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APPLYING ANALYTICAL AND MONITORING TOOLS TO IMPROVE CLIMATE CHANGE ADAPTATION IN THE AGRICULTURAL SECTOR

7th Nile Basin Development Forum
Webinar CS6

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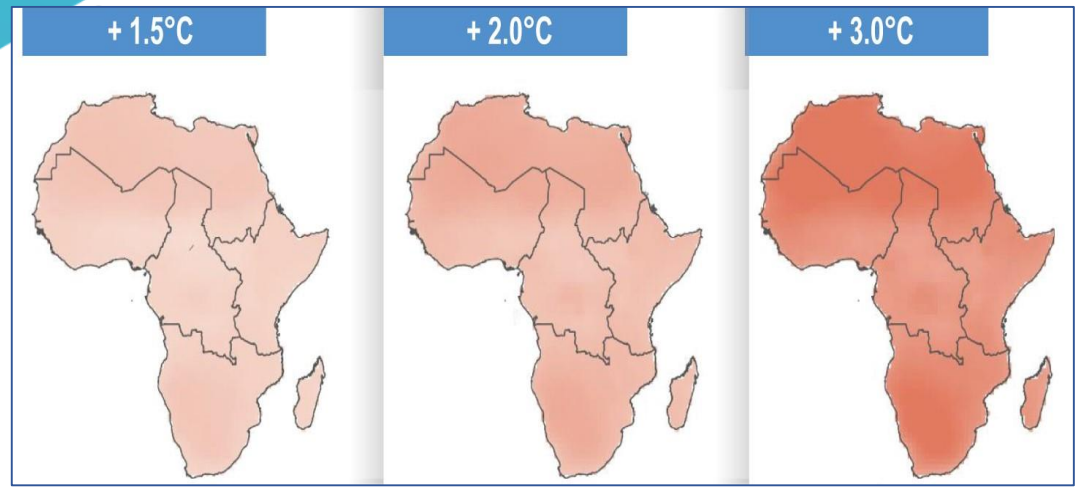
Innovative water solutions for sustainable development

