Do myth based assumptions:
1) Forests are necessarily always good for the water environment,
2) Soil water conservation is always a benign technology,
lead to perverse outcomes?

Are Watershed Development programmes really benefiting the poor?

Ian Calder, CLUWRR

Washington Workshop

February 2005

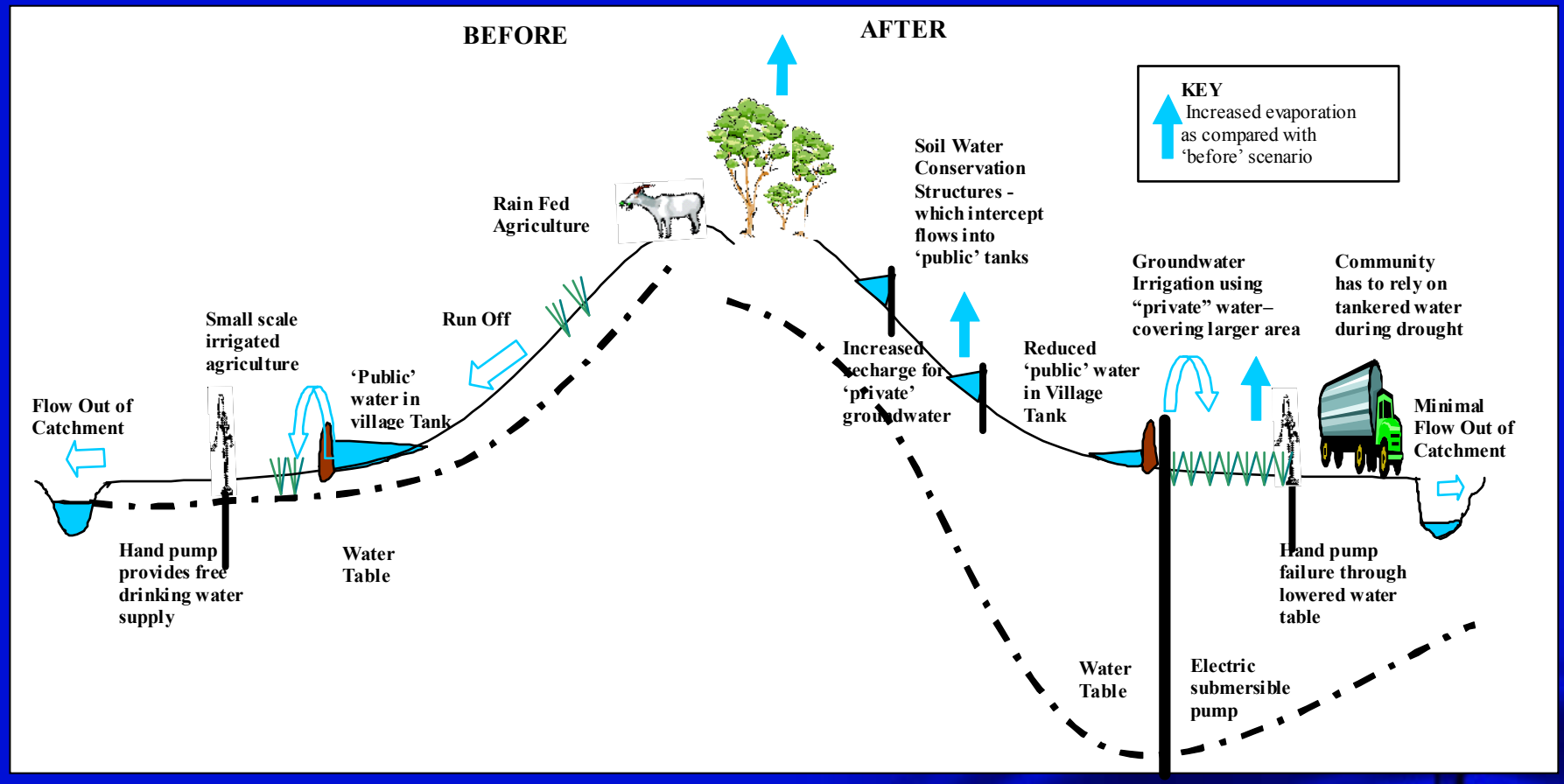
Outline

Sushma:

-Learn from successes
- and from some of the less successful experiences
from watershed development

- **Problems arising from lack of understanding of water resource constraints**
- **Misconceptions underlying some watershed development policies**
- **New tools and methodologies to assist WSD**

Projects Promoting: Forestry, soil water conservation, irrigation, without regard to water resource constraints may lead to catchment closure – Perverse outcomes

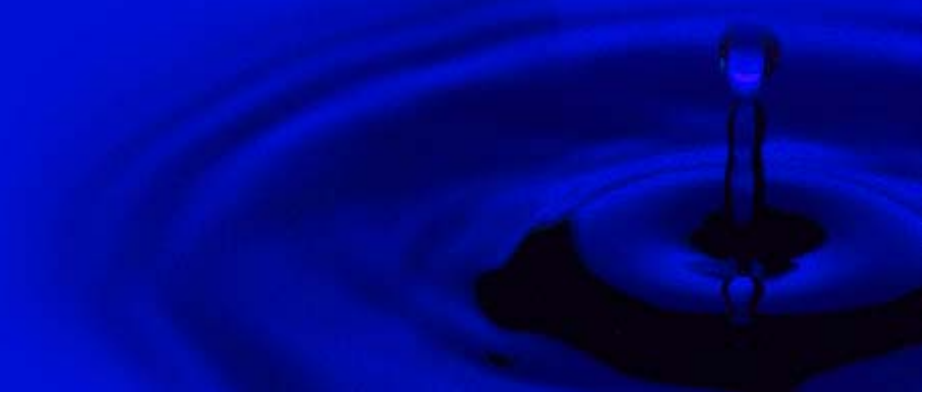


1) Forests are necessarily always good for the water environment?

