Expanding Support to Water Accounting in River Basins and Water Productivity Measurement in Irrigation Projects

ADB

UNESCO IHE DELFT

IWMI International Water Management Institute

EVENT SNAPSHOT

Part 1 – Increasing Agricultural Production Using Water Productivity

Event Details

Date and Time
18 November, 4:00–5:00 p.m. (Manila time)

Venue
MS Teams

Related water subthemes

	Water supply, sanitation, and wastewater		Flood/drought risk management and disaster resilience
x	Irrigation and productivity		Water governance and finance
x	IWRM, storage, water-food-energy nexus		Water and health

Water is by far the greatest water consumer in Asia, with agriculture accounting for between 60% and 95% of all water diversions in various countries. Over the past two years, the ADB Water Sector Group, IHE Delft Institute for Water Education (IHE Delft), and the International Water Management Institute (IWMI) have been investigating and testing how agricultural water productivity studies, which combine field and remote sensing data, can provide decision support information to guide investments and irrigation management. Such decision support is becoming increasingly important for leaders and water managers who are tasked with sustainably managing water resources, increasing water productivity, and improving food security.

During the webinar, IHE Delft and IWMI shared the outcomes of their water productivity measurement work. They introduced the concept and methodology of remote sensing-based water productivity, showcasing the results of three water productivity studies and examples of how water productivity results can impact decision-making. The session gathered a total of 131 participants, and was moderated by IHE Delft's Lauren Zielinski and ADB Water Sector Group's Jelle Beekma.

The webinar series is a reformat of the original plan to have several in-country workshops and training sessions. These events could no longer be implemented face-to-face before the end of the project due to the pandemic. The two webinars are part of a blended online approach, which also include different knowledge products (such as reports, data, videos, etc.) to be shared online through the ADB Knowledge Events website, IHE's YouTube channel, and wateraccounting.org.

Key Takeaways

Water productivity is an important tool in agricultural water management. Water productivity is an important indicator to guide irrigation managers in getting the most out of water, but also encompasses broader elements of agriculture and water by promoting a more integrated approach. This can include the integration of local, regional, and national polices, as well as agricultural investment decisions. Water productivity can be used during times of water scarcity as well as water abundance, making it helpful for year-round water management. Water productivity alone cannot always capture the full spectrum of productivity, food security, and return in investments, and it should be used in combination with other information, such as crop yields or financial returns.

Remote sensing-based water productivity analyses can provide a wide variety of information. Remote sensing-based water productivity analyses offer monitoring at high spatial and temporal scale, including global, continental, national, basin, and field scales for evapotranspiration and biomass production. This allows for customization according to the needs of the user. New satellites, advanced remote sensing techniques, and advances in information and communications technology (ICT) tools will offer more opportunities to improve the frequency and resolution of the remote sensing data, resulting in more detailed and reliable analyses.

Decision support tools can be generated by integrating remote sensing-based water productivity analysis with local information. By integrating the outputs from remote sensing analyses with locally relevant information, a powerful suite of decision support tools can be provided. This can provide better targeting of investments and selection of priority schemes, identification of areas of decreasing performance related to water availability and/or productivity, and access to information to address issues before they become critical.

> **Water productivity can guide investments, not only where where water is scarce or access is needed, but also where water consumption can be reduced.**
>
> — Dr. Poolad Karimi, water productivity expert

Questions from the Audience

Is it possible to know which crops are being produced using remote sensing or GIS data?
Yes, recent advances in remote sensing techniques allow us to map crop types at high resolution using data from satellites like Landsat and Sentinel(s). In the Karnataka case study, we performed a satellite image classification over the Kharif season using machine learning approaches to derive crop type maps (Paddy, Cotton, RedGram) of the study area. However, field data is needed to extract crop types accurately.

The approach is good for a comparative analysis. However, the biomass production from the wet and dry regions may differ more than the actual crop yield. How can you take account of outside crop vegetation?

One advantage of remote sensing-based analysis is the spatial coverage satellite data offers. We can easily consider the area outside a scheme in a buffer, and compare inside and outside the scheme or dry and wet regions, so the difference will be reflected in the analysis.

