



Emerging themes from water industry AMP5 investigations

Where is the supporting scientific evidence?

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Water Company Drivers



- Multiple requirements:
 - Water Framework Directive (PoMS, HMWB, consenting)
 - Habitats Directive (RoC, Natura 2000)

Drivers increasingly focussed at the catchment scale-
Need consistent catchment-based solutions.....

- Drought planning (Public Inquiries/hearings)
- Multiple drivers, but two main responsibilities:
 - Water resources
 - Wastewater treatment

Accepted Role for CCN



- **Bring together issues of flooding, water resources and diffuse pollution**
- **Encourage dissemination of academic research to water companies and regulatory bodies**
- **Drive the agenda for further research in relevant areas**

Potential Role for CCN



- Academic research can help quantify the costs and benefits of catchment-based schemes:
 1. Establish the **costs** of potential solutions (e.g. increased water treatment vs catchment management activity)
 2. Understand the potential **benefits** of new ideas
 - Direct, e.g. water treatment savings
 - Of greater long term relevance:
Valuation of ecosystem services



What does the water industry need?



1. Understanding of problems

- 8000 “problems” identified in RBMPs (currently being audited by the EA)
- Need to establish why “failures” of WFD standards:

Need to better define the problems in order to indentify appropriate solutions.

- Require evidence to understand cause and effect relationships and reasons for failure
- Effective solutions to achieve Good Ecological Status or Good Ecological Potential.

UKWIR Catchment Consenting – PO4



- For Ribble only **one year of post-scheme** data exist for four of the WwTWs.
- **Little evidence** of a biological response to river water quality improvements resulting from phosphorus removal.
- Recommended that the WwTWs are subject to **more detailed investigation** once a longer term larger data record is made available.
- EA study on the Ribble catchment (2005) showed evidence that improvements in riverine phosphorus quality are often rapid and measurable, but improvements in biological status tend to be slow or non-existent.
- River Wylfe studies conclude that, although **riverine phosphorus** concentrations downstream of the WwTWs have **reduced**, river biological monitoring has shown **little response** to the 50% reduction in phosphate discharged from the WwTW since 2001, with MTR scores remaining “at risk” or “probably at risk” of failing to achieve Good Ecological Status.