Forestry often promoted on 'mother statement' beliefs:

- **Forests increase rainfall**
- **Forests reduce erosion forests**
- **Forests "sterilize" water supplies - improve water quality**
- **Forests increase runoff**
- **Forests regulate flows, reduce floods**

But how do these beliefs equate with the scientific evidence?



Forests often promoted on 'mother statement' beliefs

- **Forests increase rainfall –** not proven, likely to be a small effect*
- **Forests reduce erosion –** not always from plantation forests*
- **Forests "sterilize" water supplies - improve water quality –** not in high pollution climates*

- **Forests increase runoff ?**
- **Forests regulate flows, reduce floods ?**

(*Discussed in Blue Revolution II, Earthscan)

Forests increase runoff? Evidence:

- Paired catchment experiments
- Process studies
  - "Natural Lysimeters"
  - Transpiration studies:
    - Neutron probe soil moisture
    - Micromet
    - Plant physiology
    - Tracing methods
  - Interception studies
    - Interception gauges
    - Gamma ray attenuation
    - "wet" lysimeters
    - rainfall simulators
- New Understanding of processes:
  - Two principal (and simple!) reasons for increased evap. from forests

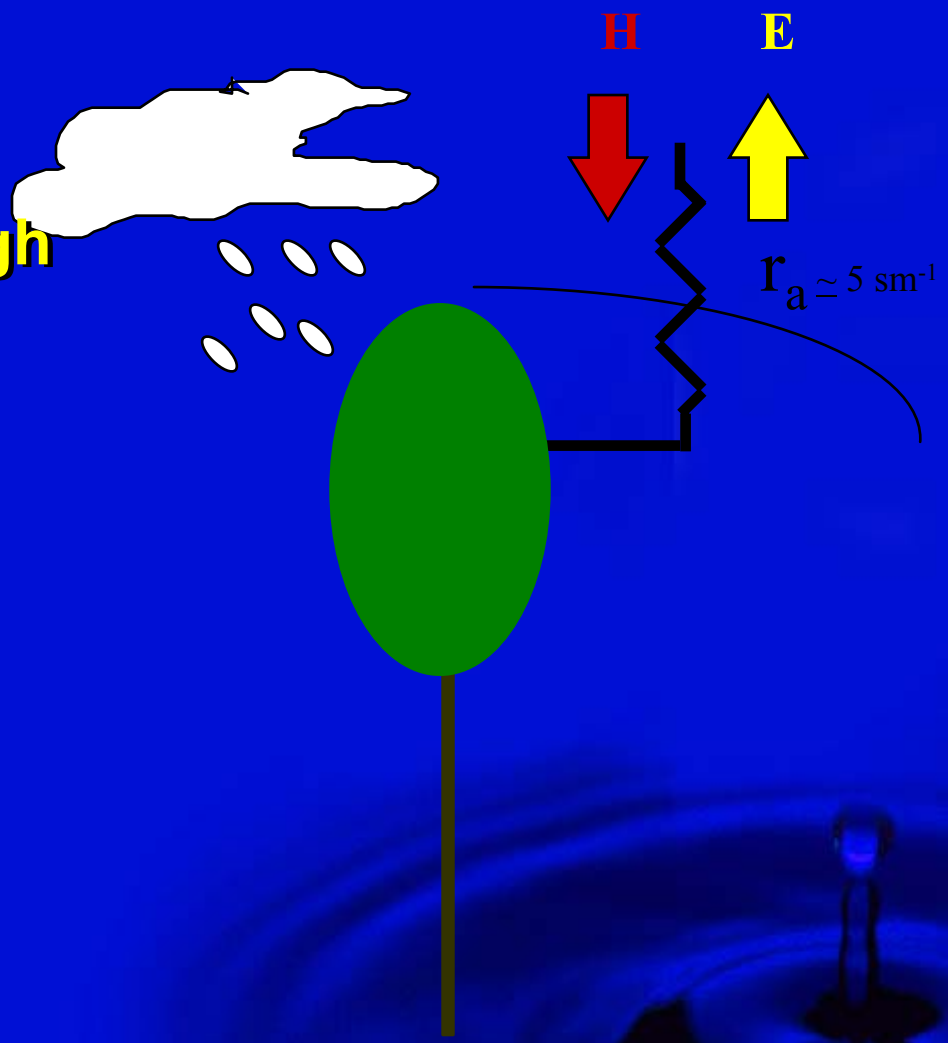







Reason 1 - Forests Are Tall

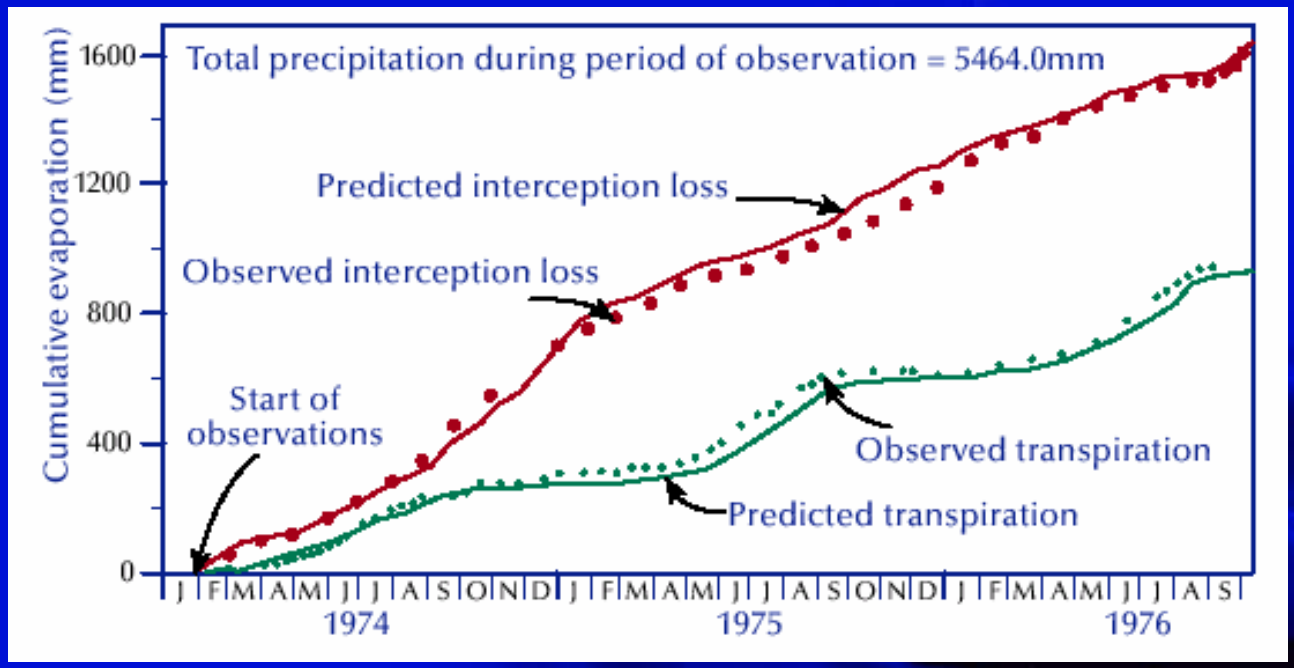
- Forests are aerodynamically rough
- High rates of evap. of intercepted water
- In wet climates evaporation higher from forests



