

Environment and Rural Affairs Monitoring & Modelling Programme (ERAMMP) Sustainable Farming Scheme Evidence Review

Report-10A: Integrated Analysis (including Improved Farmland)

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Mae'r ddogfen yma hefyd ar gael yn Gymraeg / This document is also available in Welsh

Version History

Version	Updated By	Date	Changes
0.1	BE	31/5/2019	Initial draft as Annex 10
0.2	WG	18/6/2019	Responses from WG
0.3-1.0	BE	27/6/2019	Edit to WG comments (10a & 10b split)
1.1	PMO	8/7/2019	For publication
2.0	BE	10/07/2020	Added Improved Farmland IA table (ie Section 3)

Abbreviations used in this Report

AES	Agri-environmental Schemes
CAP	Common Agricultural Policy
DEFRA	Department for Environment, Food and Rural Affairs
ER	Evidence Review
ERAMMP	Environment and Rural Affairs Monitoring & Modelling Programme
GHG	Greenhouse Gas(es)
IA	Integrated Assessment
N	Nitrogen
NH ₃	Ammonia
NO ₂	Nitrogen Dioxide
RT	Reduced Tillage
SCM	Soil Carbon Management
SFS	Sustainable Farm Scheme
SNM	Soil Nutrient Management
UKCEH	UK Centre for Ecology & Hydrology

Mae'r adroddiad hwn ar gael yn electronig yma / This report is available electronically at: www.erammp.wales/10a

Neu trwy sganio'r cod QR a ddangosir / Or by scanning the QR code shown.



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1 Introduction

The Welsh Government commissioned a series of evidence reviews to support the development of proposals for future agricultural schemes. The reviews explored the evidence for interventions around a number of key areas, and their causal links to environmental, economic and social outcomes. As part of these reviews, the Welsh Government also requested an integrated analysis to bring the findings of the evidence reviews together:

“The objective of this task is to undertake an integrated analysis across all tasks to identify interdependencies, conflicts and synergies. In undertaking this task a vision of what a new Sustainable Farming Scheme could look like based on the findings should be included.”

At the request of Welsh Government this review was split into two parts due to the fundamental difference of the nature of the two elements embedded in the task outlined above.

The first part of the WG request was for an Integrated Analysis (IA) that required an objective synthesis of the other nine Evidence Reviews exploring the interactions and co-benefits of individual interventions and outcomes. The outcome of this task is presented here. As such, this document forms a summary of the key findings of the review. The technical detail of each review is contained in a series of technical annexes that can be accessed from the ERAMMP website (www.erammp.wales)¹.

The second part of the task provided an opportunity for the evidence review team to offer some suggestions as to the concept, design, operation and evaluation of the new scheme. A complete vision for the scheme was not possible within the time schedule of the project and it is unlikely a consensus could have been reached. Instead in Report 10b: *Considerations for the new scheme*, we provide a series of considerations we hope is of value to Welsh Government during their deliberations.

The topics for the original ten reviews are shown in Table 1.1. Responsibility for leading each review was commissioned by UKCEH on behalf of the ERAMMP consortium from a range of organisations with a track record in the field. All organisations involved within the ERAMMP consortium were offered an opportunity to contribute to all of the reviews.

The review for Improved Land was commissioned later in the process and involved a subgroup of the team. This is the 11th review and completes the SFS Evidence Pack as SFS Review **Annex 4B**; ERAMMP Report-25.

¹ <https://erammp.wales/en/resources>

Report #	Annex Ref.	Title
1	1	Soil Nutrient Management (SNM)
2	2	Sward Management
3	3	Soil Carbon Management (SCM)
4	4A	Building Ecosystem Resilience (excluding Improved Farmland)
25	4B	Building Ecosystem Resilience in Improved Farmland
5	5	Building Resilience in Farm Systems
6	6	Public and Private Funding
7	7	Systems Approach to GHG Emissions Reduction
8	8	Improving Air Quality and Well-being
9	9	Flood Mitigation
10a	-	Integrated Analysis (this document)
10b	-	Considerations for the new scheme

Table: 1.1 Index of Evidence Pack Review Reports and Technical Annexes

An initial workshop was convened to bring together Welsh Government leads for each review topic and members of the ERAMMP team who had indicated an interest in contributing to the reviews to ensure a good understanding of the scope of each review. Initial working drafts of each review were then developed prior to a second workshop where these drafts were subjected to internal challenge and further development. Review leads then took responsibility for consolidating these edits and comments to produce a final draft. Final review drafts were submitted to Welsh Government for comment before final edits were completed and the completed reviews submitted to Welsh Government on the 30th June 2019.

As part of the 2nd workshop, a structure for a table to enable an integrated analysis of the reviews was developed and agreed by the team. This table is intended to capture trade-offs and co-benefits between interventions and their outcomes. The team collectively completed the table and the final outcome is thus the result of all the participants of workshop 2. This co-production is reflected in the authorship list of this report.

The structure for the late commissioned Improved Land Integrated Assessment table was modified by the group and is presented in Section 3.

2 Integrated Assessment (IA) Approach

Each individual review has considered the logic chain and causal links to outcomes for specific interventions or actions. Following this assessment, a set of issues were considered for each intervention to ensure the practicality, sustainability and potential trade-offs or co-benefits for each intervention were understood. These issues were:

- Evidence base: Causal link; Magnitude; Timescale
- Sustainability / resilience issues: Longevity/permanence; Climate interactions
- Co-benefits and trade-offs: Spatial issues; Displacement issues
- Operational issues: Social and economic barriers; Metrics and verification

A colour-coding system was then used to capture an overall assessment as to whether the team identified any major gaps in the evidence chain and/or whether there were significant trade-offs, co-benefits or leakage issues when matched against Welsh Government outcomes of interest. These outcomes are fully explained and defined in the consultation document *Sustainable Farming and Our Land*. The principal outcomes include: Air quality, Productivity (Reduced input costs), Public Health, GHG balance, Biodiversity and Water quality.