Diatom TDI scores for River Ribble

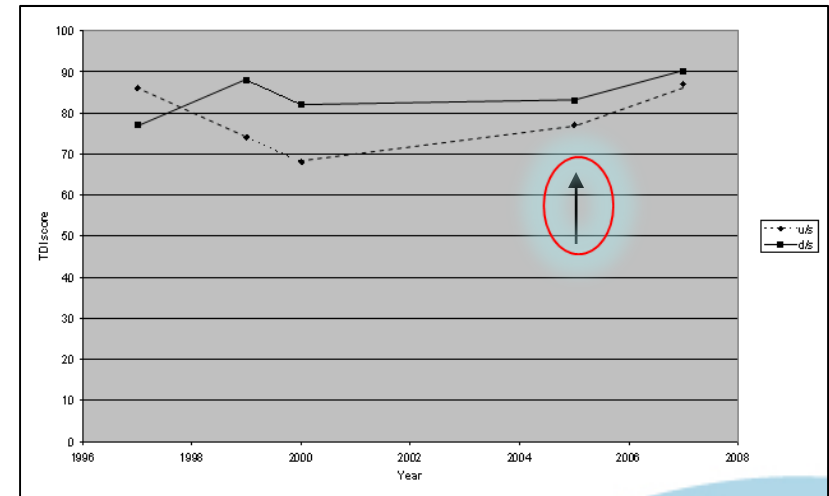
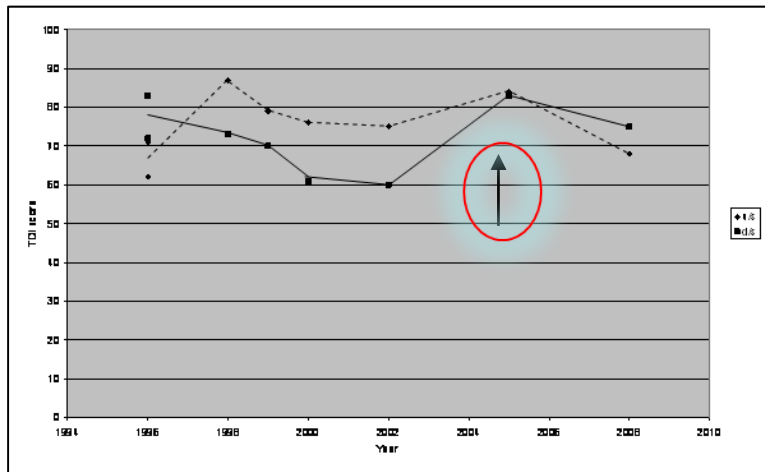
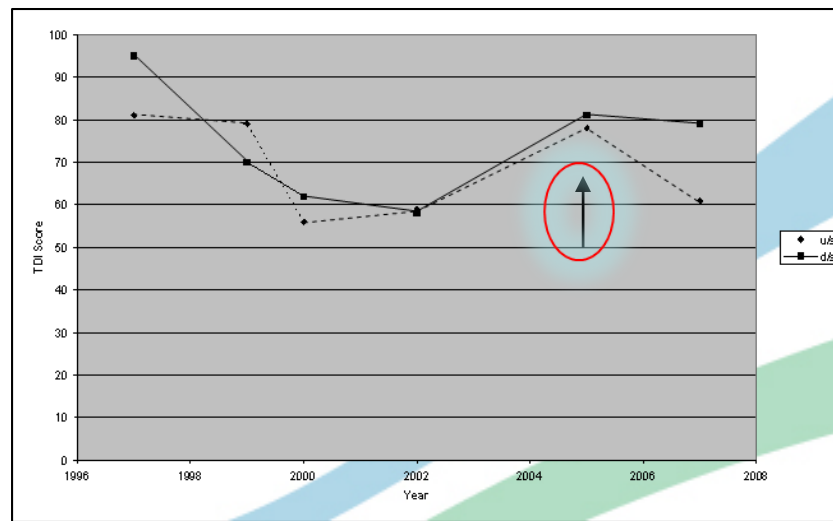


Figure 25 Changes in TDI scores u/s and d/s of Burnley WWTW (the arrow indicates implementation of P-removal)



Why is the response hard to identify?



Number of potential reasons for apparent lack of recovery of biological quality as a result of reduced phosphorus in the WwTW discharges:

- Biological communities **not impacted** significantly by PO₄;
- Reduction in PO₄ may **not have been large enough** to improve biological quality;
- **Too soon** after PO₄ removal for the biological response to manifest itself despite a change in concentration large enough to trigger a response; or
- Monitoring **data inadequate** to detect the biological response, or
- PO₄ is **not the main driver** of ecosystem health for these sites

Key findings:

- **Lack of evidence** to establish the cause and effect relationships between application of measures and the appropriate biological response at individual biological element level, e.g. fish, invertebrates, macrophytes, diatoms.
- Current limited water industry evidence would suggest that confirmed improvements in phosphorus water quality as a result of regulatory WwTW controls **have not identified the expected biological quality improvements.**

To Compound the Problem :- Diatom Quality Correlation to Macrophytes, Invertebrates and Fish

- 3,000 waterbodies have phosphorus and 300 with diatoms!
- Example of the Dee catchment – one of first Water Protection Zones.....

■ Candidate heavily modified waterbody

■ Good status (including diatoms)

■ Good status (diatoms not assessed)

Less than good status and contributing factors:

Diatoms assessed <good

■ Diatoms only

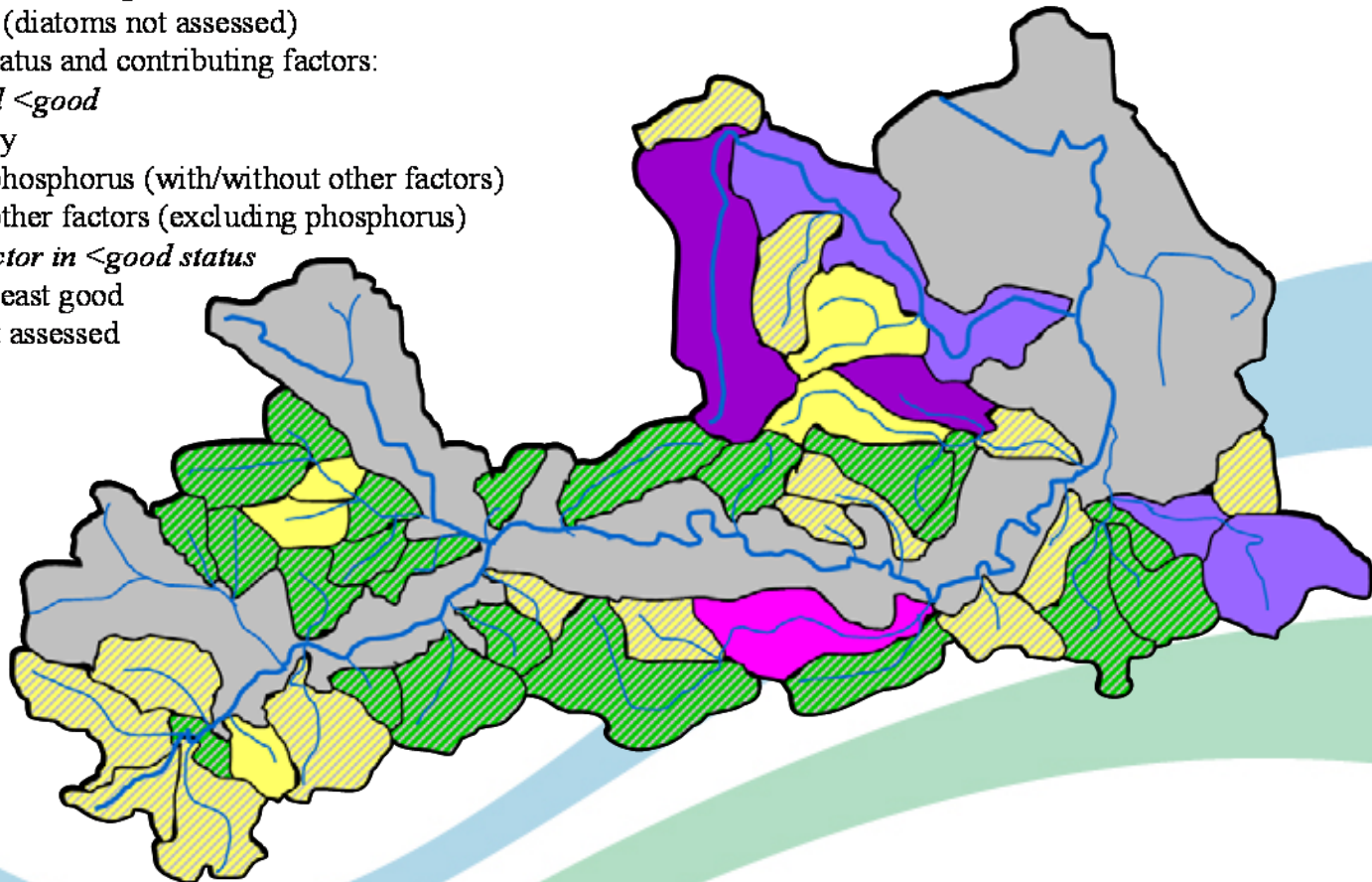
■ Diatoms + phosphorus (with/without other factors)

■ Diatoms + other factors (excluding phosphorus)

Diatoms not a factor in <good status

■ Diatoms at least good

■ Diatoms not assessed



Findings of Analysis



1. If the diatoms and phosphorus statuses are **both less than Good** in a waterbody, (3 waterbodies) then measures could be targeted at improving phosphorus concentrations in the waterbody (or upstream) with an anticipated improvement in diatom status.
2. But if the **diatoms status is less than Good** and the **phosphorus status at least Good** (none reported, but potentially in 22 waterbodies where diatoms have not been assessed), what measures would be appropriate? There may be no data for other parameters from which to make an assessment.
3. Or if the **diatoms status is at least Good**, but the **phosphorus status is less than Good** (three waterbodies), what measures are appropriate?

Very confusing for water company engineers
and solution planners

But, water companies need certainty



- WFD will drive large-scale investment in next 2 cycles
- Water resource sustainability reductions and compliance measures **WILL** be required which **WILL** be expensive
- Water companies and Ofwat **SHOULD** require greater certainty in solutions and outcomes before investment on such a scale is considered feasible.