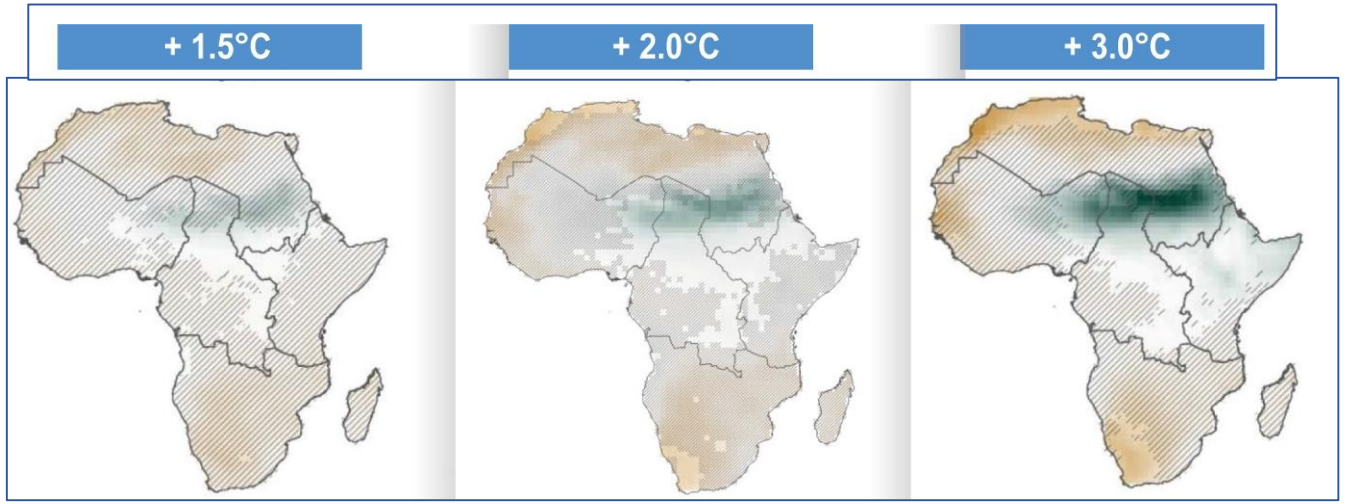
Food · Climate · Growth

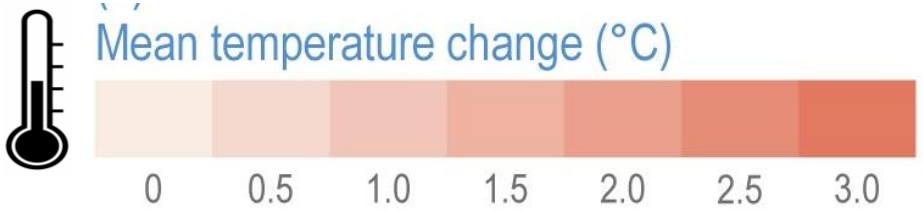
Outline

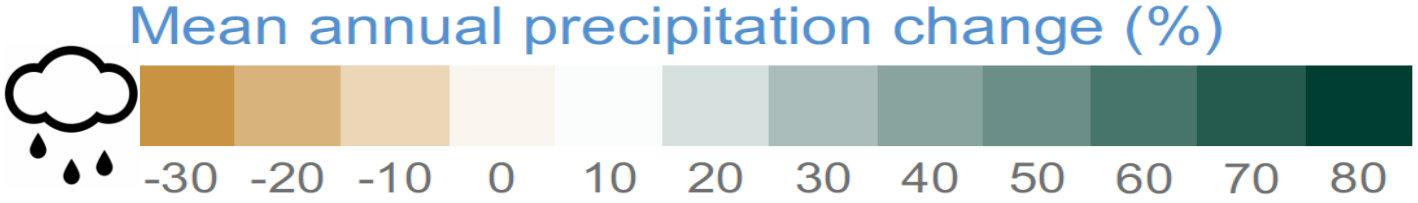
- Climate change and water in East Africa: quick overview
- Key implications for agriculture sector
- Monitoring for climate change adaptation in agriculture: What to monitor and why
- Cases studies of applying analytic and monitoring tools:
- Key steps/actions are needed to scale the limited, research focused experiences so far and mainstream them into operational workflows of governments.

Projected changes (relative to 1995 – 2014 average)









- Increase of 0.6°C, 1.1°C and 2.1°C at GWL of 1.5 °C, 2 °C, and 3 °C, respectively

- *low confidence* in projected mean rainfall change for long rainy seasons.
- No significant mean annual rainfall trend projected for rest of East Africa. *Agreement on the sign of change is low,*
- Heavy rainfall events are projected to increase over the region at global warming of 2°C and higher (high

Magnitude, and Direction of change and level of confidence

Key implications of climate change for agriculture sector (IPCC 2022)

- Observed trends: Reduction in agricultural productivity growth has been reduced by 34% since 1961 due to climate change, more than any other region.
- Projection: Shortening growing seasons and increasing water stress (high confidence).
- Global warming above 2°C will result in yield reductions for staple crops across most of Africa compared to 2005 yields.
- Climate change poses a significant threat to African marine and freshwater fisheries (high confidence).
- Under 1.7°C global warming, reduced fish harvests could leave 1.2–70 million people in Africa vulnerable to iron deficiencies, up to 188 million for vitamin A deficiencies, and 285 million for vitamin B12 and omega-3 fatty acids by mid-century. {ES-Ch9; 9.4; 9.8}

Monitoring for climate change adaptation in agriculture: What to monitor and why

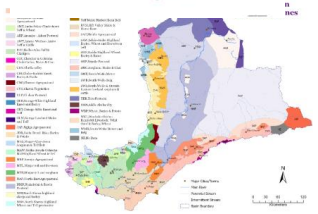
What to monitor:

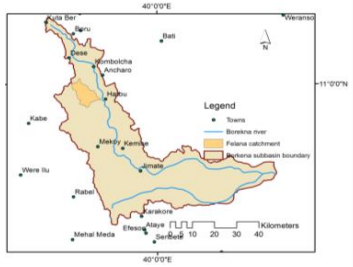
- Agricultural water use
- Water productivity
- Crop water stress?
- Irrigation water use efficiency
- ..