A colour-coding system was used to summarise the evidence base for each intervention. This was requested by WG to enhance the clarity of message. The colour coding is as follows:

- **Blue** = well tested at multiple sites with outcomes consistent with accepted logic chain. No reasonable dis-benefits or practical limitations relating to successful implementation.
- **Amber** = agreement in the expert community there is an intervention logic chain which can be supported, but either evidence is currently limited and/or there are some trade-offs or dis-benefits which WG need to consider.
- **Pink** = either expert judgement does not support logic chain or whilst logic chain would suggest it should work there is evidence of one or more of the following:
 - its practical potential is limited due to a range of issues (e.g. beyond reasonable expectation of advisory support which can be supplied and/or highly variable outcome beyond current understanding or ability to target),
 - the outcome / benefit is so small in magnitude with few co-benefits that it may not be worth the administration costs,
 - there are significant trade-offs.
- **Grey** = out of scope of the review task.
- **White** = not relevant to intervention or not considered due to time constraints.

Note that 'Amber' does not indicate the intervention is not supported by the expert reviewers. The amber coding reflects that, whilst the evidence base is limited and/or there are operational issues that need to be considered, the logic chain is consistent and the intervention could be worth supporting in the scheme. It is important to recognise that the practicality of collection of definitive evidence varies between

targets, systems and interventions, so there will always be more uncertainty in some areas than others, such as for ecological versus physical responses.

For clarity and due to space limitations the following terms have been used and are defined here:

- 'Appropriate habitat management'
This is defined as the management that is required in order to maintain, to improve or to create a wide range of broadly semi-natural habitats that are found on farms and common grazings, which depend to a greater or lesser extent on land management activities of the farmer. The details of the required management therefore differ with habitat context. In Wales, these habitats include significant areas of marginal semi-natural grasslands which have been agriculturally semi-improved but retain their potential for habitat improvement.
- 'Appropriate manufactured fertiliser application on improved land'
Application of manufactured fertiliser at the right time, in the right place and the right amount to meet crop requirements to achieve the economic optimum in arable or horticultural crop production and to grow the grass needed (within regulatory limits) to feed the animals on a livestock farm.

2.1 Summary IA table for Evidence Reviews 1 to 9

The consolidated table for all interventions across all topics is presented as Table 2.1.1. In summary, 57 interventions were reviewed and captured in the table. However, many interventions appear several times, illustrating how individual interventions rarely affect only a single outcome and why an integrated approach is needed when exploring their potential.

Table 2.1.1 Summary table for all interventions reviewed (Sustainable Farming Scheme: ERAMMP Evidence Pack Review). This table contains a summary of the evidence base of potential outcomes from a range of interventions that have been reviewed by the ERAMMP SFS Evidence Review team. Note that some interventions have been considered in several reviews. The colour coding for each outcome for each intervention indicates the status of the evidence base for the specific outcome when this has been considered. The colour code of the overall 'Topic & Intervention' cell reflects the final recommendation by the team after considering the impact of the intervention across a range of environmental, economic and social outcomes of interest to Welsh Government (i.e. Productivity, Air Quality, Public Health, Water Quality, GHG balance and Biodiversity). Note that the Outcomes have been further broken down into more precise categories for the purposes of the review and greater clarity. Note also that it was only possible to consider the outcome of Public Health within the Air Quality review but that this does not reflect the limit of potential Public Health outcomes from these interventions. These outcome categories are reflective of the overall definitions contained in the consultation document *Sustainable Farming and Our Land*.

Colour Key:

- **Blue** = well tested at multiple sites with outcomes consistent with accepted logic chain. No reasonable dis-benefits or practical limitations relating to successful implementation.
- **Amber** = agreement in the expert community there is an intervention logic chain which can be supported but either evidence is currently limited and/or there are some trade-offs or dis-benefits which WG need to consider.
- **Pink** = either expert judgement does not support logic chain and/or whilst logic chain would suggest it should work there is evidence of one or more of the following:
 - its practical potential is limited due to a range of issues (e.g. beyond reasonable expectation of advisory support which can be supplied and/or highly variable outcome beyond current understanding or ability to target),
 - the outcome/benefit is so small in magnitude with few co-benefits that it may not be worth the administration costs,
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- **Grey** = out of scope of the review task.
- **White** = not relevant to intervention or not considered due to time constraints.

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance			Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition		Improve condition of semi-natural habitat
												Biomass	Soil				
Review 1: Soil Nutrient Management																	
1	Implementation of nutrient management plans on improved grassland and arable land	Manufactured fertiliser; Manure and organic inputs; Grazing; Vegetation management (mixed); Benchmarking, baseline and skills.	Only where baseline is below economic optimum		Magnitude depends on the baseline	Magnitude depends on the baseline		Magnitude depends on the baseline	Reduced NH ₃ emissions	Assuming integration of manure and fertiliser nutrient supply	Assuming integration of manure and fertiliser nutrient supply	Only where baseline is below economic optimum See Review 3.	Where nutrient management adjusted to optimise plant species composition			Must be catchment scale to have meaningful impact on water quality	
Review 2: Sward Management																	
2	Diversification of swards in improved grassland	Vegetation management (mixed)	Some evidence Not in Welsh conditions	Needs to be tried & tested	Reduced nitrate	Reduced N load	Lack of evidence	Limited to where manufactured N fertiliser is reduced		Limited to where manufactured N fertiliser is reduced	Mainly due to reduced manufactured N fertiliser use	See Review 3	Plant, pollinator and other animal diversity			Biodiversity / Water Effect due to proximity/ increasing connectivity of Semi-Natural patches	

