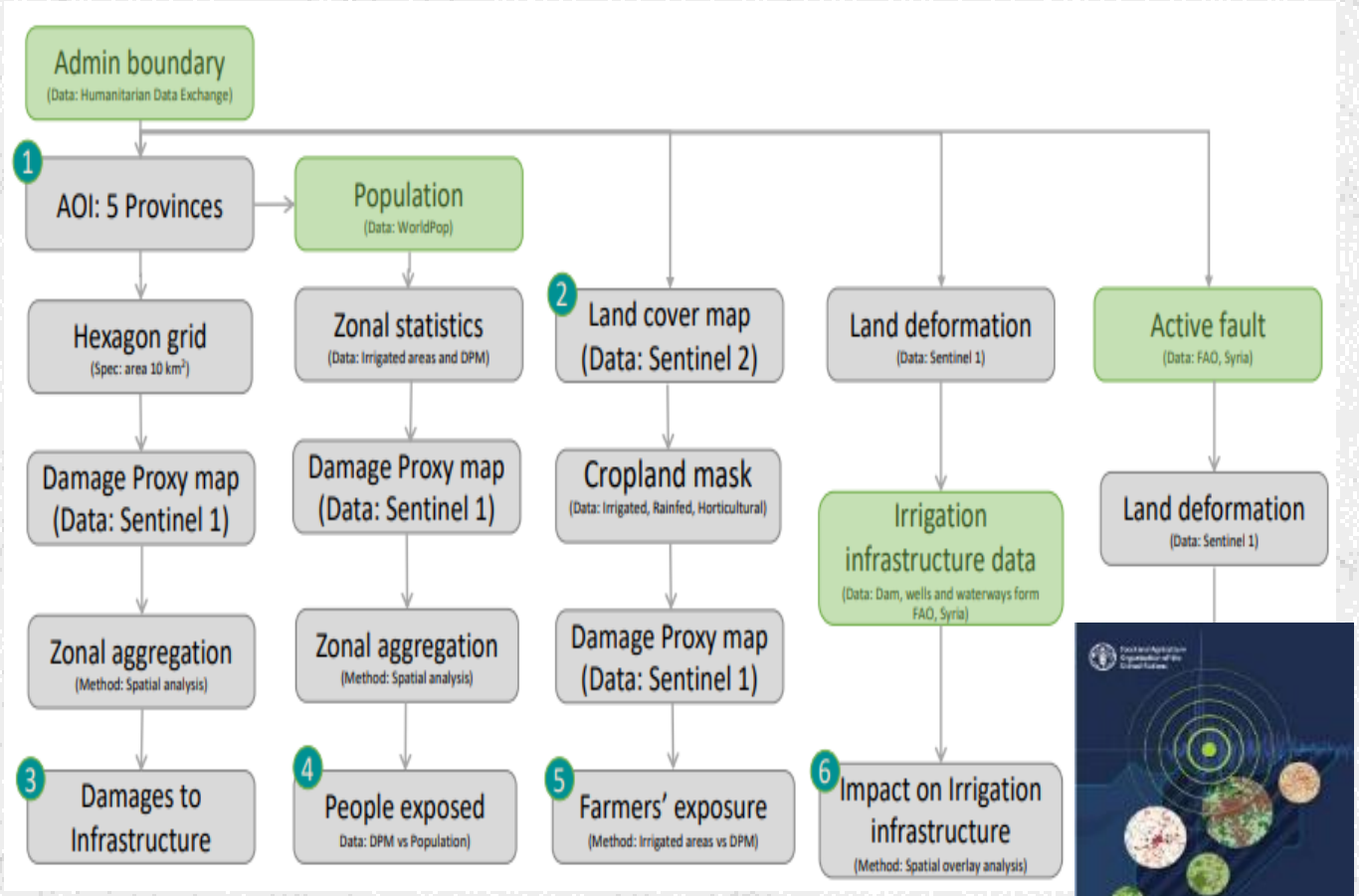


6. Flood cropland



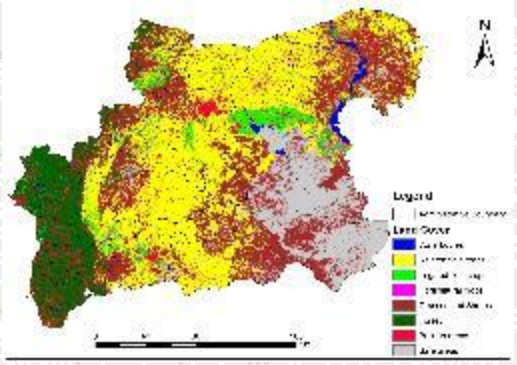
6. Flooded wheat

HEATHQUAKE IN SYRIA 2023

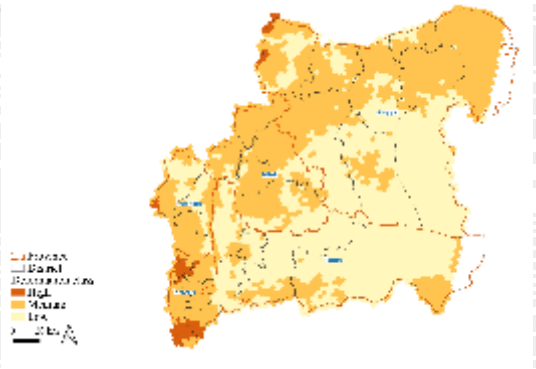


https://www.fao.org/documents/card/ru/c/CC7549EN

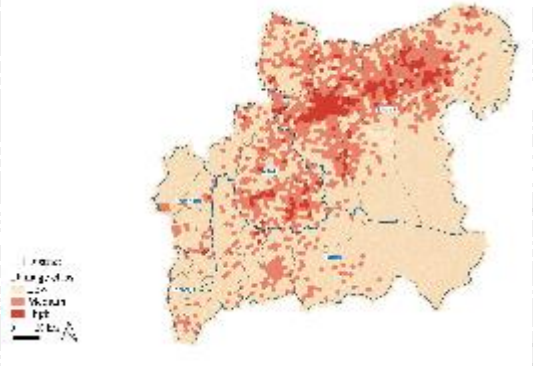
2. Land cover



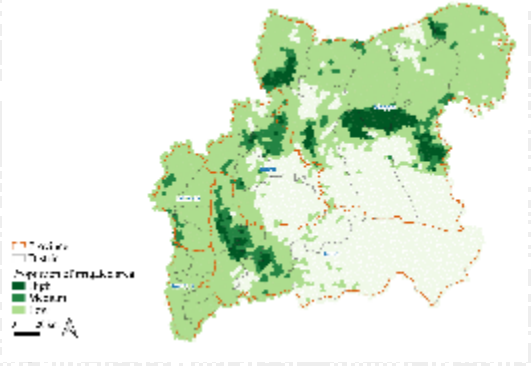
Deformation



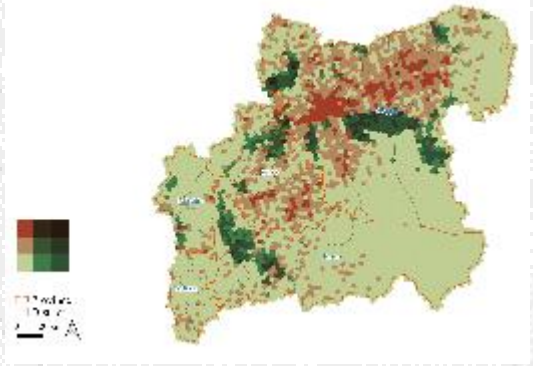
3. Infrastructure



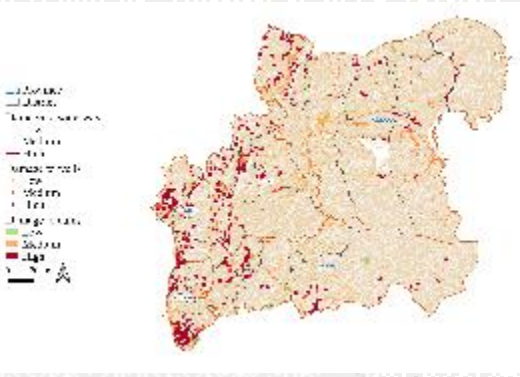
Irrigated land



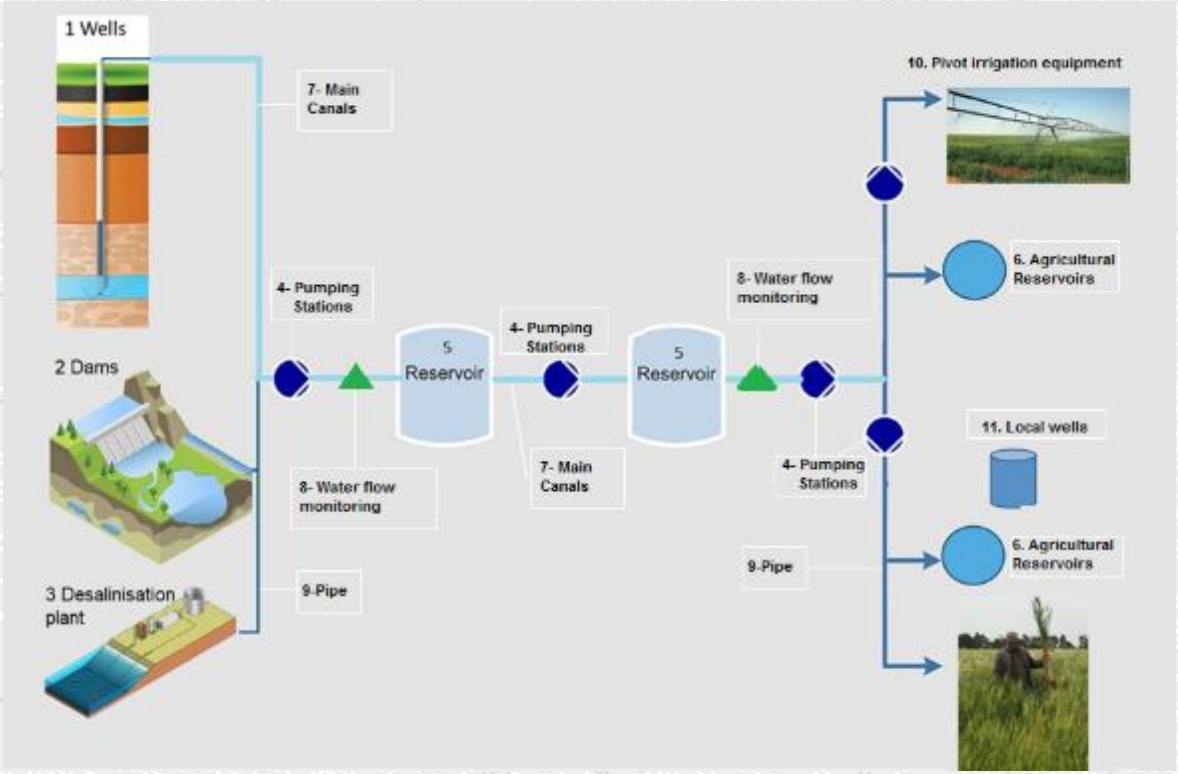
5. Farm expo.



