Scaling-up social and natural attributes of FIO risks

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Field - Farm - Catchment

Landscape risk factors:+

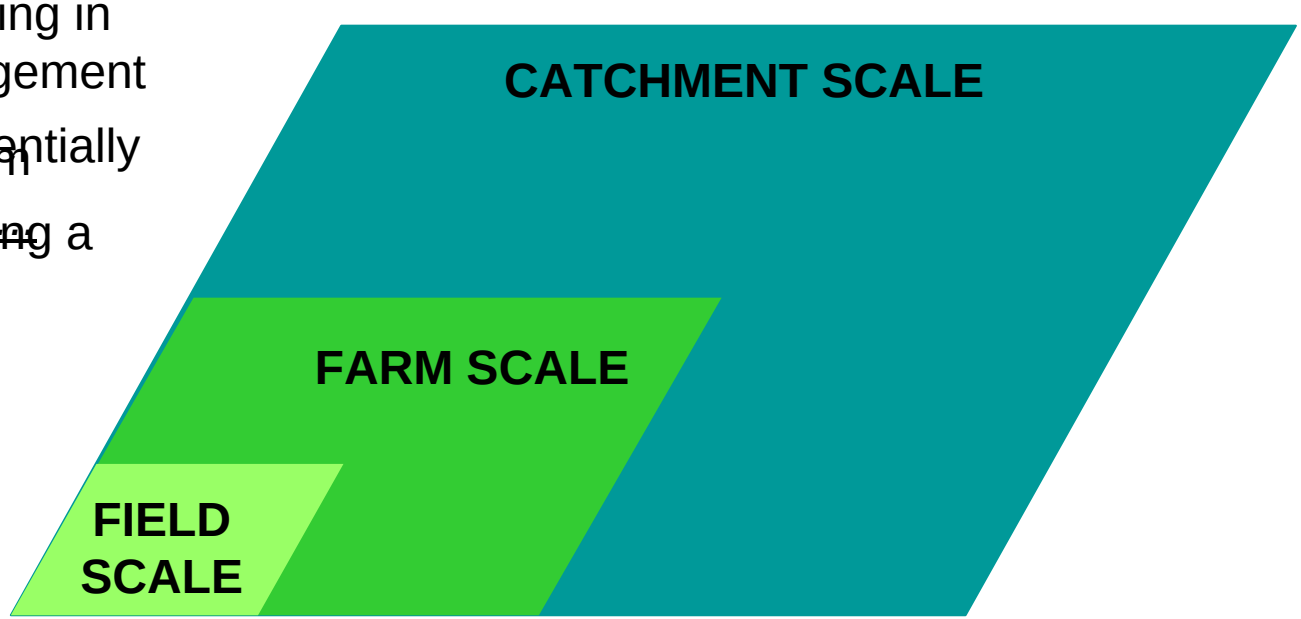
How do we meaningfully scale these risk factors to the catchment ?

Farm management risk factors:

There are already uncertainties associated with field and farm scale risk factors in terms of their relative importance and the direction of their influence

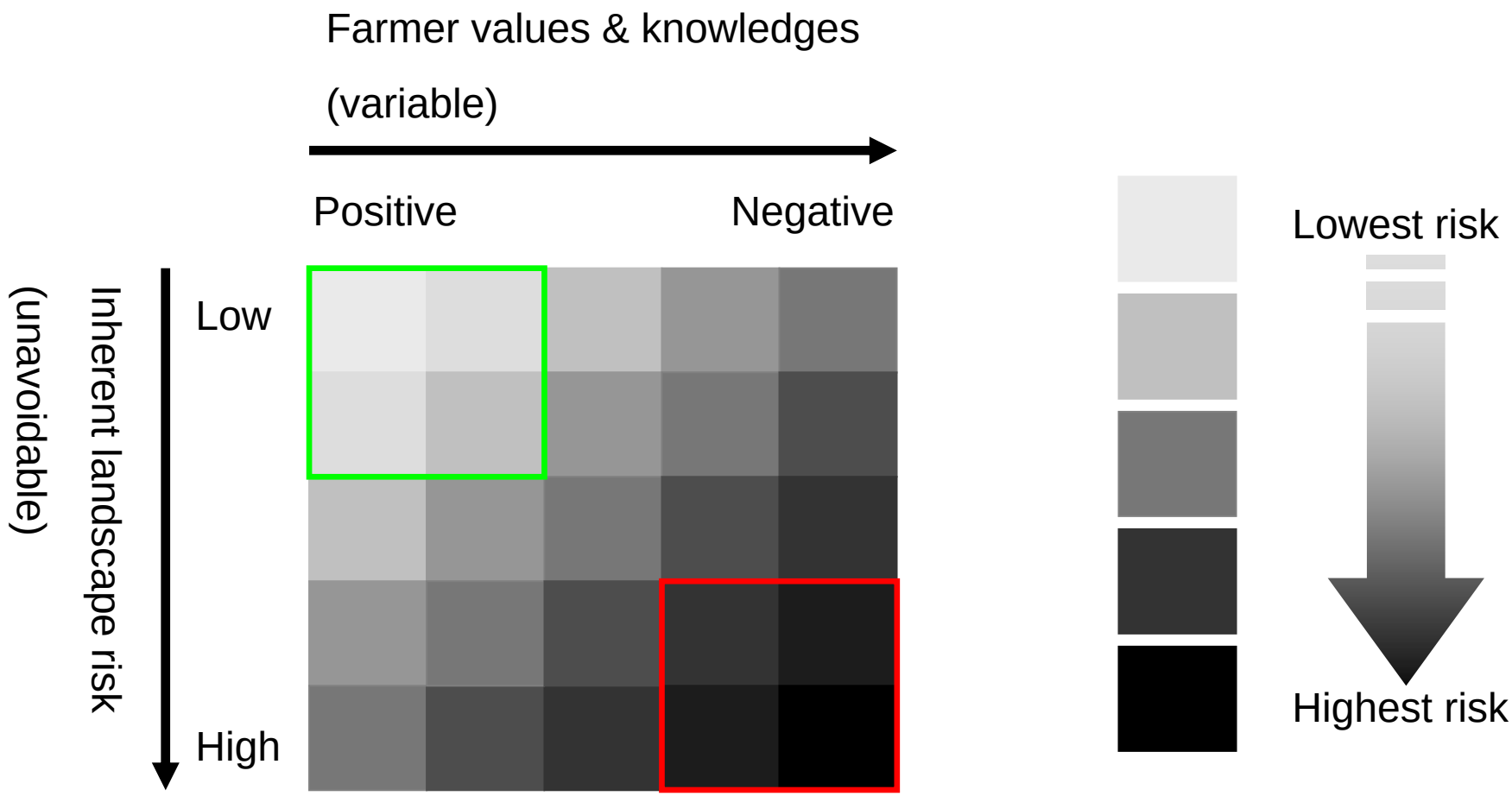
Social processes and structures imply ‘farm scale’ risk but insight is often qualitative, site specific and indirect.