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												Biomass	Soil				
Review 3: Soil Carbon Management (SCM)																	
SCM - Improved Grass (as defined by author of study)																	
3	Appropriate grazing	Grazing	'Blue' if stocking maintained, rotations improved, over-grazing reduced	'Blue' if stocking maintained, rotations improved, over-grazing reduced				See Review 9					For example, positive effects if over-grazing reduced in the process				
4	Appropriate cutting	Cutting						See Review 9									
5	Sward Management	Vegetation management (mixed)			Reduced nitrate					Limited to where manufactured N fertiliser is reduced			Evidence for deep rooted grasses and N fixers				
6	Manure application ('Blue' if included in nutrient management)	Manures and organic inputs			See Review 1			See Review 8		Displaces manufactured fertiliser							

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7	Liming	Manufactured fertiliser and liming	Increased productivity only if pH too low		Potential benefit for offsetting acidified waters						Potentially by reducing manufactured fertiliser but GHG from lime production						
8	Prevent permanent grassland conversion to arable**	Conversion	See Review 10b for more in-depth analysis		Reduces risk to water as more permanent veg cover			See Review 9					At the field scale, grassland fields support higher biodiversity				Heterogeneity in the landscape such as small areas of arable can be positive and vice versa. This is landscape-context-dependent
9	Afforestation / Agroforestry	Trees and shrubs inc. agroforestry	Could lead to displacement. May balance out for agroforestry, depending on details.		Can be benefits but also risks e.g. of erosion due to management operations			See Review 9	See Review 8	See Review 8	See review 7		Evidence needed	Increase field-scale biodiversity			Effect due to proximity / increasing connectivity of Semi-Natural patches, especially with appropriate tree species

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												Biomass	Soil				
10	Increasing manufactured fertiliser	Manufactured fertiliser and liming	Potential for increase if N limited production		Potential risk for waters			See Review 8	See Review 8	Displacement into fertiliser production							Risk of fertiliser movement into waters affected by location
SCM – Cropland																	
11	Cover cropping	Soil protection	Mixed evidence on the yield of the following crop		Reduces risk of sediment run-off as less bare soil			See Review 9		N ₂ O emissions when ploughed back in during intensive operations; less N fertiliser use				Potential bird habitat but reduces habitat quality for some species			
12	Tillage reduction	Soil protection			Fine sediment run off will reduce			See Review 9						Good for earth-worms			
13	Grass leys/convert to grassland/herbal leys	Conversion						See Review 9						Probable field-scale biodiversity benefits			

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												Biomass	Soil				
14	Afforestation/ agroforestry (positive enough for buffer strips etc., some agroforestry)	Trees and shrubs inc. agroforestry	Reduces area available for food production. / potential for displacement	More mixed system could increase resilience	Could help reduce runoff if well placed		See Review 9	See Review 8	See Review 8			Evidence needed	Increase field-scale biodiversity			Effect due to proximity/ increasing connectivity of Semi-Natural patches, especially with appropriate tree species	
15	Organic inputs	Manures and organic inputs			See Review 1			See Review 8	See Review 8	See Review 1			Positive for soil invertebrates and other taxa, if at appropriate levels				
16	Increasing manufactured fertiliser	Manufactured fertiliser and liming	Potential for increase if N limited		Potential risk for fresh waters			See Review 8	See Review 8	Displacement into fertiliser production						Risk of fertiliser movement into waters affected by location	

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SCM – Uplands																	
												Biomass	Soil				
17	Prevent drainage, restore peatlands	Peats, wetlands and floodplains					See Review 9										Scaling benefits likely for biodiversity and water quality
18	Prevent improvement, reduce grazing	Conversion / grazing					See Review 9						Some evidence that improvement and heavy grazing reduce SOC		Depends on current grazing regime; site- and habitat-specific	Depends on current grazing regime; site- and habitat-specific	
19	Burning/cutting management	Burning / cutting			Potential risks		See Review 9	Burning contributes to particulate emissions PM2.5s	Health risks linked to PM2.5s				Lack of evidence		Depends on current regime; site- and habitat-specific	Depends on current regime; site- and habitat-specific	Scale and proximity to urban centre needs to be considered with respect to health impacts

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20	Afforestation	Trees and shrubs inc. agroforestry	Could lead to displacement		Could be benefits but also risks depending on management (e.g. erosion during felling) and soil type (e.g. some soils could lead to acidification of waters).			See Review 9	See Review 8	See Review 8	See Review 7			Potentially beneficial on improved grassland, if using native tree species	Conversion of existing semi-natural habitat to a new one	Conversion of existing semi-natural habitat to a new one	Positive for other woodland, negative for open habitats; also potential benefits from landscape heterogeneity
Review 4: Building ecosystem resilience																	
Semi-natural habitat management of unimproved (including semi-improved) pastures and hay-meadows																	
21	Grazing within broad annual stocking density thresholds (lower and upper thresholds encompassing the range of situations appropriate for semi-natural habitats).	Grazing					See Review 9						See Review 3				

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22	Maintaining and improving the condition of existing habitats, (including semi-improved grasslands)	Vegetation management (mixed)						See Review 9					See Review 3				Important for common land to consider landscape issues
23	More detailed grazing interventions applicable to specific semi-natural habitats or mosaics of habitats, including variations in: <ul style="list-style-type: none"> a. Seasonal stocking thresholds; b. Temporal and spatial grazing patterns within the holding, including temporary/seasonal exclusion in particular areas c. Grazing livestock species and breeds, and combinations of species 	Grazing					See Review 9						See Review 3				

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24	<p>Management interventions generally applicable on semi-natural habitats to complement and/or facilitate appropriate grazing</p> <p>d. Temporally and spatially appropriate cutting and removal of vegetation such as scrub, bracken, rushes, etc.</p> <p>e. Improvement of fencing, gates, water points to facilitate appropriate grazing management.</p>	Vegetation management (mixed)					See Review 9					See Review 3					