6. Imp. Irrigation



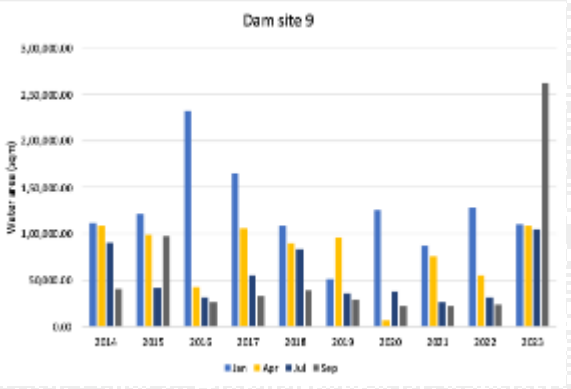
FLOODS IN LIBYA 2023



Category 1	Category 2	Category 3	Category 4
Extraction\ collection	Storage	Transportation	Distribution\ irrigation
Geolocation	Geolocation	Sampling	Sampling
↓	↓	↓	
Field form Field visit	Field form Field visit	Field form Field visit	Field form Field visit

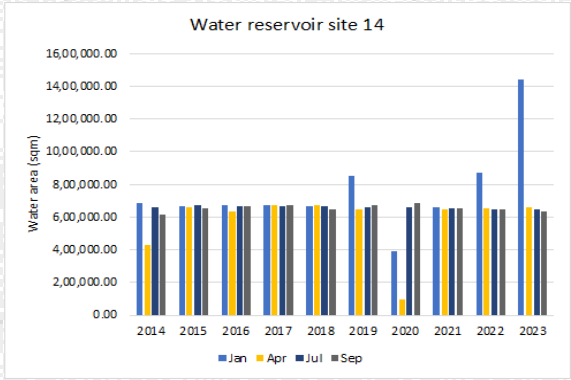
2. Dams

Water extent

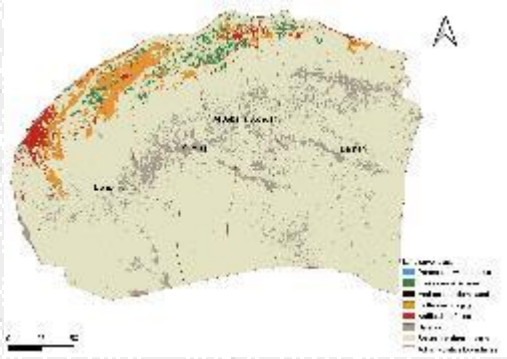


5. Reservoir

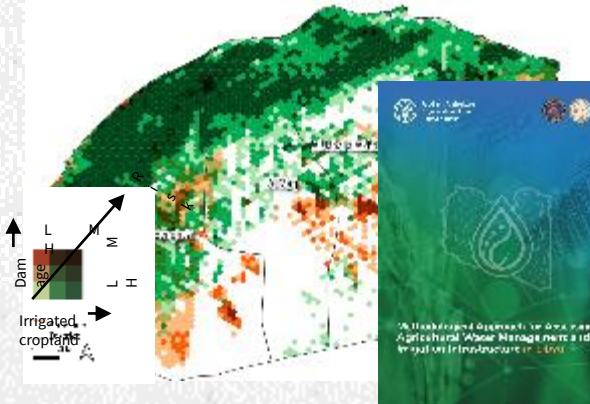
Water extent



10. Irrigation

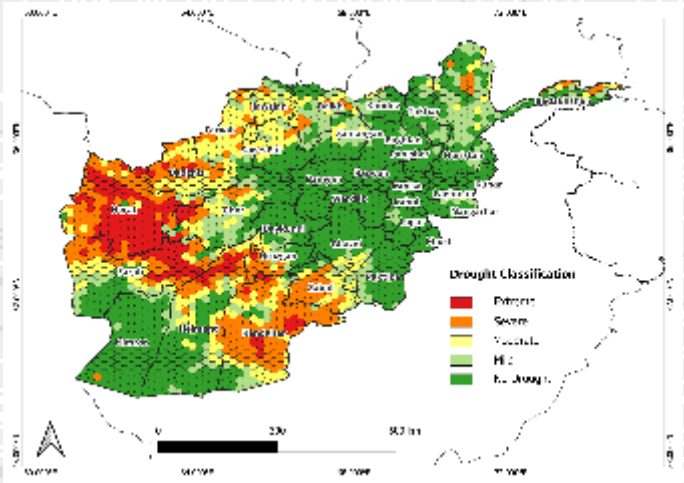


Exposure

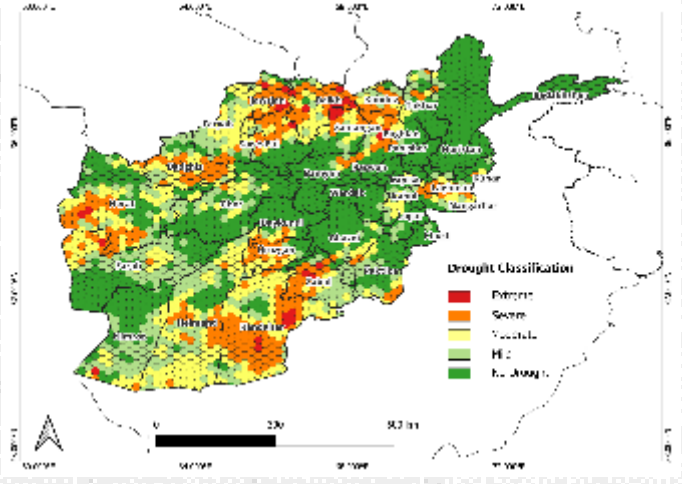


ASSESSING AGRICULTURE DROUGHT SEVERITY IN AFGHANISTAN 2023

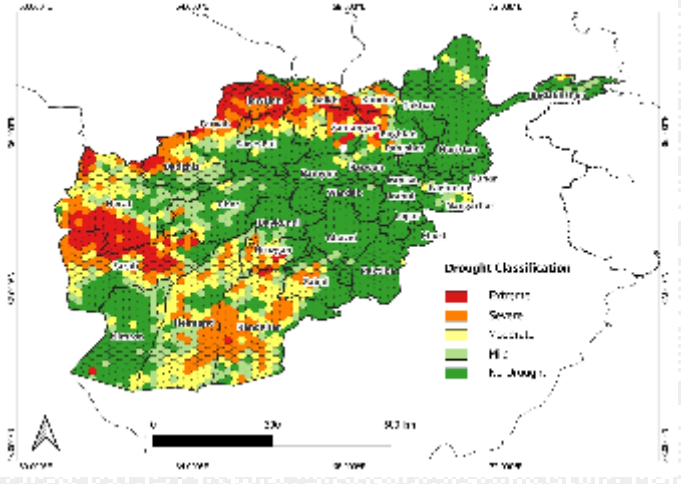
Assessing agriculture drought severity and its impacts on both irrigated and rainfed agriculture using Condition Vegetation Index (VCI) in Afghanistan from 2021 to 2023.



