Contemporary Concepts in Water Management

&

Impacts of Development on Local Hydrology

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Pollution, Health and Safety Management in ADB Projects

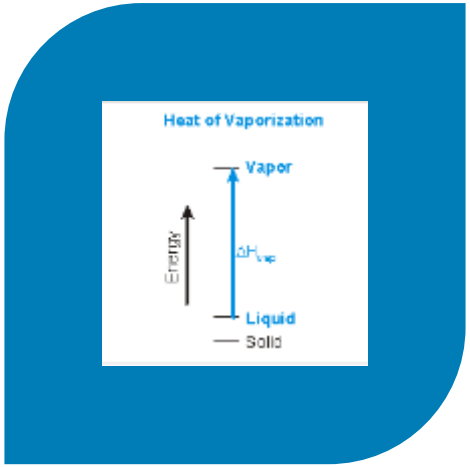
November 2018

What is Water Management? (UNU 2013)

"The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability"

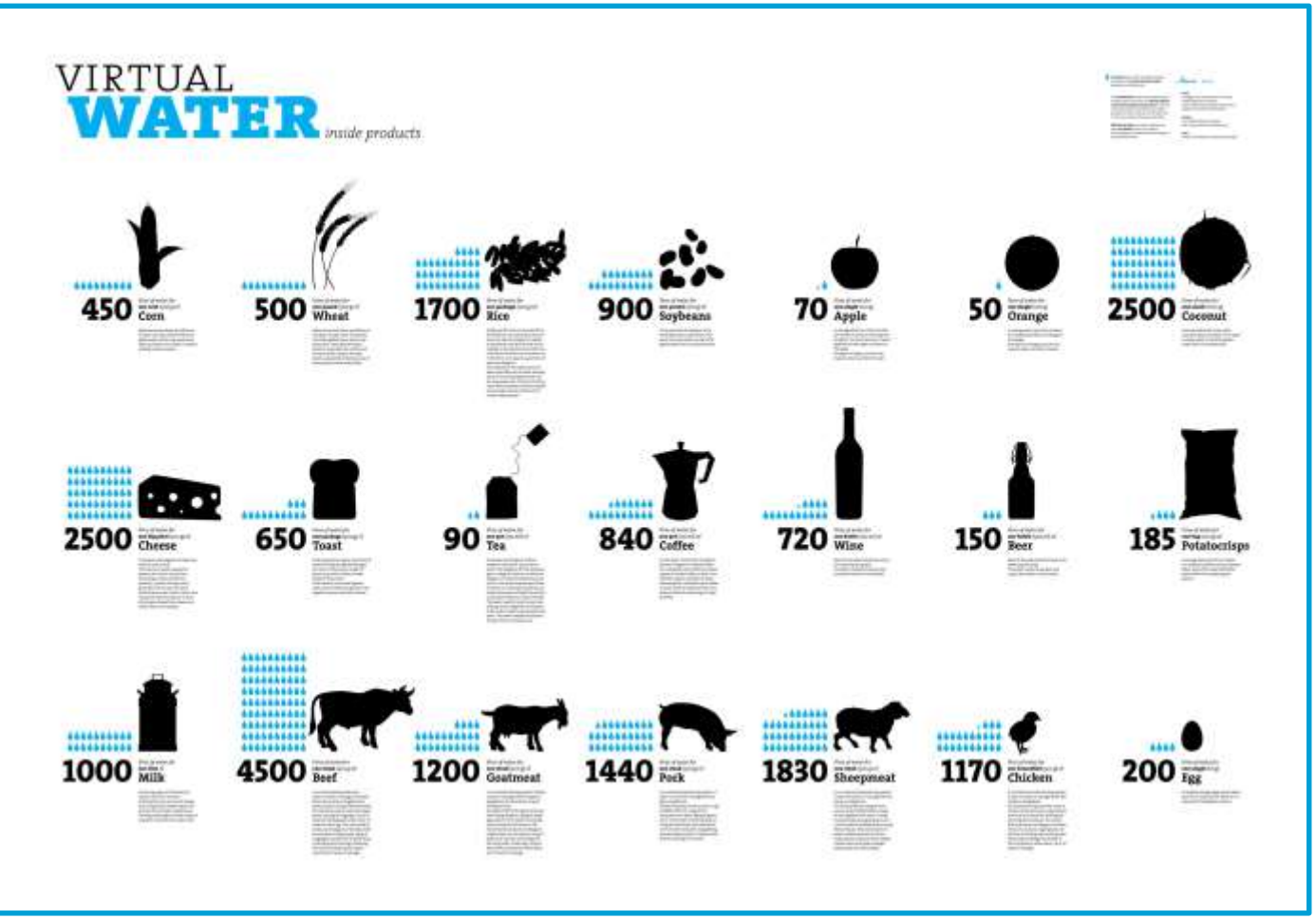

Concepts

USE Vs. CONSUMPTION



USE CHANGES WATER QUALITY

CONSUMPTION CHANGES STATE FROM LIQUID TO VAPOR



Volume of water used to produce a product, at all steps of production chain at the place of production

Does not separate use and consumption.

When a product is exported, was the water traded?