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25	<p>Management interventions specific to certain habitat types:</p> <ul style="list-style-type: none"> a. Mowing and harvesting (hay meadows) b. Habitat appropriate fertilisation / liming (hay meadows) c. Blocking of drains and grips (blanket bog, wet grasslands) f. Re-establishment of appropriate native species on semi-improved land 	Cutting / Manufactured fertiliser and liming / peats, wetland and floodplains					See Review 9 for blocking of grips and drains						See Review 3				
26	Burning where appropriate (heather moorland)	Burning					See Review 9	Burning results in emissions of particulates PM2.5s	Health impact of particulates PM2.5s.				See Review 3			Very scale-dependent	Best practice is to create a mosaic. Scale and proximity to urban centres need to be considered

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Farm Woodland habitat management																	
												Biomass	Soil				
27	Retain and improve diversity within woodlands of: <ul style="list-style-type: none"> species by planting/natural regeneration of UK native species, including understorey species where appropriate; this would include PAWS tree species genotypes, especially for long-term resilience to climate threats (pests, diseases, drought) age structure and silvicultural system (incl. continuous cover, LISS, and long-term retention) diversity of open habitats, wet habitats within the woodland retention of deadwood 	Vegetation management (mixed)					See Review 9						See Review 3				

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												Biomass	Soil				
28	Control measures (fencing, limited grazing where appropriate) for livestock and deer	Livestock exclusion											See Review 3				
29	Improve connectivity of native woodland patches by allowing natural regeneration of native species (only) or planting	Trees and shrubs inc. agroforestry		Biosecurity issues include; Positives including separation of livestock: Negative potential for conduit for disease			See Review 9	See Review 8	See Review 8				See Review 3		Depends on the effectiveness of improvements to connectivity	Depends on the effectiveness of improvements to connectivity	Need to consider biosecurity issues / disease transfer – strategic decision
30	Use of tree species tolerant of future climate advised from modelling for creation and connectivity and under-represented native trees species	Trees and shrubs inc. agroforestry													Evidence tree species are moving north		

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												Biomass	Soil				
31	Control measures aimed at INNS, pests and diseases (covers a huge number of detailed interventions that are positive if effective but efficacy has not always been proven)	Other													Big mix of interventions	Big mix of interventions	There are practical and economic issues when scaling up; should remove sources of inoculum
Trees and shrubs in farmland (inc. Agroforestry)																	
32	Habitat-appropriate management of existing: <ul style="list-style-type: none"> • scrub habitats • parkland (including veteran trees) • hedgerows/ cloddiau, • trees in hedges, in field boundaries, in fields, in ffridd • old orchards 	Trees and shrubs inc. agroforestry					See Review 9						See Review 3				The ffridd has important mosaic landscape considerations

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance			Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition		Improve condition of semi-natural habitat
												Biomass	Soil				
33	Creation of new agroforestry on arable/improved grassland	Trees and shrubs inc. agroforestry	Could lead to displacement. May balance out for agroforestry, depending on details.					See Review 9	See Review 8	See Review 8	See Review 3 and 7	See Review 3 and 7	See Review 3 and 7				Potential benefits from specific agroforestry
34	Restoration of silvopastoral systems on appropriate semi-natural habitats	Trees and shrubs inc. agroforestry						See Review 9	See Review 8	See Review 8	See Review 3 and 7	See Review 3 and 7	See Review 3 and 7		Shifts in species likely to result	Shifts in species likely to result	
35	Ensure eligibility of land with trees and other woody plants for SFS (compared to current CAP rules, which restrict eligibility of some farmland with trees and shrubs of biodiversity vale)	Benchmarking, baseline and skills													Evidence that CAP rules don't work and degradation of ineligible land/ woody features	Evidence that CAP rules don't work and degradation of ineligible land/ woody features	Evidence that CAP rules don't work and degradation of ineligible land/ woody features
All habitat interventions																	
36	Skills interventions: <ul style="list-style-type: none"> assessors farmers 	Benchmarking, baseline and skills															Farmer facilitation fund work in progress

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance			Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition		Improve condition of semi-natural habitat
												Biomass	Soil				
37	Introduce pilot result-based payment schemes for key farmland habitat types	Benchmarking, baseline and skills													Research currently in progress	Research currently in progress	
Review 7: Systems approach to GHG reduction																	
38	Assessment of GHG emissions at a farm scale	Benchmarking, baseline and skills	Emissions intensity improvements increasing productivity		Depending on the mitigation measures			Measure specific		Tool for the identification of measures			See Review 3				
39	Recording Farm Scale sequestration for woody biomass	Benchmarking, baseline and skills											See Review 3				
40	Recording of Farm Scale Carbon Sequestration from Grass	Benchmarking, baseline and skills											Large variation and uncertainty				
41	Additional Farmer administration	Benchmarking, baseline and skills								Likely requirement guidance							
42	Aggregation of data to provide Industry Indicator	Benchmarking, baseline and skills	Better targeting of activities							Benefits in understanding farm-scale emissions							

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance			Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition		Improve condition of semi-natural habitat
												Biomass	Soil				
Review 8: Improving Air quality and well-being																	
43	Reduction of manure at source; Improved manure storage; Improved manure spreading. (Fertiliser application covered under 'Soil nutrient management')	Manures and organic input	Some potential for reduced productivity, but mostly neutral		Magnitude depends on measure			Magnitude depends on measure. Some (e.g. manure spreading) may not be effective in reality)	Reduced NH3 emissions	See Review 1 and 7 Mixed. Some small potential to increase N2O, or CH4 emissions (e.g. manure storage)	See Review 1 and 7	See Review 3		Targeting emissions management, and woodland capture can maintain pristine habitats in good functioning condition		Benefits multiply at scale. Keeping clean areas pristine benefits biodiversity	
44	Land Use Change (Conversion from intensive to semi-natural or extensive)	Conversion	Reduced productivity / displacement				See Review 9		Reduced NH3 emissions		See Review 7	See Review 3				Benefits multiply at scale	
45	Woodland planting near to point sources, as buffers adjacent to protected areas, and in wider landscape	Trees, shrubs incl. agroforestry	Some loss of productive land		Mixed. Some potential to intercept nutrients, but potential for pollution swapping		See Review 9	Reduced concentrations	Reduces concentrations of PM, NH3 and other pollutants. Magnitude varies.	See Review 7	See Review 7	See Review 3		Context dependent	Context dependent	Benefits multiply at scale. Targeting planting locations can maximise health benefits	