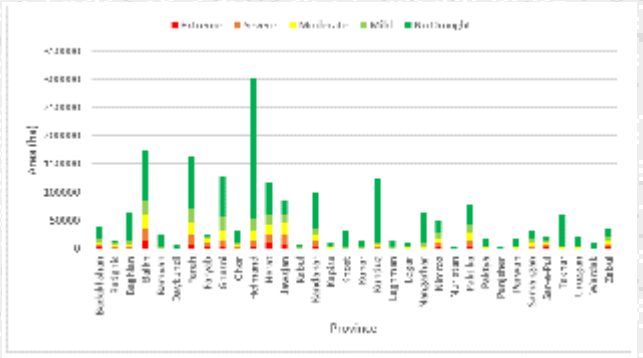
Spatial distribution of drought classification in 2021



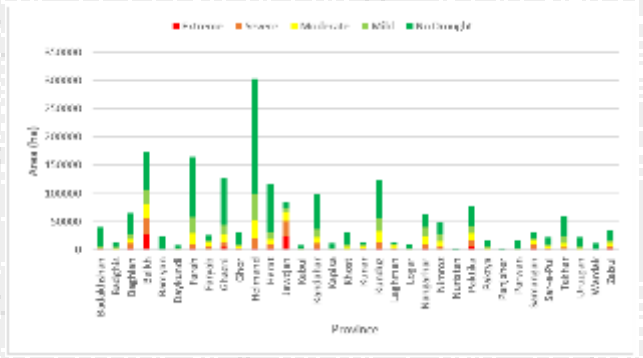
Spatial distribution of drought classification in 2022



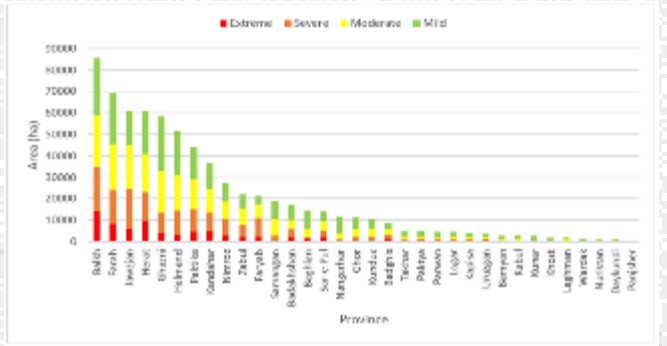
Spatial distribution of drought classification in 2023



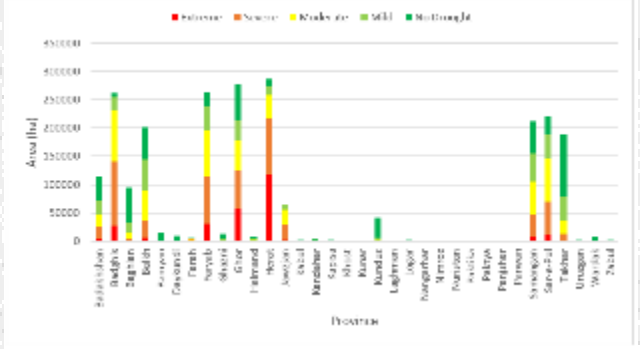
Irrigated agriculture exposure across provinces in 2023



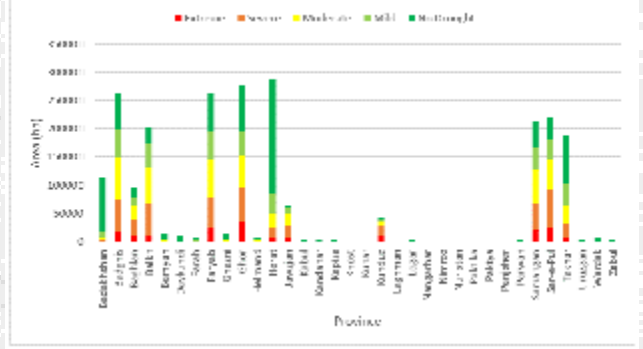
Irrigated agriculture exposure across provinces in 2023



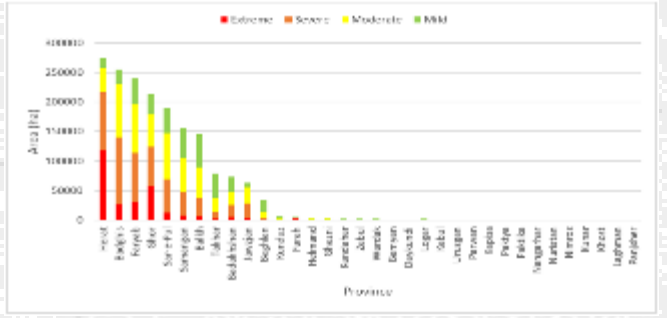
Irrigated agriculture exposure across provinces in 2023



Rainfed agriculture exposure across provinces in 2023



Rainfed agriculture exposure across provinces in 2023



Rainfed agriculture exposure across provinces in 2023

FAO – GENERAL OVERVIEW

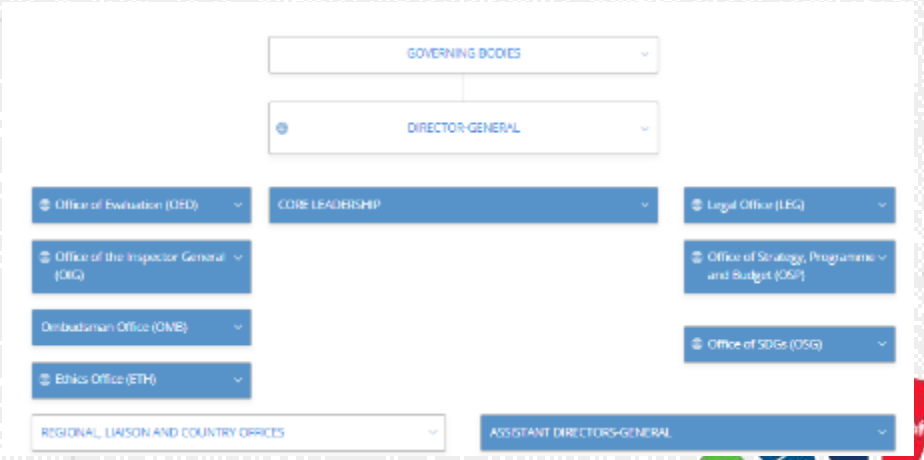
- Founded in 1945, FAO leads international efforts to defeat **hunger and improve nutrition and food security.**
- FAO is providing technical support in > 130 countries among 195 Member Nations
- HQ is located in Rome, Italy.
- Consist of 5 regional offices, 11 sub-regional offices, 6 liaison offices and 7 partnership & liaisons offices.
- Article 1 of the convention - Functions of the Organization
- *The Organization **shall collect, analyse, interpret and disseminate information** relating to nutrition, food and agriculture. In this Constitution, the term "**agriculture**" and its derivatives include **fisheries**, **marine** products, **forestry** and primary forestry products.*

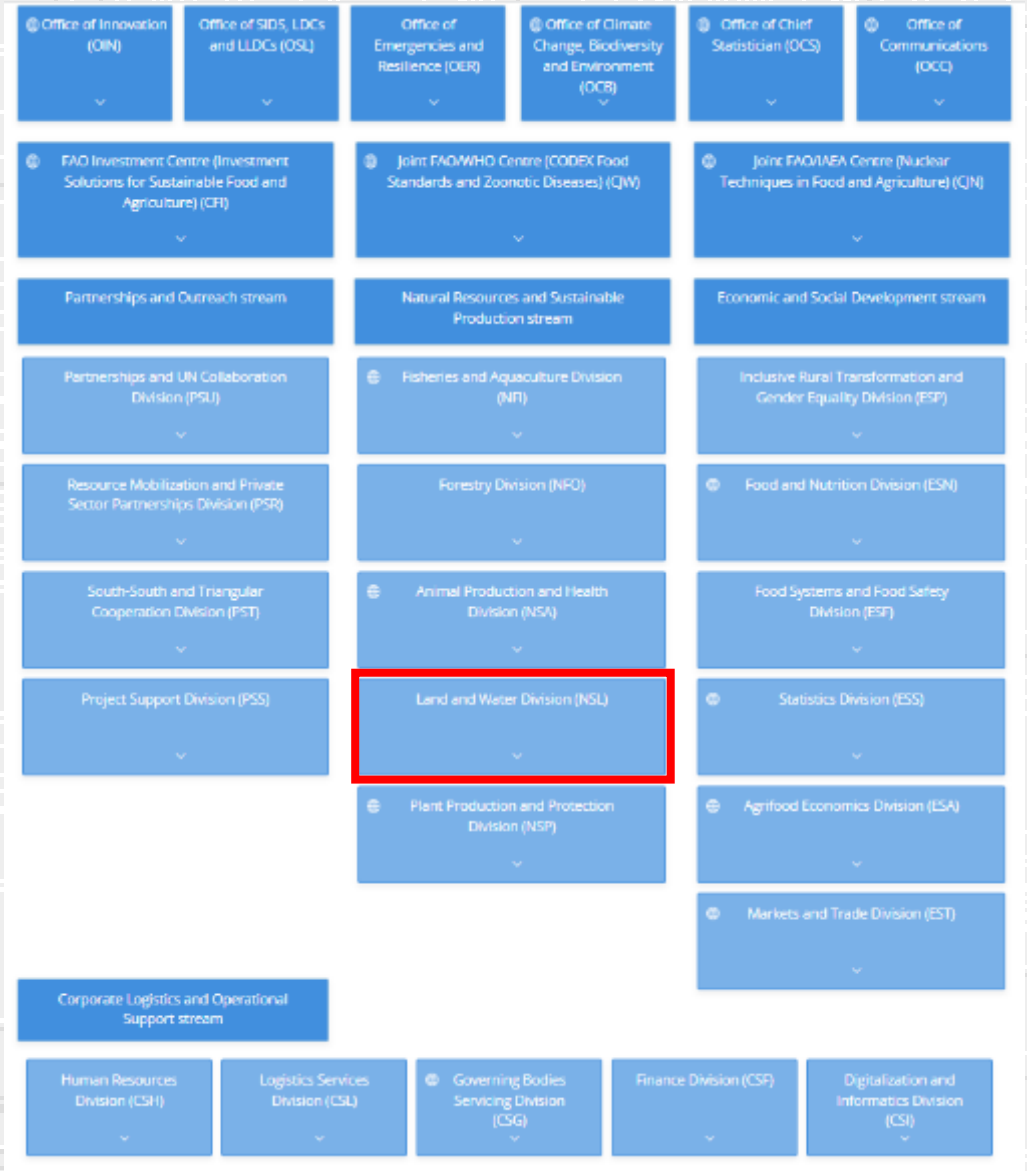
- FAO supports development plans, strategies and decision-making processes in member states through the transformation to MORE efficient, inclusive, resilient and sustainable agri-food systems for **better production, better nutrition, a better environment, and a better life**, leaving no one behind.