Horses for Courses

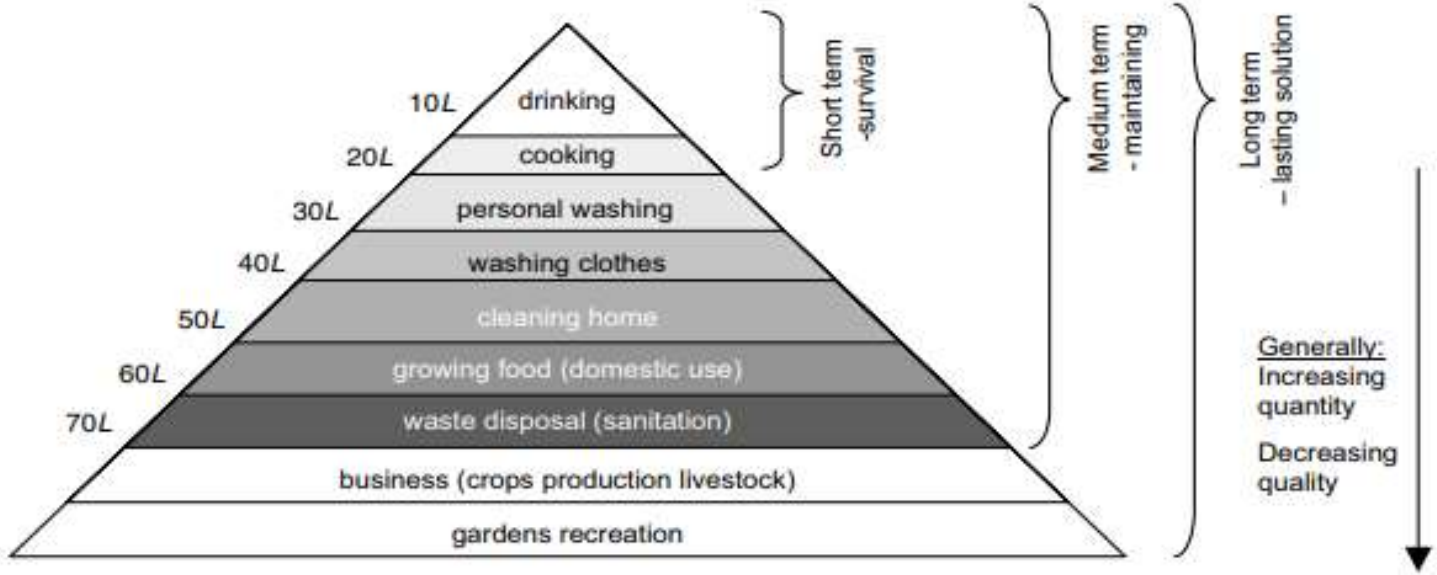
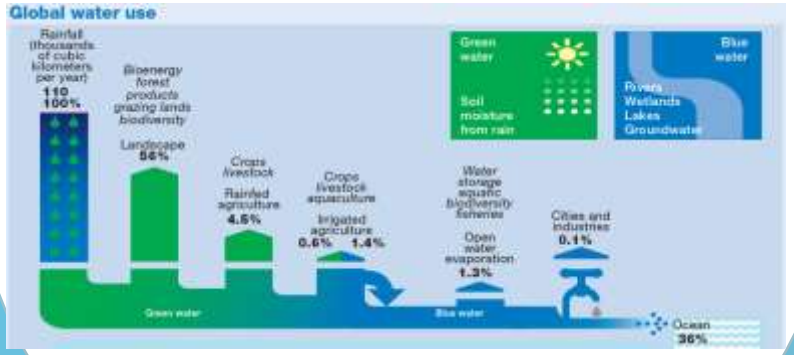
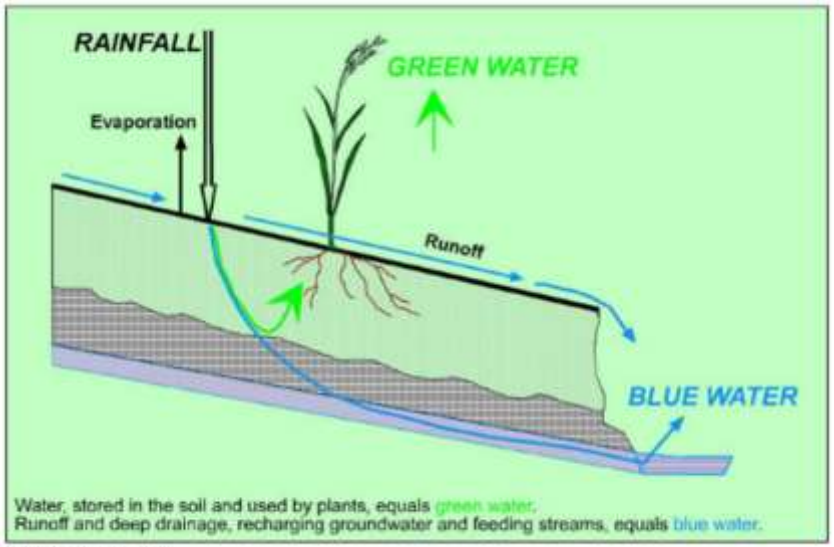


Figure 1. Hierarchy of water requirements (inspired by Abraham Maslow's (1908-1970) hierarchy of needs)

Color of water





(After Rockström, 1997)

