WaterMARKE

Mitigating Agricultural Impacts through Research and Knowledge Exchange

Improving Water Quality on Farms
A Socio-Economic & Behavioural Perspective

Teagasc Signpost Series Oct 28 2022

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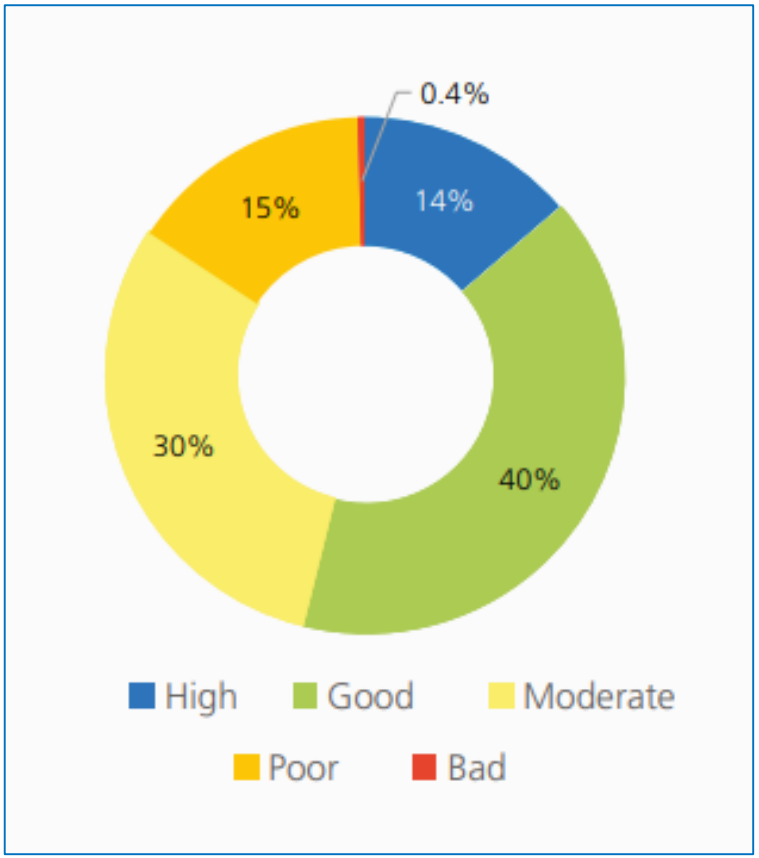
EPA 2016 - 2021 report

- Unlikely that Ireland can meet Water Framework Directive (WFD) target of good water quality in all waterbodies by 2027 and maintain high status
- Agriculture is a significant pressure on water quality.



The Nature of the Problem

Mitigating declines in water quality is complex and challenging…

Nutrient and sediment losses are:

Context specific

Interactions between activity, local hydrology, soils and weather

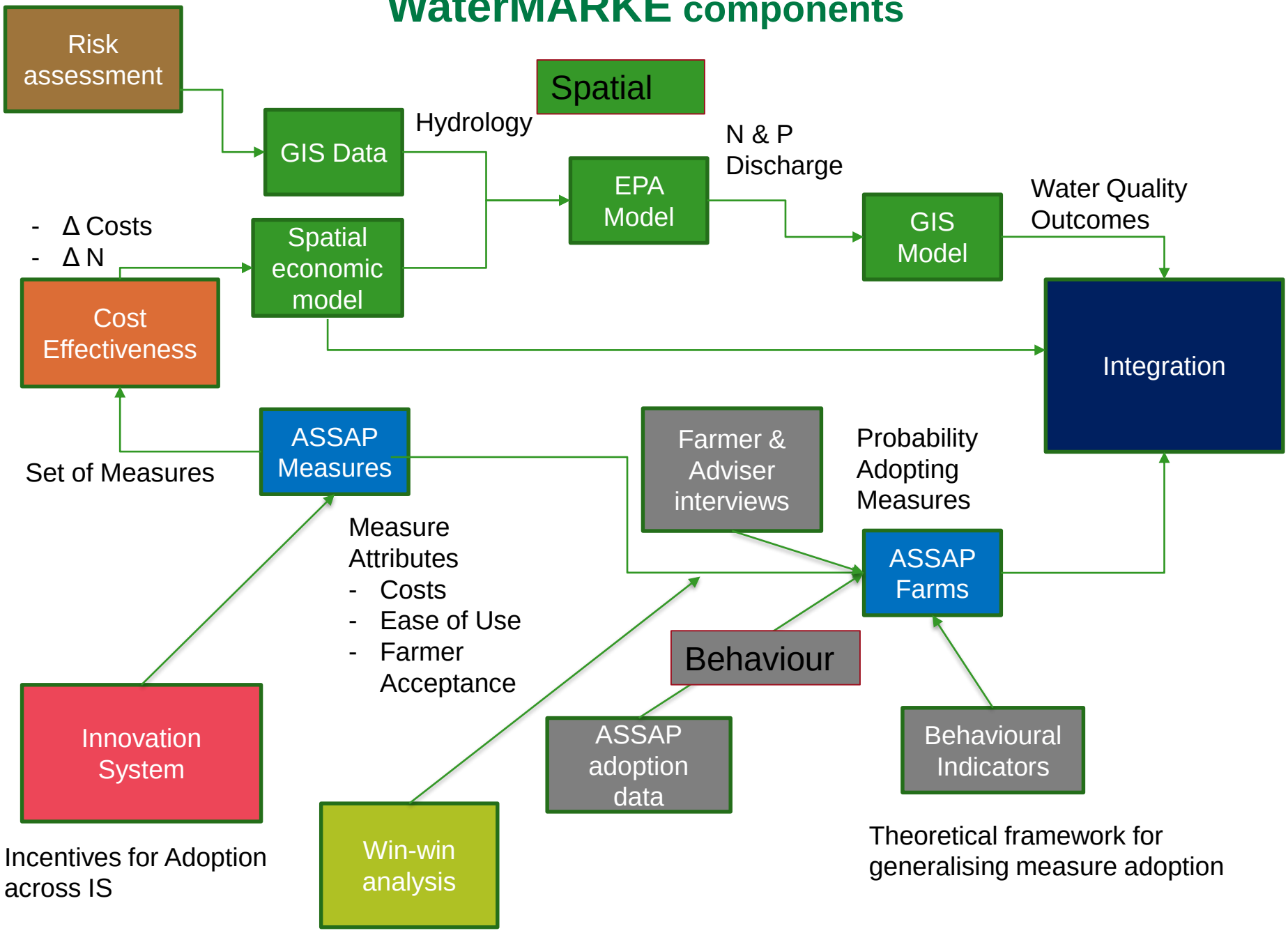
- Spatial and temporal variation
  - Varies across locations and across time

Nutrient losses largely diffuse

Difficult to link pollution outcomes directly to inputs

- Lag between polluting event and resulting pollution
- Lag between mitigation activity and resulting remediation

WaterMARKE components

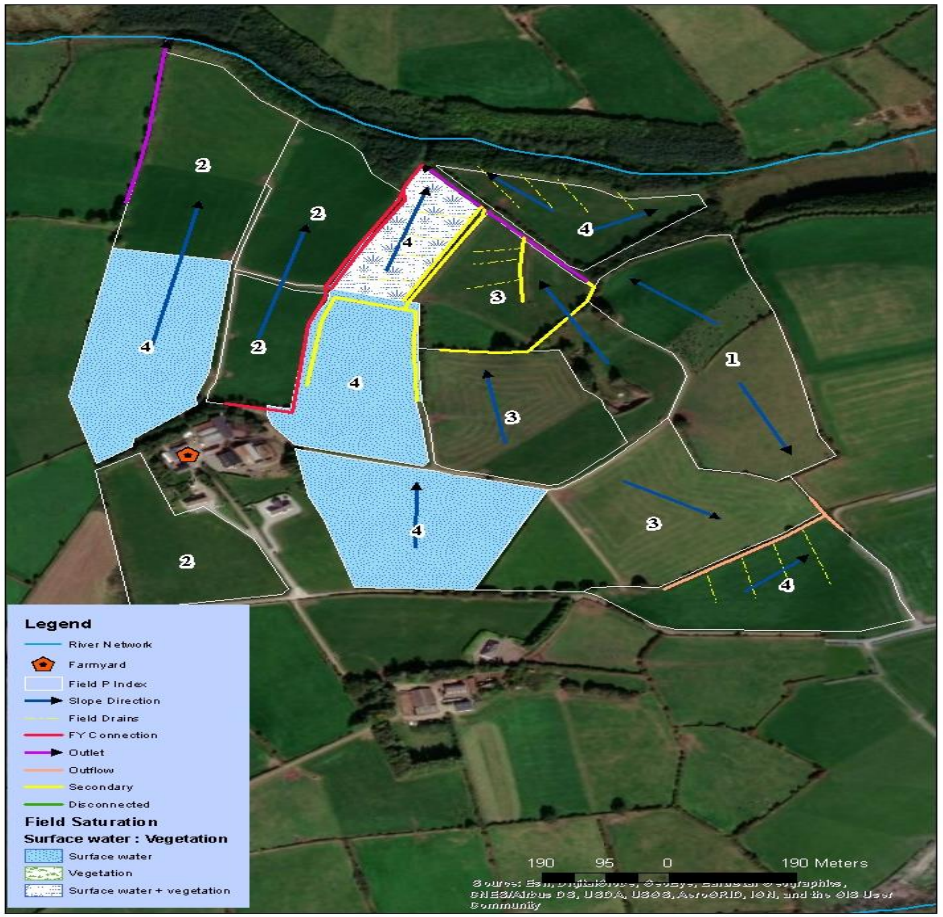


Biophysical risk

Karen Daly, Owen Fenton, Thomas Moloney

- Ditch categories
- Field P index
- Slope direction
- Surface water
- Indicator vegetation
- Subsurface drainage
- Clear risk area

