

Applications of WaterWorld to understanding the value of protected areas

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10mins

Rules of thumb for the water service benefits of protected areas



Water **quantity** services

- Protected ecosystems do not necessarily generate more rainfall than agricultural land uses.
- Protected ecosystems may have higher evapotranspiration and thus lower water yields

Thus quantity benefits difficult to prove

Water **regulation** services

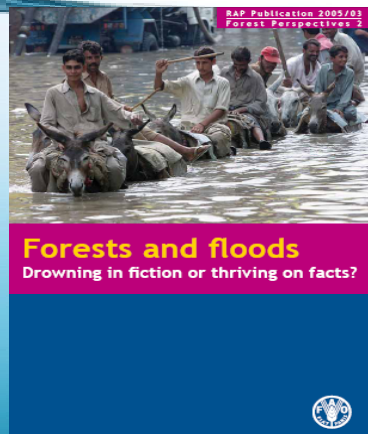
- Protected ecosystems do not protect against the most destructive floods
- For 'normal' events they do encourage more subsurface flow and thus more seasonally regular flow regimes

Likely benefits especially in highly seasonal environments

Water **quality** services (quantity for a purpose)

- Protected ecosystems encourage infiltration leading to lower soil erosion and sedimentation
- Unprotected land will tend to have higher inputs of pesticides, herbicides, fertilisers ...

Clear benefits of PA's: generation of higher quality water than non-protected areas



BUT, HIGHLY SITE AND CONTEXT SPECIFIC SO MEASURE/MODEL FOR YOUR SITE TO BE SURE


WaterWorld on a slide

- Detailed, **process based**, since 1998
- Spatial (**1ha or 1km** spatial resolution), local,national, basin
- All **required data supplied** for anywhere globally
- Fast (full analysis in **30 minutes**)
- Uncertainty** and validation tools (to data and model structure)
- Sophisticated scenarios and **intervention tools**
- Simple to use** (web-based, firefox or chrome)
- Results downloadable in **GIS** formats
- Scientist user level **free** for non-commercial use
- Free **training** programme, more than 1000 users globally
- Published** e.g.: Mulligan and Burke (2005); Mulligan (2013);
Mulligan et al. (2010); Bruijnzeel, Mulligan and Scatena (2011);
van Soesbergen and Mulligan (2013)

How to use WaterWorld

WaterWorld

Supported by:

 CGIAR Challenge Program on WATER & FOOD

 CONSERVATION INTERNATIONAL

[Further credits](#)

Welcome: (scientist) mark.mulligan

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Control panel

explore:

set-up:

[Step 2: Prepare data](#)

simulation:

[Step 3: Start simulation](#)

[Step 4: Policy exercises](#)

[Manage simulations](#)

results:

[Step 5: Results: maps](#)

[Step 6: Results: stats](#)

[Step 7: Results: narrative](#)

help:

[System documentation](#)

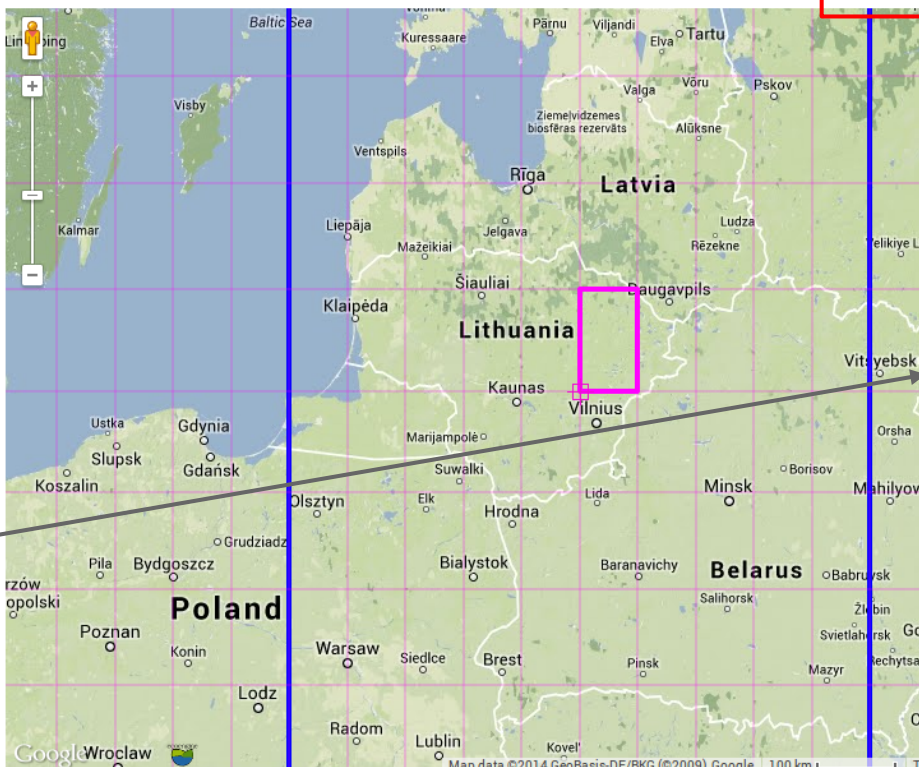
[FAQ](#)