What we are doing is essentially developing a generic theory

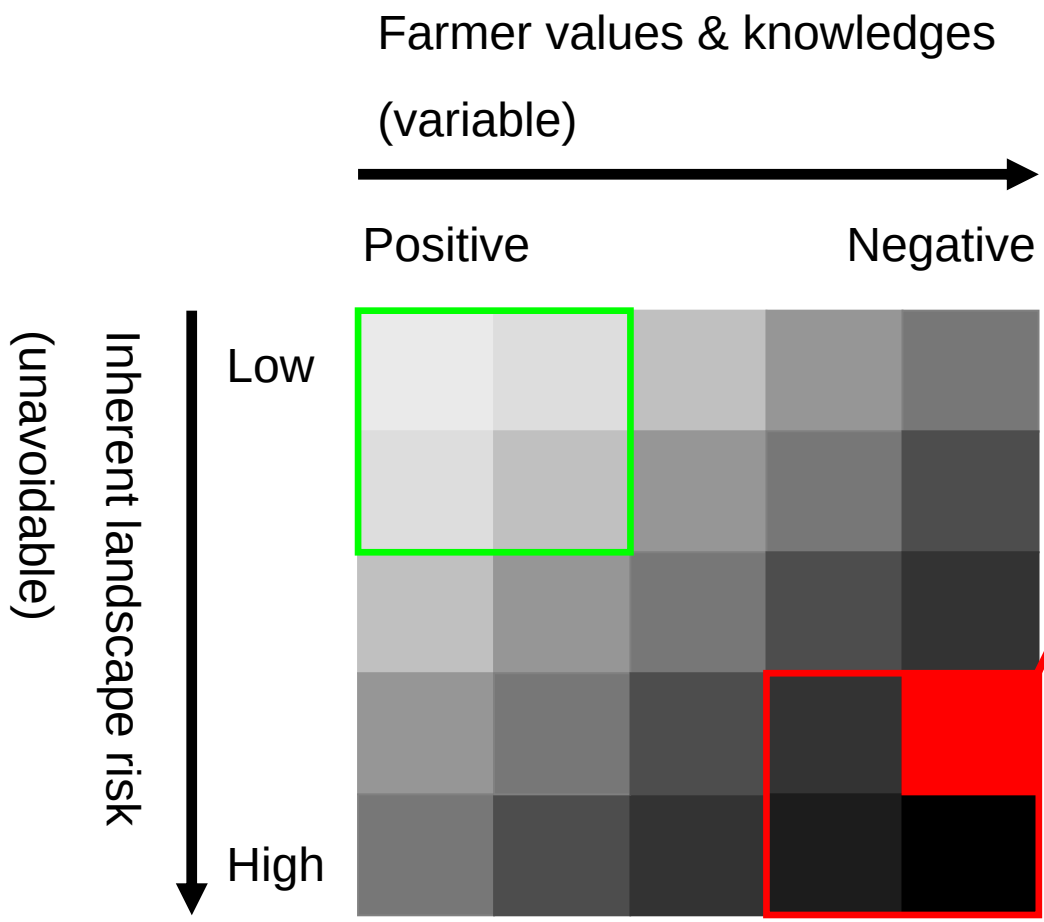


First steps in scaling from field to farm:

Conceptual linkage of farmer values with landscape



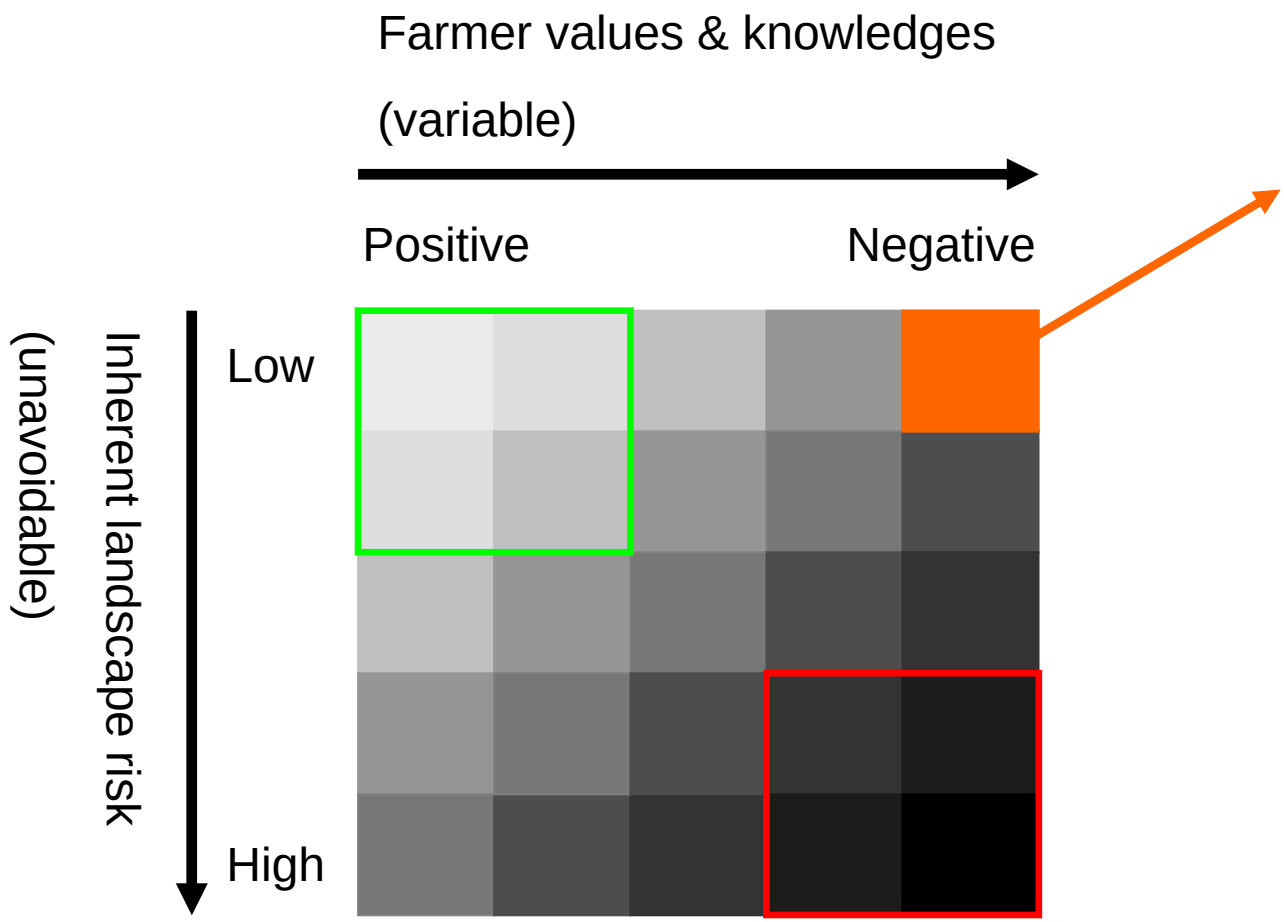
Scenario 1



A risky landscape coupled with a farmer type who farms inappropriately

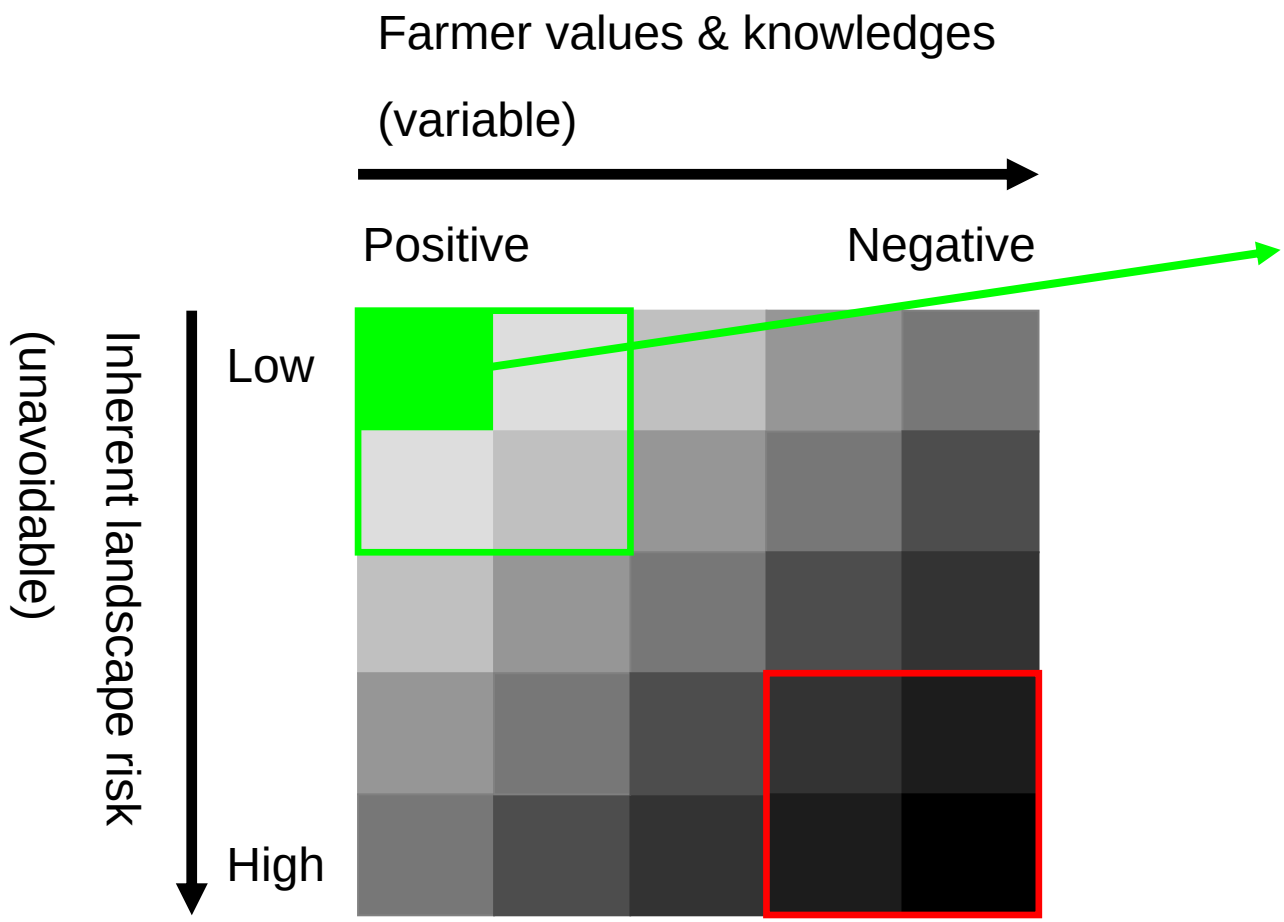
The inherently high landscape risk means that the farmers values and knowledges to farming are not strongly influential because we can't change the inherent risk of the landscape

