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IMPACT ASSESSMENT

Common Agricultural Policy towards 2020

ANNEX 2C

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Annex 2C: Available information on costs of greening

1. INFORMATION IN RURAL DEVELOPMENT PROGRAMMES

It is assumed that the level of aid for similar measures in rural development calculated based on costs incurred / income foregone could be used as proxy of costs of greening measures within first pillar. See below table with level of agri-environmental premiums (based on RDP 2007-2013):

	Green cover	Crop rotation	Ecological set-aside	Permanent pastures (AEM on PP are often going beyond "minimum maintenance")
AT	€130 arable land €50 catch crops in maize			€350 (up to €750)
BE	€100			€200-240
BG		€76		€97 €155 for restoration and maintenance of overgrazed grassland
CZ	From €104 to 401			€75; up to €417 with management
DE	€70-85 as starting level	From €20 to 100	€120-140 as starting level	€75-120 for extensive grassland (most basic)
DK			€161	€188 if grazing; €107 if mowing;
EE	A part of a measure (whole measure €80)	A part of a measure (whole measure €80)		
ES	€100-145 winter cover in arable; €100-430 vineyards €90-240 permanent crops	(use of Art.68: €60)	From €35 to 144	From €20-57 for most basic up to €100-150 and above €200 for most demanding
FI	€30-45	€24 (crop diversification)	€50 grass area; €155-180 biodiversity field; €350/450 riparian zones	Up to €55 (extensive grassland production); €224 extensive cultivation of perennial grassland
FR	Starting with €230-300 (in DOM)	€32	Max €600 (Guyane)	€76 for most basic; up to €150
HU				€108 if grazing; €71 if mowing; €250 conversion of arable into grassland
IE	€80		€23 for management of set-aside	€314
IT	~ €150	~ €150	~ €500	~ €280
LT	€145		€160 for conversion of arable into meadows; €62 if special crops to be sown in certain periods	€98 for meadows; €109 water bodies in meadows; €168-229 if wetlands
LU			€325	€107
LV	€87			€123
MT		€312		
NL		€150 (basic) (crop diversification)		€69 (up to €2190)
PL	€84-108 depending on type of cover			€128
PT			From €100 to €200	€100 (basic) up to €200 in HNV
RO	€130			€124
SE	€55 €100 if catch crops;		€222 €333 for riparian strips along watercourses	€5-222 €138-600 if specific management added
SI	€83; (€31 grassland, €184 permanent crops)	€91		€48
SK	€158 (for both rotation and green cover in one measure)		€45 (buffer strips)	From €65 for basic to 186 for more requirements

UK	~ 150€ for most basic ones	from €102	€300-480 (Wales); €435-510 (N.Ireland)	from €50/110 for basic ones to €280

Examples of calculations:

FR / Extensive grassland premium in AEM:

- Description des engagements

Eléments techniques	Méthode de calcul	Formules de calcul	Surcoûts et manques à gagner annuels	Montant annuel
Maintien de la quantité de surfaces engagées pendant 5 ans Le labour des prairies permanentes engagées est interdit. Seul un renouvellement au cours des 5 ans est autorisé, par travail superficiel du sol. Le retournement ou le déplacement des prairies temporaires engagées est autorisé une fois au plus au cours des 5 ans de l'engagement, dans la limite de 20% de la surface engagée pour le cas général et de 35% de la surface engagée pour les exploitations situées dans des départements de zone de montagne sèche[5].	Manque à gagner : diminution de rendement sur les prairies temporaires non retournées Gain : achat des semences sur les prairies temporaires non retournées	= 9% de prairies temporaires non retournées en 5 ans x (perte de productivité passage d'une PT à une PP : 1,5 t/ha/an en moyenne x 800 UF/t MS x 0,14 €/UF = 168 €/ha - achats de semences "herbe" : 75 € /ha)	8,37 €	
Obligation d'existence d'éléments de biodiversité à hauteur d'au moins 20% de la surface engagée (voir liste à suivre et coefficients de correspondance). Maintien de la totalité des éléments de biodiversité sur les surfaces engagées.	Non rémunéré		- €	

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[5] Dans le cas des exploitations pratiquant la transhumance, les surfaces d'estives collectives sont comptabilisées dans la surface engagée de l'exploitation individuelle, au pro-rata de leur utilisation. Les départements de zone de montagne sèche sont les suivants : Alpes-de-Haute-Provence, Hautes-Alpes, Alpes-Maritimes, Ardèche, Aude, Aveyron, Drôme, Gard, Hérault, Lozère, Pyrénées-Orientales, Tarn, Var et Vaucluse.