[Change log](#)

[Model documentation](#)

waterworld was developed with the [//ecoengine](#) framework.

South America ▾ Go > Go > lat: lon: Run name Tiled 1km ▾ **Step 1: Define area**



LAND AND WATER MANAGEMENT: choose the policy option that you wish to apply.

- Riparian buffer strips:**
Plant trees close to rivers to reduce soil erosion and contamination
- Bench terracing:**
g across the slope at vertical intervals, supported by steep banks or risers to
- Fanya juu on hillslopes:**
uphill to encourage infil and reduce erosion. The steeper the slope, the closer
- Eco-efficient agriculture:**
farming techniques to reduce inputs of pesticides, fertilisers and other potential
- Reduce industrial and urban contaminant emissions:**
e industrial, extractive, infrastructure and urban supply of potential pollutants
- Reduce domestic water use:**
withdrawals for domestic water use to reduce water stress and preserve water
- Install/upgrade urban sanitation capacity:**
urban sanitation capacity to reduce the pollution load of water entering water c
- Install/upgrade livestock waste management capacity:**
estock waste management to reduce the pollution load of water entering water
- Install water treatment capacity:**
Install water treatment capacity to clean water for consumption. Current:

[List baseline workspace data](#)

Current tile

[View in Earth](#) [Close window](#)

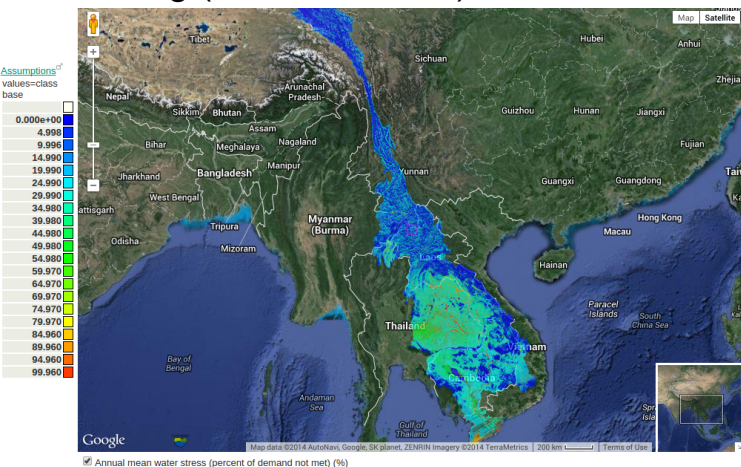
What to use WaterWorld for

Focus: targeting watershed conservation to maximize hydrological ecosystem services (HES):

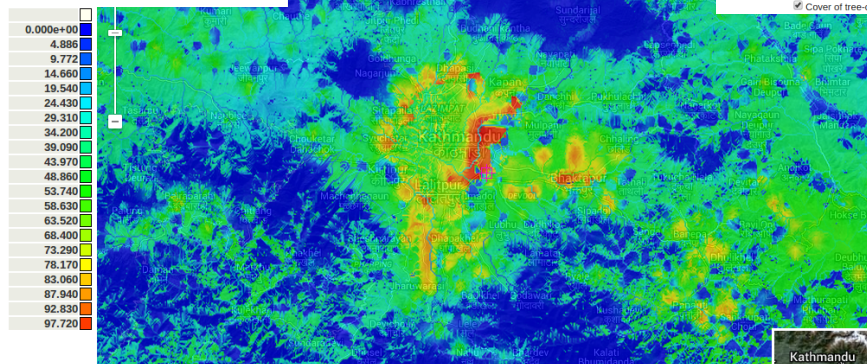
- **Where** are HES produced? (quantity, quality, sedimentation, some regn.)
- **Who** benefits? (spatially, demographically, socioecon.)
- What will (continued) **land use change** do?
- What will specific policy/mgt **interventions** do?
- What will **climate change** do?
- What will all of these do combined? **Who wins/loses?**
- What are the data **uncertainties** and how reduce?