- FAO is the custodian UN agency for **21 SDG indicators** and is a contributing agency for a further 5. In this capacity, FAO is supporting countries' efforts in monitoring the 2030 Agenda.

https://www.fao.org/home/en

FAO – GENERAL OVERVIEW





GEOSPATIAL UNIT (NSL)

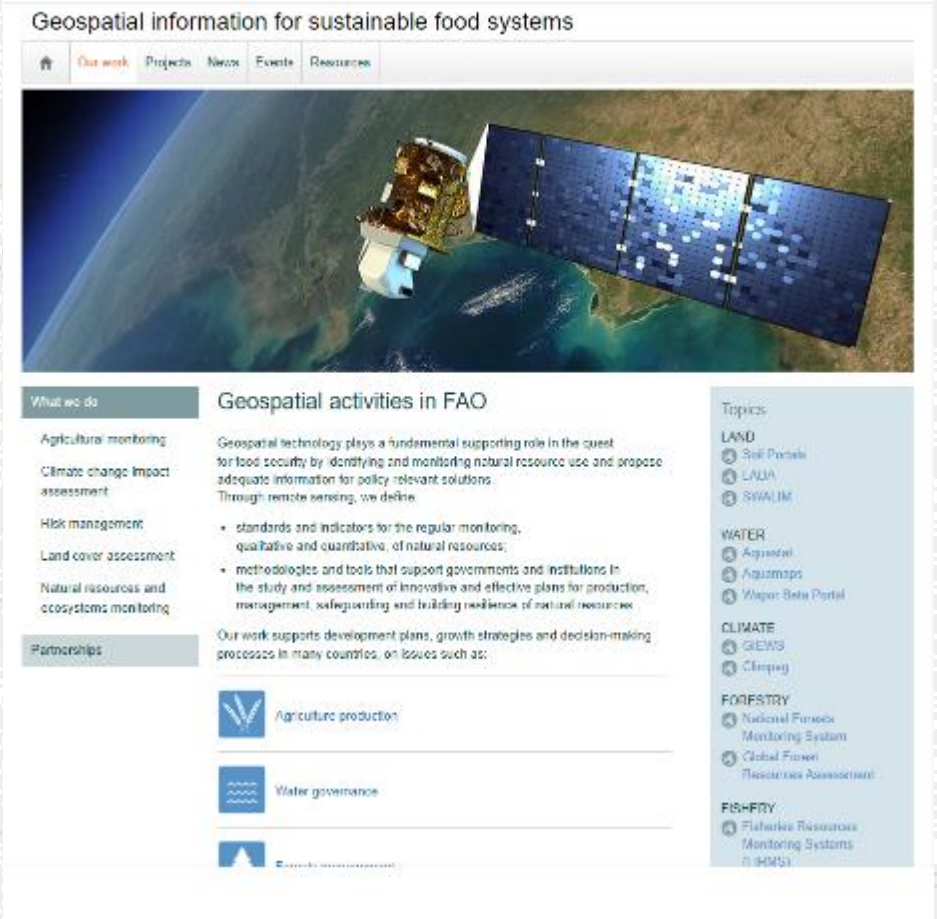
- FAO's Geospatial Unit: providing geospatial data, information, & services
- Supporting food security and monitoring natural resource use
- Proposing policy-relevant solutions through remote sensing

Our Contributions

- Define standards and indicators for regular monitoring
- Conduct qualitative and quantitative assessment of natural resources
- Develop methodologies and tools for governments and institutions

Impact

- Supports development plans, growth strategies, and decision-making processes
- Key issues addressed: land cover mapping, crop monitoring, disaster risk reduction, food security mapping, spatial planning, and environmental sustainability



↘ Land cover & Crop monitoring

↘ Agro-ecological zoning & Land evaluation

↘ Ecosystem restoration & Land degradation monitoring

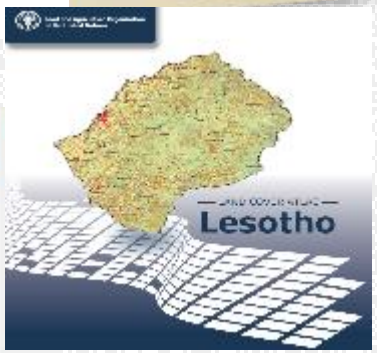
↘ Green cities & Nature-based solutions

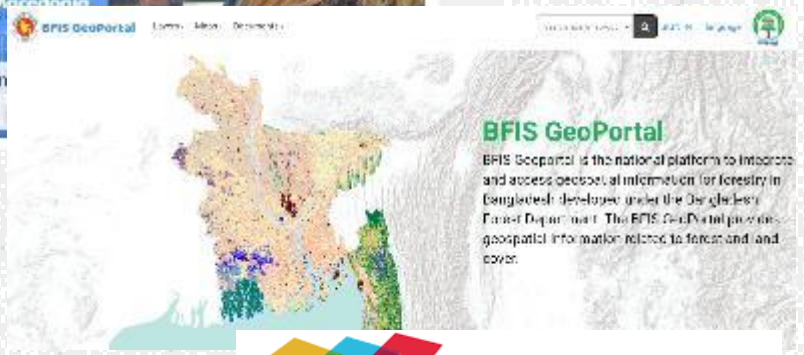
↘ Emergency & Resilience

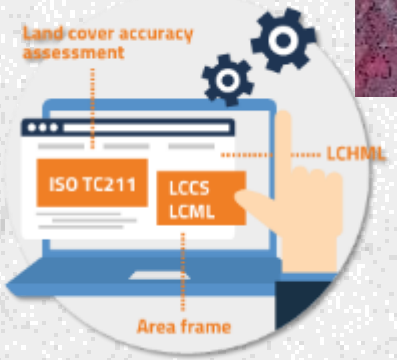
https://www.fao.org/geospatial/our-work/what-we-do/en/

Applying technological advances

- Object-Based Image Analysis
- Multi-temporal
- Optical, RADAR and LiDAR
- LCML - LCHML
- Cloud computing (SEPAL – GEE)
- Machine-learning/AI
- UAS
- Internet of Things
- Integration with local knowledge and field data
- etc….







Land Characterization System Software

DIVERSITY OF DATA INPUT AND APPLICATIONS

Diverse satellite imagery and sensors are used to assess and monitor natural resources and agriculture

MODIS (250 m spatial resolution)

Landsat (30 m spatial resolution)

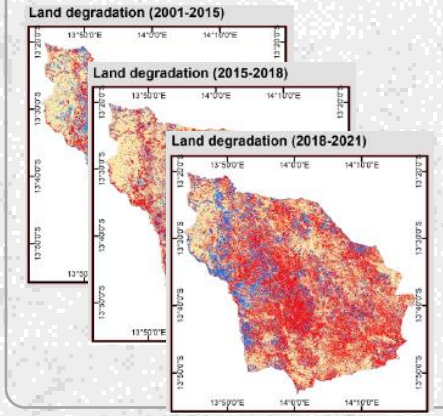
Sentinel 2 (10 m spatial resolution)

SPOT 6/7 (6 m spatial resolution)

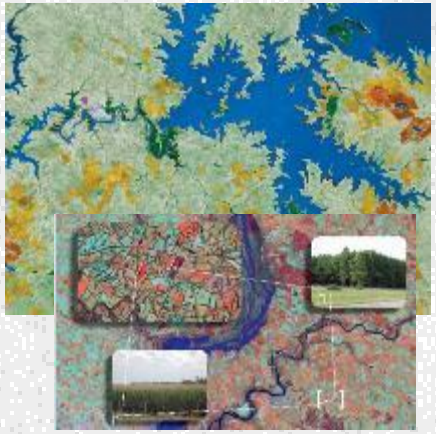
And many others… NICFI Planet, Worldview, MAXAR etc.

Ex. of applications

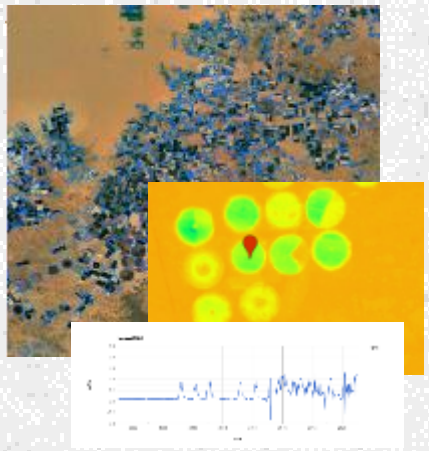
Land degradation in Angola



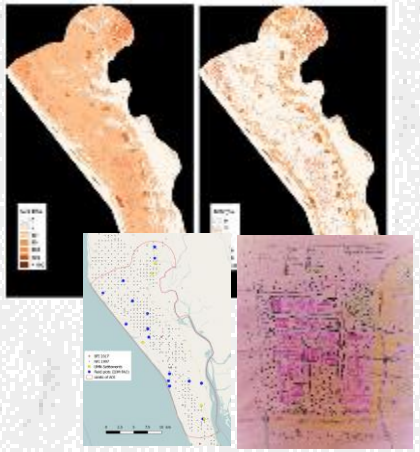
Land cover in Uruguay



Crop mapping in Libya



Woodfuel in Bangladesh



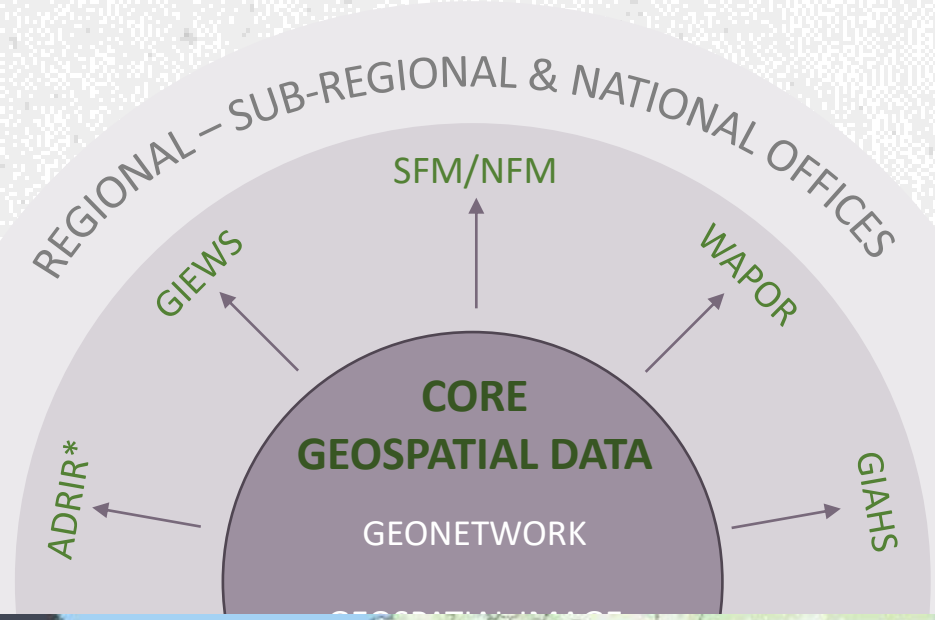
Infrasructure

Greenhouses

Challenges: compromise between temporal, spatial & spectral resolutions with available imagery (cost/ size / cloud etc.)