Analytic tools

- Water availability assessment
- Crop selection and cropping calendar
- Crop yield forecast
- Strategic decisions on land use planning ..

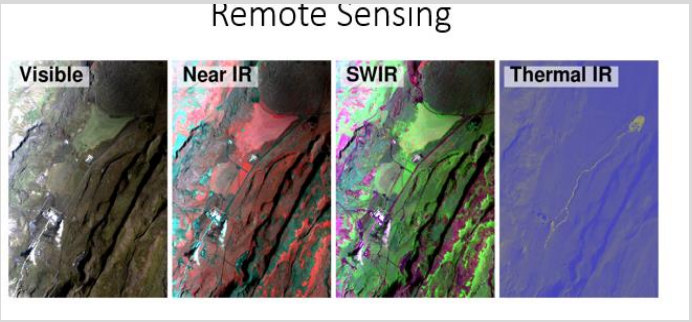
National and continental





Users	Examples of uses of DST and improved data
• Policy makers	• Monitoring of efficacy of policy interventions • Decisions on allocation of resources
• Basin development office experts	• Water allocation planning • Flood and drought risk mitigation
• District level experts at water, agricultural and irrigation offices	• Catchment management plans • Water allocation schemes • Irrigation design and management • Improve extension services
• Development Agents • Community based organizations	• Design and management of water harvesting structures • Cropping calendar decisions • Irrigation water management • Water productivity …

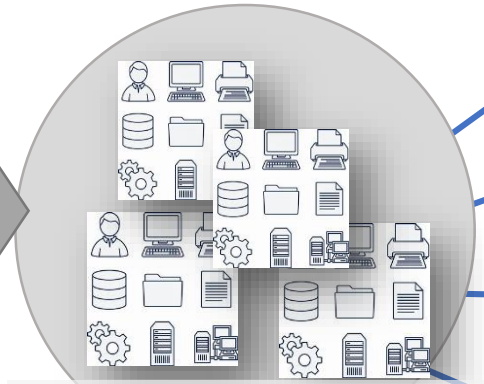
Rethinking integrated monitoring and analytic tools: Preliminary conceptual architecture of data and decision support tools



Earth observation data

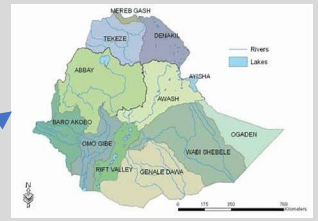
Other data sources
IoT; Big Data, Surveys