Regional, national and local applications

Mekong (1km resolution) water stress



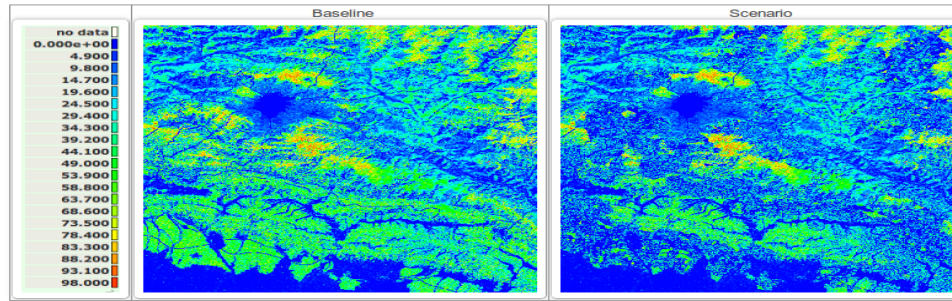
Colombia (1km resolution) tree cover



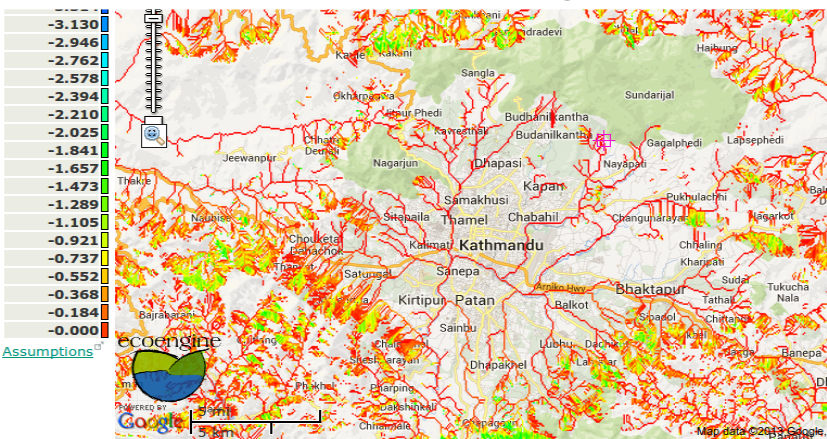
Kathmandu (1ha resolution) water quality

Shivapuri protected area: impact of reducing deforestation

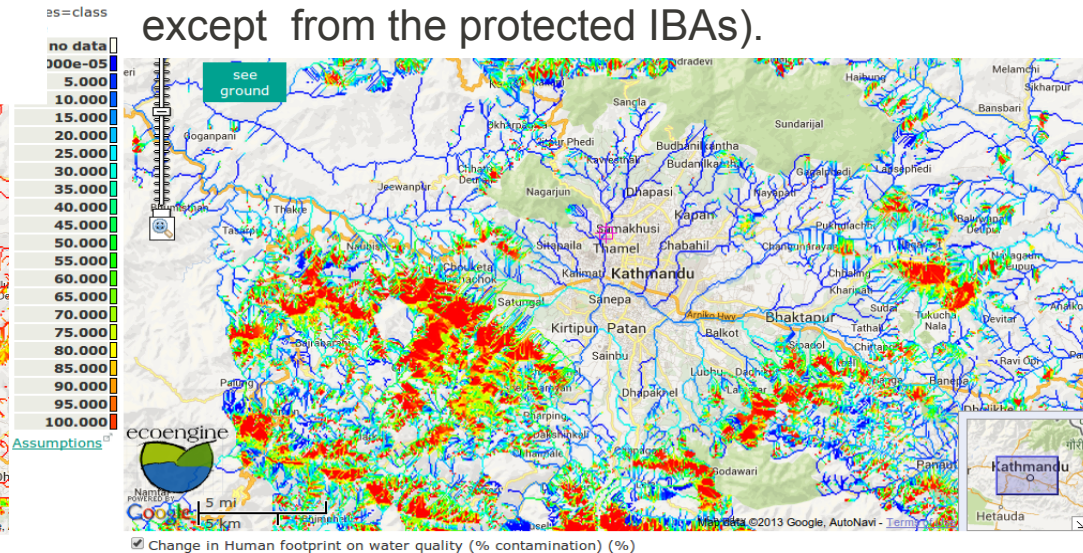
Scenario: 40 years BAU deforestation outside protected IBAs:



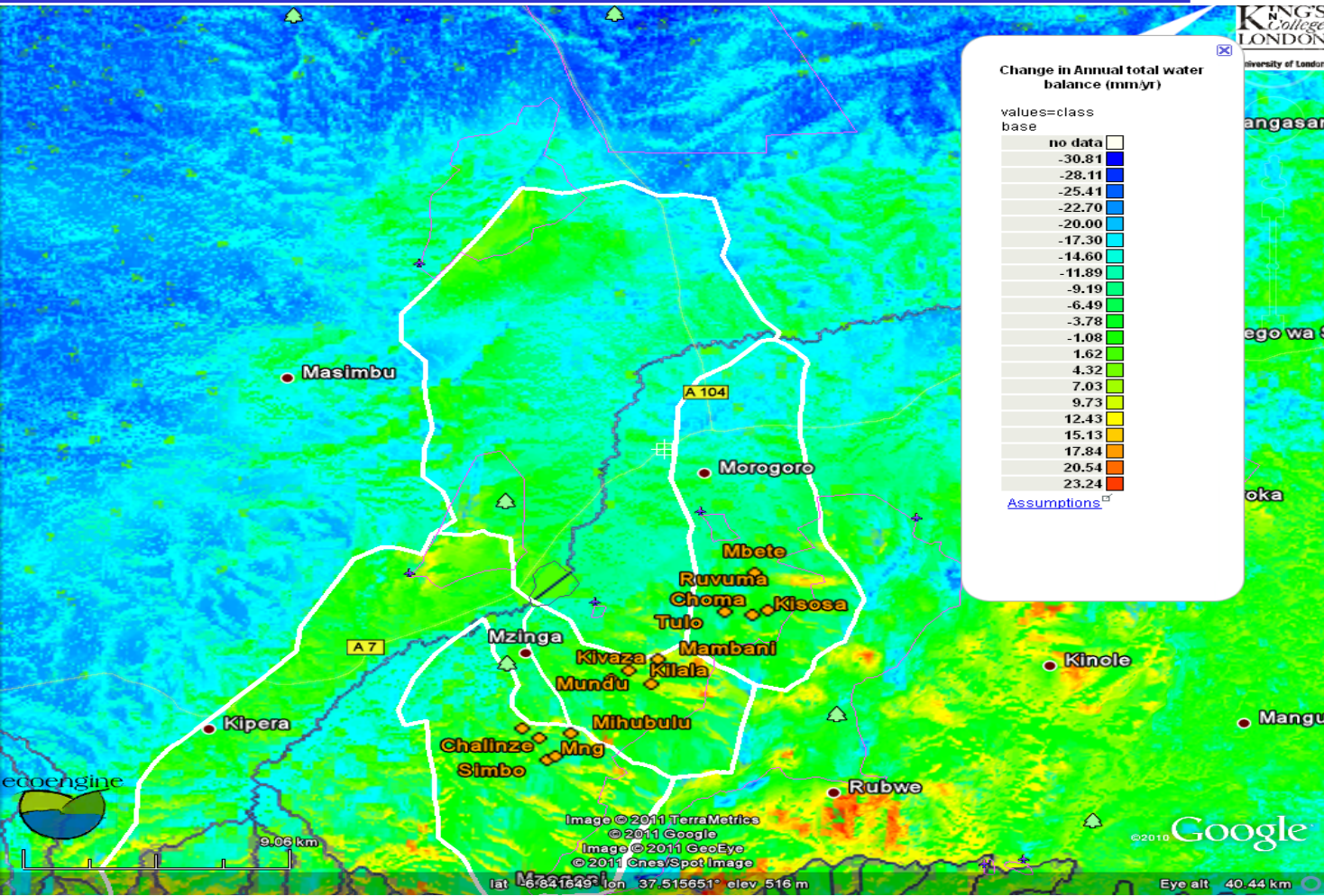
Impacts on water quantity (decreases everywhere except from the protected IBAs) because of reduced fog interception.



Impacts on water quality (decreases everywhere except from the protected IBAs).



