Water Accounting From Satellites

First steps towards a standardized description of water resources

Wim Bastiaanssen

Delft/Mini Symposium

Water Accounting

March 2, 2009

CiTG – Water Management

Delft University of Technology

Problem statement

- Growing world population
- International river basins
- Food security is under threat
- Competition for water
- Increasing uncertainty in water availability

Improved communication between all Stakeholders requires a standard description

Major questions on water flow

- Is there over-exploitation ?
- Which part of the water cycle is available in streams and aquifers ?
- Which part of available water resources are diverted ?
- Are the committed outflows met ?
- Are aquifers recharged ?
- Is the water demand met ?
- What is the role of land use and water use changes on availability of downstream water users ?
- Is managed water use sustainable ?

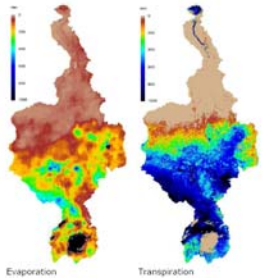
Role of land cover/land use in water cycle

- ***Natural land cover classes*** have precipitation and ET processes that occur without any interference
  > Natural forests (Gambella forest)
  > Natural lakes (Lake Victoria)
  > Natural savanna (Sudan)
- Land use is managed land cover ("***managed land use***")
  > Rainfed crops
  > Forest plantation
- ***Managed water use***
  > Irrigated crops
  > Reservoirs
  > Inundated land

Water sheet

TRMM, P

MODIS, ET



Natural land cover

Natural forest	P, ET
Savanna	P, ET
Desert	P, ET
..	P, ET

Managed land use

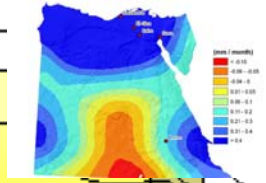
Forest plantation	P, ET
Rainfed crop	P, ET
..	P, ET