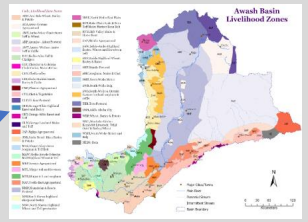
Ground-based data

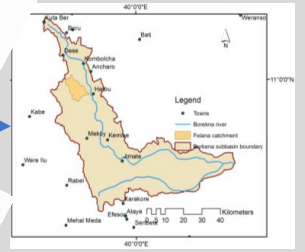


Suite of tools; AI, ML
Interoperable DBs

Multiple scales







Multiple Users/uses

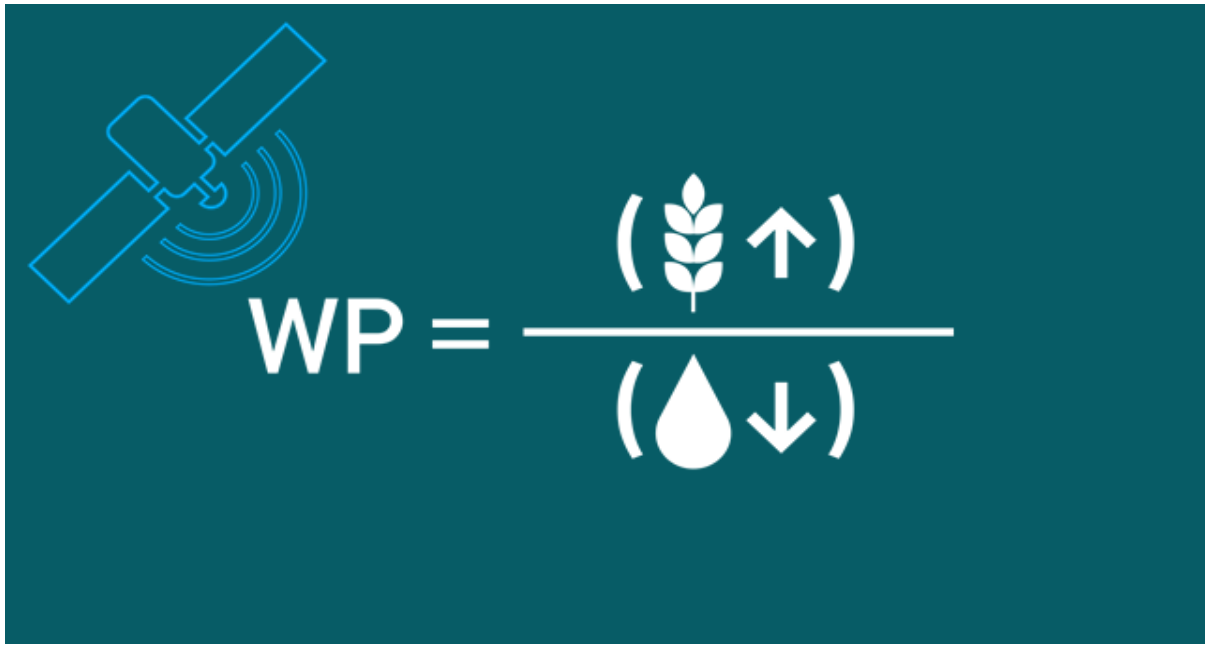
Users
• Policy makers
• Basin development office experts
• District level experts at water, agricultural and irrigation offices
• Development Agents • Community based organizations

Examples: 1) Monitoring water productivity in agriculture

We need to produce more food with less water

Water productivity in agriculture measures the output (kg/ha) per unit of water consumed (m^3/ha).

→ ***requires the estimation of water productivity is essentially the simultaneous estimation of ETa and CY***



Other variables monitored:

- Actual ET
- T and E
- Rainfall
- Water Accounts

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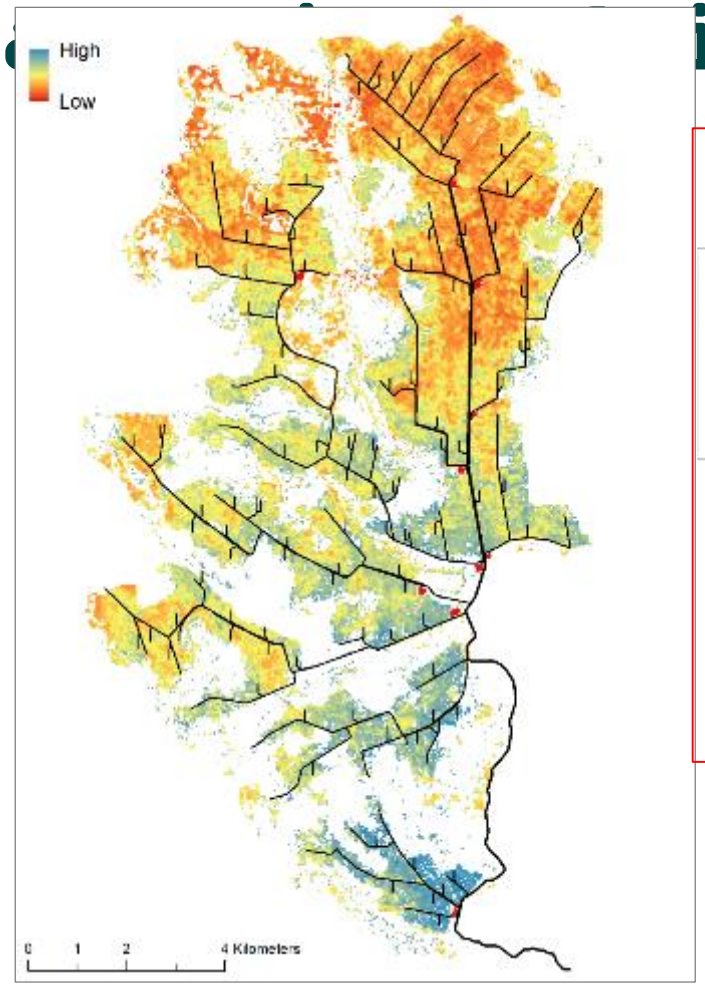
Examples: 1) Monitoring water productivity in agriculture (applying WaPOR data for agricultural water use and water productivity monitoring)

