Integrated Water Resources Management (IWRM) and SUSTAINABILITY

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Outline

- Sustainability
  - Sustainable development
  - Earth-system sustainability
- IWRM and Sustainability linkages
  - UNU Research project: Mosaic systems of traditional and modern prodcution systems for enhancing resilience
    - Water Allocation (Environmental)
    - Water management (Societal)
    - Irrigated rice and home gardens (IWRM)
    - Pricing (Economic)
    - Global change implications of

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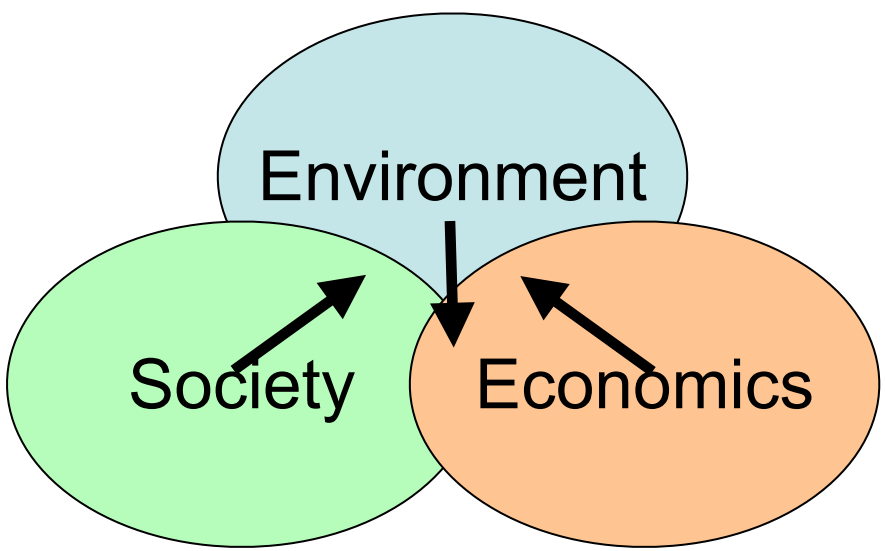
Sustainable Development and Sustainability

- Sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs.
  - World Commission on Environment and Development, 1987
- Total capital = Natural capital + Capital created + human capital
  - Can they be substituted?
- Sustainability approach should holistically consider the complexity, irreversibility, uncertainty and ethical predicaments intrinsic to the natural environment and its connections to humanity
- Sustainability Economics:
  - achieving the needs and wants of individuals: efficient resource allocation
  - Justice: between human generations, within a human generation, between nature and humans

Achieving Sustainability

- Ecological Security: Ecological security is the status reflecting the threat to human living, health. basic rights, guarantee of secure life, necessary resources, social order and the ability to adapt to environmental change.
- This covers environment, economy and society
- Bringing together the disciplines: + Sustainability of EarthSystem



Sustainability Science: (2001)

Ensure sustainability of earth system

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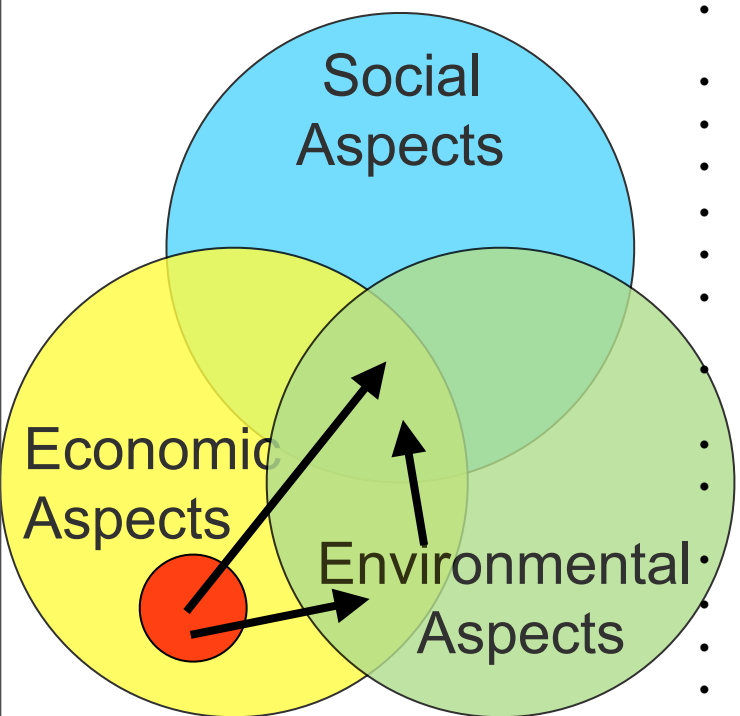
Sustainability Research

- Inter-disciplinary approach engaging components of sustainability



UN-CECAR Network

- Australian National University
- Bangladesh University of Engineering and Technology
- Tsinghua University
- Chinese Academy of Forestry
- Indian Institute of Technology Delhi
- Indian Institute of Technology Kharagpur
- Gadjah Mada University (UGM)
- Kyoto University
- The University of Tokyo
- Ibaraki University
- Ritsumeikan Asia Pacific University
- Integrated Research System for Sustainability Science
- National University of Malaysia (UKM)
- Tribhuvan University
- University of Engineering and Technology Lahore (UET)
- University of the Philippines
- Yeungnam University
- Seoul National University
- Nanyang Technological University
- University of Peradeniya
- Asian Institute of Technology
- Chulalongkorn University
- Viet Nam National University

Strategies to enhance resilience to climate and ecosystem changes

Traditional Bio-production systems

Sri Lanka

- High rural population ratio (85%)
- Two thirds of national land is arid region
- Need effective water management system

Indonesia

- Conversion from traditional bio-production to extensive plantations
- Forest and biodiversity loss from development

Vietnam

- 2nd largest rice exporting countries
- Sea level rise and sea water intrusion
- Affecting international food security

Tank irrigation system

Irrigation network system with tanks and waterways

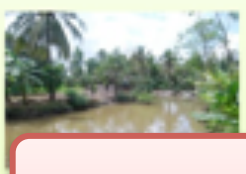
Kandyan homegardens

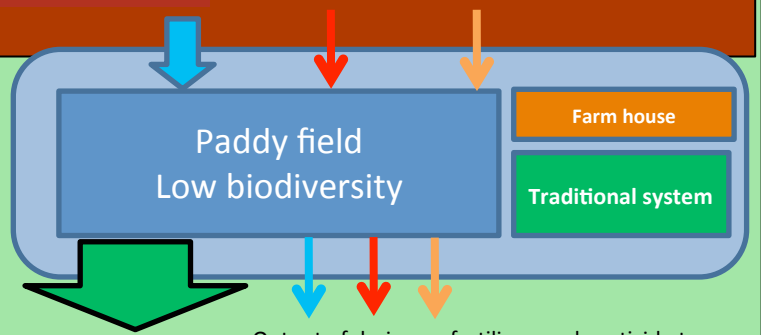
Compound system of diverse trees, crops and husbandry