GEOSPATIAL PLATFORMS

- Global Information and Early Warning System on Food and Agriculture (GIEWS)
- National Forest Monitoring (NFM)
- Remote sensing for water productivity (WAPOR)
- Globally Important Agricultural Heritage Systems (GIAHS)
- Modelling System for Agricultural Impacts of Climate Change (MOSAICC)
- Agricultural Stress Index System (ASIS)
- Global Land Cover Network (GLCN)
- Global Agro-Ecological Zones (GAEZ)
- Global information system on water resources and agricultural water management (AQUASTAT)
- Land cover legend registry (LCLR)
- The Hand-in-Hand (HIH) Initiative (HiHi).
- Emergency data Hub (DIEM).



https://www.fao.org/hand-in-hand/en

SEPAL CLOUD COMPUTING PLATFORM

- SEPAL is a cloud platform for accessing, processing and analyzing geospatial data for land monitoring.
- SEPAL is free and open: anyone can register for access to the following features
- All you need is an Internet connection to access SEPAL website

https://sepal.io/

Search and process satellites imagery

Access super computers

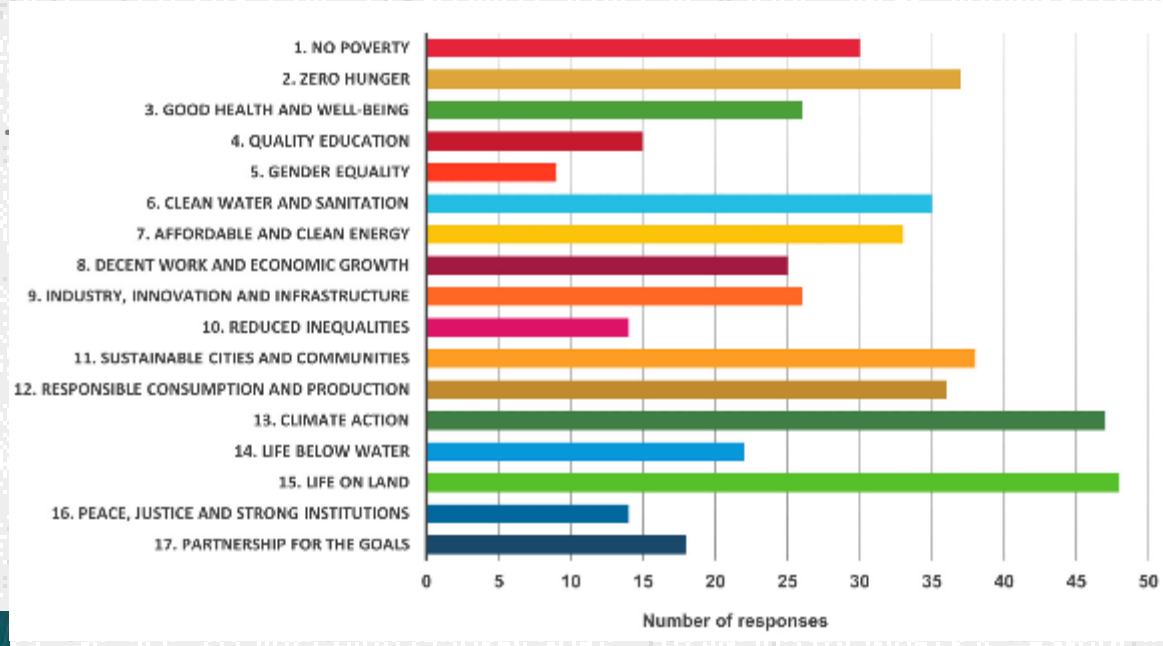
Mobile and tablet compatibility

Store and access data

Analyze data using predefined processing chains

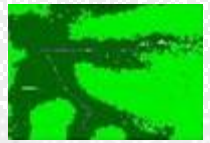
LAND COVER AND THE SDGS

- Land resources play a vital role in tackling climate change, securing biodiversity and maintaining crucial ecosystem services, while ensuring resilient livelihoods and food security.
- Assessing land-cover and land-use is essential and critical and one of the fourteenth fundamental data theme under UN-GGIM.
- Contributes to all SDGs its cross-sectoral nature as well as other international goals and initiatives including UNFCCC, ISOTC211 AG13, UNFCCC, UNCCD, UNCEEA and others.
- It is an important baseline information in national reporting to international reporting, land suitability, assessment, monitoring of various sectors (agriculture, forestry, fishery, energy, emergency) and many others