Assessing agricultural water use and t[illegible]interventions

- Monitoring agriculture water use
- Irrigation scheme performance assessment
- Crop water productivity assessment



Crop water productivity (wheat)

Co-learning from head to tail:

- **6 irrigation blocks (head-mid-tail)**
- **Multi-actor learning alliance for 2 irrigation seasons:**
  - Irrigators (647)
  - WUG, block and scheme leaders & development agents (230)
  - National research partner, students and data collectors (22)

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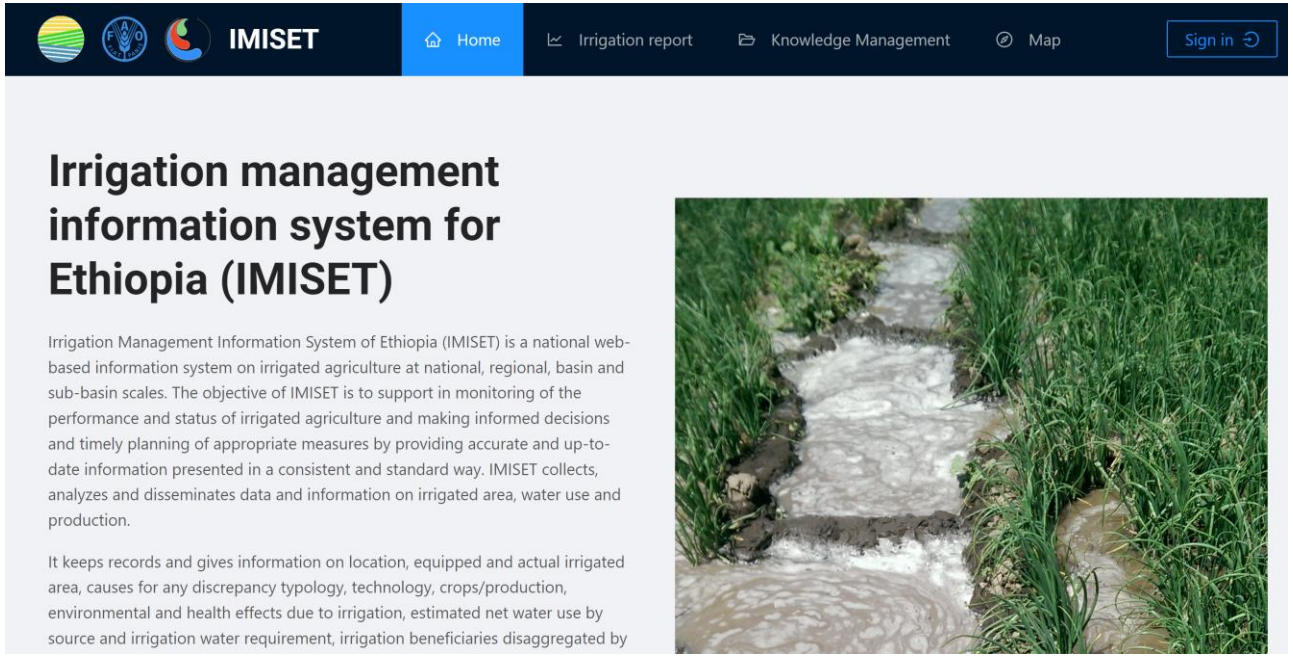
What advanced data acquisition systems (Earth Observation) can offer in this task, experiences from use of WaPOR data in Ethiopia