- 10 pilot farms
- Detailed farm-scale risk assessment methodology for P loss risk assessment and associated measures
- Upskilling advisers re implementation of measures



ELSEVIER

Science of The Total Environment

Available online 2 November 2019, 134556

In Press, Journal Pre-proof

Ranking connectivity risk for phosphorus loss along agricultural drainage ditches

Thomas Moloney, Owen Fenton, Karen Daly

Show more

Who influences agricultural water quality? (Map of Innovation System)

Intensive Farmers

Extensive Farmers

Local Context and Risk

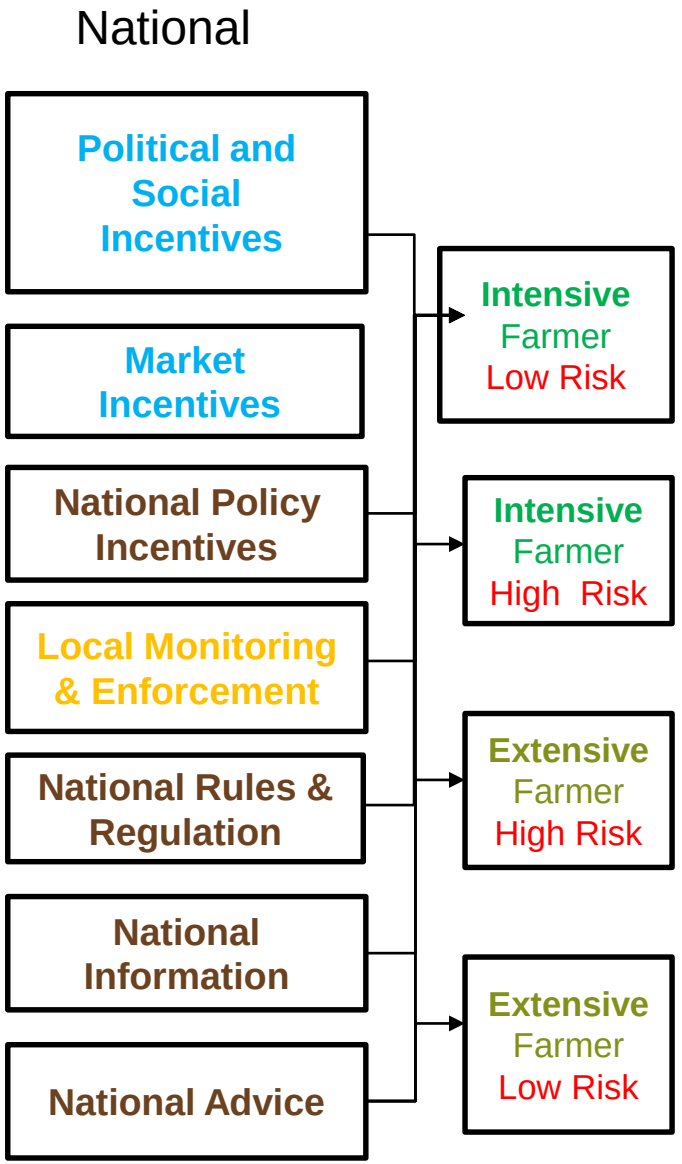
Intensive Farmer
Low Risk

Intensive Farmer
High Risk

Extensive Farmer
High Risk

Extensive Farmer
Low Risk

Incentives & Regulation



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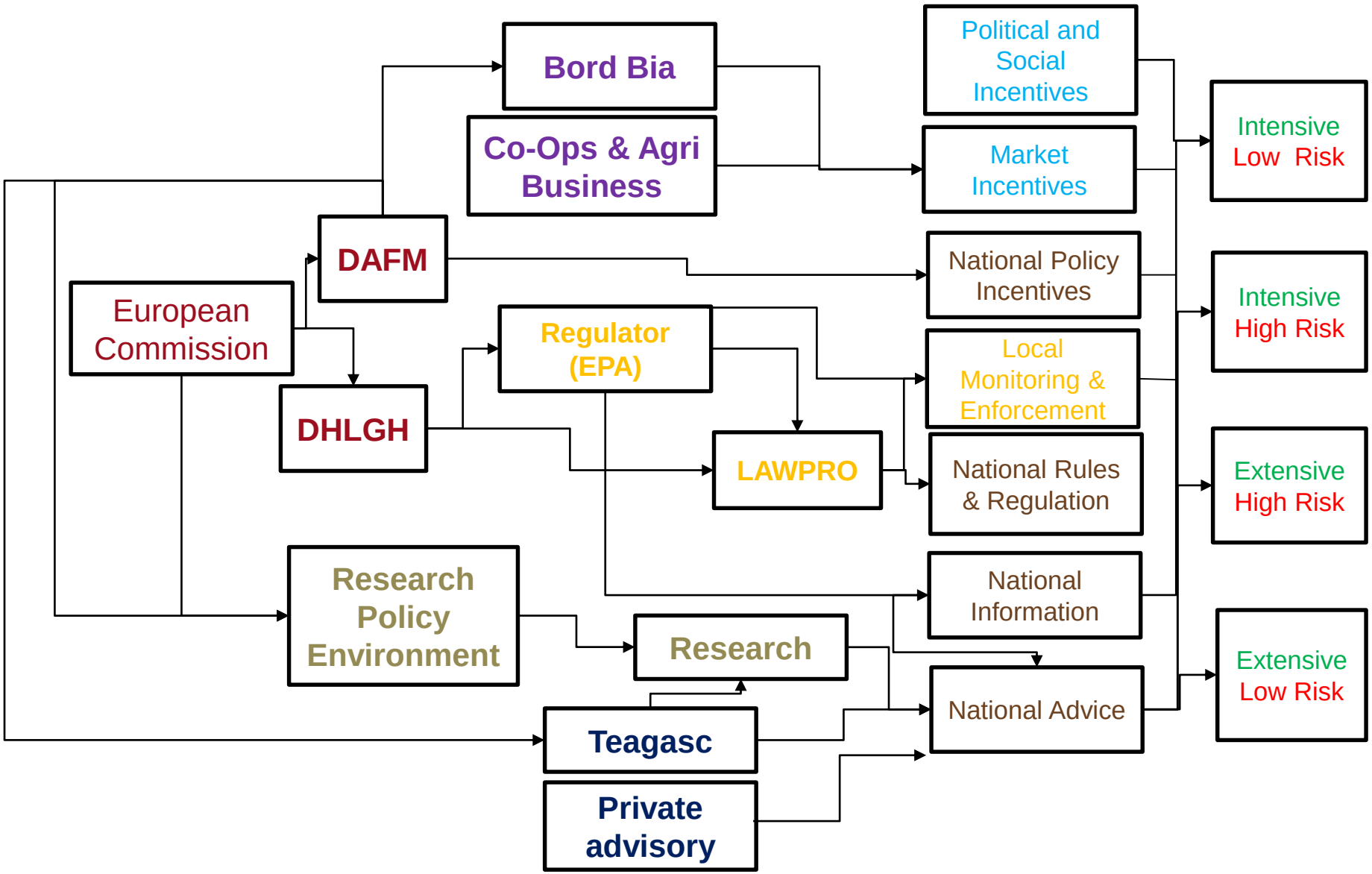
Actors (influencers) in the wider Innovation System



Policy and Legal Framework; Innovation System Governance

WaterMARKE + ASSAP: What can we learn?

- ASSAP measures
- Farm/farmer characteristics
- Psychology
- ASSAP behavioural analysis

ASSAP measure characterisation

Noel Meehan

- ASSAP advisors recommend measures to address 44 different issues
- Issues classified by type:
  - Farmyard
  - Land Management
  - Nutrient Management
- 90 different actions resulting in approx. 300 measure/issue combinations