Pour chaque parcelle engagée, respecter les conditions suivantes : - fertilisation totale en N limitée à 125 unités/ha/an, dont au maximum 60 unités/ha/an en minéral. - fertilisation totale en P limitée à 90 unités/ha/an, dont au maximum 60 unités/ha/an en minéral - fertilisation totale en K limitée à 160 unités/ha/an, dont au maximum 60 unités/ha/an en minéral La restitution au pâturage n'est pas prise en compte.	Manque à gagner : diminution de rendement Gain : économie d'achat et d'épandage des fertilisants minéraux	= perte rendement fourrager liée à l'économie de 55 UN : 2,24 € /UN économisée x 55 UN économisée/ha par rapport à un apport de référence de 180 UN total/ha - économie réalisée sur l'achat d'azote minéral : 0,66 € /UN x 30 UN minéral économisée par rapport à un apport de référence de 90 UN minéral /ha - économie d'un épandage : 1 heure/ha x (16,54 €/heure de main d'œuvre + 14,9 €/heure de matériel)	71,96 €	
Les apports de fertilisation sont enregistrés dans un document précisant au moins, pour chaque parcelle engagée, la date, la nature et la quantité de l'apport.	Non rémunéré		- €	
Désherbage chimique interdit, à l'exception des traitements localisés visant : - A lutter contre les chardons et rumex, - A lutter contre les adventices et plantes envahissantes conformément à l'arrêté préfectoral de lutte contre les plantes envahissantes et à l'arrêté DGAL « zones non traitées » A nettoyer les clôtures.	Non rémunéré		- €	
Maîtrise mécanique ou manuelle des refus et des ligneux, par gyrobroyage, ou selon les préconisations départementales.	Non rémunéré		- €	
Ecobuage dirigé suivant les prescriptions départementales, ou, en l'absence de telles prescriptions, écobuage interdit.	Non rémunéré		- €	
Interdiction de nivellement et de nouveau drainage	Non rémunéré		- €	
Total			**80,33 €**	**76,00 €**

Sources : productivité moyenne des prairies permanentes et temporaires : barèmes calamités agricoles ; valeur fourragère : INRA ; prix du fourrage : institut de l'élevage (prix du marché : 0,14 €/unité fourragère) ; semences : groupement national interprofessionnel des semences (GNIS) ; perte de rendement par unité d'azote économisée : INRA d'Avignon, modèle STICS (simulateur multidisciplinaire pour les cultures standards), 20 kg de matière sèche/ha/unité d'azote à 0,8 unités fourragères/kg de matière sèche ; coût des fertilisants : institut de l'élevage (prix du marché de l'ammonitrate) ; temps de travail et coûts du matériel : fédération nationale des coopératives d'utilisation de matériel agricole (FNCUMA).

Tout bénéficiaire de ce dispositif s'engage à respecter les exigences de la conditionnalité et les exigences complémentaires relatives aux pratiques de fertilisation et d'utilisation de produits phytopharmaceutiques.

FR / crop rotation in AEM:

Description des engagements

Eléments techniques	Méthode de calcul	Formules de calcul	Surcoûts et manques à gagner annuels	Montant maximal annuel
Diversité à l'échelle de la succession de cultures, pour chaque parcelle engagée : - Présence d'un minimum de trois cultures différentes sur 5 ans - Non retour d'une même culture deux années successives sur la même parcelle Le gel sans production est considéré comme une culture pour la vérification de ces obligations.	Manque à gagner : écart entre la marge brute moyenne de l'assolement de référence et la marge brute moyenne de l'assolement cible, moins économies de traitements phytosanitaires Coût : temps de travail supplémentaire liés à la conduite de chantiers différents de cultures + temps de travail supplémentaire lié au fractionnement des parcelles	= marge brute hors prime PAC d'un assolement moyen blé sur 50% de la surface, et colza et orge sur 25% chacun : 474,71 €/ha - marge brute moyenne hors prime PAC d'un assolement cible « blé (47,5% de la surface) - colza (20%) - orge (20%) -autre (12,5%, moyenne tournesol, pois, seigle, triticale) : 453,16 €/ha - économie de traitement phytosanitaires : 10% traitements herbicides + 10% traitements hors herbicides = 10% x 45,64€/ha + 10% x 84,75€/ha = 4,56 + 8,48 = 13,04 €	8,14 €	
Diversité à l'échelle de l'assolement, pour l'ensemble des parcelles engagées : - Part de la culture principale inférieure à 45%, - Part des trois cultures majoritaires et du gel sans production inférieure à 90%		Deux chantiers différents supplémentaires : 16 h x 16,54 €/heure de main d'œuvre / 80 ha = 3,31 € Fractionnement des parcelles : 5 % x 390 € = [illegible]	22,81 €	
Total			30,95 €	32,00 €

Sources : marges brutes : RICA 2004 / SCEES / modèle « coûts de production » ; charges d'approvisionnement en traitements phytosanitaires : RICA 2004 – exploitations spécialisées en grandes cultures ; temps de travail et coûts du matériel : fédération nationale des coopératives d'utilisation de matériel agricole (FNCUMA).

Tout bénéficiaire de ce dispositif s'engage à respecter les exigences de la conditionnalité et les exigences complémentaires relatives aux pratiques de fertilisation et d'utilisation de produits phytopharmaceutiques.

Le niveau d'aide est de 32 euros/ha/an.

Adaptation régionale

Le dispositif s'appuie sur un cahier des charges national, il n'y a pas d'adaptation régionale possible.

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UK / Rough grass margin:

Establish a grass margin between 2m to 8m in width adjacent to a cereal or root crop.

Grass may be cut in the first year but must not be cut before 1 August.