How much will it cost?



- Water resource sustainability reductions:

1 Ml/d = approx **£1 to 3 million** (for a new source)

- Projections of up to 600 Ml/d from EA *per region*
- Water resource abstractions only.....

.....some but not all linked to reservoir HMWB status

Scale of HMWB Issues in Cycle 1 RBMPs



- Information collated from the **10 RBMPs in England & Wales on HMWB/AWB classification** and the specification of mitigation measures:
- There are 732 “lake” surface waterbodies in England and Wales, of which **438 are designated HMWB, 181 designated AWB** and the remainder not designated.
- Of these, 436 HMWB/AWB, **only 216 are recorded as requiring mitigation measures** to be put ‘in place’. All of the others will have passed either the test of at least good ecological potential; or where less than good potential, passed the mitigation measures assessment test.
- Of these, **193 are designated HMWB and 23 AWB.**

Reasons for Designation

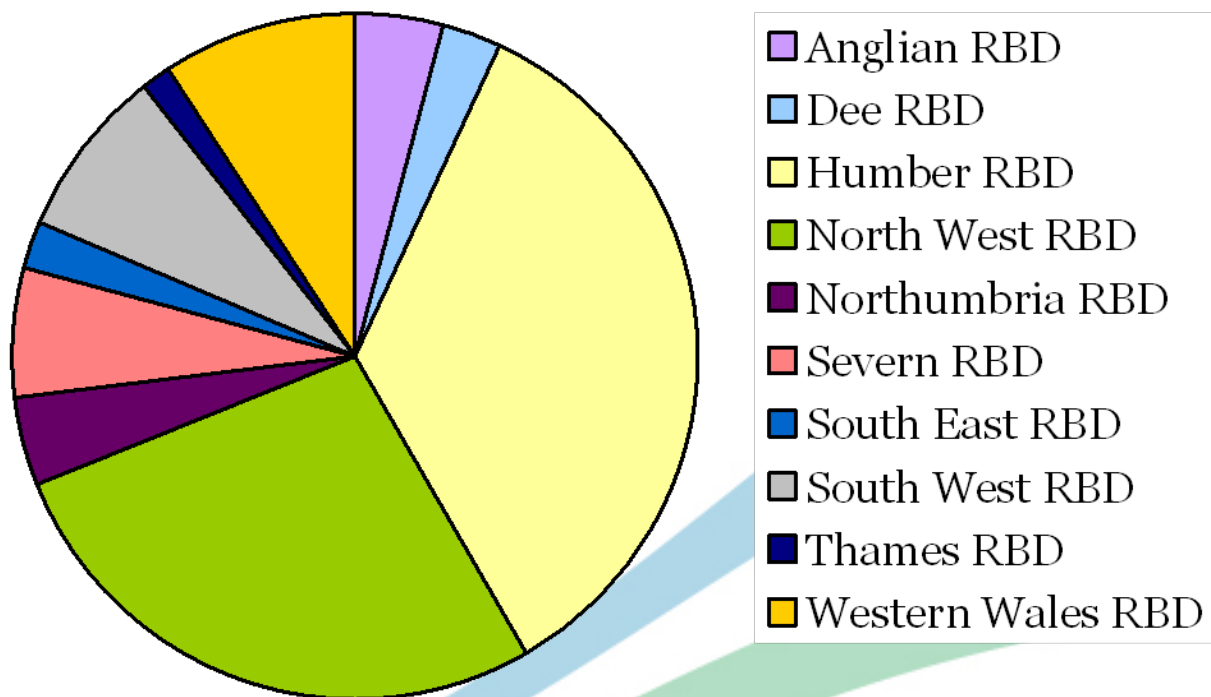


Reason for Designation	No of Waterbodies
Water Storage (non specific)	177
Drinking Water	100
Water Regulation	45
Wider Environment	20
Flood Protection	8
Recreation	5
Land Drainage	4
Navigation	0
Other	0