Interception

Upland UK studies show

- **Evaporation from mature conifer forest**
  - **≃ 2 X evaporation from short crop - grassland**



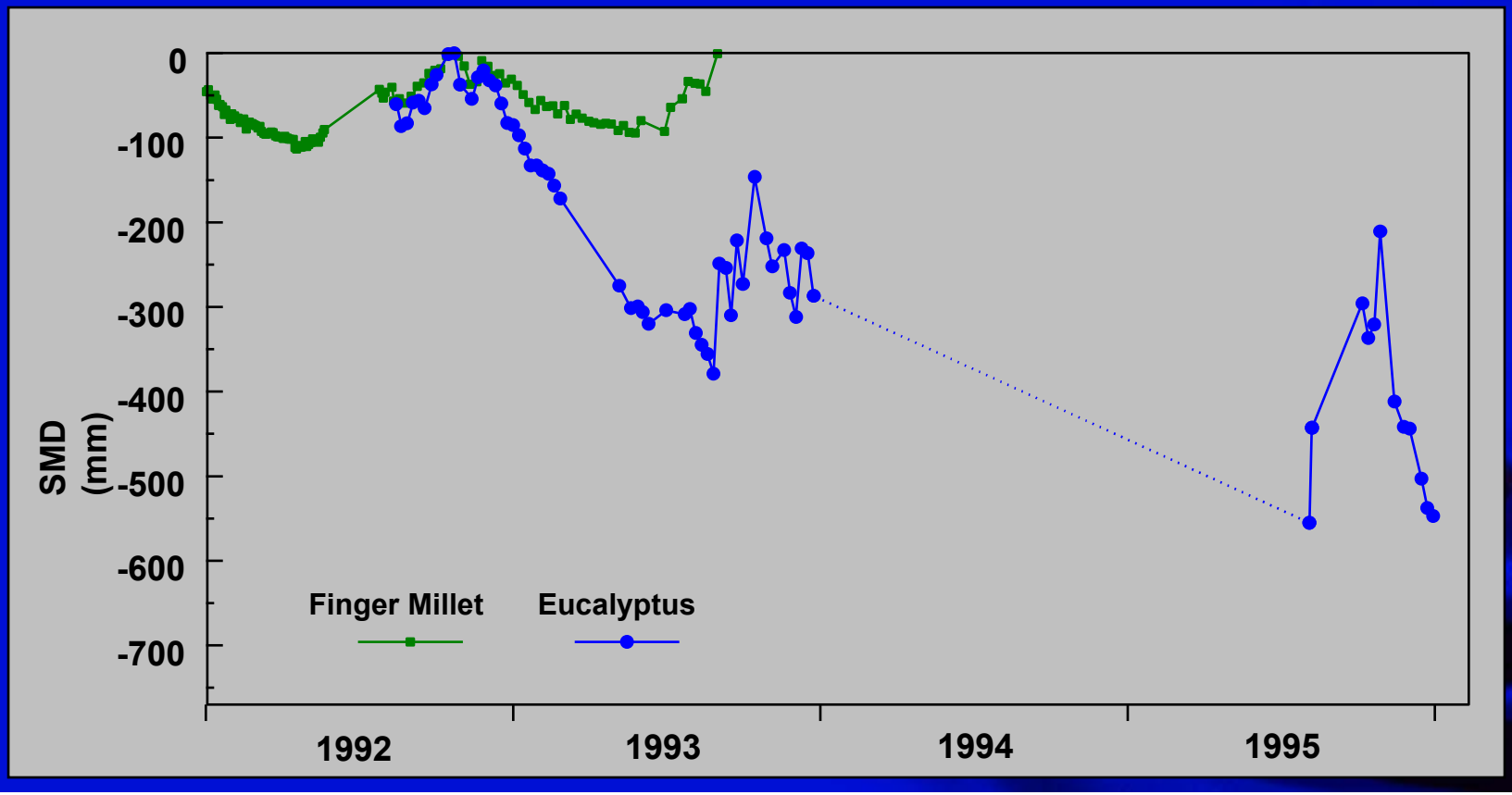
Reason 2 - Forests Have Deep Roots

- Greater access to soil water in dry conditions
- In dry climates forests evaporate more

Dry Climate - Southern India

Soil moisture studies show

- Evaporation from eucalypts
  - ~ 2 X evaporation from short crop – finger millet



Forests increase runoff? Conclusions:

- In wet conditions evaporation losses will be higher from forests because of higher interception losses
- In dry conditions evaporation losses will be higher from forests because of increased rooting depth
- Overall both mechanisms lead to greater losses from forests
- Although theoretically possible that higher infiltration rates under forests could outweigh extra evaporative losses leading to greater recharge this is likely to be a very rare situation. Field studies indicate the opposite:
  - Sherwood Forest (UK): Long term recharge under pine is ¼ and under oak is ½ that under grassland
  - India SMDs much larger under forest indicating less opportunity for recharge

Forests regulate flows? Dry season flows

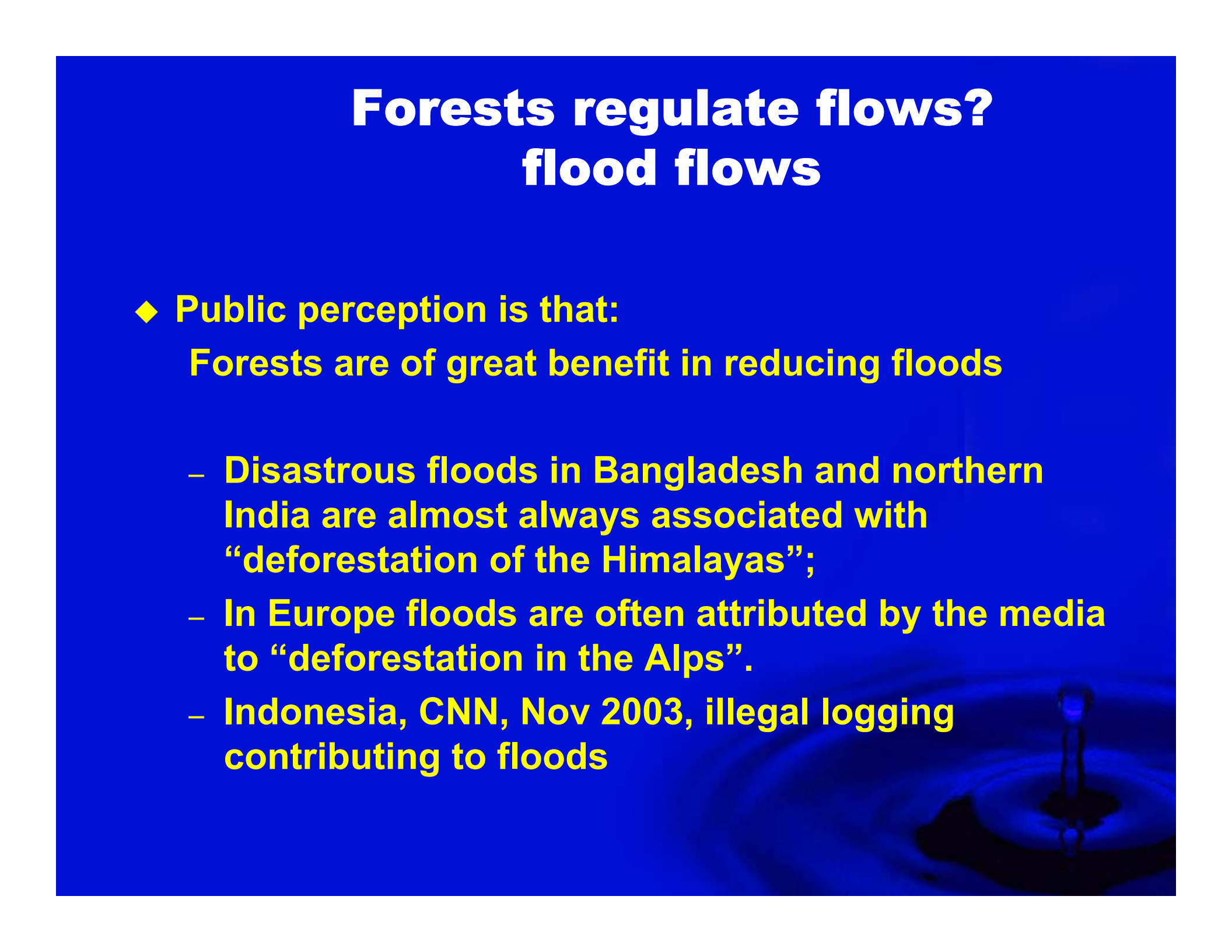
- **Theory**
  - Increased interception and increased dry period transpiration will increase soil moisture deficits and reduce dry season flows
  - Increased infiltration under (natural) forest will lead to higher soil water recharge and increased dry season flows
  - For cloud forests increased cloud water deposition may augment dry season flows
- **Observations**
  - UK Coalburn study - Forest drainage leads to increased dry season flows.
  - Bruijnzneel (1990) concludes that infiltration properties of tropical forests are critical in partitioning runoff.
  - Majority of recent paired catchment experiments: South Africa, India, Taiwan, Europe… - for both natural and plantation forest, indicate dry season flows reduced in similar proportion to total flows.
- **Modelling**
  - Shows that catchment groundwater storage capacity may be critical in determining if a change in land use effects dry season flows. For small storage capacity the maximum storage may be reached in the wet season irrespective of the higher evaporative characteristics of forests – resulting in the same dry season 'decay' flow. For larger storage capacities the maximum storage will not be reached under higher evaporative land uses such as forests – resulting in reduced dry season flows.

Forests regulate flows?
flood flows

- **Public perception is that:**

  Forests are of great benefit in reducing floods

  - **Disastrous floods in Bangladesh and northern India are almost always associated with "deforestation of the Himalayas";**
  - **In Europe floods are often attributed by the media to "deforestation in the Alps".**
  - **Indonesia, CNN, Nov 2003, illegal logging contributing to floods**



Forests reduce floods?
Theory: Competing processes

- **Increased forest evap. may reduce floods:**
  interception of rainfall by forests reduces floods by removing a proportion of the storm rainfall and by allowing the build up of soil moisture deficits. These effects would be expected to be most significant for small storms and least significant for the largest storms.