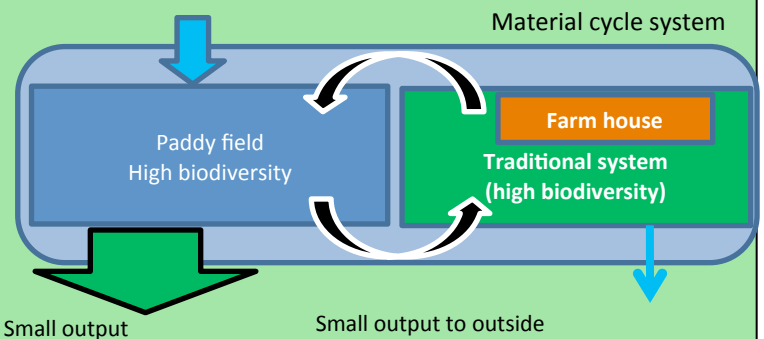
Pekarangan: Tropical homegarden system

Kebun-talun: Combination system of forestation and slash and burn cultivation

VAC System: Combination system consisting of homegarden, aquaculture pond, livestock barn







Mosaic System to Strengthen Resilience

Traditional Systems
High Resilience, Low Efficiency

Synthesis

Modern Systems
High Efficiency, Low Resilience

ANCIENT IRRIGATION IN SRI LANKA

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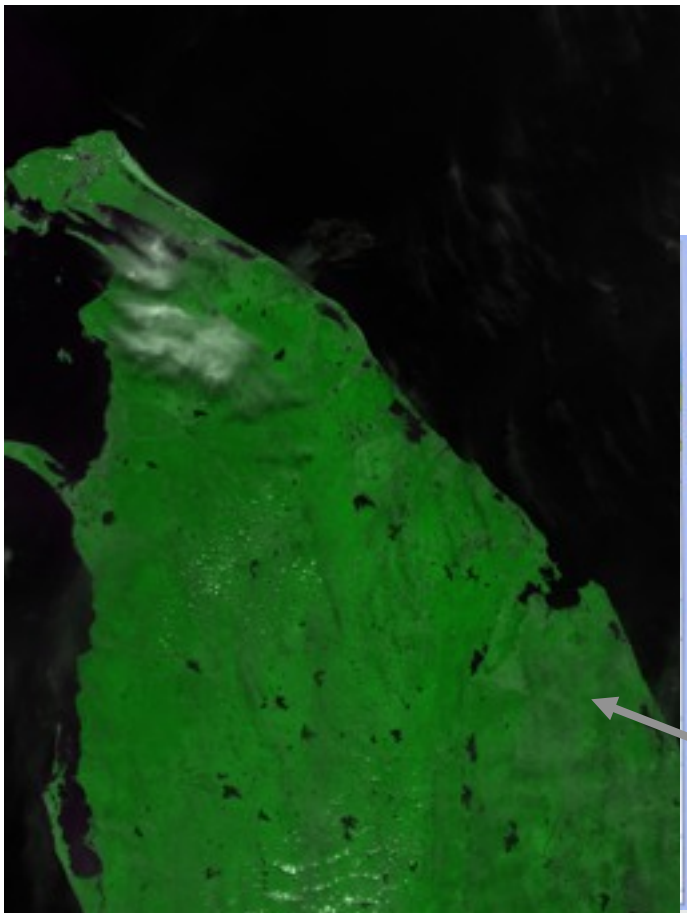
SUB THEME 2

The ancient irrigation systems have been built from 5th century BC to 12th century AD for 17 centuries. For example, the medium size Basavakkulama tank with a water spread of 107 ha was built around 300 B.C.

Main features

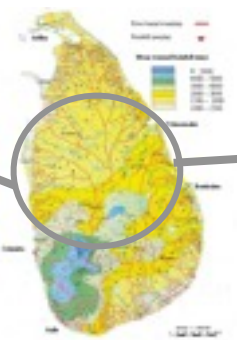
- Sustainability
- Evolution and development over a long period of time
- Technological innovation, macro-micro integration of systems and governance

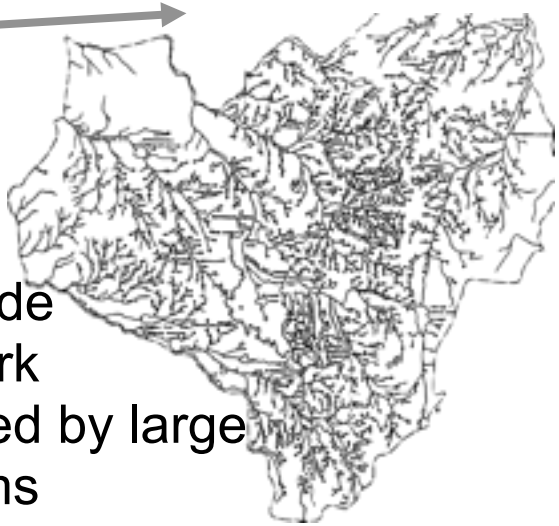
Sri Lanka Ancient Irrigation Systems



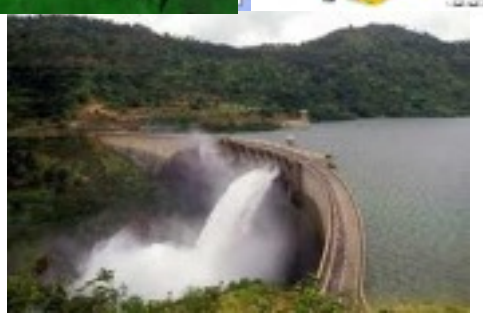
MINNERIYA
Tank (227 A.D)
135 mcm

They consist of intricate networks of small to gigantic reservoirs called tanks connected through a series of feeder canals that brought water for yearlong rice cultivation in the dry zone.