There must be no use of herbicides unless to spot treat and control notifiable weeds or invasive alien species such as spear thistle, creeping thistle, curled dock, broad-leaved dock, ragwort, Japanese knotweed, rhododendron or Himalayan balsam. The land must be managed without any lime, inorganic or organic fertilisers manure, lime or slag.

Basis of Calculations

Land is currently under arable production

In agreement, arable production is lost

Cost for establishment in year 1 seed and cults (spread over 5 years)

Grass margins are on headland is 80% average level of production. However,

production is also reduced at edge of grass margin so 100% gross margin lost

Income Forgone

Income foregone due to loss of arable production	£
Gross Margin of average rotation	440.75
Cost of seed and cultivation for Grass Margin/ ha over 5 years	54.76
(cultivation £173.80 / seed £100)	
Topping twice during first five years £54.80 divided by 5	10.96
Income Foregone	506.47
Total	

Points allocation: 500/ ha

Limitations of using those amounts as costs of greening:

- The content of the measures are different in each MS and do not exactly correspond to the greening measures as envisaged. In general requirements in RD go beyond what is expected for greening.

- The way cost incurred/income foregone have been calculated is also different between MS.

- In RD, aid amount per ha are only paid for the share of farms for which the farmer has an AE contract and not to all hectares as it may be the case for greening

- Information are lacunar as some countries do not offer the "similar" measure in RD and thus level of aid has not been calculated

2. OTHER SOURCES OF INFORMATION

Other sources of information have been looked at however without any convincing quantitative elements that could be used directly in a model based on FADN. Several case studies have been conducted and give a good feel for the variability of conditions, costs, benefits, problems. This could be used for qualitative assessment. Some interesting § are quoted below (see underlined text concerning cost).

2.1. Study on Environmental impacts of different crop rotations in the EU

http://ec.europa.eu/environment/agriculture/pdf/BIO_crop_rotations%20final%20report_rev%20executive%20summary_.pdf

Section 5.1 deals with 'economic impacts of monoculture and crop rotations'. The summary is the following (page 87):

Profitability is a function of yields, prices and costs. As long as a chosen rotation system does not change significantly relations between those variables, there are no clear conclusions regarding financial performance of different rotation systems. The relationship between these variables remains broadly stable on the short-term, explaining why short-term comparisons do not yield significant results regarding the financial performance of different cropping systems. Gebremedhin and Schwab (1998) emphasise that "caution must be exercised while interpreting the results of comparative static economic analysis of cropping systems as results can be distorted by the production of multiple products, expanded performance criteria which are not easily valued, and use of different technologies. There is a need to analyse cropping systems as they generate their physical and financial performance over time". For instance, Katsvairo and Cox from Cornell University (USA, 2000) presented 6-year study results show, that "continuous maize under high chemical and soybean–maize–maize and soybean–maize rotations under low chemical management had similar net returns in ridge tillage (26€, 20€ and 13€/ha, respectively).

By adopting a long-term perspective and provided that the rotation effect, as defined in previous sections, is well captured by the farmer, the review of existing literature (see section 9. for the references on the economic analysis of cropping systems) strongly suggests that rotations allow for synergic effects in terms of yielding potential and reduced dependence on external inputs, thus resulting in higher profitability for rotations overtime, compared to monoculture.

However, the fact that the variability in profitability is significant both between cropping systems and within cropping systems illustrates the importance of farming practices in the overall economic balance of the farm. An adequate choice of varieties, cultivation techniques, and intensity of production is essential in increasing the economic returns of cropping systems.

2.2. IEEP study for DG ENV on costing the environmental needs related to rural land management

This study assesses overall costs to tackle environmental issues at EU level based on current public funding (mainly EARDF/AEM).

Extract of table A 6.1 (page 91 of annexes): Average, minimum and maximum payment rates for different types of management from a selection of RDPs:

Management Option	Number of reviewed RDPs in which options occur	Number of Options identified	Average Payment Rate	Median	Minimum Payment Rate	RDP	Maximum Payment Rate	RDP
MO4: Reduction of inputs (fertilisers and plant protection products).	6	20	€ 96	€ 73	€ 10	FI	€ 450	BE (Fl)
MO6: Conversion of arable land to grassland, environmental land use change	8	18	€ 313	€ 298	€ 101	HU	€ 733	UK (En)
MO7: Creation of Field Margins	7	18	€ 454	€ 467	€ 13	FI	€ 865	UK (En)
MO9: Crop Rotation and Diversification to Reduce Disease	2	2	€ 28	*	€ 24	FI	€ 32	FR
MO11: Fallow (whole field)	4	7	€ 152	€ 140	€ 102	UK (Sc)	€ 237	UK (Sc)
MO12: Fallow (zones - eg. Skylark *(Alauda arvensis)* plots)	2	2	€ 330	*	€ 15	BE (Fl)	€ 645	UK (En)
MO13: Forest conservation and restoration	5	52	€ 133	€ 121	€ 36	HU	€ 268	DK
MO17: Grassland Management	21	121	€ 230	€ 130	€ 7	NL	€ 1,103	DK
MO18: Grazing Management	2	11	€ 168	€ 153	€ 2	UK (Sc)	€ 450	DK
MO23: Organic Management	21	150	€ 351	€ 304	€ 7	UK (Sc)	€ 990	BE (Fl)
MO24: Over Winter Crops / Stubble Mgt	10	16	€ 128	€ 117	€ 11	FI	€ 390	NL
MO25: Soil Management	2	2	€ 97	€ 97	€ 94	SL	€ 100	IT (Li)
MO30: Organic conversion	11	61	€ 503	€ 438	€ 64	DK	€ 1,650	BE (Fl)