ASSAP measure characterisation

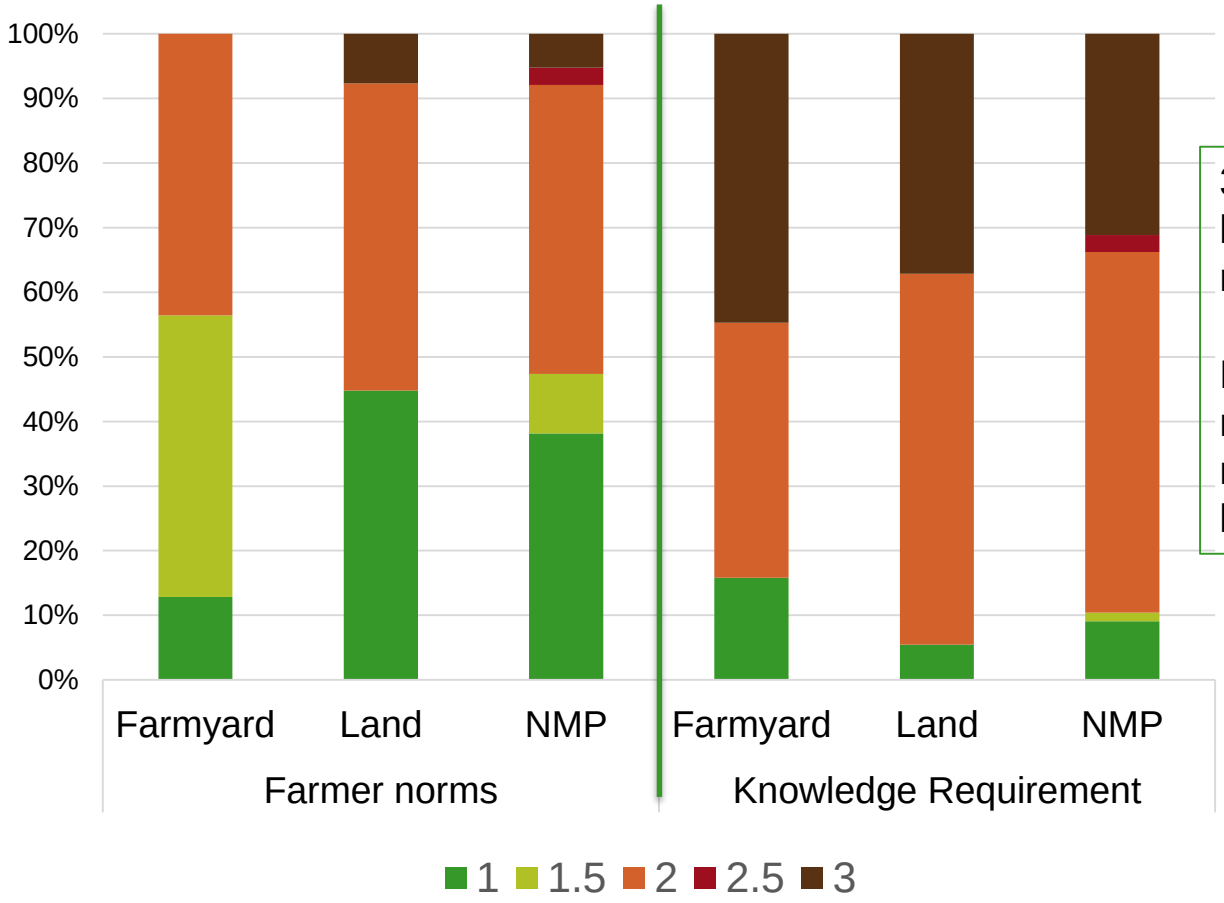
- **Knowledge**
  - Know-how, capacity, skill
- **Costs**
  - Upfront, ongoing, labour, lost area, lost productivity, farmer transaction costs (hassle, time), system transaction costs
- **Social (farmer & advisor) norms**
  - Does it align to conventions
- **Impact**
  - Scale of impact, adviser classification

ASSAP measure characterisation

44 issues | 90 actions | 300 measures

3 = aligns with farmer norms

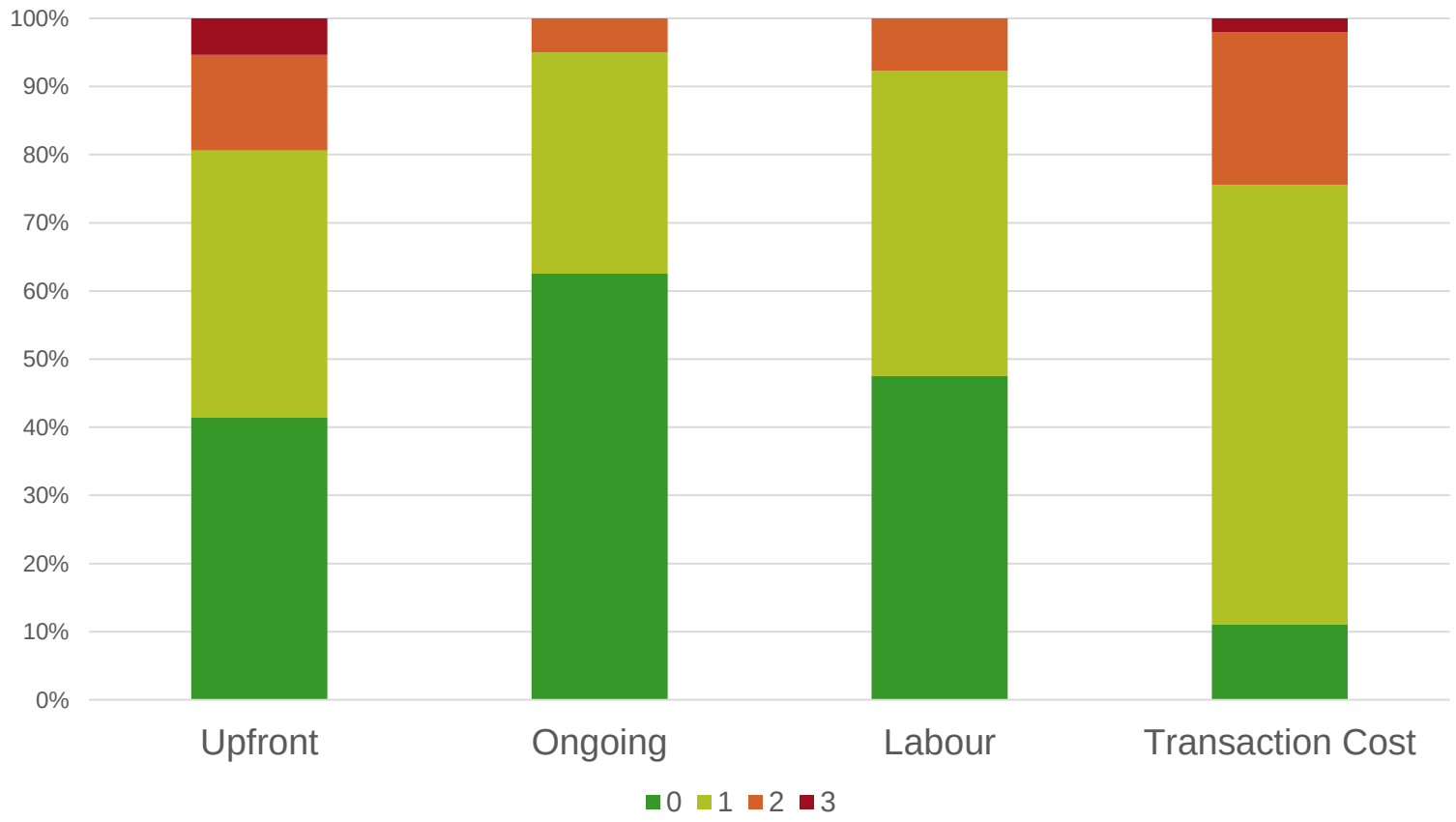
Measures assigned to farmyard issues are more aligned



3 = high knowledge required

Large number of measures require medium to high knowledge

ASSAP measure costs



ASSAP measure characterisation

Goal

- Identify measures that fit norms and have relatively low costs (or savings) compared to environmental impact
- Clustering of measures

Benefits:

- Measure priority, simplification, impact estimation

Opportunity to mainstream?

- Prioritise advisor training and farmer education

ASSAP Data Analysis: Measure Uptake + Risk

Catchment Risk	Agreed to undertake measure	Has started measure	Completed
N	8606	7797	7435
Pseudo R2	0.1062	0.1271	0.1685
Risk (High)		-***	
Risk (Moderate)		-***	-***
P Loss (Diffuse) (Y)		-***	-***
N Loss (Diffuse) (Y)		-***	
Sedimentation (Y)	-***	-***	-***
Point Source Losses (Y)	+***	+***	+***

High/medium risk farms less likely to have started than low risk

Farmers in catchments with **diffuse** P, N and sediment **losses** less likely to have engaged

Farmers in catchments with **point source losses more likely to have agreed, started and completed measures**

ASSAP Analysis: Farm characteristics

Farm characteristics	Agreed to undertake measure	Has started measure	Completed
N	8606	7797	7435
Pseudo R^2	0.1062	0.1271	0.1685
Cattle Breeding	+*	-**	
Cattle Other		-**	
Dairy		-**	
Mixed Farming		-**	
Sheep		-*	
Tillage			
Farm Size	-**		+**
Is Engaged	+***		+***
In an Agri-Env Scheme		+***	+***