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance			Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition		Improve condition of semi-natural habitat
												Biomass	Soil				
Review 9: Flood Mitigation																	
46	Floodplain and wetland restoration	Geomorphological and structural	Flooding reduces productivity					See Review 8	See Review 8	See Review 7	See Review 7	See Review 3					
47	Floodplain woodland	Trees, shrubs incl. agroforestry ; Peats, wetlands and floodplains	Timber production					See Review 8	See Review 8	See Review 7	See Review 7	See Review 3					
48	Leaky barriers	Geomorphological and structural	Flooding of riparian areas reduces productivity							See Review 7	See Review 7	See Review 3					
49	Offline storage areas	Other (Geomorphological)	Reduces productivity when filled with flood water							See Review 7	See Review 7	See Review 3					
50	Catchment woodland	Trees, shrubs incl. agroforestry	Timber production					See Review 8	See Review 8	See Review 7	See Review 7	See Review 3					
51	Cross-slope woodland	Trees, shrubs incl. agroforestry	Timber production					See Review 8	See Review 8	See Review 7	See Review 7	See Review 3					

No.	Topic & Intervention	Intervention type*	Productivity		Water			Air Quality		GHG balance			Functioning Habitats			Major added value of a landscape / proximity / catchment approach	
			Increased or decreased (latter could lead to displacement)	Resilience	Reduced pollutants to fresh waters	Reduced pollutants / pathogens to coastal waters	Flood mitigation	Reduced emissions	Public Health and Well-being	Reducing GHG emissions	Improving GHG emissions intensity	Protecting and increasing the Wales carbon sink		Improved land	Maintain semi-natural habitat if in good condition		Improve condition of semi-natural habitat
												Biomass	Soil				
52	Riparian woodland	Trees, shrubs incl. agroforestry; Peats, wetlands and floodplains						See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				
53	Run-off pathway management	Geomorphological and structural															
54	Headwater drainage management	Peats, wetlands and floodplains											Peat conservation		Functioning peatland	Functioning peatland	
55	Soil and land management (arable)	Vegetation management (mixed)	Increase with soil condition	Increase with soil carbon						See Review 7	See Review 7		See Review 3				
56	Soil and land management (grassland)	Vegetation management (mixed)								See Review 7	See Review 7		See Review 3				
57	Woody landscape features	Vegetation management (mixed)	Pollination benefits	Pollination benefits				See Review 8	See Review 8	See Review 7	See Review 7		See Review 3				

Table 2.1.2 identifies where interventions of a similar management type have been separately considered in different reviews. The many amber codings illustrate the many trade-offs and co-benefits of different interventions. The different colour coding for similar interventions also illustrates that the intended target and context of how the intervention is implemented is critical.

Table 2.1.2 The 57 interventions which have been reviewed, classified by 14 management types and the final colour coding.

Management type	Review No.	Intervention number	Blue	Amber	Pink
Manufactured fertiliser and liming	1, 3, 4	1,7,10,16,25	2	1	2
Grazing	3, 4	3,18,21,23	2	2	
Manures and organic inputs	3, 8	6,15,43	3		
Vegetation management (mixed)	2, 3, 4	2,5,11,21,22	4	1	
Trees and shrubs incl. agroforestry and wet woodlands	3, 4, 8, 9	9,20,27,29,33,34,45,47,50,51,52,57	2	10	
Conversion (not involving woody vegn)	3, 8	8,13,18,44	3	1	
Soil protection	3, 4, 9	11,22,55,56	1	3	
Peats, wetlands and floodplains	3, 4, 9	17,25,46,47	2	2	
Burning	3, 4	19,26		2	
Cutting	3, 4	4,19,24,25	2	2	
Livestock exclusion	4	24,28	2		
Invasives, non-native species and pests and disease				1	
Geomorphological and structural	9	46,48,49,53		4	
Benchmarking, Baseline and skills	1, 4, 7	1,35,36,37,38,39,40,41,42	6	3	

2.2 Selection of interventions to support

Clearly the final list of interventions to be supported will be dependent on policy priorities and cost-benefit assessments. Most interventions examined were worthy of

consideration with some clear 'Blue' interventions within all 14 management categories.

However, the team are keen to point out 'Amber' does not indicate the intervention is not supported by the expert reviewers. Rather it is our attempt to be transparent and promote an adaptive approach to keep ahead of increasing challenges in a post Brexit world combined with increasing challenges related to climate change. The amber coding reflects that, whilst the evidence base is limited and/or there are operational issues that need to be considered, the logic chain is consistent and the intervention could be worth supporting in the scheme if displacement and other potential risks are taken on board. In all cases and for all interventions being considered, we would encourage the specific review is read in depth rather than relying on the summary table.

Increasing uses of manufactured fertiliser were the only interventions that received a 'Pink' coding. The evidence base, including the greenhouse gas emissions associated with the manufacture of fertiliser and increased risks to water quality, outweigh the potential benefits.

2.3 The importance of spatial configuration of interventions in a landscape

An important spatial contextual element was highlighted for many interventions. This often related to important added value that could be achieved, or indeed the necessity for a benefit to be realised, from the spatial configuration of the intervention in the landscape. This spatial element tends to be strongest in the water quality, flood mitigation, air quality and biodiversity interventions. Benefits could be related to interventions being close to point sources of pollution or to the synergistic effects of applying the interventions in adjacent farms within a catchment or landscape. It should be noted, however, that there may also be unanticipated negative effects if some variation is not maintained in the landscape. For example, there is a risk of synchronising flood waves from sub-catchments, by reducing variability in catchments, and also of providing unintended corridors and connectivity for disease and invasive and non-native species by universal application of 'better connectivity' principles. Nevertheless, developing elements of the scheme to capture the benefits of contiguous application of interventions within a catchment could be beneficial.