Source: Individual RDPs for the 2007-13 programming period

<u>As regards green cover and crop rotation:</u>

Case study 3: estimating the costs of agricultural soil conservation with a specific focus on the Murcia region of Spain

- Costs of maintaining overwinter stubbles (page 120 of annexes):

Two estimates have been found for the practice of retaining overwinter stubbles on annual herbaceous crops (mostly cereals for the Murcia Region). The Murcia Regional Government estimates a production loss of €28/ha for not being able to sell or graze the straw, whereas the Valencia Regional Government estimates such cost to be €26/ha. The cost estimate for the Murcia Region includes the cost of not cultivating the land left with crop residues on the following year (€32.6/ha). This cost is equivalent to increasing the fallow index in cereals from the current 40% to 100%. Therefore overall, the cost of maintaining overwinter stubbles would be €60.6/ha including the cost of increasing crop rotations. This estimate is similar to the €57/ha considered for cover crops in the Impact Assessment of the Soil Thematic Strategy (EC, 2006).

- Extract of table 5.19 (page 100): Costs of practices recommended for the soil erosion and organic mater content threats:

Practice	Increased costs (€/ha)	Reduced production (€/ha)	Source of the cost estimate	Observations
Buffer strips on the field	**400-800**		EC (2006)	Establishing 3-meters wide buffer strips for medium and high erosion respectively
	75-150	**20**	EC (2006)	Maintaining 3-meters wide buffer strips for medium and high erosion respectively
Keeping overwinter stubbles	**-**	**60.6**	CARM (2007)	Cost of not cultivating the following season: 32.6 (equal to the increase in fallow index to 100) Cost of not selling/grazing the straw: 28
	-	**26**	JA (2007)	Cost of not selling/grazing the straw: 26
Change crop rotations/Increase fallow index	**33.5-217**	**58.3**	CARM (2007)	Cost of increasing the fallow index from 40 to 100: 32.6

- Extract of Table 2.1: Estimated costs of addressing soil organic matter decline in the EU-27:

land use	**Total area (million Ha)**	**% area likely to be affected by threat**	**Management practices required to address key issues identified**	**% of area where management is needed**	**Total area (Mha) where management is needed**	**Cost per ha of achieving required area (€)**	**Total cost for measure (million €)**
productive arable	104.3	45	Incorporation of legumes into the ground	100%	47.0	**57**	2,676
productive arable	104.3	45	arable stubble management	100%	47.0	**44**	2,066
productive arable	104.3	45	no burning of stubble or crop remains	100%	47.0	**44**	2,066
productive arable	104.3	45	incorporation of crop remains	100%	47.0	**44**	2,066
productive arable	104.3	45	residue management - no removal with mulching crop remains and stubble	100%	47.0	**44**	2,066
productive arable	104.3	45	retaining stubble	100%	47.0	**44**	2,066
productive arable	104.3	45	conservation agriculture, with three underlying practices – reduced and no-tillage, cover crops and crop rotation	100%	47.0	**116**	5,447
productive arable	104.3	45	Catch crops / green manure / less fallow / winter cover	100%	47.0	**57**	2,676

productive arable	104.3	45	Adding legumes / N fixing crops to rotation or undersowing	100%	47.0	**57**	2,676
productive arable	104.3	45	Residue management	100%	47.0	**44**	2,066
agricultural land	172.5	100	catch crops	21	36.22	**57**	2,065
agricultural land	172.5	100	adding legumes	28	48.30	**57**	2,753
agricultural land	172.5	100	residue management - no removal	49	84.52	**44**	3,719

The cost estimates from the Murcia region are high proportionately in comparison with these estimates for the EU-27, even when the costs for soil organic matter are taken alone. However they constitute a more accurate reflection of the costs of management needed to address the specific soil degradation issues in this region, which has a higher proportion of land with soil related problems than in the EU as a whole.

This highlights the need to treat any estimation of costs that have been calculated for the EU-27, without recourse to detailed assessments at the national or regional level, with considerable caution. The detailed assessment and comparison of the costs and benefits of potential management options to address a particular environmental pressure, for example a decline in soil organic matter, will strongly depend on the extent of the pressure and the type and extent of the implementation of the options by Member States under local social, economic and environmental conditions.

As regards green cover for permanent crop:

9.4.5. Maintaining vegetation strips/field margin (page 120 of annexes):

Cost estimates for the practice of maintaining vegetation strips/margins have been obtained from the Regional Rural Development Programmes for Murcia, Andalusia and Valencia. The most detailed estimate in the Murcia Regional Government's one, that considers an average per hectare cost of maintaining vegetated strips on the range €109 to €669 for tree crops and €55 to €159 for annual crops, depending on slope. It also differentiates between the costs of maintenance and establishment costs which are shown respectively in Tables A9.10 and A9.11.