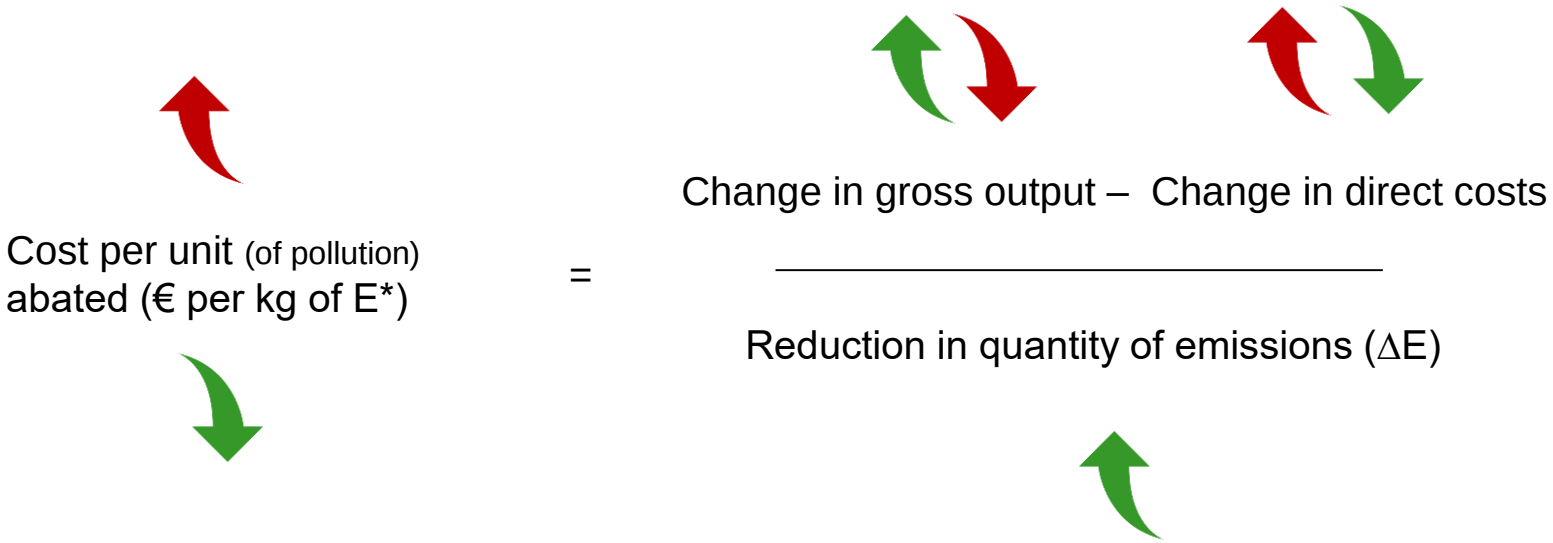
Livestock systems less likely than tillage to have started

Agri-env scheme participants more likely to have completed and to have completed

Cost-effectiveness of N mitigation measures

Daniel Urban (University of Galway, Scotland's Rural College

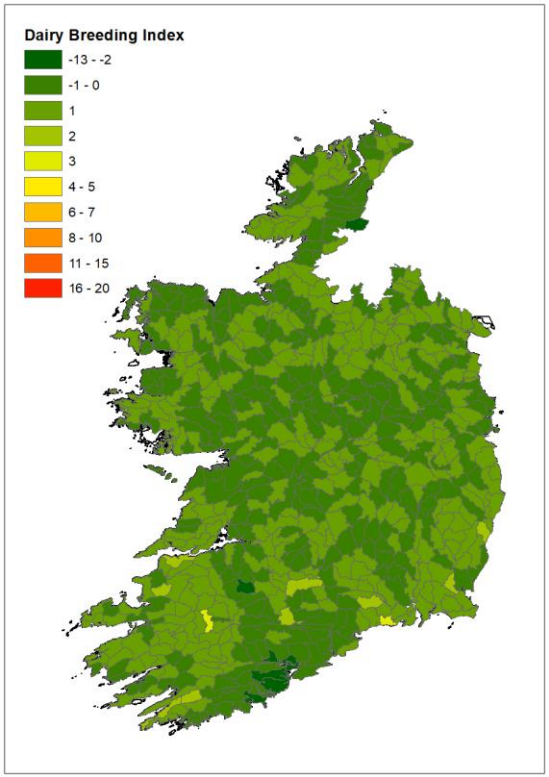
- How does cost-effectiveness of N mitigation measures vary spatially?
- Allows analysis of spatial distribution of impacts and drivers of variation in response to measures



Marginal Abatement Cost by Electoral District

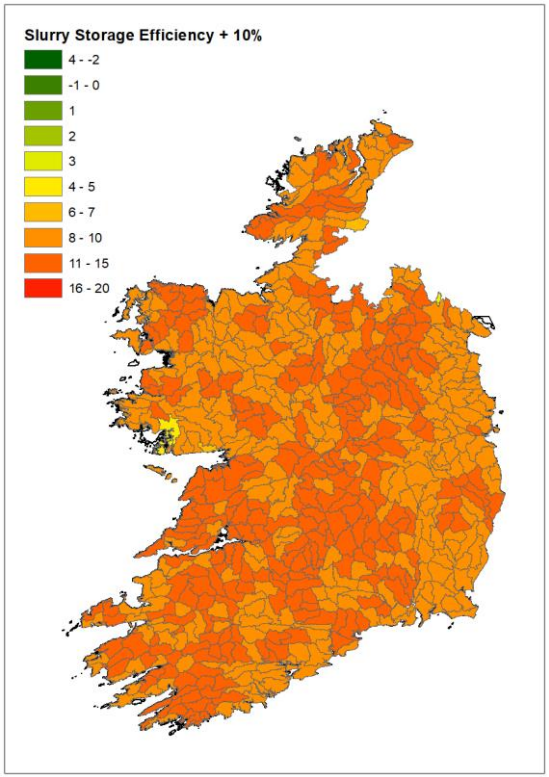
Win-win

Inc. dairy breeding index



Win-lose

Inc. slurry storage efficiency

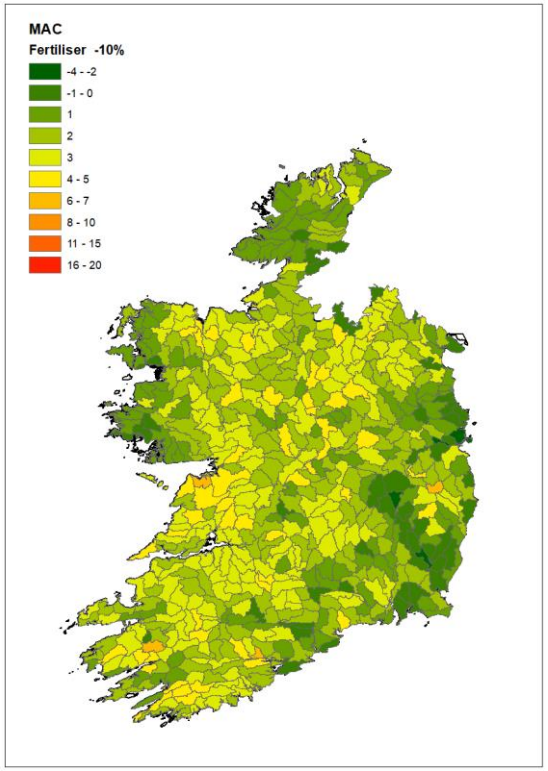


- Green – savings per unit emission decreased
- Yellow/Orange/ Red costs per unit decrease in emission

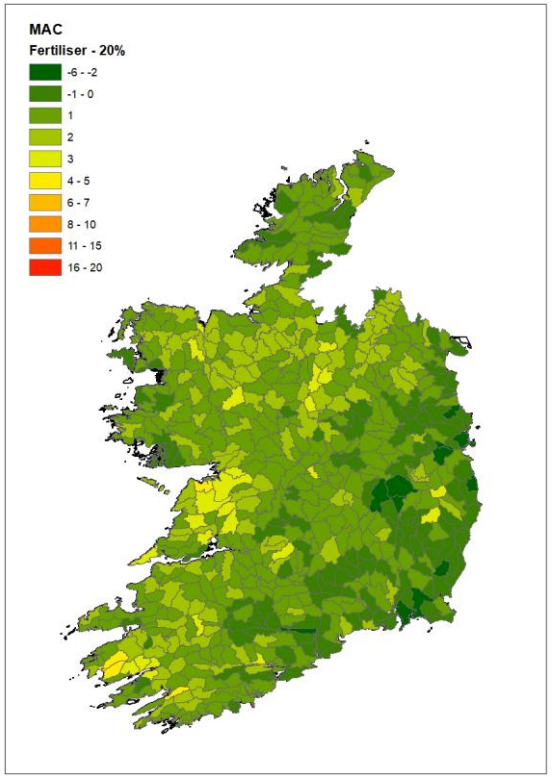
Marginal Abatement Cost (Local)

- Model suggests decreasing fertiliser use results in savings or costs
- Higher savings for 20%
- Spatial variance

Chemical fertiliser (10%)



Chemical fertiliser (20%)



Spatial MAC combined with other work (behavioural and environmental spatial modelling) can aid in identifying cost-effective combination of measures

