Modelling with stakeholders as part of an analytic-deliberative approach to catchment management

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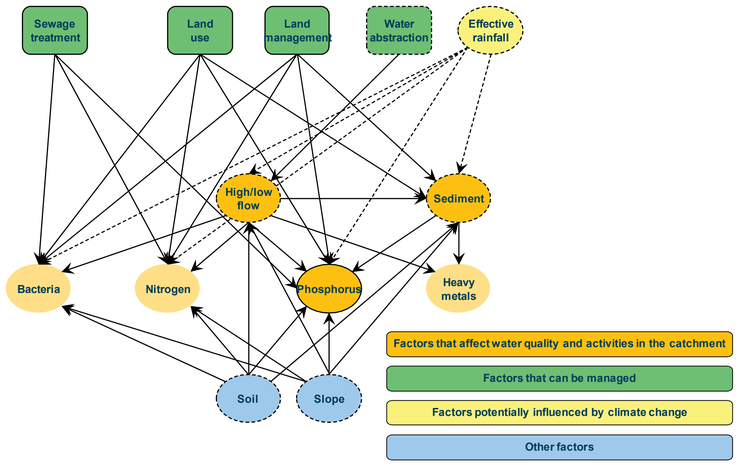
Key for an analytic-deliberative process is early stage problem framing

- A graphical conceptual model gives stakeholders the opportunity to influence model development from the start
- The ease of intuitive, shared understanding helps clarifying stakeholder expectations, with the possibility of revising the network
- This encourages transparency & openness and helps create trust in & ownership of the model

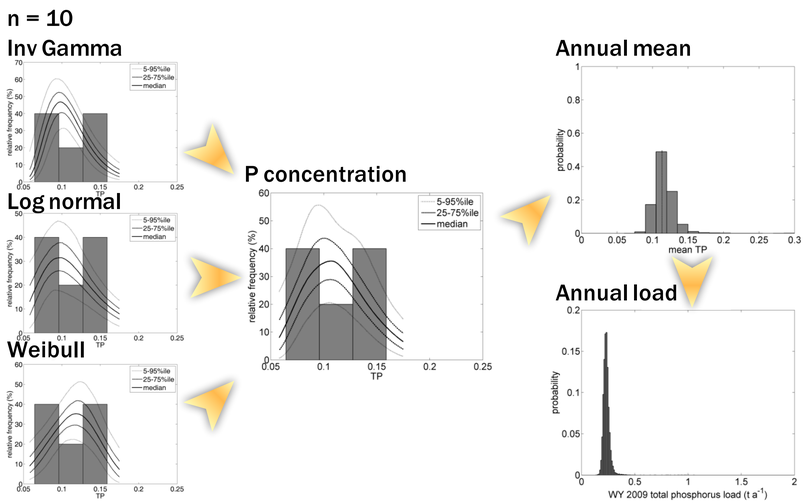
For example, a high-level conceptual model for the Tamar catchment:



We have to work with limited data

- Being honest about data limitations helps building trust in model results
- Stakeholders see uncertainties they know about being accounted for explicitly
- A farmer: "How on earth could you have come up a with a single number as a result anyway?!"

For example, Bayesian averaging of multiple data models:



The analytic-deliberative approach to catchment management

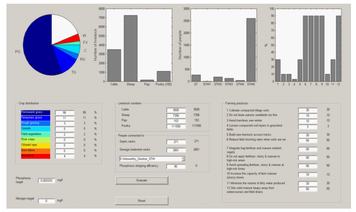
- Twin-track of scientific research & deliberative stakeholder engagement
- Inclusive & collaborative, involving all relevant stakeholders
- Creation of shared understanding of problems & shared commitment to developing solutions
- Iterative, adaptive management with the capability for 'social learning'

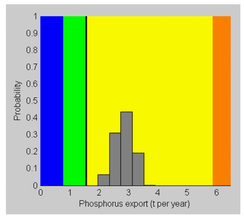
Smith & Porter (2009)