Scenario 2



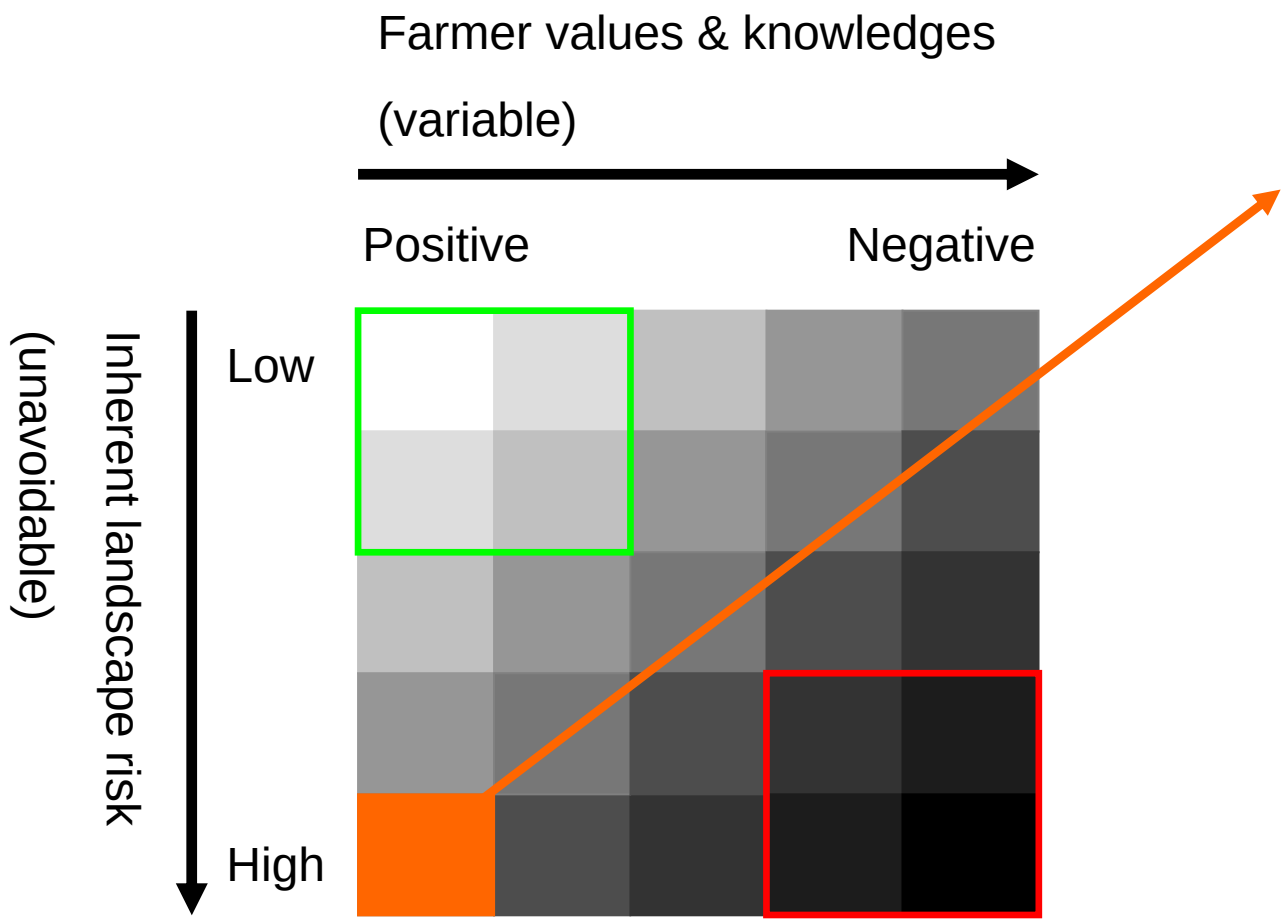
Under a low landscape risk scenario the farmers values and knowledges become more important because inappropriate farm management can convert an inherently low risk scenario into a higher risk scenario

