p4ges

can paying 4 global ecosystem services reduce poverty?

les paiements pour les services écosystèmiques globaux peuvent-ils réduire la pauvreté?

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Key WaterWorld and Co$tingNature derived results for P4GES

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MADAGASIKARA VOAKAJY

« L'excellence au service du développement »

UNIVERSITY OF Southampton

KING'S College LONDON

ITC UNIVERSITY OF TWENTE.

CONSERVATION INTERNATIONAL

PRIFYSGOL ABERYSTWYTH UNIVERSITY

Key messages from hydrological modelling:

1. **The CAZ is hydrologically very variable, with some areas acting as cloud-affected forests**

2. **The CAZ has a limited effect (footprint) downstream (esp. in dry season) - nearby populations are most affected by conservation and reforestation**

3. **The deforestation that has occurred to date is orders of magnitude greater than that which will occur over coming decades, so most of the hydrologically negative impacts have already occurred**

4. **Conservation or afforestation always improves water quality compared with BAU, but can have positive or negative effects on water quantity and dry season flow (but there are also opportunity costs of conservation)**

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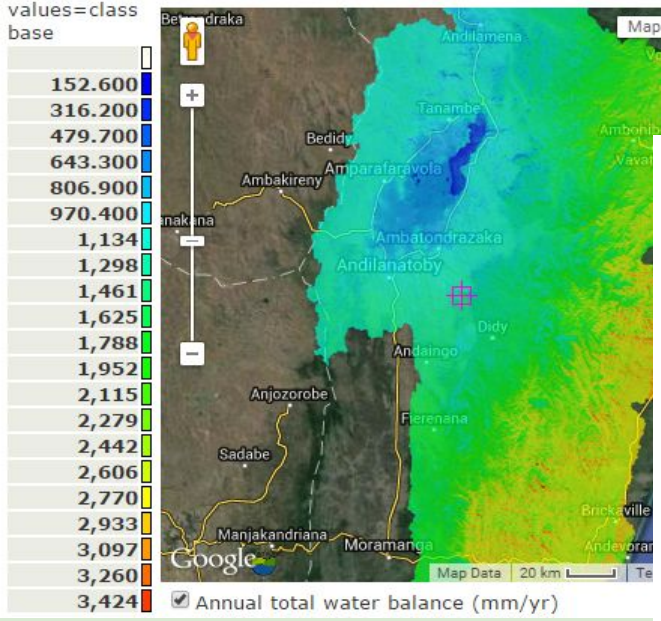
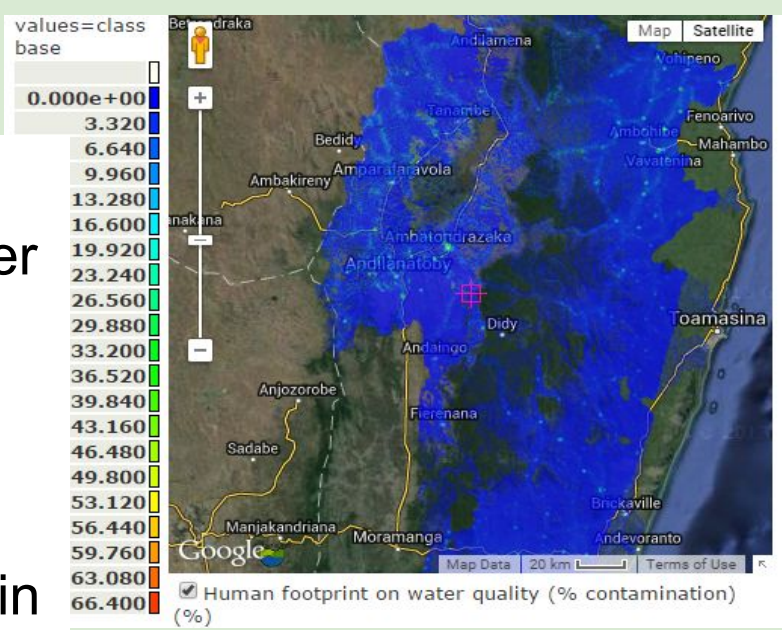
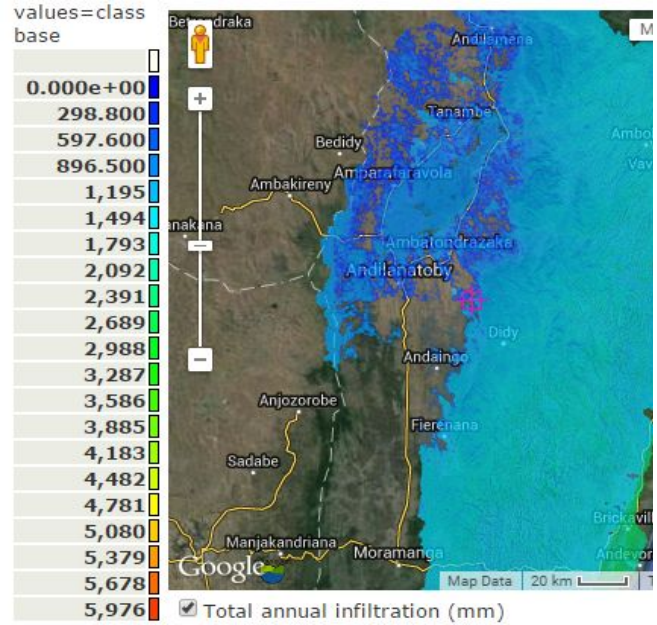


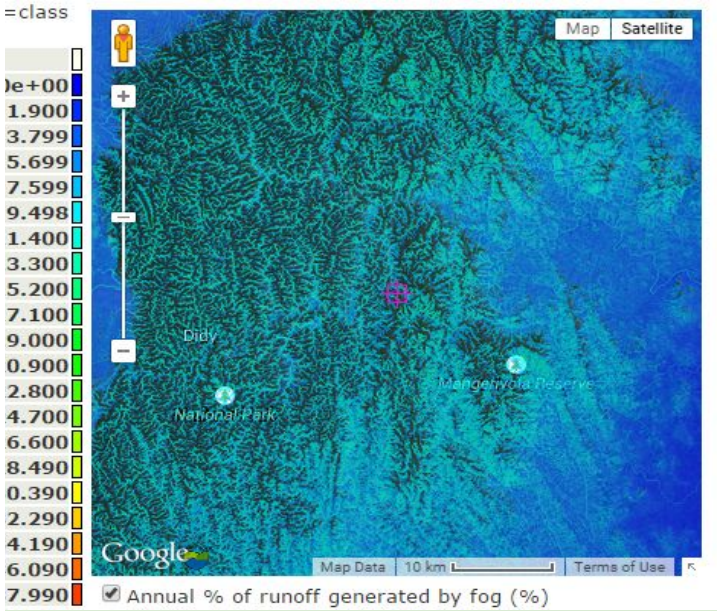


Infiltration and water balance highest on coastal plain.

Water quality high in the CAZ, provides for some populations downstream.

Fog contribution to runoff is locally significant. This is lost on deforestation.