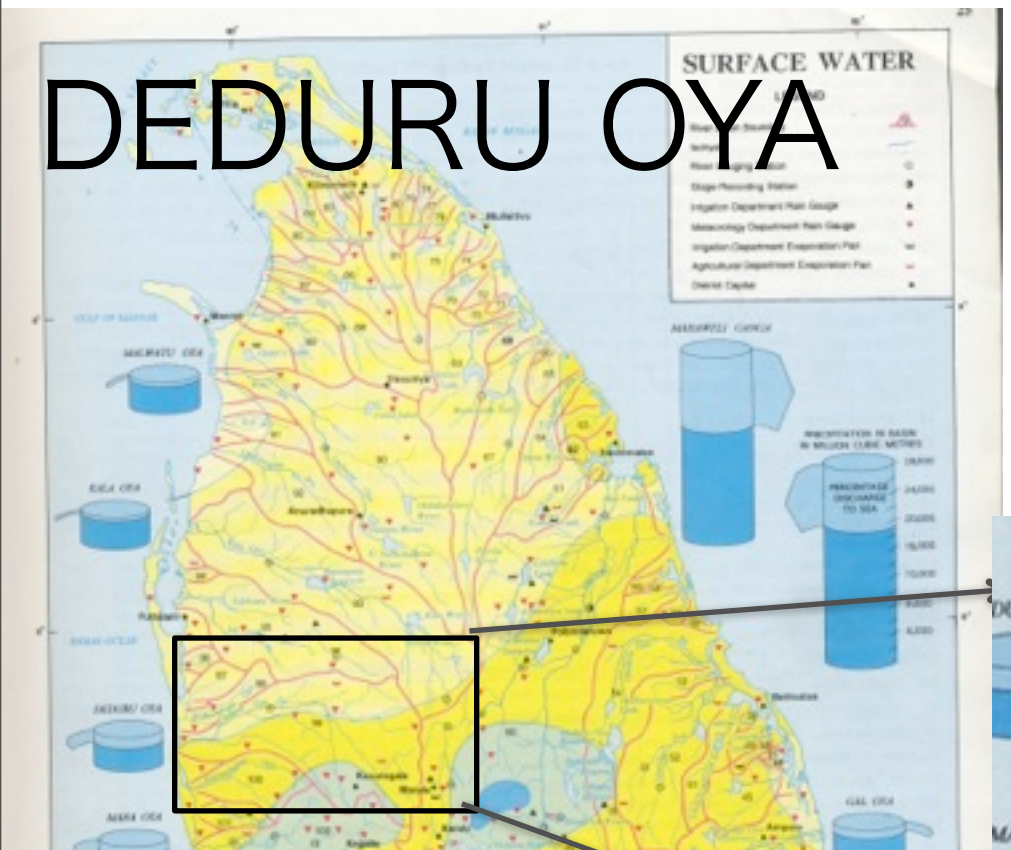
Cascade Network supplied by large systems



Local Cascades

Ancient irrigation systems provide important lessons in combining Macro and Micro systems as well as Integrating with large scale systems with local communities and ecology

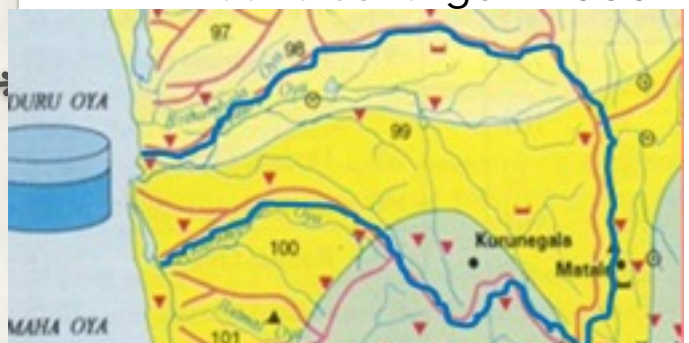
DEDURU OYA

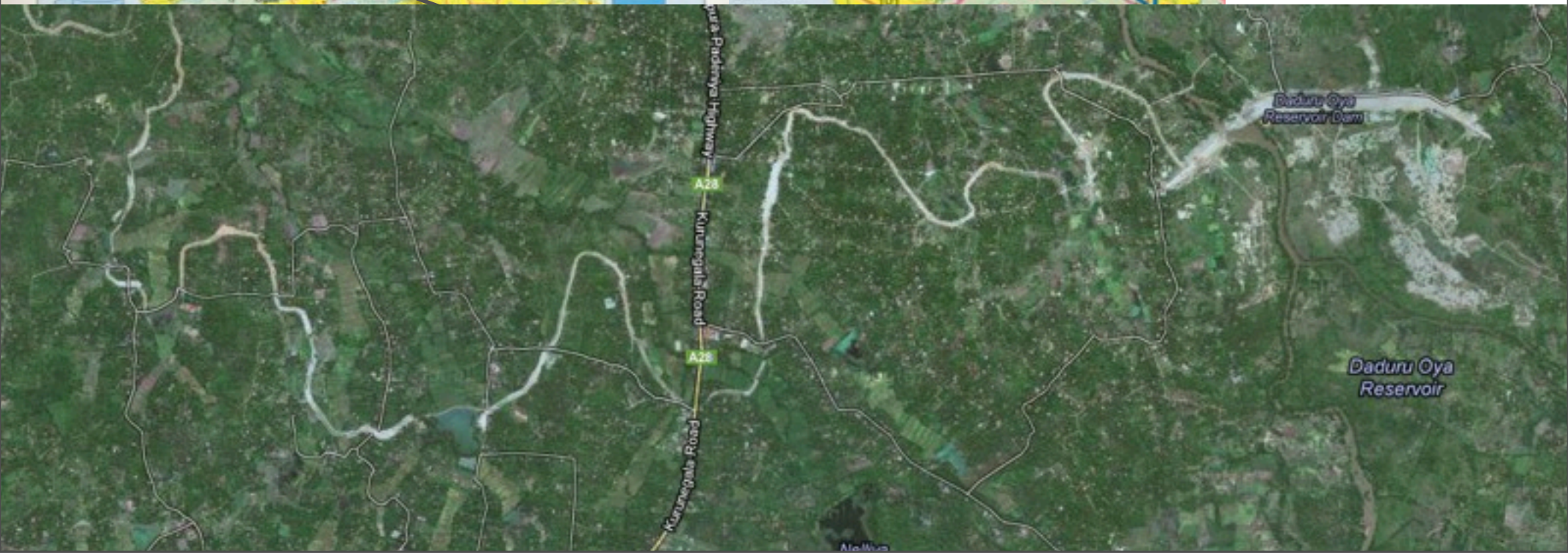


Profile

- The sixth largest River Basin in S.L Origination, West of Kandy / Matale Hills
- Catchments area - 2620 sq.km
- 90%- Intermediate Zone,