Scenario 3



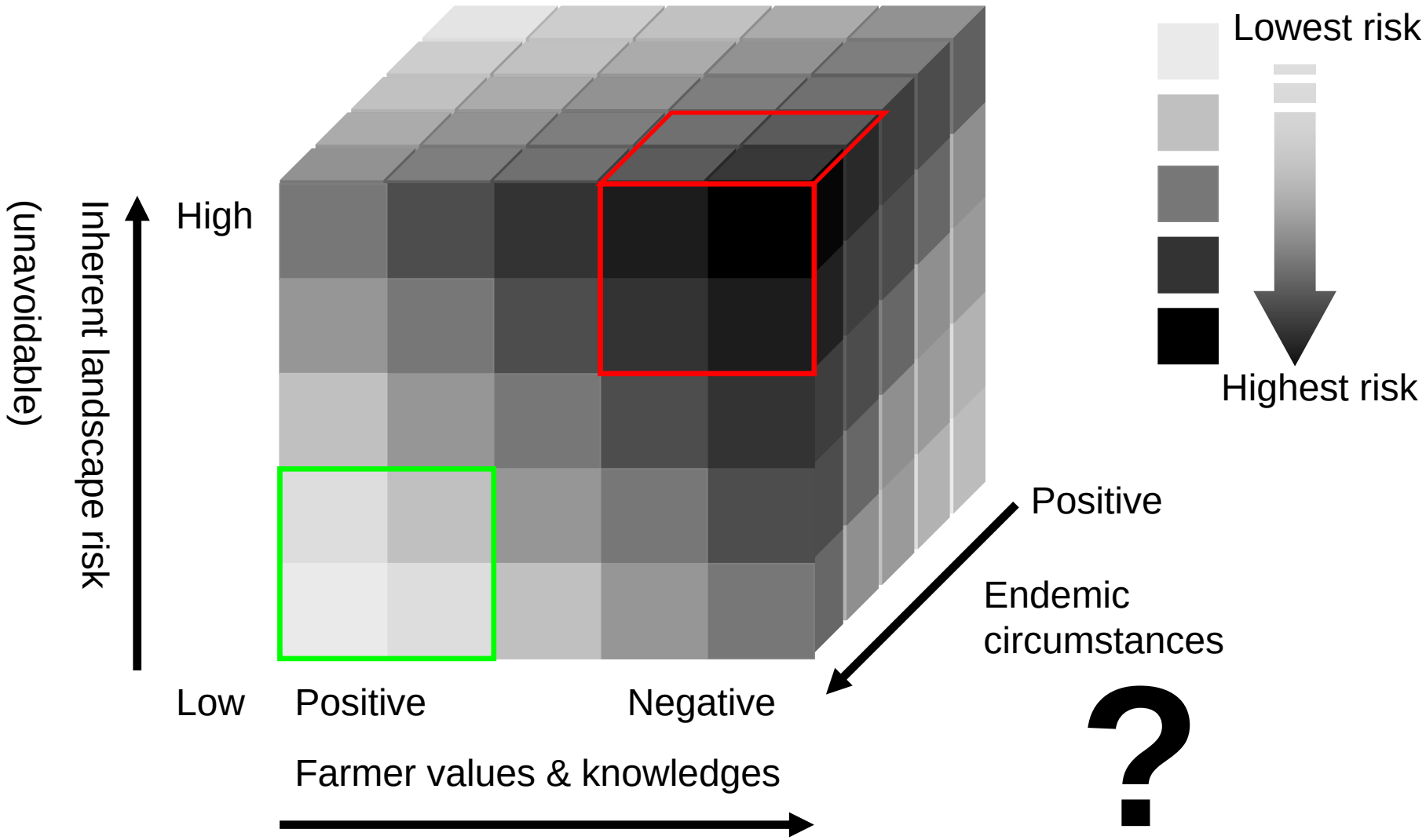
Conversely, appropriate and well planned farm management in the low landscape risk scenario leads to overall low risk of watercourse contamination

Scenario 4



However, there will also be scenarios where the inherent high risk of landscape features will force the scenario ‘riskiness’ to increase despite the best efforts of the farmer

A 3rd dimension?



We are attempting to combine farmer knowledges, inherent landscape characteristics and endemic circumstances to provide a device to explain FIO risk at the farm scale.

Relationship between precision & purpose: multiple users

How does this translate to a catchment scale?

Map landscape FIO inputs and generic farm management rules (based on model farm data) to ID FIO risk hotspots. The FIO risk cube can be coupled with our catchment scaling to function as an explanatory mechanism

Scaling social structures and processes….

Attitudes and Values

We have some plausible indicators for this category, amenable to scaling up….

And all of which we could potentially attach datasets to….

…..though data is not necessarily available… nor easily accessible!

Endemic Circumstances

Again plausible indicators for scaling this category, which we can operationalise in terms of data (for instance… Farm Business Survey and other mapable data, such as public rights of way)

But…the connection between these factors and risk is “indirect”…
….while the direction of risk is unclear.

Attempt at scaling to the catchment

Microbial flavour…..

There are no scaling rules: we can only make assumptions

Scaling natural attributes of FIO risk:

(i) FIO input to land *(assumptions)*

(ii) FIO die-off and release riskiness *(generalisations and relative coefficients)*

(iii) 'Model Farm' landscape and management risk (our use of smaller scale concepts within a larger framework) *(generalisations and relative coefficients)*

(i) FIO input to land

Uncertainties:

Reliance on nationally available datasets

Animal numbers per 1km^2 grid (coarse but available at catchment scale)

Excretion rate of each animal type – literature values

Estimated shedding rates: FIO concentration per gram of faeces

Mass of faeces x concentration = FIO load to land

Calculate per 1km^2 grid

Assumptions: equal livestock distribution, FIO shedding, excretion rate

(ii) FIO die-off and release riskiness

Focus on critical months to facilitate incorporation of die-off characteristics into the tool.