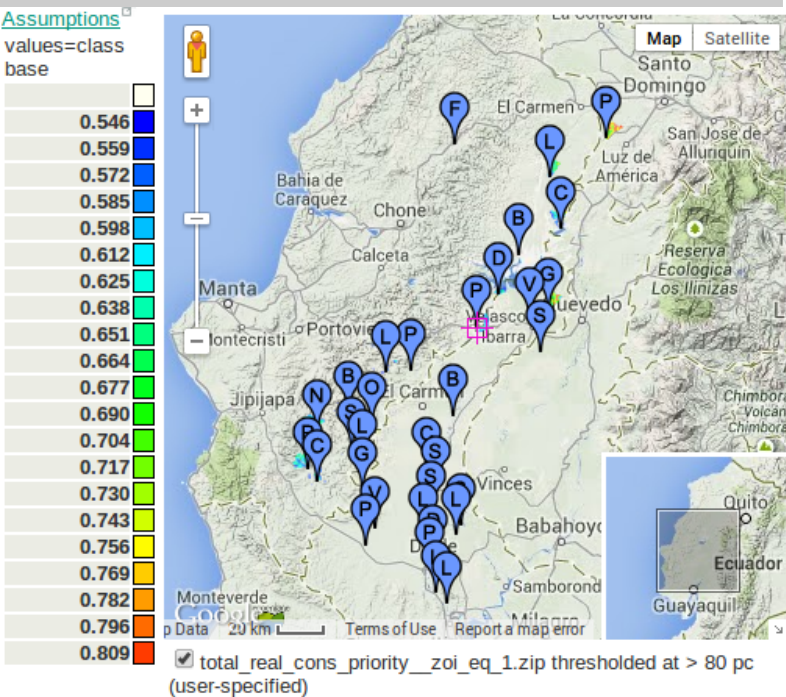
Ulugurus – Sensitivity to deforestation



Ask Where to afforest with 10% woodlots to increase water flows.

Daule: Policy support for water fund investments

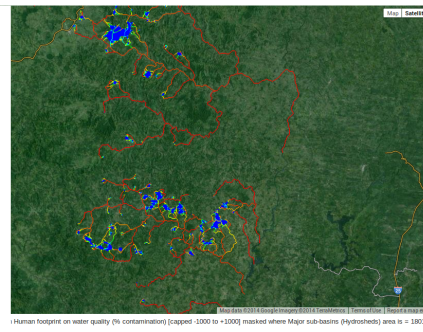
Devise the investment scenario



Run the investment scenario

Examine the impact over space

Water quality improvements from new PA (blue=high, red=low). Downstream decay.



Examine the impact at points

Green water intakes have significant benefits wrt sediment deposition and water quality

Puntos	34M AFF CN/WW Scenario Change		
	Change in Annual total soil deposition [capped -1000 to +1000] (mm/yr % Mean)	Change in Annual total soil transportation [capped -1000 to +1000] (mm/yr % Mean)	Change in Human footprint on water quality (% contamination) [capped -1000 to +1000] (% % Mean)
guayas	-0.32	0.00	-18.99
Daule/Peripa	0.00	-0.03	-1.52
barraganete	0.00	0.00	0.00
Chaune	-0.02	-0.01	-8.37
luzAmerica	-0.57	0.00	-59.47
FlavioAlfaro	0.00	0.00	0.00
PtoLimon	0.40	0.00	-29.58
piedrahita	-0.02	0.00	-1.88
PedroCarbo	0.00	0.00	0.00
limonal	0.00	0.00	0.00
ValleVirgen	0.00	0.00	0.00
guale	-0.02	-0.02	-5.37
campozano	-0.03	0.00	-5.86
pajan	-0.01	0.00	-8.99

Run another scenario

SCENARIO 1: Top 20% of (Co\$tingNature) conservation priority areas <10km upstream of POIs (water intakes) to be **afforested**:
Cost: 34.0125 MUSD

When to use WaterWorld

- To compare with other tools/approaches (never use only one tool - **each is only an opinion**)
- When local data availability or data processing capacity is low, when you are **building local hydro-capacity**
- When you want to **test multiple options** quickly and examine sensitivity of outcomes to data uncertainties
- When interested in the current **ES baseline or in impacts of scenarios** for (climate, land use or land and water management, population...all) change
- Applied previously for water funds: [Daule](#), EC Arusha, TZ. [Links with WEAP, RIOS, AQUEDUCT, GIS](#)

Key messages

- The hydrological benefits/dis-benefits of protected areas are **not as simple** as they seem, **much data** and modelling is required to get a realistic site-specific assessment.
- This is possible using sophisticated but simple to use tools like WaterWorld and Co\$ting Nature
- The tools represent decades of investment in science, data, technology. They can do what you need. They are free to use. **Use them.**
- They allow testing **uncertainties** of different datasets/model structures as understanding uncertainty is important
- There are many alternatives. WW is quick to run so you can use it alongside other models.
- <http://www.policysupport.org/waterworld>**