Managed water use

Irrigation	P, ET
Managed wetlands	P, ET
Drinking water	P, ET
..	P, ET

DMC/AWiFS, land use

Grace. ΔS



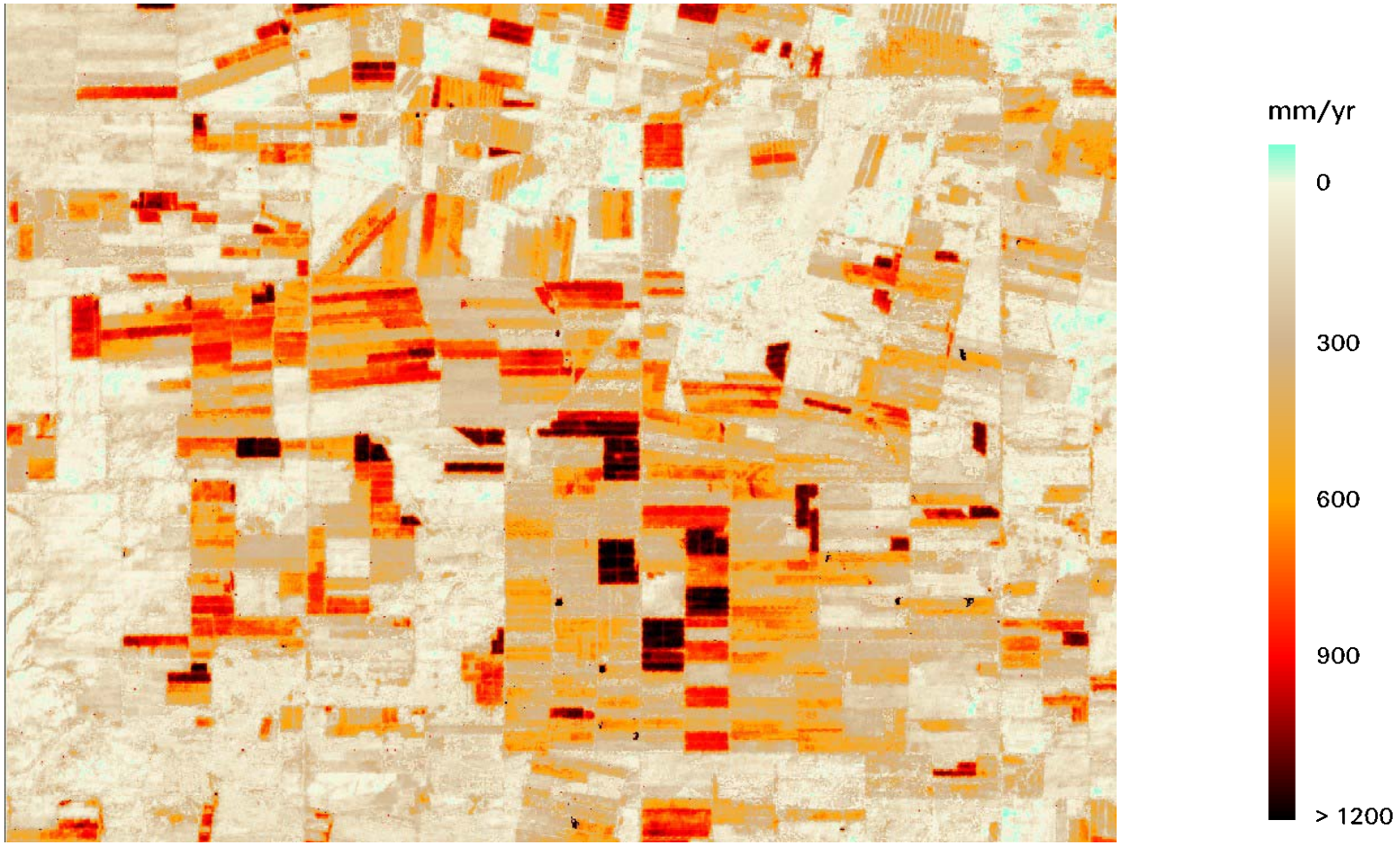
inflow

outflow

Aquifer & reservoirs

TU Delft

Groundwater abstraction Hermosillo

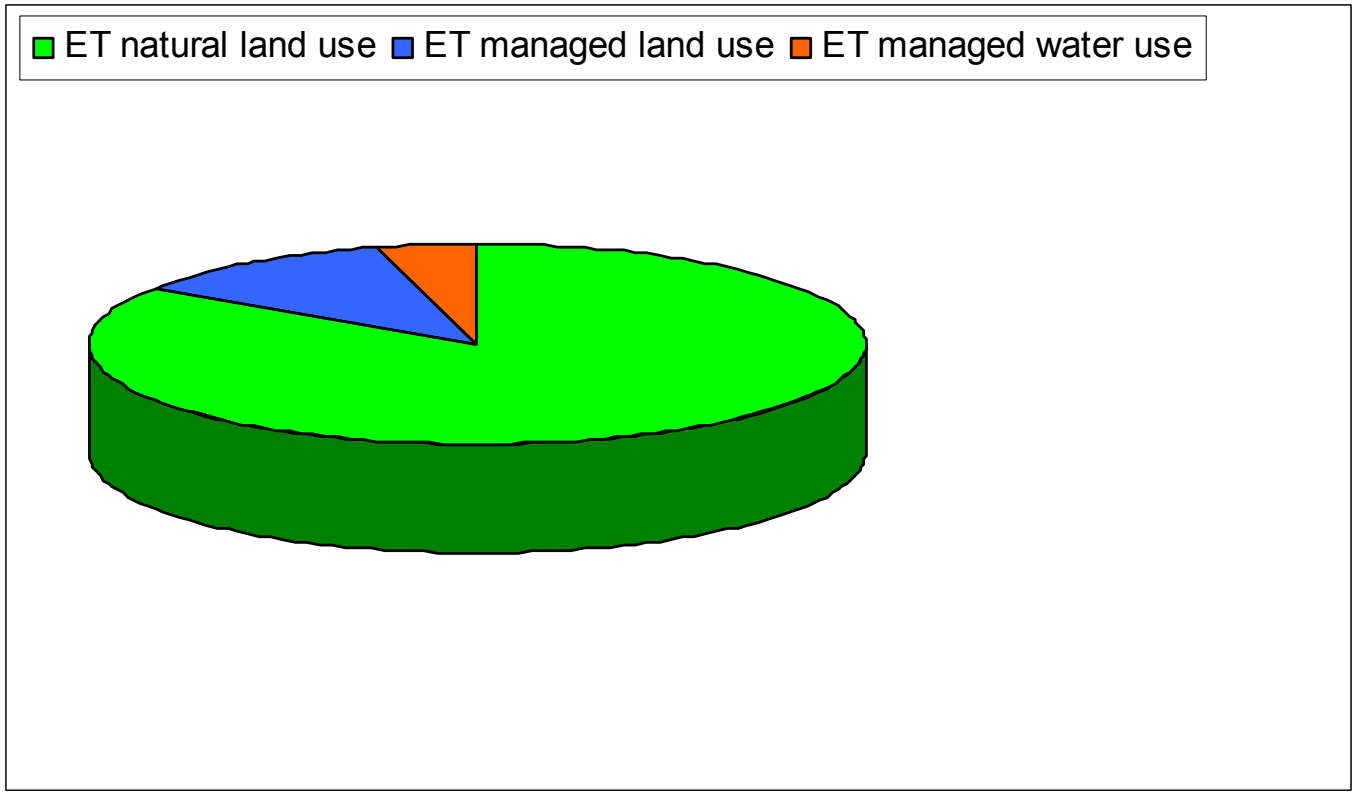


TU Delft

Major questions on consumption

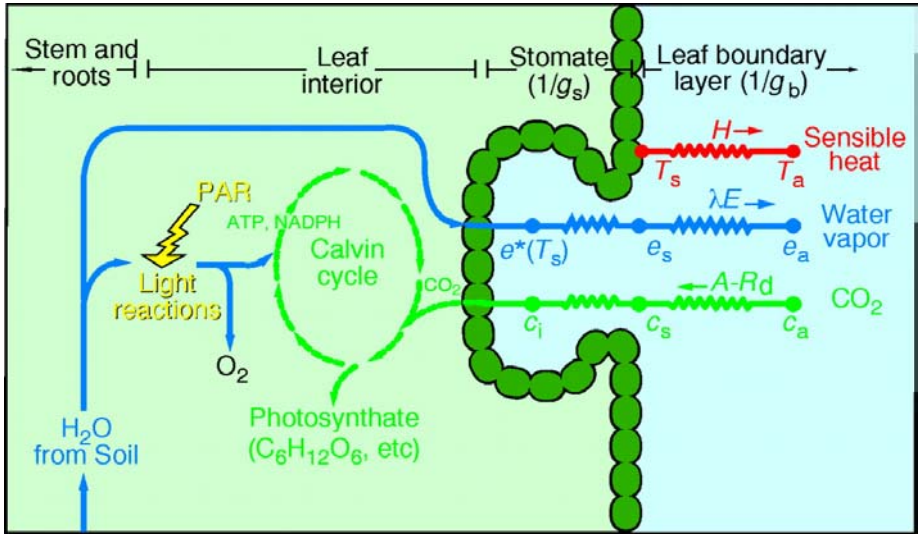
- How much water is consumed ?
- Which part of the consumption is managable ?
- Which part is beneficial and non-beneficial ?
- Do environmental and economical benefits balance ?
- How does managed land use affect the consumptive use ?
- How does managed water use affect the consumptive use ?

