Assessing the risk of farm management practices on stream FIO loads using an evidence based approach

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An expert-weighted risk-indexing approach to grade field vulnerability for FIO export (using source, transfer and connectivity drivers) coupled with detailed microbiological monitoring throughout distinctly different operationally active areas of the farm is used to identify land most vulnerable for contributing FIOs to watercourses.

This highlights FIO 'hotspots' of the farm environment that would benefit most from mitigation strategies (Phase II of the project following baseline data collection). Data collected on attitudes and approaches to manure, land and animal management via an extensive survey of farmers also contributes to the risk profiling of each farm.

Weight	Field component					
	Site transport characteristics	None (0)	Low (1)	Medium (2)	High (4)	Very high (8)
0.73	Runoff potential	negligible	v low or low	medium	high	very high
0.56	Preferential flow potential	negligible	v low or low	medium	high	very high
0.38	Erosion potential	negligible	v low or low	medium	high	very high
	Site source characteristics	None (0)	Low (1)	Medium (2)	High (4)	Very high (8)
0.49	Evidence of bacterial legacy in the soil	no count				high count
0.66	Type of waste applied to field	none		manure	mix / liquors	slurry
0.52	Waste application method	none	injection	trailing shoe	POINT	broadcast
0.59	Waste application rate					
0.35	Animal type grazing	none	Lambs	Sheep	Beef	Dairy
0.72	Grazing density	<1 LU ha-1	1 LU ha-1	2.5 LU ha-1	4 LU ha-1	>4 LU ha-1
0.58	Grazing duration	none	25%	50%	75%	100%
	Site connectivity characteristics	None (0)	Low (1)	Medium (2)	High (4)	Very high (8)
0.49	Subsurface drainage	no		yes, but poor condition		yes and fully functional
0.68	Overland flow distance	low				high
0.82	Livestock access to streams	no				yes
0.48	Tracks and tramlines against contour	with contours				against contours
0.39	Gateway location	upslope				downslope
0.73	Connected spring					

FIO field risk calculator = [∑(transfer characteristic score x weight) x ∑ (source characteristic score x weight)] x ∑ (connectivity characteristic score x weight)] - ∑(existing mitigation x weighting)]

Fig 1. FIO field loss risk indices determined via an expert weighted risk indexing tool coupled with field assessment and farm survey. Output is spatial distribution of relative FIO loss risk.

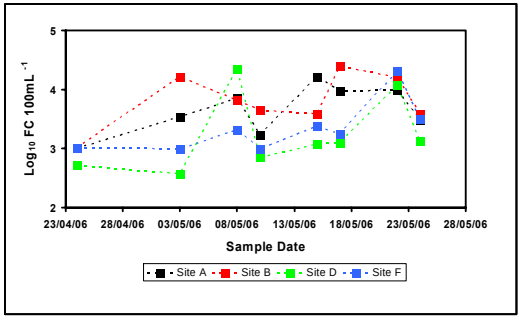

Fig 3. The potential risk is converted into actual risk: At sample site B, measured FC concentrations are significantly ($p<0.05$) higher than those entering the farm area at site F

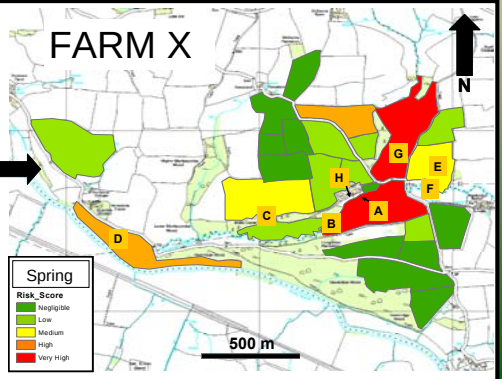

Fig 2. FIO loss from land to water on Farm X is identified to be FIELD driven. Fields identified as likely to pose high risk of FIO loss from land to water combined high runoff potential, livestock access to water and high stocking densities.

Fig 4. Cattle access contributed to high risk index of field adjacent to sample site A and increased FIO concentrations were detected.

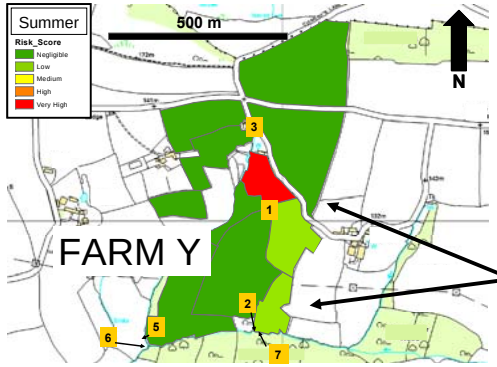

Fig 5. Conversely, on Farm Y, the expert weighted risk tool identifies field components to be low risk due to lack of animal movements and FIO source application.

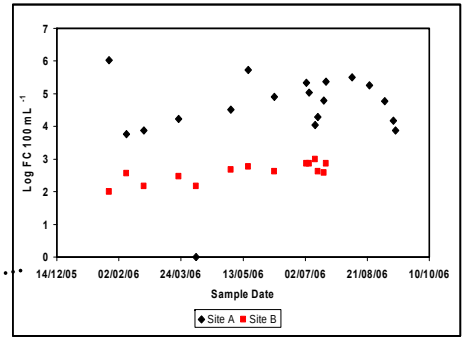

Fig 6. High FIO counts observed within a dirty ditch system (Site 1) were significantly reduced when coupled with a soak-away buffer field and delivered to Site 2.

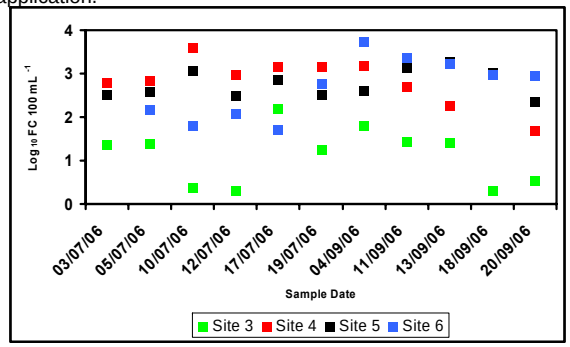

Fig 7. However, spring water from Site 3 containing low FIO concentrations is contaminated as it drains from the farm. Dirty water washings drain directly to this stream from a high risk farmyard where farm machinery is washed down with high pressure hose significantly ($P<0.05$) increasing FIO concentrations detected at Site 4, 5 and 6 (see Fig 5 and 7). FIO counts confirm high risk status of farmyard relative to fields.

Fig 8. Contamination of clean water drain with dirty water

The current expert-weighted risk indexing process will be further refined and extended by assessing the social, economic and cultural processes that assert influence on FIO export. Here, bio-physical parameters are paralleled with an assessment of risks that proceed from structures of farm ownership, farmer training and education, intrinsic attitudes to the environment, as well as stage in lifecycle.

This project is funded by the Rural Economy and Land Use (RELU) project