2.4 Metrics and verification and support for an adaptive approach

Overall, the team supports an adaptive / flexible approach to ensure suitable changes can be made as new evidence emerges from research and ongoing monitoring and evaluation. No review is ever complete and the time limit for these reviews was particularly challenging. In particular, we would encourage a sharing of this evidence base with other countries currently reviewing the evidence base (e.g. Natural England for Defra) to compare and to challenge our findings.

It should also be noted that the nine reviews contain many suggestions and issues relating to metrics and verification issues that are not summarised here.

Adaptation of the new scheme as new evidence emerges or as new priorities are set could include:

- Improved targeting
Arising, for example, from (a) unexpected new farming practices in an area, (b) new evidence of point sources of pollution that would yield greater impact if controlled or (c) evidence of ecological thresholds and their location that could yield greater benefits if targeted.
- Change in payment rates for interventions
Arising from change in costs associated with an intervention and/or improved evidence base of a lower or higher impact / return for investment in an intervention over time.
- Change in the specifics of an intervention / management practice
Arising from new evidence, such as feedback from monitoring of intervention effects, of the specific practical operational requirements for an intervention to reduce trade-offs or to improve the magnitude or permanence of the intended outcome.
- Introduction or removal of an intervention
Arising, for example, from (a) fundamental changes in the causal evidence chain (e.g. new research evidence), (b) shifts in the socio-economic environment that make an intervention change its current status, or (c) emergence of a new approach not previously considered.

3. Summary IA Table for Evidence Review Annex-4B (Improved Farmland)

The review for *Building Ecosystem Resilience in Improved Land* (Technical Annex-4B/ERAMMP Report-25) was commissioned later than the other reviews and a re-working of the structure of the IA table to provide the granularity of information for different biodiversity taxa was agreed.

Table 3.1.1 Summary table for all interventions in Evidence Review Annex-4B: Improved Farmland. This table contains a summary of the evidence base of potential outcomes from a range of interventions that have been reviewed by the Annex-4B team. Note that the Biodiversity Outcomes have been further broken down into taxa as both target taxa and outcomes may vary. The colour coding for each outcome for each intervention indicates the status of the evidence base for the specific outcome when this has been considered. No overall colour coding for an intervention was provided by the team as for Table 2.1.1. Links to other outcomes namely air quality, water quality and greenhouse gas balance are included where there had been time to consider these or there was a clear link across to previous reviews and Table 2.1.1. There are also notes on landscape context which should be considered for any intervention as well as potential impacts on agriculture production.

Colour Key:

- **Blue** = well tested at multiple sites with outcomes consistent with accepted logic chain. No reasonable dis-benefits or practical limitations relating to successful implementation.
- **Amber** = agreement in the expert community there is an intervention logic chain which can be supported but either evidence is currently limited and/or there are some trade-offs or dis-benefits which WG need to consider.
- **Pink** = either expert judgement does not support logic chain and/or whilst logic chain would suggest it should work there is evidence of one or more of the following:
 - its practical potential is limited due to a range of issues (e.g. beyond reasonable expectation of advisory support which can be supplied and/or highly variable outcome beyond current understanding or ability to target),
 - the outcome/benefit is so small in magnitude with few co-benefits that it may not be worth the administration costs,
 - there are significant trade-offs.
- **Grey** = out of scope of the review task.
- **White** = not relevant to intervention or not considered due to time constraints.

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
Grassland infield management														
1	Reduce fertilizer, pesticide or herbicide use; use organic rather than mineral fertilizers	Nutrient and control chemicals	Potential for loss e.g. if fields are N limited, potentially improved long term sustainability	Equivocal evidence for positive and negative effects and little potential for input reductions in Wales		Some positive effects, but many studies confounded by other grassland extensification measures and limited evidence for Wales	Little evidence for effects on target species, effects and little potential for input reduction in Wales			For most animal taxa, semi-natural habitat nearby may affect outcomes	Further management may be required to see benefits.	Potential for reduced NH ₃ emissions	Potential benefit for freshwater quality	Reduced GHGs from production of agro-chemicals, although some soil C may be lost
2	Adapt mowing or first grazing dates on improved or semi-improved grassland; use mowing techniques to reduce mortality; leave uncut patches in silage fields	Cutting	Potential for loss e.g. during ungrazed period, but gain if land formerly overgrazed	Positive effects of specific mowing patterns for some species but not clear in all studies			Positive effects when mowing very infrequent (2-3 year intervals)			Refuge habitat nearby has critical influences on some mowing effects	There may be added value with other interventions			
3	Change grazing management, including mob grazing	Grazing		Little studied – timing of mob	Limited evidence	Limited evidence								

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
				grazing impact would be critical and could be strongly negative	on mob grazing	on mob grazing								
4	Manipulate silage mowing height	Cutting	Possible yield loss	One trial showed no benefit and a practical design flaw										
5	Convert improved/semi-improved grassland to (more) species-rich grassland	Conversion	Mixed evidence for effects on productivity	Not studied directly but should at least have local benefits			No evidence; should at least have local benefits		Habitat creation would build connectivity of semi-natural habitats	Some species need to colonise from nearby semi-natural sites	Intervention may be required to decrease soil fertility	Potential for reduced NH ₃ emissions	Some potential for interception of nutrients	Reduce GHGs from production of agro-chemicals, and potential soil C gain
Arable infield management														
6	Reduce fertiliser, pesticide or herbicide use	Nutrient and control chemicals	lower yields/more crop losses although reduction	Increased invertebrates/ food availability, but	Increased floral diversity	Increases in pollinators,	Increased invertebrates for insectivores in theory,			Landscape context important, studies show if context not	Synergies with crop rotation, cover crops, increasing	Potential for reduced NH ₃	Potential benefit for freshwater quality	Reduced GHGs from production of agro-