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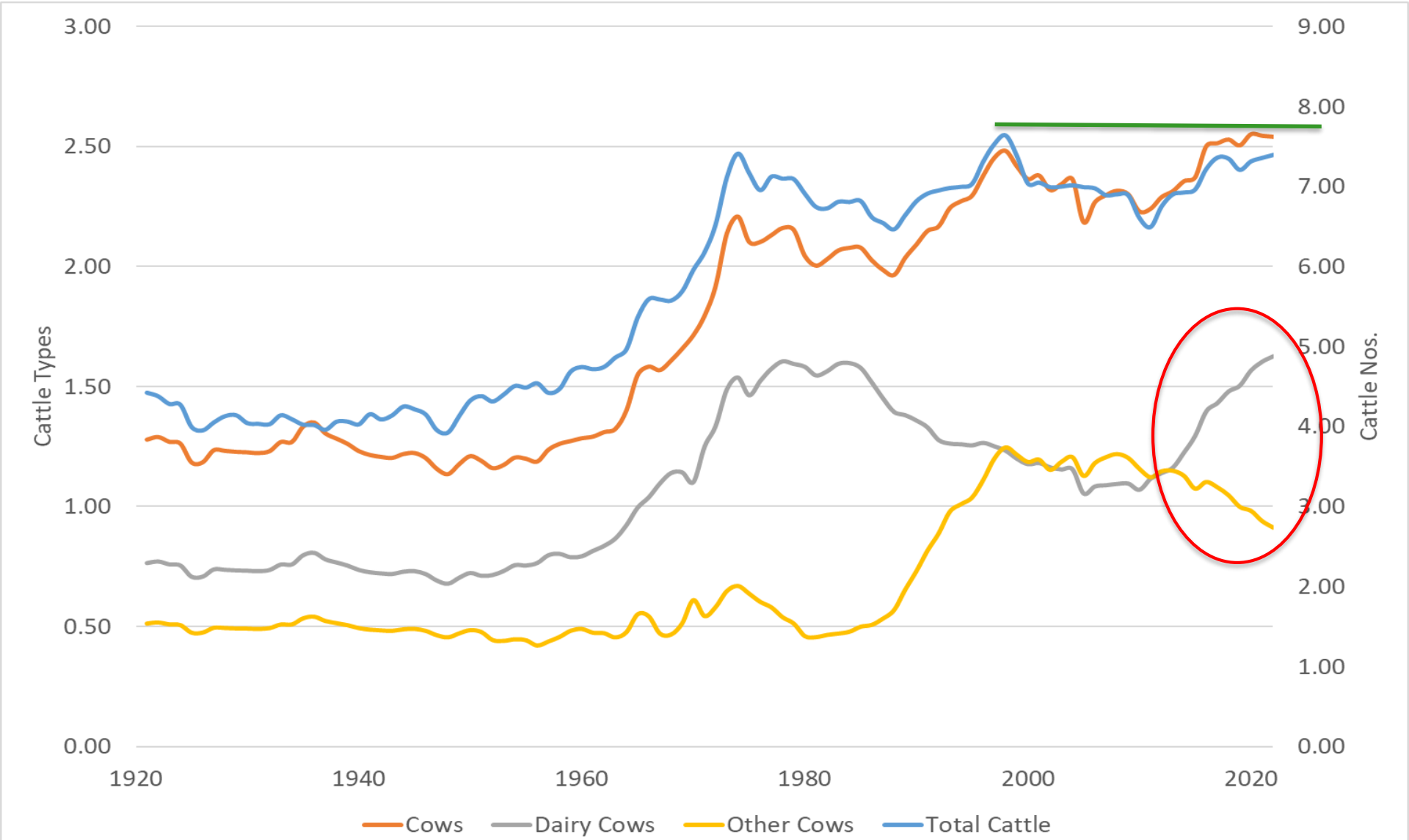
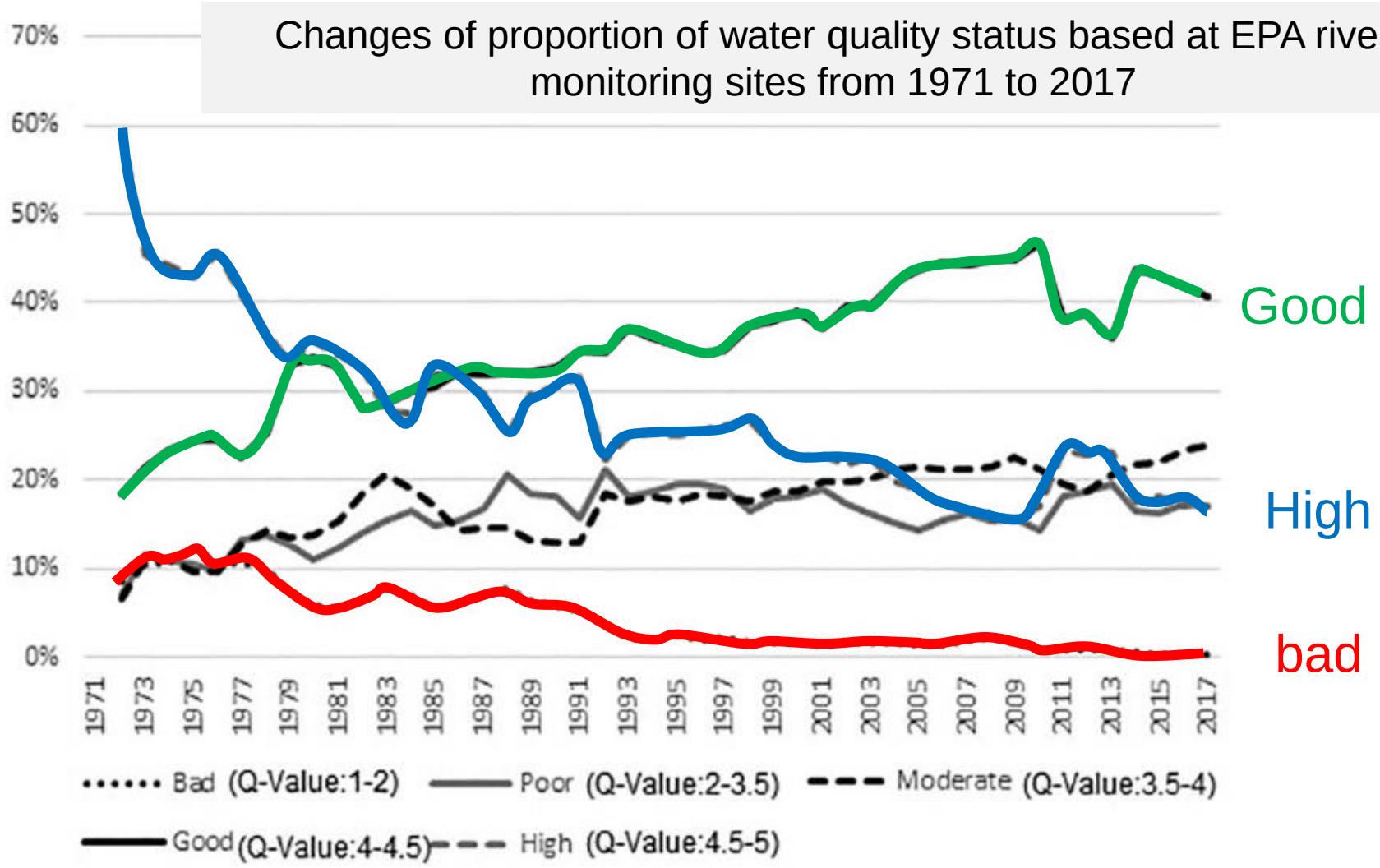
Cattle Numbers



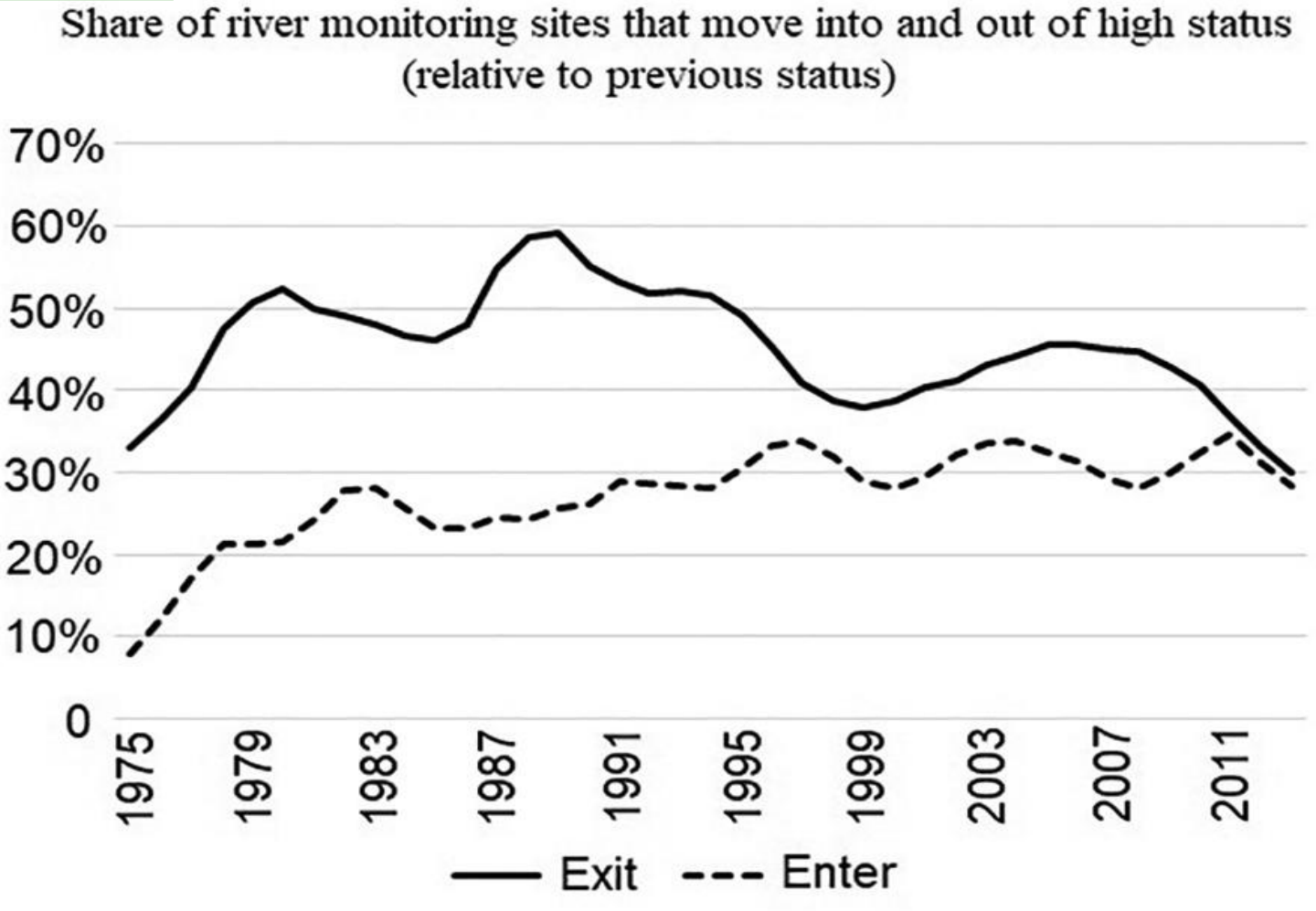
Trends in Shares of Different Water Quality Status