Quantity:
Blue water - Can be extracted and used where

Green water – to be 'consumed' in situ

Quality:
Freshwater Vs. Grey water and Black wa

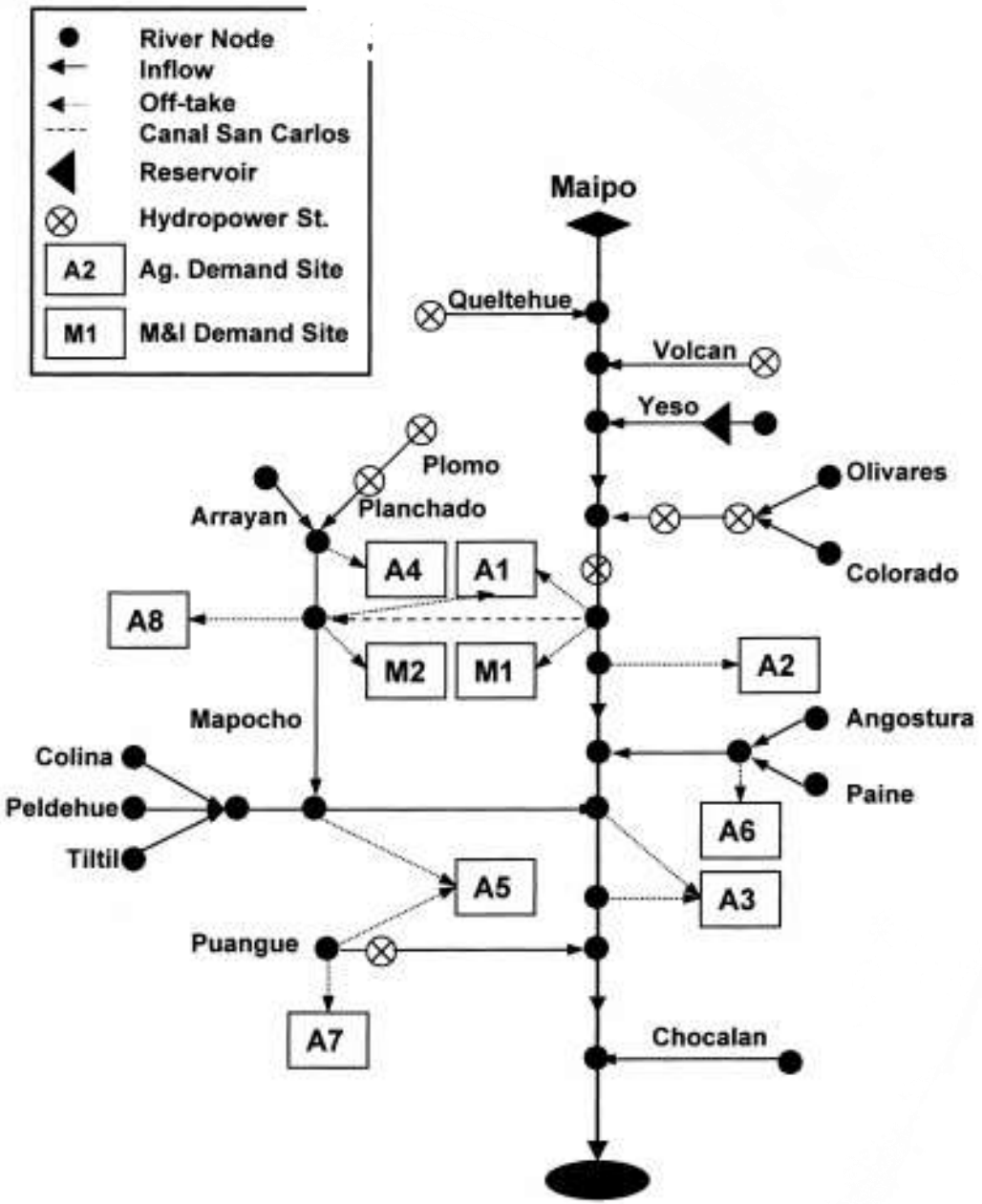


Fig. 1. The Maipo river basin network.

Managing Competition

M&I: Pollute
Envt: Cleans
Agri: Consumes

Value Laden Terms…

“Efficiency”

“Improvement”

“Upgraded”

“Water saving”