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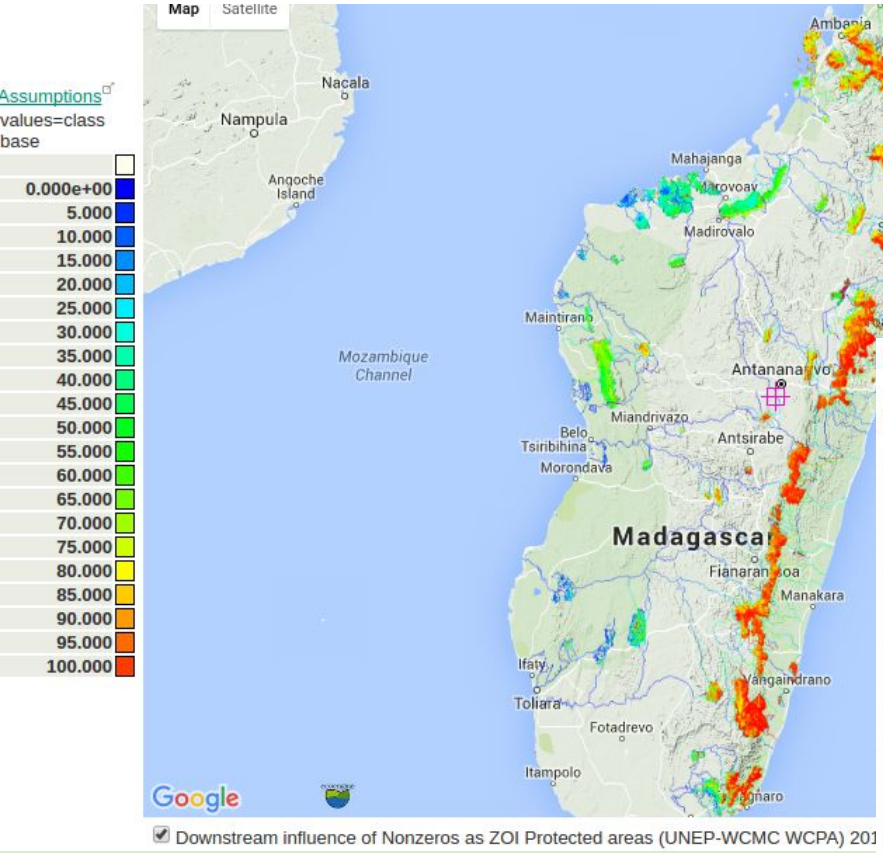
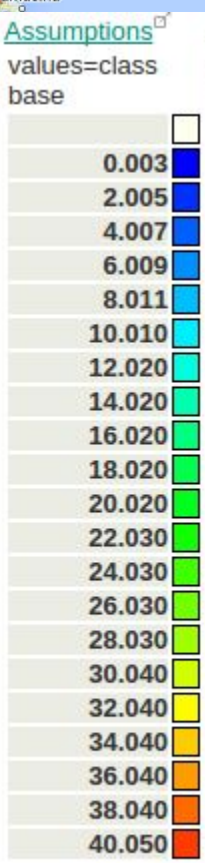
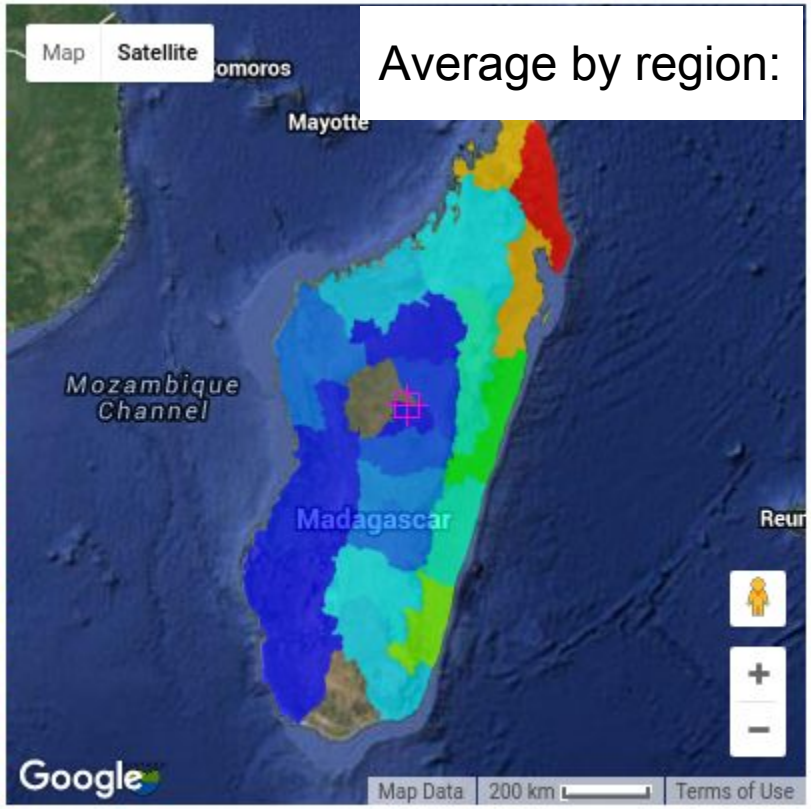
Hydrological footprint of PAs & beneficiaries (people): **annual mean**

Hydrological footprint is the % of water at a point originating in PAs upstream





Average by region:

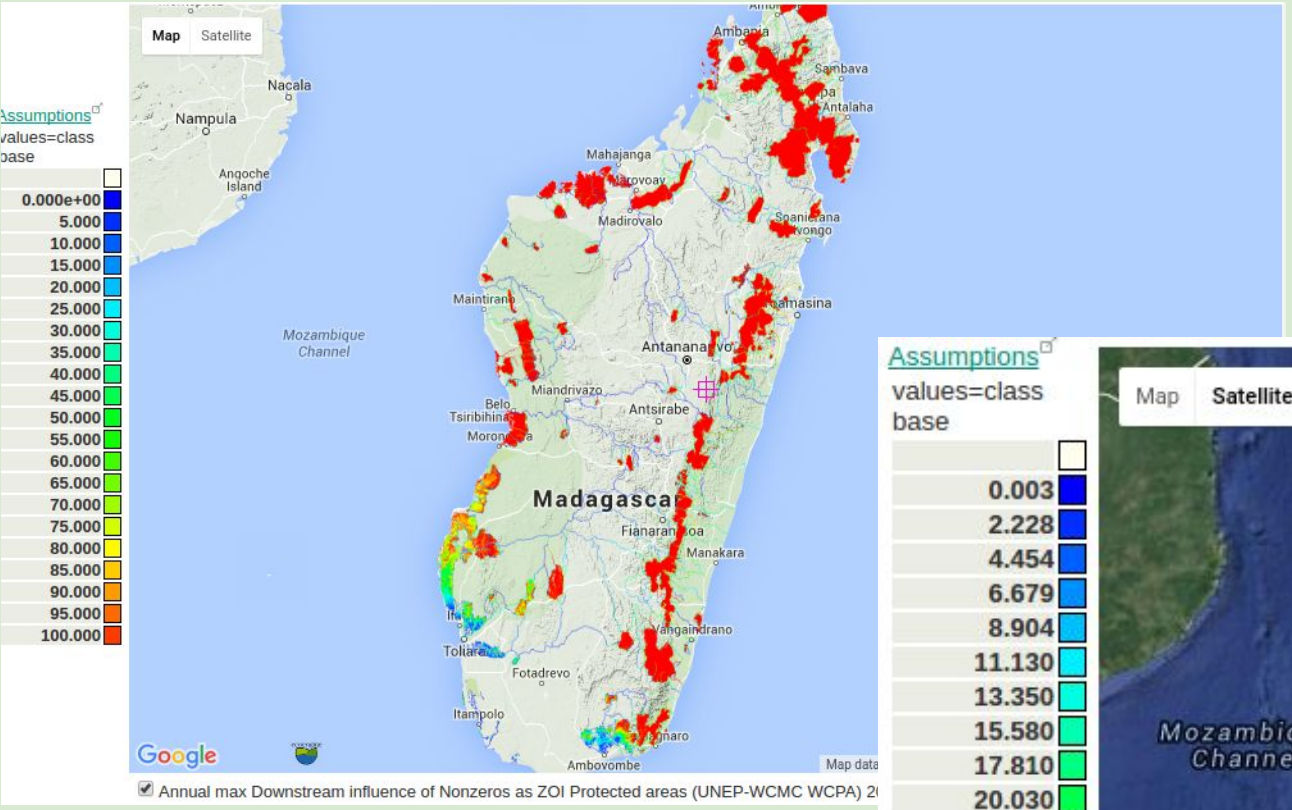


Benefitting:

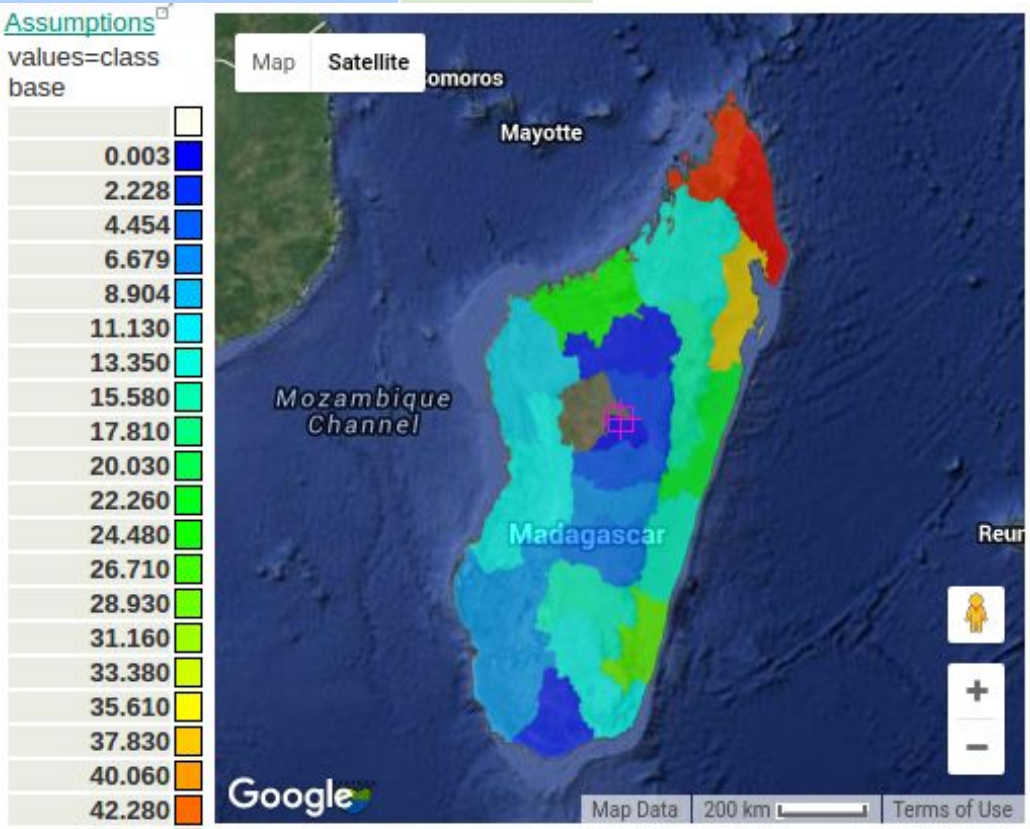
1.5m people receive water from PAs in MG