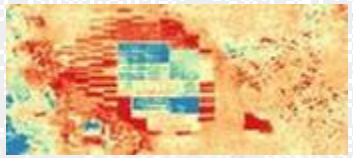


Reference systems

Rapid assessment



Agriculture, crop, forest Monitoring

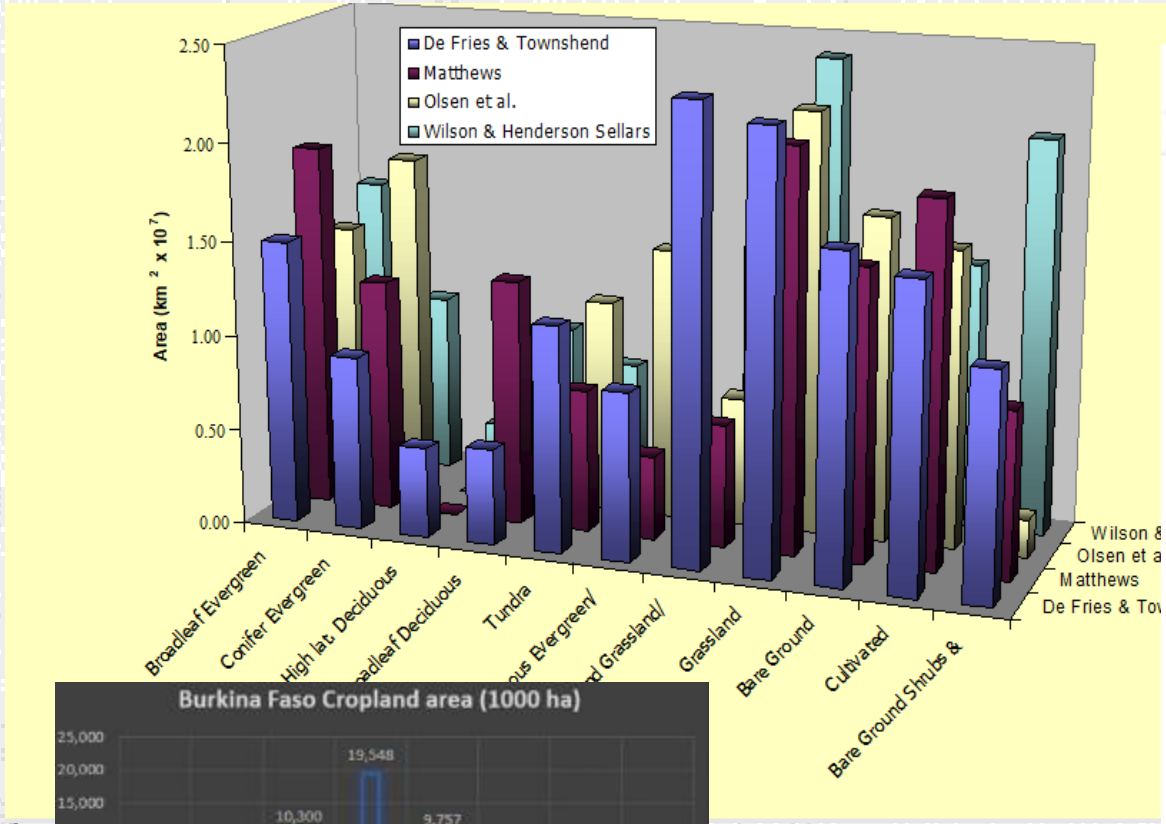


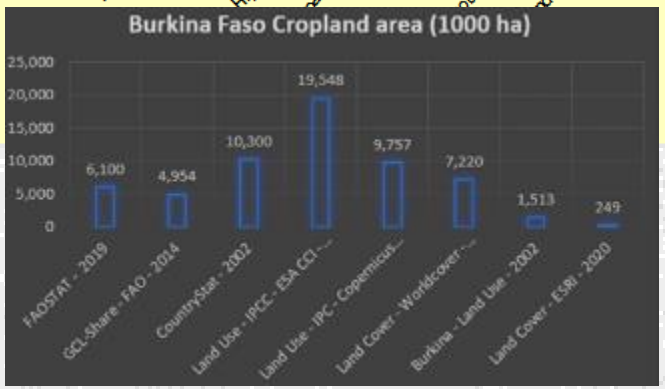
Peatland restoration

https://www.fao.org/geospatial/en/

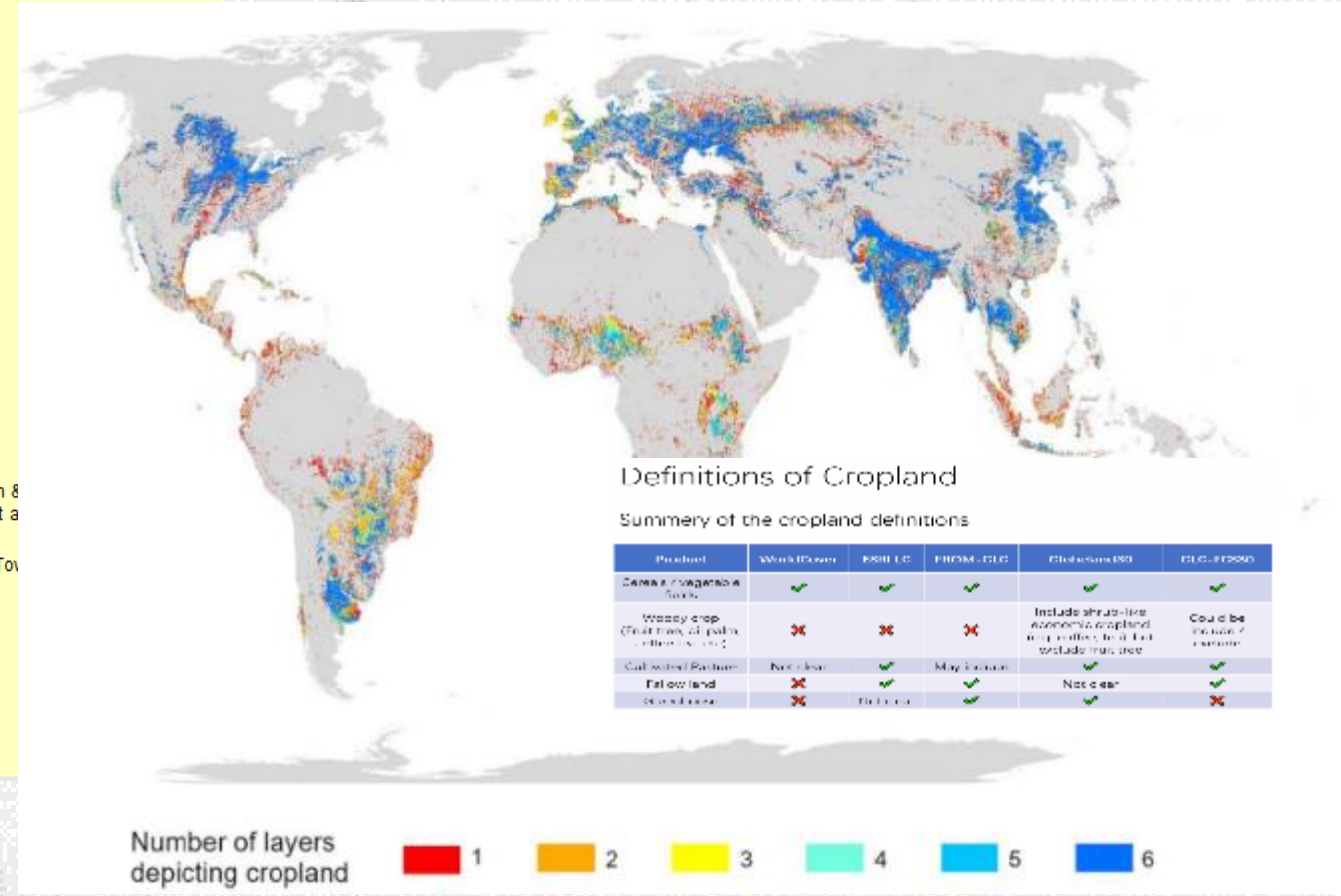
HIGH INCONSISTENCIES BETWEEN GLOBAL LAND COVER

Comparison between global land cover datasets ~2015



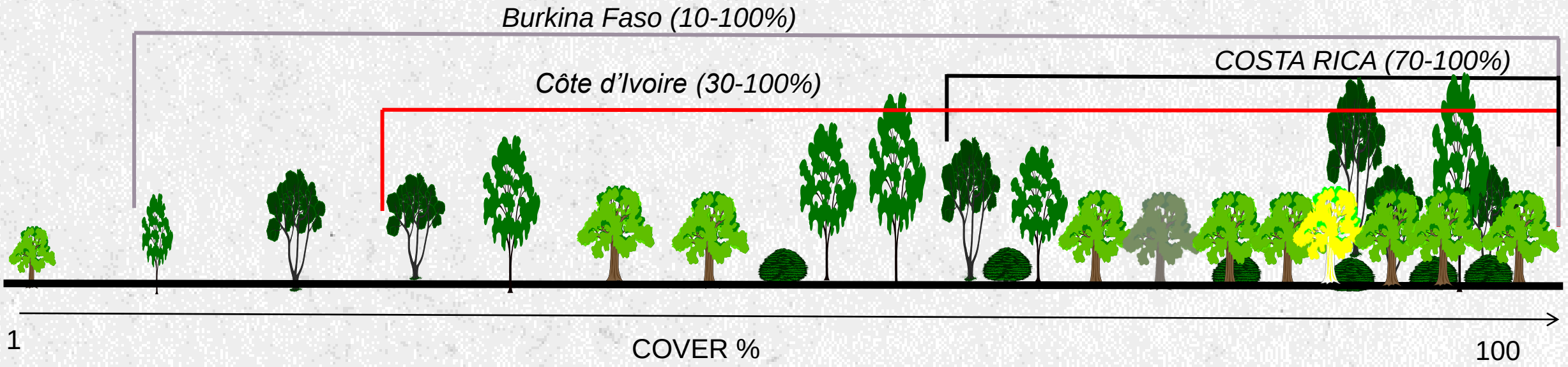


Cropland agreement map. Cropland agreement map. Pixel-level results from six high-resolution cropland maps



https://www.nature.com/article

LAND AS A CONTINUUM



Some examples of forest definitions:
Burkina Faso: area > 0.5 ha, height of trees > 5 m and tree cover > 10%, […] Land with an essentially agricultural or urban vocation is excluded.

Côte d'Ivoire: area > 0.1 ha, tree cover > 30%, height > 5 m, […], excluding plant formations resulting from agricultural activities.

Costa Rica: height of trees > 5 m and tree cover > 70%.

Limitation:
- Fixed number of land cover classes
- Classes are too general
- Missing information
- Different terms used for same concepts (**Synonymy**).
- Different understanding of homonymous concepts (**Polysemy**)

Ambiguities in the definition and comparison of different land classes.

SETTING COMMON RULES: FAO LAND COVER LEGEND REGISTRY

- It is an online library established and maintained by FAO for accessing existing land cover legend, legend class, datasets and related reference documents.

Web portal Interface

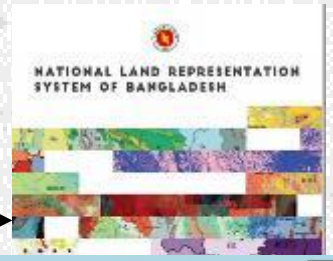
8	L9	Land cover legend for Bangladesh	Bangladesh	50	LCCS3	2015	REF-9	VALID

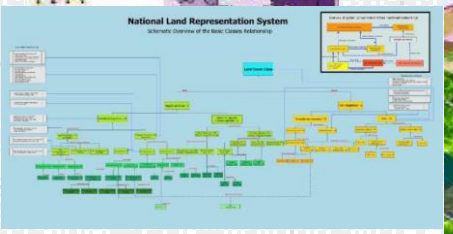
CLASS | DATASET

ENG FRA URD

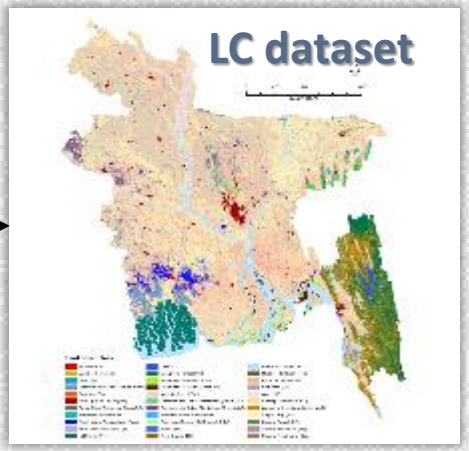
Id	Alpha Code	Name	Definition	Class Code	File
112	B1	Evergreen hill forest	Natural forest area within the reserve forest boundary and protected forest boundary of Chittagong Hill Tracts (CHT) is known as hill forest. It consists of moist tropical evergreen and semi-evergreen trees. Tree cover ranges from 80% - 100% and top canopy of trees reach a height of 25-62 m.	FEh	
113	B2	Forest plantation	The area where trees are planted for high volume of timber and wood under long-term or short- term management. Trees are generally even- aged, planted in rows in a large enough area. Tree height ranges 5 – 40 m and cover ranges 80% - 100%. Agroforestry can also be incorporated with this class.	FP	