A relevant factor in these estimates the relatively lower cost compared with maintaining vegetated strips in steep slopes. The Murcia Regional Government estimated an average per hectare cost of maintaining vegetated strips in tree crops on the range €109 to €669 depending on slope, whereas the average per hectare cost of mulching using ground pruning residues was estimated at €136/ha (CARM, 2007). For slopes greater than 6% the latter would be less costly than the former, with the relative advantage increasing with slope.

Table A 2.1 Annual cost of maintaining vegetation covers in annual and tree crops

Tree crops				Annual crops			
Slope (%)	**Maintenance**	**Loss of production**	**€/Ha**	**Slope (%)**	**Maintenance**	**Loss of production**	**€/Ha**
5-6	33.50	73.50	109	5-7	30	25	55
7-9	45.50	94.50	140	8-9	34	28	62
10-12	55.50	115.50	171	10-11	41	35	76
13-15	71	147	218	12-13	49	41	90
16-18	106	221	327	14-15	60	51	111
19-20	217	452	669	16-17	75	63	138
				18-19	86	73	159

Source: CARM (2007).

Table A 2.2 Capital cost of establishing vegetation covers in annual and tree crops

Tree crops		Annual crops	
Slope (%)	**€/Ha**	**Slope (%)**	**€/Ha**
5-6	130	5-7	148
7-9	172	8-9	164
10-12	211	10-11	202
13-15	268	12-13	240
16-18	396	14-15	291
19-20	787	16-17	358
		18-19	408

Source: CARM (2007).

The Valencia Regional Government considers a €50/ha cost for the establishment, maintenance and control of cultivated or natural vegetation cover under tree crops, regardless of the slope, but does not provides any justification of such cost estimate. The Andalusian Regional Government considers an annual cost of €110 - €120/ha for the establishment, maintenance and control of cultivated or natural vegetation cover under tree crops, regardless of the slope. We are inclined to use the Murcia Regional Government estimates as they have been calculated based on the technical recommendations by a group of regional soil experts, are disaggregated in their different cost components and are discriminated by slope and type of crop. The cost estimates from the Valencia and Andalusia Regional Governments are not disaggregated in their cost components and therefore hide some of the detail necessary for this study. Moreover, the Murcia regional estimates are of a similar order of magnitude to estimates for other countries such as England (Stevens *et al*, 2009).

Four significantly different cost estimates for the use of chopped pruning residues as soil mulch have been found. The Murcia Regional Government provides an estimate of €136/ha for tree crops, whereas the Andalusia Government estimates €60/ha for vineyards, which appears unusually low. Calatrava and Franco (2011) provide an average cost of €175/ha from 250 Andalusian olive farmers' responses to a survey questionnaire, whereas the Murcia farmers surveyed expressed an average of €209/ha. We will again use the costs estimates for the Murcia Regional Government due to the way in which they were calculated.

Another recommended practice is the leaving of non-harvested or non-cultivated margins in cereal crops. All sources of data provide similar values in the range of €15.2/ha to €17.6/ha. However, these are calculated only for low gradient slopes. It is assumed that uncultivated margins will be occupied by semi-natural vegetation but that no cost for there establishment will be considered.

As regards grassland (in HNV):

High Nature Value (HNV) Farming: The concept of HNV farming recognises the biodiversity benefits that are associated with particular types of farming, particularly low intensity farming systems. Although there is some debate about precisely how to define HNV farmland, estimates of the area of HNV farmland in the EU-27 have been produced (Parrichini *et al*, 2008) and Member States are also producing more detailed figures as the basis for monitoring success in maintaining this resource.

Two estimates have been produced on the scale of support needed to maintain HNV farming practices in the EU-27, one calculating the funding needed under Pillar One to maintain the economic viability of HNV farming systems and the other calculating the cost of maintaining HNV farming through the agri-environment measure.

The first of these provides costs for the introduction of a targeted scheme for HNV farming under Pillar One of the CAP, as part of a wider strategy for maintaining HNV farming in the EU-27 (Beaufoy and Marsden, 2010). Rough calculations suggest that, to maintain HNV farming systems in all Member States would require expenditure of €16 billion/year, assuming an average payment for HNV farming of €200 per hectare per year over an estimated HNV farmland area of 80 million hectares (likely to be a significant overestimate of the actual HNV farmland area). This cost estimate, however, is only one element of the total potential funding needed to maintain HNV farming. On top of this cost would also be costs associated with more specific and targeted management needs, for example for certain threatened species or habitats, funded for example through the agri-environment measure, as well as costs associated with capital investments, and presumably also LFA type payments, although this is not made clear.

The second estimate attempted to estimate the total economic costs associated with maintaining HNV farming through the agri-environment measure in the EU-27 (Kaphengst *et al*, 2010, in preparation). To do this, an average payment rate for HNV management was calculated, based on data on a range of relevant management practices collected from six RDPs[1] and this was applied to an estimated target area of HNV farmland to which agri-environment actions are anticipated to be applied, again based on relevant targets identified within the RDPs and scaled up to the EU-27. <u>An average per hectare figure for maintaining HNV grassland under the agri-environment measure was derived of €169/hectare</u> and a total cost of maintaining HNV farming practices over 26 million hectares of HNV farmland in the EU-27 was calculated as €4.37 billion. It should be noted that these costs are concerned solely with the costs of delivering the necessary management through current agri-environment actions. Therefore it is assumed that land managers would also be in receipt of Pillar 1 direct payments and LFA payments.