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
			rather than cessation less impact - , potentially improved long term sustainability	limited evidence of population-level effects	and arable weeds	arthropods, soil biota	but no evidence			supportive then these options only have local effects.	semi-natural habitat to enhance natural protection/nutrients			chemicals although there may be displacement of production
7	Use organic rather than mineral fertilisers; input other organic matter	Manures and organic inputs	increases in plant productivity and food production	Not tested, no effect expected as nutrient quantity is more important than type	Not tested, no effect expected as nutrient quantity is more important than type	Positive for soil inverts- from previous ER	Not tested, no effect expected as nutrient quantity is more important than type				Can maintain soil quality in reduced tillage, synergies with crop rotations and cover crops		Nitrate leaching	Reduced GHGs from production of agro-chemicals, increased SOC, but Increased N2O emissions
8	Reduced tillage	Soil protection	Reduced yield short term, long term sustainability , if combined with other options e.g. cover crops, crop rotation effects can be minimised	Only weak, inconsistent evidence for positive effects – food supply benefits may be outweighed by	Increases plant diversity but also weeds which may lead to increased herbicide use	Increase invertebrates, pest predators, earthworms	Increased small mammal density and diversity			Mitigates potential problems if there is more semi-natural habitat	Important to implement RT with other options e.g. organic fertiliser, cover crops, crop rotation to ameliorate negative effects		If higher herbicide use then negative effects , potential sediment retention	Mixed evidence of impacts on SOC, some evidence of increased N2O emissions

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
				effects of approaches to weed control.										
9	Introduce or modify crop/grassland rotations; companion cropping; undersow spring cereals; and cover/catch crops (including legumes)	Vegetation management (mixed)	Increased yields particularly with N fixing crops,	Widely variable interventions with a range of effects: more complex rotations are likely to be positive for most species, cover crops mostly negative and under-sowing possibly positive	Reduced plant diversity by weed suppression but overall benefits of less herbicide	Increases in pollinators, arthropods, soil biota	Increased small mammal density and diversity. Cover crops provide winter cover for brown hare			Improved biodiversity where more semi-natural habitats; effects are likely to be greater where changes create more contrast in landscapes	Synergies with RT, organic inputs, margins		Reduction in inputs, less N leaching and herbicides	Cover crops decrease N ₂ O emissions short term but increases longer-term due to interactions with C cycle
10	Leave overwinter stubbles, unsprayed, into late winter	Vegetation management (mixed)	Minimal effects if part of a spring	Clear positive	Lack of spraying could increase		Positive effect found for			Unlikely to be practical where rotations do		If stubble retention is encouraged, should		

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
			cropping regime	effects on birds	diversity depending upon seed bank/sources		brown hare				not include spring cropping. Will be more effects in landscapes with less existing seed-rich winter habitat.		reduce nutrient leaching and enhance water quality	
11	Leave overwinter stubbles unsprayed and follow with a spring fallow	Vegetation management (mixed)	Loss of production from a fallow year but possible longer-term benefits from fallowing	Strong evidence for habitat selection; specific population effects not yet clear	Diverse flora and vegetation structure	Increases in invertebrate diversity	Positive effects on brown hare						Should reduce nutrient leaching and enhance water quality	
12	Fallow/unsown plots	Vegetation management (mixed)	Small negative effects on yield are inevitable	Positive effects on skylark, stone curlew and lapwing	Positive effects vascular plants	Mixed effects on invertebrates					Likely to be more effective where spring cropping is rarer		Should reduce nutrient leaching and enhance water quality, but at a very small scale	

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
13	Arable reversion and landscape heterogeneity	Conversion	Negative effects on arable yield are inevitable, but if converted to grassland may be livestock production	Only limited evidence for benefits, but may deliver benefits via landscape heterogeneity in arable areas	Depends on whether restoring species rich sward or low diversity grass mix	This option can have significant positive effects on invertebrate diversity, but this depends on the type of grassland being restored				Positive in heterogeneous landscapes	Likely to be more effective where arable is dominant		Should reduce nutrient leaching and enhance water quality	Converting arable to grassland increases soil C and probably reduces GHGs from agrochemical production, but displacement effects possible
Organic farming														
14	Organic farming)	Other	Reduced yields but are context dependent (soil type, crop type, management) and may reduce over time	Positive effects on the abundance and diversity of birds (via resources used), but often related to habitat rather than	Positive effects plant diversity	Positive many invertebrates, butterflies, earthworms, etc.	Increased bat activity but linked more strongly to habitat structure rather than organic per se)			More effect locally, landscape context more important. Less effect in heterogeneous landscapes	Synergies with crop rotation, cover crops, increasing semi-natural habitat to enhance natural protection/nutrients	Potential for reduced NH3	Potential benefit for freshwater quality	Reduced GHGs from production of agrochemicals although there may be displacement of production

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
				management per se										
Modified management of strips/plots around the field														
15	Permanent grass buffer strips/margins along field edges or within fields	Vegetation management (mixed)	Mixed evidence impacts on yield	Positive for birds in terms of habitat use, but little evidence of population impacts	Positive plant diversity	Increased pollinators, other inverts	Hedgehogs, brown hare and small mammal communities use grass margin buffers	Benefits for common toad, grass snake and common lizard	Increase connectivity particularly in simple highly modified landscapes	Landscape context is important. Mixed evidence as to whether more successful in heterogeneous or simple landscapes	Synergies with other options, crop rotation, cover crops, RT; direct tests for interaction effects on birds have failed to show clear effects and evidence for negative interactions with fallow plots for skylark	Potential for reduced NH3	Act as buffer strips to retain pollutants, possibly reduced inputs e.g. pesticides	Reduced GHGs from production of agro-chemicals Enhancement topsoil SOC
16	Conservation headlands (unsprayed crop); unharvested cereal headlands	Vegetation management (mixed)	Inevitable small reductions in yield	Positive some species locally, less evidence at the population level, but	Positive plant diversity	Positive inverts				Landscape context likely to be important for species pool	Synergies with other options, crop rotation, cover crops, RT	Potential for reduced NH3	*	Reduced GHGs from production of agro-chemicals