LC Legend

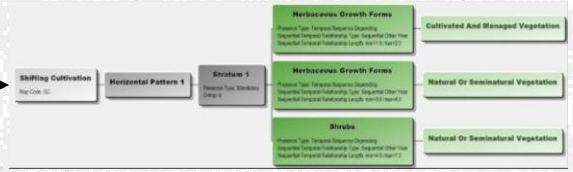




LC dataset

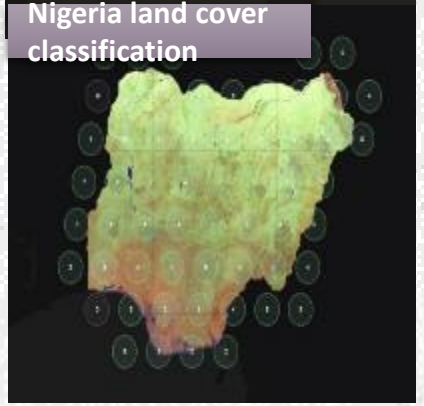


LC Class



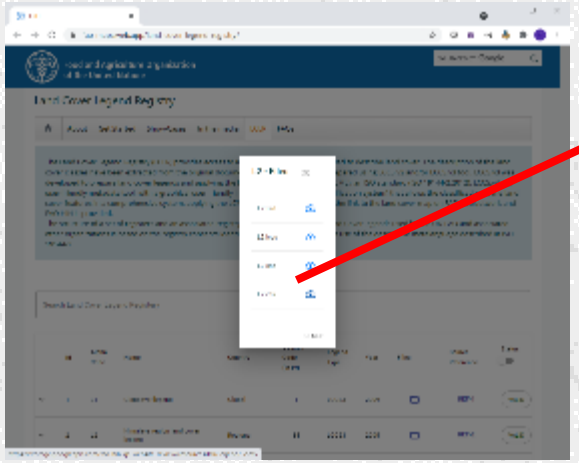
SEPAL

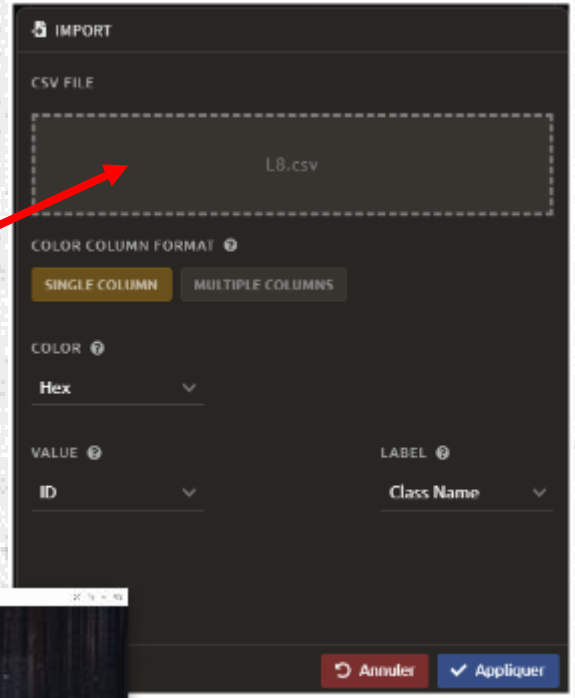
Nigeria land cover classification

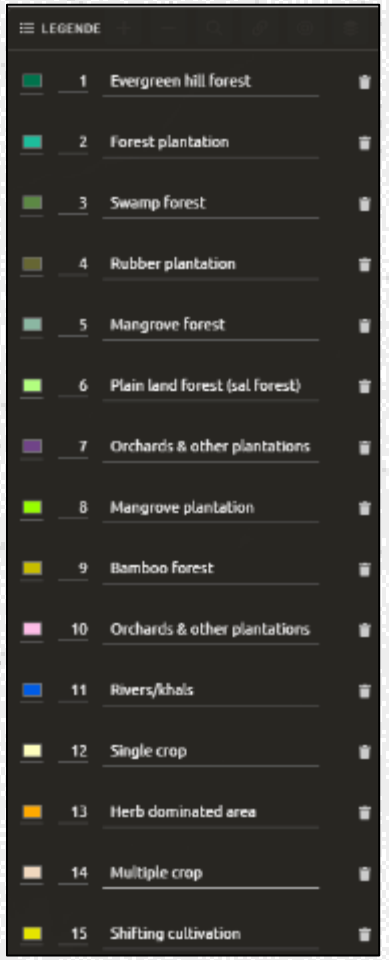


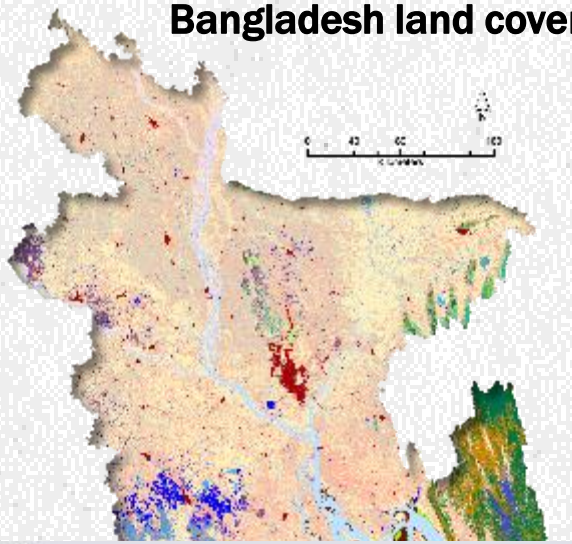
Link: An International Library for Land Cover Legends: The Land Cover Legend Registry, library, documentation

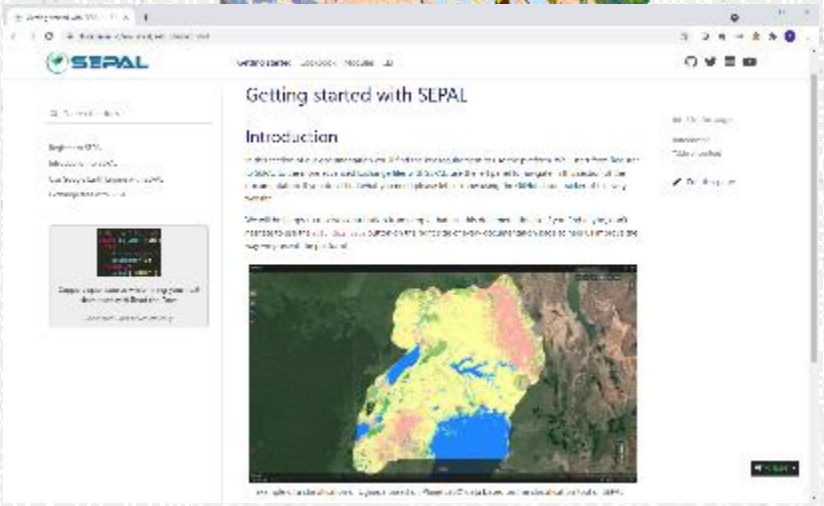
INTEGRATION OF LEGENDS WITH SEPAL











INSTITUTIONAL COLLABORATION & PARTNERSHIPS

BANGLADESH

- Multiple institutions (13)
- Different sectors
- Diverse objectives
- Different programs/projects
- Different approaches
- National and international reporting
- National and local planning

http://bfis.bforest.gov.bd/library/wp-content/uploads/2019/11/LRSB_final_11.11.19.pdf

WEST AFRICA

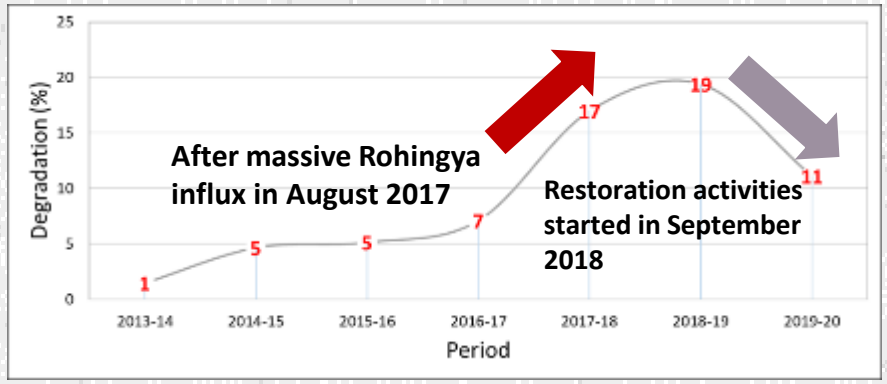
- Regional & international organizations: ECOWAS, CILS, AGRYHMET, OSS, FAO, NASA SERVIR
- 17 countries : Benin, Burkina Faso, Cape Verde, Côte D'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, and Togo.
- Area: 8 million square kilometers.
- Ecological belts: region can be sub-divided based on climate and vegetation characteristics into 5 ecological belts including Guineo-Congolian, Guinean, Sudanian, Sahelian and Saharan belts

https://www.fao.org/publications/card/en/c/CC0730EN

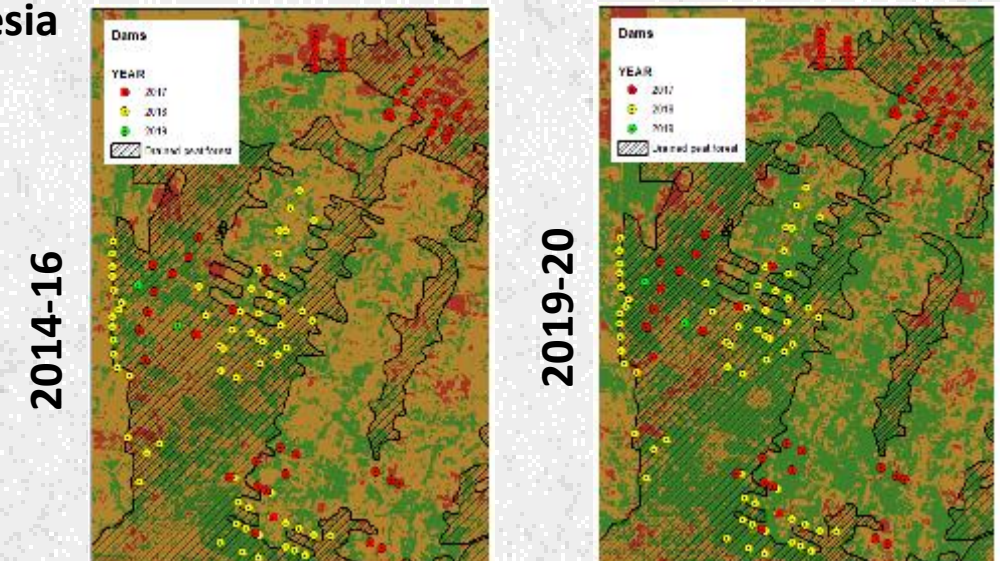
MAPPING LAND DEGRADATION 15.3.1 & RESTORATION