Neutral terminology for all sectors…

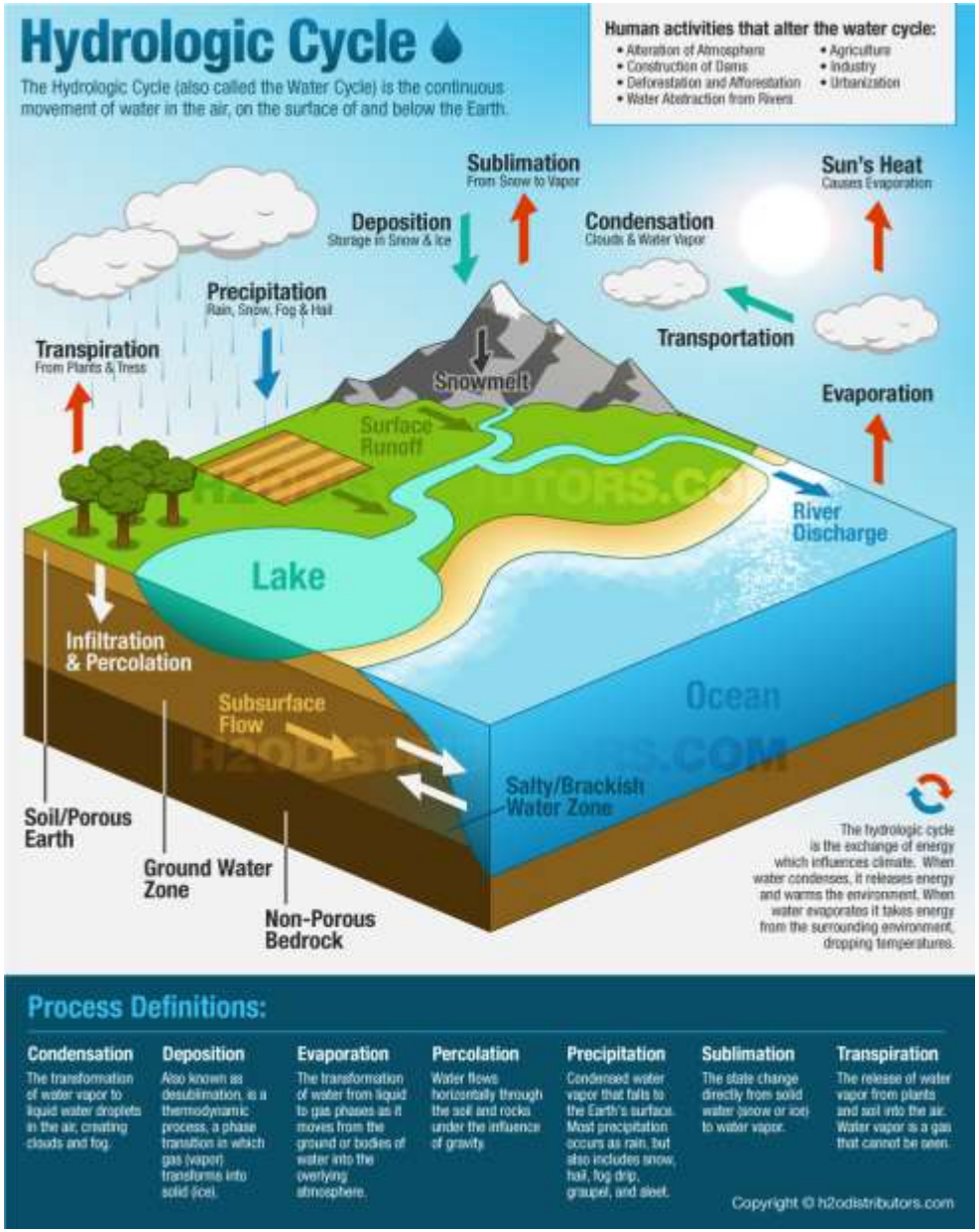
Consumed fraction

- Beneficial consumption
- Non-beneficial consumption

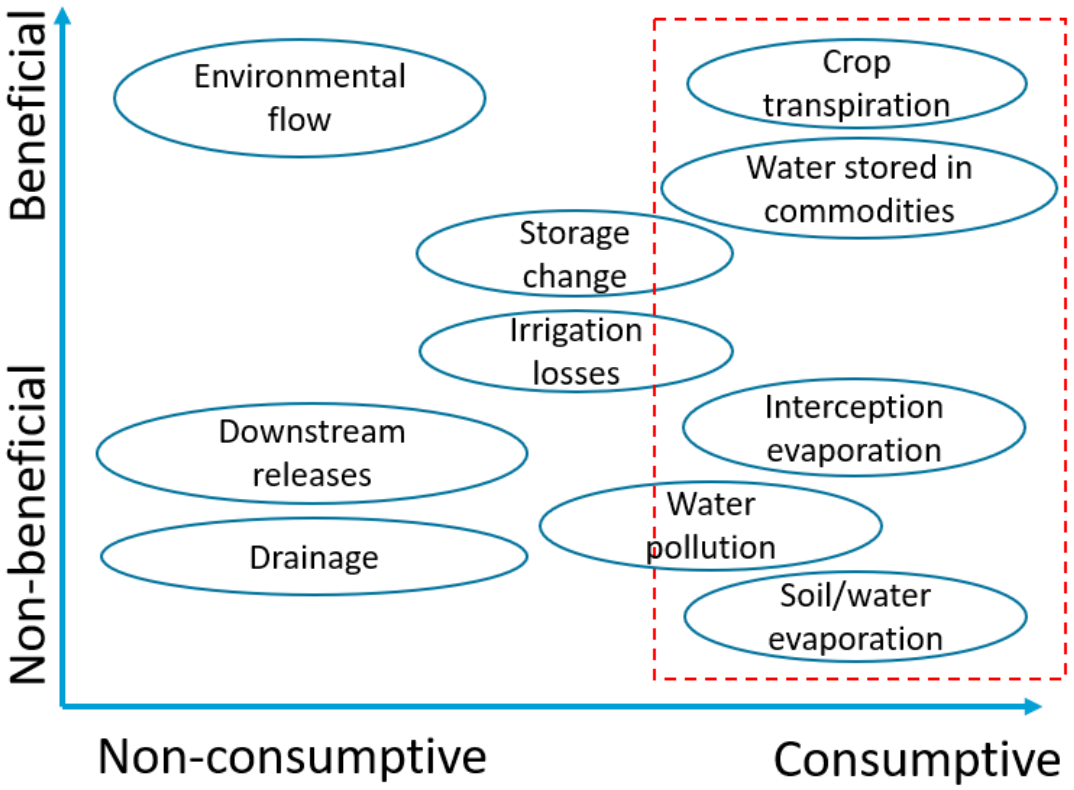
Non-consumed fraction

- Recoverable
- Non-recoverable

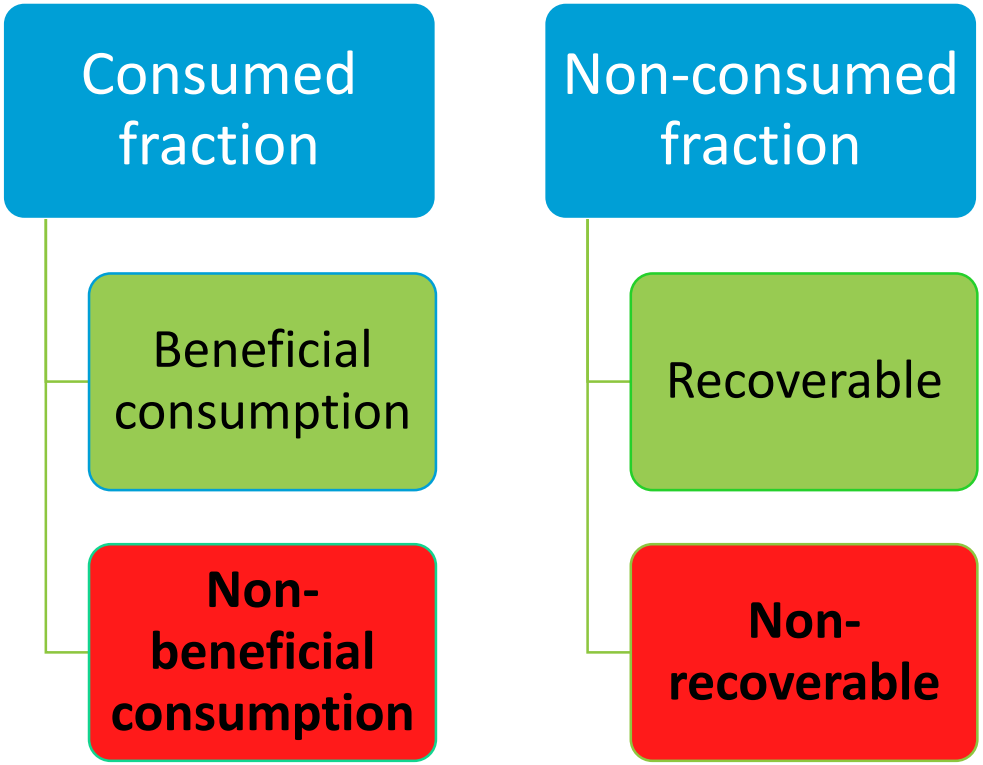
Watershed: Natural unit of land from which water drains into a common outlet.



Overlaying Hydrology and Water Management



Management Should focus on..

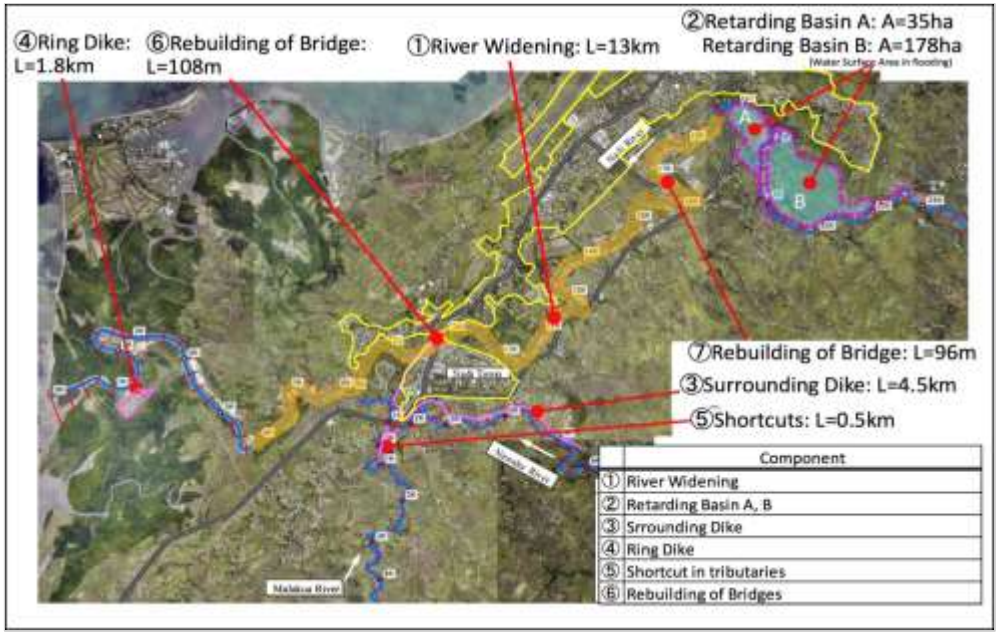


Infrastructure Development & Hydrology

Design Storm Hydrology

- Event-based hydrology
- For design of drainage infrastructure - Culverts
- Short catchment response times : 1-2 days
- Simulate 2, 5, 10, 20, 50, 100-year return periods
- Design events (synthetic):
  - Peak flow determination - no overtopping in 1-in-100-year event + freeboard
  - Free flow in 1-in-5-year event
- Methods Used:
  - Rational Method (extended to include time)
  - Unit Hydrograph Method (UHM)