<u>As regards benefits:</u>

Extract of Table 2.2: The range of environmental benefits provided by different farming and forestry practices

Type of management required to address pressure	**Biodiversity**	**Landscape**	**Water Quality**	**Water Quantity**	**Soils**	**Climate Change Mitigation**	**Climate Change Adaptation**
MO4: Reduction of inputs (fertilisers and plant protection products).	**Y1**	**N**	**Y1**	**N**	**Y1**	**P**	**P**
MO6: Conversion of arable land to grassland, environmental land use change, and specification of input levels.	**Y1**	**Y1**	**Y1**	**Y1**	**Y1**	**Y1**	**Y1**
MO7: Creation of buffer strips (incl. riparian zones, buffer strips along watercourses, grass margins and field corners).	**Y1**	**N**	**Y1**	**N**	**Y1**	**Y1**	**N**
MO9: Crop rotation and diversification to reduce disease.	**Y1**	**N**	**N**	**N**	**Y1**	**Y1**	**N**
MO11: Fallow (whole field).	**Y1**	**N**	**Y1**	**Y1**	**Y1**	**Y1**	**N**
MO12: Fallow (zones, eg Skylark plots).	**Y1**	**N**	**N**	**N**	**N**	**N**	**N**
MO17: Grassland management (including grazing, mowing and cutting regimes, reduced fertiliser inputs).	**Y1**	**Y1**	**Y1**	**N**	**Y1**	**P**	**N**
MO18: Grazing management (including reducing and increasing grazing pressure on land).	**Y1**	**Y1**	**N**	**N**	**Y1**	**P**	**N**
MO23: Organic management (in accordance with certified organic standards).	**Y1**	**N**	**Y1**	**Y1**	**Y1**	**P**	**N**
MO24: Over-winter crops / stubble management (eg maintenance/ inclusion of over-winter stubbles, catch crops and green cover crops in rotations).	**Y1**	**N**	**Y1**	**Y1**	**Y1**	**Y1**	**N**
MO25: Soil management (including crop rotation, reduction of soil inputs and change in ploughing regime).	**Y1**	**N**	**Y1**	**Y1**	**Y1**	**Y1**	**Y2**
MO30: Organic conversion (in accordance with certified organic standards).	**Y1**	**N**	**Y1**	**Y1**	**Y1**	**P**	**N**

Y1 = Management option contributes directly to environmental objective

Y2 = Management option contributes indirectly to environmental objective

[1] The six RDPs used were Austria, Bulgaria, Czech Republic, Poland, Romania, UK (England)

P = Management option has the potential to contribute to environmental objective depending on how and where it is applied.

2.2.1. *Study on Addressing soil degradation in EU agriculture: relevant processes, practices and policies (SoCo pilot project 2009-2010; Report EUR 23767)*

On green cover:

http://soco.jrc.ec.europa.eu/index.html

From main report (page 94) - http://soco.jrc.ec.europa.eu/documents/EUR-23820-web.pdf

Box 3.10: Short-term costs and technical limitations

Adopting cover crops (Uckermark, DE)

<u>High costs associated with labour, the preparation of seedbeds and the purchasing of seeds</u> (costs for mustard seed were noted as particularly high), are off-putting for farmers if a return cannot be gained from the cover crop, for example by selling the crop as fodder or by using it to replace mineral fertilisers and external improvements of soil organic matter content.

Box 3.12: Difficulties in introducing cover crops during winter in the Marche (IT)

Clay-rich soils in combination with steep slopes in the part of the Marche region with medium-height hills create difficulties for seedbed preparation of spring crops after a winter cover crop as well as difficulties in introducing no-tillage. Since the lower hills are also dominated by clay soils, the same difficulties in seedbed preparation were also reported there.

Extracts from case studies (2009) on intercrops (cover crops):

BE-FL page 17 - http://soco.jrc.ec.europa.eu/documents/casestudyBE_004.pdf

Intercrops

Intercrops are sown after the main crop, before winter. They serve two main goals. Firstly, they reduce erosion by covering soil that would otherwise be left bare. Secondly, they mitigate nitrate leaching by taking up the residual nitrate in the soil. After incorporation of the intercrop, its residues contribute to the soil organic matter pool and provide an additional source of nitrogen for the next crop. Most sown intercrops in West-Flanders are white mustard (*Sinapis alba* L.), grasses (mostly Italian rye-grass, *Lolium multiflorum* Lam.) and phacelia (*Phacelia tanacetifolia* Benth.). Almost all interviewed farmers sow intercrops.

Economic costs

- Farmers perceive sowing seed to be rather expensive.
- The Flemish government stopped subsidising intercrops in 2007, the objective of which was to get soil cover widely adopted. Most farmers regret the decision, but continue to apply the measure nonetheless. The nature and environmental organisations acknowledge the use of intercrops but believe this is good agricultural practice and should not be paid for. One farmer remarked that the subsidy was anyhow rather low (€ 50/ha). Several municipalities continue to subsidise intercrops.