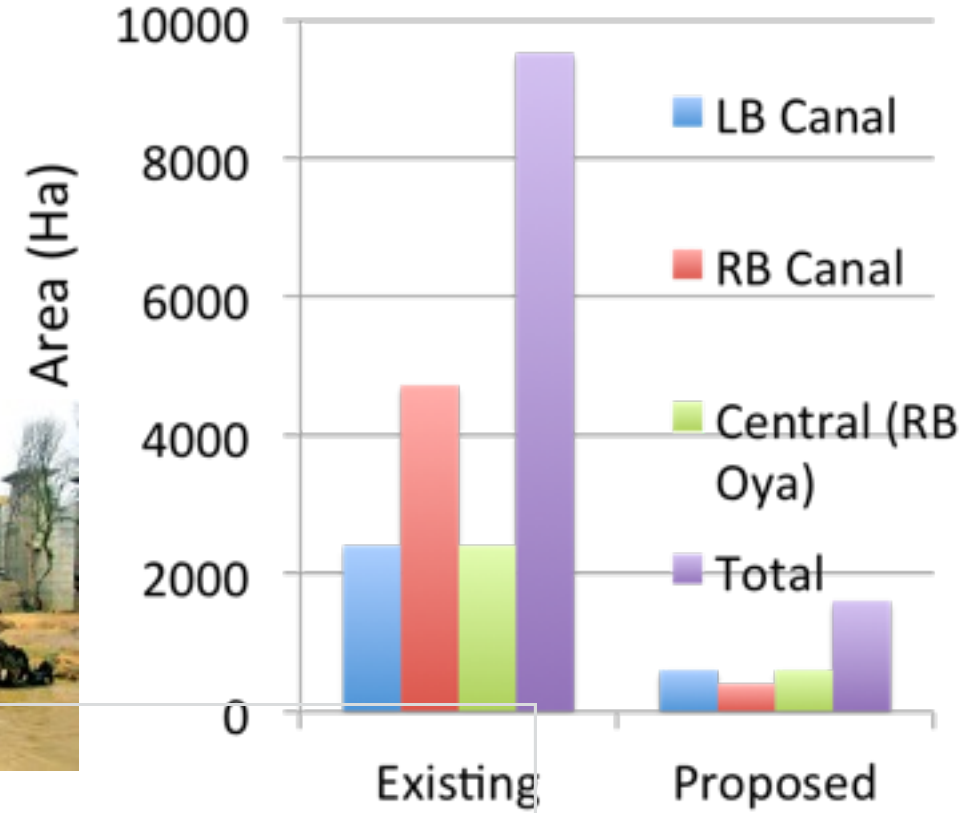
  10%- Wet Zone
- Annual discharge - 1000 MCM

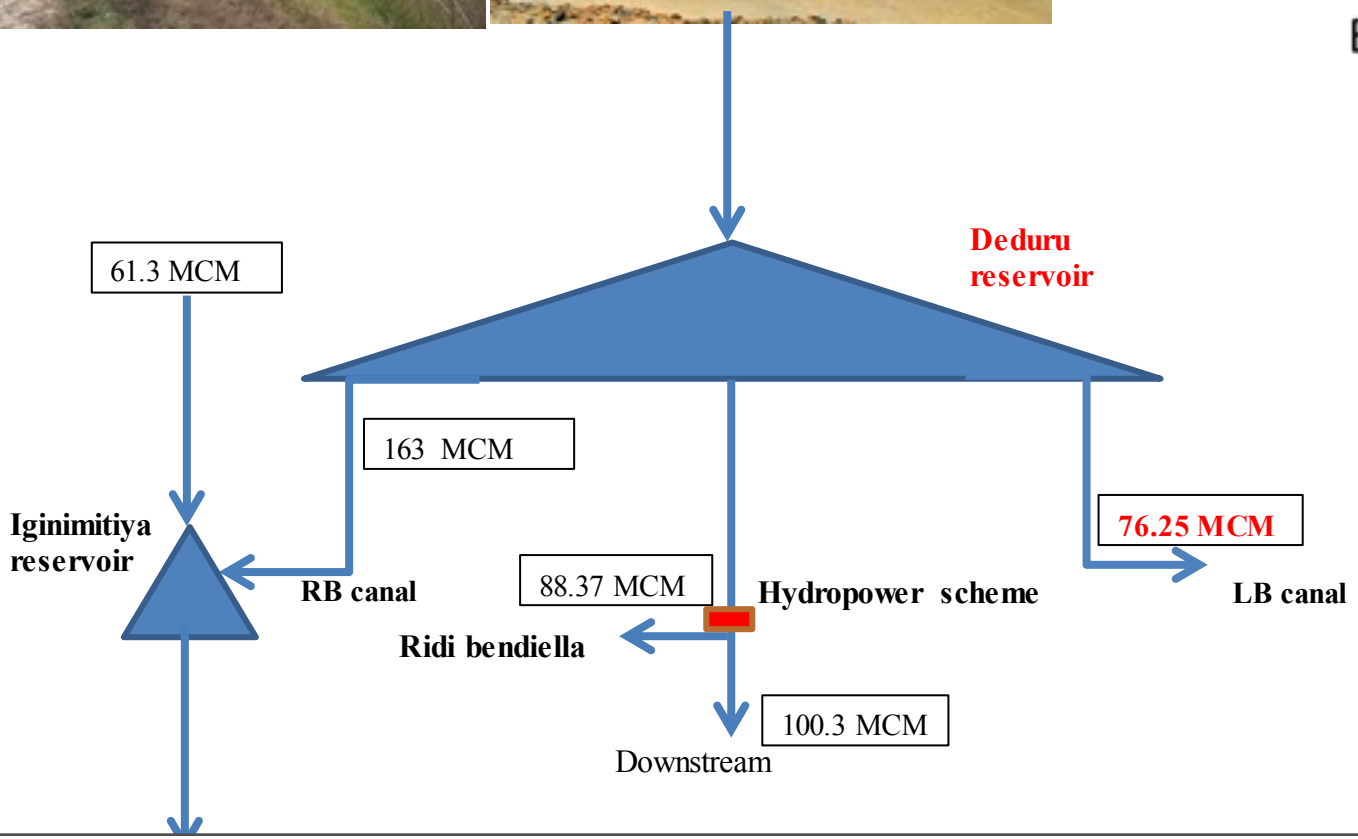




DEDURU OYA PROJECT

Started in 2007:
Expected completion 2013-2014.