O'Donoghue, C., Buckley, C., Chyzheuskaya, A., Green, S., Howley, P., Hynes, S., Ryan, M. 2021. The Spatial Impact of Economic Change on River Water Quality. Land Use Policy. 103, 105322 https://doi.org/10.1016/j.landusepol.2021.105322

Mobility between High Status and Non-high Status

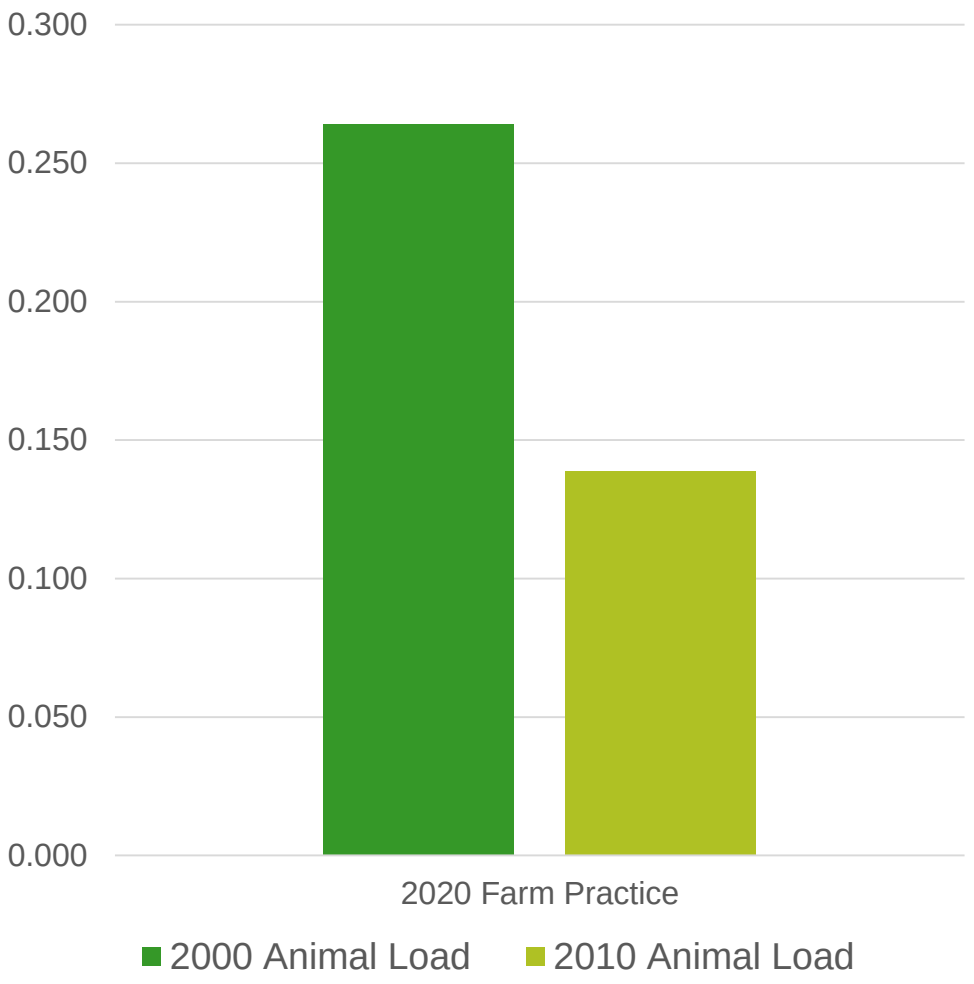
Yuting Meng



O'Donoghue, C., Meng, Y., Ryan, M., Kilgarriff, P., Zhang, C., Bragina, P., Daly, K. 2021. Trends and Influential Factors of High Ecological Status Mobility in Irish Rivers. Science of the Total Environment. 151570.

Economics: Animal Load, Farm Practices and Water Quality

- **Linking water quality** data for rivers to upstream **land use and economic activity**
- We have **published** a series of papers
- **Clear link between activity (animals & fertiliser) and water quality**
- We find that **farm management practices of 2020** would see improvements on the activity of 2000 or 2010
- Therefore **decline in WQ 2010-2020 resulted from increases in animal numbers outstripping improved practice**



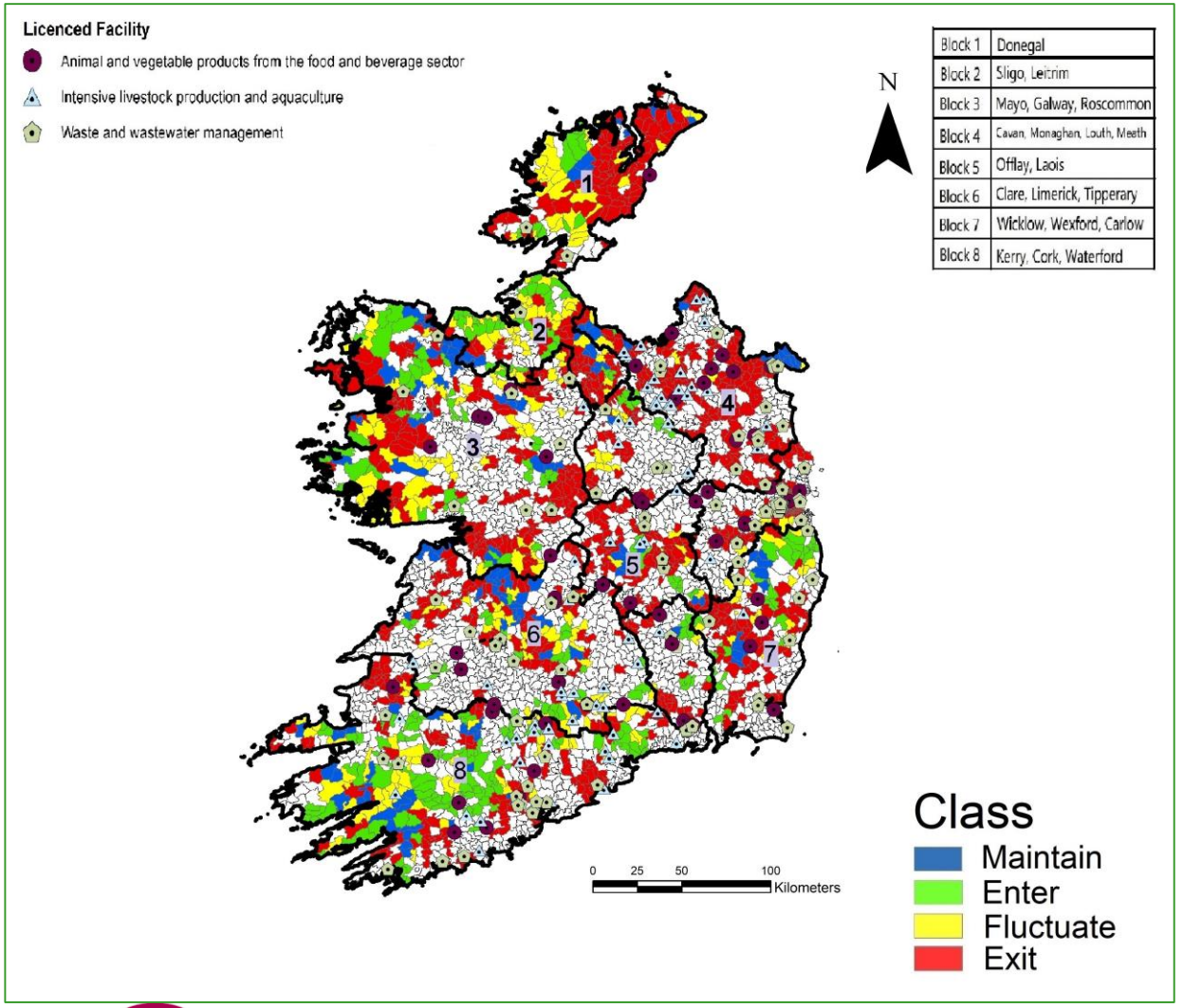
Drivers of water quality are localised

Yuting Meng

Variations in location of waterbodies exiting and entering High Status

Drivers of these fluctuations also **vary by region** Also **variation across regions**