Is ET managable ?



- Only partially in the Nile basin, unless land use is modified

Need to separate E and T by land use class



- Soil evaporation is usual non-beneficial
- Transpiration is usual beneficial
- Interception is usual non-beneficial

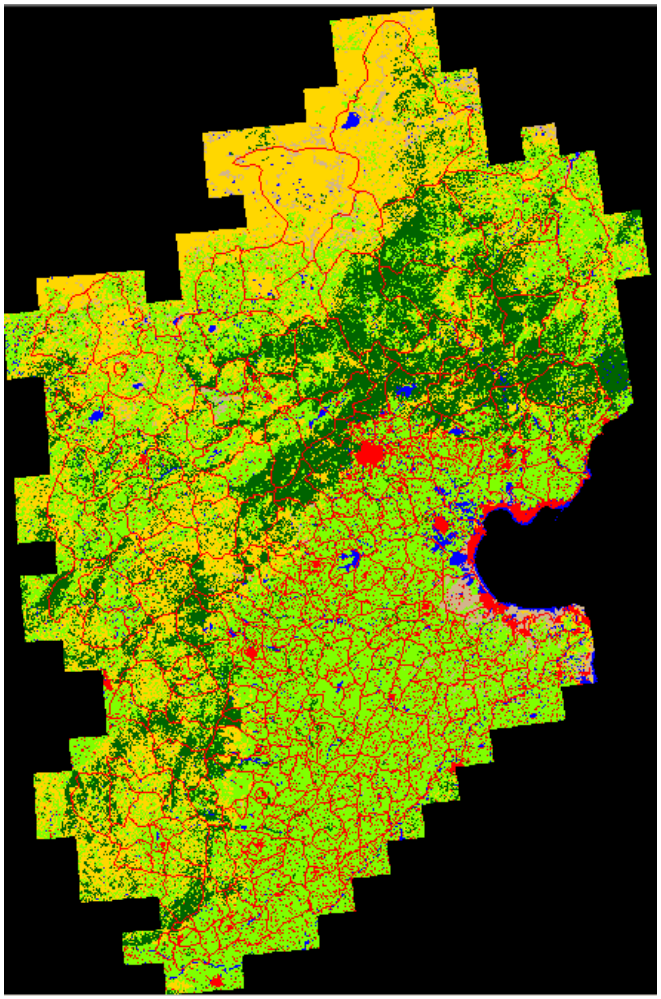
TU Delft

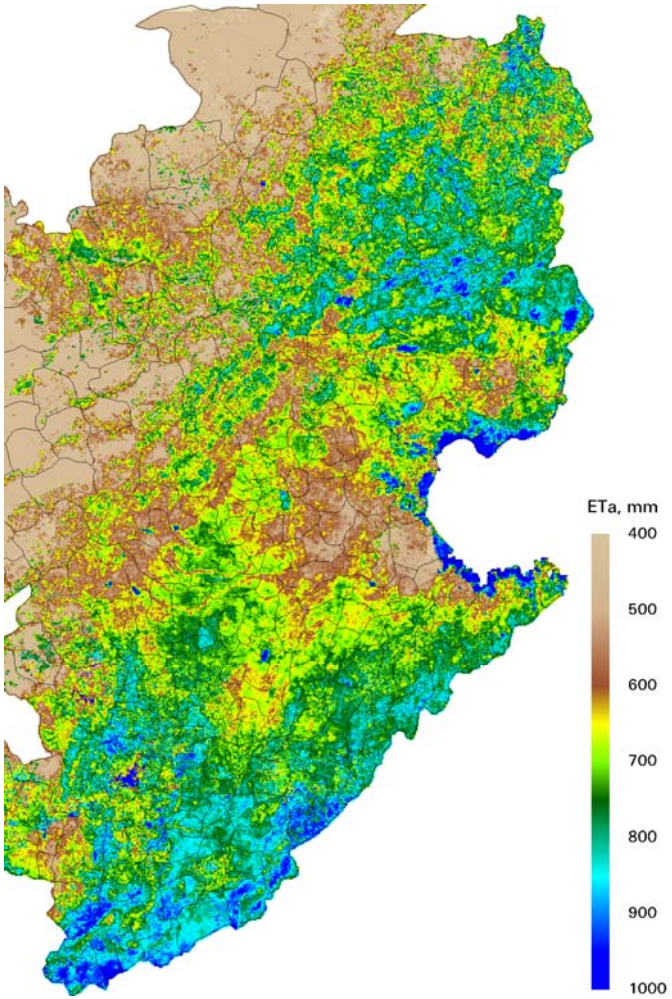
Beneficial and non-beneficial ET

Land use	Beneficial Economy	Beneficial Environment	Non-beneficial
Crop	T		E
Weed			E & T
Natural lakes	E	E	
Reservoirs	E		
Fish ponds	E		
Evaporation pond			E
Saline sink			E
Pasture	T		E
Golf course & sport parks	T	E	
Natural wetlands		E & T	
Managed wetlands		E & T	
Savanna		T	E
Woody savanna	T	T	E
Plantation forest	T		E
Natural forest		T	E
Phreatophytes			E & T
Desert			E & T
Oases	T	T	E
etc			