Technical restraints

- In grain rotations (e.g. wheat-maize) rye-grass becomes soon a bothersome weed.
- In cabbage rotations (e.g. cauliflower) white mustard may promote cabbage specific pests and diseases, such as club root and cabbage root fly.

- The development of large amounts of aboveground biomass (e.g. with white mustard) hampers the destruction and incorporation of the green manure. The most used technique for destruction is herbicide application. Experts mention that this is not such a constraint as one can sow white mustard later in time, or mow it before seed production.

- Maize and sugar beet are harvested late. Intercrops sown after those crops may not produce sufficient biomass.

- Winter control of gastropods and fungi is not possible.

Environmental effectiveness

- Several demonstration experiments proved that intercrops strongly reduce erosion. This is also confirmed by the experience of the farmers.

- Farmers report that intercrops increase the organic matter content of their soils. However, experts indicate that the effect of intercrops on the build-up of organic matter is limited.

CZ page 18 - http://soco.jrc.ec.europa.eu/documents/casestudyCZ_001.pdf

Intercrops

Intercrops (e.g. mustard, clover, grass [*lolium*]) means the growing of two or more crops on the same field with the planting of the second crop after the first one has completed its development are already widely used as soil conservation measure in the case study area especially in organic farming. In intercropping, there is often one main crop and one or more added crops, with the main crop being the one of primary importance because of economic or food production reasons.

Economic costs of intercrops

<u>Because of the necessary purchase of seeds the costs of adopting this measure are rather high. Further, there are additional costs for seedbed preparation associated with additional working costs and labour costs. Intercrops are less cultivated for economic reasons but rather for soil conservation.</u>

<u>The government supported intercrops in 2004-06 (€ 144/ha) but reduced the payment from 2007 to € 104. It is questionable whether farmers will join in sufficient numbers the scheme again. The scheme was very popular in years 2004-06. The payment is granted to area which exceeds some minimal area.</u>

Technical restraints

The use of intercrops is limited by certain types of crop rotations and climatic conditions in region.

Environmental effectiveness

Experts reported that the cover crops are effective in erosion prevention. Some farmers reported that for that reason they would continue with the measure despite of payment decrease/cease of support. When there is excessive amount of organic matter and crops survive winter fully herbicide is used to destroy it. The effectiveness of this measure as a prevention of nutrients loss is linked to sufficient biomass produced.

This means that <u>the economic efficiency of intercrops is relatively low when compared to other soil conservation measures.</u> Sometimes intercrops such as clover are used for fodder. Intercrops are important for soil conservation. As intercrops ensure covering the soil by plants, water erosion and soil run-off is generally reduced and soil fertility increases. Further, the cultivation of intercrops has a positive effect on biodiversity, provides for preservation of nutrients and accumulates soil with organic matter. Another positive effect in using intercrops is the control of spreading of weeds, e.g. bromes, and pests like mice and snails. <u>The main factor influencing the adoption of this measure is that intercropping is associated with high costs for seeds and high working costs.</u>

<u>Cover crops belong to the medium cost-effective measure and undersown crop represents the second most cost-effective measure.</u>

Marche IT page 89 - http://soco.jrc.ec.europa.eu/documents/casestudyIT_003.pdf

Successful and unsuccessful practices in relation to the Management System

As repeatedly noted and as explained in the previous paragraphs, there are no universally applicable practices that give good results in terms of soil protection. Each practice has to be evaluated according to the environment of applicability and of the Management System (see Chapter 4.2). The success or failure of a practice is closely linked to the environment of the application. However, some success stories in implementing certain practices can be highlighted by the case study Marche. One of the soil conservation practices that is mostly applied in Marche region is cover crops. Cover crops are applied mainly to reduce the soil erosion process. It is necessary to make distinctions on the basis of the Management System adopted:

- perennial crops with cover crop between the crop row,

- cover crops in arable land.

The first one is very common in the Marche region especially for vines (Management System Grapevines – SC7). The effectiveness of this practice is very good and the objective to reduce soil erosion is fully achieved. Indeed the maximum risk of soil erosion in the Marche region is during the spring/summer period due to heavy storm and rainfall and the benefit of cover crops in perennial crops is strictly linked to this period.

Different results are obtained for the cover crops in arable land. The Measure F2 of the RDP

2000-2006 for Marche (see Chapter 5.6.2), foresees cover crops during autumn/winter as practice entitled for compensation. On the contrary to the previous situation, during winter soil erosion processes are limited. In addition, due to the soil properties, very clayey, it is very difficult, if not impossible, to prepare the seedbed in spring because of high soil moisture levels. Where cover crops in arable land are applied, the soil structure is damaged by subsequent ploughing, and there are strong signs of compaction.

FR Midi-Pyrénées page 75 - http://soco.jrc.ec.europa.eu/documents/casestudyFR_000.pdf

Soil cover

The investigation highlighted that three different types of soil cover are currently in use in Midi-Pyrénées:

Straw residues on soil: this technique requires a systematic rotation of winter and spring crops. After the winter crop harvest, straws are spread over the soil evenly or homogeneously to have the complete coverage of the surface. Generally, a straw spreader is used to do this work;

Regrowth (as rape): A spontaneous coverage that is equally effective to limit erosion;

Cover crops: Investigations have shown that there are different types of coverage, cover crops with a single crop or a mixture of crops.