Distribution of HMWB/AWBs



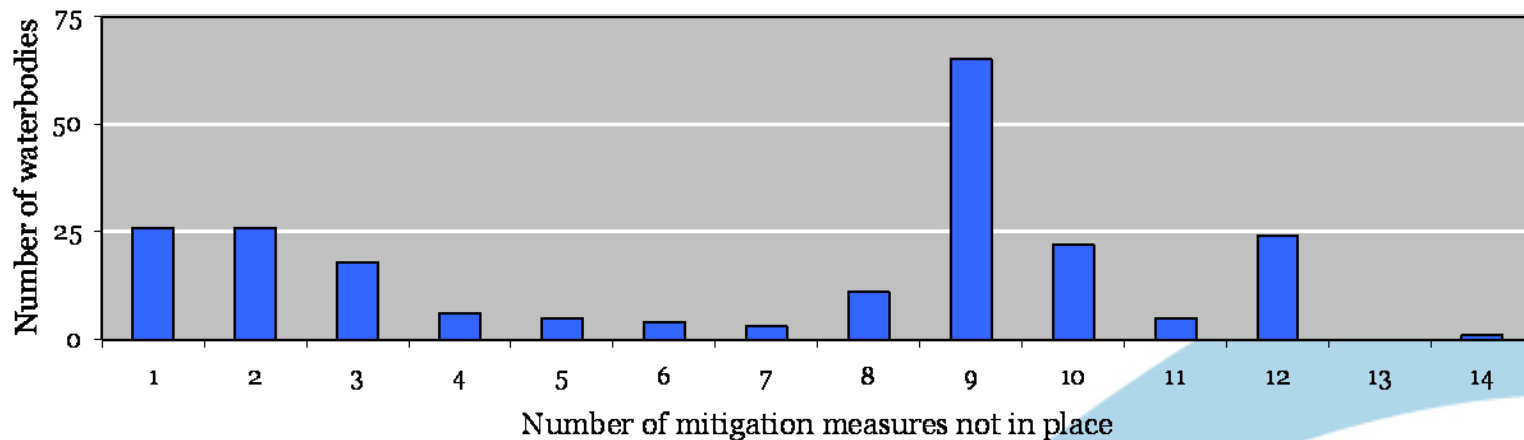
Distribution of the 216 HMWB/AWB designated for features relevant to water companies (water storage, drinking water, water regulation) with mitigation measures not in place is shown below.



Number of Measures per RDB



- In the 216 waterbodies **36 different mitigation measures are reported.**
- The 1,500 mitigation measures not (yet) in place are drawn from 12 different generic “measures” (c.f. UKTAG 9S4546, Annex II, Impoundments, column B).



- A dichotomy is apparent between few measures (1-3) or many (9-12) with limited middle ground.
- For example, the North-West RBD averages 10 mitigation measures per waterbody; Humber RBD 8 measures; Western Wales 6 measures; all other RBDs average fewer than 4 measures.

UKTAG Guidance on the classification of Ecological Potential for HMWBs and AWBs



ANNEX II: IMPOUNDMENTS FOR WATER STORAGE AND SUPPLY

Sector:

Waterbody Information:

Impoundments for Water Storage and Supply

Waterbody Name		Existing	Feinting
Waterbody ID		Downstream NGR Waterbody	
Waterbody Type		Upstream NGR Waterbody	