This value assessment is adjustable

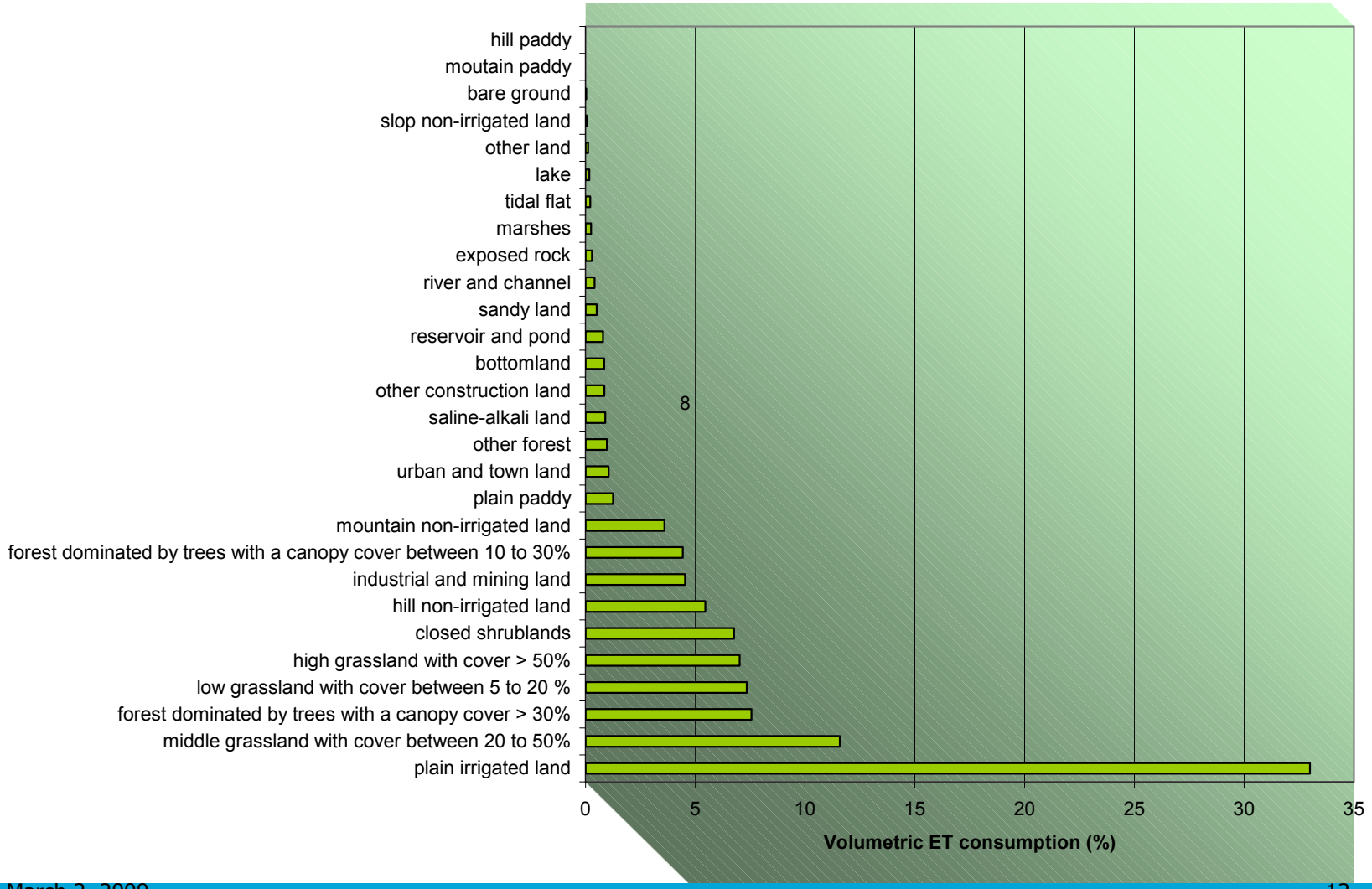
Land and water use Hai Basin





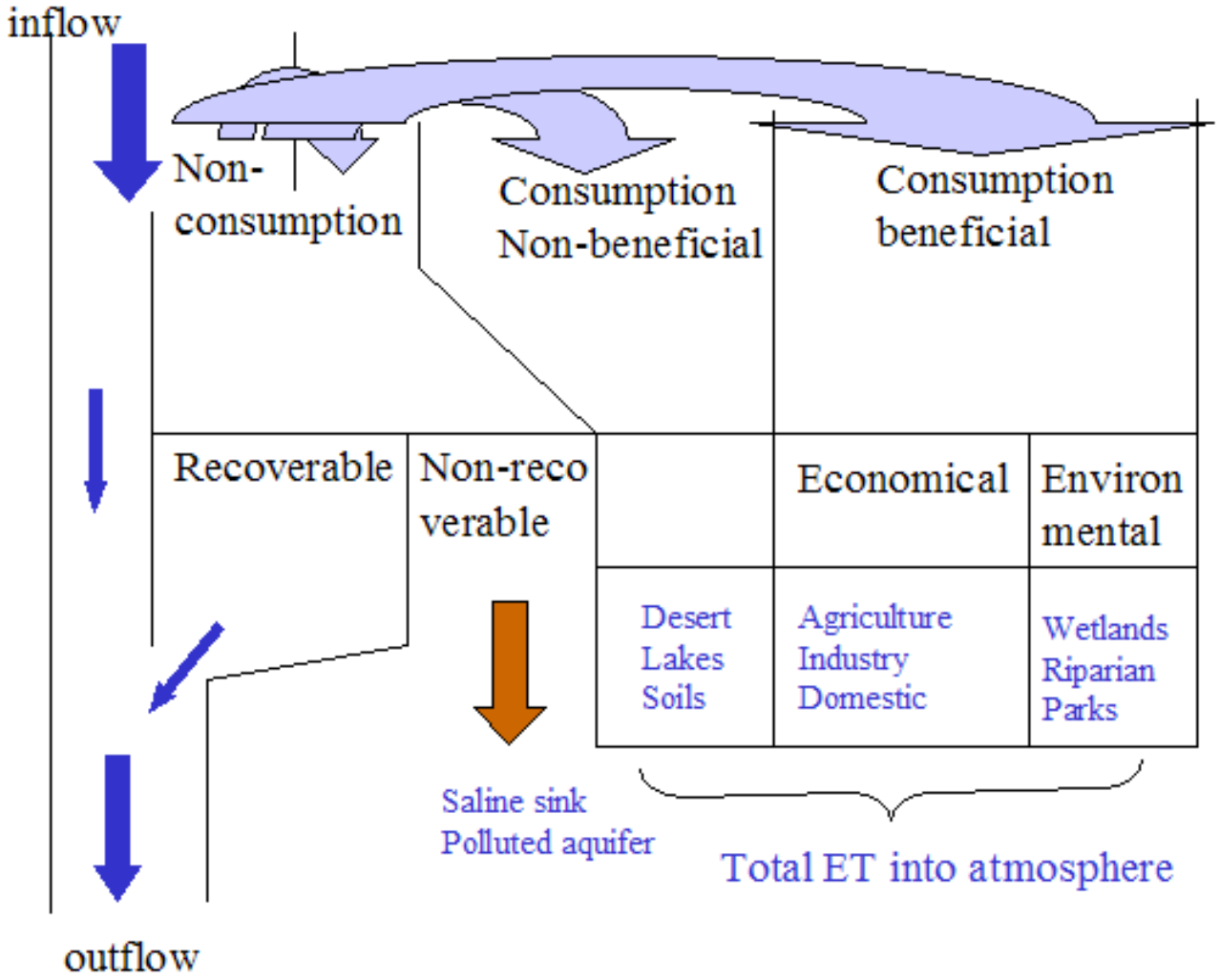
TU Delft

ET breakdown by land use Hai basin



TU Delft

Consumption sheet



TU Delft

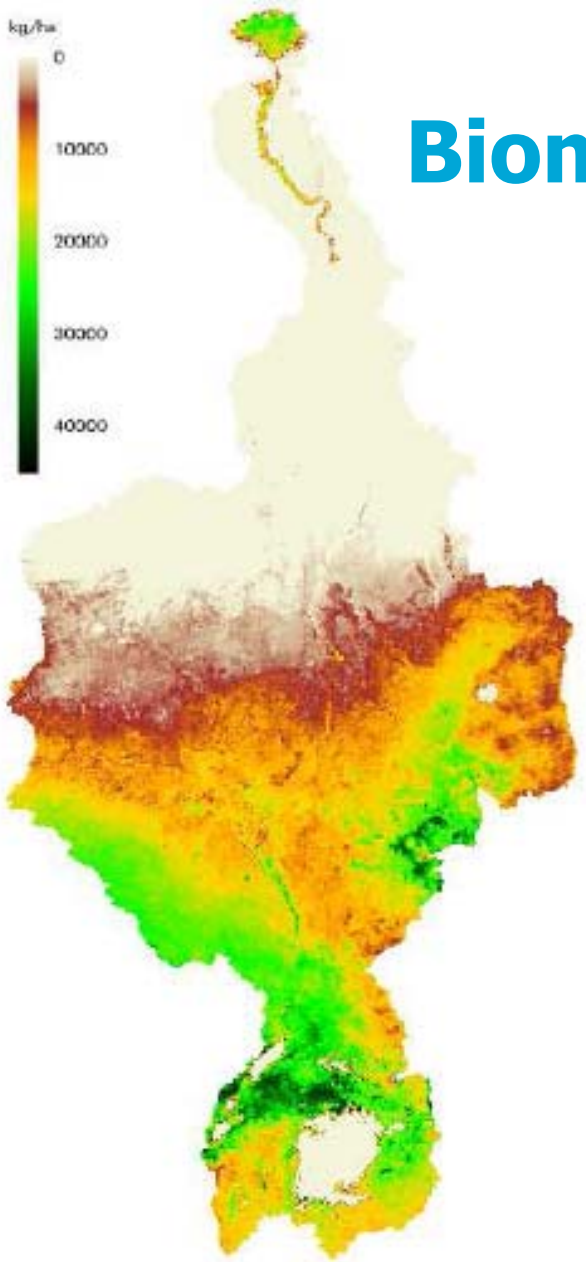
Major questions on water productivity