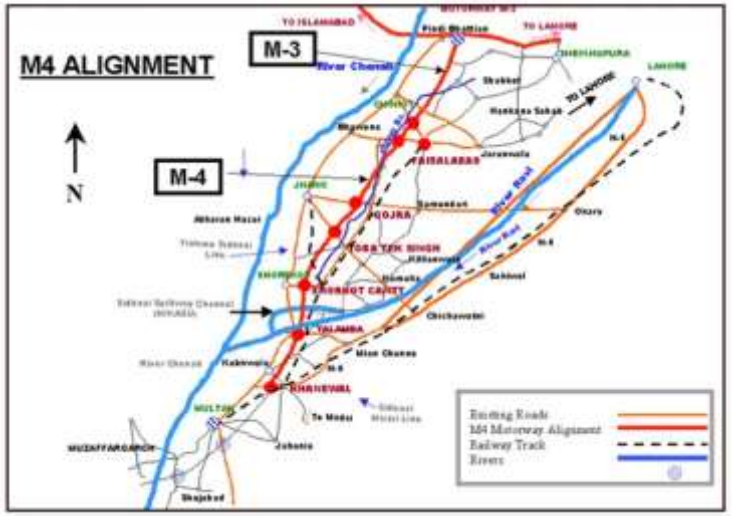
FIJI : Nadi Flood Alleviation Project



- Event based hydrology (response time 1-2 days)
- Simulate 2, 5, 10, 20, 50, 100 year design events
- Include climate change
- Estimate expected annual damages
- Search for combination of interventions which result in greatest EIRR or optimal B/C ratio

Faisalabad and Gojra Motorway, Pakistan

- 58.2 KM motorway
- 239 culverts
- Runoff will be altered
- Potential for inundation is high
  - Increase in infiltration and bare soil evaporation
  - General gradient follows the direction of the Motorway



Continuous hydrology

- Simulation/Analysis duration : 10 – 100 years
- Rainfall based on long-term gauged records
- Groundwater, soil moisture and evapotranspiration important processes
- Statistical analysis of simulated flow
- Examples include;
  - Yield analysis for reservoirs
  - Stormwater inflow into wastewater system
- For design of drainage infrastructure (volumes)
  - rainwater harvesting
  - stormwater retention basin

Tina River Hydro Project

- 15 MW Plant
- 53-meter-high dam, at 122 masl
- Increased evaporation losses:
  - The reservoir will have a surface area of about 0.28km^2
- The duration and magnitude of high pulse will be reduced and postponed
  - Mean flow: 11.5 m^3/s
  - Range: 18m^3/s and 2.4m^3/s.

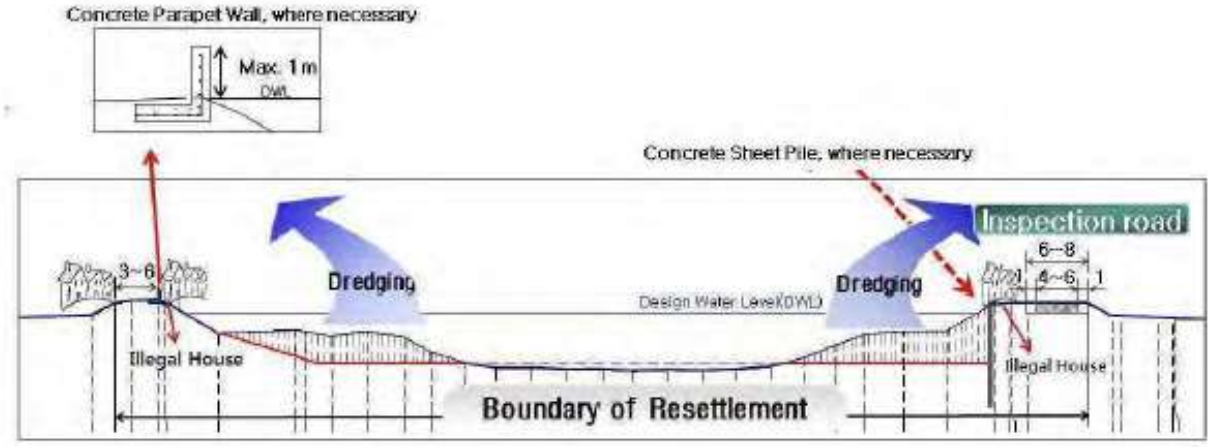
Table 5-2 Monthly flow at damsite (15 June 2010 to 21 September 2013)

Months	Average monthly flow at dam site (m^3/s)	Minimum recorded (m^3/s)	Maximum recorded (m^3/s)
January	13.87	5.97	120.94
February	21.48	4.96	342.38
March	21.94	6.55	233.54
April	18.23	5.04	141.84
May	14.27	4.53	201.50
June	8.69	3.83	185.64
July	10.55	3.42	222.93
August	10.81	3.01	234.85
September	11.62	2.85	220.06
October	12.90	3.91	176.93
November	17.12	3.26	445.62
December	20.46	4.83	298.33