782K people receive >50% of their water from PAs in MG

Hydrological footprint of PAs & beneficiaries (people) (**annual maximum influence** - usually in dry season)



Average by region:



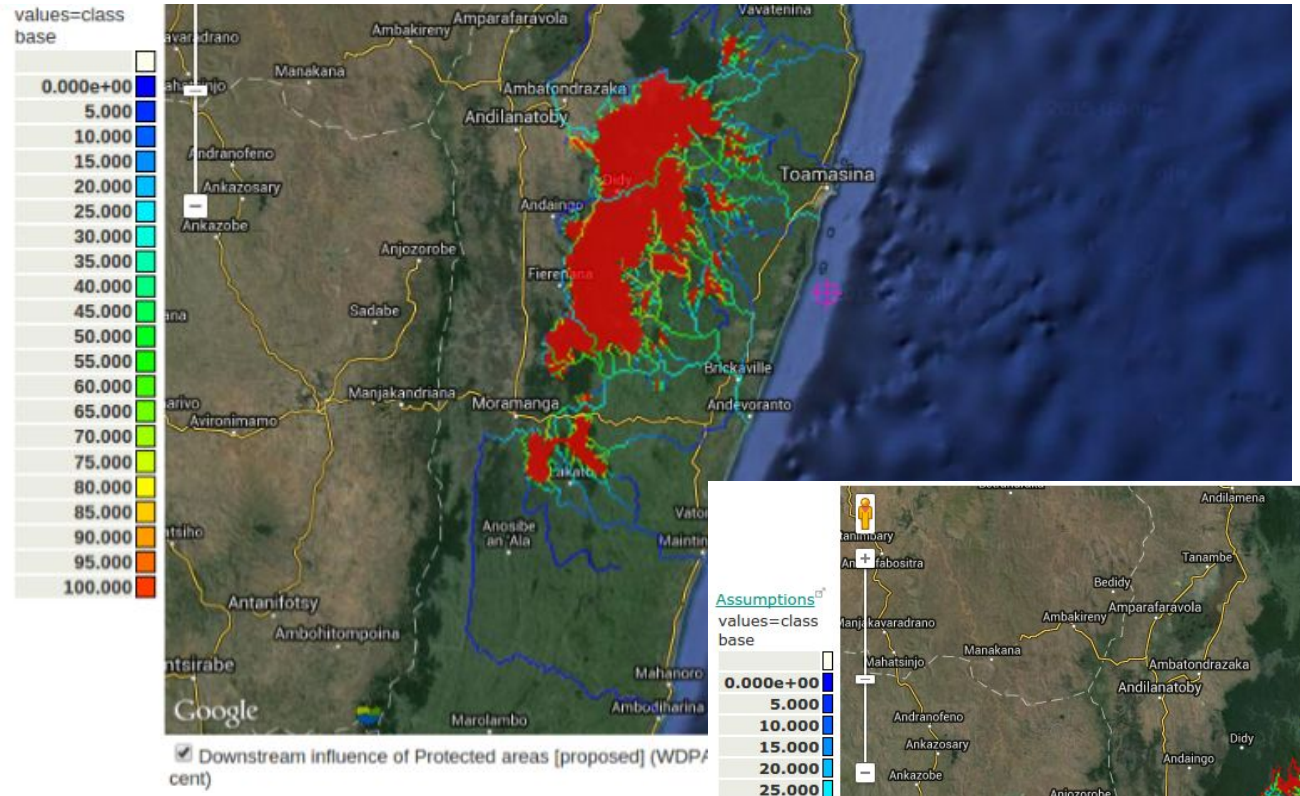
Benefitting:

1.68m people receive water from PAs in MG

1.02m people receive >50% of their water from PAs in MG

Hydrological footprint of the CAZ PAs

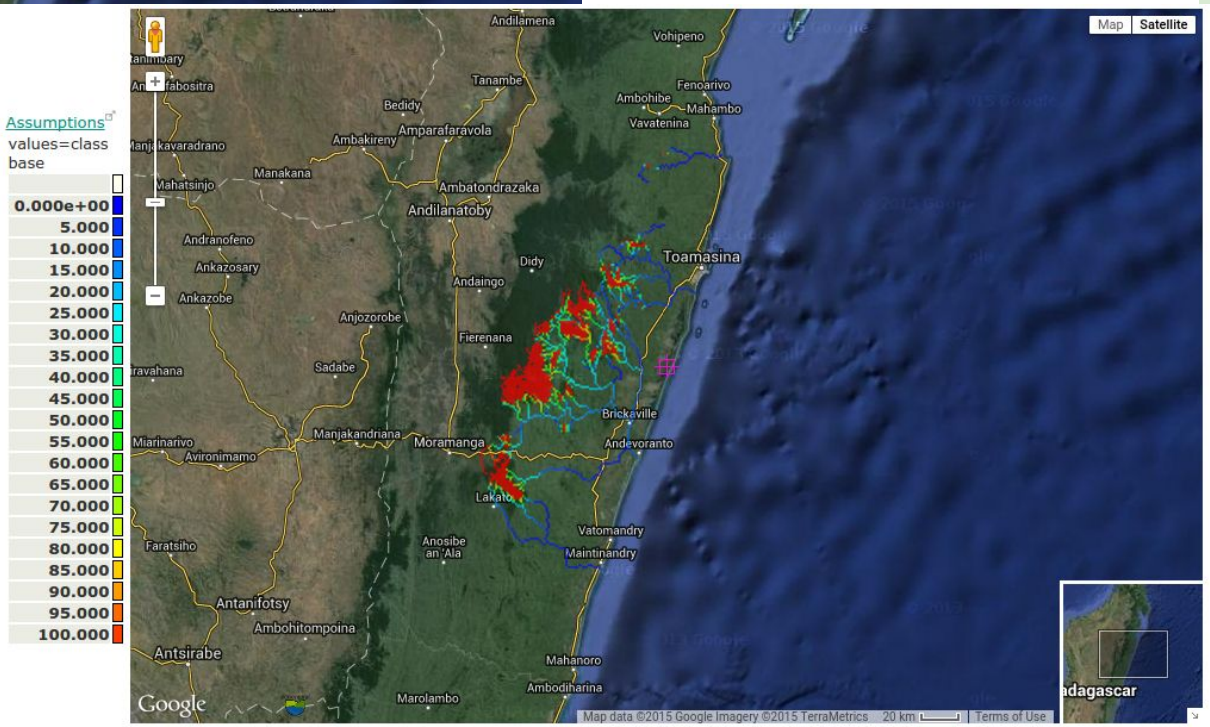
Hydrological footprint is the % of water at a point originating in PAs upstream



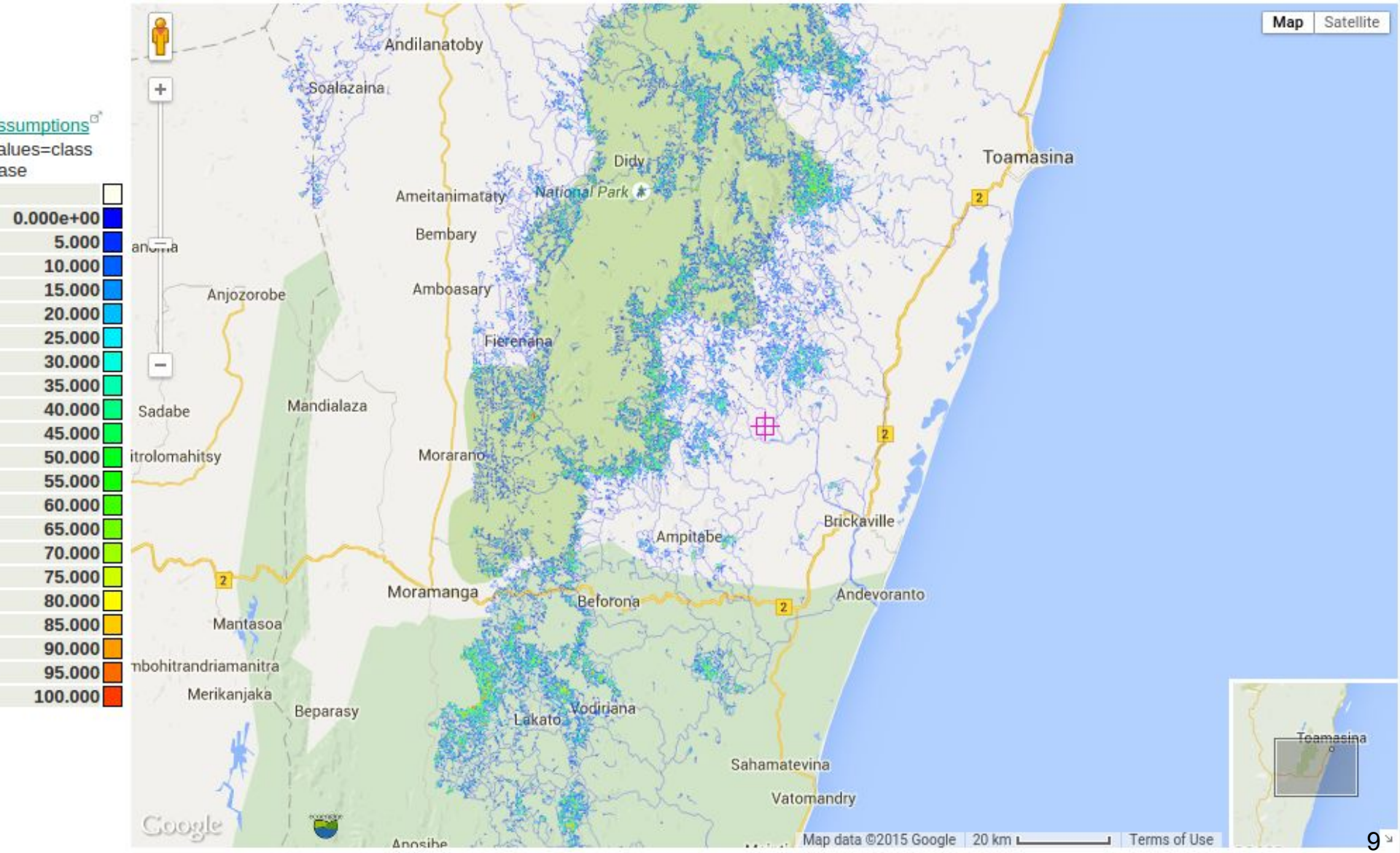
Annual - only the coastal draining rivers have a significant footprint, others are dominated by water from outside the CAZ