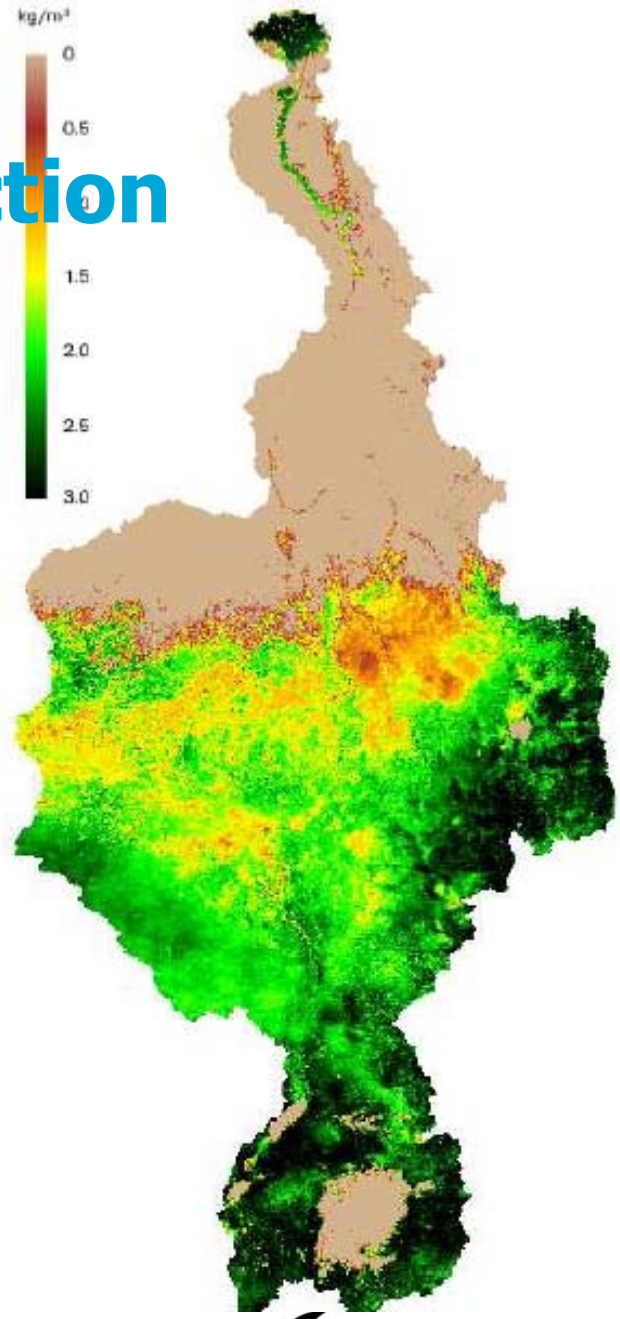
- How much food is produced in rainfed and irrigated crops ?
- What are the ranges of water productivity ?
- Is it possible to get more products from consumed water ?
- Is it possible to expand the irrigated areas by increasing water productivity ?