Restoration works for Canal Embankments

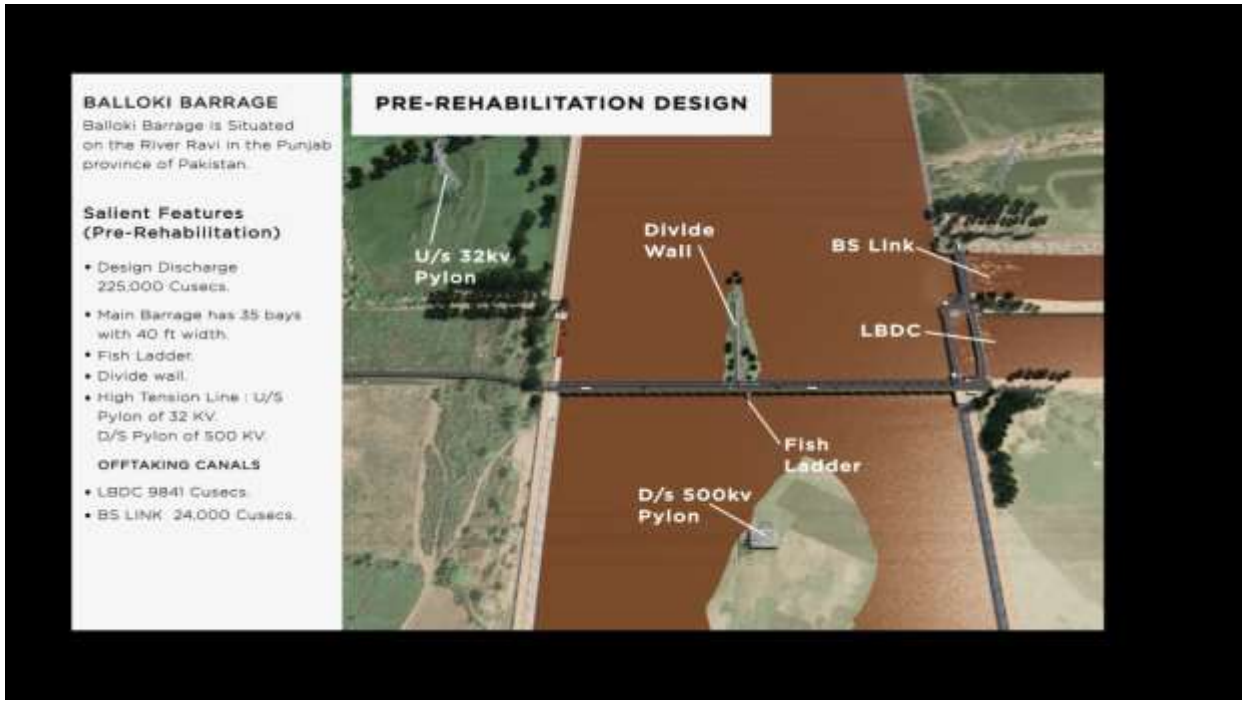
Indonesia

- Sediment Removal
  - Increase infiltration
- Restoration of Embankment Slope
  - Reduce seepage
- New Drainage Channels
  - Increase in recoverable fraction
- Improvement of inspection road
  - Reduce infiltration
  - Increase run-off



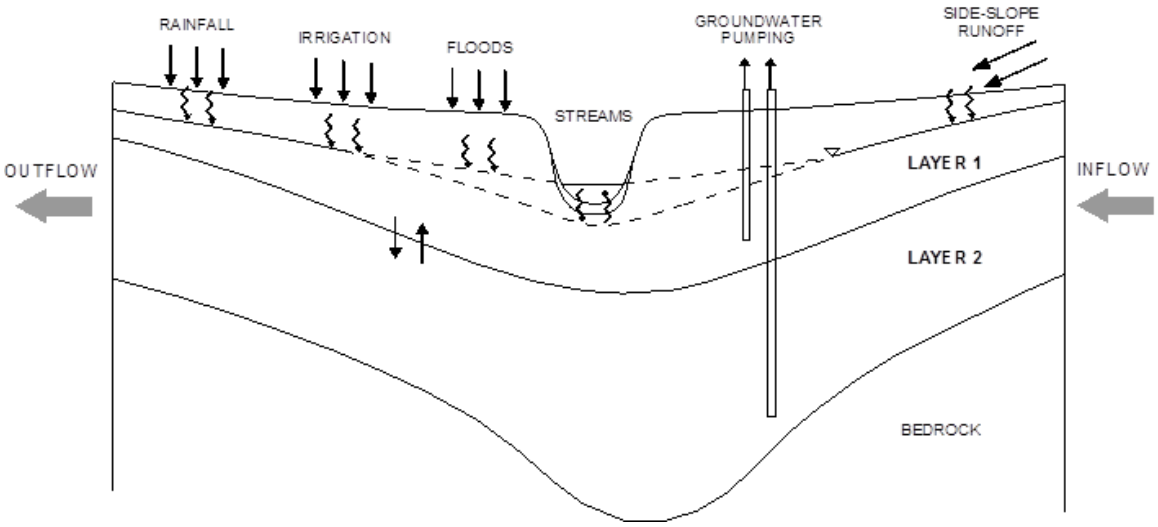
Upgraded Balloki Barrage Complex Pakistan

- Safe capacity increased from 1 in 20 years to 1 in 100 years flood.
- The new head regulator of Balloki–Suleimanki link diverts 264 m^3/s.
- The LBDC
  - the maximum operational discharge was at 244 m^3/s.
  - upgraded to take full sanctioned discharge of 278 m^3/s in 201 km.