Higher water supply to a farm leads to higher water consumption, while lower water supply at proper interval could not be directly linked with the crop yield. The relations are non-linear.
Yes, true; and that's well reflected in our analyses in Karnataka, where lower water consumption areas reported higher yield and water productivity.

Does the energy balance method work well for diversified cropping patterns (combinations of irrigated crops and rain-fed crops)? This is the most common case at tail-end farms.
This depends on the resolution of input data. What we noticed is that applying the energy balance model with high resolution satellite data like Landsat as input can capture the variations due to diversified cropping patterns. However, it would be difficult to capture these variations using course resolution data. In the demonstrated case studies, we used high-resolution datasets, hence these show the variations in water use and biomass, especially due to heterogeneous landscapes and crop types.

Given the spatial variance over the center pivots, it makes me wonder about soil heterogeneity. How is variance in the soil type, structure, and properties taken into account in the remote sensing approach?
The variation shown is mainly due to differences in vegetation growth within the center pivots. There could be underlying factors, like soil properties, which we need to explore further. In the case of Karnataka, we are now investigating the reasons behind this spatial variation in water use and biomass. Geostatistical techniques can be used for this purpose.

Can the software also track water losses in the canal system during distribution?
No, this would require in situ monitoring.

Two cotton crops with the same dry matter production can have very different fiber yield ... Can the remote sensing pick that up when calculating water productivity?
Yes, depending on the resolution of data we use. At higher resolutions, like what we have used in these analyses, we can pick this variability in biomass.

Can NDVI be used for understanding the impacts of climate change, in particular crop water productivity?
NDVI alone is not enough. We will need other biophysical parameters like biomass, yield, and water use (evapotranspiration) to compute crop water productivity. Besides, we need to analyze the water productivity for the same season in multiple years to understand the trend. Trend analysis to understand the long term patterns in temperature and rainfall (as examples) will be required to understand the climate change impacts on water productivity.

About the Speakers

Poolad Karimi

Dr. Poolad Karimi is a water resource and irrigation engineer with more than 15 years of international experience. He currently leads and contributes to several international advisory, research, and capacity development projects on water resources development and irrigation in Africa and the Middle East. He has been involved in numerous research projects pertaining to basin and field-level productivity, water scarcity management, small-scale irrigation interventions, water use efficiency, and the groundwater-irrigation-energy nexus. He has also been helping lead the development of the WA+ framework.

Sajid Pareeth

Dr. Sajid Pareeth is a researcher and lecturer in remote sensing at IHE Delft. He focuses on remote sensing technologies and land and water use monitoring, and has more than ten years of international experience. His main research in recent years has been to develop crop monitoring systems by satellite-based estimation of water use and water productivity at different scales in the spatial and temporal domain. He contributes to several projects in Asia and Africa funded by the European Union, Dutch ministries, UN FAO, and ADB. Sajid obtained his PhD in Natural Sciences from Freie Universitat Berlin. He was a DAAD scholarship recipient in Germany during his MSc in Photogrammetry and Geoinformatics at HFT-Stuttgart.

Lisa-Maria Rebelo

Dr. Lisa-Maria Rebelo is a principal researcher at IWMI. Her research involves the development of new, innovative earth observation-based methodologies to improve the understanding of interactions between basin scale hydrological and ecological functioning, and water availability and allocation; and identifying options for improved management of water resources at multiple scales. Lisa leads IWMI's water productivity and water accounting portfolio.

Karthikeyan Matheswaran

Dr. Karthikeyan Matheswaran is a regional researcher at IWMI. His research involves combining model tools and earth observation systems to provide evidence-based solutions to key water management problems. Recent research projects include remote sensing-based water productivity assessment, web-based platforms for erosion monitoring, and scenario-based water management models.

Related Resources

Open courses at IHE Delft: "Water Productivity and Water Accounting using WaPOR"
https://ocw.un-ihe.org

Interactive data and result portal (under development by FAO)
https://data.apps.fao.org/aquamaps/
http://waterinag.org/application/ADB-WP

YouTube playlist of webinar and advanced Water Productivity lectures from IHE Delft
https://www.youtube.com/playlist?list=PLYLoAVsT8gZPQ7uYMFVIir5Lq99x31abI