<p>List the pressures identified within the HMWB/AWB designation for this waterbody</p> <p>Record other water uses appearing to cause significant pressures not identified within the HMWB/AWB designation</p>	
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Pressure (physical modification)	A Is the pressure present? (Y/N) If Yes, proceed to column B.	B Potential impacts	C Is there a significant adverse ecological impact or, in the absence of any mitigation already in place, could there be a significant adverse impact? (Y/N) If yes, proceed to column C, if no document and proceed to Column G.	D Mitigation Measures		E No.	F Is the measure practicable given the characteristics of the water body? (Y/N/a) If yes, proceed to Column G. If no, document and proceed to column G.	G Is the mitigation measure in place and adequate? (Y/N/a) If No, proceed to Column E. If Yes document the mitigation measure and proceed to Column G.	H Can the measure be implemented without having a significant adverse impact on use? (Y/N/a) If yes, proceed to column F, if no document and proceed to Column G.	I Can the measure be implemented without having a significant adverse impact on the water environment? (Y/N/a) If yes, proceed to Column G, if no document and proceed to Column G.	J Document: - : For measures not in place (proceed to Column H) - / : For those already in place and adequate - : For those screened out	K Will the mitigation measure provide more than a slight ecological benefit when considered alone or in combination with other measures? If yes, proceed to Column L, if no, document	L Document any reasons which could affect the outcome of the measure in the RSRP (e.g. prioritisation in combination with other measures, disproportionate cost, other reasons why an extended deadline or less stringent target might be justified)
				1	2								
Impoundment		Adverse impact on the movement of salmon and sea trout between habitats important in their life cycles.		Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works	1								
				Where structures or other mechanisms are in place to enable fish to access waters upstream of the impounding works, the volume and timing of flow released is sufficient to enable and, where relevant, trigger fish migration.	2								
				Management of the risk of fish entrapment in turbines or intakes to enable downstream fish passage.	3								
				Enable access to relevant faster streams draining into the reservoir at appropriate times for spawning and migration.	4								
		Adverse impacts on the downstream river flows necessary to maintain river habitats and their associated aquatic plants or animals		Establish an appropriate baseline flow regime.	5								
				Re-engineering of the river where the flow regime is critical to be modified.	6								
		Adverse impacts on the morphological characteristics of the downstream river		Maintain sediment management regime to avoid degradation of the natural habitat characteristics of the downstream river.	7								
				Provide flows to move sediment downstream (fluvial and/or tidal).	8								
		Adverse impacts on the water quality of the downstream river		Ensure that good status of dissolved oxygen levels is being achieved downstream of the impounding works	9								
				Ensure that the thermal regime in waters downstream of the impounding works is consistent with good status conditions.	10								
		Adverse impacts on the level regime necessary to maintain late-fresh habitats and their associated aquatic plants and animals in the impounded water body		Ensure the rate and range of any artificial drawdown is appropriately managed to maintain aquatic plant and animal communities in the shore zones of impoundments with gently sloping shore zones.	11								
				Ensure the seasonal pattern of water levels during each year is managed so as to enable the establishment and retention of aquatic plant and animal communities in the shore zone of the impoundment.	12								

Hydro-morphology of assessment for classification

Consolidated Measures



Mitigation Measure		Number of Waterbodies	
		Not in place	In place
A	Ensure there is an appropriate baseline flow regime downstream of the impoundment	162	17
B	Maintain sediment management regime to avoid degradation of the natural habitat characteristics of the downstream river	156	0
C	Provide flows to move sediment downstream	153	9
D	Re-engineering of the river where the flow regime cannot be modified	148	2

Need consistency in application of specific measures across all RBDs for 12 “generic measures”

Use evidence base for “in place” measures to support analysis

K	Ensure the seasonal pattern of water levels during each year is managed so as to enable the establishment and retention of aquatic plant and animal communities in the shore zone of the impoundment	76	3
L	Management of the risk of fish entrainment in intakes for hydropower turbines or water resource purposes (or pumping stations) where there is downstream fish migration	44	15

What does the water industry need?



2. Certainty of solutions:

- Will they work?
- How long before the ecological responses are evident?
- What are the main sources of uncertainty in the outcome?
- Are they the right solutions for the job?
- Are there better +/- or cheaper cumulative solutions available?

A multi-sectoral catchment-based approach is the best way to develop appropriate solutions.

What then?



- EA produce ranked list of projects for Cycle 2
- Ranking on basis of costs and benefits
- Consider priorities from multiple sectors
- Consider what society can afford !
- Probably pass threshold at 2.5x benefit:cost ratio...

What water sector needs to generate evidence



- Full range of integrated methodologies
- Monitoring to support models (where, when, how)
- Modelling (stochastic, deterministic, empirical) ←
- Analysis and statistical approaches
- For:
 - Impact assessments
 - Programmes of measures
 - Regulatory assessments
 - Negotiations for licences and consents
- Full research suite to support operational decisions

Who?
Farmers
Environment Agency
Natural England
Water Industry

Delivered by:
Consultants/Academics?

Issues for CCN to consider ?



1. What is the required evidence base?
2. Is the current range of studies sufficient to furnish the evidence?
3. What are the benefits and do they really outweigh costs (include social aspects)?
4. Can CCN influence evidence base, which measures are put in place and how they are implemented?
5. How will the programme of measures be delivered at the catchment and sub-catchment scale, and could CCN help in roll-out role?

Still a long way to go!

For more information:



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