Local situation very **important**

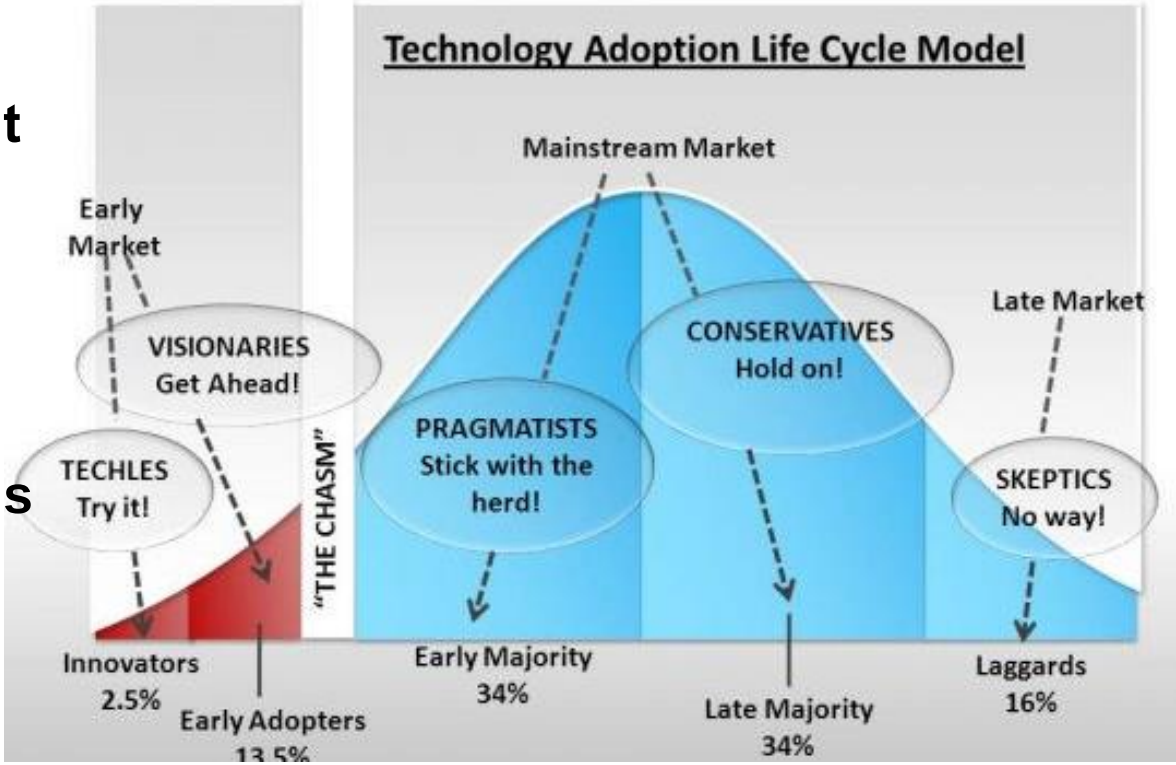


Economics

- Economically, **a national solution** (rules and regulations) to a **local problem** will result either in
  - The problem **not being solved** because the **regulations were too weak** or
  - Being **too expensive if regulations target the lowest common denominator** in applying rules to improve water quality for the most challenging environment to all farmers
- It is clear therefore that **solutions to a local problem require local solutions**.

Why don't farmers implement win-wins?

- Information failures →**haven't heard about it**
- **Income is not only driver**
  - If it takes too much **time**
  - Too much **hassle**
  - Not consistent with **norms**
- Personal Risk **attitudes**
  - **Early Adopters**
  - **Mainstream**
  - **Late Adopters**



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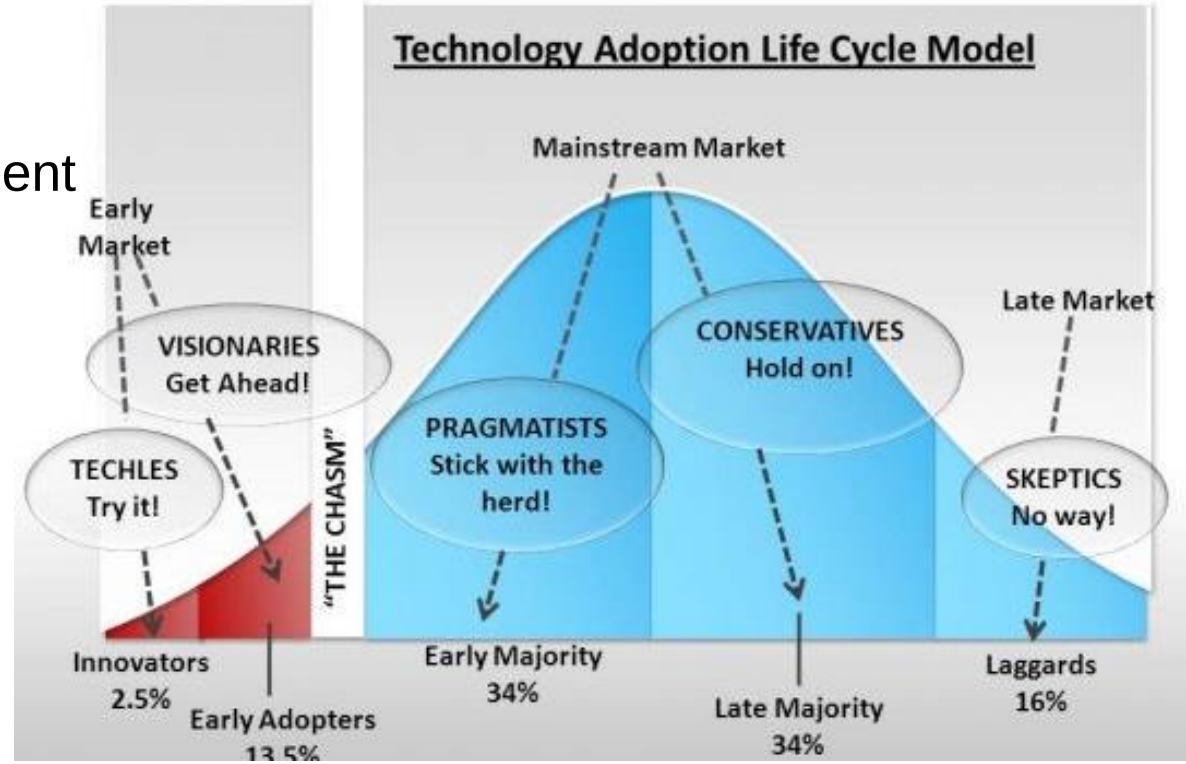
Why don't farmers implement win-wins?

- **Insufficient skills** to implement technology
- **Capital constraints**
  - Can't afford cost now
  - Can't borrow
- **Uncertain** about outcomes



Behavioural Psychology

Denis O'Hora, Jenny McSharry, Rossella diDomenico

- **2 studies (targeting Innovation System actors)**
  - **16 farmers**
  - **25 advisors (ASSAP + B&T)**
- Consistent Issues
  - Need Practical support (**time and resource limitations**)
  - Both stakeholder groups **value input of the each other** (**farmers value advisors and vice versa**)
- Particular Issues
  - Farmers **influenced by peers**
  - Farmers **feel isolated and ill-equipped**
  - Advisors feel **constrained by organisational structures**

Behavioural Drivers: Win-win v win-lose

Niall McLoughlin, ASSAP and Lakeland Dairies

	Win Win	Win Win	Win lose hassle	Win lose cost	Win win
	Nutrient Management Planning	Soil Testing	Avoid Spreading	Fencing Water Courses	Lime Application
Beliefs and Attitudes	++	+++	+		
Social Norms	+++	++	+++	+++	+++
Know How	+++	+++	+++	+++	++
Resources	++	+++		--	+++