SDG 15.3.1: Case studies & Trainings

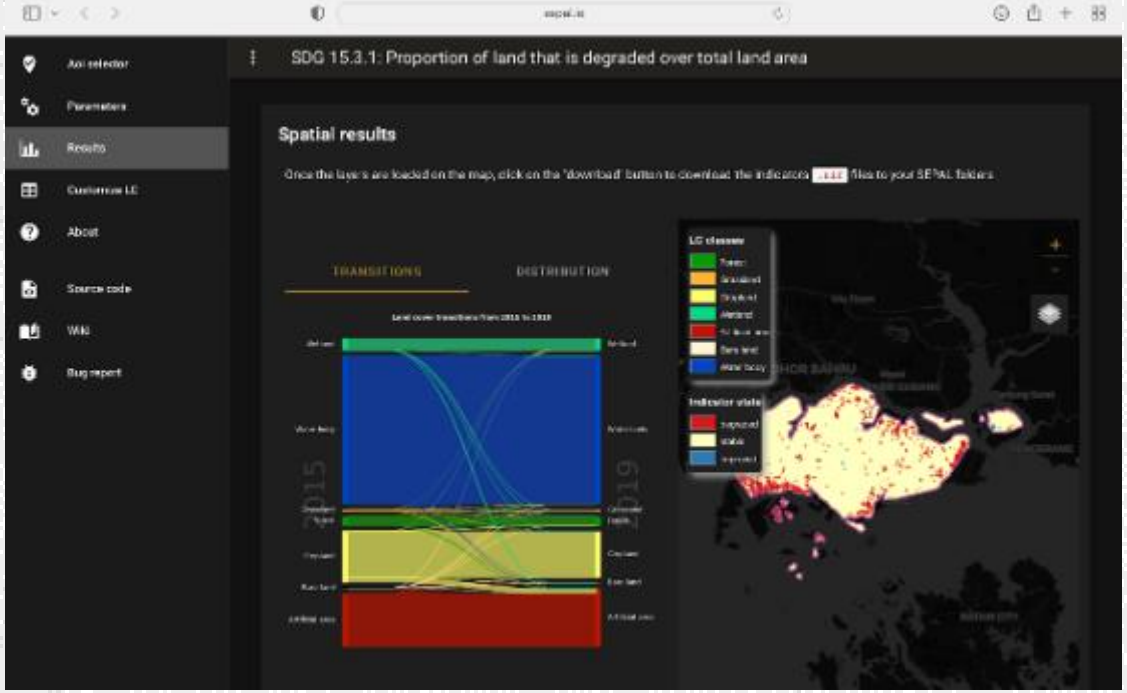
Case study: Land restoration in Refugee camps in Cox' s Bazar, Bangladesh



Case study: Peatland degradation and restoration in Indonesia



SEPAL SDG 15.3.1 based on the GPG v2 (UNCCD).



- multiple sensors (MODIS, Landsat 4, 5, 7, 8 and Sentinel 2),
- suitable vegetation index (NDVI/EVI/MSVI),
- suitable land cover ecological functional units,
- In-country land cover data including reclassification,
- etc.

GLOBAL AGRO_ECOLOGICAL ZONING

GAEZ v4 Web-platform

https://gaez.fao.org/

Hand-in-Hand Geospatial platform

Model documentation

Brochure

Video

User guide

User cases

ECOCROP

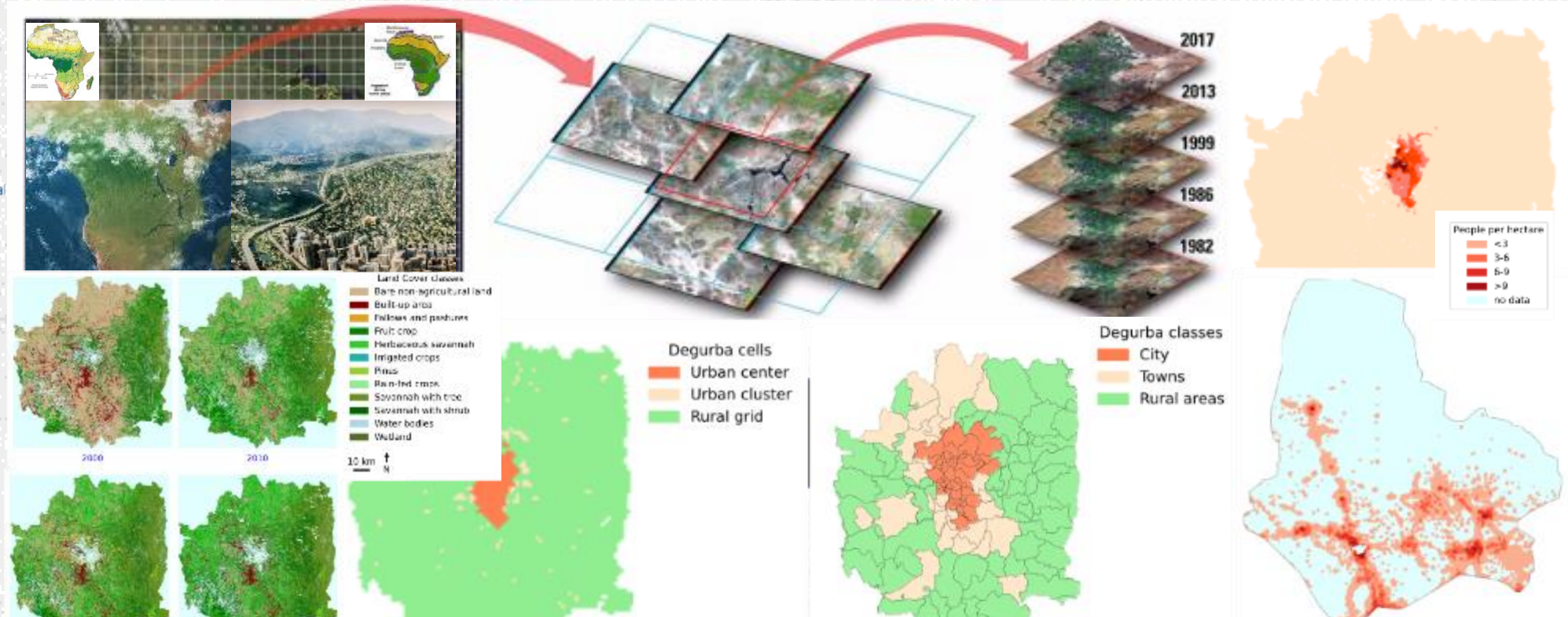
AGROMAPS

ArcGIS StoryMaps

MONITORING GREEN CITIES INDICATORS & NATURE BASED SOLUTIONS

Data (Tier 1)	Tools and platform	Methods
• Administrative Units • Satellite Imagery • Population data • Land Cover • […]	• Desktop based/stand alone (Arc/Q GIS, ERDAS Imagine, Snap, […] • Server based (Geonode, […]) • Cloud based (SEPAL, GEE, Google Colab, […])	• Delineating into degree of urbanization (degurba) classes • Generation of national level land cover • Preparing population data • Deriving Green Cities indicators

SEPAL
openforis.org/tools/sepal



CHALLENGES

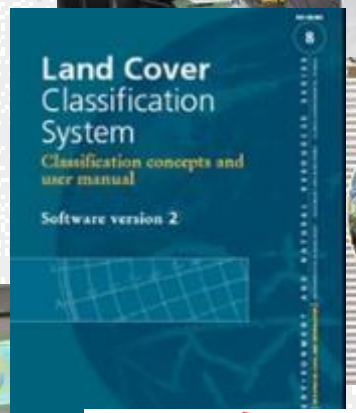
Need capacities to use standards for EO data interoperability, consistency, transparency and accuracy

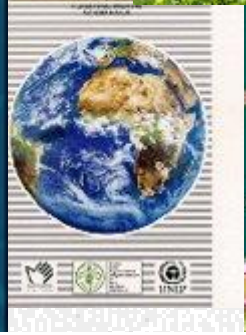
To establish sustainable frameworks, plans and programs

To benefit from the diversity of satellite data and technologies

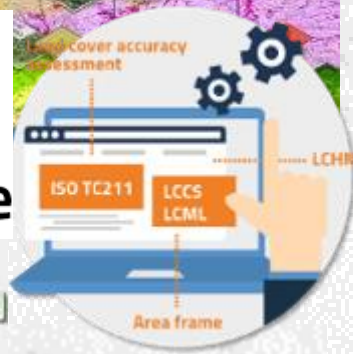
And provide data availability and accessibility in timely manner and collaboratively

For adoptable and adaptable solutions





Land Characterization System Software



UNITED NATIONS
Office for Outer Space Affairs

Committee on Earth Observation Satell

UN-GGIM

UNOSAT

Food and Agriculture Organization of the United Nations

THANK YOU

Matieu Henry

Matieu.Henry@fao.org

Geospatial Unit : https://www.fao.org/geospatial/en/