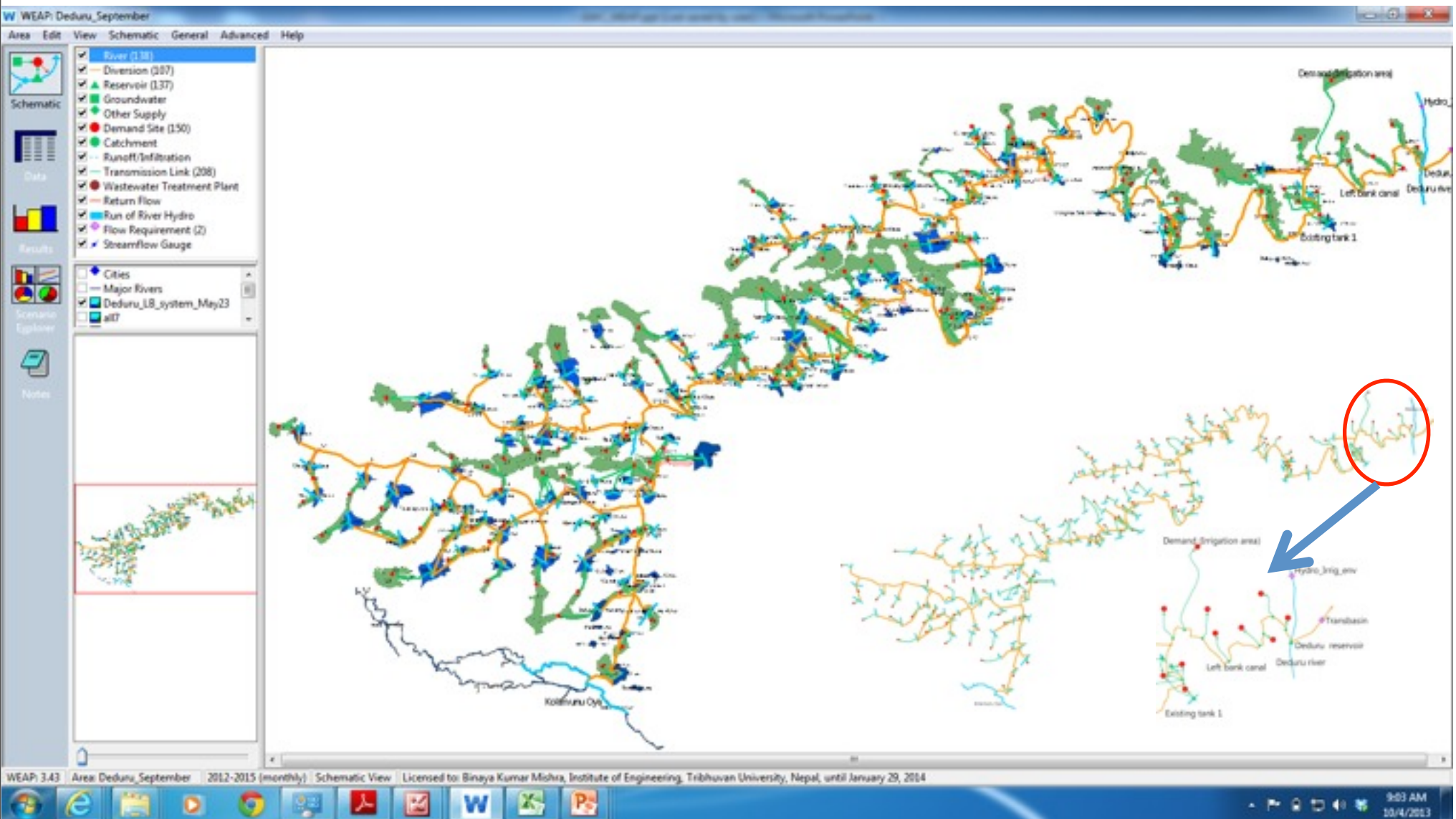




The new reservoir will produce the following types of irrigation systems

1. **Independent modern system**
2. **Modern and Ancient Systems in parallel, but not connected**
3. **Ancient system fed by the modern system**

Modeling water allocation



Water Evaluation and Planning System (WEAP)

Coverage for Normal and Dry years

- Traditional systems not sufficient
- New system alone is sufficient for normal year but not for dry year
- Mosaic system is resilient and can manage dry years.

Traditional Tank coverage in Sept.

- If the traditional individual tanks can be managed as a system, it will improve the system performance.

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Societal concerns

Water Management In the Mosaic
Who owns water?

- **Ancient Tank Village Systems:**
  - Managed by the elected water manager of the village according to availability of water in the tank.
  - Own practices: Bethma - land near water source divided equally or proportionally to enable everybody to cultivate during season of water scarcity
- **Modern Irrigation Systems: Best practice**
  - Mahaweli Ganga Development Project from ’77; 467,584 ha, 128,568 settlers.
  - Basin-level institution with a centralized authority that has experimented with different water distribution approaches
  - Mahaweli System H
    - Bulk Water Allocation (BWA)
    - high water productivity and cropping intensity
    - major scheme(31, 500 ha) Joint-management

Equity (fairness)

- Equity within the village.
- Equity between village and neighbors right to water
- Equity at national level.
- Social justice – Prevent marginalization
- Inter-generational and Inter-sectoral Equity – Environmental Sustainability

Equity Framework

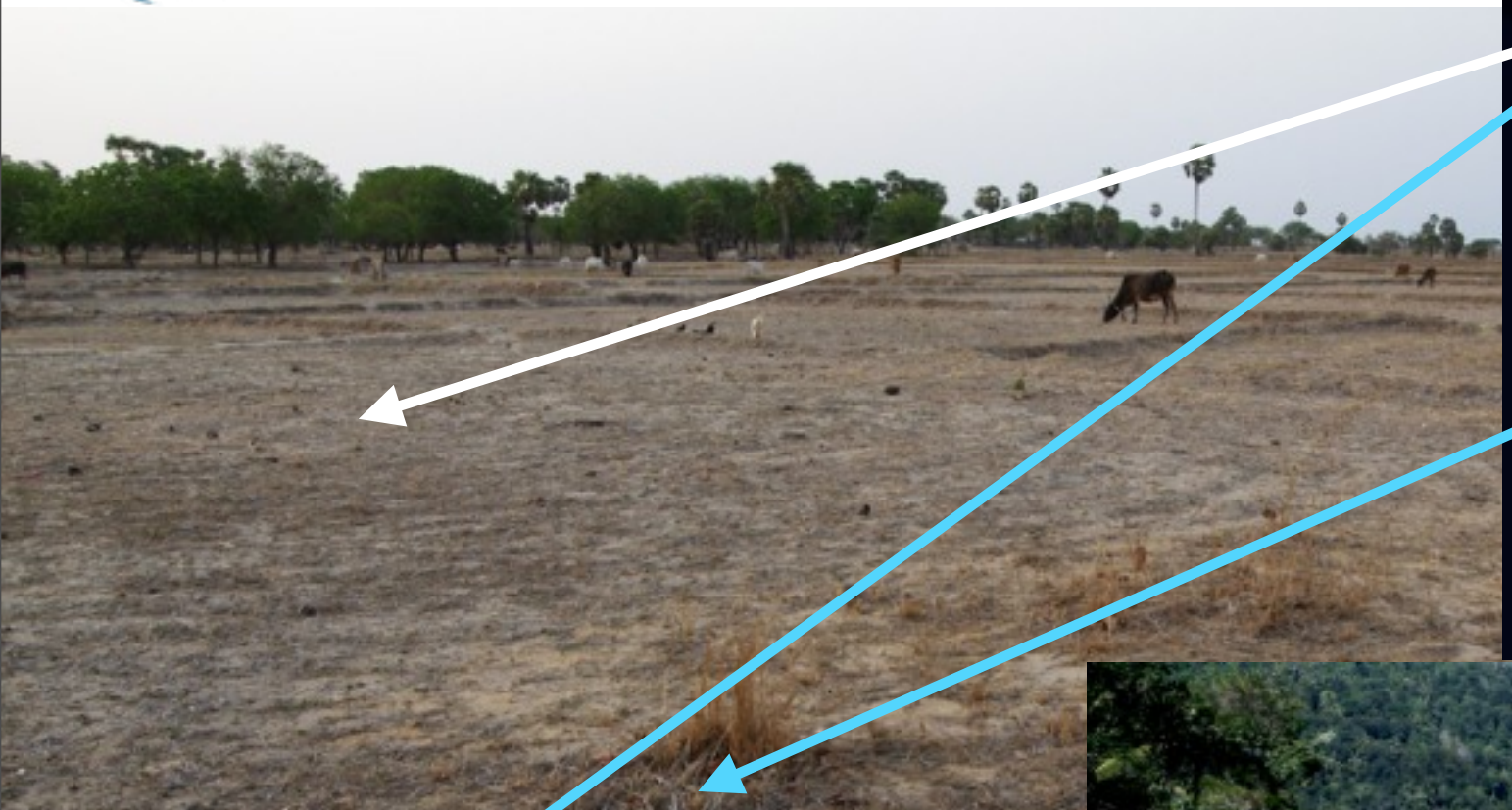
(Ostrom, 1990; Tang, 1989; Uprety, 2008; Uphoff, 1986)