Economical products arising from consumed water

- Industrial products
- Hydropower
- Food (residual is feed or fuel)
- Feed
- Wood
- Biofuel
- Milk
- Meat
- Fish
- Traction

Biomass production

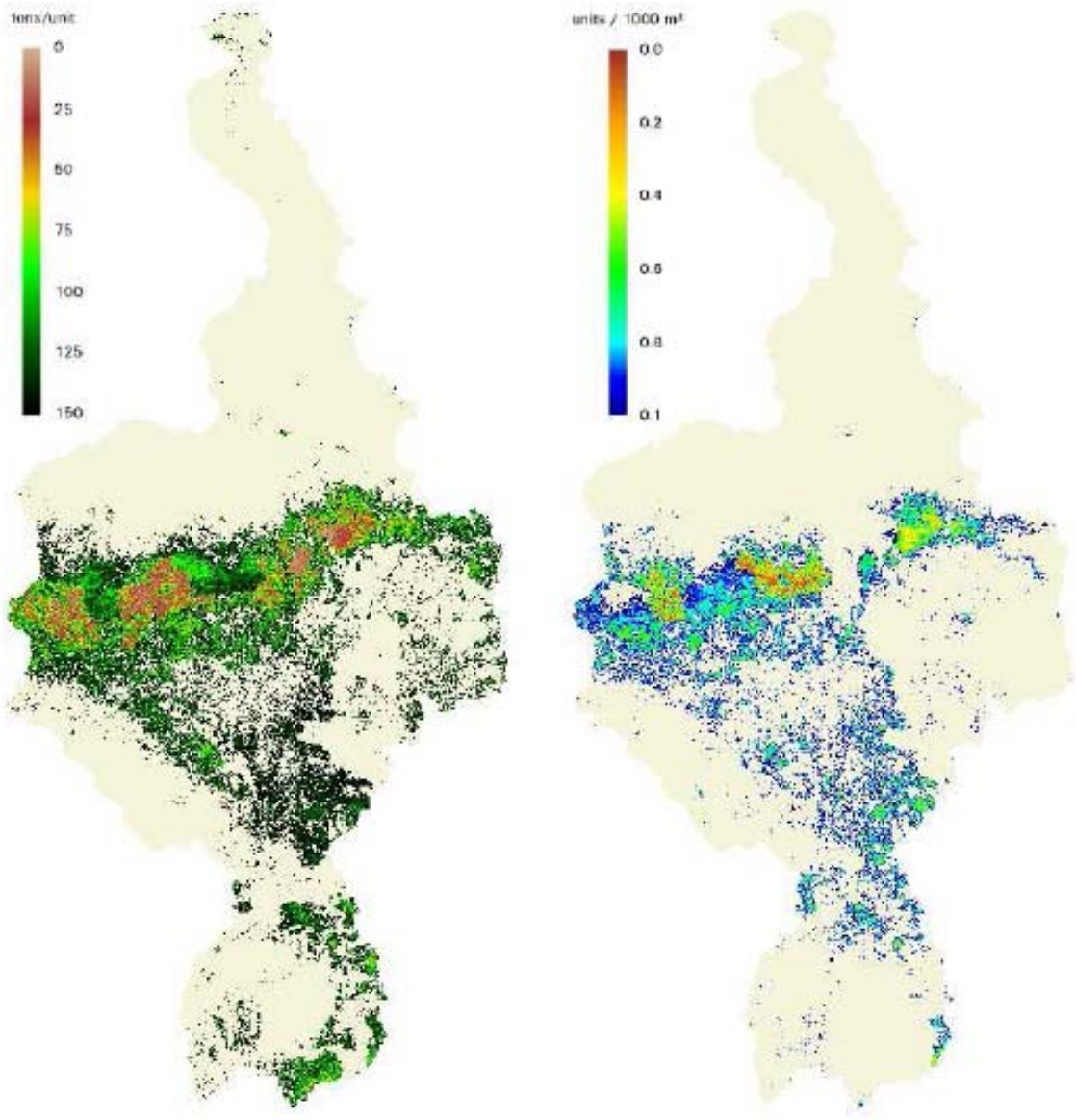




Biomass and land use need to be combined

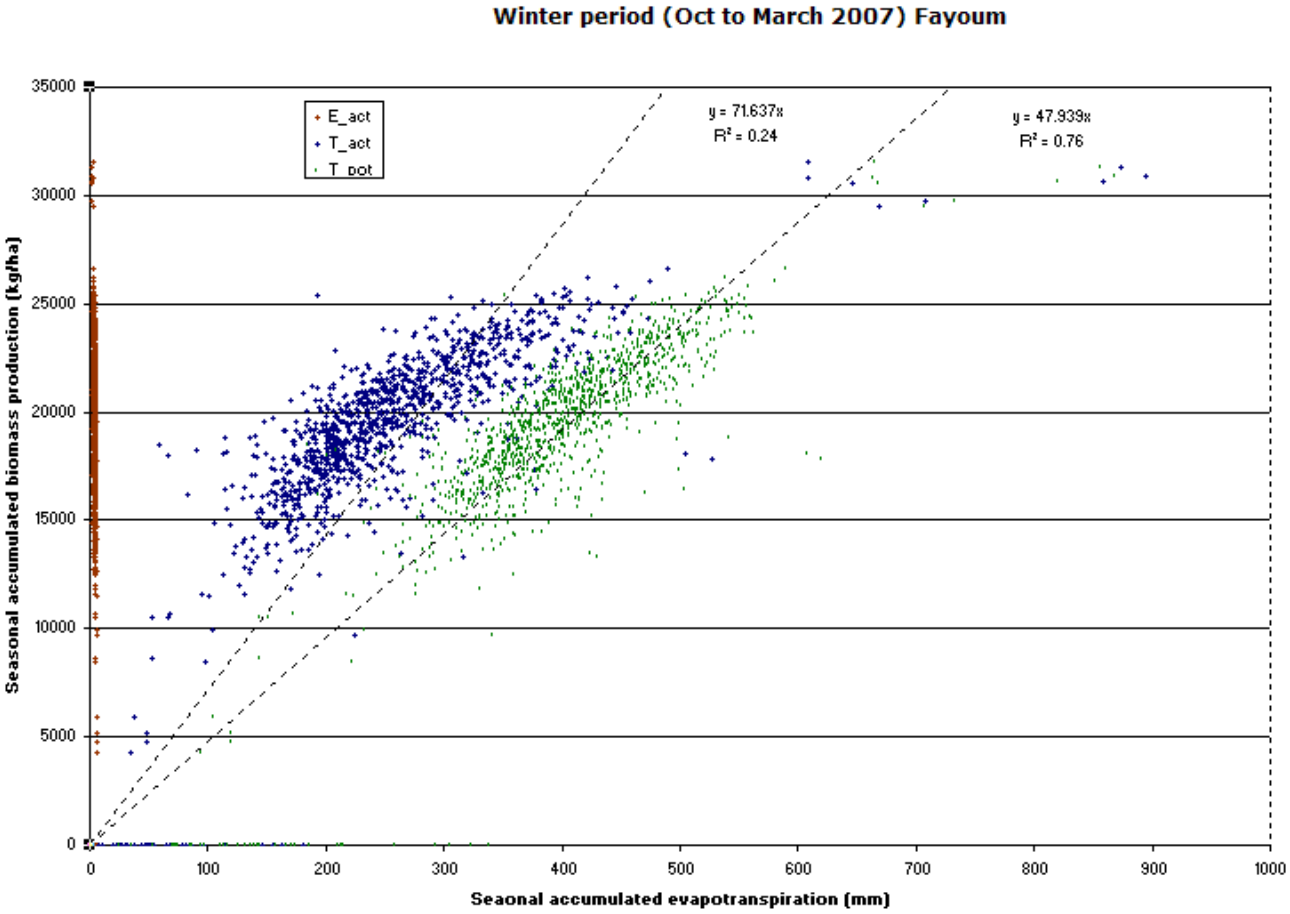
TU Delft

Water for Livestock



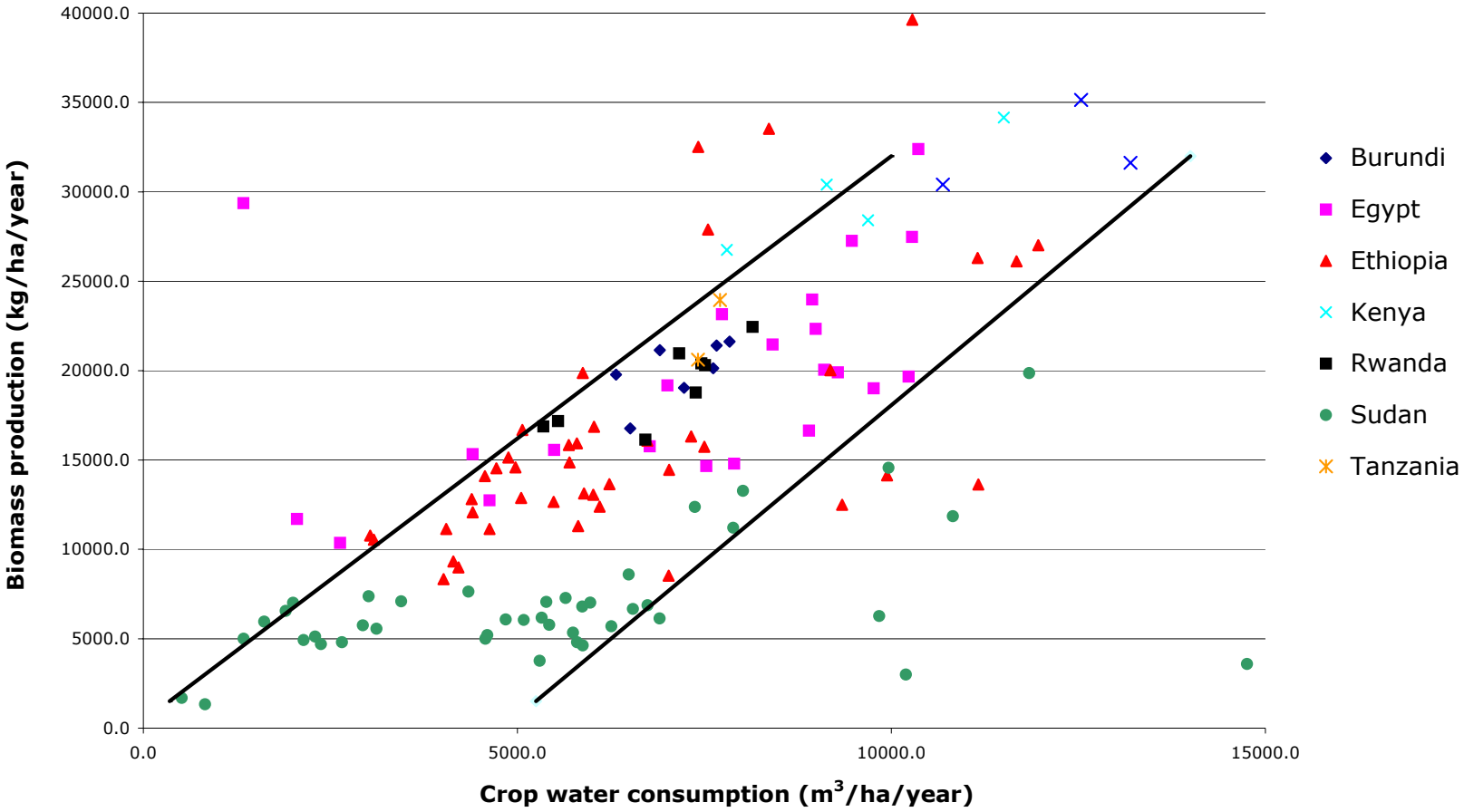
TU Delft

Fayoum irrigation Egypt



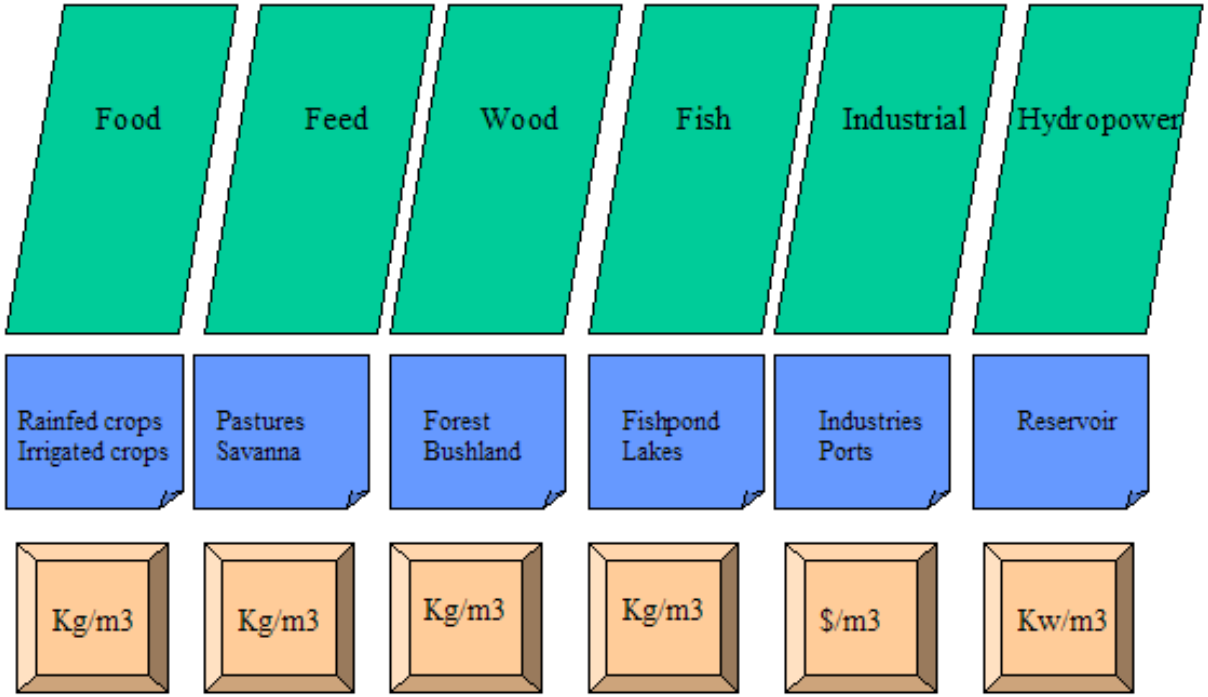
TU Delft

Optimum water productivity in irrigation



TU Delft

Economic productivity sheet



TU Delft

Environmental products arising from consumed water

- Biodiversity
- Migrating birds
- Wildlife
- Endangoured fish species
- Endangoured birds
- Water storage during flood periods

Who can use the water accounts ?

- United Nations (Blue revolution; green water credits)
- World Water Council ; Arab Water Council
- Riparian countries in international basins (NBI)
- National policy makers (longer term plans and targets)
- Water managers (action plans to meet targets)
- Donor organizations for good management
- NGOs
- CITIZENS of BASINS !!

Additions to IWMIs water accounting framework 1997

- Satellite-based, hence the dataflow is ensured
- Managable and non-managable water resources separated
- Beneficial and non-beneficial use by land use class
- More water use groups explicitly recognized
- Environmental and economical water use
- Groundwater component recognized

Next steps

- Groundwater recharge and abstractions
- Studying water demand domestic and industrial sectors
- Preparing land use maps from land cover maps
- Water quality issues
- Build up experience record and modify