National survey of farms

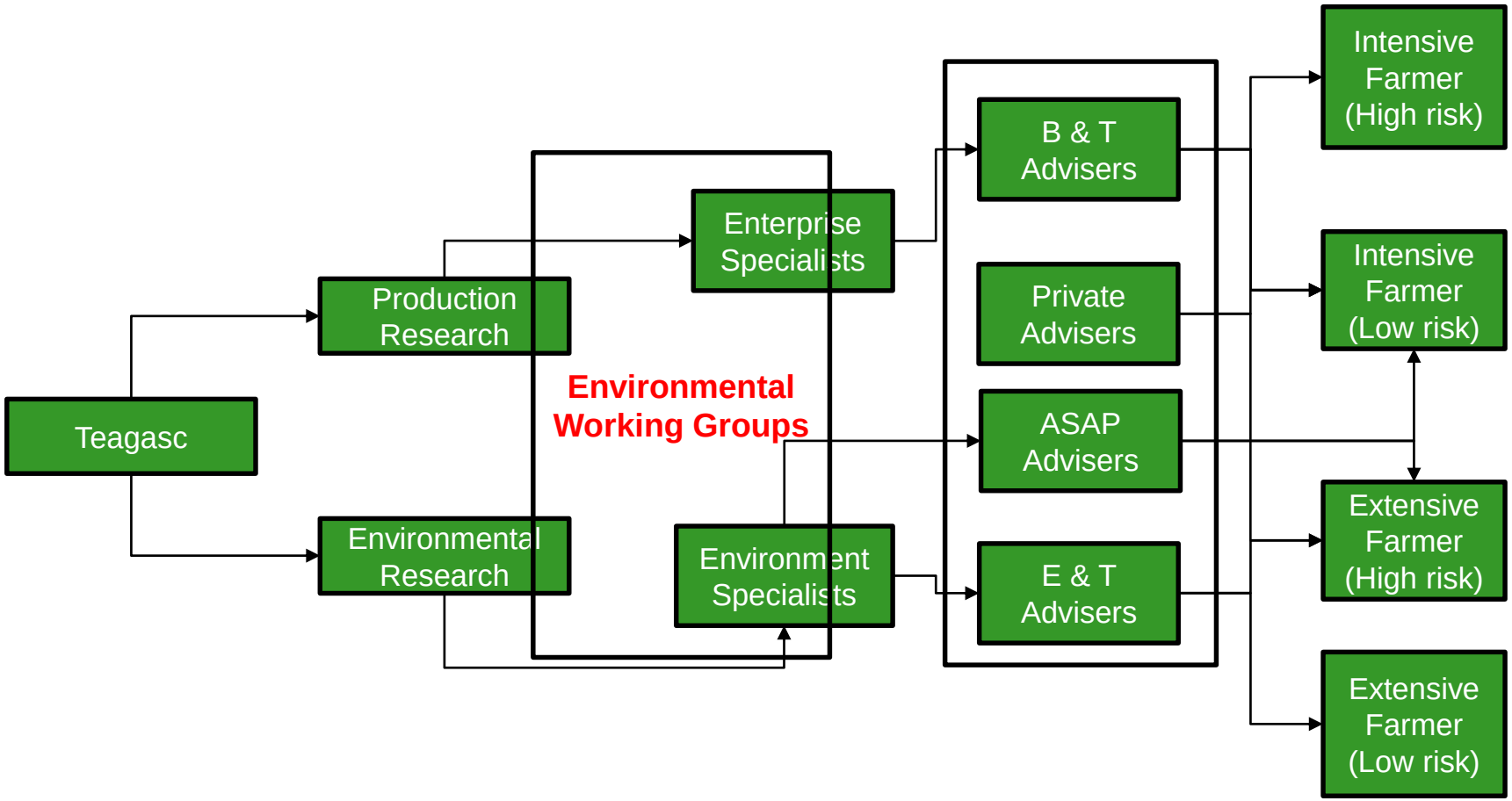
Social norms strongly positive across all measures

Positive social norms & know-how really important for win-win

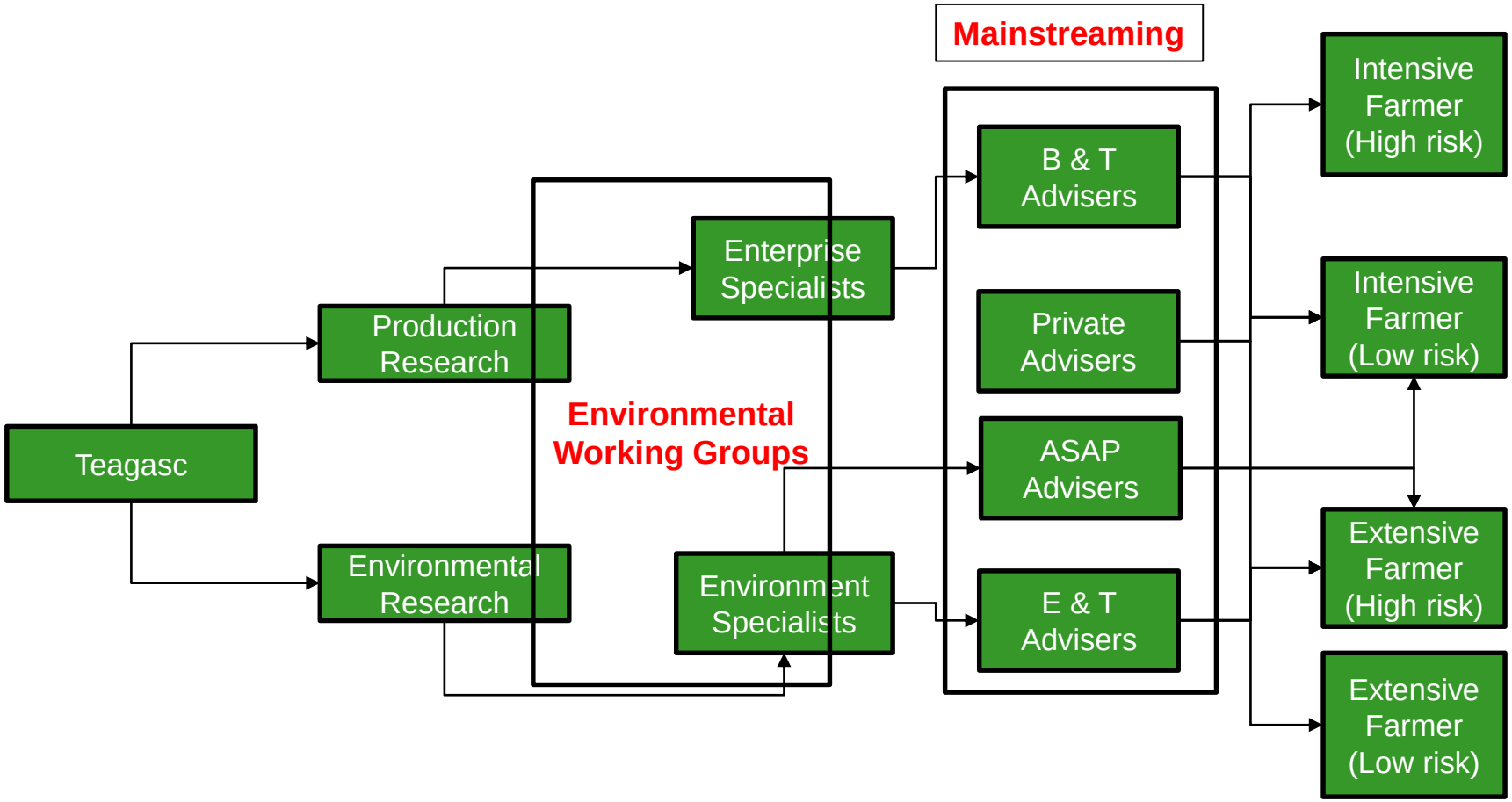
But can be outweighed by high cost -> win lose

Theory of Planned Behaviour (Ajzen, 1991). Intention to undertake translates to adoption.

Localised Advice



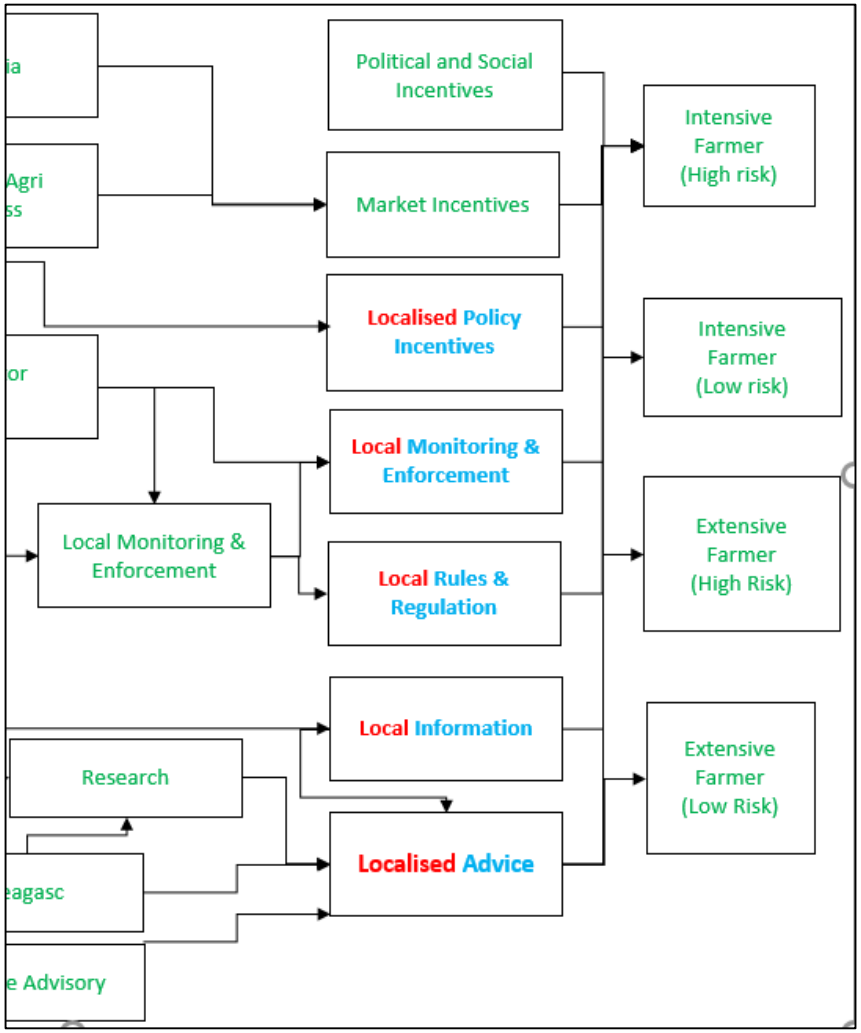
Localised Advice



Conclusions

Water quality is a complex local environmental problem

- Requires **local solutions, information and incentives**
- Taking an **Innovation System** perspective to the problem solution: changing the **behaviour of farmers** may involve changing the **behaviour of influencers**
- **Local activity and scientific data are** necessary to facilitate **local decisions**
- While solutions are local, one must by mindful of **transaction (administrative) costs**.



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Go raibh maith agaibh

Thank you