- **Forest management activities may increase floods:**
  cultivation,
  drainage,
  road construction – increasing stream density,
  soil compaction during logging

Forests reduce floods? Evidence:

- **Early hydrological studies :**
  - USA (Hewlett and Helvey, 1970),
  - South Africa (Hewlett and Bosch, 1984),
  - UK (Kirby et al., 1991; Johnson, 1995)
  - New Zealand (Taylor and Pearce, 1982)

  show little linkage between land use and storm flow.

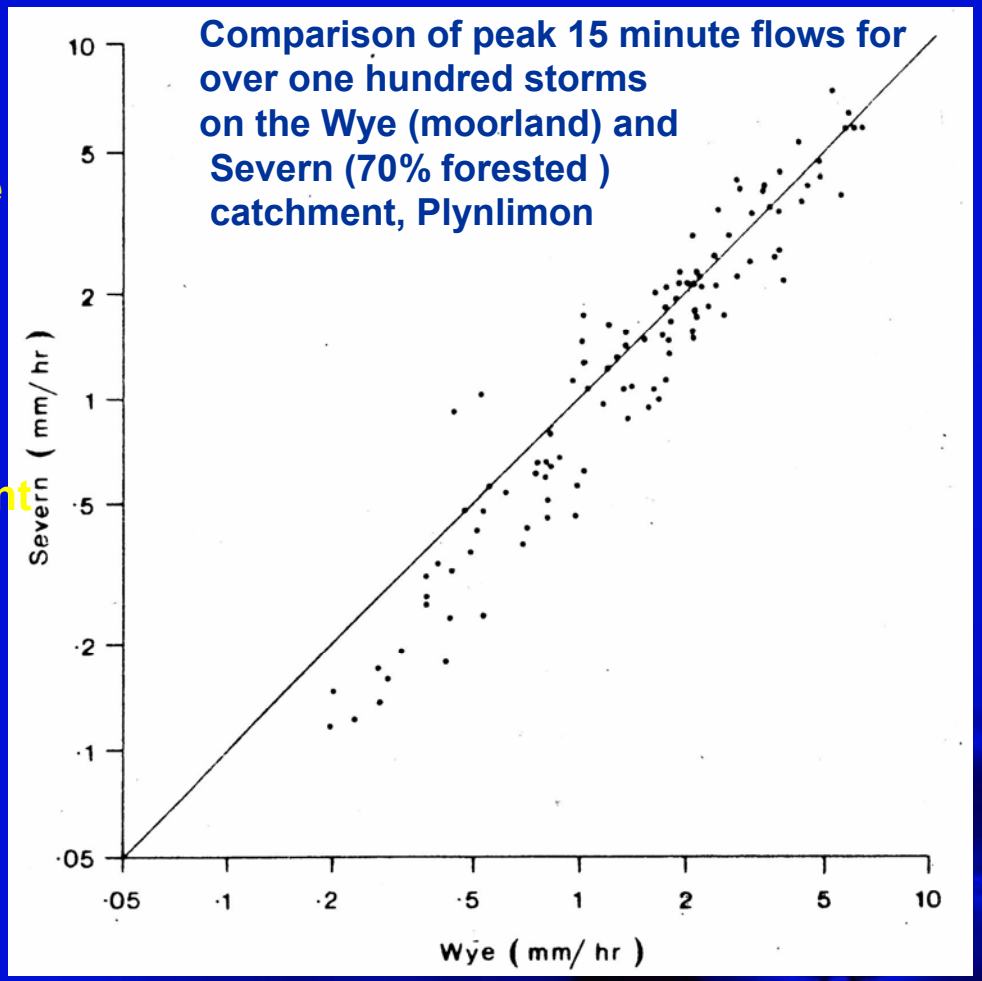
- **More recent studies:**
  - USA (La Marche & Lettenmair, 2001)
  - UK (Robinson, M and Dupyrat, 2005)
  - India (Sikka et al., 2003)

  Only show benefits at small catchment size and for small events – little or negative benefit for largest events.

- **Studies at large catchment size:**
  - Himalayas (Hofer, T. 1998)

  Show no measurable effects (Ganga-Brahmaputra-Megha) –No increase in frequency or the magnitude of flooding over the last few decades)

(reported in Calder et al., 2003, Calder 2005)



Damage caused by forest-water misperceptions semi-arid zone, India

- Suspicion that large spending of development funds in India is based on erroneous belief that tree planting will increase groundwater recharge.

- Equally – if not more serious– concern that focus on forestry programmes for improving water resources diverts attention from urgent need for demand-management of groundwater abstraction.

- Groundwater table often >100 m , hand-pumps not working, villagers buy water from tankers, pumping groundwater accounts for major proportion of all the electricity generated in some states.