On-going applications

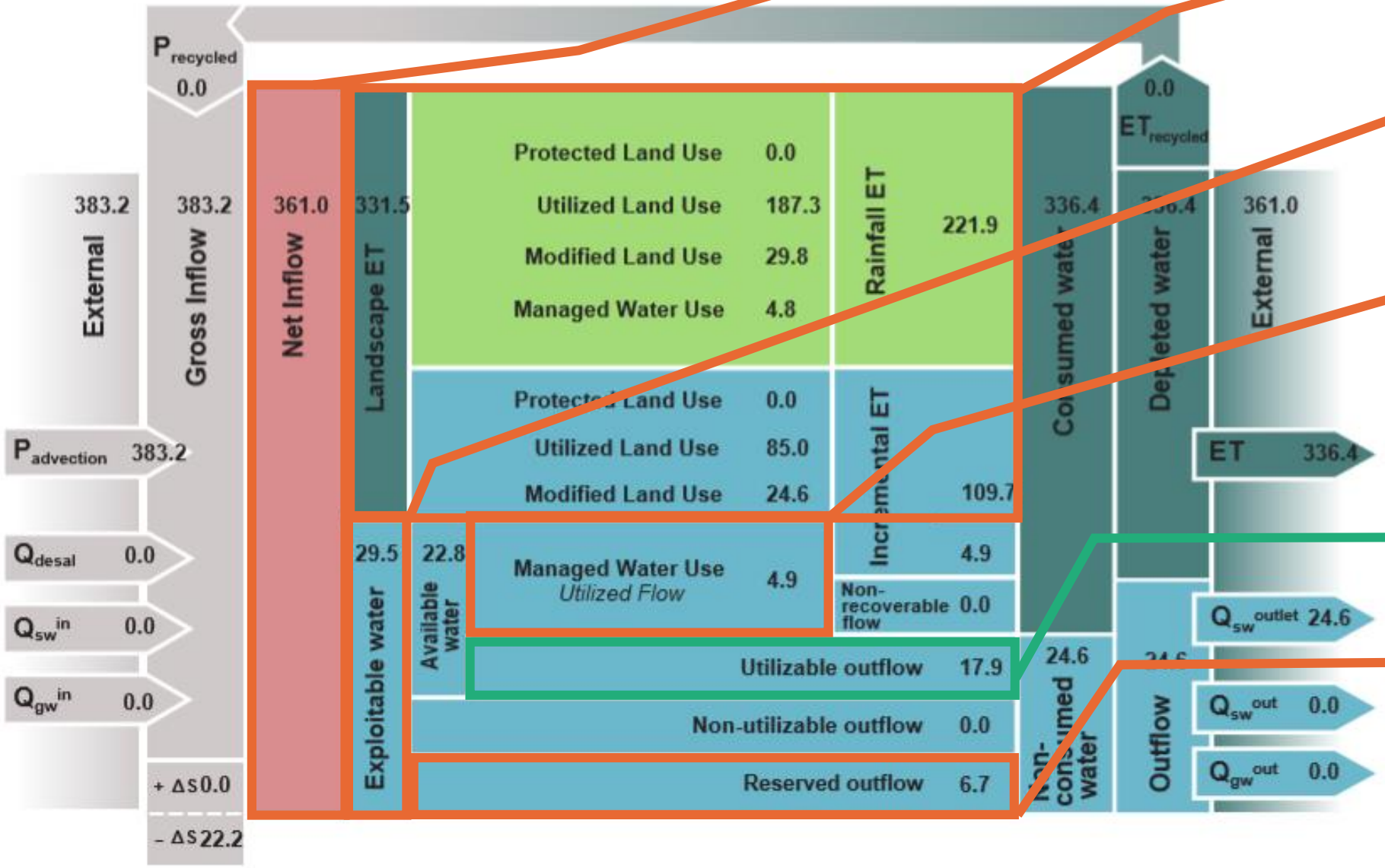
- **Strengthening the Ethiopian Irrigation Management Information System:**
  - Agricultural water use assessment
  - Estimation of irrigation water use efficiency
  - Crop productivity