Benefitting annually:
285k people receive water from CAZ PAs
135k people receive >50% of their water from CAZ PAs

Dry season - footprint exclusively in the east esp. around Brickaville.
Benefitting in the dry season: 255k people receive water from CAZ PAs;
91k people receive >50% of their water from CAZ PAs
Benefitting in the wet season: 285k people receive water from CAZ PAs;
142k people receive >50% of their water from CAZ PAs



Hydrological footprint of deforestation (2005 to 2013, PERR_FH) - the extent of MAXIMUM POTENTIAL INFLUENCE (% contribution)



Downstream influence of deforperyr_ll_1ha_masked.zip (per-cent)

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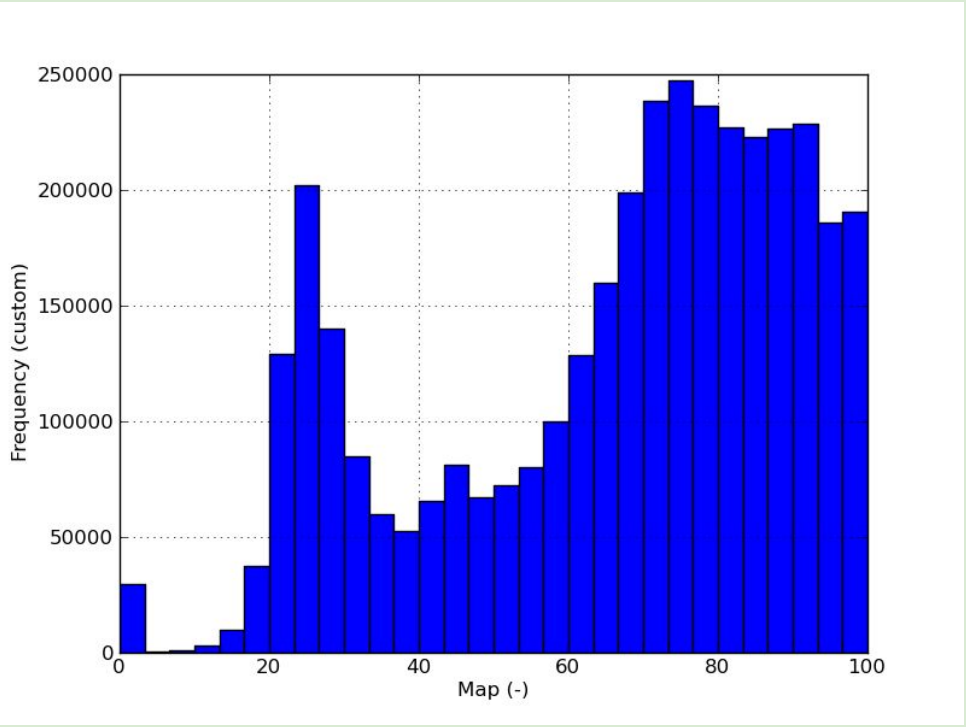
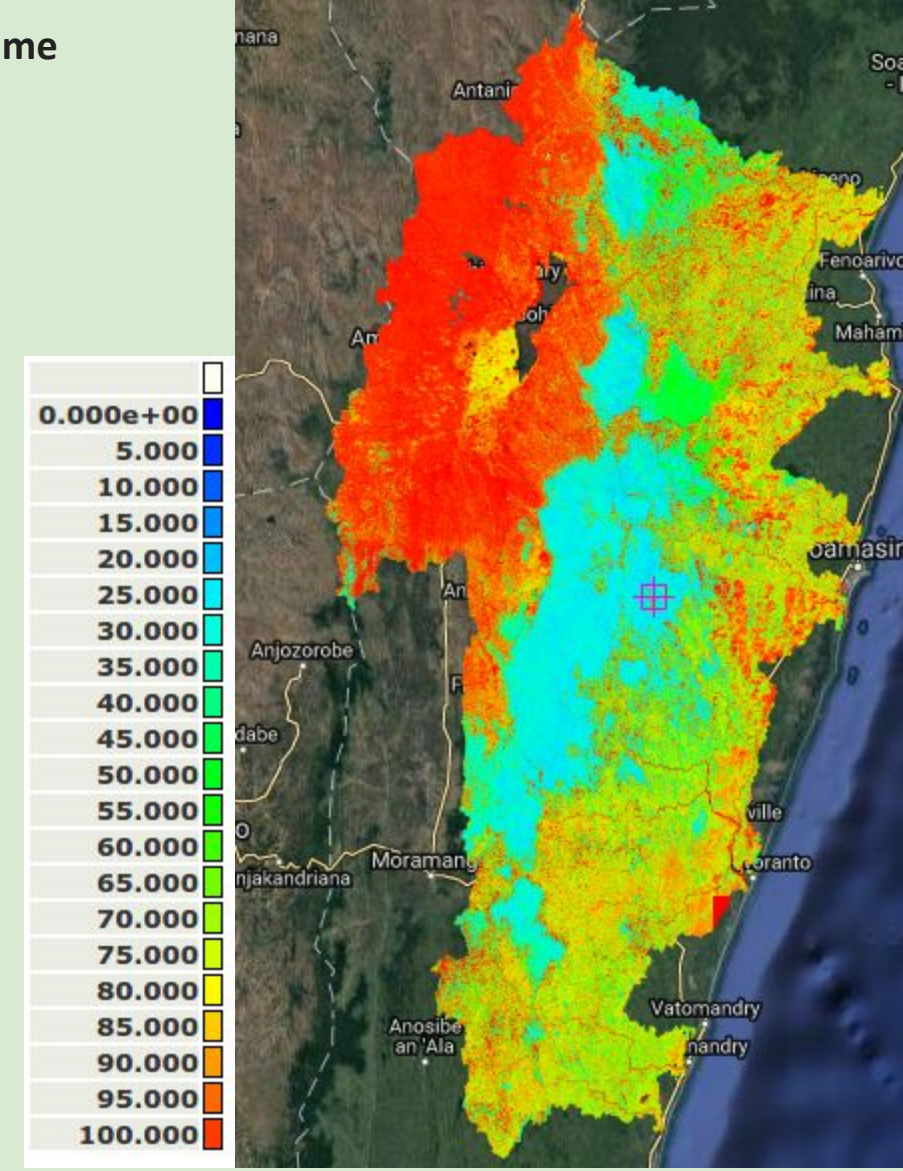
Hydrological footprints - the downstream impact of all-time historic forest-cover change (WW V3.3, 1 ha resolution)





Downstream influence (waterworld) of All-time deforestation (per-cent)

Much of this area has climatic potential to be forest. Much is forest no more. Thus there has been significant forest loss whose hydrological footprint is often high because it occurs largely in the lower parts of watersheds, also near people

Footprint>0
Dis-beneficiaries:
1.26M
99.44% of people in the basin

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Land cover and use change (LUCC) scenarios (collaborative with Jenny Hewson, P4GES)

- **Business as Usual (BAU)** - continues the 2005-2013 deforestation trajectory (1.08%/yr) to 2023 over the entire modelling extent

- **Effective conservation** - projected rate of 0.03%/yr within all protected areas (based on historic rate in MNP protected areas). Projected rate of 1.23% in all unprotected forest plus those PAs not affected until recently