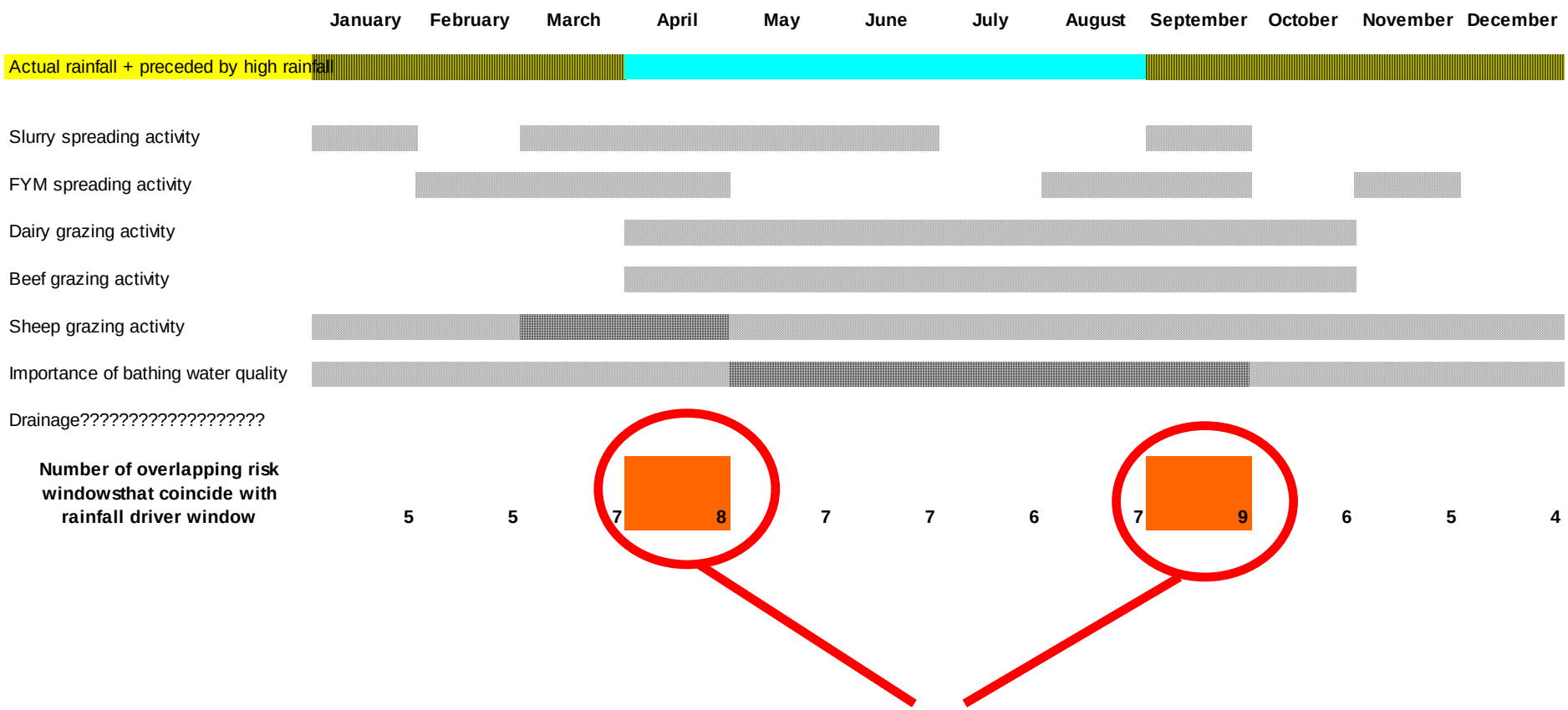
Better than trying to attribute die-off rates on an annual basis

Attempt to minimise the uncertainty – a critical month

e.g. critical source areas concept, but in time

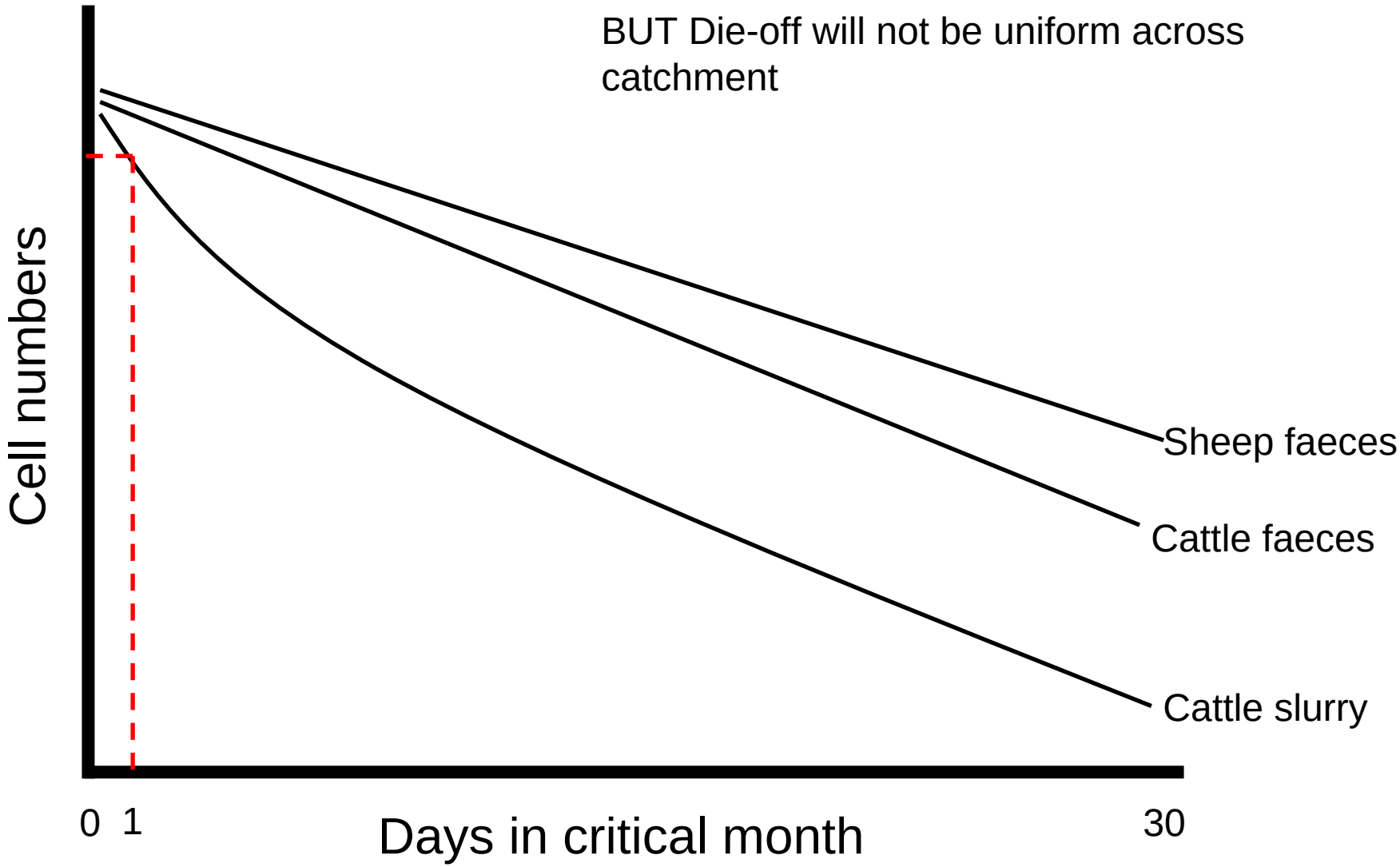
A ‘risk windows’ approach:

E.g.. Overlapping risk windows Critical months



Focus efforts on critical months (where risk overlap = greatest)

Smoothed die-off curve for faeces & manures based on field data for cattle faeces and slurry. Literature / expert judgement adjustments allow for relative die-off patterns



E. coli input + daily die-off

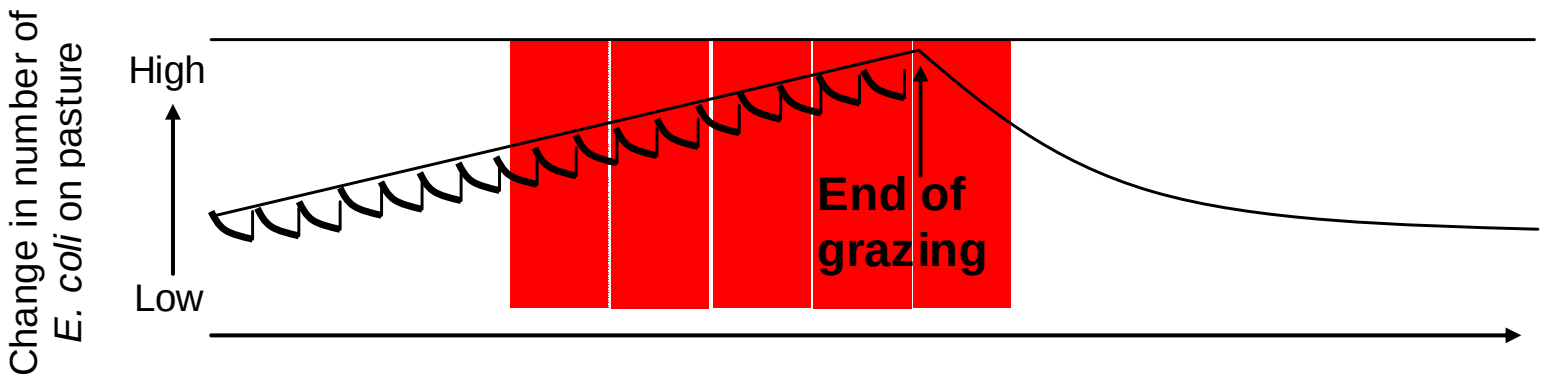
DAIRY FAECES

CRITICAL MONTH: April

Total viable cells

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	
1	10000	0	0	0						**10000**
2	8000	10000	0	0						**18000**
3	7000	8000	10000	0	0	0	0	0	0	**25000**
4	6500	7000	8000	10000	0	0	0	0	0	**31500**
5	6250	6500	7000	8000	10000	0	0	0	0	**37750**
6	6125	6250	6500	7000	8000	10000	0	0	0	**43875**
7	6062	6125	6250	6500	7000	8000	10000	0	0	**49937**
8	6031	6062	6125	6250	6500	7000	8000	10000	0	**55968**
9	6015	6031	6062	6125	6250	6500	7000	8000	10000	**61983**

Too regular! But best effort?



Release riskiness?

Manure type	Relative release 'riskiness'
Dairy faeces	
Beef faeces	
Sheep faeces	
Pig faeces	
Poultry faeces	
Slurry	
FYM	
Poultry manure	
Poultry slurry	
Pig manure	
Pig slurry	