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
				an uncommon option										
17	Beetle banks	Vegetation management (mixed)	Loss of cropped area but gain of ecosystem services?	Limited, local effects on birds		Positive effects on inverts but lower than grass filed margins					Likely to be more effective in more intensive arable landscapes with little semi-natural habitat			
18	Plant nectar flower mixture/wildflower strips	Vegetation management (mixed)	Inevitable reductions in cropped area and yield	Some evidence of impacts on specific birds, via increased invertebrates, but may be too small-scale	Increases in plant diversity-may decline over time	Increases in pollinators				Impact of landscape context taxon-dependent	Synergies with other options, crop rotation, cover crops, RT			

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)			
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance	
19	Plant winter bird food/cover strips	Vegetation management (mixed)	Inevitable reductions in cropped area and yield	Strong evidence of positive association with habitat selection and population growth, but recent evidence suggests may break down in the long term				Possible positive effect via cover for brown hare			May be more attractive in pastoral rather than arable	Will be more effects in landscapes with less existing seed-rich winter habitat (e.g. pastoral landscapes).			
20	Leave cultivated, uncropped margins	Vegetation management (mixed)	Inevitable reductions in cropped area and yield	No evidence for benefits to birds; may benefit in principle but too small-scale	Varying cultivation and timing increases diversity	Can be higher invert richness but cultivation causes mortality of some species									

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
Management of agriculturally unproductive land and features														
21	Management of farm ponds	Peats wetlands and floodplains	Wetland features play a well-evidenced role in nutrient management and flood risk management	Clear benefits of wetland management.				Clear benefits of wetland management, but also possible disease facilitation for frogs	Clear benefits of wetland management, but also possible disease facilitation for frogs	Evidence shows strong influences of surrounding landscape on wetland and watercourses.	Evidence of management effects driving enhancement if surrounding factors are also managed eg. nutrient surplus impacts on restored or enhanced wetlands..		vidence of management effects driving enhancement if surrounding factors are also managed eg. nutrient surplus impacts on restored or enhanced wetlands.*	Possible increase in NO2 emissions from reedbeds.
22	Management of hedges and wooded linear features	Tree and shrub management	No impact as unproductive features.	See ERAMMP Report-4: <i>SFS Evidence Review Annex-4 Building Ecosystem Resilience</i> for evidence of beneficial management on these groups.				Documented benefit for wooded stream and riversides.	Benefits documented for invertebrate movement and birds. More equivocal for plants.	Evidence shows strong influences of surrounding landscape	Evidence of management effects driving enhancement if surrounding factors are also managed eg. nutrient surplus	Documented benefit to air quality and pollutant interception.		Optimising C sink depends on appropriate management and downstream use of woodstock.

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)			
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance	
23	Management of farmland trees and woodland	Tree and shrub management	No impact as unproductive features except if part of the farm economy.	See ERAMMP Report-4: <i>SFS Evidence Review Annex-4 Building Ecosystem Resilience</i> for evidence of beneficial management on these groups.					Management effects depend upon the target species and whether mid-successional versus woodland habitat is beneficial.	See ER4 and National Forest for Wales evidence pack for evidence supporting positive influence of proximity to semi-natural habitats and long-continuity woodland.	See ER4 and National Forest for Wales evidence pack for evidence supporting positive influence of proximity to semi-natural habitats and long-continuity woodland.	Evidence of management effects driving enhancement if surrounding factors are also managed eg. nutrient surplus	Documented benefit to air quality and pollutant interception.		Optimising C sink depends on appropriate management and downstream use of woodstock
24	Management of small areas of semi-natural habitats and features embedded within improved land	Vegetation management (mixed)	These are agriculturally unproductive areas so no impact.	More evidence required to support the net benefit of management to the feature, especially where small, in poor condition and disconnected, and at larger scales. Effects will also be specific to the type of habitat.						Evidence shows a strong effect of surrounding land use intensity on the refuge function of small features and linear features.	Logic suggests that reinstating disturbance and connection to improved land could result in greater exposure to nutrient surpluses. Evidence is				

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)		
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance
											limited though.			
25	Creation of new woodland and agroforestry on improved farmland		See ERAMMP Report-32: National Forest in Wales – Evidence Review											
Other interventions														
26	Provide supplementary food for birds or mammals	Other	No effect	Evidence for benefits for granivorous species in trials, but limited in effect size and not demonstrated in real AESs			No trials or evidence for effects on any species of interest; not suggested as a relevant approach			Effectiveness and value likely to depend on ambient resource availability, i.e. cropping and seed-rich habitats, as well as target species densities	In theory, effectiveness should be related to complementary resource availability, such as breeding habitat, which may be provided or enhanced by other interventions, but no supporting evidence			
27	Control predatory mammals and birds (foxes, crows, stoats and weasels)	Other	No effect	Evidence supports positive effects in some specific			No trials or evidence for effects on any species of interest;			Efficacy is certain to be affected by factors such as predator population	Other AES management would be expected to provide resources for			

No.	Topic & Intervention	Intervention type*	Agriculture Productivity	Biodiversity taxa					Landscape considerations			Trade-offs and co-benefits (SFS Evidence Pack)			
			Increased or decreased (possible displacement effect)	Birds	Plants	Inverts	Mammals	Herptiles	Connectivity	Landscape context dependency	Synergy with other intervention	Air quality	Water	GHG balance	
				contexts, but yet developed or tested as a defined intervention and there are significant practical and theoretical issues with implementation				not suggested as a relevant approach			context and the alternative resources that support predator abundance, but specific studies have yet to be done	predators or to discourage them, but this has not been investigated directly			
All improved land interventions															
28	Skills interventions: <ul style="list-style-type: none"> Assessors Advisers farmers 	Benchmarking, baseline and skills													
29	Introduce pilot result-based payment schemes for key improved land interventions	Benchmarking, baseline and skills													

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