- **Models** are essential to the **deliberation** to make complexity comprehensible & manageable
- **Deliberation** is essential to the construction & use of **models** for setting priorities & goals, and resolving trade-offs in outcomes
- We need to manage stakeholder **expectations** & build **trust** in models
- We need to be able to incorporate stakeholder **knowledge**

Using models interactively

- Probabilistic output helps farmers buy into models – likely because they are used to uncertainty





Conclusions

- There seems to be a synergy between analytic & deliberative objectives: e.g. in terms of **appropriate model complexity** & **prediction uncertainty** – what makes sense scientifically also makes sense to stakeholders
- The limits of national datasets make **local knowledge** increasingly important – this yields additional benefits of **social learning** and builds **trust** in & **ownership** of models
- Modelling is an ongoing, **iterative** process set in the context of an **adaptive** management cycle

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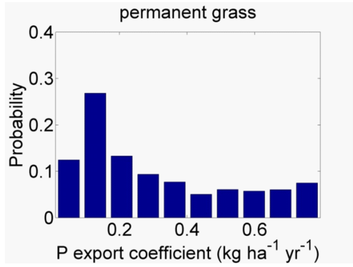
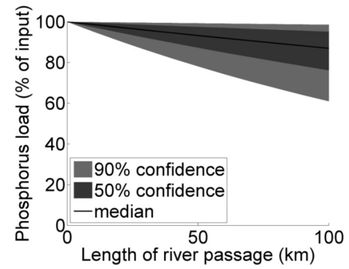
Appropriate model complexity

- At least initially, we need to trade off simplicity against detail because of data availability & parameter identifiability as well as stakeholder understanding & expectations

For example, Export Coefficients (Johnes, 1996), extended by farming practices, and SPARROW (Smith *et al.*, 1997):





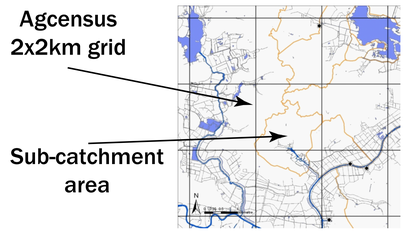
- In our study, stakeholders demanded a model of the effectiveness of farming practices, knowledge of which is very limited at the catchment scale (hence the DTCs!)

Local knowledge is important

- As there are no data on the uptake and effectiveness of farming practices at the catchment scale we are in the process of eliciting this information from experts, both local & scientific – this could serve formally as prior knowledge to be updated through the DTCs
- We also let farmers determine the list of practices included in the model according to what makes sense to their farm business – this, again, fosters their ownership of the process

Local expert opinion		Scientific expert opinion	
	Current uptake (%)	P export reduction (% range)	
Cultivate compacted tillage soils	30	25	35
Do not leave autumn seedbeds too fine	10	25	35
Avoid tramlines over winter	10	25	35
Loosen compacted soil layers in grassland fields	3	50	70
Build new livestock access tracks	30	10	10
Reduce field stocking rates when soils are wet	90	10	10
Integrate bag fertiliser and manure nutrient supply	90	4	4
Do not apply fertiliser, slurry & manure to high-risk areas	90	27	40
Avoid spreading fertiliser, slurry & manure at high-risk times	90	15	50
Increase the capacity of farm manure (slurry) stores	10	25	25
Minimise the volume of dirty water produced	30	5	5
Site solid manure heaps away from watercourses and field drains	90	4	4

- National datasets such as the Agricultural census are often too coarse for catchment-scale modelling – this situation can be improved using local knowledge



	Agricultural census 2004	Local farmers
Permanent grass (ha)	19	19
Temporary grass (ha)	3	3
Rough grazing (ha)	3	3
Cereals (ha)	33	33
Root crops (ha)	16	16
Field vegetables (ha)	3	3
Oilseed rape (ha)	0	0
Woodland (ha)	2	2
Bare fallow (ha)	0	0
Cattle	**158**	**300**
Pigs	**110**	**0**
Sheep & goats	**97**	**10**
Poultry	**35121**	**0**