Facts from space on water in agriculture

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EO4SD: satellite based services for water resources management
2019 Dec 2 | World Bank, Washington DC
Efficient use of water

Increased agricultural productivity
Major challenges for water & agriculture

RELEASE: One-Third of All Irrigated Crops Face Extremely High Water Stress

PRESS RELEASE - November 25, 2019

32 % now → 40% by 2040

Rainfed agriculture: 4x more extreme seasonal variability in water supply

Credit: WRI.org/Aqueduct
We need to increase agricultural efficiency

Water productivity = \frac{Crop yield (kg)}{Water consumption (m^3)}

or

- Reduce water consumption without decrease in yield
- Increase yield without increasing water consumption
Opportunities from space

✓ Spatial insight in water distribution
✓ Up-to-date and historical data
✓ Scalable from field to larger basins

Today’s examples:
• Irrigated area mapping
• Water productivity
• Irrigation planning
• Water auditing
• Water accounting
Where is the water consumed?

Irrigated area mapping
Niger SIIP – irrigated area mapping

Irrigated area in the dry season (Dec ’18 – May ’19)

Challenge
- Monitor irrigation development over time

Type of analysis
- Classification of multispectral and radar imagery

Value
- Reliable data on trends and changes in irrigated area

Credit: EO4SD Water Cluster (Satelligence for ESA/WB, 2019)
Irrigated area mapping - Tadla scheme, Morocco

Changes in irrigated area 2015 - 2017-18

Credit: eLEAF for GIZ AGIRE, 2019
More crop per drop

Monitoring water productivity
Actual evapotranspiration (ET) exceeds precipitation (P)

https://wapor.apps.fao.org

* Open-access data *

* on crop growth and water status *

* for Africa and the Middle East *

* 2009 – present *

Credit: EO4SD Water Cluster (eLEAF/FAO WaPOR for ESA/WB, 2019)
**Birni N’Konni, Niger: spatial and temporal variation**

**Actual evapotranspiration (mm)**

- 2017-18
- 2018-19

**Biomass production (kg/ha)**

- Dec-Mar
- 2017-18
- 2018-19

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**Challenge**
- Improve (1) water use efficiency (T versus pumped water) and (2) water productivity (kg/m³)

**Type of analysis**
- Energy balance modelling using satellite inputs (e.g. Sentinel-2)

**Value**
- Evaluate the spatial and temporal distribution of water usage and the potential for extension
Tadla, Morocco: identify largest water users

Annual $E_{\text{act}}$ minus rainfall above 6000 m$^3$ water allocation (mm/year) - 2018

$(ET \text{ minus } P) > 6000 \text{ m}^3$
Improved irrigation management

Irrigation planner
Irrigation management – the Crop Water Demand Forecast

Assists with effective irrigation scheduling
✓ Estimates water need of the crop for the next 7 days
✓ Uses actual crop factor Kc - based on the actual status of the crop

Credit: eLEAF, 2019
Irrigation management – Gezira scheme, Sudan

Scheme level

Field level information

Irrigation advice

“You need to irrigate 2 days from now”

Average yield increase: 63 %

Credit: eLEAF, 2019
...operational since 2010

Initiated and funded by the Ministry of Agriculture - SA

- Weekly updates on performance and water use
- Automated alert system in case of anomalies
- Support farmers and extension staff to increase productivity & efficient use of inputs
- 700 Users with +70,000 ha cropland in the system
Monitor water usage

Water auditing
Water auditing

Compares **actual water consumption** (irrigation) to **allowed water quota**

- satellite based compliance check
- operational in South Africa
- per field or larger unit

Early identification of larger water users

* start dialogue *

*The Water Auditing Application should not be used as a tool for direct fining, but serves as an indicator to identify trends and start communication*
Water auditing

Up-to-date information on which administrative areas exceed the water allocation
Water auditing application

Red colors indicate larger water users
Water auditing application

Water consumption exceeds allocation
Water auditing application

More detailed view:
Which fields are exceeding the water allocation?
Water auditing application

Warn farmers in time (instead of fining them after the season ended)
Country level water management

Water accounting
Water accounting (WA+)

Categorization of water

How much water is used and reused within and across sectors at different scales?

Scenarios

Credit: Molden et al., 2001
Take away message

Many opportunities for satellite-based agricultural water management (in particular ET) to increase efficiency and productivity of water in agriculture:

✓ Policy design and implementation
✓ Support farmers in sustainable production
✓ Evaluate impact of interventions

Ready for implementation at scale
Thank you!

http://eo4sd-water.net/
The sky is not the limit: Satellites in support of smallholder farming (part 1)

By Marianne Blassen, Chris Albrecht & Bach Fernandez  |  September 30, 2019

When you hear about satellite information in agriculture, you often imagine a farmer driving his tractor in a large field, with the help of a GPS and a fancy display showing the latest satellite-derived information.

But can satellite-based earth observation technology also benefit smallholder farmers, who typically farm on land that is smaller than 2 hectares? How does it fit in with the daily reality of a smallholder farmer, who often has little information available, and limited access to tractors and inputs such as water, fertilizer, seeds, and pesticides?

Potential of satellite information

In precision agriculture, satellite information is used to observe, measure and respond to inter and intra-field variability in crops on commercial farms. For smallholder farmers, it cannot provide this level of detail. Generally, the focus is more on remote monitoring of the farms since very little on-the-ground information is available, such as field boundaries and farming practices. So what value can satellite information offer to smallholder farmers?

The sky is not the limit: Satellites in support of smallholder farming (part 2)

By Marianne Blassen, Chris Albrecht & Bach Fernandez  |  October 03, 2019

Don't miss part 1 of this blog post: The sky is not the limit: Satellites in support of smallholder farming.

The World Bank recently published a paper on Harnessing Digital Technologies to Improve Food System Outcomes. It points out that new and expanding technologies have not always realized their full potential in rural areas, where access to digital technology is hampered by low connectivity and coverage.

Agricultural data can address some of these gaps. The increasing availability of high and open imagery through the European Copernicus program opens the field to non-specialized users and are a real game changer for developing countries. Improved processing and analytical capabilities ensure that the data becomes actionable for decision making.

In a previous blog, we acknowledged the challenges facing the use of satellite technology for development. In this blog, we explore the enormous opportunities that satellite data can provide in three selected areas: agricultural productivity, water management, and sustainable land management.

Enhanced agricultural productivity

Agricultural productivity is one of the cornerstones of agricultural development. Satellite data can be used to map the distribution, status and dynamics of agricultural production in relation to land and water resources.