Infrastructure Development & Groundwater Hydrology

Groundwater Processes



Impact of Climate Change and Development on Groundwater Processes

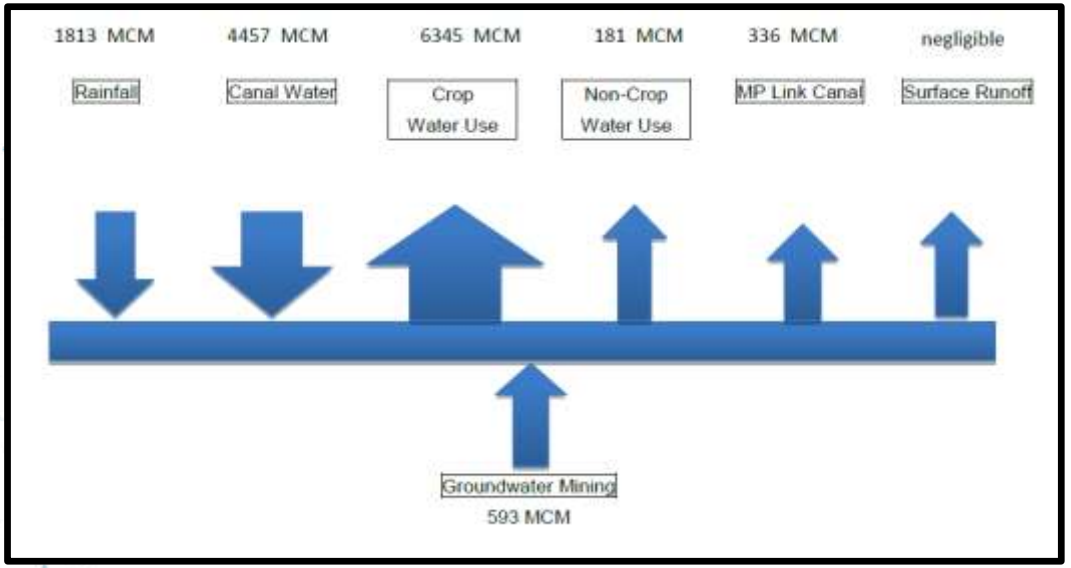
No Development Scenario

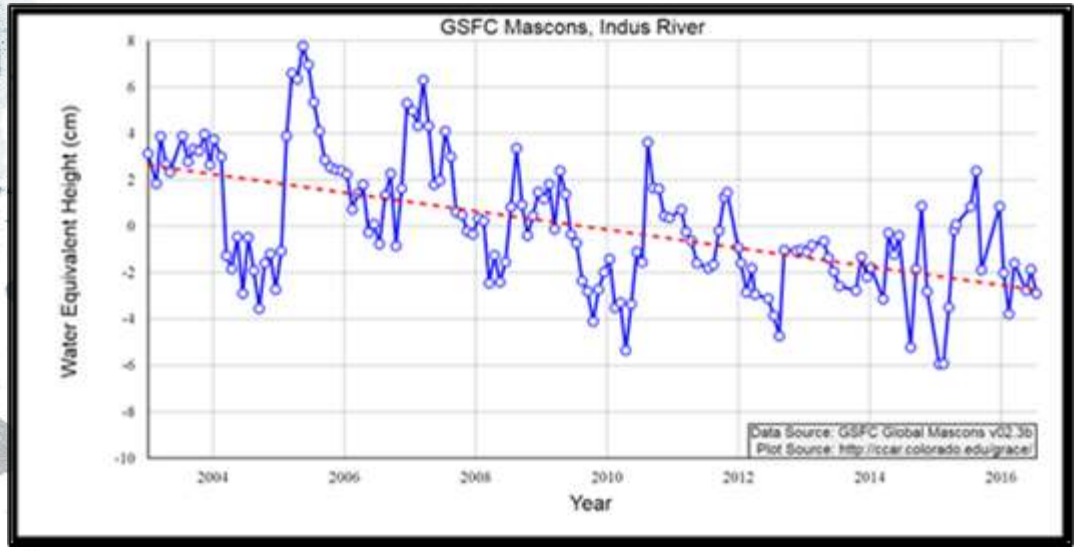
Unit=GL	Rain+Flood	River	Through Flow	ET	Pumping	Storage Change
DRY	32.41	11.45	3.81	48.04	0	-0.37
MEDIUM	38.44	12.52	4.03	55.13	0	-0.14
WET	44.69	13.08	4.29	62.15	0	-0.09

Current Development Scenario

Unit=GL	Rain+Flood	River	Through Flow	ET	Pumping	Storage Change
DRY	32.3	27.92	0.01	33.44	27.87	-1.08
MEDIUM	38.39	30.58	0.23	39.92	28.29	0.99
WET	44.63	30.82	0.77	46.57	28.33	1.32