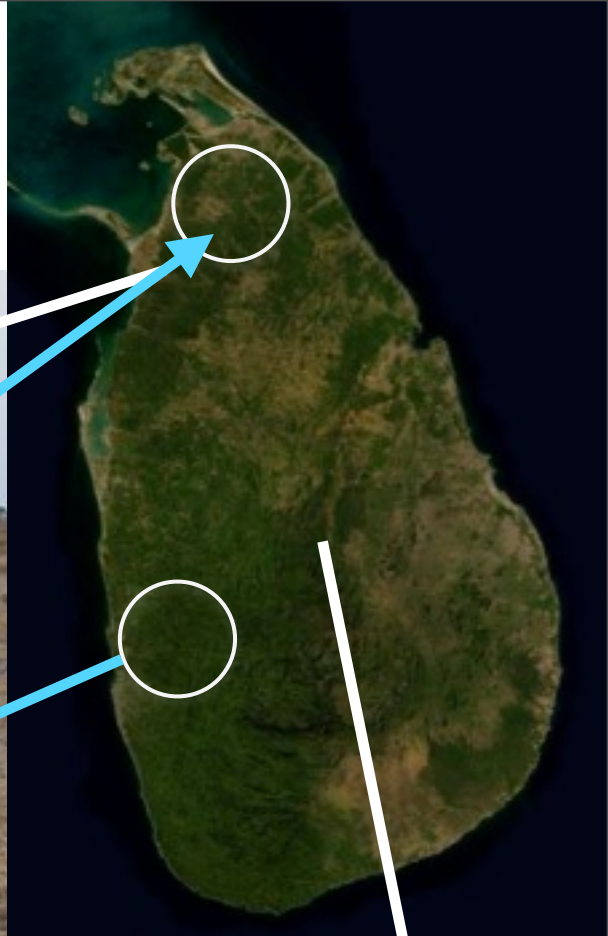
Creating new farmer organizations to manage local reservoirs connected to centralized modern system.

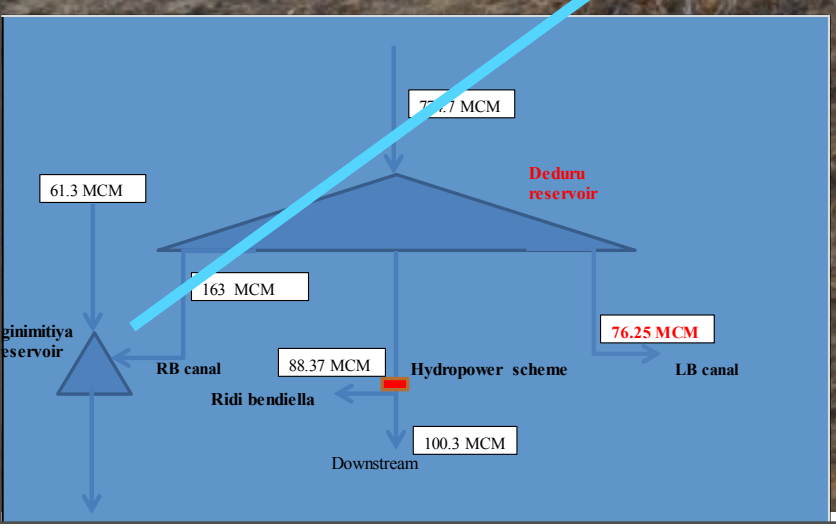
- Rights
- Decision-making
- Resource Contribution
- Allocation
  - Inter-sectoral
  - Intergenerational Equity
  - Inter-groups / individuals
- Distribution
- Conflict-resolution
- Information sharing

