Earth Observation for study of the Impacts of climate change on water resources and agriculture In Morocco

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Importance of Agriculture in GDP
- 14 à 20% of GDP
- 43% of total jobs and 78% of jobs in rural areas

Low annual precipitation level and strong inter and intra annual variability
- Low quantities, Concentrated in few days, Temporal irregularity (seasons, years) and unequally distributed in space.

Non irrigated agriculture 81% SAU, Irrigated area 19%

National strategies from the Agriculture department and water department for water saving and its valorization in irrigated agriculture
Remote sensing techniques for drought monitoring and structural vulnerability mapping in Morocco

Optimization of water resources for irrigated agriculture

Capacity building and international cooperation
Remote sensing techniques for drought monitoring and structural vulnerability mapping in Morocco

- **Periodic Drought monitoring (CDI)**
  - Part of LDAS MOROCCO: DRPE, World Bank, NASA, USAID
  
  - **Goals:** Elaboration of a DWS based on indicators in order to reduce the agricultural vulnerability to Climate Change.

  - **National partners:** Agriculture department

  - **International partners:**

- **Structural Vulnerability mapping**
Methodology of Drought monitoring

Monthly indicator produced during the agricultural season since 2003

- SPI from CHIRPS
- NDVIa (Modis/VIIRS)
- Eta from SEBSop
- LSTday_night

Climate Hazard Group
FEWSNET
MODIS

CDI November 2023

Beni Mellal - Khenifra
Oriental
Guelmim-Oued Noun

Legend:
- Red: Exceptional Drought
- Orange: Extreme Drought
- Yellow: Severe Drought
- Light yellow: Moderate Drought

CDI
40%
20%
20%
20%

Monthly indicator produced during the agricultural season since 2003
Drought vulnerability assessment

Periodic drought index

CDI (2003-2022)

Parameter 1: all drought classes during the autumn seasons

Parameter 2: occurrence of severe, extreme and exceptional drought classes during spring periods

Exposure to drought

Potential Impact

Visual overlay

Composite vulnerability Indicator

Agro-Pedology

Map: Soil Grid (TSMHT_250m)

At national level

Land cover

Land cover classes vulnerability to drought

At national level

Socio Economy

National demography statistics

Classes of Global Poverty Index

Adaptive Capacity

Source: GIZ, 2017
Objectives: Develop operational tools integrating satellite images to optimize water management in irrigated areas

National partners: INRA, ORMVAG

International partners: IRD, CESBIO
Remote sensing data for water consumption and needs estimation

Optical RS: Reflectances, Biomass, Albedo

Thermal RS (+PRI...): Land Surface Temperature, Water Stress

Weather & Irrigation

Transpiration

Evaporation

Surface Soil Moisture

Root Zone Soil Moisture

Validation data
2 methodological approaches

ENERGY BALANCE APPROACH - SEBAL MODEL with thermal data

INPUTS
- RS: Landsat (16d/30m), VIIRS (1d/375m),
- Meteorological data, Ancillary Data

OUTPUTS: ET, Sol Moisture, BIOMASS

Irrigation indicators:
- water consumption,
- Crop water need and deficit,
- irrigation advices,
- water productivity

WATER BALANCE APPROACH

- SAT’IRR platform
- the amount of water available to the plant estimation based on RS images, meteorological data (observation and forecasting) and in-situ measurements.
- Advice the farmer when and how much water to bring for the next 4 days.
- Tested on several experimental sites in the South-West of France and in the Marrakech region, Morocco.
<table>
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<th>Frequency</th>
<th>Description</th>
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<td>Irrigation Water Requirements</td>
<td>Farmer, ORMVA,</td>
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<td>Crop Water Deficit</td>
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<td>daily</td>
<td>Irrigation Adequacy</td>
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DAILY WATER CONSUMPTION
Watershed scale

Actual Evapotranspiration
10th July 2020

ETact mm/day)
Indicators Estimated at Irrigated perimeter Scale

11\textsuperscript{th} February 2020

18\textsuperscript{th} April 2020
Seasonal water consumption and biomass evolution in Kenitra province irrigated crops

Monthly water consumption evolution in 2019-2020

Monthly biomass mean evolution in 2019-2020 season
Dissemination platforms prototype
1- Creating synergy between SEBAL and SAT'IRR approaches
   • Test validation on both approaches in Gharb and Haouz Regions
   • Combining the two models through assimilation mechanisms

2 – Generate products at high spatio-temporal resolution (daily/10m)

3 – Disseminate all products via a unique dissemination platform

4- Select a sample of individual farmers or cooperatives to test the irrigation optimization system before transferring it to start-up to generalize it to a wider range of users

5- Generalize products on different Moroccan watersheds and irrigation perimeters
CAPACITY BUILDING AND INTERNATIONAL COOPERATION

- Increase the potential of national and regional users
- Support and facilitate the integration of space techniques
- Strengthen national and regional human capacities
- Raise awareness among decision-makers

To users from national and regional départements, agencies, universities and institutions

- Support of International cooperation: Funders, Space agencies, specialized institutions
- NORD-SOUTH, SOUTH-SOUTH Cooperation
International cooperation support

- 3rd International Conference on the Use of Space Technology for Water Management, PSIPW, ESA, ISNET, GEO
- International workshops on Sentinel satellite images with support of CNES, CESBIO, IRD, ESA et UE
- Organised trainings behalf LDAS MOROCCO Project
  - Drought monitoring and warning using space techniques, ITC
  - Composite Drought Indicator and Validation Methods, University of Nebraska, National Drought Mitigation Center, University of Maryland, USA
  - Estimation of soil moisture from satellite images, Vienna University of Technology, Austria

- Developing the operational drought monitoring system for Morocco in collaboration with ICBA, University of Nebraska, FAO
- Trainings on monitoring land use and estimating evapotranspiration in the field of AGIRE programme with the support of GIZ and Swiss cooperation
CAPACITY BUILDING AND INTERNATIONAL COOPERATION
Trainings for African Countries

Masters in Space Science and Technology (STE)
Remote Sensing and Geographic Information System (T&GIS) and Satellite Meteorology and Global Climate

Centres Royal de Teledetection Spatiale
Capacity building for African professionals

Training on EO and GIS for the needs of the Agricultural Field
- Partner: OADA
- Nbre of participant: 20
- 10 pays African countries

Training on Agricultural Risk Insurance and Reinsurance
- Partner: Banque Mondiale, SCR
- Nbre of partipant: 25
- 10 African countries

The use of Satellite Images and Geographic Information Systems for Analysis and Spatio-Temporal Monitoring of Projects
- Partner: PNUD
- Nbre of partipant: 15
- 8 African countries

Agrogeomatics
Smart agriculture
THANK YOU FOR YOUR ATTENTION

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