- **Understanding drivers of wheat productivity**



Examples: 2) Monitoring water accounting

Agricultural Water Accounting:



How much water is flowing into the system

How much water is consumed through evapotranspiration

How much water is available to be exploited…

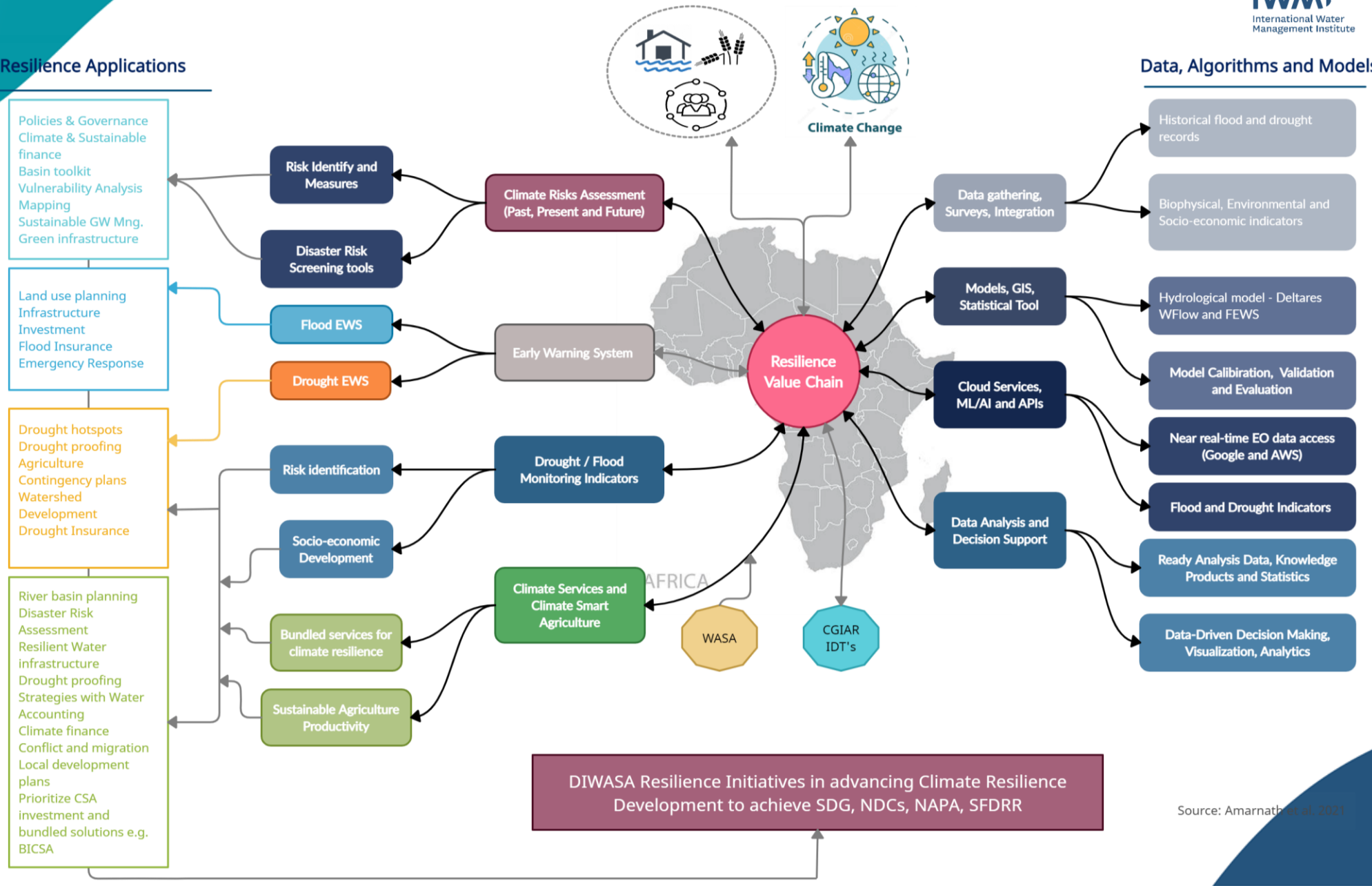
…of which, how much is already being utilized….