Damage caused by forest-water misperceptions -NFPP and SLCP, China

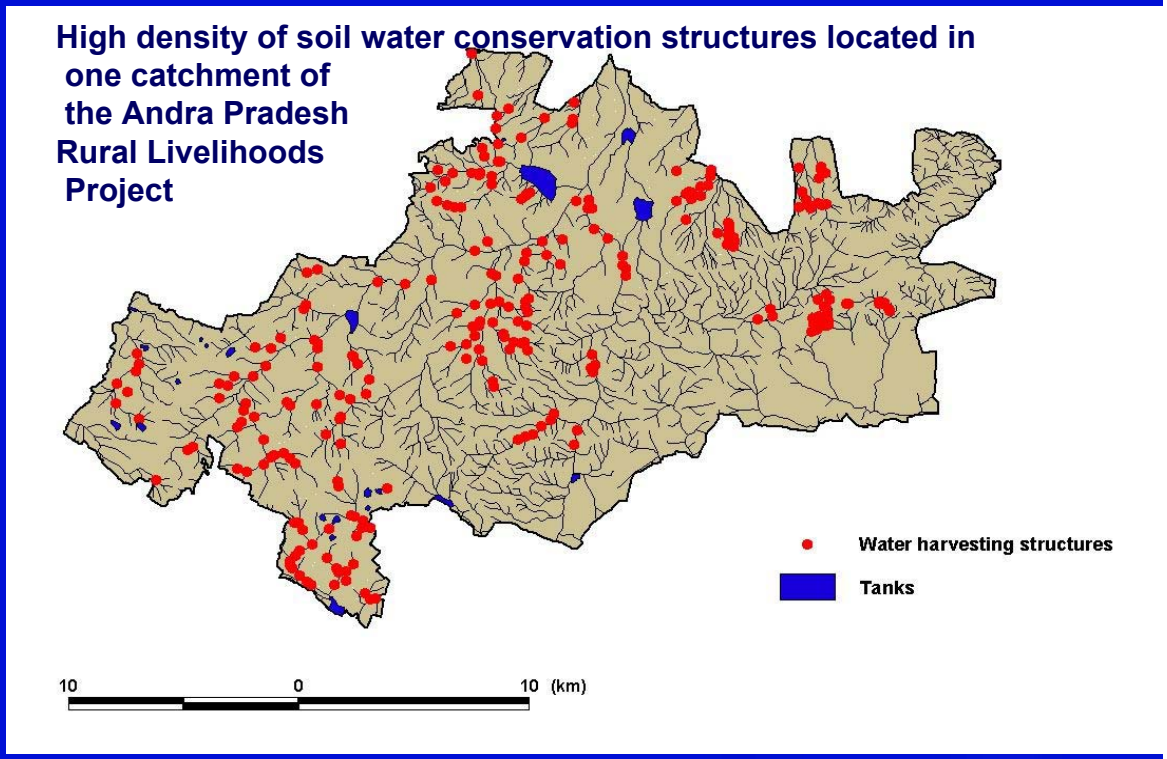
The major floods in China in 1998 precipitated:

- The Natural Forest Protection Programme (NFPP), protecting natural forests together with a complete ban on logging in the upper reaches of the Yellow and Yangtze Rivers.
- The (31 million ha) Sloping Land Conversion Programme (SLCP) (afforesting sloping land)

Possible downsides:

- Not much impact on major floods
- Increased logging in neighbouring countries
- Turning present biodiversity hot spots into biodiversity cold spots
- Huge costs and compensation may run out quickly

2) Soil water conservation is always a benign technology ?



Benefits:

- Increase recharge
- Reduce erosion
- Provide storage for irrigation

Costs:

- Higher evaporative losses from open water surface, riparian zones and irrigated areas
- In dry climates higher losses may contribute to catchment closure

Perverse outcomes:

- Continued implementation of SWC structures as catchments approach closure can have no overall benefit – just moves the water upslope
- Structures may effectively change the ownership of the water – from communal in village tanks to 'private' accessed by borehole of richer farmers

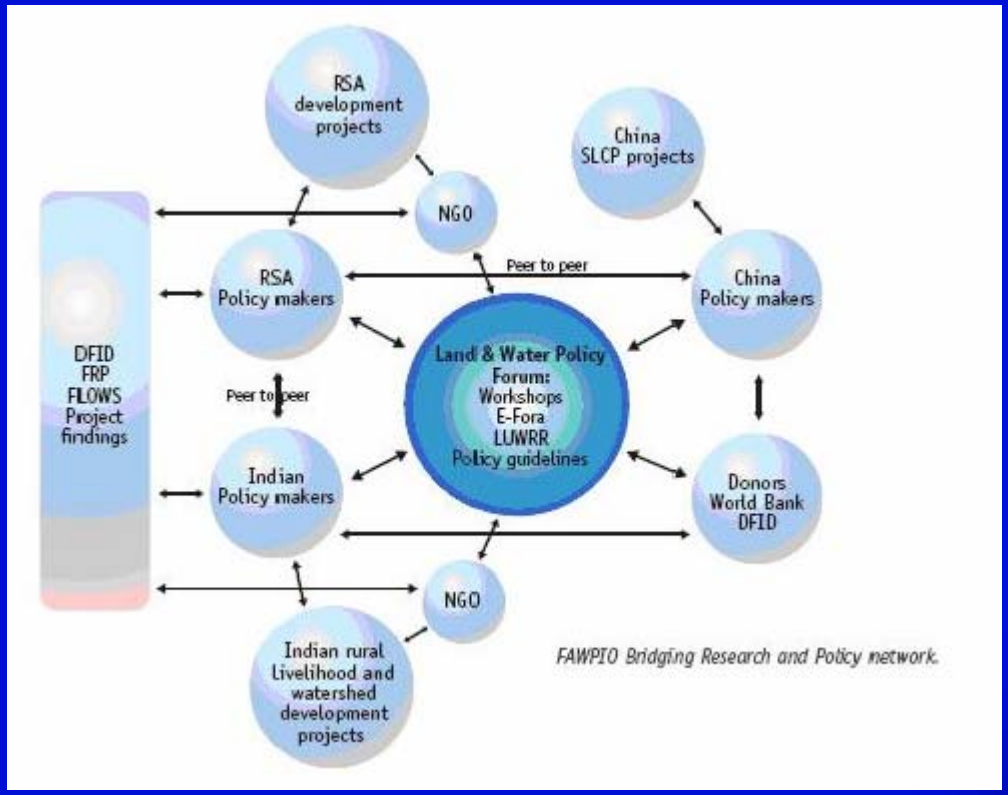
Progressing the Blue Revolution in Land and Water management

The Forest, land And Water Policy – Improving Outcomes (FAWPIO) programme recommends two initiatives:

- Bridging Research and Policy networks
- Improved ILWRM framework operating in conjunction with support tools

(FAWPIO is currently supported by DFID FRP)

FAWPIO Programme Outputs: BRAP networks



BRAP (Bridging Research And Policy) Networks will:

- incorporate advocacy and promotion techniques,
- connect and disseminate new knowledge of the biophysical and socio-economic outcomes of land and water interventions to policy makers
- use peer-to-peer networking of policymakers
- support interactive workshops and innovative media approaches including e-fora and electronic journals, e.g. Land Use and
- Water Resources Research (www.luwrr.com hosted by Venus Internet).