Groundwater Management in LBDC, Pakistan

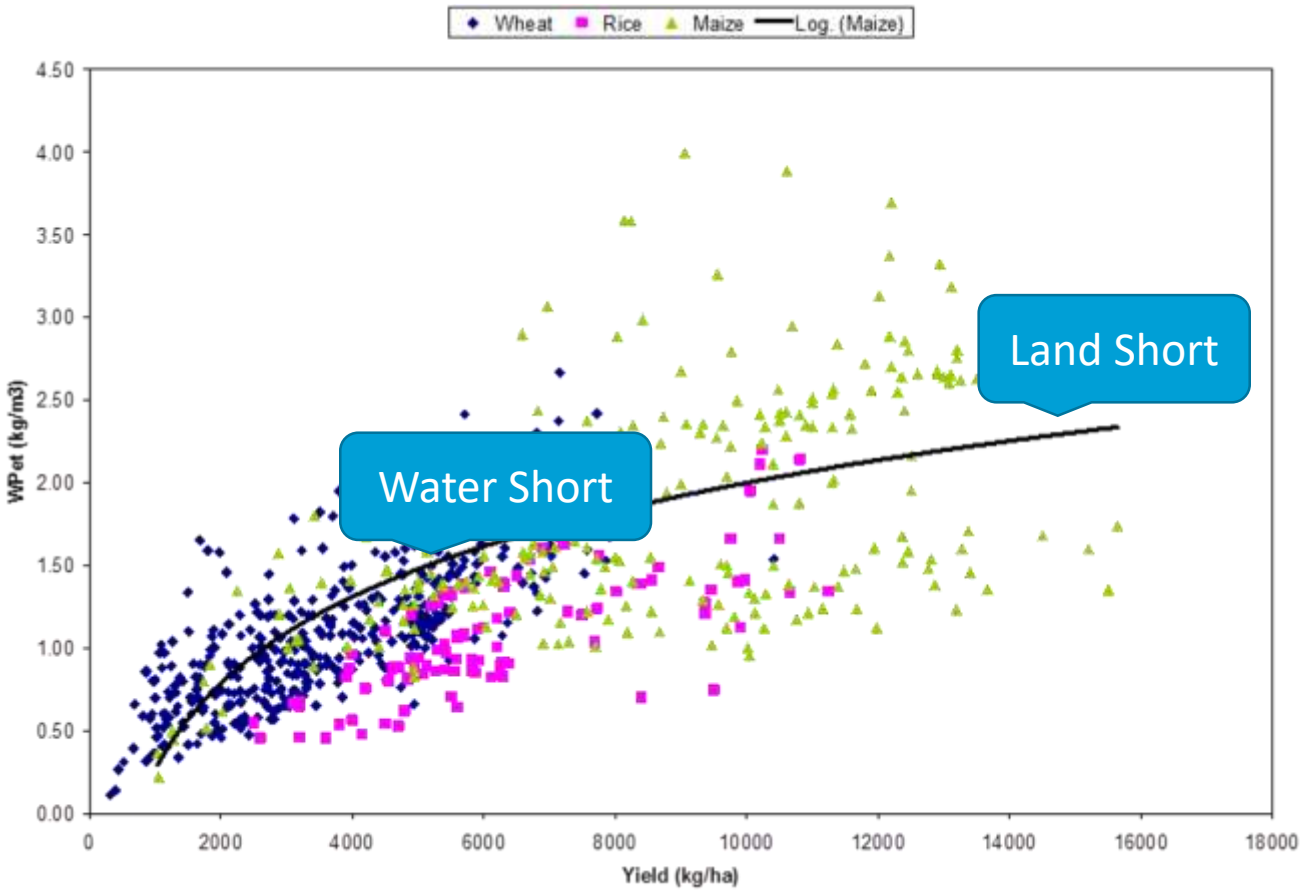




Agricultural Water Management

This is about CONSUMPTION

Water Productivity vs. Yield

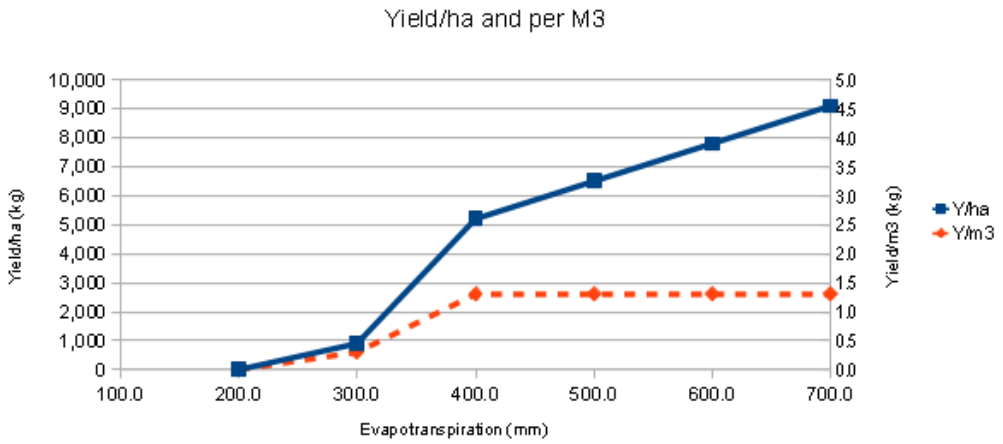


System of Rice Intensification

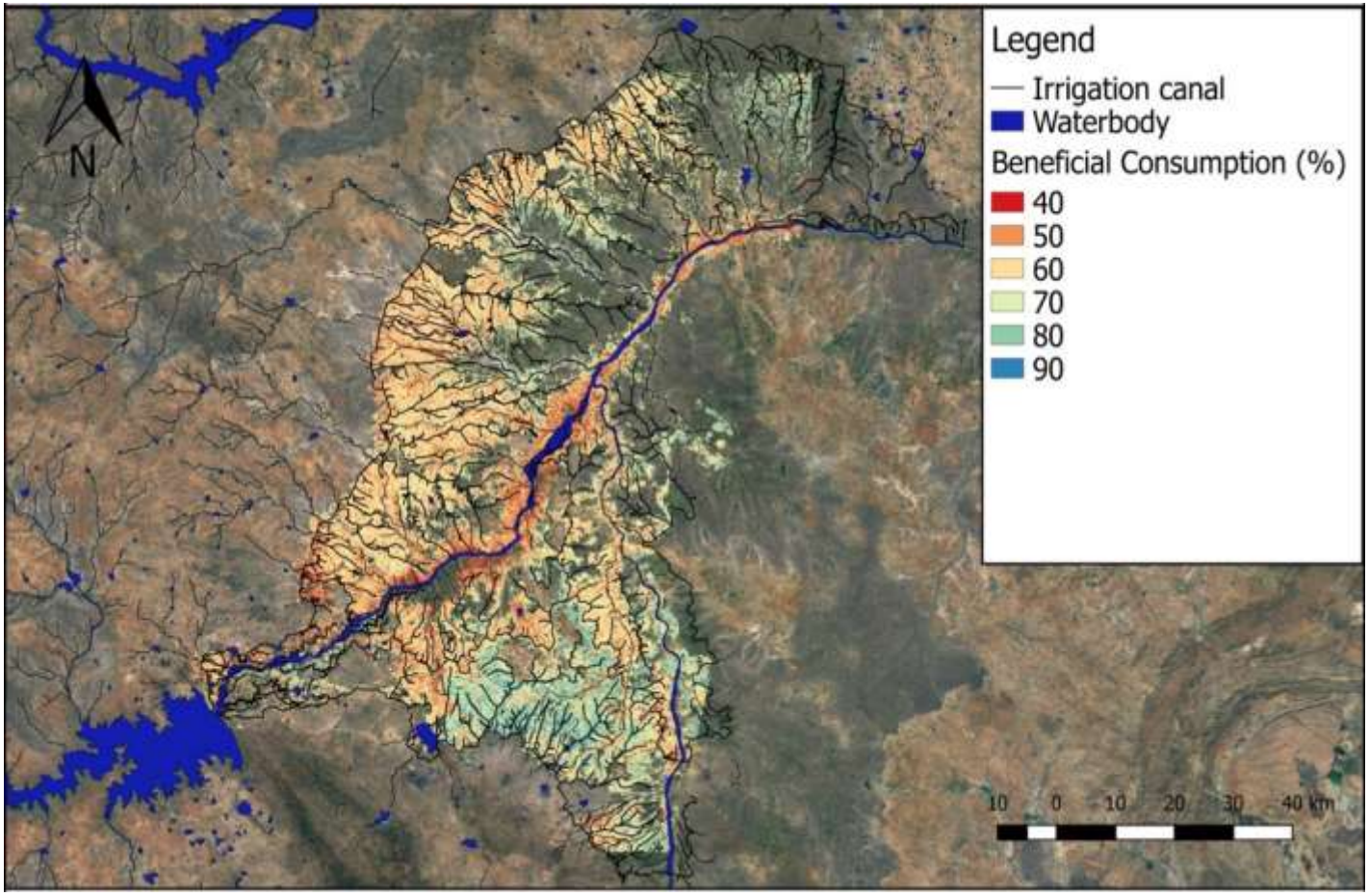
Indonesia

- Reduced water utilization for agriculture by 38%
- Increased yields up to 36%

- Yield can't go up without an increase in consumption
- Non-Consumed Fraction has reduced
- Possible reduction in recoverable fraction



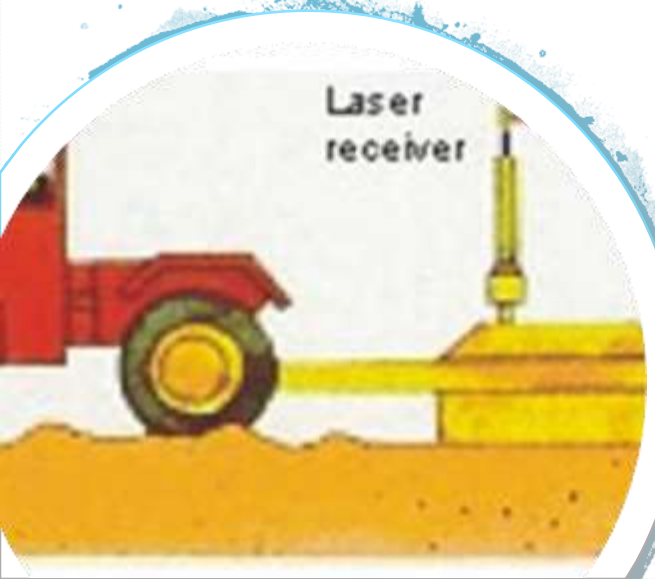
Assessing potential for improvement – IHE/ADB Study in India
BC = Ta / ETa



On-Farm Interventions in Lower Bari Doab Canal Improvement

Zero Tillage: Reduces Runoff

Raised Beds: Reduces Non-beneficial evaporation



Laser Levelling: Reduces detention storage and non-beneficial evaporation

ADB

Thank you.