For single crops, oat, sunflower or horse bean are the most used for different reasons. Oats has an important coverage and competitive power against weeds, but retains a very wet soil, unfavourable for maize. Horse bean is good for soil structure and nitrogen fixation. Sunflower is interesting for its root pivot. In mixed crops, several types of combinations exist. Farmers highlighted benefits and downsides of some of the most used:

- *Mustard + Phacelia+ horse bean + oat* (easy destruction of Phacelia and dark colour for soil warming; good permanent cover for oat; mechanical destruction with frost for mustard and horse bean)

- *Oat + fodder pea + horse bean + sunflower* (good for soil structure, promotes biological life)

- *Sunflower + vetch + fenugreek + Phacelia* (very good for roots, increases organic matter; problems of destruction with frost for sunflower and fenugreek; problem of regrowth; vetch has a good coverage power)

- *Oat + horse bean*, classical mix.

Drawbacks are also present in the choice of cover crops and might justify the reluctance of some farmers in using them:

Seed cost is generally high and cannot be recovered through harvest. Only farmers in mixed crop-livestock can make profit from livestock.

The choice of cover crop most adapted to local conditions to benefit of frost destruction is not easy.

The date of destruction may not be optimal to soil types and climate thus delaying planting of spring crops.

The utilisation of herbicides as glyphosate is important for cover crop destruction when mechanical destruction is not used.

Furthermore, farmers interviewed highlighted that cover crops might penalize the next crop because in wet years water soil circulation is insufficient and the number of slugs generally increase. In dry years, vice-versa, cover crops may contribute to water shortages for the main crops as they pump water from the ground.

On grassland:

Hoving (2005) affirmed that grassland renovation is a relatively expensive activity, where the benefits largely involve the temporary increase in net grass production. Although an appropriate cost-benefit analysis is hard to perform since financial benefits are difficult to determine, a computer program named 'Grassland Renovation Guide' for simulating a cost-benefit analysis and a nitrogen balance is available from the Animal Science Group Institute at Wageningen University (the Netherlands).

The Lithuanian Agricultural Advisory Service (2001) agreed that cost-benefit analysis is not easy to perform for grassland improvement. The latter would only be justified if the costs involved were compensated by higher yields, better forage quality and easier working.

Grasslands of medium botanical quality (50-75 % good grasses and <25 % couch grass) can be improved through proper fertilisation, intensive mowing or grazing provided that the lower quality grass species are evenly distributed over the area. However, this implies embarking farmers in a 2-year, expensive process (Lithuanian Agricultural Advisory Service, 2001).

From the conservation point of view, Hodgson *et al*. (2005) found that, over a wide range of productivity scenarios, an induced increase of grassland soil fertility causes a large, apparently exponential, increase in livestock-carrying capacity and in marginal returns. However, high levels of biodiversity are usually confined to less productive conditions, with an inherently low carrying capacity for livestock and low marginal returns. Thus, management of grasslands to maintain high biodiversity is generally incompatible with management for maximum economic profit.

According to Kumm (2004), an increasing proportion of the remaining semi-natural pastures in the Swedish forest-dominated regions are losing their grazing (along with their biodiversity). This is caused by the high costs of grazing small pastures with cattle from generally small herds, and by the cessation of income support per head of cattle from the CAP.

The author suggested, based on calculations of economies of scale in beef production and opportunity cost of forest and arable land, that recreating extensive pasture-forest mosaics consisting of existing semi-natural pastures and adjacent arable fields and forests can secure economically sustainable grazing.

On crop rotation:

From SoCO case Studies reports

Bulgaria: Improvement of crop rotation and cultivation practices: Economic efficiency.

Despite the appropriate crop structure in the region, the economic efficiency of the rotations is comparatively low, yields of the main cereal crops are low mainly due to the unfavourable soil properties.

The experts’ opinion is that the structure of the crops is suitable for the situation and can be only marginally improved.

Greece: Crop rotation: economic costs

The extra costs of legume incorporation are associated first, with the foregone in-come of not cultivating and second, with the cost of cultivating legumes and incorporating them in the soil. The aforementioned cost is significant in the light of the very small size and extreme fragmentation that prevail over many Greek farms. The economic efficiency of the measure prohibiting burning of cultivation residues is low because it accrues costs to the farm

UK:

As crop rotations are part of the farming system, costs to implement rotations are perceived to be low. Most of the crops in the rotation under conventional systems have an economic value, while some crops in organic systems are grown as a green manure, e.g. clover and mustard. Rotating crops has the advantage that the land is tilled relatively often and so compaction in the system is routinely removed as part of the rotation. Encouragement of well designed rotations that include break crops can reduce soil degradation and promote a more productive system.

2.2.2. Nitrates Directive implementation

Extract of FR implementation text of the directive as regards green cover:

"une mesure de couverture des sols pendant la période de risqué de lessivage: compte tenu de l'efficacité environnementale reconnue de la couverture des sols pour un cout de mise en œuvre relativement faible, il convient de rendre obligatoire cette mesure de couverture des sols dans les zones vulnérables."