Relative co-efficients

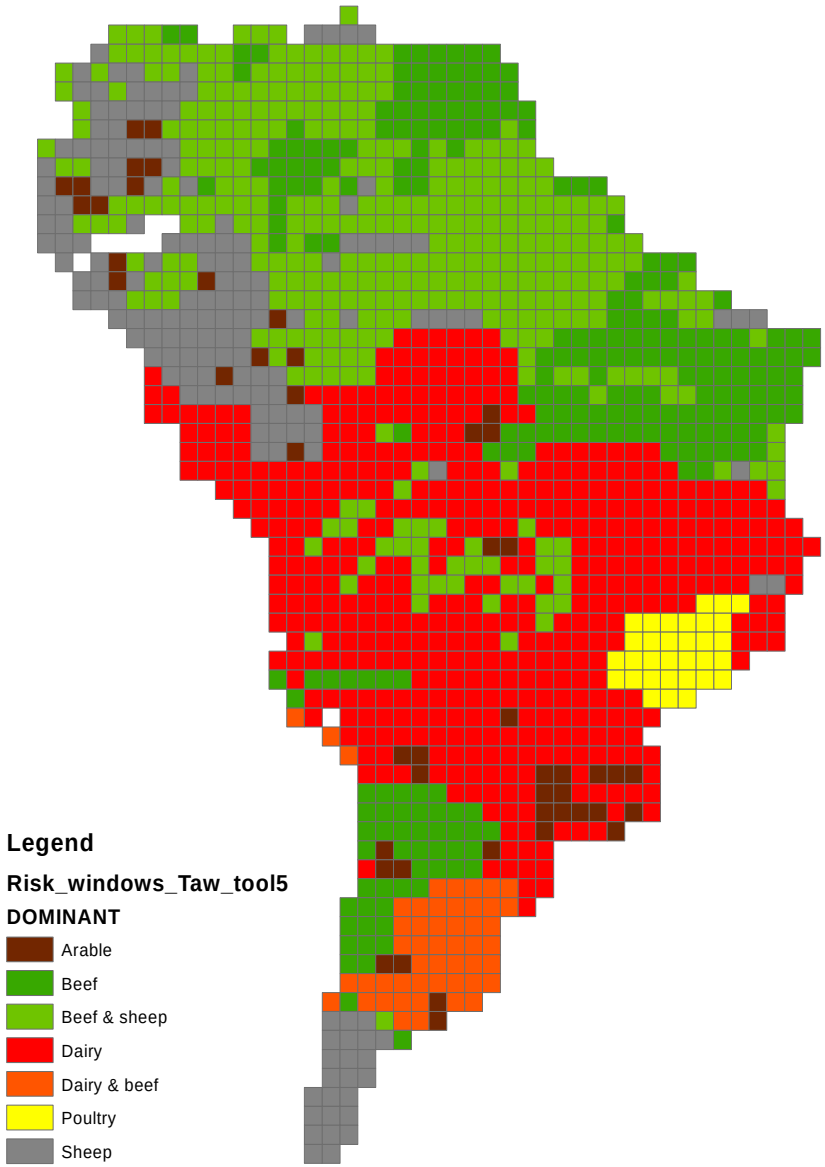
Based on Laboratory batch experiments

Mismatch of scales???????

So opt for relative rather than absolute

Provides indication of the proportion of viable *E. coli* that would be available for release

Dominant farm type



Based on LU within each grid and relative proportions as per ‘model farm’ data

MODEL FARM
Generalised management risk

Farm Type	Landscape and farm operations and infrastructure	Farm endemic circumstances
Dairy		
Beef		
Sheep		
Beef & Sheep		
Arable		
Mixed		

Relative coefficient based approach derived from Model Farm survey returns

source

transfer

connectivity

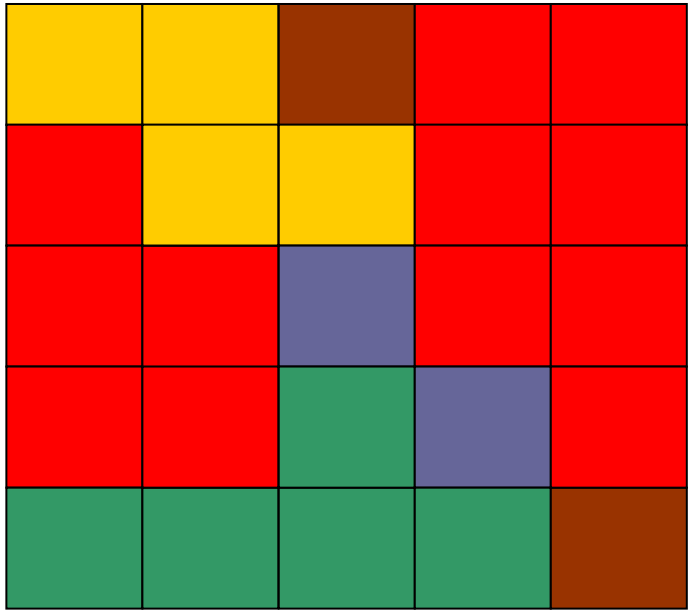
management

Example selection of data available for each model farm based on farmer survey results.

Complement with the spatial data attributed to model farms (previous presentation)

Couple with weightings of importance and feed into farm management risk coefficient.

Landscape and farm operations and infrastructure risk



Livestock numbers

Use for

(i) Calculating *E. coli* input to land

(ii) Determining dominant farm management risks attributed to model farms

Critical month (allows incorporation of die-off characteristics)

For day = 0, 1, 2, 3, 4 ……multiply total viable cells for each manure type by release risk coefficient for associated manure type

Dominant farm management (see (ii) above) allows for Risk increase / decrease as function of model farm data (e.g. multiply landscape and infrastructure risk coefficient by potential cells available for release)

Convert numerical output (estimated cell numbers) into qualitative scale of relative risk

We know that within this framework there are a number of uncertainties. A number of assumptions.

But these tools can be considered as resources for thinking and learning about catchment risks and as such does this lessen the demand for us to be ‘certain’?

We are not trying to be absolute, but transcending scales to generalise about catchment vulnerability

Issues of precision depend upon what we expect insights to do or claim

Conclusions

Scaling can be crude – but it can suit purpose

Its very simple to make things difficult and very difficult to make things simple

Assumption-led

Use of relative coefficients rather than absolutes

Scaling tools can be a resource to aid thinking (*precision to fit intention*)

Validation = problematic – scarcity of relevant FIO data at catchment scale!