Improving livelihoods

Kandyan Home gardens for the dry zone





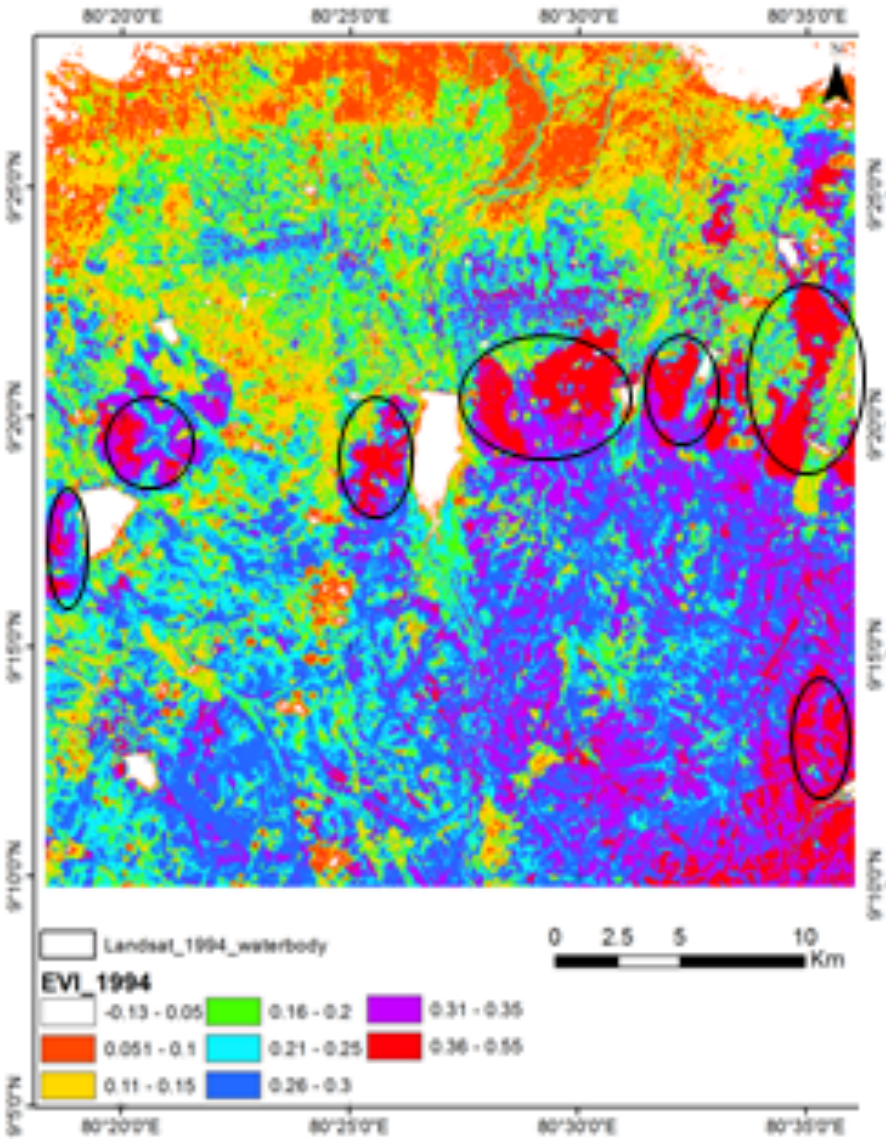


VISHWAMADU TANK, KILINOCHCHI

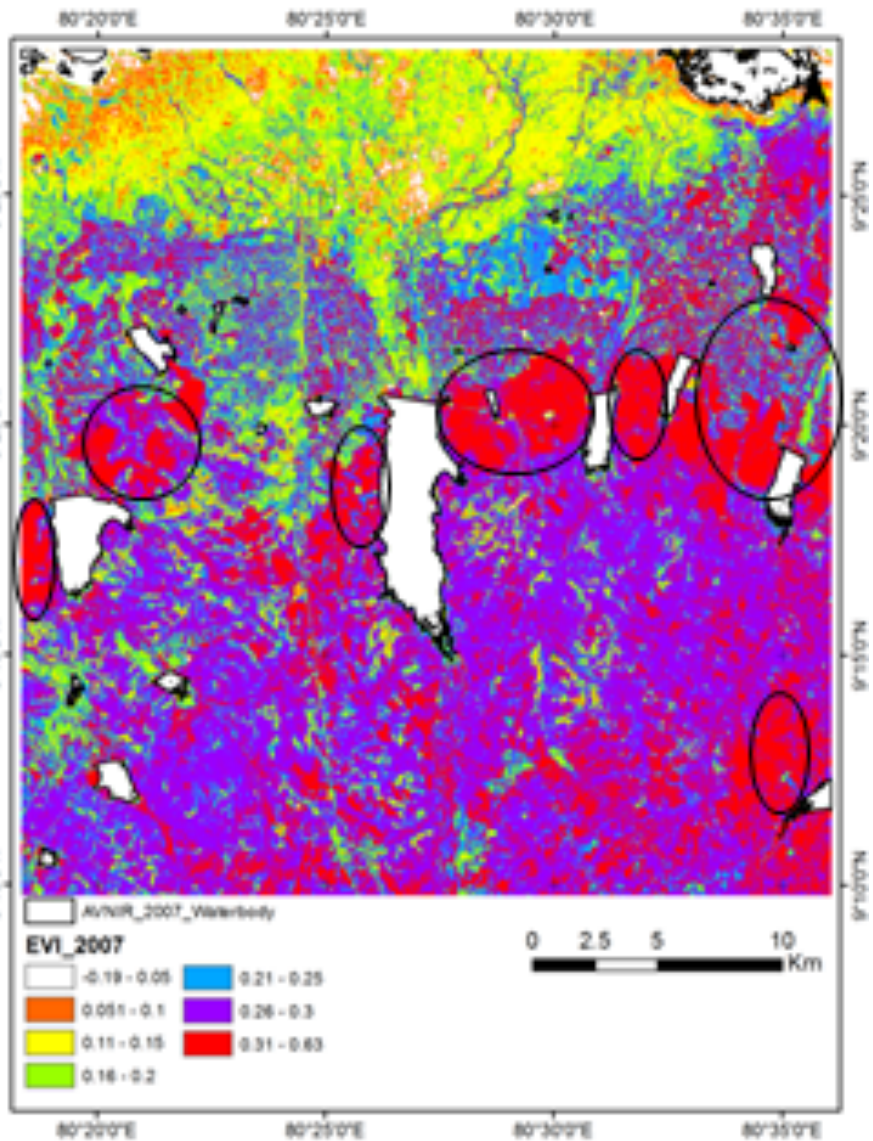
DOWNSTREAM

The Landsat TM based EVI (enhanced vegetation index), AVNIR-2 based EVI respectively. The value of the EVI is higher in the vegetative areas that are near to the water reservoirs as compared to the far away from the reservoirs