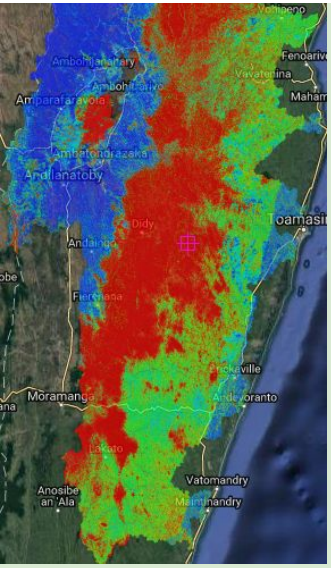
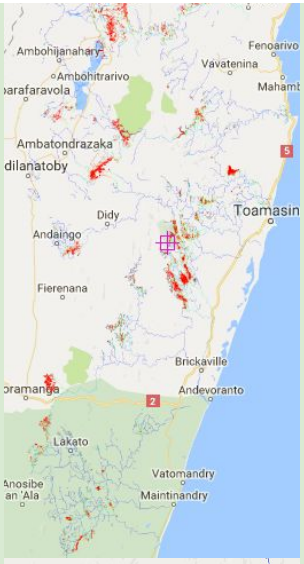
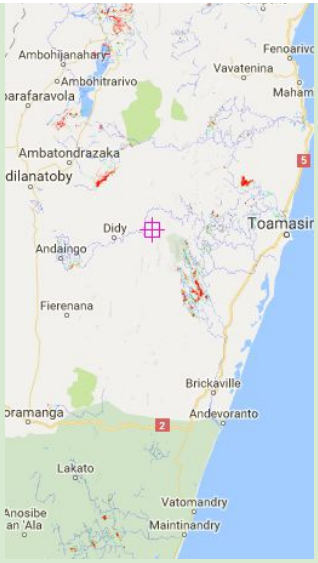
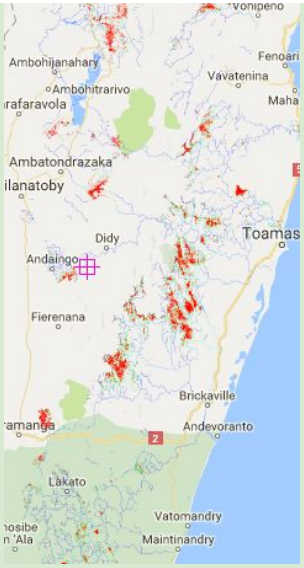
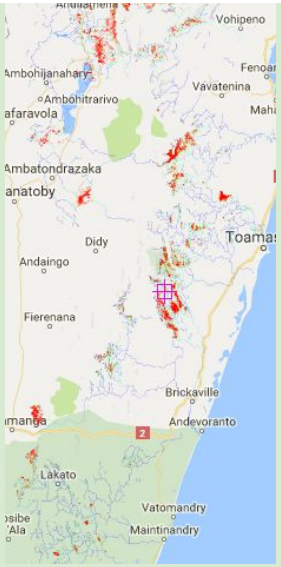
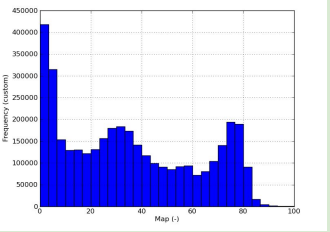
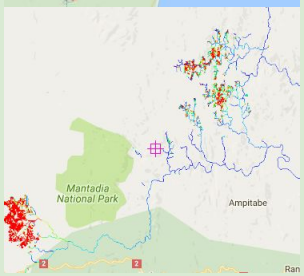
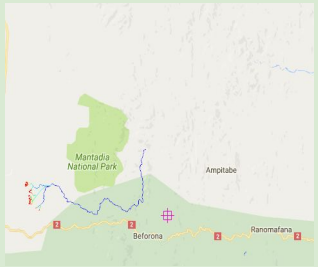
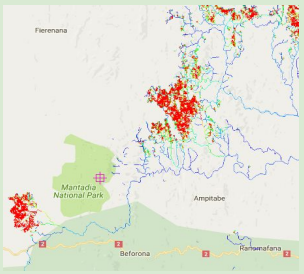
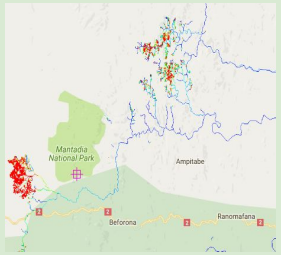
- **Infrastructural development** - considers road development and improvement that may occur (new road from Tana to Tamatave that would traverse CAZ in 2018) that redistributes deforestation to this area

- **Agricultural development** - agriculture expands only into the agriculturally most suitable areas (according to GLUES)

- **Forest recovery intervention (RECOV)** - increases tree cover to 100% in **27,000** ha of recently deforested, sparsely populated land and converts land use to non-agricultural.

- **Forest recovery intervention (RECOV50)** - The intervention increases tree cover to 100% in **135,000** ha of recently deforested, sparsely populated land and converts land use to non-agricultural.

Hydrological footprints - the downstream impact of forest and forest-cover change scenarios (WW V3.3, 1 ha resolution).

Tree cover	**BAU** Def 61Kha loss	**CON** Def 26Kha loss	**SUIT**ability Def	**INFRA** Def
				
				
Footprint>0 Beneficiaries: 1.21M **95.3%** of people in the basin	Footprint>0 Disbeneficiaries: 35464 **2.8%** of people in the basin	Footprint>0 Disbeneficiaries: 22313 **1.7%** of people in the basin	Footprint>0 Disbeneficiaries: 33900 **2.7%** of people in the basin	Footprint>0 Disbeneficiaries: 33563 **2.6%** of people in the basin

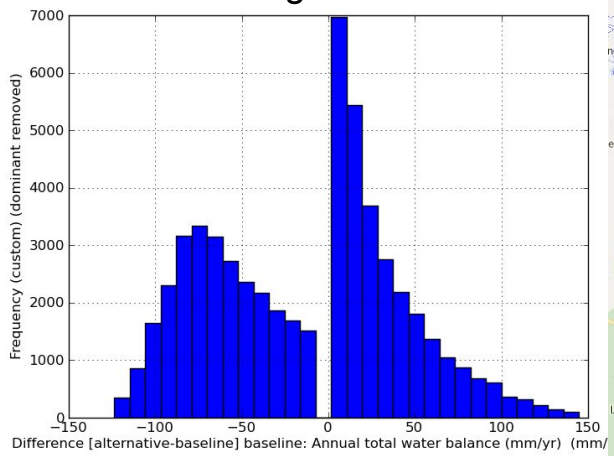
Business as usual deforestation to 2023 (61Kha loss in CAZ):

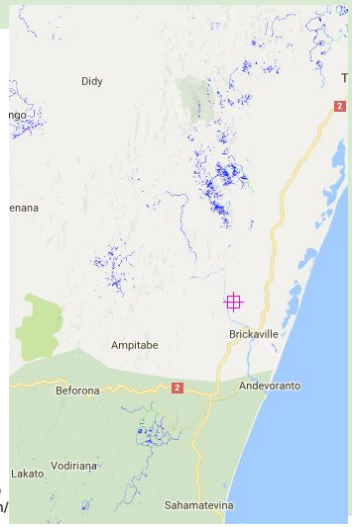
Change in water quantity (water balance)
People affected:
No change: 1.25M,
Better: 3390 Worse: 3760

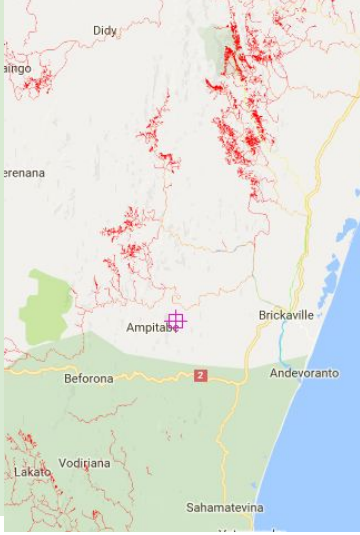
Change in water quality
People affected:
No change: 1.29M,
Better: 3195, Worse: 31,422

Change in water seasonality (V2, 1k)
People affected:
No change: 1.23 M,
Better: 27,471, Worse: 7,051

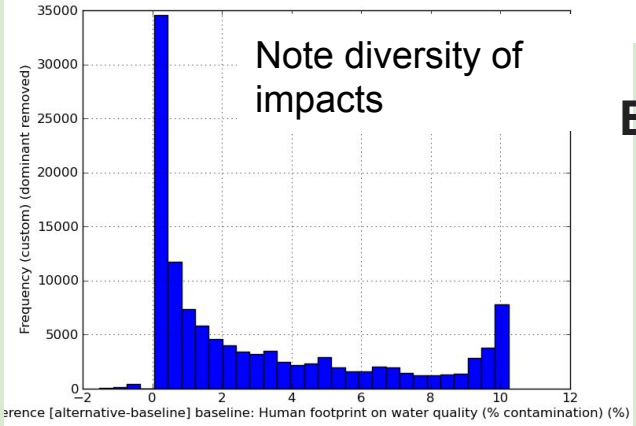
Hectares of change:

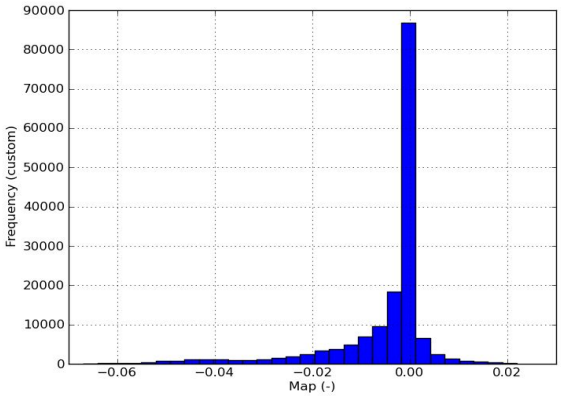






Runoff Positives Runoff Negatives





BAU:

- Most people not affected
- Water quantity: approx equal numbers better and worse off
- Water quality: 10x more worse off
- Seasonality 4x people *better-off* because of increase in overall flows

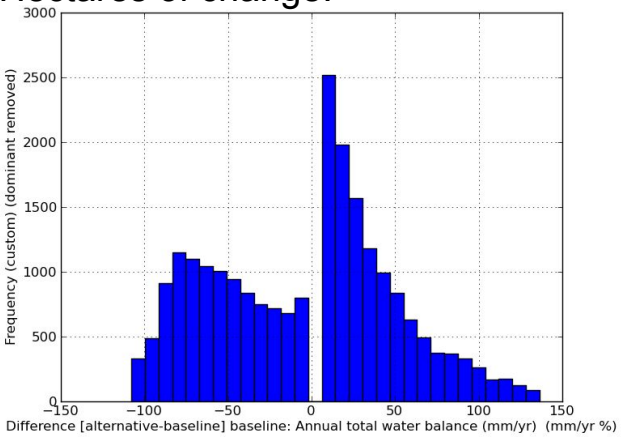
Conservation scenario deforestation to 2023 (26Kha loss in CAZ)

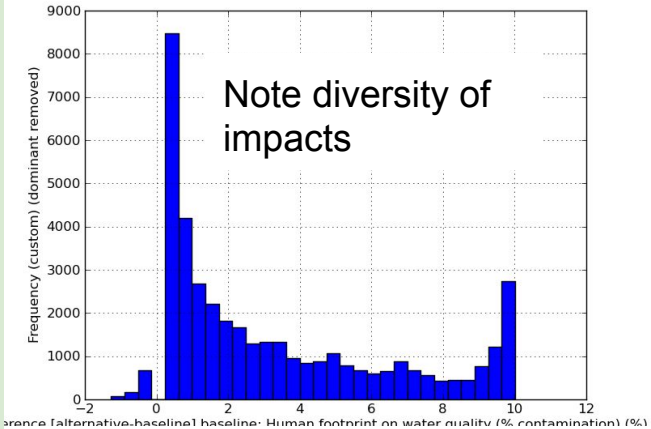
Change in water quantity (water balance)
People affected:
No change: 12.6M,
Better:1821, Worse: 1270
Fewer better off and fewer worse off *compared with BAU*

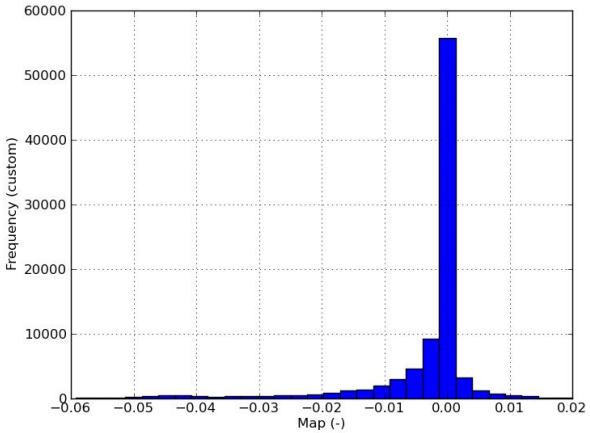
Change in water quality
People affected:
No change: 1.24 M,
Better: 2484, Worse: 19,346
30% fewer with worsening WQ *compared to BAU*

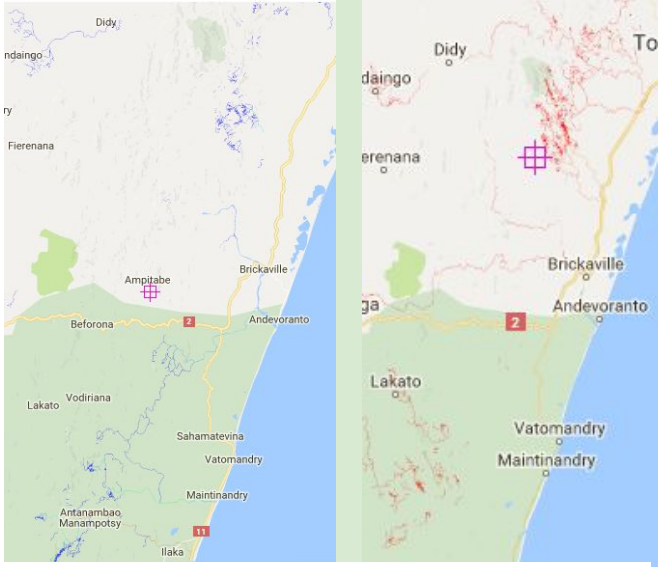
Change in water seasonality (V2, 1k)
People affected:
No change: 1.24M,
Better: 15,650, Worse: 6095
Fewer better off and fewer worse off *compared to BAU*

Hectares of change:







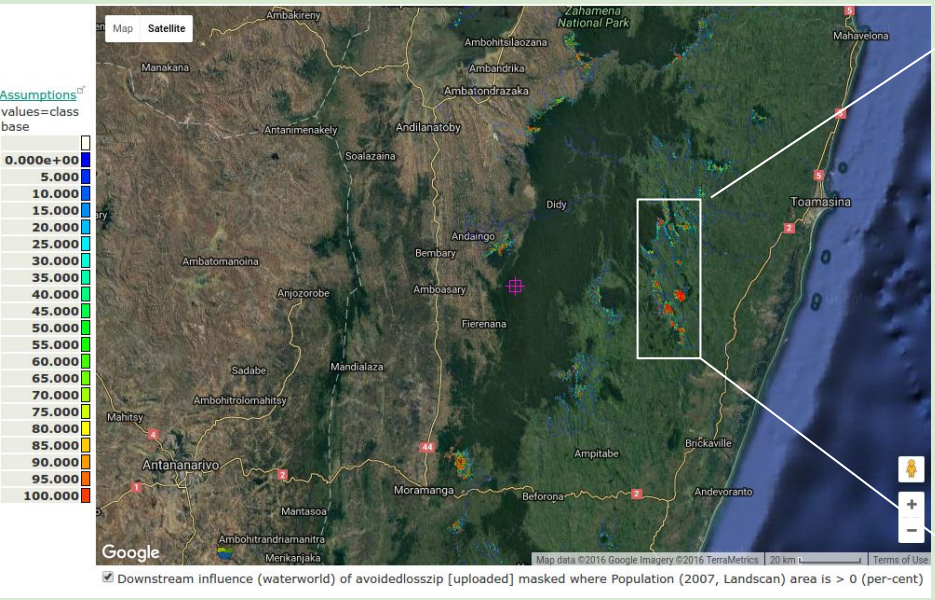


Runoff Positives Runoff Negatives

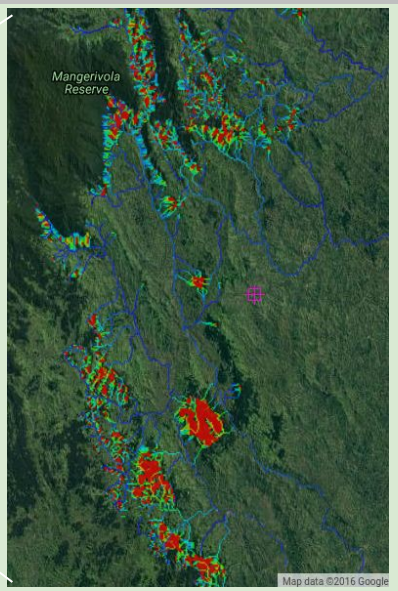
CON:

- Most people not affected
- Water quantity: approx equal numbers better or worse off
- Water quality: 10x more worse off
- **Lower impact than BAU (but not much)**
- Seasonality 2x people *better off* because of increase in overall flows

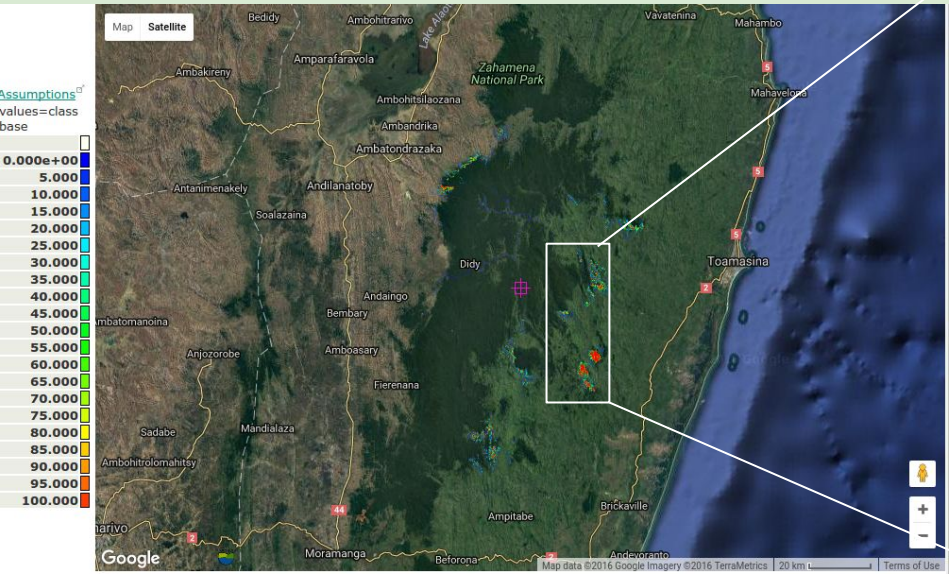
Beneficiaries of CON: hydrological footprint of the avoided loss (i.e. those benefitting from avoided forest forest loss)