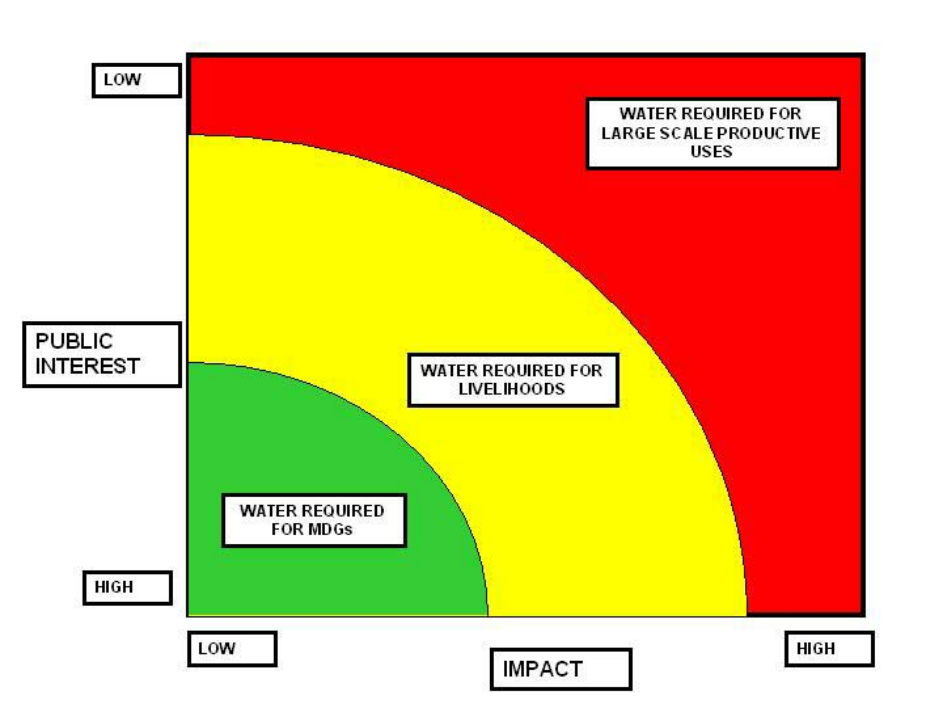
FAWPIO Programme Outputs:

Improved framework for land and water management

The framework will include:

1. ***Hydrological assessment*** **of all water uses and users within a catchment.**
2. ***Catchment Stress Assessment*** **to determine to what extent the catchment is approaching 'closure', or not meeting aquatic ecosystem requirements.**
3. ***Strategic Environmental Assessment*** **to identify, using Social Account Matrix approaches, the economic returns and employment opportunities that arise from water use in the catchment.**
4. ***Negotiation support*****, through use of a negotiation support 'toolkit' incorporating new methodologies, Allocation Equity, Greenwater Policy Instruments, EXCLAIM**
5. ***Monitoring and evaluation*****.**

New Methodologies: Allocation Equity

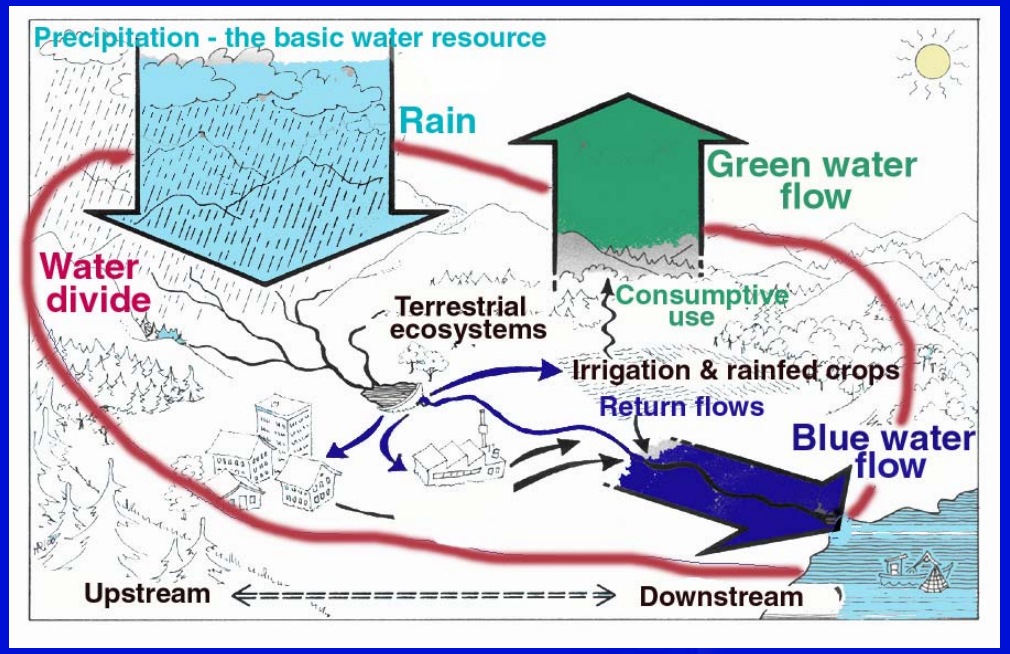


Proposed approach to balancing water resource impacts and public interest being tested in South Africa.