Landsat TM 1994/09/11 EVI

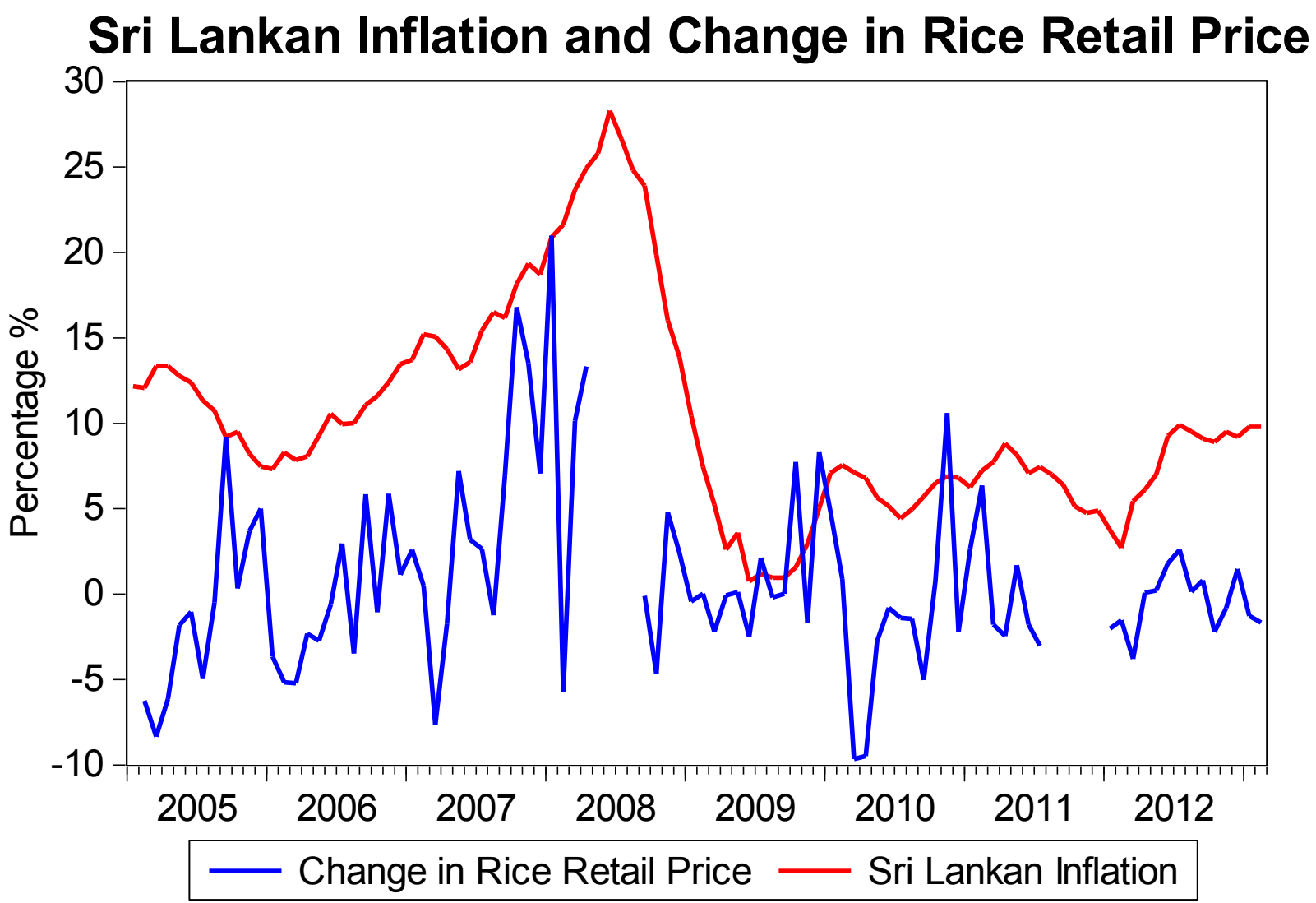


AVNIR 2 2007/03/28 EVI



Economic aspects: Agriculture product pricing and farmer livelihoods

Inflation and rice price



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Inflation modeling and retail price

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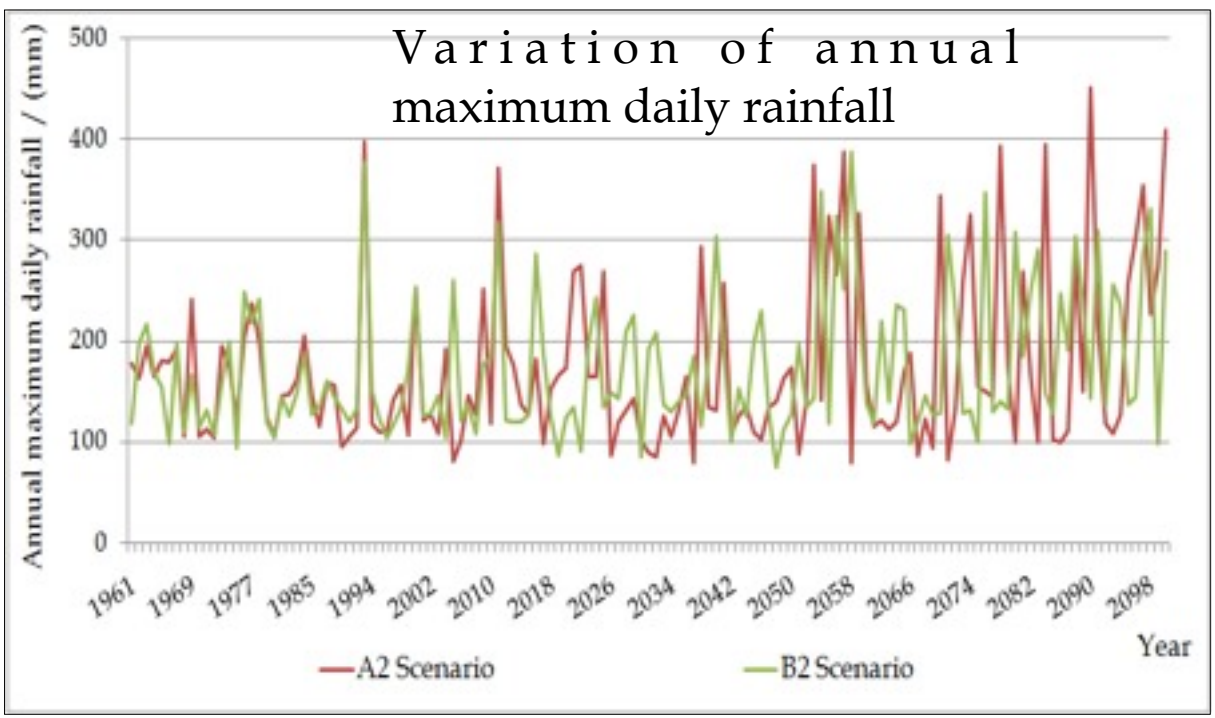
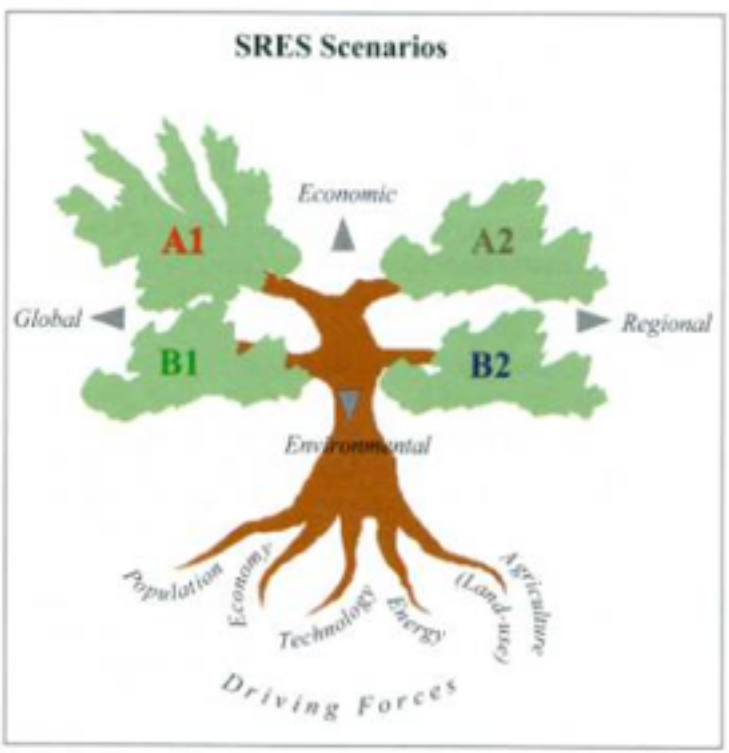
Future Climate

- Using both USA and UK climate models, downscaled projections using statistical downscaling approach

Study with University of Peradeniya, Irrigation Department, Rice Research Institute





Conclusions

- IWRM serves as an important tool in supporting sustainable development objectives.
- Consideration of environmental, economic and social dimensions helps in understanding constraints for sustainable development when we plan IWRM strategies.
- In addition to maximizing benefits, we need to link the effects of global change on local sustainability as well as impacts of local developments on global sustainability.

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