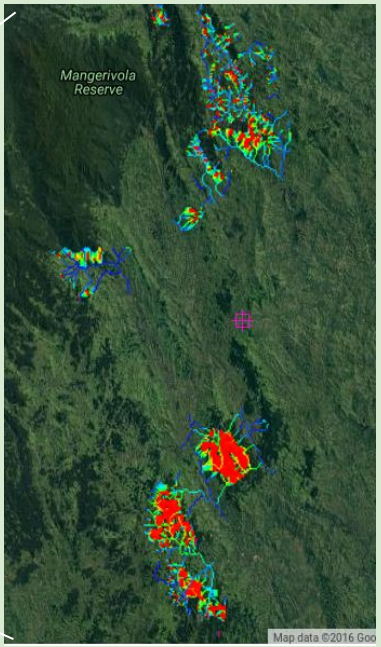
Downstream influence (waterworld) of avoidedlosszip [uploaded] masked where Population (2007, Landscan) area is > 0 (per-cent)



Beneficiaries: population in footprint of avoided loss area: **23,600**



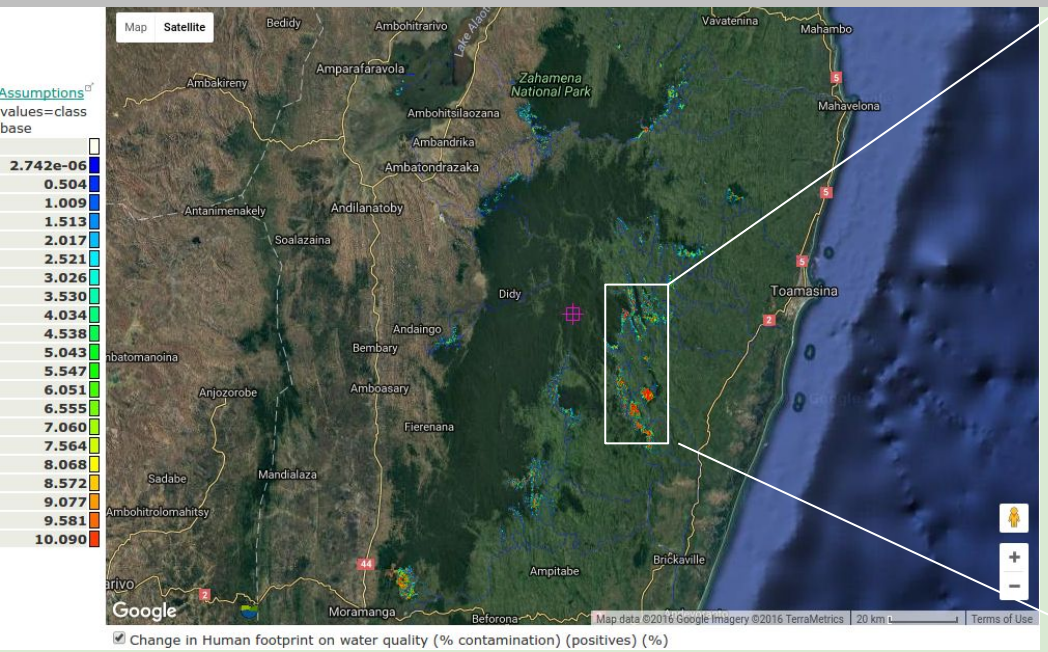
Downstream influence (waterworld) of avoidedlosszip [uploaded] masked where Population (2007, Landscan) area is > 0 masked where bufferzip [uploaded] area is = 1 (per-cent)



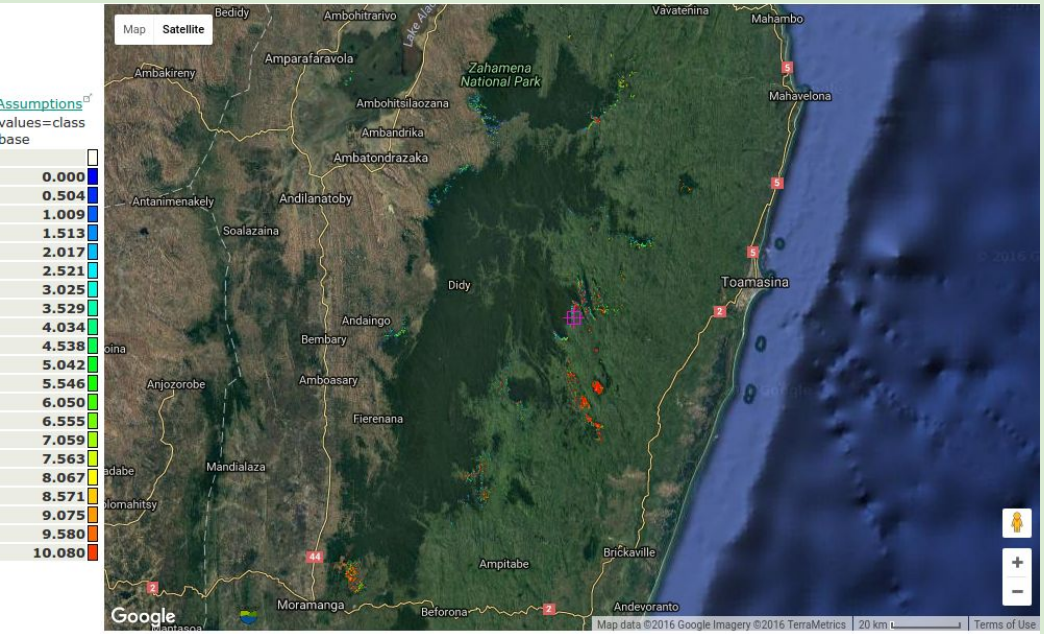
Beneficiaries: population in footprint of avoided loss area (within 2km buffer of PA): **2988**

Most of the significant benefits are within 2k buffer, but few of the beneficiaries are

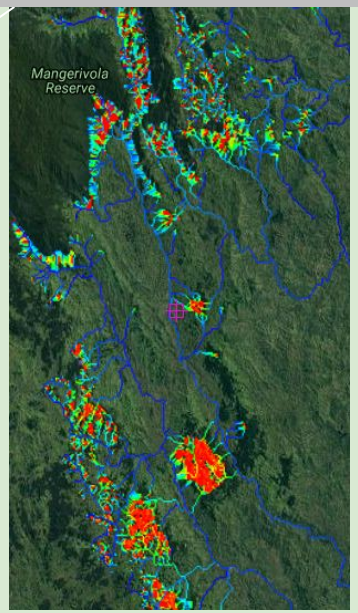
Avoided water quality degradation under CON:

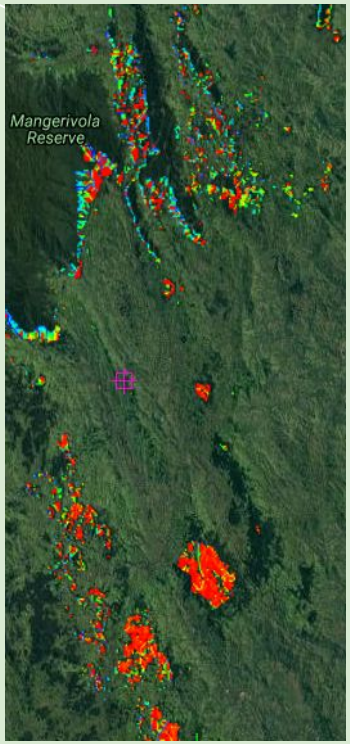


Change in Human footprint on water quality (% contamination) (positives) (%)



Change in Human footprint on water quality (% contamination) (positives) masked where avoidedlosszip [uploaded] area is = 1 (%)





Beneficiaries: population in areas of avoided water quality loss: **21, 324**

Beneficiaries: population in areas of avoided water quality loss (within 2km buffer): **2834**

Again, most of the significant benefits are within 2k buffer, but few of the beneficiaries are. They benefit but also endure opportunity costs

Key messages from hydrological modelling:

1. **The CAZ is hydrologically very variable, with some areas acting as cloud-affected forests**

2. **The CAZ has a limited effect (footprint) downstream (esp. in dry season) - nearby populations are most affected by conservation and reforestation**

3. **The deforestation that has occurred to date is orders of magnitude greater than that which will occur over coming decades, so most of the hydrologically negative impacts have already occurred**

4. **Conservation or afforestation always improves water quality compared with BAU, but can have positive or negative effects on water quantity and dry season flow (and there are also opportunity costs of conservation)**

5. **Reforestation has to scale-up significantly to outweigh hydrological effects of background deforestation (to date it has had small impacts on water)**

Forest recovery intervention (RECOV)

Name for my scenario: recov

Set/change tree, herb, bare covers: +100 % 0 % 0 % for approx: 27000 hectares of land,cluster, scale: 0.3

where: LUCC: Forest loss (2000-2012, Hansen/UMD/Google/USGS/NASA) [Water body corrected] is >= this value: 50

other rules: -

... and where: Population (2007, Landscan) is <= this value: 5

Define converted areas as: All Natural (non-human) Fraction of water exposed to contamination: 1, or: ☑ scale the default for land use.