…and therefore, how much water is still available for allocation.

…and how much is reserved for downstream countries, environmental flows, etc. …

Examples: 3) Monitoring disaster risk

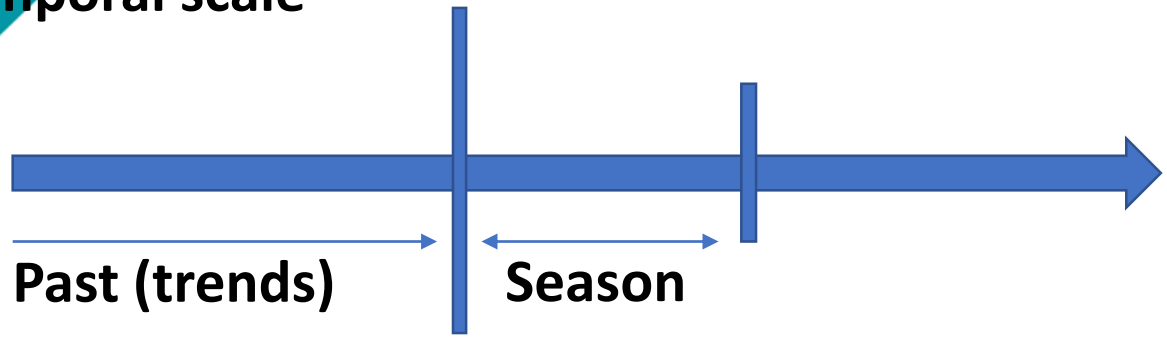
The case for value chain resilience



Source: Amarnath et al. 2021

Key steps/actions are needed for scaling …

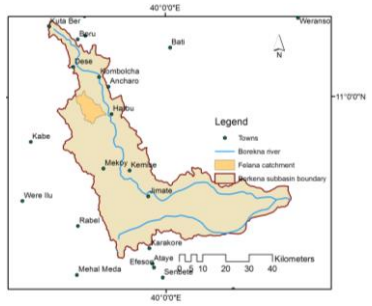
Temporal scale



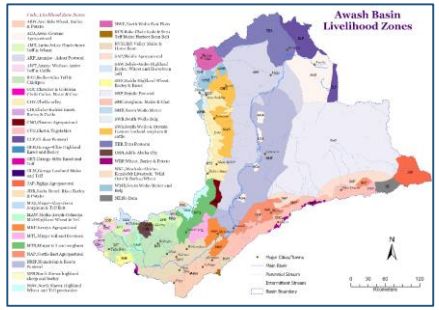
- Near real-time monitoring
- Seasonal prediction

Spatial scale

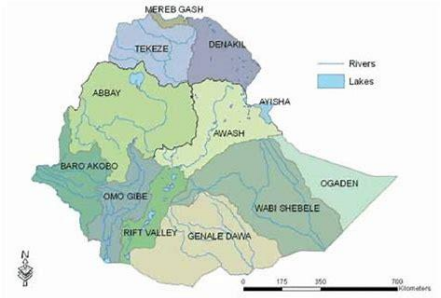
Farm/landscape



Catchment



Basin



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Conclusion: key recommendations

1. Build the capability of relevant government agencies → move from research to operational application
2. Mainstream (embed) into workflows of relevant government agencies (MoA, MILL)
3. Leveraging government land consolidation programme to address challenge of spatial resolution
4. Awareness raising on the potential value addition of the EO based agricultural productivity
5. Expand private sector role: integrating agricultural water use and productivity in their advisory services
6. Learning landscapes/farms which serve as testing and validation grounds (through in-situ data collection). Integrate farmers as part of the R and D stakeholders.

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