Allocation Equity, being developed by DWAF (South Africa), aims for :

- The equitable allocation of catchment runoff amongst all users –including the poorest
- water use is in the 'public interest'
- changes in allocation are negotiated in a sensitive and transparent manner between users.
- Minimising Impacts on 'investor confidence' and commercial returns

Improving outcomes:
Green Water Policy instruments



'Green Water' policy instruments (Falkenmark, terminology) recognise the possibility of managing evaporation:

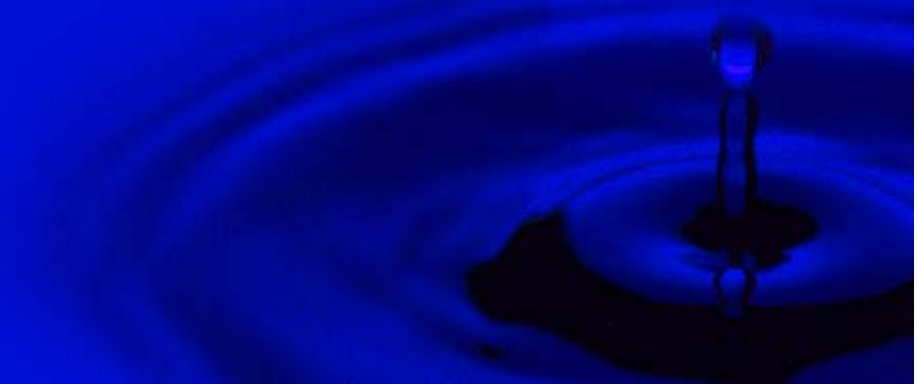
- **Through taxing high water users such as forestry -through RSA type SFRA policy instruments**
- **By payments to low water-utilising land uses such as dryland agriculture**
- **Through regulating the implementation of SWC in conditions where catchment closure is possible**

Improving outcomes: Support Tools - EXCLAIM

Exploratory, Climate, Land Assessment and Impact Management

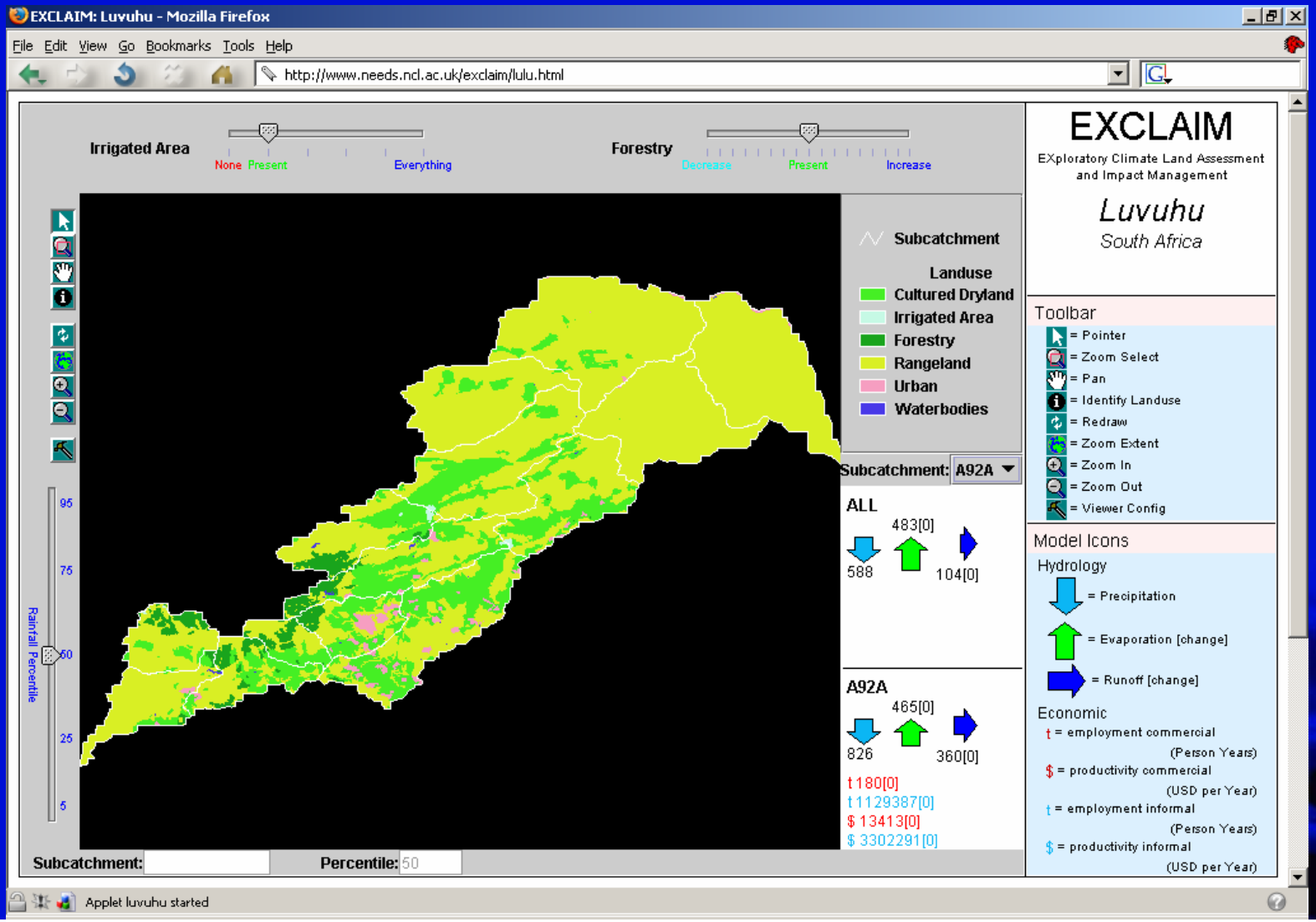
- **EXCLAIM was developed as a tool to show policymakers how land related interventions within a catchment, particularly those involving changes in forest cover, irrigation and soil water conservation structures may impact on water, production and livelihoods.**

- **EXCLAIM tool case study- *Luvuhu, South Africa***



EXCLAIM

Exploratory, Climate, Land Assessment and Impact Management



EXCLAIM

EXploratory Climate Land Assessment and Impact Management

- *Development version now available as an interactive web based tool at :*

http://www.needs.ncl.ac.uk/exclaim/

Or

http://www.needs.ncl.ac.uk/exclaim/lulu.html

(needs Java 2 runtime environment)

Partners and Funders

- FAWPIO is based on outputs from the FRP FLOWS cluster of projects supported under the United Kingdom Department for International Development (DFID) Forestry Research Programme.
- The FAWPIO programme is seeking further linkage with donors, UN organisations, NGOs and partner countries and institutions to establish this programme.