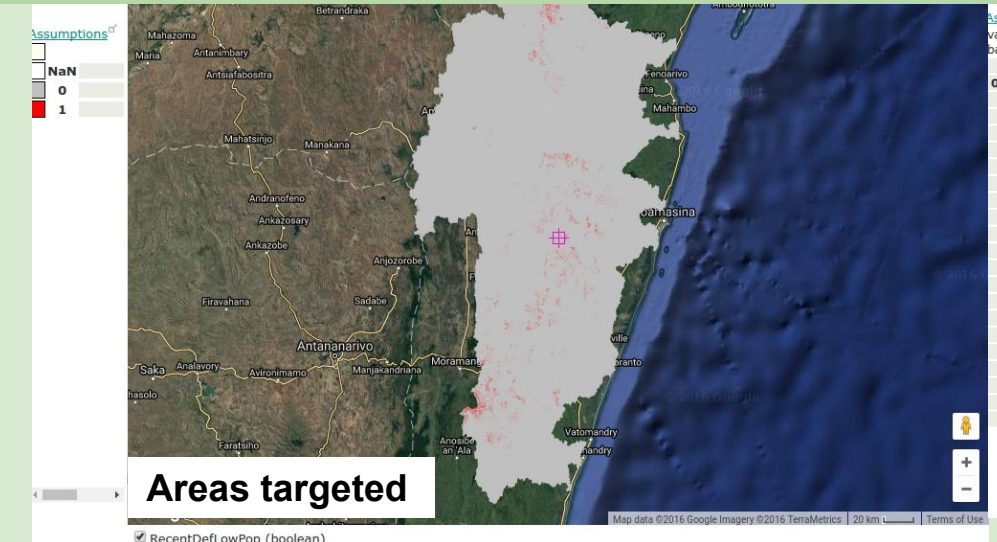
Total change in population for changed land uses (persons per sq. km.): 0

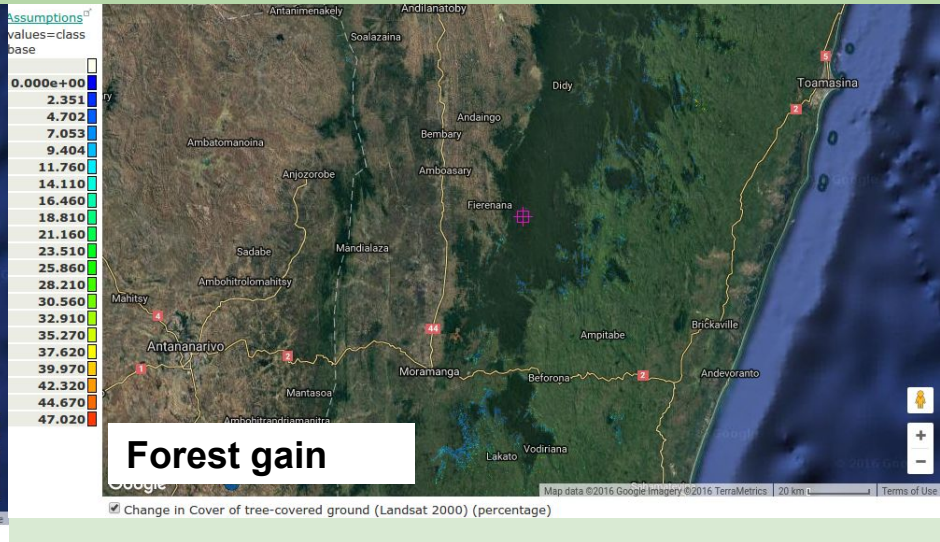
Mean conversion cost (USD per ha.): 100

Limit conversion to budget (M USD): No limit

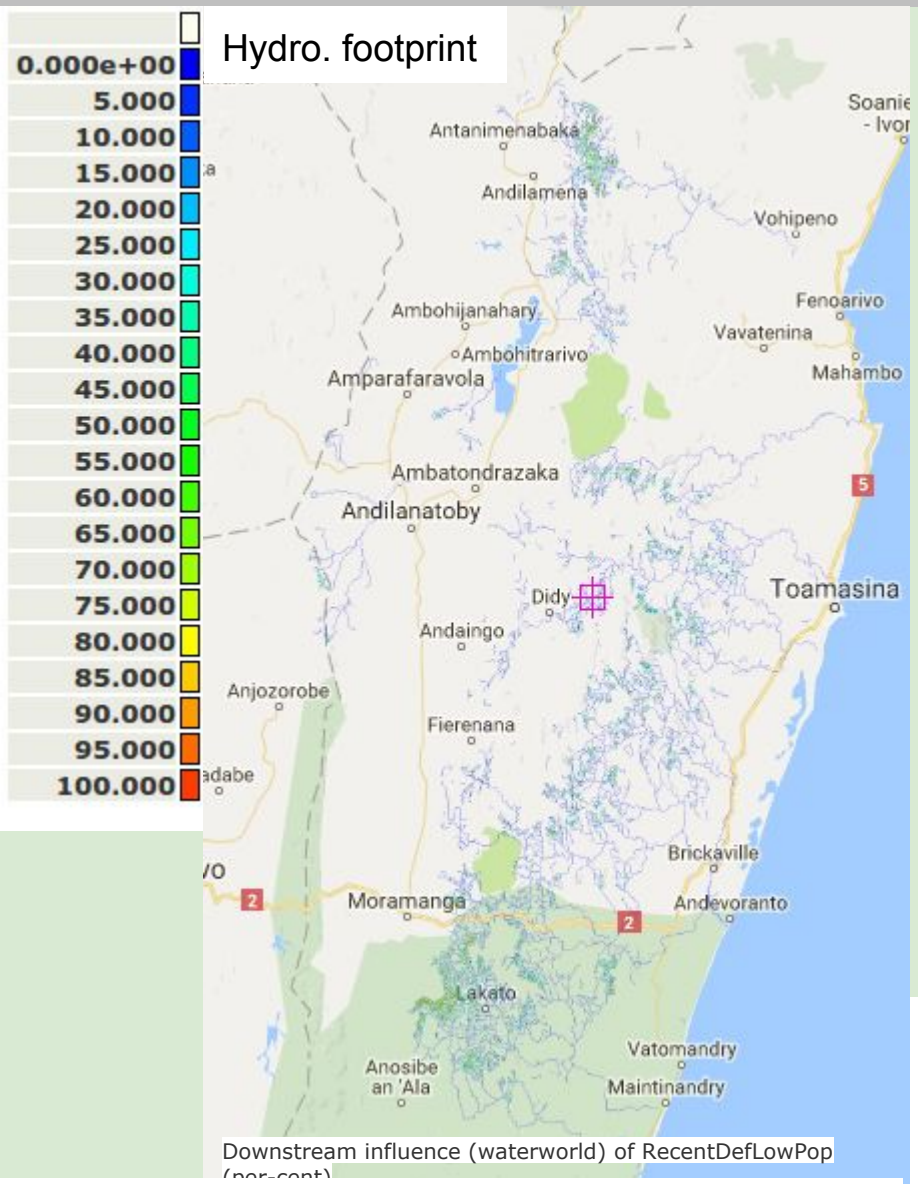
Check and Submit

- Increase tree cover to 100% in **27,000** ha of recently deforested, sparsely populated land and converts land use to non-agricultural. INCD calls for 270,000 ha reforestation in the entire country. We apply 10% of that to the CAZ watershed.
- RECOV only keeps pace with the CON-reduced rates of deforestation so there is **no net increase from present forest cover**.





Hydrological footprint of RECOV intervention



The hydrological footprint of this intervention is broadly similar to the CON one in terms of # people affected

- Intervention has no hydrological impact on **1.24 M** people
- Intervention has hydrological impact >0 on **18029** people
- Intervention has hydrological impact >0 on **3018** people within a **2km buffer of PAs**

Scenario Analysis Conclusions

1. **95%** of people are hydrologically affected by **current forest cover** (mostly a little), **99% by historic forest loss** (mostly a lot)

2. The future scenarios produce **small changes relative to those benefitting from forests and those affected by historic forest loss**, the vast majority of people will be hydrologically unaffected by short term future changes

3. The differences between the scenarios are **small in terms of number of people affected**

4. Forest loss leads to **benefits and dis-benefits** for water quantity and quality, **depending on location (winners and losers)**

5. Those dis-benefitting from poorer water quality **significantly outweigh** those benefitting from improved water quality

6. Conservation leads to a decline in forest loss, maintaining higher water quality **for around 12K people**

Over to you,

1. You can use WaterWorld and Co$tingNature to repeat, follow-up these analyses or to generate completely new analyses locally or nationally for anywhere in Madagascar.
2. You can replace our global data with your own
3. You can freely include the tools as part of your analytical toolkit for decision and policy support